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BURSA ULUDAG UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
DEPARTMENT OF ECONOMICS

THE ROLE OF FINANCIAL DEVELOPMENT, HUMAN CAPITAL, AND ECONOMIC GROWTH ON ENVIRONMENTAL SUSTAINABILITY: AN EMPIRICAL ANALYSIS OF CAMEROON

(PhD Thesis)

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Supervisor: Prof. Dr. Ferudun Yılmaz

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Yemin Metni

Doktora Tezi çalışması olarak sunduğum "Finansal Gelisme, Beşeri Sermaye ve Ekonomik Büyüme'nin Çevresel Sürdürülebilirlikte Rolü: Kamerunun Hakinda bir Açiklayici Analizi" başlıklı çalışmanın bilimsel araştırma, yazma ve etik kurallarına uygun olarak tarafımdan yazıldığına ve tezde yapılan bütün alıntıların kaynaklarının usulüne uygun olarak gösterildiğine, tezimde intihal ürünü cümle veya paragraflar bulunmadığına şerefim üzerine yemin ederim.

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The work titled “The Role of Financial development, Human capital and Economic Growth on Environmental Sustainability: An Empirical Analysis of Cameroon”: is presented as a Ph.D thesis. I hereby declear that there are no plagiarism sentences or paragraphs. I also declear that it has not been previously or currently submitted as a whole for any other degrees at Uludag University or other institutions.

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Tezin Niteliği : Doktora Tezi

Sayfa Sayısı : XVIII+162

Mezuniyet Tarihi :01/10/2020

Tez Danışman(lar)ı : Prof. Dr. Ferudun Yılmaz

FİNANSAL GELİSME, BEŞERİ SERMAYE VE EKONOMİK BÜYÜME'NİN ÇEVRESEL SÜRDÜRÜLEBİLİRLİKTE ROLÜ: KAMERUNUN HAKINDA BİR

Bu tezde, ekonomik büyümenin gelişmekte olan ülkelerde yoksullukla mücadelede bir politika aracı olarak kullanılmasının bir zorluk olduğunu, çünkü ekonomik büyüme genellikle çevreye zararlı sera gazı emisyonları ile ortaya çıktığını kaydettik. Ekonomik büyüme ve çevre kirliliği arasındaki denge bağlamsal olsa da, hem beşeri sermaye hem de finansal kalkınma, sürdürülebilir kalkınma hedefi 1 (yoksulluk yok), sürdürülebilir kalkınma hedefi 2 (sıfır açlık), sürdürülebilir hedef 4 (kaliteli eğitim), sürdürülebilir hedef 6 (temiz su ve sanitasyon), sürdürülebilir hedef 8 (insana yakışır iş ve ekonomik büyüme) ve sürdürülebilir kalkınma hedefi 13 (iklim eylemi).

Bu tezin analizi dört bölüme ayrılmıştır. İlki, değişkenlerin bütünleştirici özelliklerini değerlendirir (yani geleneksel birim kökü ve yapısal kırılmalar). 1980-2016 dönemini kapsayan Kamerun zaman serisi verilerinden yararlanılarak, değişkenlerin ilk fark I (1) 'de durağan olduğu bulunmuştur. Bu arada, yapısal kırılma testi ayrıca Kamerun'un zaman serisi verilerinde, özellikle (a) Nyos Gölü felaketi ve 1985 ile 1993 arasındaki petrol krizi sırasında, (b) 1994-2004 yerel para biriminin devalüasyonu ve sonrası seçim krizi; ve (c) Kamerun da dahil olmak üzere dünyadaki birçok ülkeyi etkileyen 2008 ila 2009 mali krizi.

İkinci analizde, yazar regresif dağıtım gecikmeli (ARDL) sınır testini kullanarak finansal kalkınma, beşeri sermaye, ekonomik büyüme, doğrudan yabancı yatırım, enerji tüketimi ve çevre kalitesi arasındaki eşbütünleşme ilişkisini inceliyoruz. Ayrıca, ARDL sınır testi ayrıca iki kategoriye ayrılmıştır: model bir ve model iki. Birinci modelde ARDL sınır testi, kukla değişkenler dikkate alınmadan gerçekleştirilmiştir. Ancak ikinci modelde, yapısal kırılmaların etkilerini yakalamak için yapay değişkenler tanıtıldı ve bu, sonuçların iyileştirilmesine büyük ölçüde yardımcı oldu. ARDL sınır testlerinden hesaplanan F istatistiklerinin alt ve üst sınırlardan daha yüksek olduğu ortaya çıkmıştır, bu da değişkenler arasında uzun dönemli bir ilişkinin var olduğunu göstermektedir. Özellikle, doğrudan yabancı yatırımlarda (DYY) %1'lik bir artış ve finansal gelişme, karbondioksit emisyonlarını sırasıyla %0,01 ve %1,34 artırmaktadır. Bu arada, ekonomik büyüme, beşeri sermaye ve enerji tüketiminde% 1'lik bir artış, karbondioksit emisyonlarını buna bağlı olarak %1,09, %3,71 ve %0,99 oranında azaltır. Doğrudan yabancı yatırım ve çevresel kalite arasındaki pozitif ilişki, kirlilik cenneti hipotezinin Kamerun ile ilgili olduğunu gösteriyor. Ekonomik büyüme ve çevresel kalite arasındaki negatif ilişki, bu ülkedeki çevresel Kuznets eğrisi (ECK) hipotezinin önemini gösterir. Beşeri sermayenin (eğitim) Kamerun'da çevresel sürdürülebilirliğin oluşturulmasında rol oynayan önemli bir değişken olduğu da belirtilmektedir.

Üçüncü analizde, finansal gelişme, beşeri sermaye, ekonomik büyüme, doğrudan yabancı yatırım, enerji tüketimi ve çevre kalitesinin nedensellik etkilerini inceliyoruz. Bu, Granger nedensellik ve Toda-Yamamoto (TY) nedensellik testleriyle test edildi. Granger nedenselliğinin sonucu, tek yönlü nedenselliğin doğrudan yabancı yatırımdan karbondioksit emisyonlarına, finansal kalkınmaya ve ekonomik büyümeye ve ekonomik büyümeden karbondioksit emisyonlarına kadar uzandığını göstermektedir. Bununla birlikte, finansal gelişme ile karbondioksit emisyonları, beşeri sermaye ve karbondioksit emisyonları arasında ve kısa vadede enerji tüketimi ile karbondioksit emisyonları arasında nedensel bir etkinin olmadığı tespit edilmiştir. Bununla birlikte, Toda-Yamamoto nedensellik testinin devreye girmesiyle, küçük örneklem modelleriyle uyumlu olduğu için daha iyi sonuçlar elde ettik. Buna uygun olarak, Toda-Yamamoto testi tek yönlü nedenselliklerin karbondioksitten finansal gelişmeye, ekonomik büyümeye ve doğrudan yabancı yatırıma ve ekonomik

büyümeden beşeri sermayeye kadar uzandığını göstermektedir. Benzer şekilde, çift yönlü nedensellik beşeri sermaye ve enerji tüketimi arasında, beşeri ve finansal gelişme arasında ve son olarak, finansal gelişme ile doğrudan yabancı yatırım arasında ilerler. Hata düzeltme terimi (EKT) katsayısı, negatif işaretli% 5 düzeyinde istatistiksel olarak anlamlı bulundu. Bu, değişkenler arasında uzun vadeli nedenselliğin varlığını destekler. Bu arada, hata düzeltme teriminin yaklaşık% 94,8 olan değeri, önceki yıldaki herhangi bir karbondioksit emisyon dengesizliğinin cari yılda düzeltileceğini gösterir.

Dördüncü bölüm, model kararlılığı ve uygunluğunun test edilmesinden oluşur. Bu, kümülatif toplam (CUSUM), kümülatif kareler toplamı (CUSUMSQ), seri korelasyon, normallik ve heteroskedastisite testleri incelenerek incelenir. CUSUM testinin sonuçları, modelin% 5 anlamlılık düzeyinde kararlı olduğunu göstermektedir. Benzer şekilde, uygunluk testleri, modelin herhangi bir heteroskedastisite, normallik ve seri korelasyon problemlerinden arınmış olduğunu gösterir. Bu nedenle bu, bu tezde sunulan sonuçların yanlı tahminler olmadığı anlamına gelir. Her şeyden önce, özet istatistiklerden elde edilen sonuçlar ayrıca tüm değişkenlerin ortalama değerlerle gösterildiği gibi uyumlu olduğunu gösterir. Ekonomik büyümenin en yüksek ortalama değeri sergilediği, ardından beşeri sermaye ve finansal gelişmenin izlediği kaydedildi. Enerji tüketimi ve karbondioksit emisyonları negatif ortalama değerlere sahipti, bu da enerji kaynaklarının Kamerun'da tam olarak kullanılmadığını gösteriyor. Standart sapma ile ilgili olarak, bu modelden elde edilen sonuçların yanlı tahminler olmadığını gösteren önemli bir varyasyon elde edilmiştir.

Bölüm yapısı açısından, bu tez beş Bölüme ayrılmıştır. Birinci bölümde, çalışmanın arka planını, problem ifadesini, çalışmanın amacını, çalışmanın kapsamını ve son olarak yenilikçi yönü sunuyoruz. İkinci bölüm, tüm CEMAC ülkelerinin ekonomisini kapsamaktadır. Bu bölüm, bu bölgesel organın ekonomik performanslarını, çeşitli CEMAC ülkelerindeki ekonomik yapıları, mali göstergeleri, sosyal göstergeleri ve son olarak çevresel değişkenleri ölçmeye yardımcı olur. İkinci bölümde teorik ve ampirik incelemeleri sunuyoruz. Bu bölüm, finansal gelişme, beşeri sermaye, ekonomik büyüme, doğrudan yabancı yatırım ve enerji tüketiminin çevre kalitesi üzerindeki etkilerini inceleyen geçmiş çalışmaları gözden geçirdikten sonra literatürdeki boşlukları belirlemeye yardımcı olur. Dördüncü bölüm metodolojiyi kapsar. Burada çeşitli değişkenler, model özellikleri, tahmin

teknikleri açıkça belirtilmiştir. Bu arada, son bölümde, bu tezde yürütülen çeşitli testlerin deneysel sonuçlarını ve tartışmalarını oluşturduk. Son bölümde, sonuçları, önerileri, gelecekteki araştırmanın yönünü ve son olarak bu çalışmanın sınırlılıklarını sunuyoruz.

Son olarak, Kamerun'da çevre kalitesinin iyileştirilmesine en çok katkıda bulunan değişken beşeri sermayesi olarak bulundu. Bu bağlamda, hükümetin, kadınlar dahil herkesi okula gitmeye teşvik ederek, beşeri sermaye gelişim düzeyini yükseltecek politikaları uygulamaya çalışması önerilmektedir. Bu arada, kirlilik cenneti hipotezinin alaka düzeyi, bulguların da gösterdiği gibi, hükümetin çevre dostu ürünleri Kamerun'a çeken politikalar geliştirmeye dikkat etmesini gerektiriyor. Ancak bu çalışmanın bulguları, iki değişken arasındaki varsayılan ilişkiye aykırı sonuçlar ortaya koymaktadır. Bununla birlikte, enerji tüketimi ile bağımlı değişken arasında bulduğumuz ters ilişki, muhtemelen Kamerun hükümetinin kirliliğin yayılmasını azaltmak için başlattığı güçlü koruma politikalarından kaynaklanmaktadır. Bu ana dallar arasında, insanların enerjinin korunmasına yönelik duyarlılığı, daha fazla yenilenebilir enerji kaynaklarının kullanılması, ağaçlandırma uygulaması ve ormansızlaşmanın önlenmesi yer alıyor.

Anahtar Kelimeler: Kamerun, Çevre Kalitesi, Beşeri Sermaye, Ekonomik Büyüme, Finansal Gelişm

ABSTRACT

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Degree Awarded : **Doctorate**

Page Number : **XVIII+162**

Degree Date :**01/10/2010**

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THE ROLE OF INANCIAL DEVELOPMENT, HUMAN CAPITAL, AND GROWTH ON ENVIRONMENTAL SUSTAINABILITY: AN EMPIRICAL ANALYSIS OF CAMEROON

In this dissertation, we noted that the use of economic growth as a policy tool to tackle poverty in developing countries has remained a challenge, as economic growth often emerges with the emissions of greenhouse gases that are harmful to the environment. Although the trade-off between economic growth and environmental pollution is contextual, both human capital and financial development are used to achieve the sutainable development goal 1 (no poverty), sustainable development goal 2 (zero hunger), sustainable development goal 4 (quality education), sustainable development goal 6 (clean water and sanitation), sustainable development goal 8 (decent work and economic growth), and the sustainable development goal 13 (climate action).

The analysis section of this dissertation is divided into four parts. The first assesses the integrating properties of the variables (i.e conventional unit root and the structural breaks). By employing the Cameroon time series data covering the period 1980 to 2016, it is found that the variables are stationary at the first difference I (1). Meanwhile, the structural break test further discloses two break points in Cameroon's time-series data, notably during

(a) Lake Nyos disaster and the petroleum crisis between 1985 to 1993 period, (b) the 1994 to 2004 local currency devaluation and the post-electoral crisis; and (c) the 2008 to 2009 financial crisis that affected many countries in the world, including Cameroon.

In the second part, we examine the cointegration relationship between financial development, human capital, economic growth, foreign direct investment, energy consumption and environmental quality using the author regressive distributive lagged (ARDL) bounds test. Besides, the ARDL bounds test was further grouped into two categoryies: model one and model two. In model one, the ARDL bounds test was conducted without considering the dummy variables. But in model two, the dummy variables were introduced to capture the effects of the structural breaks and this greatly helps in improving the results. From the ARDL bounds tests, it is revealed that the calculated F-statistics are higher than the lower and the upper bound, implying that a long-run relationship exists between the variables. Specifically, a 1% increase in foreign direct investment (FDI) and financial development raise carbon dioxide emissions by 0.01% and 1.34% respectively. Meanwhile, a 1% increase in economic growth, human capital, and energy consumption reduces CO2 emissions by 1.09 %, 3.71%, and 0.99% correspondingly. The positive relationship between FDI and environmental quality pinpoints that the pollution havens hypothesis is relevant in Cameroon. Whilst the negative association among economic growth and environmental quality indicates the significance of the environmental Kuznets curve (ECK) hypothesis in this country. It is also noted that human capital (education) is an important variable that acts in generating environmental sustainability in Cameroon.

In the third part, we study the causality effects of financial development, human capital, economic growth, foreign direct investment, energy consumption, and environmental quality. This was tested by engaging the Granger causality and the Toda-Yamamoto (TY) causality tests. The result from the Granger causality demonstrates that unidirectional causality runs from foreign direct investment to carbon dioxide emissions, financial development, and economic growth, and from economic growth to carbon dioxide emissions. However, it was established that there exist no causal effects between financial development and carbon dioxide emissions, human capital and carbon dioxide emissions, and between energy consumption and carbon dioxide emissions in the short run. However, with the

introduction of the Toda-Yamamoto causality test, we obtained better results, since it is compatible with models of small samples. Correspondingly, the Toda-Yamamoto test indicates that unidirectional causalities run from carbon dioxide to financial development, economic growth, and foreign direct investment and from economic growth to human capital. Similarly, bidirectional causality runs amid human capital and energy consumption, between human and financial development, and lastly, between financial development and foreign direct investment. The coefficient of the error correction term (ECT) was found to be statistically significant at a 5% level, negative sign. This thus supports the existence of long-run causality between the variables. Meanwhile, the value of the error correction term of about 94.8%, designates that any disequilibrium of carbon dioxide emissions in the previous year will be corrected in the current year.

The fourth part consists of testing the model stability and fitness. This is examined by studying the cumulative sum (CUSUM), the cumulative sum of squares (CUSUMSQ), the serial correlation, the normality, and the heteroskedasticity tests. The results of the CUSUM test indicate that the model is stable at a 5% level of significance. Likewise, the fitness tests pinpoint that the model is free from any heteroscedasticity, normality, and serial correlation problems. This, therefore, implies that the results presented in this dissertation are not biased estimates. Above all, the results from the summary statistics, further indicate that all the variables are compatible as indicated by the mean values. It was noted that economic growth exhibits the highest mean value, followed by human capital and financial development. Energy consumption and carbon dioxide emissions had negative mean values, signifying that energy resources are not fully utilized in Cameroon. Regarding the standard deviation, a significant variation was obtained, indicating that the results from this model are not biased estimates.

In term of chapter, the dissertation covers five Chapters. In chapter one, we present the background of the study, the problem statement, the study purpose, the scope of the study, and finally, the innovative aspect. Chapter two encompasses the economy of the whole CEMAC countries. This chapter helps to gauge the economic performances of this regional body, the economic structures in various CEMAC countries, the financial indicators, the social indicators, and lastly the environmental variables. In chapter two, we present the

theoretical and empirical reviews. This chapter aids to identify the literature gaps after reviewing past studies that examine the effects of financial development, human capital, economic growth, foreign direct investment, and energy consumption on environmental quality. Chapter four covers the methodology. Here, the various variables, model specification, the estimation techniques are clearly stated. Meanwhile, in the final chapter, we established the empirical results and the discussions of the various tests that are conducted in this dissertation. In the last section, we present the conclusions, recommendations, the direction of future research, and lastly the limitations of this study.

Lastly, human capital was found as the variable that contributes the most in improving the quality of the environment in Cameroon. In this regard, it is therefore recommended that the government should strive to implement policies that will raise the level of human capital development by encouraging everyone to go to school, including the women. Meanwhile, the relevance of the pollution havens hypothesis as the findings demonstrate, calls for the government's attention to develop policies that attract environmentally friendly products to Cameroon. Moreover, it was hypothesized that energy consumption and carbon dioxide emissions are positively related. But the findings of this study demonstrates result that is contrary to the hypothesized relationship between the two variables. However, the inverse association that we found between energy consumption and the dependent variable is probably because of the strong conservation policies that the government of Cameroon has initiated to mitigate the spread of pollution. These majors include, the sensitization of people about the conservation of energy, the utilization of more renewable sources of energy, the practice of afforestation and the discouragement of deforestation.

Key Words: Cameroon, Environmental quality, Human capital, Economic growth, Financial development

PREFACE AND/OR ACKNOWLEGDEMENT

I would like to thank my supervisor, Prof. Ferudun Yılmaz for your constant encouragement and guidance throughout the writing process and your trust in my ability. I am sincerely grateful for the way in which you have supported me from the beginning of my PhD journey.

I also wish to thank Prof. Kadir Yasin Eryiğit for your constructive advice and guiding the methodology part of my thesis. My special thanks also go to all the academic staff and my entire classmate in the economic department.

My highest and utmost gratitude is dedicated to my my lovely wife Mepha Ophilia Mweh, to my parents Tita Musa and Abiba Tita, to my all my brothers and sisters for their unconditional love, continuous prayers and encouragement.

Aboubakary Nulambeh Ndzembanteh

23/09/2020

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SYMBOLS and ABBREVIATIONS

Abbreviation	Definition
ADF	Aughmented Dicker Fuller
ARDL	Author Regressive Distributive Lag
BEAC	Bank of Central African State
CAR	Central African Republic
CFA	French Community in Africa
CO2	Carbon Dioxide
CEMAC	Economic and Monetary Community of Central Africa
EC	Energy consumption
EKC	Environmental Kuznets Curve
ESD	Education for Sustainable Development
EGM	Endogenous Growth Model
EGT	Endogenous Growth Theory
FINDEV	Financial Development
FD	Financial Development
FDI	Foreign Direct Investment
FF	French Franc
GDP	Gross Domestic Product
GESP	Growth and Employment Strategy Paper
GHG	Green House Gases
HIPC	Heavily Indebted Poor Countries
IDB	Islamic Development Bank
IDBG	Islamic Development Bank Group
IMF	International Monetary Fund LDC
MDGs	Millennium Development Goals
NGM	Neoclassical Growth moel
NIS	National Institute of Statistics
OIC	Organization of Islamic Corporation
PP	Philip Perron
R&D	Research and Development
REC	Regional Economic Community
SAP	Structural Adjustment Program
SDGs	Sustainable Development Goals
SSA	Sub Saharan Africa
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNICEF	United Nations International Children's Emergency Fund
VAR	Vector Autoregression
WBG	World Bank Group

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CHAPTER ONE

INTRODUCTION

1.1 Background

Nowadays, developing countries are becoming exposed to the danger of climate change and global warming and in Cameroon, this situation is not different. Having been labelled as African in miniature by many researchers, a vast majority of Cameroonians are still depending heavily on primary activities for the sustenance of their livelihood. Meanwhile these activities (farming, mining, and deforestation) are to generating massive damage to the environment through negative externalities (pollutions). A key element is that during the process of economic development, there is a shift from the extractive industry (agriculture) to manufacturing industry along with increase in greenhouse gases.

As these economic transformations occur in the long run, so do the social, political, environmental, and cultural norms. Some researchers refer to cconomic growth as a sustained increase in the welfare of an economy together with changes in economic structures, public health, literacy, demography, and income (Neil & Paul, 2001). Besides, the government has as objective to raise growth with the intention to mitigate poverty. But achieving this objective is quite challenging since there is always a trade-off often between environmental indicators and economic growth (Galeotti, 2007). Due to this conflicting scenario, scholars have termed it as a complex and long-run phenomenon. According to Angelescu (2005), a GDP growth of 3% a year could raise the potential GDP by 10% for every three years and a doubling in 23 years. In other word, economic growth can either be positive, zero, or negative. Positive growth occurs when the average growth in the macroeconomic indicators are higher than the average growth in population. On the other hand, a zero growth arisis in a situation where the growth population is equal to the growth in GDP meanwhile a negative growth takes place when the growth in GDP is less than the population growth.

The Sub Saharan African countries are sometimes subjected to constraints like rise in the population, limited resources, inadequate infrastructure, inefficient utilization of resources, and excessive governmental intervention. These troubling factors couple with wars, poverty and bad governance have made researchers to classify the African growth into five categories: A) Jobless growth - growth which does not expand employment opportunities. B) Voiceless growth – this is growth that is not accompanied by the extension of democracy or empowerment. C) Rootless growth – growth which causes people cultural identity to wither. D) Futureless growth – growth where the present generation squandered resources needed by the future generation. E) Ruthless growth – growth that is not inclusive, but turn to benefit mostly the rich.

Conferring to the Report from World Bank (2009), developing countries including those of the SSA are characterized with inadequate haman capital (HC), poor financial market and high dependency on commodity sectors (agriculture, forestry, mining, and fishing), whereas these sectors are fairly vulnerable to environmental hazards. Panayotou (1993) argues that the agrarian economies turn to emit less carbon dioxide emissions compared to the advanced economies and this explains the reason why agrarian economies turn to produce less pollutants than the industrialized countries. According to Oxfam (2020), the annual emissions of pollution per head in Cameroon, Rwanda, South Africa and Britain are 0.40 tons, 0.09 tons, 1.68 and 4.7 tons respectively. In line with this statistics, someone in Britain may take just five days to emit the same amount of carbon dioxide that someone in Rwanda does for a year. In this regards, there is a growing concern about poverty and the danger of climate change in Sub Saharan Africa (SSA).

The major concern is that African countries are still experiencing the crisis of industrialization despites the fact that most of it's economies are blessed with huge resource potentials. This is because serious attention has not been given in developing the African industrial base including the business climate. Due to this, most economists used to marvel if Africa could have the privilege to claim the 21st century without failing. In other words, many projected that Africa might remain the "doomed continent". But despite these challenges, the region is presenting some of the fastest growing economies in the world, with overall growth rate of 3.7 % in 2019 (Adegoke, 2019).

Another common concern is that economic growth turn to emerge with greenhouse gases (GHG), particularly carbon dioxide emissions, with greater consequences on human health and the environment. It is therefore crucial to develop policies that ensure a balance between economic activities and environmental quality. In this regards, there is a global worry on how developing economies could achieve sustainable development in these presence dispensations. This is well elaborated in the United Nations Sustainable Development Goals (SDGs), with proposed sollutions for policymakers in various nations to incorporate sustainable approach in their economic development programs.

In this study, financial development, education, economic growth and carbon dioxide emissions have been taken as the key pillars for sustainable development. A balance in these three pillars could be termed sustainable development. It is defined as a process of meeting the needs of the present without conceding the needs of the future cohorts (Irsan & Utama, 2019). Notably, human capital (HC) and financial development (FinDev), have enormous impact on Sustainable Development Goals. This dissertation will help in achieving close to six sustainable development Goals: no poverty, zero hunger, quality education, clean water and sanitation, decent work and economic growth, climate change action and life on earth. The variables used in this study are grouped into economic sustainability (e.g. 8 – decent work and economic growth), social sustainability (e.g. 1 – no poverty, 2 – zero hunger and 4 – quality education) as well as environmental sustainability (e.g. 6 – clean water and sanitation, 13 – climate change action and 15 – life on land). Despite the attempt to address these real life issues, there is always a trade-off between one SDGs to another and the extent of such trade-off is context dependent. For instance, economic growth and environmental pollution can be decoupled by investing in financial development and investment in human capital.

The main focus of this study is to interact financial development and human capital development in order to generate environmental sustainability (CO2 emissions) in Cameroon. It is suggested that, human capital may influence the environment through the growth canal. According to the endogenous growth theory, education, technology, and innovations play a leading role in stimulating growth in most nations. But these theories felt to include the aspect of environment in their model formulations and recent arguments have

demonstrated that education may influence the quality of environment through several factors: productivities, size of population, and variations in the demand and supply mixed. In other terms, education enables people to change their preferences to demand for more environmental goods. Educated people tend to be more environmentally friendly, which usually results to a great ecological enhancement. Moreover, quality education helps in solving the problems of asymmetry of information by allowing people to have good access to information, which further induce them to consume more environmentally friendly products. Nevertheless, human capital accumulation (Education) could generate high income, productivities and consumptions and may in turn raises pollution. In countries where literacy rates are high, the purchasing powers of individuals in those countries are usually high. Consequently, the majority of people in these countries have the ideology of "consume more to be happier" making them to develop the desire to live well without taking care of their environment.

But focusing on Cameroon, it has started implementing the sustainable development program in their education system, called Education for Sustainable Development (ESD). Although this program is still at the initial stage, it has as objective to motivate and empower learners to be more environmental friendly by addressing communities, developmental and environmental challenges in the world.[1] Another key mediating variable that will interact in generating sustainable development is financial development (FinDev). Financial development turns to impact the quality of environment through the growth channel. It is often regarded as the "engine of growth" in most economies. Aghion et al. (2005) predict that financial development will enable poor countries to converge to the growth path of the advance societies. Levine (2014) supports this view by stating that, financial development acts as a good forecaster for future economic growth, capital accumulation, and technological change. Besides, Beck (2013) also argues that the financial sectors act as an engine of growth in facilitating payment and the provision of intermediary services between the lenders and borrowers. In other words, the financial sector is vital, since it offers households, and firms with good managerial facilities. Despite the important of financial development in impacting

[1] https://cameroon.panda.org/our_work/education_for_sustainable_development/

the real sector, in Cameroon, statistics have shown that less than 10% of the population have access to a bank account. Moreover, majority of women have higher ratio of account ownership than men and the proportion of women using credit card with mobile account are larger compared to men in almost all the socio-economic categories.[2] To support this argument, Saud et al (2019) state that financial development positively enhanced environmental quality in 59 Belt and Road Initiative countries.

Apart from the above mentioned variables, foreign direct investment (FDI) is included in this study as a control variable to capture the effects of the pollution haven hypothesis in Cameroon. The impact of foreign trade on environmental quality has been subjected to intense debates. This is because international trade often generates the issue of pollution havens hypothesis, where nations with weak environmental regulations turn to attract more polluting industries. In this regard, Bernard & Mandal (2016) settle that foreign trade has a detrimental effect on the environment, since it raises carbon dioxide emissions. Sun et al., (2019) on the other hands, demonstrate that international trade is negatively related to environmental pollutions and thus has a beneficial effect. Meanwhile in literature, two theories are used to study the link between CO2 emissions and FDI: The Pollution Havens Hypothesis (PHH) and the Pollution Halo Hypothesis (PH_2). The PHH postulates that FDI allows pollutions to flow to countries with fragile environmental policies but through the process of economic development, this situation changes as the demand for air quality increase (Eskeland et al., 2003). Whereas, the proponents of the (PH_2) argues that FDI turn to improve environmental conditions in developing countries, since it leads to the transfer of skills, technology, capital, and better management techniques. In other words, foreign enterprises have the tendency to transfer clean energy and technology to developing countries that further reduce the level of carbon dioxide emissions.

In order to facilitate growth and economic development, most African countries have engaged positive steps in improving the role of the private sector. As a result, an increasing number of them are now letting foreign involvement in the denationalization of their state owned enterprises. Likewise, the rule of law governing private businesses have equally been

[2] International Monetary Fund • Publication Services PO Box 92780 • Washington, D.C. 20090

amended through the removal of constraints on the expulsion of returns, and the provision of the liberal tax incentives. Today, it is widely believed that the policy framework for FDI adopted by many African countries has become very similar to those of the other developing countries (Sukar & Ahmet, 2010). These positive developments are expected to attract more foreign capital to the region, thereby enhancing economic growth.

Another key variable that this dissertation considered is energy consumption (EC). It as well passes through the growth channel to impact the quality of the environment. In literature, researchers have proposed four propositions to test the liaison among energy consumption and economic growth. The first is the neutrality hypothesis, which states that there is no causal effects between energy consumption and economic growth. This expressly means that, a country's energy policies have no impact on economic growth. Secondly, the growth hypothesis, which assumes that energy consumptionand economic growth are unilaterally related. In other words, energy consumption turn to raise the economic growth in most countries. Thirdly, the conservation hypothesis, which settled that a unilateral causality instead runs from economic growth to energy consumption. Lastly, the feedback hypothesis, which concludes that a bilateral causality exists among energy consumption and economic growth. To support these arguements, Hundie (2018) states that in Ethiopia, energy consumption has a positive impact on carbon dioxide emissions.

Considering the above issues that we have raised, it is therefore, crucial to assess the environment-financial development nexus, the environment-human capital nexus and the environment-growth nexus, in the presence of foreign direct investment and energy consumption. The environment growth-nexus is usually model using the environmental Kuznets curve (EKC). This curve was first introduced by Kuznets (1955) to survey the link among income inequality and economic development. It was later developed by Grossman & Krueger (1991) to assess the association among income and the quality of environment. Taking into account the significant role of financial development, economic growth and human capital on environmental quality, this thesis therefore assesss the association between these constructs and environmental quality (CO2) in Cameroon. Above all, the fact that economic growth emerges with greenhouse gases, it is therefore mandatory for policymakers in developing countries to introduce policies that raise growth in a more sustainable way.

1.2 Problem Statement

The United Nations agenda 2030 is to have a world free from hunger, malnutrition and climate change, where financial development, human capital and economic growth contribute in raising the living standards of everyone in society, especially the poor masses in a more eco-friendly way (Johnston, 2016). Climate change is one of the key issues nowadays (Pearse, 2019). There is widespread concern about Africa where, the greater share of their GDPs are in agriculture whereas this sector is quite sensitive to climatic vulnerabilities. It is, therefore, challenging for SSA to tackle both extreme poverty and global warming since a trade-off often arise between economic growth and environmental pollutions.

A practical example is seen where the level of pollution emissions in most part of the world is rising. Figure 1.1 shows that the East Asia and North America dominate the other regions in the emissions of greenhouse gases. Although Latin America and Sub Saharan Africa are emitting less CO2 compared with the other regions, their current trends are still increasing. In this regards, the UN reported that in situation where the climate change and global warming issues are not resolved, by 2050, there will be close to 1 billion climate refugees (Pearse, 2019). Moreover, most Scientists have settled that if the rise in global temperature is not reduced to less than 2°C, the world will face an irreversible climate change. This will in turn lead to more climate crisis, poverty, wars and large losses in GDP (IPCC, 2007) as cited in (Ranganathan & Bali Swain, 2018).

Moreover, there is a major concern about the environmental policies in developing countries. The environmental policies in most developing countries are often weak. According to the pollution havens hypothesis, countries with weak environmental regulations turn to attract more polluting industries from stronger nations (Eskeland et al., 2003). This partly explain the region why African countries, blessed with abundant natural resources, have not been able to use their huge resource potentials to mitigate the spread of poverty (Songwe, 2012). As a practical example, polluting industries are shiftin from the industrialized countries to Africa, especially from China. In addition, the traditional trade theories equally argue that countries that are blessed with natural resources will specialize in

the export of products with comparative cost advantage and import those that are scarce domestically (Verter, 2017). Based on this theory, African countries will continue to export mainly raw materials and importing the processed or manufactured ones at exorbitant price. Also, the western countries, characterize with huge industrial sectors that emerges and pollution intensive goods have comparative advantage in the export of pollution. All these factors make it difficult for African countries to generate a sustained growth that benefits their fast-growing population.

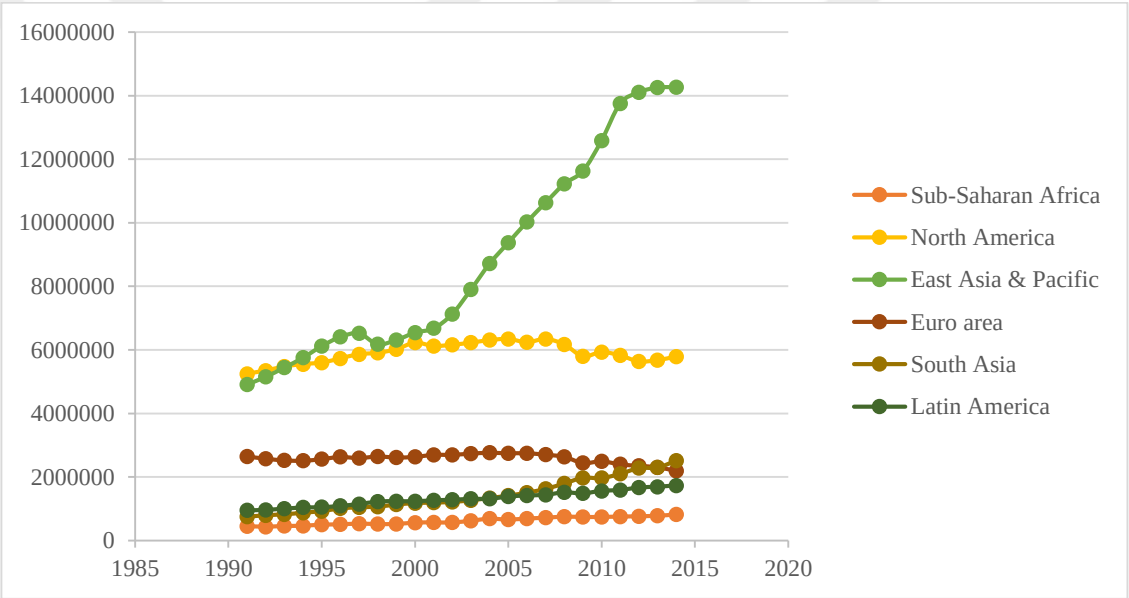

Figure 1.1. Carbon dioxide emissions in different parts of the world (kt) 1991-2014
Source: World Development Indicators (2020)

Nonetheless, in recent years, numerous efforts have been made by the governments of developing countries to use financial development, human capital development, economic growth to generate environmental sustainability. Nevertheless, the ability of these constructs to impact environmental quality in developing countries has been a subject of hot debate and remains inconclusive. While several scholars are of the view that financial development, education, and economic growth have a positive effect on environmental quality (Awad & Warsame, 2017) and (Hundie, 2018), others have demonstrated that these variables are negatively related with environmental quality (Ali, 2018) and (Phuong et al., 2018).

Nonetheless, for African countries to grow, combat poverty, limit malnutrition and the spread of climate change, it is therefore imperative to develop policies that generate inclusive growth and environmental sustainability. These policies could involve the sensitization of people about the danger of climate change, the encouragement of people in using environmental friendly goods, valuation of the ecosystem and the boosting of efficient use of energy resources.

The main problem of this study is to answer to the question of the lack of inclusive growth and environmental sustainability in Cameroon despite the huge resource potentials that this nation is blessed with. In order to clarify the theoretical and practical relationship between financial development, human capital, economic growth and environmental quality, the following research questions will be addressed in this study: does financial development, education, and economic growth influence environmental conditions in Cameroon? Are there any causal effects between financial development, education, economic growth, and environmental quality in Cameroon? Can inclusive growth be achieved in Cameroon through the influence of financial development and human capital?

1.3 Objective of the Study

The Global concerns, for instance, persistent poverty, troubling economic prospects, natural resource depletion, environmental degradation, loss of biodiversity, and freshwater scarcity, are increasingly making the world unsustainable and unsafe for the future generations. In order to provide a lasting solution to these troubling issues, a new approach that integrates and balances the three dimensions of sustainability: economic (GDP), social (education), and environment (pollution) is highly needed. The specific objectives are:

1. To study the nature of association that exists among financial development, human capital, economic growth and environmental quality in Cameroon,
2. To assess the direction of causality between financial development, human capital, economic growth and environmental quality in Cameroon and,
3. To suggest some policy recommendations that can help to achieve sustainable development in Cameroon.

This thesis contributes to the on-going debates about the key determinants of environmental quality in developing countries with a special focus on Cameroon.

1.4 Study Scope

In this research, the main goal is to assess the effect of financial development, human capital (education), and economic growth on environmental sustainability in Cameroon. Since the use of more relevant variables could improve the results, we have included other constructs like FDI and energy consumption as control variables. The sample size is small and consists of 36 observations. Because we have a short sample, the validity and robustness of the results may be affected. To remedy the situation, we employed tests that are more compatible in model with small sample problems (the author regressive distributive lagged test and th causality test following the Toda-Yamamoto). The annual time series data range from 1980-2016, extracted from World Development Indicators (WDI), National Institute of Statistics Cameroon (NIS), and the Islamic Development Bank Group (IDBG). We have equally used the conventional (ADF and PP) unit root tests and the multiple breaks unit root tests to study the integrating properties of the variables.

1.5 Purpose of the Study

Economic meltdowns have pushed Cameroon to enter into numerous programs, motivated by the government's vision of becoming an emergent country by 2035. These programs range from the Structural Adjustment Programs (SAP) 1997 to 2000, the Millennium Development Goals (MDG) 2000-2010, and the national Growth and Employment Strategy Paper (GESP) 2010-2020. These programs were created with specific objectives; to restore the internal and external balances and to generate sustainable growth in most developing countries. The application of these agendas contributed in reestablishing the main macroeconomic equilibriums of Cameroon, which since has reverted to the growth path. It further made it possible to halt the drop in the purchasing power of the population and to lessen the occurrence of poverty by more than ten points. These programs, correspondingly helped Cameroon in reaching the verdict point of the Heavily Indebted Poor

Country (HIPC) Initiative, with significant benefit that impressively help in reducing Cameroon's external debt.

Also, the huge performance of SAP has made Cameroon to later initiated another program called the Millennium Development Goals (MDGs). It focused on poverty, maternal health, education, gender equality, etc. Cameroon joins this program to generate solutions to some rampant or common societal problems that were affecting most of her citizens. This program was successful in reducing poverty, infant mortality, and further led to a great improvement in gender equality. However, little efforts were made in tackling climate change and global warming. After the MDGs, Cameroon introduced the national Growth and Employment Strategy (GESP), which aimed to generate a favorable investment climate and to boost growth for the period 2010-2020. According to the GESP, investments in infrastructure and technology will raise productivity in the rural sector and help in meeting the food desires of the rising population. The above-mentioned initiatives have made the Cameroonian government to take high-level political and economic decisions to develop its agro-industrial plantations, to create jobs, generate economic growth, and foster development. Also, numerous efforts were made to increase the regional trade integration, intensify the trade links with Nigeria, and to expand the trade flows in the emerging markets for instance China, Brazil, and India.

Nevertheless, the aforementioned initiatives did not make Cameroon to emerge and reach the income level that was expected. Today, the government is targeting to become an emergent country by the year 2035. This dream has some short-term objectives, particularly: (i) poverty alleviation; (ii) becoming a middle-income country, (iii) becoming a newly industrialized country, and (iv) consolidating democracy and national unity while respecting the country's diversity. For the government to achieve these objectives, it is therefore imperative to develop policies that foster growth in a sustainable manner. Thus, this study is conducted with the aim to propose policies that will enable the Cameroon government to realize its vision of becoming an emergent economy during the expected period.

1.6 Innovative aspects

This study is aimed to assess the relationship between financial development, human capital, economic growth, and environmental qualities in Cameroon. The findings will add to the ongoing debate in the literature about the finance-environment nexus, human capital-envıronment nexus, and environment growth-nexus. It is also useful since it will enable the policymakers in Cameroon to know about the quality of the environment and how education, finance, and growth together can help in tackling the issues of climate change.

Specifically, this study will be useful in several ways: It will pinpoint the view of the current performance of Cameroon's economy, like the current trend in financial development, economic growth, and environmental qualities. This will go further to demonstrate the possibilities of generating a sustained growth policy in Cameroon. Moreover, the findings will provide adequate guidelines to the authorities in framing appropriate economic and environmental policies that ensure the utilization of eco-friendly products. From the review of literature, we have identified numerous research gaps, that are summarized in three categories: the knowledge-based gap, the methodology gap, and the evidence-based gap. Firstly, the knowledge gap arises since very few studies have explored the link between financial development, human capiatl, economic growth, and environmental quality in Cameroon. Even those that existed, turned to focus on the bivariate model such as financial development-growth and environmental and energy-growth and environmental quality. Thus, this paper seems to be amongst the few pieces of research that jointly gauge the role of financial development, human capital and economic growth on environmental sustainability in Cameroon. Secondly, the methodological gap is focused on the estimation techniques that researchers have employed. In literature, most studies fail to employ the tests that take into account the structural breaks.

Hence this paper will add to the literature by employing more recent ARDL bounds test, the Toda-Yamamoto test methods, and the recent structural break unit root test. Also, the study seeks to cover the evidence gap since previous studies remained inconclusive. Most the past studies in the literature have pinpointed a positive association between the above-mentioned variables (Tiwari, 2011), (Akpan, 2012), (Agarwal, 2012), (Awad & Warsame, 2017) and (Hundie, 2018), while others have settled for a negative relationship (Joysri, 2009),

(Bozkurt & Akan, 2014), (Zheng, 2015), (Valadez & Hu, 2016), (Ali, 2018) and (Phuong et al., 2018).

1.7 Organization of the Study

Chapter one focus on introduction. In this chapter, the background of study, problem statement, purpose of study, scope of study and innovative aspect are presented. Chapter two covers the economy of CEMAC countries and in chapter three, we present the theoretical and empirical reviews that look at the effect of financial development, human capital, FDI, and GDP on environmental quality. This chapter is divided into two sections. The first section covers the theoretical framework and the last section provide review for the empirical studies. In chapter four, the methodology is discussed. It covers the variables descriptions, the model specification, and lastly the presentations of the various estimation techniques. Meanwhile, chapter five covers the empirical results and discussions of the various tests. The last section covers the conclusions, recommendations, direction of future research, and the limitations of study.

CHAPTER TWO

THE ECONOMY OF CEMAC COUNTRIES

2.1 Introduction

The CEMAC state is a regional and economic body, that comprises of Cameroon, Central African Republic, Chad, Congo, Gabon, and Equatorial Guinea. This started when countries within this region began looking for ways to enter into a regional agreement with one another after independence. Specifically, it began in 1962 with the creation of a Customs Union of Central Africa (UDEAC) in Brazzaville that later transformed into the CEMAC.[3] The CEMAC regional body is created with the aim to generate financial stability, price stability, economic cooperation, and better conditions for member states. It also has as objective, the creation of a conducive business climate that attracts FDI and guarantees the free circulation of people, goods, and services.

All countries within the CEMAC share a common currency, the CFA franc. They are equally required to pool their foreign reserves (about 50% income) and deposit them in an operational account found in France. The CEMAC state has a population of about 50 million people, with estimated area of 3 million square kilometers. Cameroon constitutes close to 46% of the CEMAC population and is regarded as the most populated meanwhile the Equatorial Guinea is the least populated with a share of about 2% see Figure 2.1 below.

[3] Trade orientation and economic growth of cemac countries: opportunities from the chinese market.

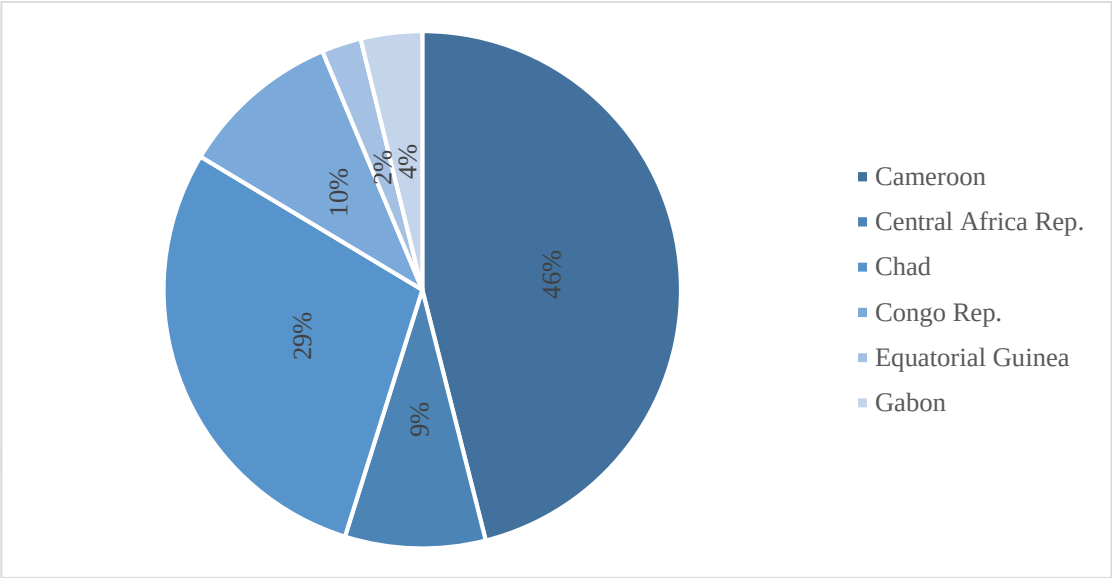

Figure 2.1. The CEMAC's population in 2019
Source: Africa Development Bank Statistics

Most CEMAC countries are blessed with abundant natural resources, with an extensive range of unexploited mineral deposits and agricultural products. Congo is home to the world's second largest forest after the Amazon and holds internal renewable water reserves of 1.715 cubic kilometers (44 % of Africa's total) and Chad, Equatorial Guinea, and Gabon are known to be among Africa's top ten oil producers. Despite the presence of these huge resources, the region is still affected by the political unrest (Anglophone crisis in southern Cameroon) and insecurity along the Lake Chad Basin. Also, the fall in the price of oil and other raw materials has generated a substantial effect on the CEMAC macroeconomic balance.

In addition to above, the free circulation of people across the region still remain a regional challenge. People are required to have a valid visa before entering the other member states even though the goal of this body is to guarantee the free movement of people, goods and services. Moreover, the problems of high tariff and other trade barriers (lack of infrastructures, trade routes, energy and technology) hinder intra-regional trade among the member countries. Above all, administrative and political corruption lower the inflows of FDI by inducing higher risks for investors meanwhile high street level corruption hinders trade and function as an "extra tax" on the poor.

2.2 The Structure of the economy

This section focuses on the various sectors of the CEMAC economies (agriculture, service, and manufacturing sector). After that, we make a comparative analysis between the various sectors of the CEMAC economies which permit us to see the sector that contributes more in generating employment and raising the GDP of CEMAC countries.

2.2.1 Agricultural sector

Agriculture in Cameroon, like in most countries within the CEMAC state is the backbone of the economy, employing more than 70% of the working population and contributing significantly to the performance of the economy Tambi (1999). It is carried out on large scale plantation farming mainly in the tropic, where the climatic conditions are favorable. These methods of farming were brought to the country by the colonial masters (German, French and British) and it permitted the production and exportation of goods such as cocoa, coffee, banana, rubber and timber products. In 1987, the country started depending heavily on the oil sector which generates a serious crisis that affected most nations in Africa. During this period, the prices of the basic commodities started to increase couple with high rate of inflation until 1994 when the local currency was devalued.

In late 1994, the government took several measures to move Cameroon from this economic meltdown. For instance, the local currency was devalued relative to the French franc (FF), salaries of civil servants reduced, taxes increased and the government subsidies decreased. All these mechanisms enabled the agricultural sector to realize a recovery and the prices of exports goods started to increase and reached 24% immediately after 1994.

Agricultural sector in Cameroon faced some internal and external problems. Internally, most farmers face the problem of lack of capital or means of financing since access to credit by farmers are poor. According to (United Nations, 2005) less than 5% of the population have access to bank account. Also, businessmen and investors face a number of problems, notably small market size, inappropriate government policies, lack of awareness of business opportunities, capital shortage, limited HC, difficult internal transport and inadequate infrastructures. Moreover, there is the problem of climate change which often comes with drought and unpredictable rainfall patterns and underpinning food systems. Much

need to be done in upgrading rural infrastructures, encouraging greater use of credit/debit cards and mobile phone banking which is one of the major problems most Cameroonians are facing.

In 1971, the sector contributes approximately 27% to the GDP of Cameroon, which later increases to 30% during the pre-oil period in 1974. However, with the advent of the oil boom in 1984, the average contribution of this sector declined to 19% in Figure 2.2. Meanwhile, the average value-added from 2000 to 2012 stands at approximately 23%. It is important to note that the decrease in the value-added of the agricultural sector is attributed to the huge dependency on the oil sector due to the rapid increase in the prices at the national and international levels. The increase in the prices of oil further provokes a rise in the prices of other basic products. However, the contributions of this sector to the economy of Cameroon has recorded a major fluctuation.

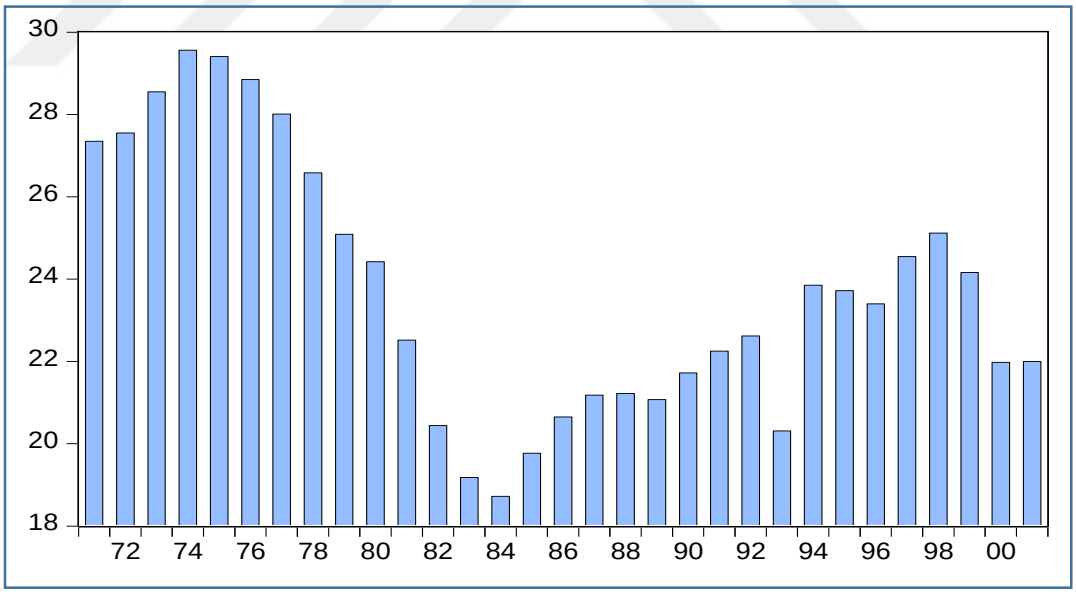

Figure 2.2. Agricultural value added as percentage of GDP 1971-2001
Notes: The vertical axes are in percentage while the horizontal axes are in year
Source: Food and Agriculture Organization

2.2.2 Transports and Communications

It is often said that, where there is a good road network, development follows since good transportation systems, facilitate the transportation of products to the market and elsewhere. Cameroon is experiencing great change in the telecommunication sector but much needs to be done to improve this sector. This is because this sector is not yet strong enough to support the type and quality call centers as seen in other countries such as Senegal. Nevertheless, there are many on-going projects, that the government has introduced in Cameroon to modernize the telecommunications industries and the introduction of the optical fiber network between Cameroon and Chad. Specifically, in 2016, access to the main telephone line was still limited in most CEMAC countries and Cameroon has been dominating the other CEMAC countries. Her access to the main telephone line stood at 4.5 per 100 people, followed by Gabon with 1 per 100 people. Meanwhile, in terms of the mobile phone line, Gabon and Congo dominated the other CEMAC countries meanwhile Cameroon remains the backbone of the CEMAC state in the use of the internet.

However, in terms of electricity consumption, the CEMAC countries are not doing very well. There is a limited interconnection between the member countries couple with poor internet usage. A local method that will augment the utilization of different sources of energy (renewable energy and electricity), in particular, is highly recommended. In regard electricity access, only Gabon (91 %), Guinea (68 %), and Cameroon (60 %) did better compared to the other CEMAC countries in 2016 see Table 2.1.

Table 2.1. The CEMAC access to services in 2016

	Telecommunications, 2016					
Country	Main telephone lines per 100 people	Mobile telephone lines per 100 people	Number of Internet Usage %	Access to electricity, 2016 % of population	Availability of Drinking water, 2015 %	Basic sanitation services, 2015 %
Cameroon	4.5	79.9	25.0	60.1	65.3	38.8
CAR	0.0	27.2	4.0	14.0	54.1	25.1
Chad	0.1	38.6	5.0	8.8	42.5	9.5
Congo	0.3	105.8	8.1	56.6	68.3	15.0
Guinea	0.9	47.1	23.8	67.9	49.6	74.5
Gabon	1.0	149.6	48.1	91.4	87.5	40.9
Africa	2.1	78.5	23.7	51.6	63.3	38.0

Source: ADB group (2020)

2.2.3 Mining and manufacture sector

The mining sector is quite vital for countries that are in the process of development, especially those of the SSA, where most of their states depend heavily on the extraction of natural resources. Within the CEMAC states, the mining sector is contributing very significantly to the economic growth (GDP) of this region. Before we proceed to look at the share of this sector to the economy of CEMAC, it is imperative to find know the history behind a nation's extractive industries. Cameroon has been practicing small-scale and artisanal mining after independence in 1960, mostly in the Eastern region of the country. This was brought to Cameroon by their colonial masters (Germany, French, and Britain). In the late 80s, during the oil boom, Cameroon depends heavily on the extraction of oil resources. During this period, the oil sector accounts for 25-50% of the national income.

Back in 1971, the contribution of the mining sectors was quite small, amounting to about $200 million. As time goes on, the revenue from this sector increases and reach close to $2 billion in 1980. It further rose to $3.5 billion due to the performance of the oil sector during the oil boom. However, in the early 90s during the oil crisis, the share of this sector dropped to $2 billion. After that, different economic policies have been initiated by the government to revamp the economy. In 2011, the contribution of this sector rose to $6 billion,

spearheaded by the construction of Chad –Cameroon pipeline linking the two countries see Figure 2.3.

Another key sector is the manufacturing sector. This sector is still fragile in Cameroon since the industrialization process is still fragmented. Also, Cameroon depends heavily on the western countries for her agricultural inputs and manufactured products. In most cases, Cameroon turns to focus on the exportation of primary materials, with fewer diversifications. Particularly in 1971, this sector generates nearly $200 million. The value increases to $1.3 billion in 1980 and remains stable until 1985 before increases further to $2 billion. However, the contribution of this sector drops during the oil crisis couple with inadequate energy supply and aggressive competition from the Asian countries see Figure 2.3.

Despite being blessed with huge resource potentials, electricity remains expensive in Cameroon. Electricity consumption is always in short supply, with a negative effect on the other sectors, particularly the manufacturing sector. After the devaluation of the local currency in 1994, the manufacturing sector has been experiencing an upward trend to date. In 2010, this sector contributes about $4 billion to the GDP of Cameroon, though still lower than the shares of the other sectors.

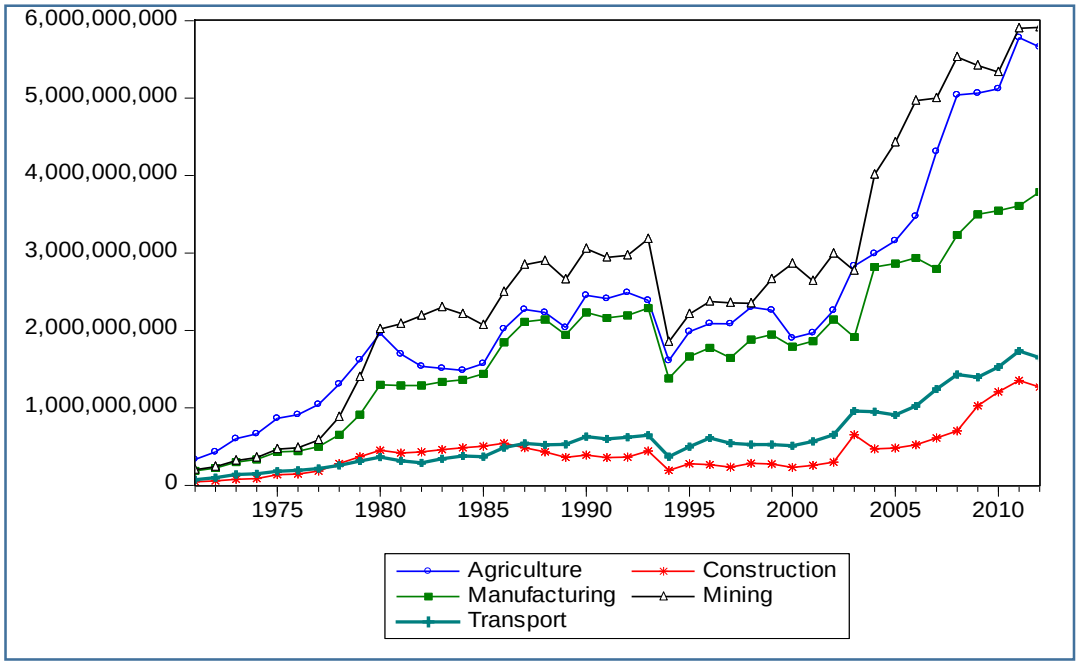

Figure 2.3. The sectorial value added to the GDP in Cameroon US$ 1971-2012
Source: World Development Indicators (2020)

2.2.4 CEMAC sectorial comparison

Most CEMAC countries are experiencing rapid growth in their population. Because of this, there is a need for each member state to industrialize its economy to meet-up with the needs of the fast-growing population. Previous studies have shown that third world countries need to undergo a structural transformation (from agriculture to industry) during the process of economic development (Haller, 2012). This phenomenon is common within the CEMAC sub-region as countries of this regional block are now shifting from agriculture to industrialization.

In 2016, the service sector dominates the other two sectors, with a share of close to 45%. The industrial sector contributes approximately 32% while that of the agriculture generate above 23% of the CEMAC GDP. This indicates that the industrial sector is increasing meanwhile the agricultural sector is decreasing. The service sector dominates the other sectors in all the CEMAC countries except in Central Africa and Chad, where the agricultural sector dominates (45% and 50%) respectively (see Table 2.2).

Table 2.2. The shares of CEMAC GDP 2016 (percentage)

Countries	Agriculture	Services	Industry
Cameroon	16.66	56.72	26.62
CAR	42.86	41.10	16.04
Chad	50.06	35.12	14.82
Congo	21.86	44.63	33.51
Gabon	5.34	46.77	47.88
Guinea	2.58	46.63	50.79
CEMAC	23.22	45.16	31.61

Source: World Development Indicators (2020)

In Gabon and Equatorial Guinea, the industrial sector dominates the other sectors in terms of output. Also, the per capita income of Gabon and Guinea are higher than those of the other CEMAC states, due to their small population size. Focusing on the service sector, Cameroon remains the dominant and the most diversified country in this region see Figure 2.4.

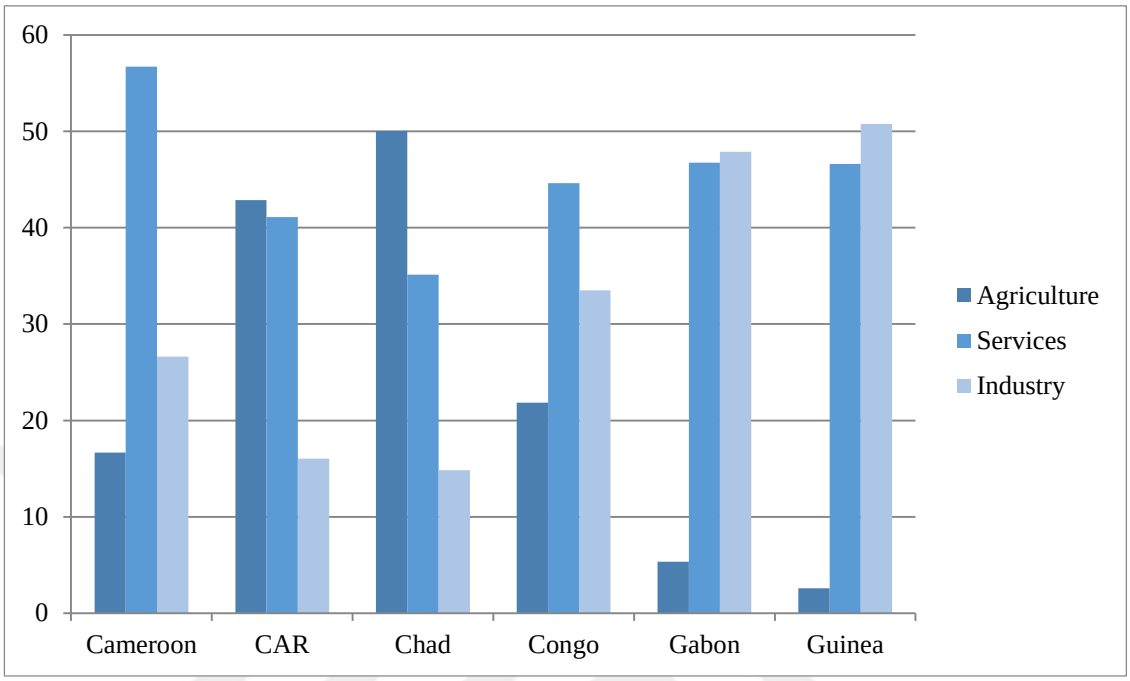

Figure 2.4. CEMAC economies by sectors 2016 (percentage)
Source: World Development Indicators (2020)

Agriculture remains the most dominant sector for most CEMAC countries in terms of employment. In 2017, it employs more than 50% of CEMAC's population. The service sector follows with total employment of about 38% whereas the industrial sector remains fragile, employing just about 10%. In other words, more are still needed to industrialize the CEMAC region (refers to Table 2.3).

Table 2.3. CEMAC sectorial employment 2017 (percentage)

Countries	Agriculture	Industry	Service
Cameroon	61.8	8.7	29.5
CAR	72.4	4.3	23.3
Chad	76.6	2	21.4
Congo	65.3	5.9	28.8
Gabon	16.4	19.1	64.5
Guinea	18.8	18	63.2
CEMAC	51.9	9.7	38.4

Source: Author's generation (2020)

2.3 The performance of CEMAC economy

This section focuses on the performance of the six CEMAC countries that jointly formed the economic and monetary community. The indicators considered here are economic growth, economic globalization, export, import, FDI, FinDev, and inflation. After looking at the economic performances of these countries, we then move ahead to gauge the environmental health of these states, with a principal focus on carbon dioxide emissions and energy consumption.

2.3.1 Economic growth in CEMAC

Economic growth (GDP) is the value-added of all the goods and services produced in a country within a period of one year. In other words, it registered all the domestic production of a nation, irrespective of whether the income accrues to the local or international institutions. Countries of SSA have been experiencing a rapid growth that has led to a huge decline in extreme poverty and massive expansion of the middle-income classes. Even with that, more is still needed to generate an inclusive growth that will take Africa away from poverty and malnutrition.

As shown in Figure 2.5 below, SSA and Asia are amongst the continents that have recorded the highest growth rates. Specifically, in the early 70s, Asia registered the highest growth, close to 12%. During this period, the growth rates in SSA were quite low. However, with the rapid advancement in the continent's macroeconomic parameters, this region has grown and is now catching up with the other regions. Particularly in 2004, SSA dominates

the other regions with a growth rate of about 12%. These multiple growth rates coupled with the huge resource potentials that Africa possesses has made other continents depend heavily on Africa for their survival and the supply of raw materials.

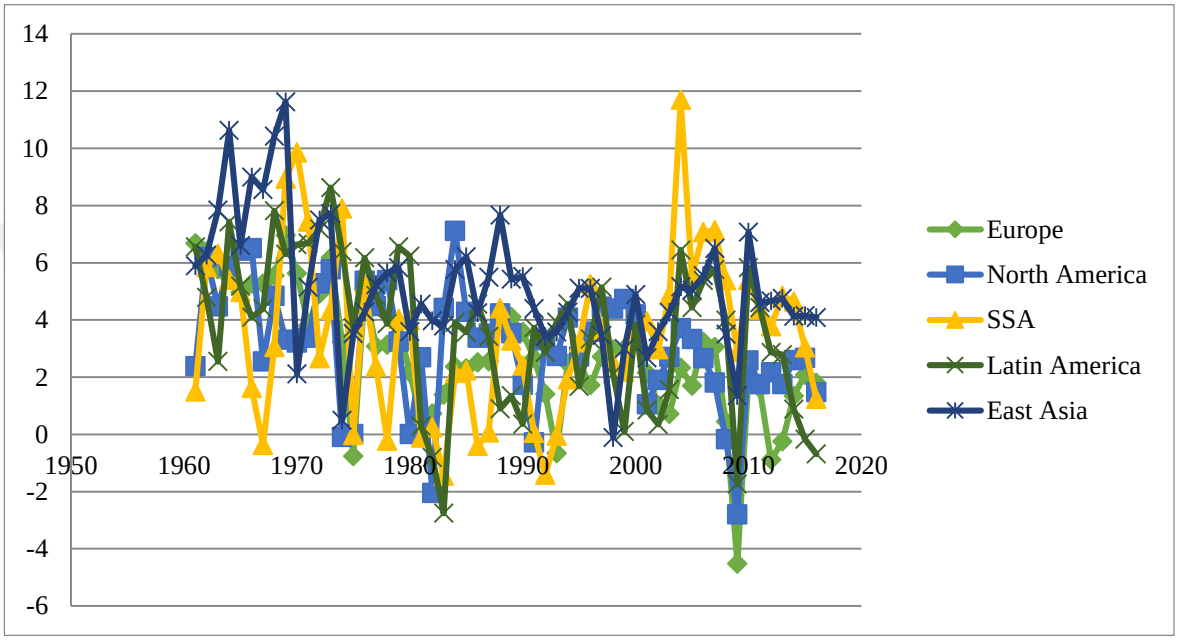

Figure 2.5. Growth rates in regions of the world 1961-2016 (percentage)
Source: World Development Indicators (2020)

Nevertheless, the CEMEC growth rates have greatly been affected by the recent 2008 crisis, that has generated to a huge reduction in the demand of petroleum and a drop in economic growth rate. In 2009, the growth rate of Cameroon, Central African Republic and Chad felt to about 2%. After the crises, there has been a major improvement in the economic activities of these countries. In 2016, the CEMAC records a growth rate of 5.3 %, 5 %, 2% in CAR, Congo, Gabon and CAR respectively see Figure 2.6.

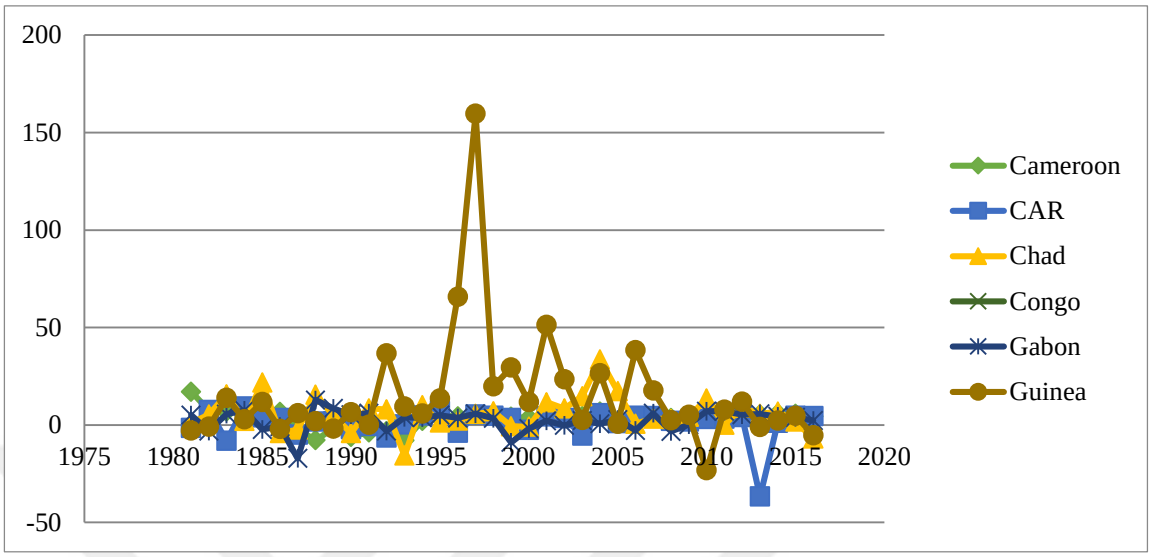

Figure 2.6. The CEMAC annual growth rate 1981-2016 (percentage)
Source: World Development Indicators (2020)

With focus to the GDP share, Cameroon and Gabon dominate the other CEMAC countries, with a share of 42% and 19% respectively. Meanwhile the Central African Republic contributes the lowest with a share inferior to 1% refer to Figure 2.7. Meanwhile this little contribution of the Central African Republic to this region might be due to the war that this country has been experiencing in the past years.

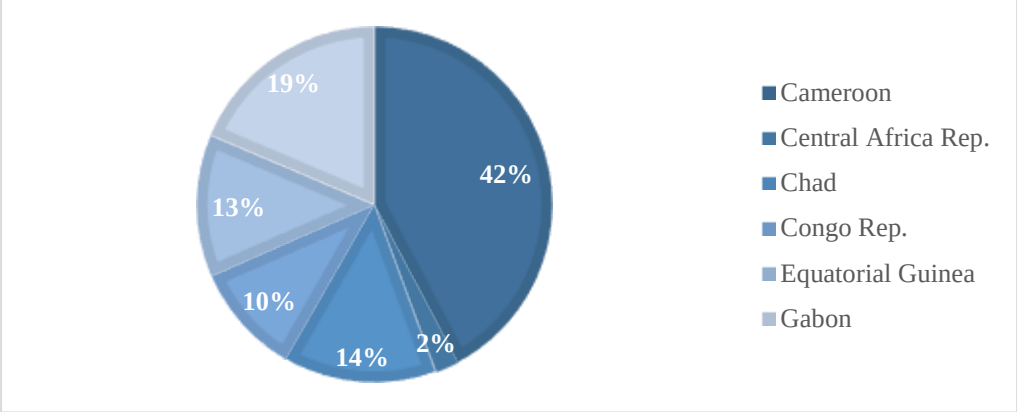

Figure 2.7. CEMAC share in terms of GDP
Source Author's generation

The enormous rise in commodity exports and agricultural production in most CEMAC states has led to the construction of more infrastructural projects and economic development. Also, the robust financial and economic performance of Cameroon and the Central African Republic have compensated the economic downturn in Guinea. Likewise, Cameroon is estimated to have a real GDP growth rate of 4.8 % in 2020, up from 3.8 % in 2018. Meanwhile, Chad, the Central African Republic, and Congo, are estimated to have GDP growth rates of close to 6%, 5%, and -0.1 % respectively see Table 2.4. Despite the progress, the humanitarian crises in the north and southwest of Cameroon are hampering the government efforts and vision of becoming an emergent country by the year 2035.

Table 2.4. The CEMAC real GDP growth 2010-2020 (percentage)

Year	Cameroon	CAR	Chad	Congo	Guinea	Gabon	Central Africa	Africa
2010	3.300	3.000	13.600	8.700	-8.900	6.300	4.200	5.800
2011	4.100	3.300	0.100	3.400	6.500	7.100	4.900	2.900
2012	4.500	4.000	8.900	3.800	8.300	5.300	6.100	7.300
2013	5.400	-36.70	5.700	3.300	-4.100	5.500	4.000	3.600
2014	5.900	1.000	6.900	6.800	0.400	4.400	5.900	3.700
2015	5.700	4.800	1.800	2.600	-9.100	3.900	3.300	3.500
2016	4.600	4.500	-6.400	-2.800	-8.600	2.100	0.200	2.100
2017	3.500	4.000	-3.800	-3.100	-2.900	0.500	1.100	3.600
2018	3.800	4.300	2.800	2.000	-7.900	2.000	2.200	3.500
2019	4.400	5.000	4.200	3.700	-2.700	3.400	3.600	4.000
2020	4.700	5.000	5.800	-0.100	-2.500	3.400	3.500	4.100

2.3.2 Economic globalization

Globalization often takes place when countries are allowed trade with one another without any form of barriers or restrictions. There exists different types of globalization. Economic globalization involves the abolition of trade barriers between the parties in trade and are generally characterized by free circulation of goods, free movement of services, capital, and people. Countries of the CEMAC state are allowed to freely trade with one another. This started around 1985 when many developing countries turned to reduce their trade barriers (tariffs and import quotas), which further led to the opening-up of their borders.

The trends in the globalization index of CEMAC countries are depicted in Figure 2.8. It demonstrates an increasing trend in nearly all CEMAC countries. Specifically, in 1970, the globalization index of Cameroon stands at about 31 %, Gabon 46 %, Equatorial Guinea 46 %, and Chad 16%. It peaks in 1995, with Cameroon recording 40%, Gabon 51%, Equatorial Guinea 67%, and Congo 33%. Chad and Central Africa are still the least globalized economies, with a globalization index of just 31.16% and 30.88 % respectively. In 2015, these values drop slightly for all the countries, with Equatorial Guinea and Cameroon still dominating the other CEMAC countries (refer to Table 2.5 below).

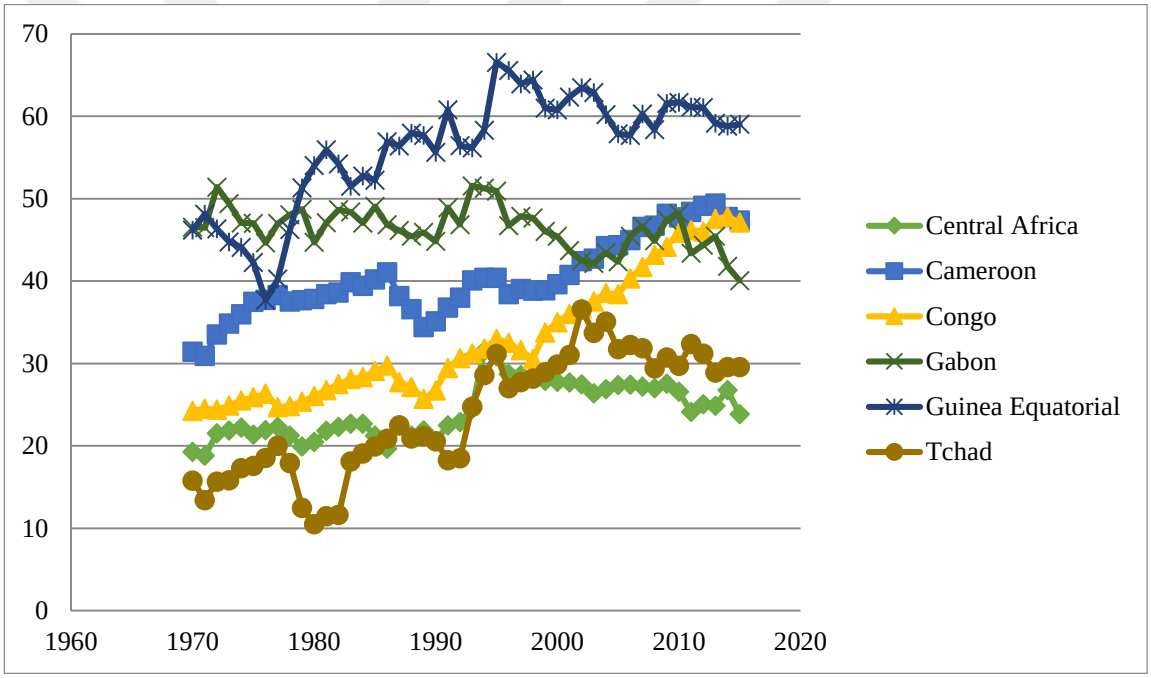

Figure 2.8. CEMAC globalization rates 1970-2015 (percentage)
Source: Africa Development Bank Statistics (2020)

Table 2.5. CEMAC globalization rates 1970 – 2015

Year	Central Africa	Cameroon	Congo	Gabon	Guinea Equatorial	Chad
1970	19.269	31.409	24.259	46.550	46.179	15.785
1975	21.361	37.498	25.909	47.010	42.247	17.569
1980	20.457	37.827	26.082	44.697	54.019	10.488
1985	21.260	40.216	29.088	49.057	52.247	19.942
1990	20.597	35.126	26.741	44.812	55.637	20.561
1995	30.878	40.399	32.974	50.936	66.543	31.163
2000	27.780	39.636	35.009	45.431	60.772	29.854
2005	27.373	44.348	38.411	42.350	57.861	31.729
2010	26.570	47.746	45.882	48.212	61.699	29.727
2015	23.860	47.332	47.112	40.059	59.029	29.5789

Source: Africa Development Bank Statistics (2020)

2.3.3 Exports

Generally, the expansion of export turns to raise the output growth especially in situations where the resources are allocated efficiently in a foreign market transaction. It generates foreign exchange and allows more capital goods and technology to be traded and in turn, raises economic growth. The government of any country generally put in place policies measures to increase production through export subsidization. It is often said that export subsidization does not always lead to a positive outcome but it at times decreases economic and social welfare.

Export plays some leading roles in the development of the CEMAC countries. The main export partners of CEMAC countries are France, China, and Belgium. But China is increasing her trade relations with these countries in order to maintain consistent access to African natural resources. In 2009, most CEMAC economies turn to record negative growth in exports which was likely due to the recent financial crisis that gripped almost all the countries in the world. However, in 2010, the export growth rates witnessed an increase in nearly all the countries, with Congo dominating with a growth rate of approximately 48%, while the Central African Republic recorded just -27 % see Figure 2.9.

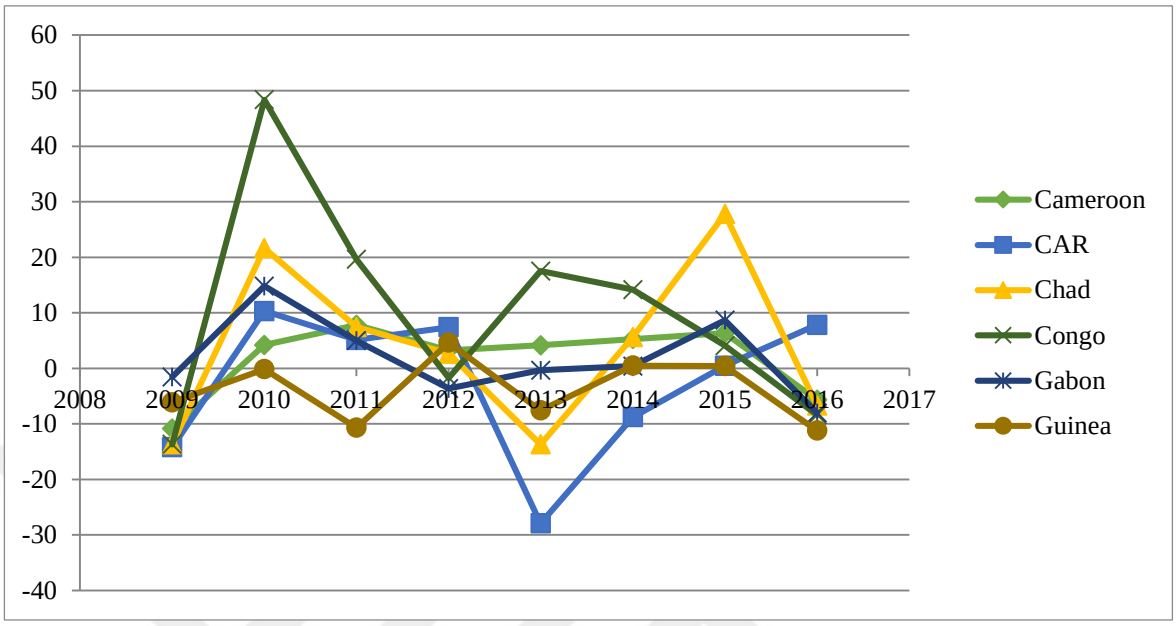

Figure 2.9. The CEMAC exports growth rate 2009-2016 (percentage)
Source: World Development Indicators (2020)

Nevertheless, the CEMAC exports are dominated with primary materials and regional integration remains a challenge in the sub region. Exports from most CEMAC countries continue to be vibrant to the overseas markets but fluctuations in export earnings are raising concerned to the future growth Amoro and Shen (2012). In regards to these problems, African countries need to diversify their exports and to safeguard a common market within the continent. Other developing countries in Asia have shown that it is possible to change from raw materials exporting countries to high technology exporting ones. For instance Indian are exporting mostly high technological products to other parts of the world, including America.

2.3.4 Imports

Imports of a nation is beneficial, if it allows that nation to exploit her "comparative advantages", the things it does best with less cost than the others, and to reap the benefits of other countries doing the same by removing trade restrictions. Also, nation turn to import from the other nation mostly in situation where the foreign price is relatively low compares

to the autarky price. In case the imports of a country exceed her exports, an unfavorable situation is created.

In 2009, Chad and CAR records the highest imports growth rate of close to 22% and 9% respectively, while Congo registers the lowest rate of approximately -26%. After a year (2010), the trend changes. Congo import growth rate jumps to 38% while that of Chad decreases to 17%. These changes occur as a result of the recent financial downturn (2009) that affected most nations in the world including the CEMAC (refer Figure 2.10).

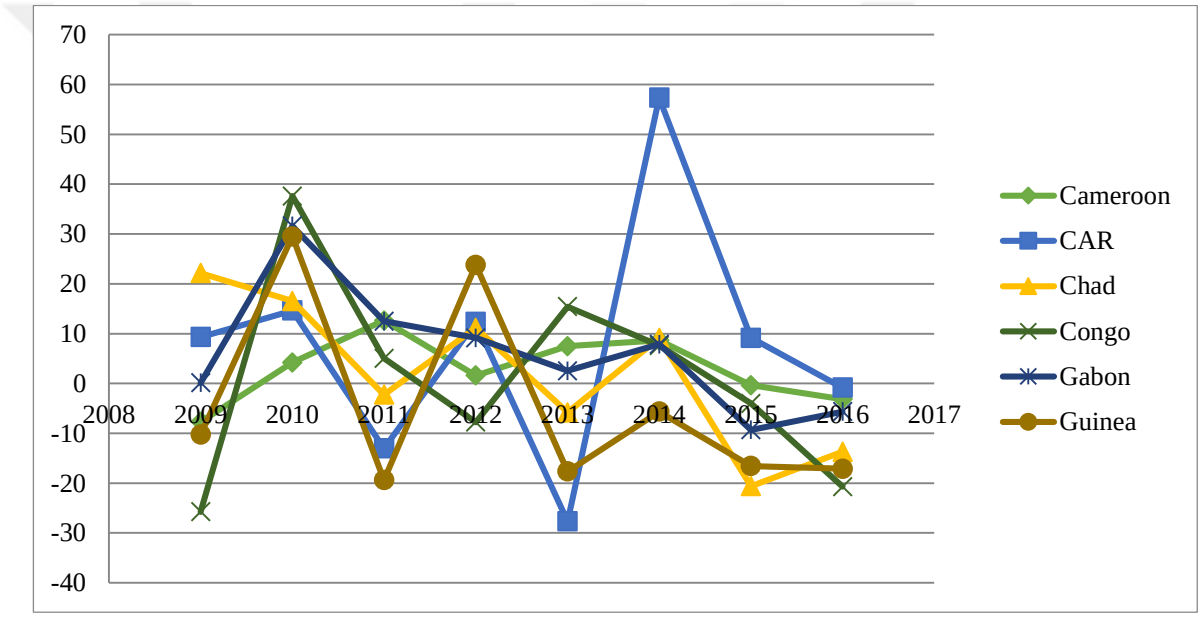

Figure 2.10. The CEMAC imports growth rate 2009-2016 (percentage)
Source: World Development Indicators (2020)

In most situations, the impact of import on growth is seen to be equivocal. It mostly depends on the nature of the goods in question. Imports are beneficial in situation where they are used for further production (capital goods) and for long term investment. Conversely, it is not beneficial in case the goods imported are mostly consumable and war equipment. Statistics have shown that Africa spent approximately 35 billion USD a year on food imports and it is projected that this amount will reach 110 billion USD by 2025 according to report from the African Development Bank. The dependency on the western countries for food imports, machines and lack of industrialization in Africa still remain a major challenge.

2.3.5 Interest rates and FDIs

In a country, interest rate acts as the determinant of investment. In other words, it is the lending rate that is habitually adjusted in real term by deflating with the GDP deflator. It increases with the cost of investment capital and thus moves in the opposite direction. A fall in the rate of interest, allow firms to diversify their portfolio in the market by further acquiring more investment capitals. Differences between the economic situations between one country to the other, also create the disparities in the rate of interest. In some situations, the rate of interest is determined by the regulatory authority in one country in order to regulate the supply of money and price stability (inflation). However, Seruvatu & Jayaraman (2001) state that the channel in which the rate of interest affects investment depends on the institutional and financial set up of the market.

Figure 2.11 shows that the rate of interest is fluctuating in nearly all CEMAC countries. Around the 80s, interest rate records its lowest value of about 2% in Cameroon, 7% in CAR, 3% in Chad 18% in Gabon and Equatorial Guinea. However, it further increases in nearly all the countries except Equatorial Guinea. Particularly in 2001 the CEMAC interest rates in a global scale, went up to 19% in Cameroon, 20% in CAR, 6% in Chad, 21% in Gabon, and 12% in Guinea. Meanwhile, in 2015, this rate keeps fluctuating in most CEMAC countries.

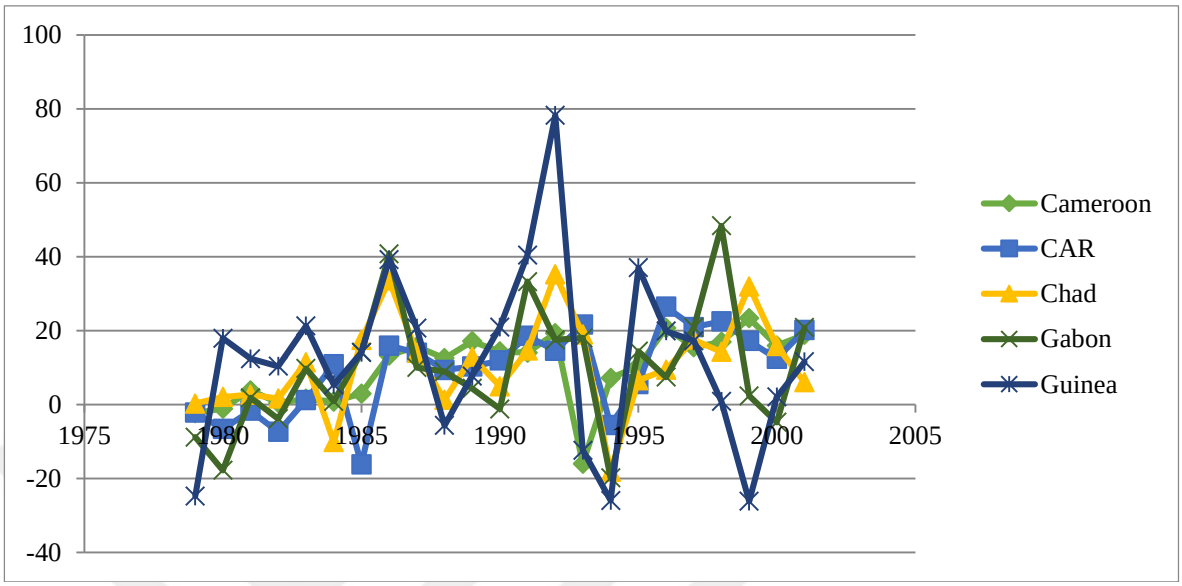

Figure 2.11. The CEMAC real interest rate 1979-2001 (percentage)
Source: World Development Indicators (2020)

It can be observed that investment in almost all the CEMAC countries is highly fluctuating. In the mid-80s, there was an economic downturn that affected most of developing countries, leading to a fall in the domestic investment. In 1987, investment as a percentage of GDP in Cameroon, CAR, Congo, Gabon, and Guinea record 26 %, 13 %, 14%, 28 %, and 79 % respectively see Figure 2.12. The values later drop in Cameroon, CAR, Congo, Gabon, and Guinea, due to the 1993 oil crisis that affected most developing countries in the world. But After this period, the government perhaps implemented some macroeconomic policies that help to revamp the CEMAC economy and consequently led to an increase in private and public investments in these countries.

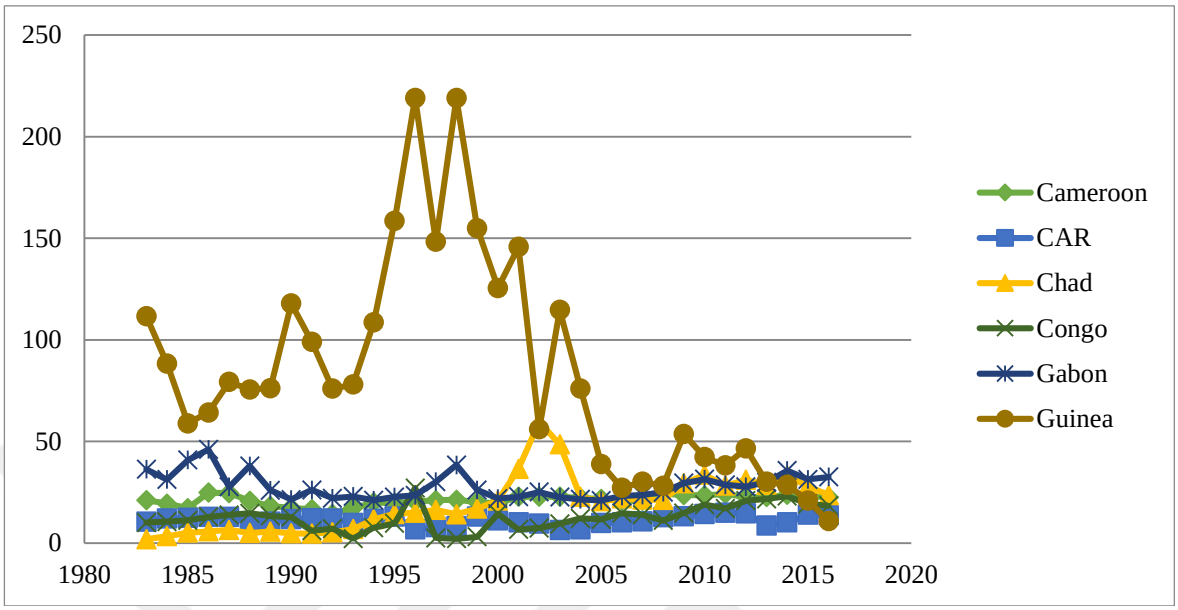

Figure 2.12. The CEMAC investment 1983-2016 (percentage of GDP)
Source: World Development Indicators (2020)

FDI comprises of the total values of all investments that are prepared by a resident enterprise in another country. Investment is considered as FDI when the foreign firm owns at least 10% or more shares or voting rights of the enterprise. Before the 1980s, the inflows of FDI to the CEMAC countries were insignificant. This was because most African heads of states had some antagonistic policies concerning foreign investors and FDI in particular. Being young states just emerging from independence, most of them were skeptical of engaging with foreign firms in the giant sectors of their economy, with the legitimate fear of losing the grip of their economies. Despite the problems outlined above, the current trend shows that FDI inflows are rising in nearly all the CEMAC countries.

In 1983, the FDI inflows in the CEMAC state stood at $776.49 million, $577.22 million, and $ 697.84 million in Congo, Cameroon, and Gabon respectively. FDI inflows to this region have increased significantly due to the strong macroeconomic policies adopted by the member states and a great improvement in their business climate. In the 80s, Equatorial Guinea was the lowest Country in terms of FDI inflows but has now managed to pull a lot of FDI. In 2016, Guinea occupies the second position, with close to $13410.92 million while

Congo top the list with about $21186.81. Chad and the Central Africa Republic have registered the lowest inflows of FDI refer to Figure 2.13.

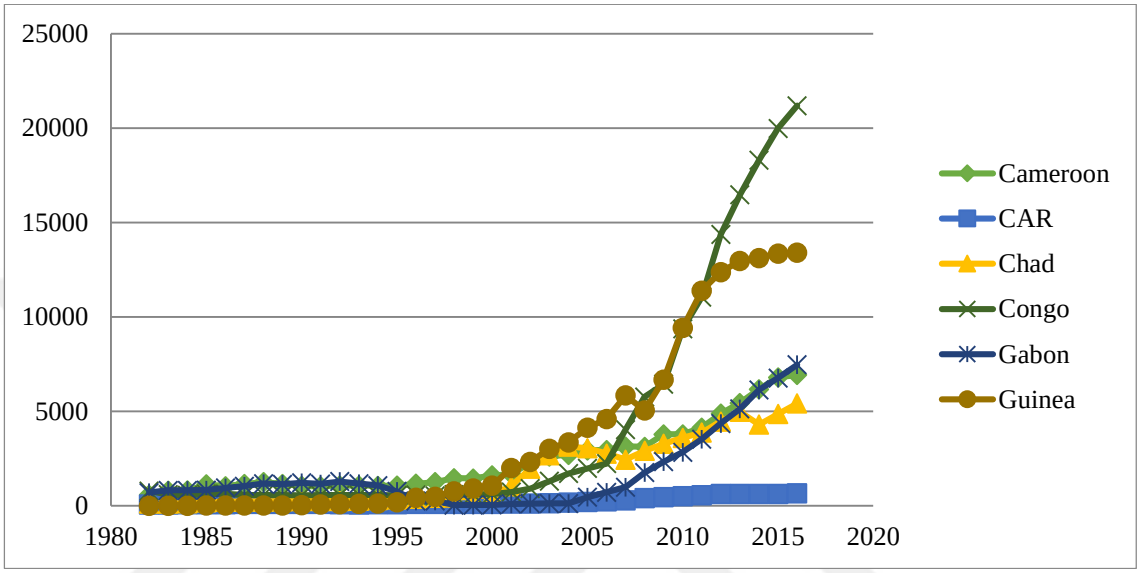

Figure 2.13. The CEMAC FDI in USD 1982-2016
Source: UNCTAD (2020)

Table 2.6. The CEMAC FDI inflows 1980-2018 (USD)

Year	Cameroon	Central Africa Rep.	Chad	Congo	Gabon	Equatorial Guinea
1980	330.387	49.630	121.370	709.230	511.520	…
1985	1124.936	77.170	183.890	620.440	832.910	5.580
1990	360.432	95.388	249.680	546.40	1208.448	25.354
1995	378.545	79.660	330.727	541.080	750.790	175.340
1998	773.302	99.685	436.184	582.850	32.920	751.198
2000	916.608	104.306	575.882	617.360	…	1059.994
2005	2248.036	198.288	3039.982	1974.068	362.621	4123.967
2010	3099.017	510.618	3593.944	9368.136	3286.972	9412.552
2011	3454.417	547.526	3875.844	11055.040	4161.845	11387.550
2012	4193.594	617.561	4455.637	14367.180	3940.971	12372.810
2013	4972.591	619.414	4975.838	16465.430	4712.164	12955.760
2014	5042.521	622.889	4300.292	18308.600	5759.867	13123.630
2015	5137.617	626.000	4859.736	19982.100	6750.302	13356.870
2016	5602.316	633.251	5104.223	21186.810	7991.286	13410.830
2017	6522.652	640.123	5439.220	22527.010	9489.324	13714.900
2018	7224.396	658.118	6101.427	24020.890	10335.080	14110.790

2.3.6 Financial development

The financial sector acts as the engine of growth in most economies. The financial sector mobilizes funds between the net savers and the net borrowers. It ensures that this fund reaches the most productive uses through the allocation and relocation functions. Also, the financial sector collects information that helps in solving the problems of the asymmetry of information and moral hazard.

Cameroon often experiences a great fluctuation in its financial credit. For Cameroon to raise growth, it is required that the government boost the financial sector. As a practical example, Cameroon is currently liberalizing its financial sector by reducing the number of state-own banks and financial institutions credit. This allows more investors to borrow money and opens more accounts which in turn generates growth. In 1980, the bank credit was about 29%. From 1980 to 1985, the financial sector has witnessed a great improvement, spurred by the good performances of the agricultural sector where most banks have been opened to the financial market. Meanwhile, in 1985, the private sector credit decreased to

24% before rising to 26 % in 1990. The private sector credit is higher in Cameroon and Guinea compared to the other CEMAC states. In 2018, Cameroon, Guinea, and Chad credits were close to 15%, 16%, and 10% respectively see Figure 2.14.

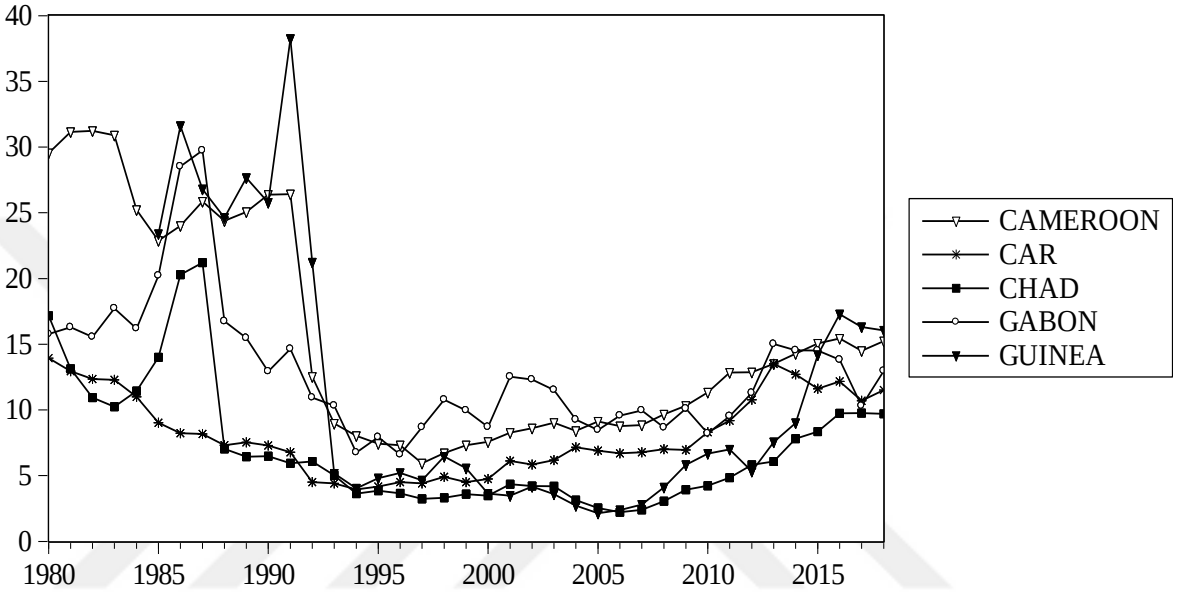

Figure 2.14. Cameroon's private sector credit 1980-2016 (% of GDP)
Source: World Development Indicators (2018)

Although there is a great improvement in Cameroon's financial sector, more efforts are required to provide firms underpinning for growth. In Cameroon and most other CEMAC countries, less than 10% of the population have access to a bank account and women have a higher ratio of account ownership than men. The proportion of women using a credit card with a mobile account is larger compared to men in almost all the socio-economic categories.[4] Also, the CEMAC financial system is not fully developed, and the absence of a vibrant credit market hinders more dynamic economic growth. In Cameroon, the poor banking system could be blamed on the Douala Stock Exchange market which since inaugurated in 2003 has failed to mobilize funds within the country. Additionally, the system has an excessive dependence on the Central Bank, especially for medium-term loans, as a source of funds.

[4] International Monetary Fund • Publication Services PO Box 92780 • Washington, D.C. 20090

2.3.7 Inflation and exchange rates

One of the objectives for the formation of the CEMAC state was to maintain price stability. This will thus help to ensure the financial integration and economic performance of this sub-region. The focus of this section is on how countries of the CEMAC state use inflation and exchange rate to achieve the above-mentioned objective. These countries share the same currency known as the Central African CFA franc, with all their foreign reserves being managed by the Bank of the Central African States (BEAC). All the member countries are required to deposit close to 50% of their foreign earnings to the French treasury. Despite the use of a single currency, the inflation rates are different among countries of this state, ranging from 0.6% to 3.9%. In 2018, it was 1.1% in Cameroon, Chad (2.1%), Congo (1.5%), Gabon(2.8%), and Equatorial Guinea (0.6%), quite below the targeted range of 3% except in the Central African Republic with 3.9% see Table 2.7.

The exchange rate is the value of one currency in terms of the other currency. It usually takes the form of fixed, flexible, forward, and spot exchange rates. Countries of the CEMAC state are practicing the fixed exchange rate method, where the CFA franc is pegged to the euro. However, the economic conditions allow the fixed parity to be adjusted, following consultations with the BEAC and the French authority. It has been appreciated by 8.9% in terms of the USD-from 580 CFA francs per USD. Meanwhile, the CFA franc and the obligation of depositing close to 50% of foreign earnings by each member state to France, has greatly been criticized.

Table 2.7. The CEMAC inflation and exchange rates

Country	Inflation (%)				Exchange rate (local currency per USD)			
	2017	2018	2019	2020	2015	2016	2017	2018
Cameroon	0.6	1.1	1.1	2.0	591.4	593.0	582.1	530.2
CAR	4.1	3.9	3.3	3.2	591.4	593.0	582.1	530.2
Chad	-0.9	2.1	2.3	2.3	591.4	593.0	582.1	530.2
Congo	0.5	1.5	1.6	2.0	591.4	593.0	582.1	530.2
Guinea	0.7	0.6	1.4	1.9	591.4	593.0	582.1	530.2
Gabon	3.0	2.8	2.3	2.5	591.4	593.0	582.1	530.2
Central Africa	9.3	7.3	4.7	4.1	…	…	…	…
Africa	12.6	10.9	9.2	8.1	…	…	…	…

… is not available.
Source: African Development Bank statistics

2.4 Social indicators

This section, focus on human capital (education), unemployment rates and poverty in CEMAC. It starts with the education enrollment, unemployment rates and lastly the poverty rates. These variables are considered as indicators for the social sustainability.

2.4.1 Education

In Cameroon, the government has as objective the provision of a universal system of education for everyone to achieve the Sustainable Development Goals 4 (SDG). This is because improvement in HC through education will intend raise growth. The literacy rate in Cameroon is closed to 78%, higher than the other CEMAC countries.

Around the early 80s, only close to 17 % of Cameroonians were enrolled in school. After that, the government then initiated various programs that encourage many youths to enroll in school. In 1994, following the local currency devaluation, school enrollment went up to 27% before falling to 23.83% in 1997. However, the school enrollment peaked in Cameroon peaked in 2016, with 61.12 % see Figure 2.15 below.

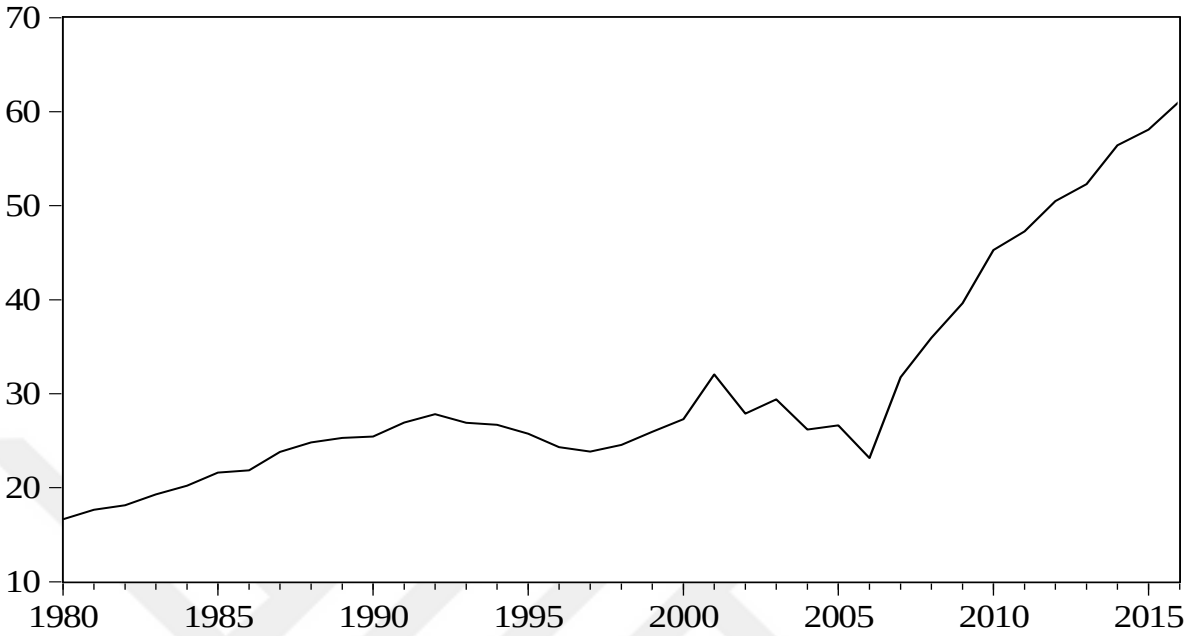

Figure 2.15. Cameroon's HC 1980-2016 (% of gross)
Source: World Development Indicators (2020)

Despite the huge progress in the Cameroon's educational system, there are still some challenges. The problems of providing universal education for everyone in Cameroon remains a challenge. Likewise, poor effectiveness, lack of infrastructure, and limited professional-oriented fields remain as impediments to the achievement of the principle of universal education. The enrollment of men and women in secondary school is not evenly distributed. In 1985 it was 28% for men and 17 % for females. Meanwhile, In 2016, the enrollment rates had increased for both men and women (57% and 66 %) respectively, even though men's participation rates in school are still higher than that of the women see Table 2.8 below.

Table 2.8. School enrollment in Cameroon 1980-2016 (percentage)

Year	Female	Male
1980	12.238	22.304
1985	17.043	27.778
1990	21.288	31.128
1995	21.437	31.283
2001	29.642	36.517
2005	24.488	30.955
2006	21.382	26.918
2007	29.031	37.315
2008	33.480	41.739
2009	37.856	45.222
2011	45.546	53.709
2012	48.941	57.035
2013	50.657	59.064
2014	54.389	63.780
2015	56.001	65.324
2016	57.089	66.376

Source: World Development Indicators (2018)

Moreover, insufficient funds and inadequate management of the education sector remain a challenge: The portion of the national budget allocated to education sector declined in real terms from 2014 to 2015 and only 36% of the sector's budget were allocated for basic education. Meanwhile the poor management in this sector couple with unfair distribution of inputs have helped to keep many youths from receiving the basic education. Only 27% of children nationwide have access to preschool programs, and this figure has droped precipitously for children in the lowermost income bracket and in the rural areas. Another problem is that the number of students per teacher is quite high couple with limited teaching materials. While in school, children often find themselves in overcrowded classrooms

(average of 76 students for every teacher) and are forced to share the basic resources, like textbooks. Based on a sampling study conducted by UNICEF in some targeted zones in Cameroon, the average ratios are: 17 pupils for every reading French/English textbook, 9 for mathematics and 31 for sciences.

Late enrolment and low retention rates equally remain a challenge in Cameroon. Meanwhile girls' enrolment in school is growing, too many children still enroll in school too late and turn to drop out early. The completion rate for primary education was 76% in 2015 (72% for girls), and 78% of those continued (77% for girls) on to lower secondary education nationwide. However, in the northern regions, the average transition rate is 47% (43% for girls). More than 12% of primary school children in Cameroon repeat a grade each year. Security situation: An influx of refugees from Central African Republic and Nigeria to some areas of Cameroon is putting extra pressure on schools. 386,000 children – including refugees, internally displaced children and children in host communities – are in need of education services.

2.4.2 CEMAC unemployment rates

Most CEMAC employments are in the informal sector, particularly agriculture. The lack of social welfare, poor urbanization, and poor development in human and social capital are amongst the factors that explain the poor employment rates in the CEMAC state. The Central African region records an unemployment rate of 4.7 % in 2018. Whereas, Gabon dorminate with close to 20% followed by Congo (11 %), Equatorial Guinea (7.6 %) Chad (5.9 %) Central African Rep. (5.8 %), and Cameroon (4.2 %).

The CEMAC employments are mostly in the informal sector, particularly agriculture. Agriculture employs more than 70% of the CEMAC population. Inadequate infrastructures, social welfare, and limited human capital (skill workers) are some of the reasons for the CEMAC high unemployment rates. In 2018, unemployment rate in Gabon was 20%, Congo (4.2%), Chad (5.9%), CAR (5.8%), and Cameroon (4.2%) refer Table 2.9. Considering the high rates of unemployment the authority need to develop policies that facilitate industrialization and intend to enhance more job creations. The government also needs to create a favorable business climate that attracts more investors and thus limits the increasing

numbers of young people that are willing to emigrate to other places to search for job opportunities.

Table 2.9. The CEMAC labor indicators, 2018

	Employment rate for ages 15 and above (%)			Labor participation rate for ages 15 and above (%)			
Country	Total	Female	Youth	Total	Female	Male	Unemployment rate, total (%)
Cameroon	73.0	67.6	50.6	76.4	71.4	81.4	4.2
CAR	67.4	59.2	48.4	76.8	70.8	83.1	5.8
Chad	66.9	60.3	49.7	71.6	64.0	79.3	5.9
Congo	61.8	59.2	34.3	70.4	67.6	73.2	11.3
Guinea	54.7	51.3	24.7	83.1	72.0	92.9	7.6
Gabon	41.6	31.2	10.8	52.4	42.9	61.7	19.5
Central Africa	69.1	65.9	45.1	72.3	69.5	75.3	4.7
Africa	59.6	51.0	40.1	65.9	55.5	75.9	7.8

Source: African Development Bank statistics

2.4.3 Poverty and inequality in CEMAC

Major advancement have been done to reduce the rate of poverty within the CEMAC state. This has caused the number of people under the poverty line drop to 60 % in 2018.[5] Meanwhile the conflicts and socio-political crises in the southwestern Cameroon and the Central African Republic could reverse the trend. Most CEMAC economies are agriculturally oriented, but climate change could greatly affect this sector. This is because agricultural sector is quite vulnerable to climatic conditions. This therefore implies that the CEMAC economies might enter into food crises and rise in poverty rates if majors are not taken to mitigate the impact of climate change.

Another problem affecting the CEMAC countries is income inequality. The high level of inequality within this region turn to erode the positive impact that emerges with economic growth. Despites the averagae growth rates of close to 5 % for the past 25 years in SSA, this

[5] African Development Bank 2018a

region is still recording high poverty rate of about 41 %. This rate is relatively above those of the other third world countries. Also, there are high concentration of land, HC, and physical capital on the hands of few individuals and the role of the state remains limited, infrastructures unevenly distributed between the rural and the urban cities. Above all, the SSA Gini coefficient of CAMAC state has declined from 0.47 in 1991 to 0.43 in 2011 eventhough this state still remains the least egalitarian region in the world.[6]

As shown in Table 2.10 below, close to 38 % of Cameroonian are living below the poverty line in 2014 meanwhile their income inequality remains high, with Gini coefficient of about 47. Also, statistics have shown that, in 2014, close to 24 % of Cameroonian were living on less than 2 dollars per day. In 2008, approxately 66 % of the population in Central African Republic were living in less than 2 dollars per meanwhile that of Chad were about 38 % in 2011. In terms of income inequality, it is lower in Gabon compared to other CEMAC states with Gini coefficient of close to 38 in 2017 and less than 4 % of their population living on less than 2 dollars per day. Above all, the SSA Gini index has dropped to 0.43 in 2011 and even at that, the CEMAC state remains the least egalitarian world region.[7]

[6] UNDP 2017

Table 2.10. Poverty and income distribution indicators in CEMAC

National poverty line*			International Poverty line (1.90 dollar a day)		Gini index**	
Year		Population below the poverty line (%)	Year	Population below the poverty line (%)	Year	Value
Cameroon	2014	37.5	2014	23.8	2014	46.6
CAR	2008	62.0	2008	66.3	2008	56.2
Chad	2011	46.7	2011	38.4	2011	43.3
Congo	2012	63.9	2011	37.0	2011	48.9
Guinea	2006	76.8	...	...	...	...
Gabon	2017	33.4	2017	3.4	2017	38.0

... represents is not available.
*. Defined as two-thirds of average consumption.
**. Based on income distribution.

2.5 Environmental indicators

Developing countries in the world including those of the African countries have begun to realize the importance of sustainable development. Cameroon and other CEMAC countries have placed emphasis on the SDGs to maintain a more sustained environment. In order words, sustainable development necessitates countries to take into account distributional equity, health, education, political accountability and a well-functioning society in developing their macroeconomic policies. It also requires that the depletion of nonrenewable resources should sufficiently be remunerated by investing in other substitutes and renewable resources. This section, will focus on pollution (CO2 emissions) and energy consumptions in CEMAC state.

2.5.1 Carbon dioxide emissions in CEMAC

The quest to intensify economic activities in developing countries, often put much pressure on the environment. In Cameroon and other CEMAC countries, this situation is not

different. According to research conducted by the Club of Rome, environmental damages move in a similar direction with economic growth. In other words, economic growth leads to the emissions of greenhouse gases, and to mitigate the spread of pollution, economic growth has to be mitigated as well.

Generally speaking, environmental problems are not the same everywhere, implying that different countries require different solutions. In Figure 2.16 below, CO2 emissions are rising in most of the CEMAC countries. Particularly in 1980, Cameroon emits close to 3905.36kt of carbon dioxide, which later drops to 1103.77kt in 1991. Statistics have shown that transportation is responsible for close to 61% of CO2 emissions against 11% for manufacturing and construction in Cameroon. However, the government of Cameroon has ratified the Paris Agreement and is developing strategies to reduce CO2 emissions by 32%. In 2014, countries with the highest emissions of CO2 are Cameroon (7003.97kt), Equatorial Guinea (5346.49), and Gabon (5192.47kt).

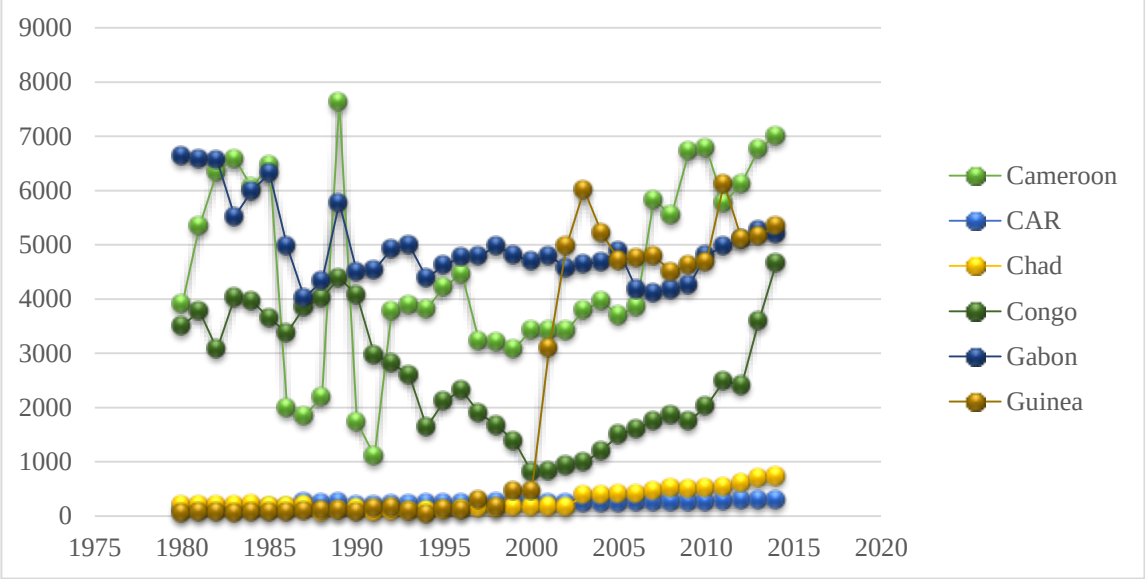

Figure 2.16. CEMAC carbon dioxide emission 1980- 2016 (kt)
Source: World Development Indicators (2020)

In terms of environmental conditions, factors like industrialization, urbanization, and too much exploitation of resources, are responsible for environmental degradation in CEMAC state. These problems often generate other adverse issues like climate change,

global warming, rise in sea level, loss of aquatic life, and increase in famineAccording to Stern (2007) According to Stern (2007), CO2 emissions have increased from 280 parts per million (ppm) during the industrial revolution to 430 ppm nowadays and may reach a critical level of 550 ppm by 2100. Moreover, indoor air pollutions are common in most African homes, including Cameroon. This normally takes place when people turn to use wood, charcoal, and kerosene for cooking, and to address the pollution issues, both outdoor and indoor pollution should be considered.

Table 2.11. Carbon dioxide emissions in CEMAC 1980-2016

Year	Cameroon	CAR	Chad	Congo	Gabon	Guinea
1980	3905.355	106.343	209.019	3501.985	6633.603	58.672
1985	6475.922	161.348	179.683	3641.331	6318.241	66.006
1990	1734.491	198.018	143.013	4070.37	4499.409	66.006
1995	4228.051	234.688	110.01	2123.193	4624.087	128.345
2000	3432.312	267.691	176.016	814.074	4693.76	454.708
2005	3696.336	234.688	399.703	1499.803	4888.111	4712.095
2006	3861.351	249.356	407.037	1609.813	4173.046	4756.099
2007	5834.197	253.023	462.042	1756.493	4118.041	4796.436
2008	5544.504	253.023	509.713	1859.169	4173.046	4503.076
2009	6725.278	253.023	491.378	1749.159	4250.053	4620.42
2010	6780.283	264.024	517.047	2020.517	4811.104	4679.092
2011	5768.191	278.692	539.049	2493.56	4972.452	6127.557
2012	6127.557	293.36	612.389	2401.885	5104.464	5115.465
2013	6772.949	297.027	700.397	3589.993	5280.48	5163.136
2014	7003.97	300.694	729.733	4671.758	5192.472	5346.486

Source: World Development Indicators (2018)

2.5.2 Energy consumption in CEMAC

The CEMAC countries are blessed with abundant natural resourc especially in the natural resource sector. In Cameroon, the energy sector comprises of hydroelectricity (the second largest in Africa after Democratic Republic of Congo), gas and renewable energy. Figure 2.17 below shows that the consumption of energy in Cameroon and Congo are still low compared to that of Gabon. According to the World Bank (2019), only about 21% of people in the rural and 91% in the urban areas in Cameroon have access to electricity. Less than 23%

of people at national level have access to clean cooking solution since most households are still using firewood as the first source of energy.

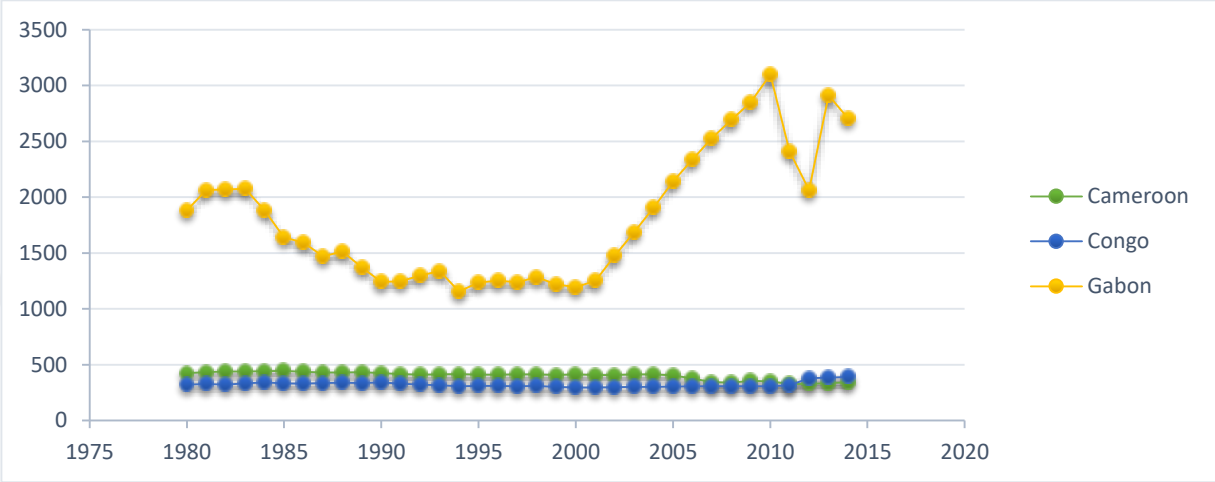

Figure 2.17. CEMAC energy consumptions 1980-2016 (kg of energy)
Source: World Development Indicators (2020)

The level of energy consumption in Cameroon is falling while in Gabon and Congo, it is increasing. In 1985, Cameroon consumes close to 444kg of energy but this value drops to 115kg in 2009. In 2014, Gabon is still dominating with close to 3000kg consumption of energy while Cameroon and Congo are consuming less than 500kg of energy.

Table 2.12. Energy consumption in CEMAC 1980-2016 (kg of energy)

Year	Cameroon	Congo	Gabon
1980	424.1485	321.2019	1884.549
1985	443.553	333.0623	1638.267
1990	425.1607	340.8488	1240.695
1995	411.374	308.5832	1234.832
2000	413.0916	295.4088	1194.544
2005	404.9495	304.3473	2140.71
2006	375.5975	305.8663	2338.376
2007	344.6361	306.8263	2526.955
2008	338.2447	307.8465	2691.666
2009	355.7959	306.7412	2851.201
2010	348.8546	307.6133	3098.422
2011	327.1993	315.9633	2411.372
2012	328.4376	379.1481	2064.221
2013	336.0036	385.4002	2913.543
2014	341.8627	389.5674	2705.823

Source: World Development Indicators (2018)

2.6 Chapter Summary

This chapter starts with a brief introduction of six CEMAC. After that, the performance of these economies with indicators such as economic growth, globalization, exports and imports are presented. Next, we look at the structure of the economies (agriculture, industries and services). In this section, we note that agriculture is the dominant sector in most of the CEMAC economies. Finally, we present other variables like FinDev, interest rates, FDI, CO2 and energy consumptions in the CEMAC states. Meanwhile in the next chapter, we will cover the theoretical and empirical reviews for the effect of FinDev, huaman capital, economic growth, FDI and energy consumption on environmental quality.

CHAPTER THREE

LITERATURE REVIEW

3.1 Introduction

Scholars usually visit the growth theories to find out the feasibility to replicate the models of growth that are practiced in developed countries to less developed economies in order to reduce poverty and income disparity. However, the continuous increase in environmental quality and income inequality between nations, have made researchers to question the relevance of the growth theories. Some growth theories suggest that poor countries will grow to catch-up with high-income countries. But today, it is quite challenging for developing countries to develop and meet-up with the industrialized countries. This is because most third world countries turn to specialize in the export of raw materials, with little diversification and industrializationand. Agriculture remains the main activities and their economies are characterized with low level of technology, poor development of HC, underprivileged investment climate, lack of adequate infrastructures and high price fluctuations Amoro & Shen (2012). This chapter will thus, covers the theoretical and the empirical framework

3.2 Theoretical Framework

In this section, we assess the various theories that are related to this research, particularly the financial development theories, environmental theories, and sustainable development theories. The section starts with the presentations of the growth theories, which comprise of the Harrod-Domar model (HDM), Solow-Swan model (SSM), and the endogenous growth model (EGM). Next, we present the finance and environmental theories, the growth and environment theories, and lastly the sustainable development theories. In brief, this chapter will cover the theoretical and empirical framework.

3.2.1 Harrod & Domar growth model

Economic theories are sometimes conflicting in relating real life phenomenons. They often provide results that are quite contradictory to one another[8]. Harrod & Domar (1939) developed a model to investigates the possibility of achieving a sustained growth in developing countries using the saving rates and the productivity of capital. Although this model is an extension of the Keynesian short-run growth model, it went ahead to suggest three types of growth. These consists of the natural growth rate (G_n), the actual growth rate *(G),* and the warranted growth rate (G_w). The natural growth rate is determined by natural conditions such as the stock of labor force, natural resources, capital equipment, and technical knowledge. The actual growth rate is explained by the actual growth rate of savings and investment within a country. Meanwhile the warranted growth rate refers to the growth of the economy at its full capacity. For a nation to maintain a sustained growth path, these three rates need to be equally as the model assumped. But looking at the real life phenomenons, it is quite difficult for these three rates to move in the same direction. The mathematical formulation of this model will be introduced below.

A. Mathematical formulations

Let *Y* signify output, *K* represent capital stock, *S* is total saving, s indicate the savings rate, and *I* is investment. δ stands for the rate of depreciation of capital stock. The Harrod & Domar (1939) model makes the following priori assumptions:

1. Output is a function of capital stock, given by; $Y = f(K)$.
2. The marginal product of capital is constant and the production function unveils constant returns to scale. This suggests that the marginal product of capital and the average products are the same. That is $\frac{dY}{dK} = c$. This implies that $\frac{dY}{dK} = \frac{dY}{dK} = \frac{Y}{Y}$.
3. Capital is a necessary factor for output and this indicates that $f(0) = 0$.
4. The product of the savings rate and output is equal to saving, which is equals to investment. This is given by $sY = S = I$.

[8] Review of theories and models (2014)

5. The change in the capital stock equals investment minus the depreciation of the capital stock. This is designated by $\Delta K = I - \delta K$. These assumptions permit us to derive the output growth rate, given by

$$c = \frac{dY}{dK} = \frac{Y(t+1)-Y(t)}{K(t)-sY(t)-\delta K(t)-K(t)} \quad (1)$$

$$c = \frac{Y(t+1)-Y(t)}{sY(t)-\delta\frac{dK}{dY}Y(t)} \quad (2)$$

$$c(sY(t) - \delta\frac{dK}{dY}Y(t)) = Y(t+1) - Y(t) \quad (3)$$

$$cs - c\delta\frac{dK}{dY} = \frac{Y(t+1)-Y(t)}{Y(t)} \quad (4)$$

$$s\frac{dY}{dK} - \delta\frac{dK}{dY}\frac{dk}{dY} = \frac{Y(t+1)}{Y(t+1)} \quad (5)$$

$$sc - \delta = \frac{\Delta Y}{Y} \quad (6)$$

An alternative (and, possibly, modest) derivation is demonstrated as follows, with dots (for example, $\dot{Y}$) denoting the percentage growth rates. First, assumptions (1) - (3) imply that output and capital are linearly related. These assumptions thus generate equal growth rates between the two variables. That is,

$$Y = cK \text{ where } d\log(Y) = d\log(c) + d\log(K) \quad (7)$$

Considering the fact that the marginal product of capital, c is constant, we will have;

$$d\log(Y) = d\log(K) \Rightarrow \frac{dY}{Y} = \frac{dK}{K} = \dot{Y} = \dot{K} \quad (8)$$

Next, with assumptions (4) and (5), the capital growth rate is given by,

$$\dot{K} = \frac{I}{K} - \delta = s\frac{Y}{K} - \delta \quad (9)$$

$$\Rightarrow \dot{Y} = sc - \delta$$

B. Criticisms

Proponents of this growth model hold that economic growth might not be sufficient to maintain full employment. This is because the relative price of capital and labor are fixed,

and often used in the same proportion. In practical situations, both capital and labor turn to depreciate, making it difficult to realize the conditions of full employment. In other word, this model is not clear since it assumed that economic recession and economic boom are influenced by output or the accelerator principle) but in real life, investment decisions are not only limited to the output growth. Besides, this model considered economic growth and development as a similar entity whereas, in actuality, economic growth is a subset of development. Also, the model states that third world countries should borrow in order to raise capital for their development projects which will in turn trigger growth. However, history has shown that in poor countries, debt often causes repayment problems especially when the money is used for consumption and to purchase war equipment.

Moreover, this model hypothesized that economic growth is a function of savings and investments. In order words, economic growth is stimulated in countries that used their savings and investment efficiently but developing countries do not always have sufficient capital to lend to investors. But according to Kuznets (1976), economic growth depends on how industrialized a country. The author went further to explain that inputs or returns will be higher when laborers change from agriculture to industry but too much concentration on the industrial sectors might cause the industrial output to fall. Another criticism is that this model assumed that for a country to be stable, the three rates of growth have to be equal but in real life, the possibility for these three rates to be equal is quite difficult because the saving rates depend on household while investments rely on the hands of the capitalists. Similarly, the savings rate is assumed to be exogenously established outside the model. This model is thus bound to be unstable, leading to the development of other models of growth.

In addition to above, Rostow (1959) states that poor countries need to pass through five major stages to become developed. These stages are the traditional society, the preconditions for take-off, the take-off proper, the drive to maturity, and the stages of mass consumption. In most parts of Africa, the political elits conrtol nearly everything and the poor are mostly left behind. The rich keep growing richer and the poor growing poorer. To break this chain, Rostow suggests that more capital should be accumulated by forgoing the present consumption.

3.2.2 Neoclassical growth model

The neoclassical growth was introduced to explain the reasons for income disparities between countries (Solow, 1956). This model extends the Harrod & Domar (1939) growth model, with the introduction of a new term in growth theories known as productivity growth. According to this model, the primary determinant of economic growth is productivity and this construct explains the main reasons for the differences in standards of livings across countries.[9]

A. Assumptions

The neoclassical growth model (NGM) assumed that capital turn to diminished as more and more capital is used. According to this assumption, capital is subject to diminishing returns to scale. Because of no technical progress, the amount of new capital generated will just be equal to depreciation or the capital lost. Because of the assumption of diminishing return to scale and lack of technical progress with the NGM, the economy might stop to grow.

Likewise, the NGM assumed that the economy consists of one sector that produce only one type of commodity, which is either used for investment or for consumption purposes. It equally states that the economy is closed to international transactions with limited government involvement. Moreover, the saving rate is assumed to be equal to the investment rate and the model equally states that money has nothing to do with the functioning of the economy (monetary neutrality). Based on these norms, the NGM, will always operate in a state of equilibrium (market clearance) due to flexibility in price see Snowdon B. and Vane H. (2005, pg. 622). The model will be demonstrated mathematically as shown below.

B. Model formulation

This model is formulated with the consideration of four basic macroeconomic equations:

1. Th production function in macro sense.
2. The equation in terms of GDP

[9] https://www3.nd.edu/esims1/solow_model_fall_2014.

3. The saving function
4. The capital and labor force changes

The production function im macro sense

Solow assumed a Cobb-Douglas production function that take the form,

$$Y = AK^{\alpha}L^{1-\alpha} \qquad (1)$$

In the above equation, *Y* stands for total production within the economy. *A* represents productivity (also known as technology), *K* represent capital and *L* pinpoints the labor force. The macro-production function will be given by;

$$Y = AK^{\alpha}L^{1-\alpha} \leftrightarrow y = AK^{\alpha} \qquad (2)$$

The production function is then divided by *L* to have total production per capita *y* and the capital intensity *k*. The savings function is then given by $I = sY$ and the changes in capital is then given by,

$$\Delta K = sY - \delta K \qquad (3)$$

where $\mathcal{S}$ stands for the depreciation rates. Meanwhile the Changes in workforce is given by,

$$L_{t+1} = L_t(1 + gL) \qquad (4)$$

In equation 4, gL is the growth function for labor. In order to derive the model solution, we first need to define some important functions. This start with the growth in capital, given by $gK = \frac{\Delta K}{K}$, growth in the GDP, given by $gY = \frac{\Delta Y}{Y}$ and lastly, the growth function for capital intensity, given by. $gk = gK - gL$. We need to derive the solution by first assuming that there is no technical progress in growth, which makes the derivation more comprehensible:

$$gK = \frac{\Delta K}{K} \rightarrow \frac{sY - dK}{K} \rightarrow \frac{sY}{K} - d \qquad (5)$$

The following calculation is conducted based on fact that there is no growth in *A*: $gK = gL = gY$. By Moving on, we obtained $gK = \frac{sY}{K} - d$. By dividing the fraction by *L*, we obtained that $gK = \frac{sy}{k} - d$, where,

$$gK = \frac{sy}{k} - d \rightarrow \frac{sAK^{\alpha}}{k} - d \rightarrow \frac{SA}{k^{1-\alpha}} - d \qquad (6)$$

After that we subtract gL from gK leading to:

$$gk = \frac{SA}{k^{1-\alpha}} - (d + gL) \qquad (7)$$

In the first section on the right side of equation 7, we note that $\lim_{k\to 0} gk = \propto$ and $\lim_{k\to \propto} gk = -(d + gL)$. This then enable us to generate the steady-state equation given by, $\frac{d\frac{K}{L}}{dt} = \frac{dk}{dt}$ where $k = \frac{K}{L}$and k denotes the capital per worker. which is; $\frac{dk}{dt} = \frac{\frac{dK}{dt}}{L} = \frac{dk}{dt} - \left(\frac{\frac{dL}{dt}}{L}\frac{K}{L}\right)$. We know that $\frac{\frac{dL}{dt}}{L}$ represents population growth (*n)*. The statdy-state equation is then given by,

$$\frac{dK}{dt} = sY - \delta K \qquad (8)$$

where δ represents the depreciation rate of capital. By rearranging equation 8, we then obtained: $dk = sy - (n + \delta)k$ (9)

Equation 9 represent the fundamental Solow equation. The same can by including the technical progress in the model. In the steady state the change in dk must be 0, leading to,

$$sy = (n + \delta)k \qquad (10)$$

Meanwhile, the steady state consumption is then given by,

$$c = y - (n + \delta)k^* \qquad (11)$$

C. Criticism and policy implications

This model fails to incorporate education policies, taxes, R&D subsidies, and entrepreneurial activities as some of the key elements in impacting growth. Besides, the model is limited in that, it fails to explain the sources of technical progress and assumed that it exogenously determined the growth of a nation. Moreover, the NGM places more emphasis on the macroeconomic parameters that determine economic growth but fails to incorporate many microeconomic indicators. Also, the model predicts that poor countries will grow faster and catch-up with industrialized economies. This is quite true for the East Asian countries where, Hong Kong, China, the Republic of Korea, Singapore China are among the countries that are catching up with the industrialized economies (Chandra et al., 2013). Meanwhile, the SSA countries have not been able to catch up rapidly like their Asian counterparts as predicted by this model. Another downside of this model is that it does not focus on international trade. In Fagerberg and Srholec (2005) sense, five factors need to be considered for a country to grow rapidly: knowledge, openness to trade (knowledge from abroad),

FinDev, governance quality as well as the democracy advancement. Base on the above arguments, this model is porous in tackling real-life issues. Despite the limitations of this model, it however acts as a stepping stone in the development of the other growth models.

3.2.3 The endogenous growth model

The expression "endogenous growth" was first coined around the 1980s to embrace the group of empirical and theoretical works concerning economic growth. The Edogenous growth model (EGM) was developed by Arrow (1962), Lucas (1988) Romer (1990), Barro (1992), and many other economists. This model differs from the NGM in that it considered growth as endogenously determined (Romer, 2011). It employs the endogenous technological progress to illustrate the reason for income disparities in many countries. According to Maré (2004), a positive relationship exists between productivity and economies of scale. This implies that in the EGM, capital does not follow a diminishing return as stated in the NGM. In the EGM, productivity growth will offset the effects of diminishing returns by allowing capital and output to keep growing together. The main future of the EGM is that it functions with the nonexistence of diminishing returns as assumed in the NGM. This model does not just criticize the NGM but, rather augments it with the introduction of endogenous technical progress. The proponents of the EGM, together with their contributions are elaborated in details below.

The EGM focuses on HC, R&D, infrastructures and innovation (learning by doing). The theory of HC started with Adam Smith, where the author try to use it to explain the reasons for wage differential between workers and countries. This theory has led economists to extend this view, by explaining that everything being equal, personal incomes may vary according to the amount of investment in HC, especially through education and training. Moreover, Lucas (1988) provides a fundamental understanding of HC and economic growth. This author shows that HC and technological differences act as the main reasons for the differences in growth between countries. This explains the reasons why countries with poor HC development (third world countries) are characterized by a low level of economic development and rapid population growth. In other words, human capital plays a leading role in stimulating growth.

Meanwhile, Arrow (1962) introduces the idea of learning by doing, by considering it as the main determinant of economic growth. He states that firms can make more productive use of capital in a country where people have collectively acquired sufficient knowledge through learning by doing process. Besids, Romer (1990) extend the concept of HC in the endogenous growth model. He sees HC as the stock of knowledge and skills that are obtained from education and vocational training. This theory holds that training and education raise worker's output and knowledge transfer that in the long term run will stimulate future growth.[10] The author further postulates that even though expenditures on education and training are costly, it should be considered as a long term investment for growth. Barro (1992) on the other hand, states that the development of HC will further lead to the development of investment and physical capital. This because HC plays a significant part in the development of most nations, especially in countries where the government gives priority to HC development. Ultimately, physical capital is also important, but precedence should be placed in developing human resources.

The channels through which HC impact growth may involve the positive spillover of HC to physical investment and from HC to economic growth. This is mostly in situations where the ratios of human to physical capital are high and because of this, countries have experienced rapid growth as a result of speedy development in HC. For instance, the success of Malaysia today is largely due to the priorities that the government placed on HC see Aflizan et al. (2014). This model made the following assumptions.

A. Assumptions

1. There exists a perfect competitive market with many firms.
2. Having knowledge or technological advantage is not seen as a rival good.
3. There exists an increasing return to scale to all the factors of production taken together and a constant return to a single factor, for at least a factor.
4. Technological advantage depends on the creation of new ideas and the things people do.

[10] Becker, G. (1994) Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education. Chicago: The University of Chicago Press.

5. Many individuals and firms have market power and earn profits from their innovations.
6. Increasing return to scale at times, generate imperfect competition.

B. Mathematical formulation

The model starts with the production function, given by,

$$Y = AK \quad (1)$$

Here A represents technology, K stands for human capital. By substituting in the above equation leads to, $Y = AK$. In term of capital growth, the model is given as;

$$\gamma_k = \frac{\dot{k}}{k} = \frac{sf(k)}{k} - (n + \delta) \quad (2)$$

Here γ_k represents capital ratio; n stands for the supply of labor and δ indicates the rate of depreciation. Equating the productivity of capital to technological progress leads;

$$\frac{f(k)}{k} = A \quad (3)$$

In other terms, the capital accumulation process is given by;

$$\gamma = sA - (n + \delta) \quad (4)$$

The positive technical progress given by the term A, therefore, implies that the marginal and average propensities of capital will be constant. This means that the term will equally be constant, making it possible for the condition of the positive accumulation of capital, $sA > (n + \delta)$ equally hold. In other words, without the exogenous technical change, it will still be feasible to accumulate capital. The AK growth model with the steady-state equilibrium of per capita GDP, capital and consumption growth rates are given by;

$$\gamma = \gamma^* = sA - (n + \delta) \quad (5)$$

It is significant to take into consideration that changes in population growth rates in the NGM could mainly lead to a level effect but the EGM with increasing return to scale will possibly generate some growth effect. Moreover, in the NGM, it is possible for a country to technically convergence towards the steady-state whereas, in the AK models, these conditions might not take place since the per capita income growth is independent of the per capita income levels. To overcome these problems, the narrow definition of capital should be improved by considering both human and physical capital. A substitute, could be to consider K as the basis of learning by doing process. In this respect, physical capital becomes the

engine of growth. In the Solow growth model, investments do not have economic growth effect and the production function will then look like;

$$Y = AK^{\alpha+\beta}L^{1-\alpha} \quad (6)$$

C. Criticisms and the policy implications

The assumption of increasing returns in both physical and HCs means that investment return will not fall in developed countries relative to the developing nations. In order words, the rate of return for capital in developed countries is likely going to be higher than those in developing ones, causing capital to flow from developing countries to more industrialized economies. This implies that the growth convergence between the developed and less developed countries is no longer possible. On the contrary, countries like Hong Kong, China, South Korea, Singapore among other countries are now growing and catching-up with the industrialized economies see Chandra, Lin, and Wang (2013).

Mankiw, Romer and Weil (1992) re-assessed the Solow growth model to find out whether it is still relevant in explaining trade variations and living standard between nations. Using physical and HC, the authors explored the possibilities for countries to converge in their living standard as proposed by Solow. The authors outlined the possibility for zero convergence, which could take place when countries turn to lower their population growth rate and invest in physical and HCs. In other words, HC, saving, education and population are important in explaining the cross country variation in per capita income. It was concluded that the assumption of decreasing return to scale is still relevant in explaining growth theories and the reasons for convergence and income disparities between countries.

We have present the various growth model as shown above. Despite of the positive points that the various models have suggested in raising growth, the main issues are that the growth theories fail to incorporate the aspect of environment. Economic growth often leads to natural resource exploitation and thus it is important to consider the negative externalities (pollution) that it raises during it measurement. Another major challenge is that, economic growth does not record all the goods and services produced, especially from the informal sector (black market). In addition, it does not take into consideration the time factor put in during work, which obviously affects the societal welfare. Our study is therefore different from the growth models in that, we have taken into considerations the aspect of environment

in the formulation of our model. This will be done by looking at the determinants of economic growth in Cameroon and their impact on the quality of environment.

We have presented the various growth models as shown above. Despite the significance of the various growth in raising growth, the main issues are that most growth models fail to incorporate the aspect of the environment. Economic growth often leads to the exploitation of natural resources. Because of these, it is required to take into account the negative activities (pollution) in formulating the models or its measurement. Other challenges are that economic growth does not record all the goods and services produced especially from the informal sector (black market). Besides, it does not take into consideration the time factor put in during work, which affects societal welfare. We, therefore, seek to cover these gaps, by looking at the determinants of economic growth in Cameroon and their impact on the environment.

3.2.4 Financial development theory

The theory of Financial development was first introduced by McKinnon and Shaw. This theory holds that the financial sector is essential for a nation's growth. In other word, the growth of the financial sectors, lead to the growth of the real sector. It states that the forces of demand and supply operating in the market will generate an equilibrium rate of interest and further stimulates savings and investment. The financial sectors ere vital in modern market economies. It acts as engine of growth in facilitating payment and the provision of intermediary services between the lenders and borrowers. These sector equally offers households, and firms with good management tools see Beck (2013). FinDev affects economic growth in different channels and researchers have grouped them in two broad categories Levine (2005). The first view, is based on the standard neoclassical framework and is regarded as a direct channel. According to this view, FinDev will stimulate economic growth through increase in domestic investment and saving thereby reducing the cost of capital. The second view focuses on indirect channels and according to this interpretation, FinDev provides the catalyst for certain collateral benefits like domestic institutional development, better governance, macroeconomic discipline that positively spillover to economic growth.

According to Sehrawat, Giri & Mohapatra (2015), the production factors (such as labor and capital) determine the rate of economic growth. Hence, if international financial integration could lead to growth of the factor of production or efficient gains in the use of such factors, then it would promote economic growth. Likewise, economic growth is determined by structure of market, factors of production, financial development, with limited government interventions. Therefore FinDev would be beneficial since it involves the elimination of market misrepresentations, which are by description ineffective (Levine, 2005). Moreover, Levine (2014) further states that FinDev is a good predictor of future economic growth, capital accumulation, and technological change. The author went further to explain that although theories hold that the development of the financial markets have an insignificant effect on the real sector, there is a positive, first-order relationship between FinDev and economic growth. Barth & Levine (2000) argue that the financial systems range from extremely fragile to relatively stable in different parts of the world. They further explained that a well-functioning financial systems accelerate economic growth by allowing funds to move to investors that are in need of finance.

Aghion et al. (2005) on the other hand, predict that countries with more critical level of FinDev will converge to the growth rate of the world technology frontier, and that all other countries will have a strictly lower long-run growth rate. It was further explained that variables such as education, geography, health, policy, politics, and institutions do not affect the significance interaction between FinDev and economic growth. In contrast, some economists do not believe that the finance-growth relationship is important. Lucas (1988) asserts that economists "badly over-stress" the role of financial factors in economic growth, while development economists frequently express their skepticism about the role of the financial system by ignoring it**.** Robinson (1952) declares that "where enterprise leads finance follows." According to this view, economic development creates demands for particular types of financial arrangements, and the financial system responds automatically to these demands.

Many studies have been employed to look at the relationship between FinDev and economic growth but the association between FinDev and environment quality has received little attention. Moghadam and Lotfalipour (2015) investigate the relationship between

FinDev and economic growth in Iran. The authors state that FinDev affects environmental quality through many channels. Firstly, FinDev enables firms to acquire more capitals to develop their agricultural and industrial sectors which in turn generate more environmental pollutions. Secondly, FinDev enables firms to have good access to new technology with positive impact on the environment and finally, the development of the financial sector means providing more financial resources to firms at less costs to finance their environmental projects.

3.2.5 Economic growth and environmental theories

Economic growth is one of the vital notions in society and the global system. It involves the process of increasing the sizes of national economies and the macro-economic indicators like the per capita income. Economic growth defers from development in that it focuses on the quantitative aspect whereas development pinpoint the qualitative impact of growth in society.

Verbruggen (1994), introduces a model that study the linkage between economic growth and environmental quality. This model includes the environment, both in welfare and in production function. The model distinguishes between flows, stocks and considered environment as a factor of production. The author, equally assumes a homogeneous production function of degree one. The model is elaborated as shown below.

$$q = f(k, e, s_e) \qquad (1)$$

The variables are all represented in terms of labor. In equation 1, q stands for production, k indicates capital, e denotes environmental quality and s_e pinoionts the use of environmental captal (energy resources). Apart from s_e, investment (i) and investment in environmental capital (ι_e) represent the independent variables in this model. The total consumption is gieven by;

$$c = q - i - i_e \qquad (2)$$

This model presents the foundation on how to measure the trade-off between environmental quality and economic variables. The author further states that economic growth will inevitably raise environmental damage so that economic decline (negative economic growth) might be needed for a cleaner environment and it is as well useful for introduce the concept of abatement to reduce environmental damage (Verbruggen, 1994).

It is vital to note that the political and policy debates for the trade-off between environmental quality and economic growth stem from the conceptions where international trade have a great consequence on the environment. According to the World Bank (2009), international trade would lead to economic growth and once nations reached a certain level of income, the negative impacts on the environment will turn to reduce. Moreover, international trade leads to a mass migration of pollution-intensive firms to nations with weaker environmental laws, which at times put more pressure on the environmental regulations in nations with stringent norms. Meanwhile, Jones & Manuelli (1999) provide more satisfying variants from macro-growth perspective. The authors state that the young should choose to tax pollution that will exist when they are older and that collective decision-making turn to influence the income–pollution path. Their model helps to move the debate forward by considering that pollution will be corrected as wealth increases.

Carson (2010) on the other hand, introduces a model that links pollution and economic activities, demonstrated in the form of an equation: $I = PAT$. This act as an identity and it implies that the environmental impact (*I*) is the product of population *(P*), affluence (*A*), and technology (*T*). This equation reveals that impact increases when the variables on the right hand turn to increase. According to this view, technological progress is a large positive influence that is resource conserving and pollution reducing. Technology turn to grow in a large scale and is possible enough to offset the impacts of population growth and rising affluence Chertow (2002). According to this model, technology is negatively related to environmental pollution while population growth and affluent on the contrary impact environmental pollution positively.

3.2.6 The Environmental Kuznets curve hypothesis (EKC)

The Environmental Kuznets curve (EKC) has extensively been used in literature to study the environment-growth nexus. This model was first introduced by Kuznets (1955) to study the relationship between economic development and income inequality. Grossman & Krueger (1991), revitalized this model to study the relationship between economic growth and environmental quality. In their work, the authors state that there exists an inverse U-shape association between environmental factors (pollution) and the per capita income. To demonstrate the reasons for this inverse relationship, they state that at the early stages of

economic development, pollution increases but beyond a certain level of income, it reverses so that at a higher level of income, any further growth will lead to environmental improvement.

But, the inverse relationship between these constructs is possible only in situation of static technological progress. In countries where there is no structural improvement in technology, further growth would result in growth in pollution and other environmental damages. This shape of this curve follows an inverted U-shape as presented in Figure 3.1.

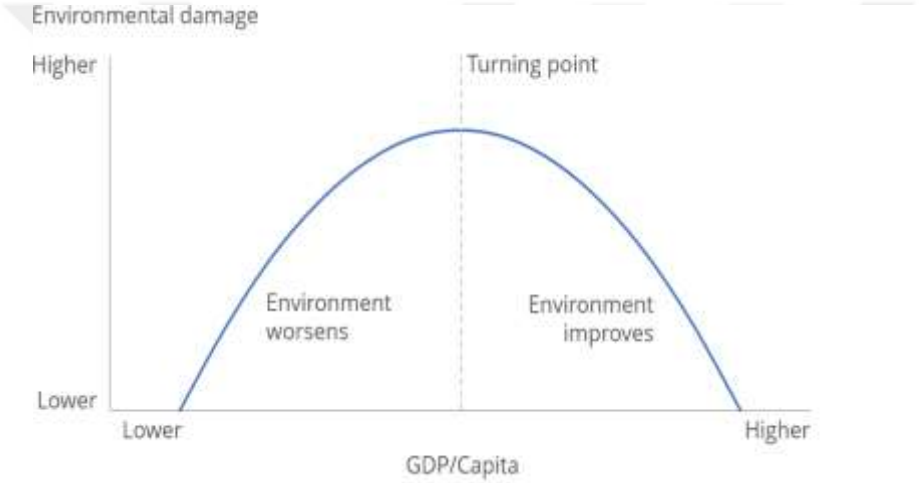

Figure 3.1. The environmental Kuznets curve
Source: Grossman & Krueger (1991)

Numerous factors are used to explain the shape of the EKC. According to Panayotou (1994), five factors could best explain the nature of the EKC: economic size (GNP), the sectoral structure of the economy, demand for environmental goods, level of technology, and the effectiveness of conservation policies. To illustrate these points, the author first notes that countries with large size (GDP) turn to emit more greenhouse gases. High production generally leads to high pollution emissions and to be specific, a 1% increase in scale will lead to a 1% increase in emissions Stern (2004). However, there could be a situation where increase in scale lead to economies of scale as pollution techniques and control requires large scale production Andreoni & Levinson (2001).

Secondly, the shape of the EKC depends on the structure of the economy. Agrarian economies turn to emit less carbon dioxide emissions compared to industrialized economies. This explains the reason why countries that are dominated by agriculture turn to generate fewer pollutants compared to industrialized economies. Also, in the production process, the input-output mix usually changes. In early phase of economic development, there is a shift from agriculture to heavy industries together with heavy emissions and after that, there is a change from heavy industries to service sector with less emission of pollutants. Focusing on input-output mix, usually involve the substitution of a less environmental damaging inputs for a more damaging one and vice versa. For instance, substitution of natural gas for coal, low Sulphur coal in place of high Sulphur coal and fossil fuel for renewable energy.

Thirdly, technology equally accounts for the differences in environmental quality between countries. In some situations, countries with the same economic structures and different levels of technology may, however, emit a different level of industrial waste. This is because, poorly maintained industrial machinery and plants are less efficient in material and energy use, and turn to produce a high amount of waste materials than new and better maintained industrial plants.

Fourthly, environmental awareness equally accounts for the shape of the EKC. As the author stated, in the early stages of economic development, the poverty rates are often high, tax collections are not effective and environmental awareness (being income elastic) is quite low. The government turns to focus on poverty alleviation, and little funds are allocated for environmental protection. This partly explains the reasons why the demand for a quality environment in third world countries is low. Lastly, strong environmental policy could also justify the reasons for environmental conditions in most nations. Countries with strong environmental regulations turn to have lower emission rates compared to those with weak policy.

Finally, technical progress has as well been used to explain the shape of the ECK. Increase in technical know-how might imply less deforestation and more planting of trees which generally leads to less emissions per unit of output (Stern, 2004). Meanwhile Andreoni & Levinson (2001) study the relationship between pollution and economic growth, using the Cobb–Douglas production function. In their model, the authors assumed that the utility

function comprises of consumption and pollution. Likewise, pollution in turn dependent on both consumption levels and environmental regulation (which reduces consumption). The authors state the inverted U-shaped depends to the nature or type of return to scale. According to them, an inverted U-shape between growth and pollution will occur when there is increasing returns to scale in terms of the pollution control effort, a linear relationship occur during constant returns to scale and finally, a U-shaped association arise when there is decreasing returns to scale. Neverthesless, other growth-environment scholars further argued that economic growth might come to a steady state if majors are not taken to mitigate the spread of pollution (CO2) (Solow, 1963) and (Pettinger, 2017).

3.2.7 The green Solow growth model

Within the context of the pressing economic and environmental challenges, both national and worldwide endeavors have been taken to promote green growth as a modern source of growth. Building on this force, can aid in providing advancement toward sustainable development and poverty eradication through for instance, friendly utilization of the natural resources, use of renewable energy and the conservation of the ecosystem. In other word, green growth can lead two things: the reduction of poverty through inclusive growth and the tackling of resource scarcity and climate change via sound environmental management.

Does green growth matter for developing countries?

Green growth is essential for developing countries in two different ways: Firstly, emerging economies are increasingly becoming the sources of pollutants and global warming through massive exploitation of natural resources. Although the global emissions of pollution from developing countries are low compared with the developed countries, their emission could be high, if the keep following the conventional growth patterns. Secondly, third world countries are confronted with extreme economic, financial, social and environmental threats mostly caused by the poor utilization of energy, water uncertainty, climate change and severe weather risks. Furthermore, emerging economies are quite sensitive to environmental hazards. This is because, developing countries are more reliant on natural resource exploitation compared to the advanced economies. They are sometimes confronted with

untimely death as a result of greenhouse gases, water pollution and illnesses linked to climatic factors.

In order to handle the challenges that we have specified above in a sustainable way, the concept of green growth has risen as a modern method to improve the previous models of growth. This concept re-examines the numerous economic choices in meeting energy, agriculture, water needs and resource requirements of economic growth in environmental friendly approach.

Based on the above, (Brock & Taylor, 2010) introduced the green growth model also known as the Green Solow model. The Green Solow model is the adaptation of the (Solow, 1956) growth model with the introduction of the environmental quality indicators. This model is quite useful compared to other growth models because, it modeled both the theoretical and the empirical association among growth and environment (Brock & Taylor, 2010). In this model, pollution emissions and abatement are considered as factors of production. This model is described in details as shown below.

A. Formulation of the model

This model focus on the one sector neoclassical growth model (NGM) , given by;

$$Y = F(K, BL), \dot{K} = sY - \delta K, \dot{L} = nL, \dot{B} = g_B B \quad (1)$$

Here *Y* represents the production function with capital (*K)* and labor (*L)* as fctors of production. *B* stands for labor augmenting technical progress with growth rate g_b, *n* is the population growth rate, *s* pinpionts the savings growth rate of capital and δ indicates the rate of depreciation. The influence of pollution is modelled by hypothesizing that any change in output leads to Ω change in pollution and abatement. According to Brock & Taylor (2010), the total emissions will be given by;

$$E = \Omega F - \Omega A(F, F^A) \quad (2)$$

$$= \Omega F[1 - A(1, F^A/F)] \quad (3)$$

$$= \Omega F a(\theta) \quad (4)$$

Where F^A represents the amount of economic output that are used for abatement, *A(F, F^A)* takes the form of a linear homogeneous production function and it captures the abatement in

terms of total output and effort spent on abatement, $a(\theta) \sim \left[1 - A\left(1, \frac{F^A}{F}\right)\right]$and $\theta = F^A/F$ represents the fraction of economic activity that is devoted for abatement.

The second line above follows from the linear homogeneity of A and the third line follows from the definition of θ. Meanwhile the abatement function is considered to be strictly concave and so $a'(\theta) \prec 0$and $a''(\theta) \succ 0$. Brock and Taylor incorporate these assumptions about emissions in the Solow growth model to obtain what is today known as the Green Solow model, given by;

$$y = f(k)[1 - \theta] \quad (5)$$

$$\dot{k} = sf(k)[1 - \theta] - [\delta + g_B + n]k \quad (6)$$

$$e = f(k)\Omega_a(\theta) \quad (7)$$

$$\dot{\Omega} = -g_A\Omega \quad (8)$$

The green Solow growth model, as demonstrated above, introduced the environmental variable (pollution) in the Solow growth model (Brock & Taylor, 2010). This model will be used as a bench mark in explaining the connection between FinDev, economic growth and environmental factor in Cameroon. We will equally extend the green Solow model by introducing other relevant variables to capture their effect on the quality of the environment.

B. Criticism of green growth model

Firstly, developing nations have just started to evaluate the opportunities, dangers and undoubtedly meaning of a green economy pathway. In any case, the arrangement, thoughts and innovations are not straightforwardly available nor totally pertinent to the countrywide development wants. There is an unequivocally governmental comeback against the green growth notion in limited developing countries. Also, third world countries have a few worries about the stipulations of green growth. A few issues relate on the measurement of the worldwide green growth protectionism and the green conditionality for official advancement.

Another major concern is that: How will green growth help in mitigating poverty and other development issues? The green growth policy implications being talked about with their accentuation on low-carbon and high-technology, do not clearly handle the equity issues ether at the national or international level. To be specific, the issues about poor nations and individuals within the informal sector and how decision making will be implemented have

not been taken into consideration. Likewise, sufficient consideration has not been paid to the potential of using the natural capital in an efficient manner and most governments are concerned that more focus on green growth could undermine the Rio Principle, specifically the principle of common but differentiated responsibilities.

Furthermore, the concept of green growth will generate more cost for the developing countries. The high initial costs for the transition to green growth may act like a barrier for poor countries for instance the use of solar power for rural communities. Even the elementary necessities are still limited in most developing countries predominantly in the areas of water treatment, household and hazardous waste management, energy efficiency and integrated water resource management. Also, there is a fear that the technology used in most developing countries will not be enough and thus, will not be able to compete with the advanced societies. In this regards, developing countries will be obliged to depend on advanced countries of the import of technology. Nevertheless, if developing countries manage their resources in a suitable manner, there will be no problems in incorporating the green growth concept. In the next section we have presented the sustainable development models.

3.2.8 Sustainability model

Sustainability involves three main pillars: economic, social and environment. It is informally referred to as the 3PS (people, planet and profits). The social aspects involve poverty, access to education, employment, and equal opportunities for everyone in society Achmad Romsan, et.al, 2017 as cited in (Irsan & Utama, 2019). Economic factors incorporate profit, FinDev, economic growth, R&D, and many others. Meanwhile environmental indicators include the use of natural resources, reduce of carbon footprint, biodiversity, and ecological health. The interactions between these pillars may further generate other outcomes as shown below.

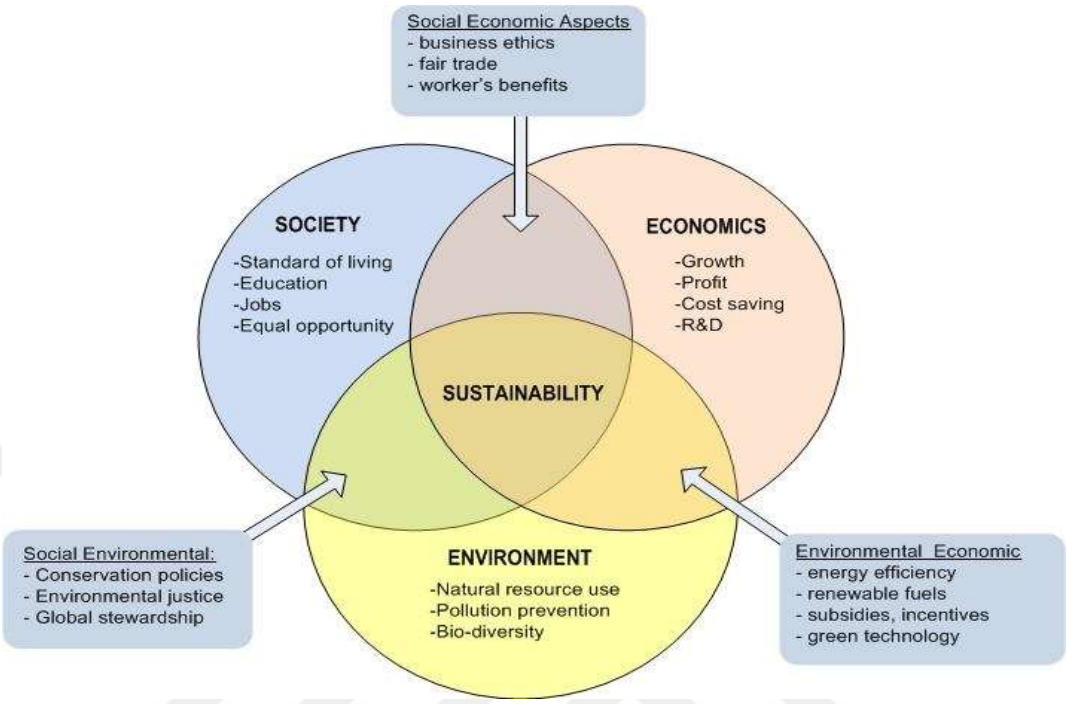

Figure 3.2. The three dimensions of sustainability
Source: University of Michigan sustainability assessment, Rodriguez et al., (2002)

As illustrated in Figure 3.2 above, the interaction between the economic and environment pillars give rise to environmental economic. Which in turn result to the development of more renewable resources, green technology, energy efficiency, and the creation of subsidies for sustainable business and environmental goods. Policymakers need to use the social and environmental pillars in framing environmental policy. The use of these pillars will help in generating environmental justice, energy conservation, and global stewardship, Also, it will lead to good business ethics, workers allowance, and fair trade. Meanwhile, it is imperative to note that the above mentioned do not operate in isolation from each other. The sustainability model has helped in developing the conceptual framework as illustrated in Figure 3. 3 below.

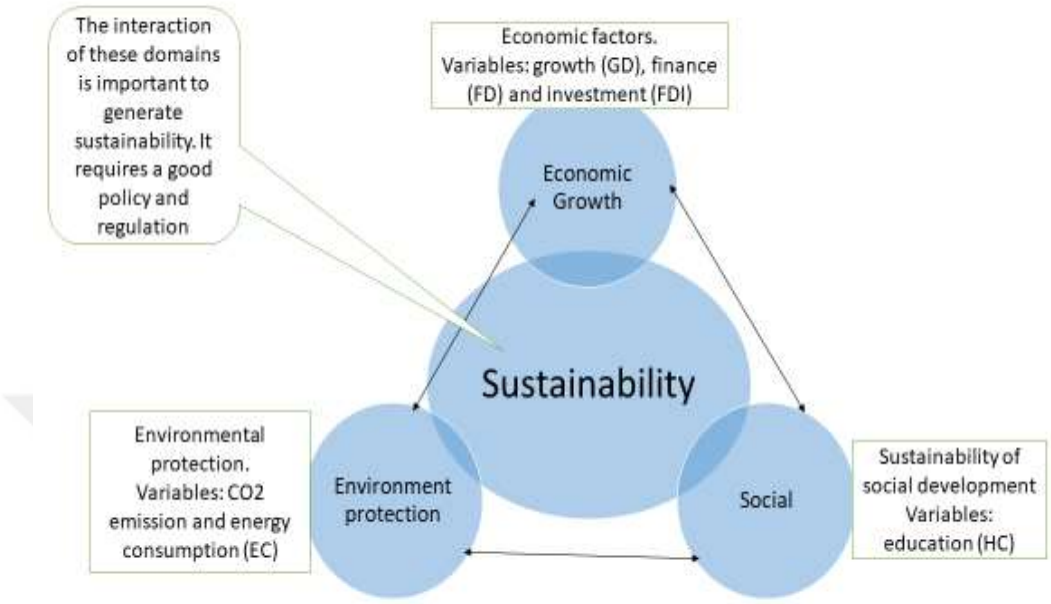

Figure 3.3. The role of economic growth, education and environment in sustainability
Source: Author's generation

Meanwhile Sutamihardja, 2004 as cited in (Irsan & Utama, 2019) further demonstrate other important factors that are necessary to generate a more sustained environment. These factors are;

1. The maintaining a balance between the human quality and their habitat.
2. Provide a sustainable welfare for most people in the community.
3. Uphold the management of natural resources that will intend generate a long-term or sustainable long-term benefits.
4. Maintain equity in the management and utilization of natural resources in a friendly approach.
5. Utilization and management of natural resources for the purpose of pursuing economic growth for in a sustainable ways.
6. Safeguarding the preservation of the existing natural resources and the environment to ensure a good quality of life for the future generations.

Based on the above illustrations, it is therefore imperative for the Government to implement strict regulations in order to make the local and foreign companies to reduce their ecological footprint. This is because any damage in any of the environmental pillar will turn to affect the other pillars (social and economic). In the next section, we present the empirical framework.

3.3 Empirical Literature

In this section, we look at the previous studies that assess the association between financial development, human capital economic growth, foreign direct investment, energy consumption, and environmental quality.

3.3.1 Economic growth and environmental quality

Agarwal (2012) analyzes the joint effect of economic growth, FDI, and finDev on environmental quality in Malaysia, using time series data that runs from the period1980 to 2008. The study finds that the environment-growth nexus via the Environment Kuznets Curve Hypothesis (EKCH) is positive in Malaysia. Aboagye (2015) studies the influence of environmental qualities on economic growth in SSA, by means of the panel data within the period 1985-2010. The author confirms the existence of the Environmental Kuznets Curve (EKC) for energy consumption but not for CO2 emissions, after using these two variables as indicators of environmental quality. This finding indicates that in the long run, pollution emissions are instead increasing in Malaysia. Hilaire (2014) surveys the impact of economic growth on environmental quality for four Congo Basin countries (Cameroon, Congo, Gabon, and the Democratic Republic of Congo) within the period 1978 to 2012. The author demonstrates that in the long run, economic growth has a positive impact on CO2 emissions in these countries. Likewise, energy consumptions, population density, and industrial activities significantly increase CO2 emissions in the above-mentioned countries.

Meanwhile, Tiwari (2011) investigates the causal effects of energy consumption, CO2 emissions, and economic growth in India and finds that energy consumption Granger-cause economic growth. In terms of correlation, it was found that CO2 emission has a positive impact on energy consumptions but not with economic growth. Aka (2014) studies the

impacts of trade intensity (share of exports plus imports in GDP) and economic growth on air pollution (CO2 emissions) in Sub-Saharan Africa for the period 1961-2003, using the Autoregressive distributed lag (ARDL) analyzes. The results show that economic growth is positively related to CO2 emissions, a degradation of air quality. The author equally obtained that trade intensity turns to decrease CO2 emissions in the short and long-run periods, thus pinpointing the significance of international trade in sustaining the SSA economies. Likewise, Phimphanthavong (2013) explores the association amid economic growth and environmental degradation, with data running from 1980 to 2010. While using the EKC's hypothesis, he confirms that in the early stage, economic growth increases pollution which turns to fall high level of income, confirming the existence of the EKC hypothesis. Awad (2017) recently carried out a study to assess the impacts of economic growth on carbon emissions in 54 African countries with data ranging from 1990-2014. The author uses the method of panel data analysis to verify the presence of the environmental Kuznets curve (EKC) hypothesis but came out with contradictory results. However, a study conducted in Australia by Bond et al. (2015), using time series data shows that economic growth has a negative impact on environmental degradation in the long-run, confirming the relevance of the EKC in this country.

Alege & Ogundipe (2013) investigate the relationship between environmental quality, and economic growth in Nigeria for the period 1970-2011, using the method of co-integration analysis. In using control variables such as institutional quality, trade openness and population density, the author finds that weak institutions and unrestricted trade openness increase the extent of environmental degradation. Their study, however, failed to attain a reasonable turning point and hence the non-existence of EKC in Nigeria. On the other hand, Carillo & Maietta (2017) employs the dynamic panel data to verify the impact of growth on environmental quality in Italy. The results strongly confirmed the existence of the EKC hypothesis in the country. Meanwhile, Fakher & Abedi (2017) recently analyzed the relationship between economic growth, FDI, and environmental quality in some selected developing countries using panel data that runs from 1983 to 2013. The authors settle that in the long run, economic growth has a positive impact on environmental quality.

Moreover, Zheng et al. (2015) investigate the relationship between economic growth and environmental pollution in 111 Chinese cities for the period 2004–2012. The study confirms the existence of the EKC hypothesis, implies that economıc growth decreases pollution emissions in the long run. Likewise, Valadez & Hu (2016) pinpoint a similar result, by demonstrating that economic growth and trade have a negative impact on the Chinese environment, in the long-run, thus indicating the relevance of EKC in China. Bozkurt & Akan (2014) jointly investigate the relationship between energy consumption, carbon dioxide emission (CO2), and economic growth in Turkey, with time-series data that runs from 1960 to 2010. In studying for co-integration, the authors find that energy consumption impact the Turkey's growth positively but with CO2 emissions, the relationship was negative, indicating the existence of the EKC in this country.

Aali-Bujari, Venegas-Martínez, & Palafox-Roca (2017) investigate the impact of energy used on economic growth in the Organization for Economic Cooperation and Development (OECD) countries from 1977-2014, by means of panel study. It was found that energy consumption is positively related to economic growth in the long. While, Akpan (2012) assesss the causal effects between electricity consumption, carbon emissions, and economic growth in Nigeria, using annual time-series data, that run from 1970 to 2008. Correspondingly, the author finds that a positive long-run relationship exists between economic growth and carbon dioxide emissions, contradicting the EKC hypothesis. The author equally concludes that a unidirectional causality exists among economic growth and carbon emissions in Nigeria.

Farhani & Rejeb (2012) employ the panel cointegration and panel causality test to assess both the association and causality between energy consumption, economic growth, and carbon dioxide emissions for 15 MENA countries from 1973 to 2008 period. Their findings pinpoint that energy consumption causes economic growth and CO2 emissions in the short run meanwhile their panel co-integration test revealed a long-run relationship between the three variables. Tiwari (2011) assesses the causal linked between energy consumption, CO2 emissions and economic growth in India using the Granger approach in the VAR framework. It was found that energy consumption Granger causes economic growth but not otherwise. Moreover, it was concluded that energy consumption, CO2, and economic

growth are positively related in the long run, contradicting the views of the EKC. Mugableh (2013) investigate the effects of economic growth and energy consumption on CO2 emissions in Malaysia for the period 1971 to 2012 by using the ARDL method. The results indicate the existence of co-integrating relationships among the variables. The author also finds that energy consumptions have a positive impact on economic growth and CO2 emissions in the short and long-run. Whereas Saidi & Hammami (2015) employ the dynamic panel data to investigate the impacts of carbon dioxide emission and economic growth on energy consumptions and finds a similar result, that is contradicting to the EKC hypothesis.

Hundie (2018) recently analyses the relationship between energy consumption, affluence, FinDev, trade openness, urbanization, population, and CO2 emissions in Ethiopia by employing the time series data that runs from 1970–2014. In using the ARDL bound tests, the author concludes that energy consumption has a positive impact on CO2. The author equally employs the Toda-Yamamoto granger causality test and finds that a bi-directional causality exists amid energy consumption and CO2 emissions. In terms of unidirectional causality, it was found running from FinDev to energy consumption. Ali (2018) assesss the variables that generate carbon emissions in France with a specific focus on FDI, finanDev, economic growth, energy consumption, and energy research innovations using the annual data that runs from 1955 to 2016. The author employs the unit root test in the presence of structural breaks to study the integrating properties of the variables. To test for cointegration, the author employs the bootstrapping bounds testing approach and finds that the variables are co-integrated. The results demonstrate that energy research has a negative impact, on carbon emissions meanwhile FinDev turns to lowers the emissions of carbon dioxide, thereby improving the French environmental quality. Besides, it was found that energy consumption is positively linked to carbon emissions.

3.3.2 FDI and environmental quality

The empirical investigations between FDI, economic growth, and environmental quality have been conducted in three major ways: First using time series analysis, second using cross-sectional and third using the panel data analysis. Nevertheless, the results from these empirical studies are still conflicting and remained inconclusive. While the focus of

this section is on the relationship between FDI and environmental quality, we have equally assessed the relationship between FDI and economic growth.

To begin with, Ioannis Kostakis (2011) investigates the role of FDI inflows on environmental quality (C02) for the period 1970 - 2010 in Asian countries, using the ARDL, FMOLS and OLS methods. The author finds that FDI inflows do not generate a negative impact on Singaporean and other Asian countries in the short run but in the long run it does. Meanwhile, Aliyu (2005) assesss the impact of FDI on environmental quality (C02) for the OECD countries, using the method of panel data analysis for the period 1990 to 2000. The author concludes that, FDI outflows is positively related to environmental degradation whereas FDI inflow does not. Due to the negative relationship that he finds between FDI inflows and pollution emissions, the author recommends that these type of investments should be encouraged in developing countries. Also, Guominge, Cheng, Yangui & Zhan (1999) survey the relationship between FDI and environmental quality in China. The authors argue that the relationship between FDI and environmental quality depends on the type of country that China is trading with (developing or developed). This is due to the fact that high-income countries turn to place more value in protecting their environment than low-income countries and as such it was concluded that FDI is positively related to environmental degradation in developing countries but not for developed nations.

Joysri (2009) investigates the relationship between FDI, economic growth and environmental quality in India for the period 1980-2003 using time series data. His findings from the co-integration tests indicate that FDI positively impacts Indian growth. The wen further to demosntare that the pollution haven hypothesis is not relevant in India, but that FDI inflows instead improves the quality of environment through the output growth. Balıbey (2015) on the other hand, studies the causal relationships between economic growth, carbon dioxide emission, and FDI in Turkey with data ranging from 1974-2011. The author notes that FDI and economic growth have a positive and significant effect on the environment, but however, disregards the significant of the EKC in Turkey.

Abdouli & Hammami (2017) recently investigated the impact of FDI inflows, environmental quality, and capital stock on economic growth in the 17 Middle East and North African Countries (MENA) countries. By using panel analysis, that runs from 1990-2012,

the authors obtained similar results, which indicate a positive relationship between FDI, and environmental quality in the long-run. Meanwhile, Phuong, Thi, & Tuyen (2018) investigate the causal relationship between CO2 emissions, FDI and economic growth in Vietnam using annual time series data that runs for the period 1986- 2015. The authors find that there exists a long run relationship between the aforesaid variables in Vietnam. They equally conclude that the link between income per capita and carbon dioxide emissions follows an inverted U-shape and thus, supports the relevance of the ECK. In terms of causality, a one-way causal relationship was observed, running from FDI to CO2 emissions.

For FDI-economic growth nexus, Emmanuel (2014) assesss the impact of FDI on Economic Growth in CEMAC countries using panel data analysis. The author argues that FDI impact Growth positively. Meanwhile, Dogan (2013) investigates the causal effects of FDI on economic growth in Turkey with the help of time series analysis. The author obtains a similar result, showing that FDI positively influenced the economic growth. In investigating the relationship between FDI and economic growth in Sub Saharan Africa by means of the panel data, Sukar & Ahmed (2010) state that FDI have a marginal and significant effect on growth. However, the authors observe that despite the importance of FDI, institutions and lack of strong macroeconomic policies may limit the inflows of FDI to Sub Saharan Africa (SSA). Besides, Volos (2015) verifies the effect of FDI on economic growth in two countries (developed and less developed), using tools of nonlinear dynamics. Although the author employs the method of simulation analysis, he obtains a strong connection between FDI and economic growth. Other researchers have not just focused on the impact of FDI on economic growth. In this reasoning, Mucuk et al. (2013) verify the impact of FDI on unemployment in 7 developing countries for the period 1981 to 2009 using panel data analysis. Their results demonstrate that FDI and unemployment are co-integrated in the long run. Although FDI increases unemployment in Turkey and Argentina it instead reduces it in Thailand. Ullah et al. (2014) investigate the relationship between domestic investment, FDI, and economic growth in Pakistan for the period 1976–2010 using the Johansen co-integration tests. The authors pinpoint the existence of a long-run relationship between FDI and economic growth. In terms of causality, the authors employ the Tada-Yamamoto techniques and find that a bidirectional causality exists between FDI and

economic growth in Pakistan. On the other hand, Ahmed (2012) assesss the influence of FDI, HC, labor force, physical capital, and gross domestic product (GDP) on Malaysia's productivity growth, using quarterly data for the period 1999 to 2008. He however, disregards the views for a positive relationship between FDI and economic growth in Malaysian growth.

In Africa, Nketsiah et al. (2017) employ other control variables like inflation, gross fixed capital formation, trade openness, and government spending to investigate the relationship between FDI and Economic Growth. Their time series results suggest that FDI positively impacts economic growth in Ghana. Whilst Chanie (2017) lately studied the effects of FDI on economic growth in Ethiopia for the period 1974 to 2014 using time series data. The author also obtains a positive and statistically significant association between FDI and economic growth in Ethiopia. He believes that Ethiopia could enhance its economic growth by improving the amount of FDI inflows. Meanwhile Libanda et al. (2017) recently surveyed the impact of FDI on economic growth in Zambia and conclude that FDI instead negatively impact Zambian growth. He proposes that it is due to the fact that most foreign investors in Zambia are ripping the economy from the little resources it has.

Bano et al. (2015) assess the extent and determinants of FDI outflows for East, Southeast, and South Asian developing countries between 1980-2011. The authors test for correlation between the selected variables and conclude that FDI outflows are closely associated with high levels of GDP, high domestic savings, large foreign reserves, export orientation, and FDI inflows. Likewise, Raičević et al. (2016) re-assess the relationship between FDI, exchange rate, exports, imports, and economic growth in Serbia using the regression method. Their findings demonstrate that exchange rate, export, and import positively impact Serbian growth. Nevertheless, the authors conclude a negative association between FDI and economic growth in Serbia, which requires that Serbia should decrease the share of her budget deficit. Can et al. (2017) study the links amid FDI and economic growth in G-7 countries for the period 1996-2011. The authors find that the series are co-integrated in the long-run, with a unidirectional causality running from FDI to R&D expenditures and to economic growth. Meanwhile Bruno et al. (2013) employ the meta-analysis on two data sets covering 549 micro and 553 macro variables to estimate the effects of FDI on economic growth. The authors argue that the effects of FDI on economic growth using micro data could

be different if macroeconomic data are used. In line with this, their findings show that the effects of FDI on economic growth is larger in macro data than in micro studies, and greater in low income-economies than in high-income countries.

Sothan et al. (2017) attempt to assess the causal links between FDI and economic growth over the period 1980–2014, using the Granger causality test with a principal focus on the vector error correction model. Their empirical results provide strong evidence for the causal impact of FDI on the Cambodian economic growth. They equally underscored the negative effects of war on the Cambodian economy and thus proposed the need for more foreign capitals. Meanwhile, Azam (2015) assesss the role of HC and FDI on economic growth in some selected Commonwealth countries. The author employs linear regression model and panel data analysis running from 1993-2011 and finds that FDI is significant in explaining the Commonwealth growth. Focusing on different sectors, Alfaro (2003) assesss the impact of FDI on growth in the primary, manufacturing, and services sectors using cross-country data for the period 1981-1999 in 47 developing countries. The author concludes that the effects of FDI on economic growth differ from sector to sector and thus he disregards the views of a positive relationship between FDI and growth in developing countries.

Roy (2012) conducts a study to verify the causal relationship between FDI and economic growth for selected Asian economies covering the period 1981-2008. Using Granger-causality, the author finds that in countries like China, India, Pakistan, Sri Lanka, Indonesia, Philippines, and Singapore, unidirectional causality runs from economic growth to FDI whereas for Malaysia there is no causal effect. But for the case of Thailand, a bidirectional causality was observed, running between FDI and growth. Likewise, Mazenda (2014) investigates the effects of FDIt on economic growth using the Johansen test of co-integration, with particular reference to the South African for the period 1980 to 2010. The author argues that FDI is vital in stimulating growth. Bayar (2014) investigates the relationship between economic growth and FDI inflows, in Turkey during the period 1980–2012 using the co-integration test and vector error correction model. He however, concludes a negative relationship between FDI and economic growth in Turkey. Whereas, Choi et al. (2017) assess the relationship between FDI, trade, and Indian economic growth using the co-integrated vector autoregression. In employing the Solow residual approach, the authors

conclude that FDI and trade indeed improved Indian growth. Javed et al. (2012) conducted similar studies to assess the impact of FDI and trade on economic growth in some selected South Asian countries using the Generalized Method of Moments. Their findings show that FDI has a mixed impact on growth, indicating an inconclusive outcome.

3.3.3 Financial development and environmental quality

In this part, we look at the relationship between financial development (FinDev) and environmental quality and between financial development and economic growth. To begin with, Moghadam & Lotfalipour (2015) investigate the effect of FinDev on environmental quality in Iran using the method of Auto Regression Model Distributed Lag (ARDL) with data running from 1970-2011. The authors show that finDev causes lots of damages to the Iranian environment meanwhile trade openness turns to reduce these damages. Mensah (2011) assesss the impact of FinDev on environmental quality in Pakistan using the quarterly data that runs from 1985-2004. He equally settled for a negative relationship amid FinDev and environmental quality. The author further argues that FinDev acts as an impediment to the environment. On the other hand, S. Li, Zhang, & Ma (2015) jointly study the relationships between FinDev, environmental quality, and economic growth in 102 countries, using the generalized method of moments (GMM) estimation methods that runs for the period 1980-2010. Their result shows that FinDev positively affects the quality of environment. Meanwhile, Saud et al. (2019) conclude that FinDev positively enhanced environmental quality in BRI countries.

Focusing on the impact of financial FinDev on economic growth, Gregorio (2018) recently investigates the relationship between FinDev and economic growth in the USA, using cross-sectional and panel data analysis. The author employs a ratio of bank credit to the private sector as a proxy for FinDev and discovers that FinDev positively impacts growth for cross countries sample but negatively related to growth for the panel data of Latin American countries. Oluitan (2012) studies the relationship between FinDev (liquid liabilities) and economic growth using dynamic panel data analysis for some selected African countries. The author concludes that the ratio of liquid liabilities significantly exhibits a positive impact on economic growth. He recommends that African countries should try to improve their financial sector since it will lead to a more efficient and effective allocation of

resources. For the OIC countries, Samimi et al. (2014) employ the generalized method of moments (GMM) within the framework of a dynamic panel data approach. The authors provide evidence for a positive link between FinDev and economic growth. Meanwhile, in Nigeria, Iheanacho (2016) investigates the relationship between FinDev and economic growth over the period 1981–2011, using the ARDL model. His findings however, contradict that of Oluitan (2012) and Samimi et al. (2014)**,** where the authors settled for a negative association between f FinDev and economic growth.

Akinsola et al. (2017) assess the impact of FinDev on economic growth, using a sample of 30 sub-Saharan African (SSA) countries. The study applies a dynamic panel estimation to investigate the special role of FinDev and banking crises on economic growth in SSA. The linear generalized method of moments is estimated according to the Arellano and Bover approach. The result indicates that the coefficient of FinDev is positive and statistically significant in impacting the SSA growth. Nevertheless Azmeh et al., (2017) investigates the relationship between financial liberalization and economic growth using panel data in developing countries. The author employs the share of foreign banks as a proxy for FinDev. The results indicate a negative relationship between FinDev and economic growth, contradicting Levine's theory which states that FinDev has a positive impact on economic growth.

Orji et al. (2015) investigate the impact of FinDev on economic growth in Nigeria for the period 1981 to 2012, using the McKinnon–Shaw framework. The authors employ the ordinary least squares and co-integration method of analysis. The results show that FinDev and private investment have a significant positive effect on economic growth. Whilst the real lending rate proves to be adversely associated with growth. Munir et al. (2013) equally investigate the empirical linkages between economic growth and FinDev in Pakistan during 1972-2010, using annual time series data. The correspondingly argue in favor of a positive relationship between FinDev and economic growth. Likewise, Muhammad et al (2011) explore the association between FinDev and economic growth in Pakistan, using annual data for 1971-2007. The finding also shows that FinDev positively influences growth in the short run but was statistically insignificant in the long run.

In comparative terms, Yay (2009) investigates the relationship between FinDev and economic growth usind panel data for developed and developing countries. He found that both stock markets and banks positively influence growth whereas in developing countries meanwhile, only stock markets are positively related to economic growth in developed countries. Batuo (2017) assesses the links between financial instability, financial liberalization, FinDev, and economic growth in 41 African countries for the period 1985-2010. The results suggest that FinDev and financial liberalization have a positive effect on financial instability. He argues that economic growth reduces financial instability. Meanwhile, Rashti et al., (2014) studies the influence of FinDev on economic growth with an emphasis on the recent financial crisis, using ratio of banking system credits to GDP, ratio of services provided by the banking system to the private sector to GDP and the stock exchange to GDP as FinDev indicators. The results show that financial crisis mostly impacts but the developing countries. Rana (2015) equally assesss the relationship between FinDev and economic growth using panel data for five emerging South Asian countries for the period 1974 to 2012. The author employs five major variables as proxies of FinDev: domestic credit provided by the financial sector, total debt services, gross domestic savings, broad money, and trade balance. The results indicate that the growth of total debt services and domestic savings have a significant impact on the economic development of these countries. Whereas, broad money, trade balance, and domestic credit have no considerable influence on fostering economic growth.

Mehrara (2014) investigates the effect of FinDev on economic growth in developed countries, using panel data in 10 selected countries for the period 1997-2007. Although some economists believe that FinDev has no impact on the functioning of the real sector, previous studies have demonstrated a strong relationship between FinDev and economic growth. Likewise, the author has shown that FinDev positively affects growth. Therefore, it can be said that the supply of financial markets would boost economic growth. Al-Zubi et al (2006) investigate the impact of FinDev on economic growth using panel data for eleven Arab countries during the period 1980-2001. The results show that all financial indicators are insignificant and do not affect economic growth. However, the modified model shows that

pubic credit has a significant and positive effect on economic growth, indicating the dominance of the public sector in economic activities.

Maimbika (2016) investigates the effects of development on economic growth using the interest rate and capital formation as proxies for FinDev in Zambia using time series data that runs from 1983 to 2013. The empirical finding indicates that FinDev and economic growth are positively linked in the long run but negatively related in the short run. Njikam (2017) assesss the effect of FinDev on economic growth using a panel of 45 Sub-Saharan Africa (SSA) countries. The study finds that FinDev is positive and significantly related to SSA countries. Aka (2006) equally investigates the relationship between FinDev and economic growth using time series data in Côte d'Ivoire. He argues that FinDev negatively influences growth in the long run.

Moghadam & Lotfalipour (2015) investigate the effect of FinDev on environmental quality in Iran using the method of Auto Regression Model Distributed Lag (ARDL) with data that runs from 1970 to 2011. The findings show that FinDev causes lots of damages to the Iranian environment meanwhile trade openness turn to reduce the damages. Mensah (2011) assesss the impact of FinDev in Pakistan using the quarterly data that runs from 1985 to 2004. The author notes that a negative association exists amid FinDev and environmental quality, which makes him to argue that FinDev acts as an impediment to the environment. On the other hand, Li, Zhang, & Ma (2015) jointly study the relationships between FinDev, environmental quality, and economic growth, using the generalized method of moments (GMM) estimation methods, with data that runs from 1980 to 2010 in over 102 countries. Their result shows that FinDev positively affects environmental quality. Saud, Chen, Danish, & Haseeb (2019) recently assessed the impact of FinDev and economic growth on environmental quality for a panel of 59 Belt and Road Initiative (BRI) countries, for 1980–2016. The authors conclude that FinDev positively enhanced environmental quality in BRI countries.

3.3.4 Human capital and environmental quality

Human capital (HC) is determined mostly by learning ability of an individual and it also saves as the engine of growth in majority of nations. In this regard, Chakraborty & Gupta (2014) assess the relationship between HC, environmental quality, and economic

growth and find that environmental quality and HC are positively related. The authors elaborate that in situation where people are educated, they turn to use the available resources efficiently without causing many harms to the environment. In other words, environmental pollution turns to yield a negative effect on the health of an individual, which goes a long way to lower the learning ability of that individual. Likewise, pollution may impact HC negatively particularly when noise pollution turns to disturb the learning environment. In this regard, Roth (2017) states that air pollution causes a negative impact on scholastic achievement and HC formation.

Goetz, Debertin, & Pagoulatos (2016) investigate the relationship between HC, income and environmental quality and find that higher educational attainment has an independent, positive effect on the quality of the environment. In other words, countries with high literacy rates turn to have better environmental conditions. This implies that education plays a leading role not just in generating growth but also in bringing additional benefits in the improvement of the environment. Torras & Boyce (1998) regress environmental pollution on income, literacy rate, Gini coefficient of income inequality and find that literacy rate has a significant negative effect on pollution particularly in low-income countries, while Petrosillo, Zurlini, Corlianò, Zaccarelli, & Dadamo (2007) find that tourists attitudes are highly dependent on their education level. In other words, those with high school attainments turn to generate less environmental damages.

In some instance, HC (education) turn to have a positive impact on the environment, especially in countries that have passed through economic transformation (agriculture to industry) and from less pollution HC to more polluting physical capital. In this type of country, environmental pollution will take the form of a U-shape. Emmanuel (2014) holds that unlike ordinary labor, HC is expandable, self-generating, transportable, and shareable. The author explains that HC is expandable and shareable in the sense that the stock of knowledge increases an individual's HC as the original knowledge turns to grow and continuously developed. Meanwhile, it is transportable and shareable to those that hold knowledge and have the possibility of sharing it with the others. In line with the above, the author concludes that more economic diversification and the accumulation of HC will boost growth in developing countries.

A study conducted by Bakan (2016) to verify the impacts of HC on economic growth in Turkey shows that there exists a positive and significant relationship between economic growth and HC. By employing education as a proxy of HC, he concludes that inadequacy and low quality of education act as an impediment to the performance of the Turkey economy. Likewise, Eyyüp (2016) investigates the casual relationship effects HC and economic growth in Turkey over the period 1990-2013 by using the ARDL approach. The author finds that a long-run relationship exists between economic growth and HC. Besides, he adds that HC through education and health positively impacts Turkey's growth and the author stressed the need to invest in HC in sustaining the Turkey growth. Beskaya et al. (2010) investigate the long-run relationship between per capita school enrolments, and per capita income in Turkey for 1923-2007. Using the Autoregressive Distributed Lag (ARDL) approach to co-integration, they find evidence of a long-run relationships between school enrolments and real income. In terms of causality, evidence of a bidirectional causality was observed between real income and school enrolments meanwhile unidirectional causality runs from HC to real income.

Amadu et al. (2017) investigate the impact of HC (health development) on growth using the HC model of Lucas (1988). The findings show that health expenditures contribute significantly to stimulate economic growth in Cameroon only in the long run. From the results, it is recommended that the government should increase health spending as suggested by the African Union and the World Health Organization. Emmanuel (2014) assesss the mechanisms through which HC influences growth in the CEMAC region, using the Two-Stage Least Square (2SLS) multiple regression model. His results show that HC (education) positively impact the CEMAC economic growth. Jerry et al. (2010) investigate the influences of HC development on economic growth in Nigeria during the period 1970 to 2008, using time series data. The Johansen co-integration technique and the vector error correction analysis were used to ascertain this relationship. Their results indicate that HC development has a positive impact on Nigerian growth. Meanwhile, Mohamed (2013) investigates empirically the impact of HC on economic growth in Sudan for the period 1982 to 2009, using a simultaneous equation model that links HC and economic growth. Likewise, the author finds that education quality is positively linked to Sudan's economic growth.

Aflizan (2014) investigates empirically, the relationship between HC, and economic growth in Malaysia and found a positive association between these constructs. He further adds that the rapid emergent of the Malaysian economy is due to the advancement in HC and that the aspiration of becoming a high-income nation by 2020 should be intensified. Also, Islam et al 2016) recently assesss the impact of HC on economic growth in Malaysia and they confirm that education positively effects Malaysian growth. Correspondingly, Nowak (2016) finds that secondary and higher education contributes significantly to the Real GDP Per Capita in Nepal. Conversely, Jabbar (2013) explores the effects of HC on economic growth and finds contradictory results that state that HC is negatively related to Nepal economic growth.

3.3.5 Population, institution and environmental quality

Population growth rates have a significant effect on the environment. Countries, with rapid population growth, implies that more people are producing and consuming goods, with negative consequences on the environment. For instance, China with being the most populated country in the world is also the highest emitter of greenhouse gases. But through education, the effect of population growth on the environment will be reduced. In countries where the majority of people are educated, the impact of population growth on the environment will be lower since educated people are always eco-friendly thereby emitting fewer pollutants.

There are numerous ways in which population growth through education will influence the quality of the environment. Firstly, education enables women to have the necessary information require in making useful fertility choices with a clear on the environment. Secondly, education raises other opportunities for women to pursue wage-earning activities rather than being responsible only for childbearing responsibilities. Also, schooling empowers people to shift from traditional ways of life (where the decisions to have many children are determined by fate) to a valued system, where birth controls are applicable to childbearing. Finally, education allows people to become aware of other happenings in the world by inducing them in choosing other lifestyles.

The population growth rates equally pass through the growth channel to influence the environment negatively. This observes where countries with a larger population and GDP

turn to emit more pollutants. The most influential school of thought, or the Malthusian school, asserts that given limited resources, population growth hams economic growth (Li & Zhang, 2007). The other school, called the neo-Boserupian school of thought (Boserup, 1981), is more optimistic. It argues that the population may have a scale effect that is beneficial to economic growth. Moreover, it challenges the Malthusian model for treating technological progress as exogenous. Once technological progress is allowed to be endogenously derived in the model, the role of the population on economic growth becomes neutral or even positive.

Dao (2015) assesss the economic effects of the demographic transition in developing economies, using World Bank data. It was found that the growth rate of per capita income is linearly dependent on population growth. It was settled that the population growth rates (active) positively influences economic growth while the effect of the old population (dependency) was found to be negatively related to growth. The author explains that rapid population growth is detrimental to a nation's growth since economic growth emerges with environmental factors such as soil erosion, water pollution, falling water tables, loss of fuelwood, and deforestation. In this regard, he recommends that the governments should develop policies aimed at controlling the population growth rates in developing countries, including Africa.

Mahmud (2015) investigates the relationship between economic growth and population growth in India using time series data from 1980 to 2013. Employing the Johansen co-integration test and Vector Error Correction Model, the author found a positive association amid population and economic growth. Similarly, a unidirectional causality, running from economic growth to population growth was also realized. It was suggested that the government should take population as a virtue by investing more resources in HC development through quality education, infrastructures as well as encouraging small and medium-sized enterprises to achieve long-run economic growth. However, in China and employing a panel data set of 28 provinces over twenty years, Li & Zhang (2007) concluded that the high birth rate is detrimental to economic growth. The finding not only supports the Malthusian theory but also suggests that China's birth control policy is indeed growth-enhancing.

Prettner (2011) investigates the consequences of the aging population on long-run economic growth, using the model of research and development (R&D). It was observed that longevity is positively related to income meanwhile a fall in fertility rate is detrimental to economic growth. The author states that the longevity effect overpowers the fertility influence in endogenous growth models whereas the aging population turns to foster the long term growth in this model. Meanwhile, Nwosu et al. (2014) settled for a positive long-run relationship amid economic growth and population growth in Nigeria. The authors also provide evidence for unidirectional causality running from population growth to economic growth. A study conducted by Tartiyus et al. (2015) in Nigeria also came out with similar results. However, a negative relationship was observed between population growth, life expectancy, and crude death rate. It was recommended that the average population growth rate of Nigeria should be maintained since it positively effects the Nigerian economic growth.

Thuku et al. (2013) employ time-series data to investigate the relationship between economic growth and population growth in Kenya for the period 1963 to 2009. The results indicated that population growth positively influences Kenyan growth. A study conducted by Furuoka (2014) also came out with a similar result indicating that population growth positively impacts Thailand's growth. Besides, it was shown that unidirectional causality runs from population growth to Thailand's economic development. However, Peterson (2017) recently shows that the effects of population growth on economic growth in developed countries differ from those in developing nations. In this regard, low population growth in high-income countries likely creates social and economic problems while high population growth in low-income countries may slow their growth and development. Whereas, international migration could help to adjust these imbalances even though opposed by many.

Vedia-Jerez & Chasco (2016) perform panel data analysis on South American countries from 1960-2008 to assess the long-run determinants of economic growth using a two-equation framework. Their finding reveals that economic growth is driven mostly by physical and HC accumulation and sectorial exports. Besides, institutional quality and constraints on executive power have a positive impact on economic growth meanwhile the rule of law and financial institutions credibility indicator (contract-intensive money) raise the attractiveness of South America for overseas investors. According to these results, a

favorable political institution act as an important factor for income growth, since it stimulates productivity as well as the attraction of foreign capital. Under the same research context,

Fayissa & Nsiah (2013) employ the fixed and random effects, and Arellano-Bond models to investigate the role of governance on economic growth performance of African economies. The results pinpoint that good governance accounts for the differences in African growth and that governance role on economic growth depends mostly on the level of income. In a nutshell, these results suggest that without the establishment and maintenance of good governance, achieving rapid growth and development will be limited in Africa.

In a similar publication, Siddiqui & Ahmed (2013) survey the influence of institutional variables on economic growth using thirty-one indicators each covering 84 countries over a period of 5 years. Also, these variables were classified as institutional and policy rents, political rents, and risk-reducing technologies using the principal component analysis. By employing panel OLS and GMM-based estimation methodologies, the authors suggest that favorable institutions have a positive effect on economic growth. According to these results, strengthening the forms of institutions and eliminating corruption, bureaucratic inefficiencies, and providing competitive market systems will promote economic growth. In the same research field, Joao Tovar Jalles (2011) employ the quality of governance with particular focus on control of corruption and the level of democracy to study factors that influence the relationship between external debt (borrowing opportunities/constraints) and economic growth in a panel of 72 developing countries over the 1970-2005 period. The results demonstrate that countries with lower corruption turn to use and manage debt more efficiently meanwhile the results of the panel Granger-causality tests only demonstrate weak support for the claim that causality runs from debt/institutional quality to growth.

Acemoglu, Johnson & Robinson (2001) research the colonial origins of countries based on governance indicators to estimate the effect of the rule of law on growth. In their research, the authors used the mortality rate of colonizers' as a measurement of the rule of law. Besides, assuming that a better rule of law exists in countries where the colonizers have settled compared to those that they did not, the authors conclude that a better rule of law will lead to rapid economic growth. In the same scientific field, Mbulawa (2015) study the determinants of economic growth in the Southern Africa Development Community and

settled that institutional quality generates a favorable environment for enhancing economic growth. Similarly, Robinson, Acemoglu & Johnson (2004) argue that economic institutions are the key determinant to long-run growth. Moreover, political institutions, cultural and geographical factors may also influence the economic performance of these countries. On the contrary, Commander & Nikoloski (2010) conclude that institutions have no significant effect on economic growth.

3.3.6 International trade and environmental quality

Another factor that determines growth and environmental quality is exports. It acts as a catalyst to raise output growth and indirectly through efficient allocation of resources, greater capacity utilization, exploitation of economies of scale, and stimulation of technological improvement but all these in, turn affect the quality of the environment. Also, export leads to an increase in productivities that further lead to economies of scale in developing economies. Moreover, export promotion leads to economies of scale, increased capacity utilization, productivity gains, and greater product variety. Mattoo and Subramanian (2000) argue that an increase in economic growth may lead to trade expansion, with a negative impact on the environment. This is because export expansion could reduce protectionism policy by facilitating transactions between countries. Thus, there is a possibility of a two-way causal relationship between growth and trade.

Mehmet and Nulambeh (2017) explore The causal effects of trade openness, FDI, and economic growth in Turkey, using time series data for the period 1974 to 2015. The authors conclude that a long-run association exists between the variables meanwhile the result of the causality tests indicates unidirectional causality running from economic growth to trade openness and bidirectional causality running between exports and per capita income, trade openness and per capita income. Likewise, Yusoff and Nulambeh, (2016) investigate the hypothesis of export-led growth in Cameroon. The authors find that exports, gross domestic investment, and exchange rate are positively linked to economic growth in Cameroon. Nevertheless, export raises the foreign exchange that allows people to import more capital goods but it raises the growth of environmental degradations.

Ekanayake (1999) uses co-integration and error-correction models to analyze the causal relationship between export growth and economic growth in eight Asian developing

countries using annual data from 1960 to 1997. His findings show support for the relevance of the export-led growth hypothesis. Also, the author state that bi-directional causality runs between export growth and economic growth in India, Indonesia, Korea, Pakistan, Philippines, Sri Lanka, Thailand, and Malaysia. Chemeda (2001) analyzed the role of exports on economic growth in Ethiopia using the Cobb-Douglas production function for the period 1950 to 1986. The result point out that that the exports growth rate has a positive effect on the economic growth rate. Although in the long run, the contribution of exports was seen to be greater than that of the short run from the co-integration test that they conducted.

Lin and Li (1990) proposed a new estimation method to look at the relationship between export and economic growth in China using demand-oriented analysis and ordinary least square method. It was concluded that a 10% increase in exports resulted in a 1% increase in GDP in the 1990s in China. They stressed the fact that the past study concludes a weak relationship between exports and economic growth in China which was because the traditional method used to estimate the contribution of foreign trade to GDP growth did not distinguish between the different roles of imports and exports in economic growth. Meanwhile, Mishra (2000) reinvestigate the dynamics of the relationship between exports and economic growth for India over the period 1970 to 2009. A popular time series econometric technique of co-integration and vector error correction estimation was applied. It was concluded that exports do not Granger caused growth rejecting the hypothesis of export-led growth for India based on the error vector correction method. The result empirical result indicated that both exports and economic growth are related to past deviations (error correction terms) from the empirical long-run relationship.

Elbeydi and Hamuda (2010) looked at the relationship between exports and economic growth in Libya for the period 1980-207 using time series data to test for the direction of causality and the long-run relationship. It was observed that GDP, exports, and exchange rates are co-integrated. Moreover, they conclude that both export and economic growth are related to past deviations (error-correction terms) from the empirical long-run relationship. While Tesfaye (2014) assesss the determinants of exports in Sub-Saharan Africa (SSA) using panel unit root test of selected 42 countries over the period 2000-2008. Their finding concludes that real GDP, GDP (lagged), and agricultural inputs are statistically significant in

determining the exports of most SSA countries. This implies that if a country GDP increase, the volume of goods exported will also increase since GDP measure the total value of goods and services produced within a country for a given period. The author also concludes that demand and supply factors are very essential in determining the Sub Saharan African agricultural exports.

On the other way round, the different sectors of the economy also impact growth and the environment differently. For the past three decades, agriculture in most African countries have not performed its potential role as the backbone of the economy. Rather than generating growth, this sector had pooled it down in many areas. Thus much need to be done in diversifying this sector rather than depending solely on the exportation of primary materials. It is without a doubt that the agricultural sector plays a major role in alleviating poverty in many African countries as many people are employed in this sector. This therefore, implies that to achieve a sustained growth, this sector should be industrialized and this will go a long way to improve the economic wellbeing of millions of extremely poor people (FAO 2011) Faridi (2012) estimated the relationship between Gross Domestic Product (GDP), agricultural and non-agricultural exports for Pakistan using the Johansen co-integration technique for the period 1972 – 2008. He concludes that exports have a negative and significant effect on economic growth and bidirectional causality runs between exports to real GDP. Also, he stressed the fact that export should be encouraged through export diversification. Meanwhile Gilbert, Linyong & Divine (2013) studied the contribution of agricultural exports to economic growth in less developed countries. The authors used two theoretical models in his analysis, the first model based on the agricultural production function, including both agricultural and non-agricultural exports as inputs. The second model was a dual economy model i.e. agricultural and non-agricultural where each sector was subdivided into exports and no export sector. Fixed and random effects were estimated in each model using a panel data of sixty-two less developed countries for the period 1974 – 1995. The study provided evidence from less developed countries that support the export-led growth theory. The results of the study highlighted the role of exports in economic growth, suggesting that export promotion policies should be balanced.

Yusoff (2005) assesss the structure and trend of Malaysian bilateral exports and imports then investigates whether these bilateral exports and imports have caused Malaysian economic growth. By sing the Granger causality test, the author concludes that it is the bilateral imports that have caused economic growth in Malaysia rather than the bilateral exports. Thus the imports of manufactured goods play a significant role in determining economic growth and development in Malaysia. Whereas Amoro and Shen (2012) assess the factors that influence exports in Ivory Course with specific reference to Cocoa and rubber using secondary data and Ordinary Least Squares regression (OLS). It was shown that rubber exports were significantly influenced by domestic production and interest rate while cocoa was significantly determined by cocoa production and domestic consumption.

Studies carried out by Gbetnkom and Khan (2002) to investigate the determinants of three agricultural exports of Cameroon between 1971/72 and 1995/1996 namely cocoa, coffee, and banana using ordinary least square showed that rainfall played a significant role in determining the volume of exports in agricultural products in Cameroon. The authors settled that domestic demand, credit to exporters, good farm to market roads, improved road networks, and governance positively influence the production of agricultural products in Cameroon. While Hatab and Romstad (2010) employed the gravity model approach to analyze the main factors influencing Egypt's agricultural exports for the period 1994 to 2008. Their findings point that GDP, distance, and language played a significant rule in inducing agricultural exports in Egypt. On the other hand, market access which is seen as conditions determined by the legal and administrative framework imposed by importing countries under international agreed trade regulation equally determine the exports of a country United Nation (2005).

Amoro and Shen (2012) look at the determinants of exports in Cote d'Ivoire by applying the method of Ordinary Least Squares regression. They demonstrated that domestic demand can be detrimental to exports in the sense that if everything being equal, an increase in local demand reduces the volume of goods exported. Thus at lower domestic demand, the excess production will increase the volume of exports through the trade balance. It was concluded that output, domestic consumption, interest rate, producer price, and exchange rate significantly influence the volume of exports in Cote d'Ivoire. Meanwhile, Musila (2004)

analyzed the impact of a common market for Eastern and Southern Africa on Kenya exports and came out with the findings that export is associated with high volume exported and not the high price for the product. This implies that if a country produces more goods and everything being equal, the volume of good available for exports will turn to be high. Ngouhouo (2013) analyzes the determinants of exports in Cameroon for the period 1970-2008 applying the method of two Stage Least Square. They reaffirmed that exchange rate; trade openness and export lag at one period are the main determinants of export in Cameroon. However, the author finds that FDI is insignificant in determining exports. Meanwhile, Agasha (2009) studies the determinants of export growth in Uganda for the period 1987-2006 by regressing export growth on the real exchange, the term of trade, and the lagged of export growth. The author states that terms of trade and foreign prices significantly influence the exports in Uganda and this made him concludes that export growth in Uganda is strongly influenced by its previous growth.

According to reports from World Trade (2002), lack of infrastructure is a major impediment to international trade, sustainable development, and competitiveness in most Sub Saharan Africa. This is seen as a problem because poor roads delay the goods to reach the market on time and some of these goods get destroyed before reaching the market. Also trade in infrastructure will stimulate trade in other sectors through the transaction cost channel. Good transport infrastructures, macroeconomic soundness, and good quality institutions appear to be major determinants of exports. Also, institutional quality is seen as one of the major supply-side constraints in most developing countries Fugazza (2004), although its impact on manufactured exports is different from that of the primary commodities exports. In most developing countries, natural resource endowments may generate economic rent that is usually controlled by the government. This usually led to corruption, mismanagement, and poor accountability. Likewise, it is paradoxical that the export of primary materials may be negatively associated with the presence of these institutions rather than positively affected.

From empirical literature, the investigation into the relationship between FinDev, HC, and economic growth has helped in identifying many research gaps: methodology, research, and evidence gaps. Firstly, we start with the methodological gap where most of the studies are focus on the conventional unit root tests. Most studies failed to employ the unit root tests

that take into account the structural breaks. Hence this paper attempts to fill this gap by employing both the conventional and the modern unit roots structural break test methods by Lee & Strazicich (2003). Likewise, we have equally employed the ARDL bounds test and the Toda-Yamamoto methods to assess the relationship between the aforementioned constructs and environmental quality in Cameroon. Secondly, the research gap focus on the fact that no known studies existed that have jointly investigated the impacts of FinDev, HC, economic growth, FDI, energy consumptions, and environmental quality in Cameroon. Thirdly, the evidence gap focus on the fact that the relationship between FDI, FinDev, economic growth, and environmental quality is still inconclusive. Some studies have pinpointed a positive relationship between the aforesaid constructs and environmental quality (Tiwari, 2011), (Akpan, 2012), (Agarwal, 2012), (Awad & Warsame, 2017) and (Hundie, 2018), while others have settled for a negative relationship (Joysri, 2009), (Bozkurt & Akan, 2014), (Zheng, 2015), (Valadez & Hu, 2016), (Ali, 2018) and (Phuong et al., 2018).

3.4 Chapter Summary

In this chapter, we have presented a theoretical and empirical framework. For the empirical framework, we presented the various studies that assess the relationship between FinDev, FDI, economic growth, HC, energy consumption, and environmental quality. Whilst, the theoretical framework consists of the growth, and environment theory, the Harrod-Domar growth model, the Solow-Swan growth model, the A-k growth model, and finally the FinDev model. This review of literature has helped us to identify the different channels through which economic growth passed to influence the quality of the environment, as summarized in Figure 3.4.

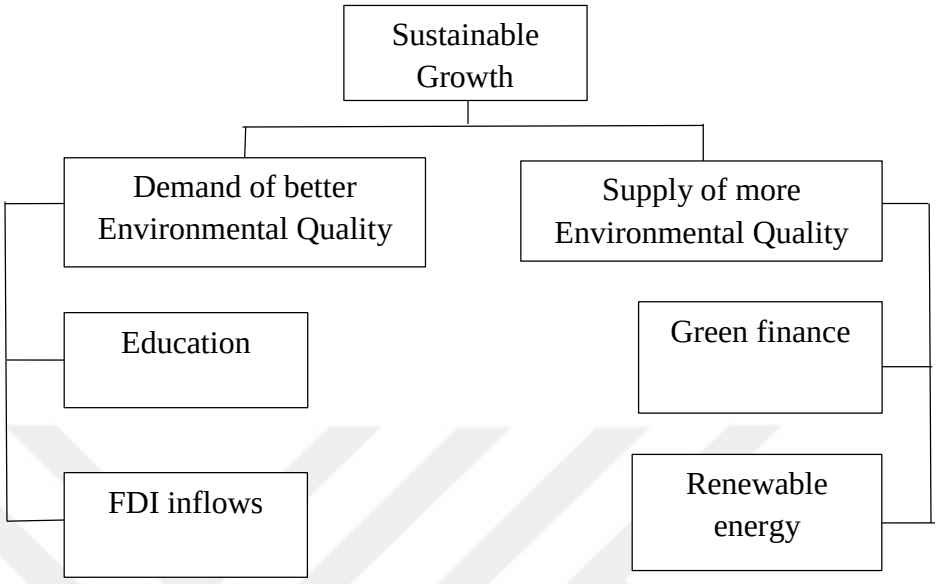

Figure 3.4. Indicators of Sustainable Development
Source: Author's generation

CHAPTER FOUR

METHODOLOGY

4.1 Introduction

This thesis focus on two things. Firstly, the association between FinDev, HC, FDI, GDP, EC, and environmental quality. This relationship will be investigated by means of the Author Regressive Distribution Lag (ARDL) test. Secondly, the test of causality between the above-mentioned variables, using the pairwise Granger causality test and the Toda Yamamoto (TY) test methods. Here we will cover the variable descriptions and the estimation techniques.

4.2 Variables and model specification

This part covers the variables descriptions, data sources, and model presentations. It is important to note that all the variables have been converted to a logarithmic form in order to facilitate the interpretations of the results.

4.2.1 Variables description

The data are collected from various sources. The data on carbon dioxide emissions per capita, economic growth, FinDev, education and energy consumption are collected from the World Development Indicators (World Bank 2019) meanwhile that of FDI is extracted from the United Nation Statistics Division (UNSD). This study will employ the Cameroon time series annual data that runs from 1980 to 2016. The justification of the time frame is based on the availability of data and the various events that has taken place in Cameroon. Table 4.1 shows the variables description with their respective symbols that are employed in this research.

Table 4.1. Proxies and variables the description

Indicator	Proxy	Symbol	Source
Environmental quality	Carbon dioxide emission	$CO2_t$	World Development Indicator
Foreign direct investment	FDI inflows	FDI_t	United Nation Statistics Division
Financial development	Domestic credit to the private sector	FD_t	World Development Indicator
Human capital	Secondary school enrollment	HC_t	World Development Indicator
Energy	Energy consumption	EC_t	World Development Indicator
Economic growth	Gross domestic product	GDP_t	World Development Indicator

Source: Author's generation

In this study, the dependent variable is CO2 and it is measured in metric tons per capita. Education corresponds to secondary school enrollment often used as an indicator of HC. For FinDev, researchers have used numerous variables as a proxy in literature. Munir et al. (2013) state that the variables commonly used as a proxy of FinDev are FDI, deposit rate, lending rate, and broad money (M2). In this regard, we have considered FDI and credit to the private sector as indicators of FinDev.

4.2.2 Model presentations

A model is simply a diagrammatic or mathematical representation of an economic phenomenon that accurately describes the population and the sample size of the chosen model. Since it is believed that models are the abstraction from reality, it is required that the explanatory variables should be selected in a manner that correctly reflects the reality. In specifying the model, three possibilities could render it to be biased. Firstly, the omission of a relevant variable(s) secondly, the inclusion of unnecessary variable(s), and lastly, the adoption of a wrongly functional form in the model. Base on the above reasons, we have

included energy consumption as a control variable in order to minimize the possibilities of obtaining a spurious outcome which might render the finding meaningless. This study employs similar methods like those of Brock & Taylor (2010) and Ali (2018) to test the relationship between FinDev, education, economic growth, FDI, energy consumption, and environmental quality in Cameroon. The econometric models are formulated as follows:

$$CO2_t = f(FDI_t, FD_t, GDP_t, HC_t, EC_t) \quad (1)$$

By taking the log of both side, we then obtained equation two as noted below;

$$LCO2_t = \alpha_0 + \beta_1 LFDI_t + \beta_2 LFD_t + \beta_3 LHC_t + \beta_4 LGDP_t + \beta_5 LEN_t + \varepsilon_t \quad (2)$$

From equation 2, $LCO2_t$ represents the log of Carbon dioxide emission, $LFDI_t$ stands for the log of FDI and LFD_t indicates the log of Financial development. Likewise, $LGDP_t$ represents the log of economic growth, LHC_t pinpoint the log of human capital (education), LEC_t represents the log of energy consumption and ε_t is the white noise term with zero mean and constant variance. Moreover, $\beta_i (i = ,1,2,3,4,5)$ are the estimated parameters and are projected to be positive except β_4, expected to have a negative sign.

4.3 Estimation techniques

In this section, we have presented the different techniques employed in this study. It comprises of the unit root tests, the co-integration tests, the causality tests, and the diagnostic tests. The techniques will be illustrated as shown below.

4.3.1 Unit root tests

An important assumption underlying the Classical Regression is that the variables must be (covariance) stationary, exhibits mean reversion that fluctuates around a constant long-run mean and has a finite variance that is time-invariant with a theoretical correlogram that diminishes as lag length turn to increase. When a time series is non-stationary, it, therefore, implies the violation of at least one of the above mentioned classical assumptions.

We will begin the econometric techniques by first analyzing the integration properties of the variables with the help of appropriate tests that will assess whether the series contains a unit root or not. This test is carried out to ensure that the series should not drift apart but keeps moving together. In most cases, macroeconomic variables usually contain a unit root in level, which indicates that the series is non-stationary but can be made stationary by differencing (Nelson and Plosser, 1982). Thus one may risk having a spurious regression if the integration property of the series is not taken into consideration. Granger (1974)

The stationary properties of the data (FinDev, FDI, education, economic growth, energy consumption, and carbon dioxide emissions) in Cameroon are tested by employing the popular ADF test introduced by Dickey & Fuller (1979) and the PP test by Phillips (1988). According to Eangle & Granger (1987), the ADF unit roots test is one of the best methods used in testing the stationary properties of the variables and this is due to the stability of its critical values as well as its power over different sampling experiment. The null hypothesis of the ADF test is that the variable Z is non-stationary or contains unit root versus the alternative hypothesis that Z is stationary. Our test equation with intercept and trend is given as;

$$\Delta Z_t = \alpha + \theta t + \lambda Z_{t-1} + \sum_{i=1}^{k} \phi_i \Delta Z_{t-i} + u_t \qquad (3)$$

where, Z_t could stand for $LCO2_t$, $LFDI_t$, LFD_t, $LGDP_t$, LHC_t and LEC_t. Lag k can be set by using information criterion such as AIC and SC. Also, u_t is the white noise or stochastic error term assumed to follow a normal distribution with mean zero and constant variance, t= 1,.,N is the time trend variable.

In trying to identify the presence of a unit root in the generating time series, Z is hypothesis as Null: $\lambda = 0$. If the null cannot be rejected, then we proceed to test ΔZ. Likewise, if the null still cannot be rejected, then we again test for $\Delta^2 Z$. Once the variable is stationary, then it is said to be integrated of the order that is equal to the number of differencing. It will be important to note that the null hypothesis is rejected when the probability (P-value) is less than its significant level.

However, the ADF and PP unit roots tests do not take into account the existence of structural breaks in the chosen series. In most cases, structural break occurs as a result of the following: a change in the political systems, a change in policy directions and finally the presence of some external shocks. All these situations may cause a fall or a jump up in a country's economic activities.

The conventional unit root test methods do not make adjustment for structural breaks and in this regards, Shahbaz et al. (2013) argued that these conventional unit root tests at times provide a biased and spurious outcome due to the limited knowledge about the structural breaks. Perron (1989), stated that the existence of structural breaks in conventional unit root test methods may cause a stationary series to become non-stationary .

Although the TY and Author Regressive Distributive Lag (ARDL) test are generally employed irrespective of the integrating properties, the conventional unit root tests are necessary to find out whether there exist I (2) series above which the ARDL method is not applicable (Hundie, 2018). Clemente et al. (1998) have recommended tests that take into account the existence of structural breaks in the series. These structural breaks either take the form of additive outliers (IO model) or double-break additive outliers (AI model) see Hundie (2018). The structural breaks usually used dummy variables and are presented as shown below;

$$y_t = \mu + \delta_1 DU_{1t} + \delta_2 DU_{2t} + \bar{y}_t \tag{4}$$

$$\bar{y}_t = \sum_{i=1}^{k} \omega_{1i} DT_{b1,t-i} + \sum_{i=1}^{k} \omega_{2i} DT_{b2,t-i} + \alpha \bar{y}_{t-i} + \sum_{i=1}^{k} \theta_i \Delta \bar{y}_{t-i} + e_t \tag{5}$$

$$y_t = \mu + \delta_1 DU_{1t} + \delta_2 DU_{2t} + \varphi_1 DT_{b1,t} + \varphi_2 DT_{b2,t} + \alpha y_{t-i} + \sum_{i=1}^{k} \theta \Delta y_{t-i} + e_t \tag{6}$$

Equation 4, indicates two structural breaks models, in which DU_{mt} = for $t \succ T_{bm}$ + 1 and 0 otherwise, for m = 1,2. T_{b1} and T_{b2} are the two break points. Baum et al. (1999) as cited in Hundie (2018) argues that $\bar{y}_t$ should represents the residuals of the estimation and should take the form a dependent variable as shown in equation 5 above.

The model is regressed, taking into account the lagged values and the corresponding lagged differences. Here, $DT_{bm,t} = 1$ for $t = T_{bm} + 1$ and 0 otherwise, for m = 1, 2. The minimal value of t-ratio in equation 5 is then compared with the critical values (Perron and Volgelsang, 1992). In our case, we will employ the modern Lee & Strazicich (2003) unit root test methods to analyse the structural breaks in our Cameroon time series data.

4.3.2 Cointegration tests

In this section, we present the model that takes into account the co-integrating properties of the variables and where we note that economic variables are said to be co-integrated if they all share a long-run relationship. Most economic theories tend to emphasize long-run relationships rather than short-run because some variables may deviate in the short-run but in the long run, the abnormality will be restored.

In co-integration tests, adjustment coefficients are usually represented with the ECT. In other words, the ECT demonstrates how fast the variables are converging to equilibrium and for it to be meaningful, the sign should be negative and statistically significant Acaravci & Ozturk (2010a) as cited in Hundie (2018).

Granger & Newbolt (1974) have shown that when non-stationary series are detected, the co-integration tests are necessary. Hence, the co-integration test is one of the most important preliminary tests after the unit-roots test, and it quite useful when the series has a unit root at the level. The co-integration test is mostly conducted by employing the Johansen (1988), Johansen & Juselius (1990) tests of co-integration. In case a co-integration exists between the variables, the Error Correction Model (ECM) is then estimated in order to investigate the short-run and long-run dynamics of the model. Engle & Granger (1987) state that before proceeding to test for co-integration, we should make sure that all the variables are integrated of the same order. Since the Johansen co-integration test is well known it is not discussed here in detail. The trace tests statistic for the null hypothesis is that there exists at most one distinct co-integrating vectors as given below; $\lambda trace = T\sum_{i=r+1}^{N} \ln(1-\lambda r)$, where λr's are the $N - r$ smallest squared canonical correlations between Z_{t-1} and ΔZ_t

(where $Z_t = LCO2_t, LFDI_t, LFD_t, LGDP_t, LHC_t$ and LEC_t.). The variables entering Z_t are presumed to be I(1), corrected for the lagged differences effects in Z_t process. The maximum eigenvalue statistic, is given by; λ max = − Tln (1− λr +1).

In the situation of small samples data, the likelihood tests can be biased and at times conclude more co-integrating equations. This problem could be corrected by multiplying the t-statistics with (T-np)/T and compare the outcome with their critical values as suggested by Godbout and Norden (1997). In this situation, T is the number of effective observations, n represent the number of endogenous variables, and p signifies the number of lags. For this study, we are faced with limited observations, and because of this, the co-integrating properties of the variables will be assessed by applying the recent Author Regressive Distributive Lag (ARDL) method. This approach is suitable in comparison to the Johansen (1988) and Johansen & Juselius (1990) tests of co-integration for many reasons. Particularly, this method turns to minimize the endogeneity problems, the stationarity problems, and is quiet applicable irrespective of whether the model is I (0) or I (1) see Hundie (2018). The ARDL model with the ECT is stated as;

$$\Delta CO2_t = \alpha_1 + \sum_{i=1}^{p} \beta_{1i} \Delta CO2_{t-i} + \sum_{i=0}^{q_1} \eta_{1i} \Delta FDI_{t-1} + \sum_{i=0}^{q_2} \gamma_{1i} \Delta FD_{t-1} + \sum_{i=0}^{q_3} \theta_{1i} \Delta HC_{t-1} + \sum_{i=0}^{q_4} \pi_{1i} \Delta GDP_{t-1} + \sum_{i=0}^{q_5} \phi_{1i} \Delta EC_{t-1} + \delta_1 LCO2_{t-i} + \delta_2 LFDI_{t-i} + \delta_3 LFD_{t-i} + \delta_4 LGDP_{t-i} + \delta_5 LEC_{t-i} + \varepsilon_{1t} \quad (7)$$

$$LCO2_t = \alpha_2 + \sum_{i=1}^{p} \beta_{2i} LCO2_{t-i} + \sum_{i=0}^{q_1} \eta_{1i} LFDI_{t-1} + \sum_{i=0}^{q_2} \gamma_{1i} LFD_{t-1} + \sum_{i=0}^{q_3} \theta_{1i} LHC_{t-1} + \sum_{i=0}^{q_4} \pi_{1i} LGDP_{t-1} + \sum_{i=0}^{q_5} \phi_{1i} LEC_{t-1} + \varepsilon_{2t} \quad (8)$$

$$\Delta CO2_t = \alpha_3 + \sum_{i=1}^{p} \beta_{3i} \Delta CO2_{t-i} + \sum_{i=0}^{q_1} \eta_{3i} \Delta FDI_{t-1} + \sum_{i=0}^{q_2} \gamma_{3i} \Delta FD_{t-1} + \sum_{i=0}^{q_3} \theta_{3i} \Delta HC_{t-1} + \sum_{i=0}^{q_4} \pi_{3i} \Delta GDP_{t-1} + \sum_{i=0}^{q_5} \phi_{3i} \Delta EC_{t-1} + \psi ECT_{t-1} + \varepsilon_{3t} \quad (9)$$

$$ECT_t = CO2_t - \alpha_2 - \sum_{i=1}^{p} \beta_{2i} CO2_{t-i} - \sum_{i=0}^{q_1} \eta_{1i} \Delta FDI_{t-1} + \sum_{i=0}^{q_2} \gamma_{1i} \Delta FD_{t-1} + \sum_{i=0}^{q_3} \theta_{1i} \Delta HC_{t-1} + \sum_{i=0}^{q_4} \pi_{1i} \Delta GDP_{t-1} + \sum_{i=0}^{q_5} \phi_{1i} \Delta EC_{t-1} \quad (10)$$

The parameters that show the corresponding long-run multipliers are given by δ_i, where I = 1,2,3,4,5. Meanwhile the short run coefficients of the ARDL model are represented with β_i, η_i, γ_i, θ_i, π_i, ϕ_i and ϖ_i. In ARDL bounds testing approach, we have two stages.

The first stage is to investigate whether a long run relationship exist between the variables in equation 7. In this regards, an appropriate lag length is selected, based on the Schwartz Bayesian Criteria (SBC). The ARDL approach is determined by comaparing the F-statistics of no co-integration, $H_o : \delta_i = 0$ against the alternative hypothesis of $H_1 : \delta_i \neq 0$, I = 1,2,3,4,5. In case the calculated F-statistic is above the upper band level, the null hypothesis is rejected, indicating the presence of co-integration or loung-run relationship. But, if it falls below the critical bound, the null hypothesis of no co-integration is not rejected. Finally, if it lies between the critical bounds then the result is inconclusive.

4.3.3 Granger and Toda-Yamamoto causality tests

The presence of co-integrations between two or more indicators, indicate that some form of causalities exist between the variables (Ghosh, (2010) as cited in Hundie (2018). Let us assume that we have two variables say Y and X. If there exists any co-integration between Y and X, then any of the 3 causal relationships may occur: a) X causes Y, b) Y causes X and c) X and Y cause each other. The first two represent unidirectional causality while the third indicates bidirectional causality. In case of no co-integration, then neither of the variables causes each other and are therefore independent.

Granger (1969) and Toda Yamamoto (TY) have introduced tests that examine the causal association amid variables. We will engage both tests to investigate the causal effects between FinDev, FDI, education, energy consumption, economic growth, and environmental quality in Cameroon. The TY method is preferable because it has several statistical advantages over the other causality tests. This method is used regardless of whether the variables are I (0) or I (1) and as well useful in model with small samples see Chindo et al. (2014). The focus here is to officially augment the VAR order, k, with $d_{\max}$ extra lags. The $d_{\max}$ represents the variables maximum order of integration. We note that Equation 11 is the representation of the dependent variable in the TY causal form. The TY representation of the other variables are written as shown in equations 12, 13, 14, 15, and 16.

$$LCO2_t = \beta_{10} + \sum_{i=1}^{p} \theta_{1i} LCO2_{t-i} + \sum_{i=p+1}^{p+d_{\max}} \Omega_{1i} LCO2_{t-1} + \sum_{i=1}^{p} \delta_{1i} LFDI_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \phi_{1i} LFDI_{t-1} + \sum_{i=1}^{p} \gamma_{1i} LFD_{t-1}$$
$$+ \sum_{i=p+1}^{p+d_{\max}} \psi_{1i} LFD_{t-1} + \sum_{i=1}^{p} \mu_{1i} LHC_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \eta_{1i} LHC_{t-1} + \sum_{i=1}^{p} \vartheta_{1i} LGDP_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \omega_{1i} LGDP_{t-1} \quad (11)$$
$$+ \sum_{i=p+1}^{p+d_{\max}} \varphi_{1i} LEC_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \mu_{1i} LEC_{t-1} + \varepsilon_{1t}$$

$$LFDI_t = \beta_{20} + \sum_{i=1}^{p} \theta_{2i} LCO2_{t-i} + \sum_{i=p+1}^{p+d_{\max}} \Omega_{2i} LCO2_{t-1} + \sum_{i=1}^{p} \delta_{2i} LFDI_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \phi_{2i} LFDI_{t-1} + \sum_{i=1}^{p} \gamma_{2i} LFD_{t-1}$$
$$+ \sum_{i=p+1}^{p+d_{\max}} \psi_{2i} LFD_{t-1} + \sum_{i=1}^{p} \mu_{2i} LHC_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \eta_{2i} LHC_{t-1} + \sum_{i=1}^{p} \vartheta_{2i} LGDP_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \omega_{2i} LGDP_{t-1} \quad (12)$$
$$+ \sum_{i=1}^{p} \varphi_{2i} LEC_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \mu_{2i} LEC_{t-1} + \varepsilon_{2t}$$

$$LFD_t = \beta_{30} + \sum_{i=1}^{p} \theta_{3i} LCO2_{t-i} + \sum_{i=p+1}^{p+d_{\max}} \Omega_{3i} LCO2_{t-1} + \sum_{i=1}^{p} \delta_{3i} LFDI_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \phi_{3i} LFDI_{t-1} + \sum_{i=1}^{p} \gamma_{3i} LFD_{t-1}$$
$$+ \sum_{i=p+1}^{p+d_{\max}} \psi_{3i} LFD_{t-1} + \sum_{i=1}^{p} \mu_{3i} LHC_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \eta_{3i} LHC_{t-1} + \sum_{i=1}^{p} \vartheta_{3i} LGDP_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \omega_{3i} LGDP_{t-1} \quad (13)$$
$$+ \sum_{i=1}^{p} \varphi_{3i} LEC_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \mu_{3i} LEC_{t-1} + \varepsilon_{3t}$$

$$LHC_t = \beta_{40} + \sum_{i=1}^{p} \theta_{4i} LCO2_{t-i} + \sum_{i=p+1}^{p+d_{\max}} \Omega_{4i} LCO2_{t-1} + \sum_{i=1}^{p} \delta_{4i} LFDI_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \phi_{4i} LFDI_{t-1} + \sum_{i=1}^{p} \gamma_{4i} LFD_{t-1}$$
$$+ \sum_{i=p+1}^{p+d_{\max}} \psi_{4i} LFD_{t-1} + \sum_{i=1}^{p} \mu_{4i} LHC_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \eta_{4i} LHC_{t-1} + \sum_{i=1}^{p} \vartheta_{4i} LGDP_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \omega_{4i} LGDP_{t-1} \quad (14)$$
$$+ \sum_{i=1}^{p} \varphi_{4i} LEC_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \mu_{4i} LEC_{t-1} + \varepsilon_{4t}$$

$$LGDP_t = \beta_{50} + \sum_{i=1}^{p} \theta_{5i} LCO2_{t-i} + \sum_{i=p+1}^{p+d_{\max}} \Omega_{5i} LCO2_{t-1} + \sum_{i=1}^{p} \delta_{5i} LFDI_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \phi_{5i} LFDI_{t-1} + \sum_{i=1}^{p} \gamma_{5i} LFD_{t-1}$$
$$+ \sum_{i=p+1}^{p+d_{\max}} \psi_{5i} LFD_{t-1} + \sum_{i=1}^{p} \mu_{5i} LHC_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \eta_{5i} LHCO2_{t-1} + \sum_{i=1}^{p} \vartheta_{5i} LGDP_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \omega_{5i} LGDP_{t-1} \quad (15)$$
$$+ \sum_{i=1}^{p} \varphi_{5i} LEC_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \mu_{5i} LEC_{t-1} + \varepsilon_{5t}$$

$$LEC_t = \beta_{60} + \sum_{i=1}^{p} \theta_{6i} LCO2_{t-i} + \sum_{i=p+1}^{p+d_{\max}} \Omega_{6i} LCO2_{t-1} + \sum_{i=1}^{p} \delta_{6i} LFDI_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \phi_{6i} LFDI_{t-1} + \sum_{i=1}^{p} \gamma_{6i} LFD_{t-1}$$
$$+ \sum_{i=p+1}^{p+d_{\max}} \psi_{6i} LFD_{t-1} + \sum_{i=1}^{p} \mu_{6i} LHC_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \eta_{6i} LHC_{t-1} + \sum_{i=1}^{p} \vartheta_{6i} LGDP_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \omega_{6i} LGDP_{t-1} \quad (16)$$
$$+ \sum_{i=1}^{p} \varphi_{6i} LEC_{t-1} + \sum_{i=p+1}^{p+d_{\max}} \mu_{6i} LEC_{t-1} + \varepsilon_{6t}$$

Lastly, to check for stability and model fitness, researchers need to apply the model fitness and stability tests. In this study, the cumulative sum (CUSUM), the cumulative sum of squares (CUSUMSQ), the serial correlation , the normality, and the heteroskedasticity tests will be applied in order to checki the the stability and model fitness of our model (Hundie, 2018).

4.4 Chapter summary

This chapter provides the methods use to examine the impact of FinDev, FDI, HC, GDP, and EC on CO2 emissions in Cameroon. The chapter starts with a brief introduction and the variable descriptions and model specification follow. After that, the estimation technique follows, with focus on the unit root test, co-integration test and the causality test (Granger and Toda-Yamamoto). In the next chapter, we provide empirical results and discussion of the findings.

CHAPTER FIVE

EMPIRICAL RESULTS AND DISCUSSION

5.1 Introduction

This chapter presents the results of several tests that as discussed in the previous chapter, notably the descriptive statistics summaries, the unit-roots test, the co-integration test, and the causality tests. Firstly, with the unit-roots, we explore the PP, ADF, and the Lee and Strazicich unit-root structural break test meanwhile for co-integration, we adopt the ARDL bounds test approach. In terms of causality, we use the Granger and Toda-Yamamoto causality test methods. We first present the results of the descriptive statistics, follow by the unit-roots, the co-integration, the pairwise Granger causality, the Toda-Yamamoto causality, and lastly the result of the various diagnostic tests.

Table 5.1. The descriptive statistics

Variable	Obs.	Mean	Median	Std. Dev.	Maximum	Minimum
$LCO2_t$	37	-6.482	-6.511	0.483	5.789	-7.876
LFD_t	37	2.594	2.527	0.538	3.442	1.782
$LFDI_t$	37	2.094	2.220	0.546	2.891	1.033
$LGDP_t$	37	8.841	8.793	0.320	9.504	8.247
LHC_t	37	3.364	3.283	0.345	4.113	2.812
LEC_t	37	-8.853	-8.854	0.090	-8.706	-9.024

Source: Author's computation

Table 5.1 presents the summary statistics of the study. The results indicate that all the variables are compatible. Economic growth exhibits the highest mean value, followed by HC and FinDev. Energy consumption and carbon dioxide emissions have negative mean values, which might signify that energy resources are not fully utilized in Cameroon. In regards to the standard deviations, a significant variation is noted, and this indicates that a remarkable estimate will be obtained from this regression analysis.

5.2 Empirical results

This section presents the results of the various tests that have been conducted in this research. These include, the unit root tests, the structural break test, the co-integration test, the causality test, and lastly the diagnostic tests.

5.2.1 Unit roots

The conventional unit roots test results (ADF and PP) are necessary for determining the integration properties of the variables. These tests are presented in Table 5.2 and the results indicate that the variables are having unit-roots problems at level but became stationary after taking the first difference I (1). This gives us the room to carry forward with the ARDL bounds test as it requires that none of the variables should be stationary in the second difference I (2). However, it is important to note that the ADF and PP tests do not take into account the presence of external shocks or multiple breakpoints in the series.

Table 5.2. The Conventional Unit Root Tests

Test in Level				
	ADF		PP	
Variable	No Trend	Trend	No Trend	Trend
$LGDP_t$	-2.682	-1.773	-1.503	-1.424
LFD_t	-1.867	-0.487	-1.571	-0.706
LHC_t	0.091	-1.165	0.091	-1.370
$LCO2_t$	-1.590	-3.375	-3.106	-3.414
$LFDI_t$	-1.693	-5.724	-1.841	-2.370
LEC_t	-3.910	-4.134	-1.445	-1.522
First Difference				
	ADF		PP	
Variable	No Trend	Trend	No Trend	Trend
$\Delta LGDP_t$	-3.349**	-3.621**	-3.398**	-3.622**
ΔLFD_t	-3.945*	-4.285*	-3.957*	-4.2184*
ΔLHC_t	-6.136*	-6.168*	-6.134*	-6.168*
$\Delta LCO2_t$	-7.088*	-5.867*	-11.001*	-14.676*
$\Delta LFDI_t$	-6.237*	-6.144*	-6.239*	-6.149*
ΔLEC_t	-3.589**	-3.426**	-2.819**	-2.744**

Notes: The values in the table are t-statistics, * and ** indicate significant at 1 % and 5%
Source: Author's computation

To solve this issue, we equally plot the Cameroon annual data and found two break points in the series see Figure 5.1 below. It is shown that the dates of these structural breaks in most cases point to (a) Lake Nyos disaster and the petroleum crisis between 1985 to 1993 period, (b) the 1994 to 2004 local currency devaluation and the post-electoral crisis; and (c) the 2008 to 2009 financial crisis that affected many countries in the world, including Cameroon.

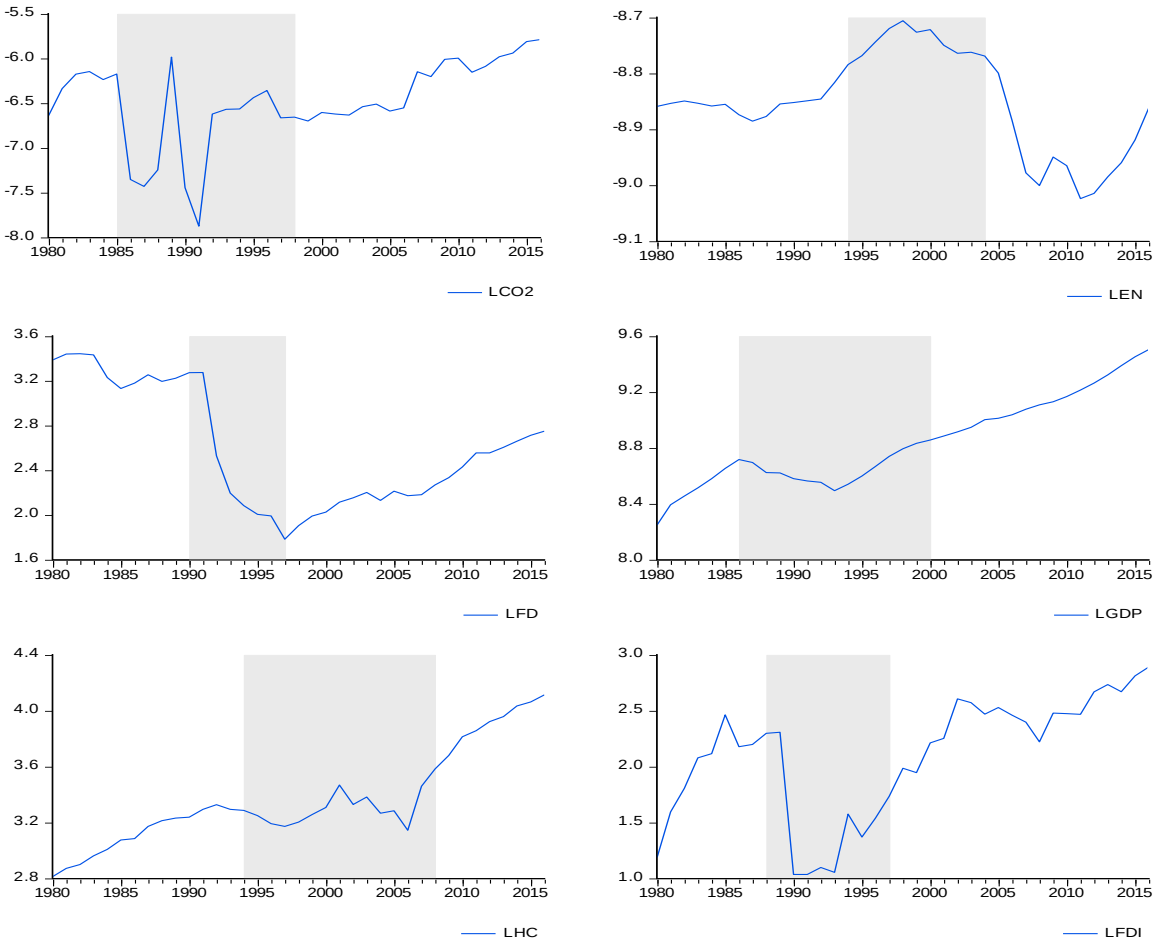

Figure 5.1. Actual data with the two structural break points
Source: Author's generation

In Table 5.3 below we present the variables, the model types, and the two structural breaks unit roots tests. According to Lee and Strazicich (2003), all the variables are stationary at 5% significance level. These results correspond to that of the conventional unit roots test above by further indicating that the variables are stationary, paving way to conduct the co-integration tests.

Table 5.3. The structural break unit root tests

Series	Model	Lag	Break times	λ	t -statistics	Critical values 5%
$LCO2_t$	Model C	1	1986 1998	0.2 0.6	–6.27	–5.74
$LFDI_t$	Model C	3	1988 1997	0.2 0.6	-5.84	-5.74
LFD_t	Model C	3	1990 1997	0.2 0.6	-7.55	-5.74
$LGDP_t$	Model C	3	1986 2000	0.2 0.6	-5.45	-5.74
LHC_t	Model C	2	1994 2008	0.4 0.6	-5.10	-5.65
LEC_t	Model C	4	1994 2004	0.4 0.6	-4.95	-5.67

Note: *p*- values at the 5 % significance level were obtained from Lee and Strazicich (2003).
Source: Author's computation

5.2.2 Model One ARDL bounds tests

The first step to conduct the ARDL model requires that an appropriate lag length should be selected. In this regard, we employ the Akaike Information Criterion (AIC) and interestingly, the order of the ARDL model took the form (2,3,3,3,1,2) with 3, as maximum lags. In the second step, we test to verify the co-integration properties of the variables after ensuring that none of the series are I (2). We find that the critical value ranges from I (0) = 2.62 to I (1) = 3.79 and both significant at 5% level, with calculated F-statistics of 9.57. The calculated F-statistics is more than the lower and the upper bounds, indicating that a long run relationship exists between the variables. In Table 5.4, we present the estimation of the long-run coefficients of this model.

Table 5.4. The results of model one ARDL long run estimates

Regressors	Coefficients	t-values
Intercept	-48.215	-5.758*
$LFDI_t$	-0.996	-3.276*
LFD_t	0.451	2.795**
$LGDP_t$	3.912	3.852*
LHC_t	-2.076	-3.514*
LEC_t	-1.702	-2.862**
Diagnostic tests	Test-statistics	p-value
Heteroscedasticity (ARCH)	1.3177	0.303
Normality test	1.4066	0.495
Serial correlation LM	8.610	0.005*

Notes: The values in the table are t-statistics, * and ** indicate significant at 1 % and 5%.
Source: Author's computation.

The results indicate that all the variables are significant in impacting CO2 emissions in the long run. Also, we note that economic growth and FinDev have a positive impact on carbon dioxide emissions in the long term. Meanwhile, FDI, HC, and energy consumption are negatively related to the dependent variable, carbon dioxide emissions. From the results, a 1% increase in economic growth and FinDev lead to 3.91% and 0.45% increase in carbon dioxide emissions respectively, whereas, a 1% increase in FDI, HC, and energy consumption decrease it by 0.99 %, 2.07%, and 1.70% sequentially. Moreover, the diagnostic tests (Table 5.4) indicate that this model is free from normality and heteroscedastic problems but it surprisingly, suffers from the serial correlation problem. In line with this, the estimated results may be biased estimates.

In the next step, we present the short-run model. The results in Table 5.5 demonstrate that FDI and economic growth are positive and statistically significant in explaining CO2 emissions. Also, FinDev and energy consumption are positive but statistically insignificant in causing CO2 emissions in the short-run. Likewise, HC development is not significant but negatively related with CO2 emission in the short run. Moreover, we obtain that economic growth is the variable that dominates in emitting CO2 emissions in the short-run. We as well note in Table 5.5 that the ECT (-1) is negative and statistically significant at 1% level. This

thus further discloses that a long-run relationship exists between the above mentioned variables. The value of the ECT (-1) is -1.482 and this therefore pinpoints that any departure from the long term equilibrium, due to external shocks, is corrected by 148% over the next year.

Table 5.5. The results of the ARDL short run model estimates

Regressors	Coefficient	t-values
ΔLEC_t	1.535	0.976
ΔLFD_t	0.426	0.715
$\Delta LFDI_t$	1.021	3.890*
$\Delta LGDP_t$	8.390	4.102*
ΔLHC_t	-1.092	-1.668
ECT(-1)	-1.482	-6.013*

$$ECT = LCO2_t - (-70LEC_t + 0.45LFD_t - 0.99LFDI_t + 3.91LGDP_t - 2.07LHC_t)$$

*and ** indicate significant at 1% and 5* level.
Source: Author's computation

The stability of the model is further assessed by applying the CUSUM and the CUSUM of square tests. We first present the result of the CUSUM test as shown in Figure 5.2. The finding indicates that the estimated coefficients of the model are stable at a 5% level of significance, pinpointing the stability of this model.

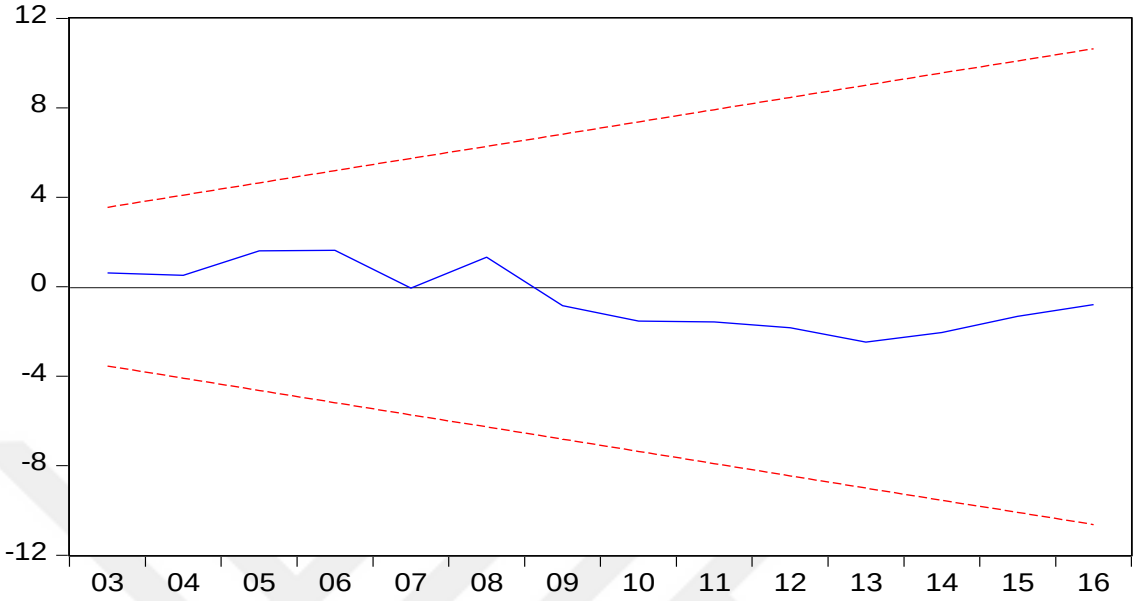

Figure 5.1. CUSUM at 5 % significance
Source: Author's generation

In like manner, Figure 5.3 below, denotes the CUSUM of squares. The results demonstrate that this model is not stable at a 5% level of significance. The instability of this model could result in a biased estimate. To remedy this situation, a different model that takes into consideration the dummy variables is further estimated (model two). In the next section, the result of Granger causality is presented before proceeding with the estimation of the ARDL bounce test of model two.

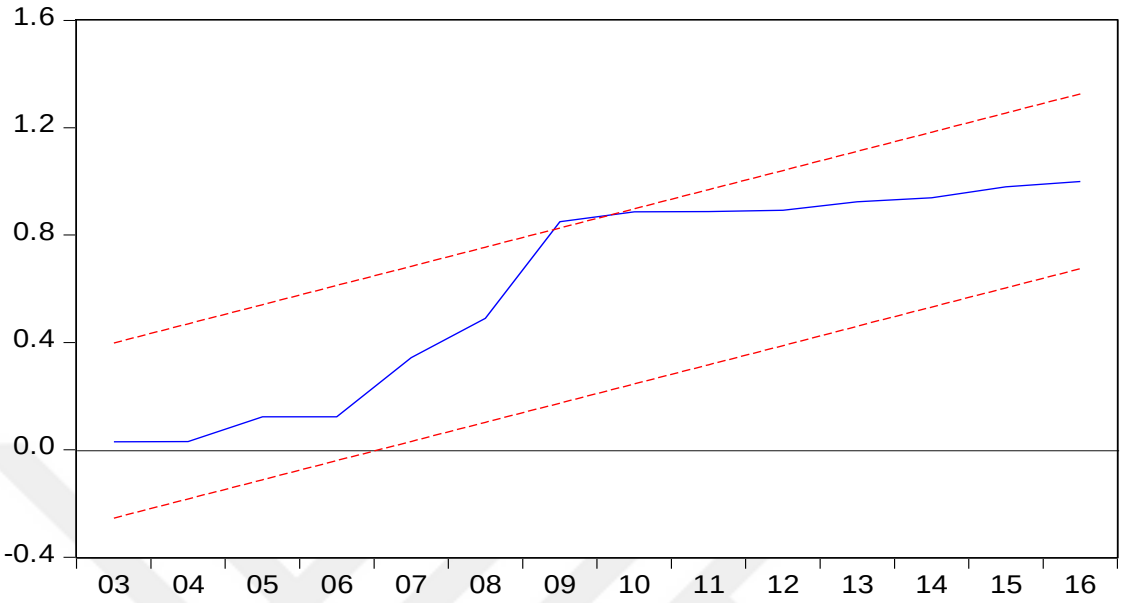

Figure 5.2. CUSUM of squares at 5 % significance
Source: Author's generation

5.2.3 Model one Granger causality

In this section, the causal effects between FinDev, FDI, HC, economic growth, and CO2 are assessed using the Granger causality. In Table 5.6, we find that unidirectional causality runs from FDI to CO2, FinDev, and economic growth, and from economic growth to CO2 emissions. However, we note that no causality runs from FinDev, HC, and EC to CO2 emissions in the short run. This finding correspond with that of the short-run model in Table 5.5 above, where FinDev, HC, and energy consumption do not cause carbon dioxide emission.

Table 5.6. Results of Granger causality tests

Dependent Variables	$LCO2_t$	LEC_t	LFD_t	$LFDI_t$	$LGDP_t$	LHC_t
$LCO2_t$	--	[0.335] (0.846)	[0.712] (0.700)	[11.440] (0.003)*	[0.827] (0.014)**	[3.440] (0.179)
LEC_t	[0.119] (0.942)	--	[1.444] (0.486)	[2.364] (0.307)	[0.130] (0.937)	[2.015] (0.365)
LFD_t	[1.602] (0.449)	[1.569] (0.456)	--	[11.782] (0.003)*	[0.193] (0.907)	[1.939] (0.379)
$LFDI_t$	[2.473] (0.290)	[1.025] (0.599)	[5.057] (0.080)	--	[3.939] (0.140)	[2.708] (0.258)
$LGDP_t$	[3.235] (0.198)	[0.757] (0.685)	[0.290] (0.865)	[14.370] (0.001)*	--	[2.814] (0.245)
LHC_t	[0.014] (0.993)	[3.256] (0.196)	[0.198] (0.906)	[2.351] (0.309)	[0.796] (0.672)	--

*and ** indicate significant at 1% and 5% level and the value in [ ] and ( ) represent Chi sq. statistics and p-values. Source: Author's computation

5.2.4 Model two ARDL bounds tests with dummy variables

This section focuse on model two that incorporates the dummy variables in the ARDL model to capture the effects of the structural breaks in the Cameroon time series data. As we saw in model one above, there were some irregularities with the results. Firstly, we found that the diagnostic tests, suffers from the serial correlation problems. Secondly, we noted that the error correction term (ECT) has an absolute value of more than one whhereas in theory, the ECT should be negative and its absolute value ought to be less than one. This is because a value of more than one indicates that the model is instead divergencing from its equilibrium point. Lastly, we equally noted that the CUSUM of the square as shown in Figure 3.3 was not stable. All these irregularities may give rise to a biased estimate.

The incorporation of the dummy variable in model two helps to remedy these situations. Before proceeding with the test like in model one, the lag structure is first selected automatically via the Akaike Information Criterion (AIC). The lag order (3,3,2,3,3,3) is

chosen, with critical values I (0) = 2.62 and I (1) = 3.79, significant at a 5% level. We obtain 11.41 as the calculated F-statistics and by comparing this value with the critical bounds demonstrates that a long-run relationship exists among the variables. Lastly, the estimation of the long-run coefficients of ARDL (3, 3, 2, 3, 3, 3) model 2, is presented in Table 5.7.

Table 5.7. The results of model two ARDL long run estimates

Regressors	Coefficients	t-values
$LFDI_t$	0.011	0.980
LFD_t	1.342	0.034**
$LGDP_t$	-1.090	0.396
LHC_t	-3.713	0.051**
LEC_t	-0.989	0.411
DT_1	0.162	0.012**
DT_2	0.008	0.583
Diagnostic tests	Test-statistics	p-value
Heteroscedasticity (ARCH)	0.698	0.687
Normality test	0.221	0.895
Serial correlation LM	3.343	0.088

*and ** indicate significant at 1% and 5* level.
Source: Author's computation

From Table 5.7, we note that FinDev and HC are statistically significant in impacting CO2 emissions in the long run while GDP, FDI, and EC do not. Specifically, a 1% increase in FDI and FinDev raise carbon dioxide emissions by 0.01% and 1.34% respectively. Meanwhile, a 1% increase in GDP, HC, and EC reduces CO2 emissions by 1.09 %, 3.71%, and 0.99% correspondingly. It is noted that with the introduction of the dummy variables that captured the structural breaks in Cameroon's time-series data, a better result is obtained in model two. This is supported by the fact that the model two is free from heteroscedasticity, normality, and serial correlation problems. This, therefore, implies that these results may not be biased estimate.

The result of the short-run model is presented in Table 5.8. We find that FDI, and economic growth are statistically significant in causing CO2 emissions in the short-run whereas, FinDev, HC, and EC do not. Although FinDev, HC, and EC are not significant to

impact Cameroon's CO2 emissions in the short-rum, their lag values are statistically significant. We equally note that GDP and EC are the variables that contribute more in raising CO2 emissions in Cameroon within the short-run.

Table 5.8. The results of model two ARDL short run estimates

Regressors	Coefficient	t-values
ΔLEC_t (-1)	5.874	2.555**
ΔLFD_t	0.494	0.878
ΔLFD_t (-1)	-0.032	-2.777**
$\Delta LFDI_t$	0.706	2.574**
$\Delta LGDP_t$	9.901	4.960*
ΔLHC_t	-0.139	-0.253
ΔLHC_t (-2)	1.234	2.136**
ΔLDT_1	0.153	7.690*
ΔLDT_2	0.007	0.574
ECT(-1)	-0.948	-3.014**
$ECT = LCO2_t - (-99LEC_t + 1.34LFD_t - 0.01LFDI_t - 1.09LGDP_t - 3.71LHC_t + 0.162LDT_1 + 0.01LDT_2)$		

*and ** indicate significant at 1% and 5* level.
Source: Author's computation

Also, the coefficient of the error correction term, ECT (-1) is statistically significant at a 5% level and its sign is negative, thus pinpointing the existence of a long-run causality between the variables. Unlike model one, the absolute value of the ECT(-1) is less than 1 and this demonstrates that about 94.8% of disequilibrium of CO2 emissions in the previous year will fall back to equilibrium in the current year. Moreover, the stability of the model is checked by applying the CUSUM and the CUSUM of square tests. The CUSUM test is represented in Figure 5.4 and the results pinpoint that the model is stable at a 5% level of significance.

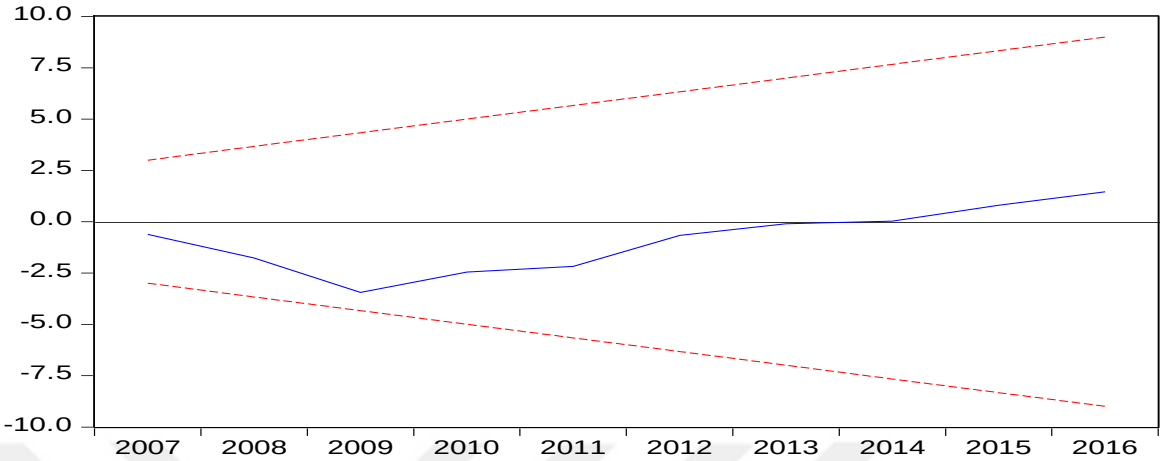

Figure 5.3. Model 2 CUSUM at 5 % significance
Source: Author's generation

Furthermore, Figure 5.5 below depicts the result of model 2 CUSUM of the square. According to these results, the estimated coefficients are stable at a 5% level of significance. Unlike the CUSUM of the square of model 1, this model is stable and does not suffers from any stability problem. We can thus, conclude that model 2 is stable and will generate better outcomes compared to model one. The next step will be to test for causality by using the Toda-Yamamoto test method.

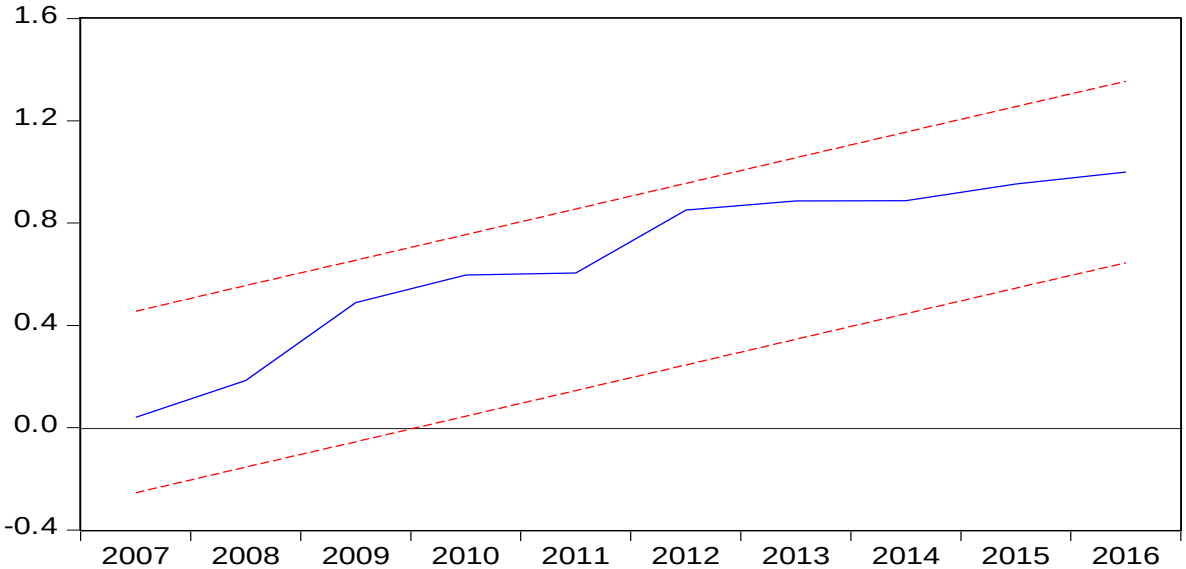

Figure 5.4. Model 2 CUSUM of squares at 5 % significance
Source: Author's generation

5.2.5 Model two Toda-Yamamoto causality tests

In model one above, we note that no causal effect exists between FinDev, HC, EC, and CO2 emissions. We equally observe that only FDI and GDP caused CO2 emissions uni-directionally in the short run. In this regard, these results may be improved by employing the recent Toda-Yamamoto (TY) causality test. The TY causality test has some advantages over the Granger causality in that, it is applicable irrespective of whether the variables are a mixture of I (0) and I (1), and it is also suitable in model with small sample biased (Chindo et al., 2014).

In model two, the causal effects between FinDev, FDI, GDP, HC, EC, and environmental is investigated by using the TY causality test. The results in Table 5. 8 below indicate that, a unidirectional causality runs from CO2 to FinDev, GDP, and FDI at a 95% confidence interval. Besides, we also find more unidirectional causalities running from GDP to HC and from HC to FDI unlike in model one. Meanwhile, bidirectional causalities flow between HC and EC, HC and FinDev and lastly between FinDev and FDI. But surpirsingly, the TY causality results indicate that FinDev and EC do not cause CO2 emissions in the short run.

Table 5.9. Toda-Yamamoto causality tests

Dependent Variables	$LCO2_t$	LEC_t	LFD_t	$LFDI_t$	$LGDP_t$	LHC_t
$LCO2_t$	--	[2.366] (0.500)	[5.430] (0.143)	[10.966] (0.012)**	[27.133] (0.000)*	[9.262] (0.026)**
LEC_t	[0.884] (0.830)	--	[4.023] (0.259)	[1.655] (0.647)	[0.801] (0.849)	[8.191] (0.042)**
LFD_t	[0.868] (0.829)	[1.709] (0.635)	--	[8.601] (0.035)**	[0.471] (0.925)	[8.840] (0.032)**
$LFDI_t$	[0.769] (0.857)	[0.901] (0.825)	[18.636] (0.000)*	--	[0.214] (0.975)	[7.009] (0.072)
$LGDP_t$	[2.855] (0.415)	[0.581] (0.901)	[1.854] (0.603)	[17.756] (0.001)*	--	[7.61027] (0.055)**
LHC_t	[0.752] (0.861)	[7.774] (0.051)**	[7.909] (0.048)**	[7.637] (0.054)**	[1.666] (0.645)	--

*and ** indicate significant at 1% and 5% level and the value in [ ] and ( ) represent Chi sq. statistics and p-values.
Source: Author's computation

5.3 Discussions section

The objective of this study was to assess the relationship between FinDev, FDI, HC, economic growth, and environmental quality in Cameroon. To achieve these, the following research questions were raised: What is the impact of FinDev, FDI, HC, and GDP on CO2 emission in Cameroon? Are there any causal effects between the above-mentioned constructs and environmental quality in Cameroon? To answer the above research questions, the following tests were conducted. We first examined the conventional unit-root tests (PP and ADF) and the structural breaks unit roots tests to assess the integrating properties of the variables. Secondly, we employed the recent ARDL bounds test to study the cointegrating relationship between the variables and lastly, the Granger and the TY causality tests were used to study the causal effects between the variables.

5.3.1 Unit roots

We found in the conventional unit root (PP and ADF) that the variables are non-stationary at level but became stationary after taking the first difference I(1) and the Lee and Strazicich (2003), structural break tests further confirmed that all the variables are stationary at 5 percent significance level. Also, the structural break test revealed two breakpoints in Cameroon's time series data, notably: (a) Lake Nyos disaster and the petroleum crisis between 1985 to 1993 period, (b) the 1994 to 2004 local currency devaluation and the post-electoral crisis; and (c) the 2008 to 2009 recent financial crisis that affected many developing countries.

5.3.2 Model one ARDL bounds tests

In the first model, the ARDL bounds test results disclosed that all the constructs were statistically significant in determining carbon dioxide emissions in the long run. The results equally demonstrated that the coefficient of the error correction term (ECT) was negative and statistically significant at a 1% level which thus, indicated that a long-run causal relationship existed between the variables. Meanwhile, its value of 148% further demonstrated that the model is instead diverging from its equilibrium point.

Specifically, in model one, we noted that economic growth was positively related to carbon dioxide emissions in the long term. This result is in line with the IPAT model introduced by Carson (2010) and the work of Stern (2004) where it was demonstrated that a 1% increase in production turn to generates a 1% increase in carbon dioxide emissions. The authors state that in countries where the level of technology is low, any increase in economic growth turn to raise environmental pollutions. Previous studies by Agarwal (2012), Aboagye (2015), Fakher & Abedi (2017) and Hundie (2018) also disclosed that economic growth has a positive impact on environmental pollution. However, these findings contradict with the works of Phimphanthavong (2013), Bond et al. (2015), Valadez & Hu (2016) and Ali (2018).

In literature, few studies have investigated the relationship between FinDev and carbon dioxide emission but of the studies have turned to focus on the relationship between FinDev and economic growth. This dissertation extended the knowledge gap by observing the association among FinDev, HC and CO2 emissions. In this thesis we found that FinDev

has a positive impact on carbon dioxide emissions and this result supports the previous work of Mensah (2011) and Moghadam & Lotfalipour (2015). According to Levine (2005) theory, FinDev leads to an increase in investments, a rise in savings, which at times raises economic growth and environmental pollution. According to this theory, FinDev will increase pollution by passing through the growth channel. Meanwhile Li et al. (2015) and Saud et al. (2019) settled for a negative correlation amid FinDev and environmental quality.

Moreover, the association between FDI and carbon dioxide emission was underscored. The results revealed that FDI impact environmental quality negatively and this is contrary to what we expected. According to the "pollution havens hypothesis'', jurisdictions with weak environmental regulations (developing countries) turn to attract more polluting industries from stronger nations (developed countries), based on this, a positive relationship was expected between FDI and carbon dioxide emissions. But on the contrary, our findings indicated that the pollution havens hypothesis is not relevant in Cameroon. Instead, we found that FDI brings in technology that helps to improve the quality of the environment, through the output growth. This finding is in line with Aliyu (2005), Joysri (2009) and Ioannis (2011) but it contradicted the work of Balıbey (2015) and Abdouli & Hammami (2017) who settled for a positive association among FDI, and CO2 emission.

Focusing on HC, we obtained that this construct is negatively related to CO2 emissions. This outcome is in line with our hypothesis, explained by the fact that educated people turn to have good access to information, which makes them be more environmentally friendly. Petrosillo et al. (2007), Goetz et al. (2016) and Roth (2017) equally demonstrated that education and pollution emissions are negatively related. Nonetheless, people with a high level of education may in some cases generate an adverse influence on the environment, especially through the output growth. For instance, high accumulation of HC could raise investment, consumption, and economic growth which may in turn augment carbon dioxide emissions.

One of the objectives of this research was to investigate the impact of EC on CO2 emissions. Our findings unveiled that EC influence CO2 emissions negatively, and this is contrary to our hypothesis. In theory, an increase in the consumption of energy generally leads to more emissions of pollutions. The inverse relationship that we fould between EC and

CO2 emissions might probably due to the strong conservation policies that the government of Cameroon has initiated in order to mitigate the spread of pollution. These majors include, the sensitization of people about the conservation of energy, the utilization of more renewable sources of energy, and the practice of afforestation. Ali (2018) also settled for a negative association between energy research and CO2 emisssions. He further emphasized the importance of research, education, and innovation in reducing the spread of pollution. This fiding is contrary to the works of Tiwari (2011), Mugableh (2013), Ali (2018) and Hundie (2018) where a positive relationship was noted between EC and CO2 emissions.

5.3.3 Model one Granger causality tests

The causal effects between FinDev, FDI, HC, GDP, and environmental quality were assessed by means of the Granger and TY causality tests. The results of Granger causality test indicated that unidirectional causality runs from FDI to CO2 emissions, FinDev, and GDP and from GDP to CO2 emissions. We equally found that FinDev, HC, and EC have no causal effect on carbon dioxide emissions in the short-run. This outcome is in line with the works of Tiwari (2011) and Nuryartono & Rifai (2017), where neither a unilateral nor bilateral causality exist between EC and CO2 emissions. Likewise, Bashir et al. (2019), equally concluded that there are no causal effects between HC and CO2 emissions.

5.3.4 Model two ARDL bounds tests

The second model involves the modification of the model of ARDL bounds test by including the dummy variables and further using the Toda-Yamamoto causality test method. With these modifications, we obtained that the results of both the CUSUM and CUSUM of the square in model two are stable unlike the previous model. Also, the diagnostic tests revealed that this model is free from any problems and the ECT further demonstrated that about 94.8% of disequilibrium of carbon dioxide in the previous year will bounce back to the long-run rate of equilibrium in the current year. Similarly, to model one, the results of model two disclosed that FinDev and HC (education) were statistically significant in explaining Cameroon's carbon dioxide emissions. Likewise, we also realized that FinDev has a positive impact on carbon dioxide emissions meanwhile HC impacted it negatively. Moreover, in

model two we noted that economic growth and FDI were negative and statistically insignificant to impact carbon dioxide emissions.

The negative association that we found between economic growth and environmental quality indicated that in the long run, pollution decreases with an increase in income and therefore supports the relevance of the environmental Kuznets curve (ECK) in Cameroon. In like manner, the positive links between FDI and environmental quality, supported the relevance of pollution havens hypothesis in Cameroon. This is because most foreign firms turn to rip the African countries from their natural resources and often produce goods that harm the quality of the environment (Libanda et al., 2017). Lastly in both models we found a negative and statistically insignificant relationship between energy consumption and environmental quality and this might be due to the fact that the level of industrialization process in Cameroon is at it early stage.

5.3.5 Model two Toda-Yamamoto causality tests

One of the objectives of this study was to find the causal effects between FinDev, FDI, GDP, HC, EC, and environmental quality in Cameroon. In order to improve the results of model one, we used the TY causality method to find the causal relationship between the above-mentioned constructs. The results settled that unidirectional causality runs from CO2 to HC, GDP and FDI. But unlike model one, the TY causality results indicated more other unidirectional causalities running from GDP to HC and from HC to FDI.

In addition to the above, the TY causality tests further demonstrated other bidirectional causalities. The results from the Granger causality test in model one have pinpointed that no bidirectional causality exists between the variables. Meanwhile in model two, we found bidirectional causality running between HC and EC, between HC and FinDev, and finally, between FinDev and FDI. However, CO2 emissions do not cause FinDev and EC in the short run. This is in line with Beskaya et al. (2010), the author equally noted that bidirectional causality runs between real income and school enrolments and that unidirectional causality runs from HC to real income. Also Ullah et al. (2014) investigate the relationship between domestic investment, FDI, and economic growth in Pakistan. By using

the Tada-Yamamoto techniques they as well found that a bidirectional causality exists between FDI and economic growth in Pakistan.

5.6 Chapter Summary

This chapter presents the results and discussion of the various tests that were conducted to assess the relationship between FinDev, HC, economic growth, FDI, energy consumption and environmental quality. The chapter begins with the presentations of the results of the conventional (ADP and PP) and the structural breaks unit root tests. Interestingly, both tests demonstrate that the variables are stationary at first difference I(1) and the structural breaks further pinpoint two break points in the Cameroon's data.

Next, the results of model one co-integration tests through the ARDL bounds tests and the pairwise Granger causality tests were presented. The ARDL results of model one demonstrate that a long run relationship exists between the variables and the Granger causality tests reveal many unilateral causalities that run from FDI and economic growth to environmental quality ($LCO2_t$). After that, we present the results of model, which include the ARDL bounds test with dummy variables and the Toda-Yamamoto causality. The ARDL bounds test results of model two, indicate that FinDev (LFD_t) and HC (LHC_t) are statistically significant in explaining the Cameroon's carbon dioxide emissions ($LCO2_t$). Moreover, the results display that the variables are co-integrated in the long run, with a speed of adjustment of 94.8%. Finally, the results of the Toda-Yamamoto causality tests were covered in the last section. Specifically, we finds that there exists both unilateral and bilateral causalities among the constructs. The next sections will cover the conclusion, policy implications, limitations and the direction of future studies

5.7 Conclusion and Recommendations

This study was conducted with the objectives to assess the relationship between FinDev, FDI, education, economic growth, and environmental quality in Cameroon using the ARDL bounds test and the Toda-Yamamoto causality test. In other words, the study aimed

to interact the above mentioned variables (social, economic and environment) to achieve environmental sustainability in Cameroon, which will further assist the government in achieving her dreams of becoming an emergent economy by 2035. In this regards, the credit to the financial sector, GDP and secondary school enrollment were considered as proxies for FinDev, economic growth, and HC development respectively. Before proceeding with the analysis, we first studied the integrating properties of the variables by using the conventional (ADF and PP) unit root tests and the structural breaks test methods. Interestingly, we found that all the variables are stationary, after taking the first difference I (1) and the structural break test further discloses two structural breakpoints in the Cameroon's time-series data. The analysis was conducted using two different models. In the first model, we mainly focus on the ARDL bounds test and the Granger causality meanwhile in the second model, the dummy variables that take into account the structural breakpoints were included, and it helps to improve the model one results. Moreover, instead of the Granger causality test, we have conducted the Toda-Yamamoto causality test in model two and it has also aided in ameliorating the results.

The results of the ARDL bounds test in model one indicates that all the variables namely FinDev, FDI, HC, economic growth, and energy consumption contribute significantly to impacting Cameroon's environmental quality. Whereas, in model two, only HC and FinDev are significant in impacting carbon dioxide emissions in Cameroon. Also in both models, the calculated F-statistics were higher than the lower and the upper bound, which implies the rejection of the null hypothesis of no long-run relationship between the variables. This, therefore, pinpoints that the variables are co-integrated in the long run. It is established in both cases that HC (education) is a significant construct that influences Cameroon's carbon dioxide emissions negatively.

Moreover, the Toda-Yamamoto causality results reveal that HC is an important variable that helps in improving the quality of the environment in Cameroon. It is therefore recommended that policy measures that will raise the level of HC should be encouraged. This could be done by combining strengths with other countries to develop HC and the practice of green education in Cameroon. Also, the policy of education for all, a more technical

system of education, and the high enrollment of women in higher education should be encouraged in Cameroon and other CEMAC countries.

In model one and two, we find that FinDev is significant and positively related to carbon dioxide emissions. This implies that FinDev acts as a stimulus in raising environmental pollution in Cameroon. It is therefore mandatory for policy-makers to introduce the financial policies that mitigate the spread of pollution, through banks empowerment and the practice of sustainable (green finance) in Cameroon. It is equally recommended that the government should develop the financial system in a way that will promote inclusive finance among the younger generations and women as well as green finance.

In terms of FDI, we find contradictory results. In mode one, a negative and significant association exists between FDI and environmental quality. This result signifies that the "pollution hallo hypothesis'', is relevant in Cameroon. In other words, FDI brings in knowledge (skills) and technology that improve the quality of the environment in Cameroon. Thus, the government should encourage the inflows of FDI in an environmentally friendly approach. Meanwhile, in model two, we found a positive link between FDI and environmental quality, and the results, support the relevance of pollution havens hypothesis in Cameroon. This shows that foreign firms are ripping Cameroon from their natural resources in producing goods that harm the quality of the environment. To tackle this issue, it is therefore recommended that the government should develop policies that attract environmentally friendly goods to Cameroon. In other words, policy-makers need to create a favorable business climate and to ensure that foreign firms are not transferring carbon-intensive goods to Cameroon.

The results equally demonstrate conflicting views with economic growth. In model one, economic growth is significant and has a positive impact on carbon dioxide emissions in the long run. This signifies that economic growth generates more environmental pollution and thus pinpoints the absence of the environmental Kuznets curve (ECK) hypothesis in Cameroon. It is therefore crucial for the government to implement growth and eco-friendly policies that mitigate the spread of pollution. In model two, we find a negative but statistically insignificant association between economic growth and carbon dioxide emissions. This

indicates that carbon dioxide decreases with an increase in income in the long-run. This thus supports the relevance of the environmental Kuznets curve (EKC) in Cameroon.

Finally, both models point that a negative relationship exists between energy consumption and carbon dioxide emissions. In model one, energy consumption is found to be statistically significant in impacting environmental quality, but in model two, it does not. This finding signifies that pollution turn to decrease when energy consumption increases and this is against most economic theories. But perhaps this outcome might be due to the strong conservation policies that is practiced in Cameroon. It is therefore recommended that the government should continue in the sensitization of its citizens about the importance of energy conservation, renewable energy, afforestation, and to discourage the practice of bush farming and deforestation. These findings are useful in that it will help the policy-makers to determine the direction in which the future environmental policies are taking, whether to emphasize more on the financial sector, educational sector, energy sector, or both.

5.8 Limitations

The research uses secondary data which covers the period 1980-2016. We faced the problem of small sample size biased and lack of data for some CEMAC countries. Better results could be obtained in a situation where more data are used. We also face the problem of lack of data availability in selecting some of the relevant variables that impact environmental quality in Cameroon. For instance, the issues on the relationship poverty, inequality, economic growth, and environmental quality are not discussed.

5.9 Direction for future research

The study we conducted focuses on the neoclassical growth model to verify the export led-growth hypothesis in Cameroon. To begin with, future research in this area should employ the sustainability models to look at the relationship between poverty, inequality, governance, and environmental footprint in Cameroon or elsewhere. Moreover, because Cameroon is an agrarian economy, future research should equally focus on the impact of

agricultural exports, manufactured exports, and globalization on environmental quality in Cameroon.

Also, future research should apply the cross-sectional data, panel data or structural equation modeling to look at the impacts of finance, education, economic growth on environmental quality within the Economic Community of Central African State (CEMAC) which includes Cameroon, Chand, Gabon, Equatorial Guinea, Central Africa Republic, and Congo and in other areas. The economic impact of climate change on economic growth in any country could as well be dwelled upon. Lastly, for the government to reach the objective of becoming an emergent country by 2035, more efforts need to be made in raising the financial capital, in improving HC development, in using more renewable energy and all these will help to reduce Cameroon's carbon footprint.

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