UNIVERSITY OF GHANA

LEGON

COLLEGE OF HUMANITIES

THE EFFECT OF FOREIGN DIRECT INVESTMENT ON THE GHANAIAN ENERGY CONSUMPTION

BY

WINFRED NII ATTOH

(10455071)

THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON, IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF PHILOSOPHY (MPHIL) DEGREE IN ECONOMICS

DEPARTMENT OF ECONOMICS

OCTOBER, 2020

DECLARATION

I, Winfred Nii Attoh, hereby declare that besides consulting other studies, which have been given their due recognition, this thesis is my own genuine work conducted after registering for the Master of Philosophy Degree in Economics at the Department of Economics, University of Ghana, Legon; and for which my supervisors in the same department have directed. As a matter of fact, there has not been its submission to any academic institution or unit elsewhere for the giving of credit or for the award of an academic degree. I, therefore, accept that the provision of imprecise information may have legal repercussions.

NAME	SIGNATURE	DATE
WINFRED NII ATTOH (STUDENT - 10455071)		29/07/21.
PROFESSOR DANIEL K. TWEREFOU (SUPERVISOR)		29/07/2021.
DR. WILLIAM BEKOE (SUPERVISOR)	…………………....	29/07/2021.

ABSTRACT

The electricity consumption levels (demand) of the populace in Ghana (especially) have not been met most of the time. FDI is one resource which can be incessantly used to address this situation; so, it ought to be often treated as a pivotal determinant of electricity consumption. However, empirical studies conducted on the relationship between FDI and electricity consumption are generally scanty; they have also produced mixed results. Moreover, the direction of causality between these variables is irresolute. Therefore, using yearly data from 1980 to 2018, and employing the Nonlinear Autoregressive Distributed Lag (NARDL) estimation technique, this thesis endeavours to decompose FDI into its positive and negative shocks whose long-run and short-run effects need to be examined; to justify the overall role of FDI on electricity consumption in Ghana. In this vein, this thesis finds inspiration that; this contemporary technique actually aids in ascertaining any possible presence of asymmetry in the nexus which, when overlooked, renders biased model specification (especially when FDI in the power sector usually experiences cost sensitivities). Finally, this thesis conducts an inquiry into the exact form of causality prevailing between FDI and electricity consumption. It is found that the significant negative effect of the positive shock in FDI dominates (in terms of weight) the distinct effect of the negative shock in FDI when analyzing both long and short runs; and this led to the significant negative effect being found of general FDI on electricity consumption. In fact, as inconspicuous as the relative difference in magnitude of the above effects was, there was symmetry found for FDI effect on electricity consumption in both periods. Also, a unidirectional causality was found to move from FDI to electricity consumption. Generally, this thesis discovered the fulfilment of the Composite Effect Theory which illustrates the precise path to tread on. It is still recommended that more of FDI needs to be encouraged to reverse the abysmal electricity trends; and to industrialize Ghana more.

DEDICATION

This thesis is dedicated to the Almighty God, to the Attoh family, and to the Department of Economics at the University of Ghana, Legon.

ACKNOWLEDGEMENT

Upon the completion of this thesis, I adjudge it obligatory to acknowledge, first and foremost, our Creator without whom the thesis would have been immaterialized. Secondly, I owe much gratitude to my parents, Mr. Frederick Attoh and Mrs. Sophia Abigail Attoh, as well as my siblings, Hilda, John, Jeffrey and Adriel; for their guidance, inspirations and constant prayers whilst writing my thesis. Also, many thanks need to be channeled to the supervisors of my thesis, Professor Daniel Kwabena Twerefou and Dr. William Bekoe, for the prudent instructions and support offered me as I climbed further in the programme. Furthermore, I am grateful to my course mates and friends, Solomon Addokwei Boye, Lawrence Sackey, Peter Dotse Junior, Ruben Kwaku Adzah and Peter Assan, for their immense contributions to my thesis and course work. Last but not least, to all who have been of uncommon assistance in providing me with credible information during seminars, through personal conversations, or by any other means, I say: God bless you abundantly.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS & ACRONYMS

ADB	African Development Bank
ADF	Augmented Dickey Fuller
ARDL	Autoregressive Distributed Lag
ASEAN	Association of Southeast Asian Nations
BOST	Bulk Oil Storage and Transportation
CIF	Climate Investment Funds
CPI	Consumer Price Index
CUSUM	Cumulative Sum
CUSUMSQ	Cumulative Sum of Squares
Dr.	Doctor
DSM	Demand-Side Management
EC	Electricity Consumption
ECG	Electricity Company of Ghana
EKC	Environmental Kuznets Curve
ELM	Electrical Load Management
ENCON	Energy Conservation
ERP	Economic Recovery Programme
ERS	Elliott, Rothenberg and Stock
FASDEP	Food and Agriculture Sector Development Policy
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GIDA	Ghana Irrigation Development Agency
GIPC	Ghana Investment Promotion Centre
GLS	Generalized Least Squares
GMM	Generalized Method of Moments
GNP	Gross National Product
GNPC	Ghana National Petroleum Company

GPRS	Ghana Poverty Reduction Strategy
IEA	International Energy Agency
IEAC	Industrial Energy Assessment Centre
IMF	International Monetary Fund
INF	Inflation
IRP	Integrated Resource Planning
kg	kilogramme
kt	kilotonne
LEAP	Long-range Energy Alternative Planning
LM	Lagrange Multiplier
lnGDP	logarithm (natural) of Gross Domestic Product
lnINF	logarithm (natural) of Inflation
log	logarithm
MCC	Millennium Challenge Corporation
MDGs	Millennium Development Goals
MENA	Middle East and North Africa
MW	Megawatts
NARDL	Nonlinear Autoregressive Distributed Lag
NEB	National Energy Board
NED	Northern Electrification Department
NPA	National Petroleum Authority
NRDC	Natural Resources Defense Council
OECD	Organization for Economic Co-operation and Development
OLI	Ownership, Location and Internalization
OLS	Ordinary Least Squares
PHH	Pollution Haven Hypothesis
PMG	Pooled Mean Group
PP	Phillips-Perron
PPP	Public-Private Partnerships

PURC	Public Utility and Regulatory Commission
SAARC	South Asian Association for Regional Cooperation
SAP	Structural Adjustment Programme
SDGs	Sustainable Development Goals
SEFA	Sustainable Energy Fund for Africa
SNEP	Strategic National Energy Plan
sqkm	square kilometre
SREP	Scaling Up Renewable Energy Programme
STIP	Science, Technology and Innovation Policy
TFC	Total Final Consumption
TNCs	Transnational Corporations
TOR	Tema Oil Refinery
TPER	Total Primary Energy Requirement
TR	Trade
UAE	United Arab Emirates
UNCTAD	United Nations Conference on Trade and Development
US	United States
USAID	United States Agency for International Development
VALCO	Volta Aluminium Company
VECM	Vector Error Correction Model
VRA	Volta River Authority
WDI	World Development Indicators

CHAPTER ONE

INTRODUCTION

1.1 Background

Among the structures required to drive economic growth, foreign direct investment (FDI) serve one major component. It remains pivotal when it comes to the transfer of technology and skills, the creation of employment and the formation of capital for an economy (UNCTAD, 2003). Tsikata *et al.* (2000) affirmed that foreign direct investment is the amalgamation of resources which accompany other financial flows with the ultimate goal of significantly augmenting development.

According to Djokoto & Dzeha (2012), in the 1960s, when most African countries gained independence, it became mandatory for such sovereign countries to protect their domestic industries, particularly the infant ones, by imposing capital controls and trade restrictions. However, as recent as about four decades ago, FDI has been observed to significantly impact various sectors, primarily due to the later democratic governance experienced by most of these African countries whose stories, in terms of economic system, have changed from being socialist to liberal (Tsikata *et al.*, 2000; Djokoto & Dzeha, 2012). Ndikumana (2003) noticed that the trend of FDI in most of these countries in Africa had been rising; a characteristic which was witnessed especially in the 1990s. This good performance of FDI had been reflected in diverse areas such as productivity and industry. A more macro-level scenario of its advantages or its important roles for host countries are in line with the description given by Moosa (2002). Thus, output and growth, balance of payments and trade flows, environment and market structure, among others, have received significant impacts from FDI.

Mavikela & Khobai (2018) asserted that FDI is a financial development tool which is aimed at increasing the economic efficiency of the financial system in an economy. In this way, it is worth noting that virtually all developing countries have either reaped or are on the path of reaping this wholesome benefit. Similarly, Yakubu & Mikhail (2019) posited that developing countries are viewed to be potential FDI destinations. Nevertheless, when it comes to ranking these developing countries in Sub-Saharan Africa, Amusa *et al.* (2016) reported that West Africa is one of the leading and largest recipient of FDI, followed by Southern Africa, North Africa and East Africa. In accordance with UNCTAD (2013), on the basis of regional proportion, however, FDI inflows to Sub-Saharan Africa recently recorded a low percentage relative to that of the Americas and Asia; thus, between 1995 and 2012. The World Development Indicators (WDI) of the World Bank (2016) revealed this similar trait existing between 2000 and 2014. Also, at the global level, although the African share of FDI extended to 3.1% in 2005, it could not be compared to what was achieved in the 1970s; since Africa was recorded to have more than double of such portion in the 1970s (Ndikumana & Verick, 2007). According to Amusa *et al.* (2016), the manufacturing sector in Africa experienced structural obstacles which led to the decrease in FDI inflows. The textiles industry in some countries within Africa also experienced high labour costs, and so on.

Like FDI, the development of energy is crucial for the growth and development of an economy. As closely associated as energy development is to economic development, the supply of energy to meet the demands of a growing population is a deciding factor to achieve the Sustainable Development Goals (SDGs) which have been advocated for by the United Nations (Asumadu-Sarkodie & Owusu, 2016). However, about 10% of the population in the world lacks access to electricity, of which 22% resides in developing countries (International Energy Agency, 2016). Energy consumption, thus, is as phenomenal as a challenge on the global scene. By 2015, the

International Energy Agency (IEA) added that, of the 22% indicated above, 97% has been living in some parts of Asia and Sub-Saharan Africa (International Energy Agency, 2016). Asumadu-Sarkodie & Owusu (2016) agreed that, to some extent, there exists a similarity between when a country is poor and when it has not developed enough of its energy sector. Thus, with respect to improving the general welfare level in an economy, a close relationship between high infant mortality rate and insufficient energy consumption; and between low life expectancy and inadequate energy consumption, is likely to be observed.

From a narrow or regional perspective, the pattern of the access to energy in Africa is akin to that of FDI. To some extent, this phenomenon is geared towards providing information on the level of energy consumption. It has been the central discussion among economists and researchers because of its challenging nature (Latief & Lefen, 2019; Alam *et al.*, 2015). The severity of the energy consumption status in Africa is especially reflected in the increasing trend of population which lack access to energy in Africa. Bilotta & Colantoni (2018) reported the upward movement of the population without access to energy in Africa between 2000 to 2013. This demonstrates that the security for energy consumption in Africa relatively declined within this thirteen-year period. The International Energy Agency (2016) revealed that, as at 2014, 53% represented the proportion of Sub-Saharan Africa population which did not have access to electricity. This, however, took a turn from 2014 to 2015. According to Bilotta & Colantoni (2018), in Africa, this was about the first time the growth rate of the population which had access to electric power surpassed the population growth rate. Showing somewhat a flat graph, the IEA data seemed to forecast the moderate security for energy consumption in the subsequent five years (including the current period). This, in accordance with the reports of IEA, can be reversed in Africa through providing adequate measures at all levels (International Energy Agency, 2016).

Studies have, therefore, reported that FDI can be beneficial to any economy through its innovative capacity in managing energy demand (Polat, 2018; Latief & Lefen, 2019; Alam *et al.*, 2015). Again, as it has been the case that domestic investment, despite its large share of Gross Domestic Product (GDP) relative to that of FDI, remains low and/or has been declining within economies in Sub-Saharan Africa, as well as not being adequately responsive to economic progress over the years, FDI would play a complementary role to improve the economy in general, and specifically, the energy sector; since FDI has been relatively increasing within this region (Ndikumana & Verick, 2007). For instance, between 1970 and 2005, domestic private investment in Sub-Saharan Africa increased temporarily from about 15% to about 20%, but declined over the years, achieving mostly 10% share of GDP; nevertheless, FDI increased most of the time, thus, from attaining about 1% to 5% share of GDP (Ndikumana & Verick, 2007).

The cases in Ghana are not much different. In accordance with UNCTAD (2017), FDI in Ghana, measured as a percentage of Gross Fixed Capital Formation (GFCF) between 1980 to 2000, had been unstable; when it even rose, it revealed slow growth. Again, between 2006 and 2016, FDI in Ghana (measured in US dollars) followed a similar pattern (UNCTAD, 2017). According to Kwakwa & Aboagye (2014), generally, energy consumption and energy production levels in Ghana both positively grew between 1970 to 2009. Nonetheless, there had been some disparities in the pattern between them. Thus, from 1971 to 1982, energy consumption levels had been greater than the levels of energy production. The difference was somewhat constant between these years till the gap declined in 1983. This, however, widened after 1983. Kwakwa & Aboagye (2014) reported that energy consumption and energy production levels had respectively been 5819.137 and 4521.33 (in kt of oil equivalent) around the mean. This meant that there was shortage: energy supply fell short of meeting the growing energy demand (ultimate target) of the increasing population. The situation improved in the early parts of the next decade, especially after the commissioning of some hydroelectric plants like that of Bui (to support such energy demand) around the year 2013 (Power Africa, 2018). But there has been that persistent shortage, one that portrays instability till date. The year 2015 was one of the years of 'Dumsor', a term connoting how unstable power had been, or with respect to power supply being shut down most of the time (Kumi, 2017; Power Africa, 2018).

It has been understood that amidst the varied drivers to influence energy consumption, FDI is one of importance, especially for a developing country such as Ghana (Latief & Lefen, 2019; Polat, 2018). For Ghana, after her energy sector has benefitted immeasurably from FDI, it would cause the share of FDI in GDP to improve by a wide magnitude; from the average 1.38%, which was obtained between 1970 and 2005, to being virtually equal with the 8.48% and 9.26% shares of domestic private investment and public investment in GDP which were also recorded and found by Ndikumana & Verick (2007) within these years.

Figure 1.1 illustrates the trends (and relationship) of FDI and electricity consumption in Ghana.

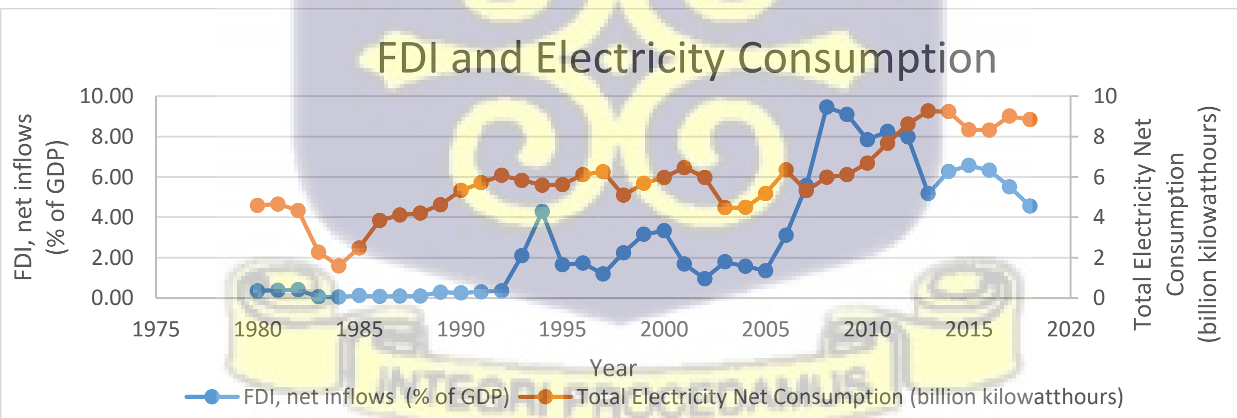


Figure 1.1: Trends (and Relationship) of FDI and Electricity Consumption in Ghana

Source: The extraction of author based on data from World Bank (2020) and US Energy Information Administration (2020)

1.2 Statement of the Research Problem

Achieving economic growth and development in any country is intricately linked with the energy sector development of that country. Energy plays significant roles at both micro and macro levels; generally, the agricultural, industrial and transport sectors, among others (Kwakwa & Aboagye, 2014). More importantly, the United Nations (2005) was convinced of the essential role played by energy in achieving the Millennium Development Goals (MDGs). Same is reinforced for the Sustainable Development Goals (SDGs). According to Kwakwa & Aboagye (2014), as provided in the background of the present thesis, there were disparities between the consumption and production of energy, such as electricity, in Ghana between 1970 and 2009. In these years, FDI was beckoned to play an active role in closing these gaps. Its efforts to do so did not avail much; attempting to influence electricity supply to meet the growing electricity demand, for instance, only resulted in chains of power rationing (Power Africa, 2018). The situation improved especially after the commissioning of some hydroelectric plants like that of Bui around the year 2013 (Power Africa, 2018). But the story of inadequate electricity production has not significantly improved to meet the pressing electricity demands of the country; the seemingly current stability notwithstanding. Given these current trends which may project into the future, it still calls for measures as FDI (which has been used over the years) to consistently and adequately help in curbing the prevalent issues such as the lack of transparent procurement framework and the high cost of generation, as reported by Power Africa (2018); in order to meet such escalating demands. The above practical issue sets the stage to explain how the link between FDI and electricity consumption in Ghana is important for study (rationale) before discussing the technical gaps.

FDI would support domestic private investment in this vein, since even the increases of domestic private investment in Ghana have not been large recently (FocusEconomics, 2015). According to

FocusEconomics (2015), domestic private investment expanded by 24.4% in 2010, 37.7% in 2011, 27.6% in 2012, and declined by 4.7% in 2013. Then, it expanded by 4.8% in 2014, 6.8% in 2015, and was forecasted to be 8% in 2016, 7.6% in 2017, 7.5% in 2018, and finally, 7.3% in 2019 (FocusEconomics, 2015). These recent yearly variations (relative to those of previous FDI inflows), and the fact that the share of domestic private investment in GDP has been retained at approximately 20%, especially between 2004 and 2012 as affirmed by FocusEconomics (2015), still necessitate the support from FDI henceforward.

Now, one gap worth of filling can be identified from below. Following the challenges which greeted the doorstep of the power sector in 2014, including the inadequacy of available power generation capacities to serve the growing demand at the time, it was imperative for more FDI to be channeled into the sector (as a caveat; by and large, it is expected that electricity generated from the influence of FDI equally amounts to electricity finally consumed). This importance, hereby, lies in the policy response: firstly, total installed capacity by 2013 was 2,837MW within the period the hydroelectric plant at Bui was commissioned. Thereafter, FDI was still regarded as one of the premium ingredients necessary to attain the target of 5,000MW by 2015/2016 (Power Africa, 2018). The outcome of the intervention by 2018 showed 4,398.5MW of installed capacity (Power Africa, 2018). Although there has not been the achievement of the 5,000MW midway between 2013 and 2018, it is worth acknowledging what FDI has done in increasing the total installed generation capacity by more than half. This does not imply that FDI started becoming significant only from 2018, but the above scenario indicates the burgeoning effect that FDI would have on electricity consumption in the near future if more of FDI is consistently encouraged.

Nonetheless, although the above policy response indicates some sort of correlation between FDI and electricity consumption (through electricity production), it does not demonstrate any form of causation. So, it is not very clear and absolute if the expansion in FDI may have actually caused or triggered the increase in the total installed generation capacity; especially when, instead of achieving the above target of 5,000MW, it was rather 4,398.5MW which was obtained.

Furthermore, although a number of factors have been proven necessary in driving the consumption of energy, such as that of electricity (in terms of statistical significance), inclusive of the required impact of FDI on such consumption in an economy which the contemporary views or studies within the empirical literature argue, these studies on the FDI-electricity consumption nexus are scanty; and their results produced are mixed (Polat, 2018).

There have been some works on what determines the consumption of energy in Ghana; the work of Adom & Bekoe (2013) being non-excludable when emphasis was laid on that of electricity, but virtually none of the works made for Ghana has contributed to the existing literature in empirically estimating FDI as a focal influence to the consumption of electricity especially. So, with regard to scantiness, and from observations, empirical studies on the linkage between FDI and electricity consumption are practically non-existent in Ghana. Even at the global level, it is rather highly probable to come across studies on the connection between FDI and economic growth, and that of electricity consumption and economic growth, to the extent that constructive theoretical frameworks have been contrived for them. An example is the study by Latief & Lefen (2019). In this vein, according to Omri & Kahouli (2014), the relationship between FDI and electricity consumption in the literature tends to be given the least attention. Therefore, in unearthing a plethora of evidence, this thesis will extend the depth of knowledge within this nascent area of energy economics by analyzing the case for Ghana amidst the scanty literature which has provided mixed results.

With regard to mixed results, for instance, Omri & Kahouli (2014) found FDI to positively drive the consumption of energy for the middle-income countries and from the global panel perspective; however, Islam *et al.* (2013) found that FDI is energy-reducing through the purchase of energy efficient devices. Lee (2013) and Sbia *et al.* (2014) also saw this negative connection. To some others, such as Adom *et al.* (2019), these mixed results or variations in effects actually arise based on the stage of development, adjustment costs and the level of technology absorptive capacity (where all of these happen over time). Given the irresolute debate, it becomes imperative to respond to the question; what will the effect of FDI on electricity consumption be for Ghana?

Also, occasionally, the decrease in electricity consumption, especially for developing nations such as Ghana (for instance, in the short run), becomes influenced by the negative shock in FDI; and this allows FDI to be labelled as cost-sensitive (Sharma & Kautish, 2019). The implication would then be for policymakers to devise mechanisms which may cause FDI to be less prone to fluctuations in costs of production and/or inflation, so that the expected and desired electricity consumption level can be achieved. It, thus, becomes vital to find rejoinder to the query; what appropriate estimation technique can be used to cater for such probable occurrences?

In a nutshell, with all of these issues surfacing within the literature, and which are of practical and technical concern, this thesis finds it worthwhile to utilize a contemporary technique, thus, the Nonlinear Autoregressive Distributed Lag (NARDL) model of Shin *et al.* (2014), for its empirical estimations of the effect of FDI on the Ghanaian electricity consumption. This thesis is motivated by the fact that; using long-run and short-run analyses, the assessment of the required FDI effect would assist Ghana in treading along the path to desirably influence electricity consumption, and/or to introduce the flow of efficiency into the power sector, through the immense assistance of the NARDL estimation technique which splits the effect of FDI into its positive (increase) and negative (decrease) changes. In this latter vein, the thesis, through the NARDL model, would be able to handle the tendency for FDI to be sensitive to cost whilst securing the electricity needs of the populace. More importantly, any possible presence of asymmetry can be ascertained. The exact direction of causality can also be clarified using this contemporary econometric technique.

1.3 Research Questions

Of what nature is the FDI-electricity consumption nexus in the Ghanaian economy? Specifically,

1) Is the effect of FDI on electricity consumption for both long and short runs in Ghana asymmetric?
2) What form of causality exists between FDI and electricity consumption in Ghana?

1.4 Research Objectives

The main objective is to assess the FDI-electricity consumption nexus in Ghana by attempting to:

1) Examine the asymmetric effect of FDI on electricity consumption for both long and short runs in Ghana.
2) Investigate the exact form of causality existing between FDI and electricity consumption in Ghana.

1.5 Justification (Significance) of Thesis

Despite the investment instability between 1980 to 2000 and 2006 to 2016, as reported by UNCTAD (2017), Ghana has still been recognized over the years as one of the leading recipient of investments relative to her West African neighbouring nations; this is due to her comparative investment climate and political stability (Power Africa, 2018). So, Ghana should continue to advance policies to attract investment opportunities; the gigantic challenges faced by the power sector in Ghana, in accordance with the 2018 Power Africa reports, can be tackled by an enabling environment created by investment.

Given that the United Nations (2005) identifies the development of energy as SDG 7, and that such development plays a key role in achieving the rest of the SDGs, analyzing the influence of FDI on electricity consumption tends to offer desirable outcomes; since the former can only facilitate the role of the latter. By and large, the level of electricity consumption is, unswervingly, associated with the overall advancement or socioeconomic development of a nation (Latief & Lefen, 2019; Mahmood *et al.*, 2014). So, its role in the economy can be enhanced by FDI.

Ghana will benefit from this research, as it will serve to inform her populace about one of the key drivers of electricity consumption. In doing this, where necessary, the government will improve upon existing policies in order for the country to meet the electricity demands. This should avert any dismal picture or trends in the future such as load shedding.

Moreover, virtually no study has been conducted for Ghana, on the relationship between FDI and electricity consumption, using the NARDL model of Shin *et al.* (2014); from which this thesis draws inspiration. And more importantly, this will help to broaden knowledge as far as responding to this essential interrogation is concerned: on the basis of responsiveness in both long and short runs, will the FDI effect be asymmetrical or otherwise for Ghana?

Furthermore, it will be of value focusing on a specific country such as Ghana; or microscopically viewing this relationship because, for instance, as finalized by Keho (2016), studies based on panel data across nations would only present inaccurate inferences which could extremely mislead in formulating policies for individual countries such as Ghana. With studies on Ghana, one is likely to have ample arrays of information pertaining to and for only her, from which more robust conclusions to guide policy may be obtained. So, it is needful to explore, as FDI inflows remain at the core of main development assistance schemes in less developing economies such as Ghana.

1.6 Scope of Thesis

This thesis uses an annual time series data, from the period 1980 to 2018, to investigate the effect FDI has on the Ghanaian electricity consumption. The timespan is large enough to cover most important technological and/or investment revolutions which may have made Ghana prone to both foreign and domestic policies over the years. The data for analysis is an updated one from the World Development Indicators (WDI) of the World Bank (2020) and the United States Energy Information Administration (2020) as at the time of this research.

1.7 Organization of Thesis

This thesis is structured under five (5) chapters. Chapter One introduces this thesis by giving information on the background of thesis, problem statement, research questions and objectives, significance of thesis, and scope of thesis. Chapter Two provides an overview of FDI and electricity consumption in Ghana. Chapter Three offers both theoretical and empirical literature reviews related to the subject. Chapter Four explains the methodology (inclusive of the theoretical framework and the empirical model), and presents and discusses the results of the thesis. Chapter Five highlights on summary, conclusion, and policy and research recommendations of thesis.

CHAPTER TWO

OVERVIEW OF FOREIGN DIRECT INVESTMENT AND ELECTRICITY CONSUMPTION IN GHANA

2.1 Introduction

This chapter generally presents a discussion on the linkage between foreign direct investment (FDI) and electricity consumption in Ghana. In this chapter, the concepts of FDI and electricity consumption in Ghana are presented. Financial and developmental policies for the energy sector in Ghana are elaborated on as well. Finally, the chapter provides the chapter summary and/or concluding remarks about the discussions.

2.2 Foreign Direct Investment (FDI) in Ghana

2.2.1 Past FDI Development

During the Nkrumah regime in the late 1950s to early 1960s, FDI was viewed as an agency to spread capitalism. However, the regime did well to ensure that the dam at Akosombo worked together with Volta Aluminium Company (VALCO), which was partially established by Kaiser-Reynolds, to provide electricity for the country (Moxon, 1969; Tsikata *et al.*, 2000). In accordance with these researchers, the green light was given for this partnership to be operational which resulted to little inflow of FDI into the industrial, services and mining sectors. This worsened in the early 1970s when the military took over power in the country. The coup created an atmosphere which posed hostile to local and foreign investments. The interventions the military leaders projected, and the policies they implemented, reflected from their anti-neocolonialism thoughts. Adverse economic growth rates were, therefore, recorded.

Tsikata *et al.* (2000) noted that, in 1983, quite long after the government of Dr. Hilla Limann was overthrown, Flight-Lieutenant Jerry John Rawlings emulated the economic reforms which were then in vogue at the global level, especially within Africa. This helped to advance the Economic Recovery Programme (ERP) which was intended to address the prevalent adversities in the economy. As part of the Structural Adjustment Programme (SAP), this intervention was of assistance in putting the economy back on its feet. Between 1984 to 1991, an annual economic growth of 5% on average was observed to have taken effect (Tsikata *et al.*, 2000). So that, slowly and especially midway between the above stipulated years, the inflows of FDI, much against the grasps of political instability, was revived. The mining sector received majority of the inflows. The agricultural sector, with cocoa farming having been a predominant activity, did not largely experience the expansion created by FDI; same applied to the energy sector in Ghana, as there were even shortfalls of about 10% in capacity utilization during these times (Tsikata *et al.*, 2000). In 1985, the reappraised Ghana Investment Code established the Ghana Investment Promotion Centre (GIPC) which was geared to attract and guide FDI inflows; and to ultimately affect the deficient economic sectors (Ghana Investment Promotion Centre, 1991; Tsikata *et al.*, 2000). At the beginning of the 1990s, the rate of economic growth dwindled and this posed a huge setback for the government which was then about transiting from the military administration to civilian. On the path of letting Ghana achieve middle-income prominence, a policy like 'Ghana: Vision 2020' was enacted to guide the flow of FDI into the country (Vision, 1995; Tsikata *et al.*, 2000).

2.2.2 Trend of FDI in Ghana

The trend of FDI in Ghana is depicted in Figure 2.1. It is shown that FDI has been unstable for some time. There was a slight increase in FDI (net inflows) between 1990 to 1992. There was a further increase in FDI between 1992 and 1994. This increase occurred by a wide margin as reflected by the steep slope. However, between 1994 and 1997, there was not much of an expansion of FDI in Ghana; thus, it declined from 1994 to 1995, slightly increased from 1995 to 1996, then dropped in 1997. It then started to expand, however, this did not occur by a very wide margin. This feature ended in 2000. From 1999 to 2000, a flat slope was virtually observed. Unfortunately, at the beginning of the millennium, there was not much attained from FDI; between 2000 and 2005, most of the pattern of FDI was of a declining nature. However, in the subsequent three years, FDI surged as compared to the previous years. It is worth of note that, since 2008, the quantum of FDI started to dwindle (World Bank, 2020).

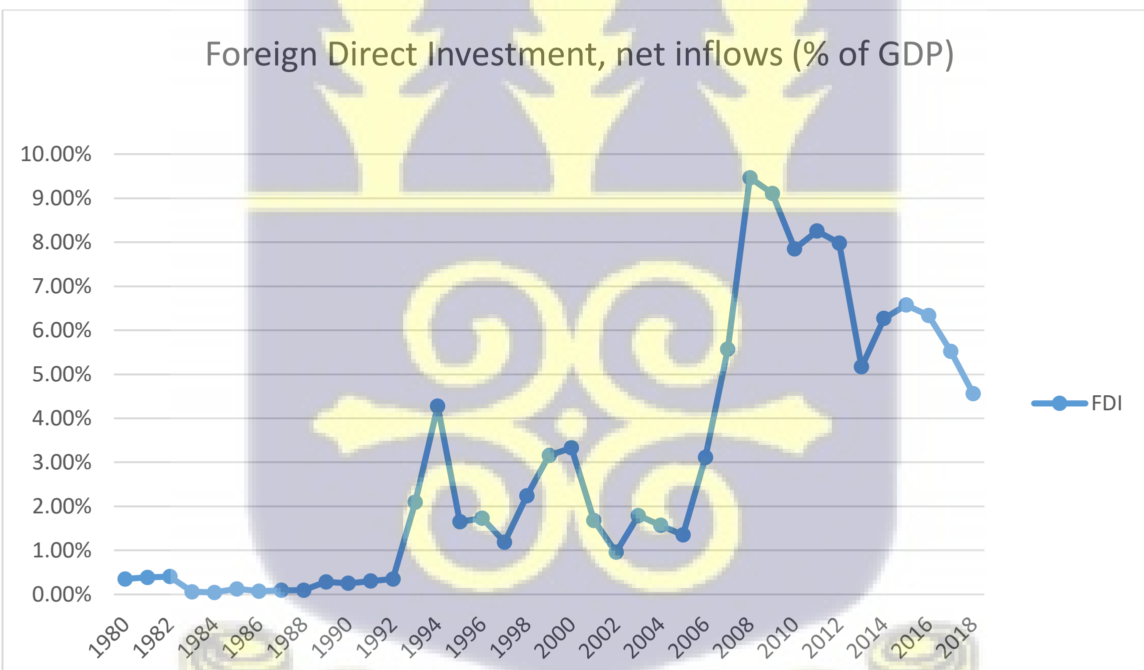


Figure 2.1: Trend of FDI in Ghana

Source: The extraction of author based on data from WDI of the World Bank (2020)

The economic reasons and/or intuitions behind the trend of foreign direct investment (FDI), as given above, are provided in the next subsections.

2.2.2.1 Supply-Side Factorial Analysis of FDI Trend in Ghana

What may be responsible for the expansion and contraction of FDI over the years in Ghana could be owed to certain fundamental determinants of FDI. These determinants of FDI can be analyzed from the supply-side viewpoint. Generally, the supply side lends itself to macroeconomic conditions.

From the supply-side perspective, the Ghana Investment Promotion Centre (GIPC) may have had it tough in stabilizing FDI inflows into the country when utilizing vital instruments. For instance, between 1990 and 1992, the slight expansion in FDI inflows may have been instigated by favourable but weak policy framework for FDI. Here, FDI may have been attracted by some protective schemes, sectoral policies, and tax holidays and incentives. Afterwards, thus, between 1992 and 1994, the wide expansion in FDI inflows may have been propelled by robust import-substitution and export-orientation trade policies, and resilient monetary and fiscal policies. From 1994 to 1995, the contraction in FDI inflows may have been influenced by poor handling of investment incentives and other corporate considerations; and the reverse of these may have accounted for the slight expansion in FDI inflows from 1995 to 1996. As UNCTAD (1998) is very likely to put it, the contraction in FDI inflows from 1996 to 1997 could be owed to banking, legal and accountancy services not being attractive for FDI inflows into the economy and/or power sector. The Ghana Investment Promotion Centre (GIPC) may have tried hard to revive the economy with such business facilitation factors, but they were not adequately attractive for FDI; this may have been the reason for the slight expansion in such inflows between 1997 and 2000.

Still on the supply side, there are a number of factors which have contributed in attracting foreigners to invest in the country. There are equally many items that have posed hostile to foreign organizations. To some extent, the levels of investment have been traded off between these two opposing factors. Often, at a point in time, the economy of Ghana tends to be distinguished by either the strengths or otherwise at attaining the desired levels of investment. Either ways, some supply-side determinants tend to tell the story of the FDI trend in Ghana, especially at the beginning of the millennium.

From the country-level perspective, infrastructural deficiency may have tended to be one factor inhibiting foreigners from investing in the country (although FDI itself is needed to reverse such problems in Ghana, especially in relation to those within the power sector); this may have been the reason behind the rife contractions in FDI between 2000 and 2005. The consistent provision of electricity did not largely meet the expectations of the populace, and the transportation system needed improvement as well. As at 2003, Ghana did not seem to have prioritized the provisioning of these amenities in encouraging FDI inflows. This may have accounted for the decline in FDI between 2003 and 2005, as depicted in Figure 2.1. Again, by 2003, the chronic infections rate in the country, due to poor health services, may have impeded the inflows of FDI. Despite measures to curb the rate of morbidity in Ghana, the delivery of effective health services may not have been up to standard; and tropical diseases, such as malaria, may have been still prevalent. Also, due to the low remuneration often given to workers, they may not have been inclined to produce effectively; even when their ventures obtained funding in the form of FDI. Nevertheless, between 2005 and 2008, the expansion in FDI inflows may have occurred owing to proper handling of the labour market, and effective industrial and labour relations.

From the sectorial perspective, Ghana exhibited robustness in the mining sector in the early 2000s (UNCTAD, 2003). By and large, this may have accounted for the high inflows of FDI recorded between 2005 and 2008. The performances of the mining sector had often left much to be desired;

in that, the varied natural resources, which the country is endowed with, generated excessive foreign exchange for her. In view of this, the processes through which the mining sector in Ghana undergoes, when exploring and extracting diamond, manganese, bauxite and gold, encouraged more foreigners to invest in the country. In the agricultural sector, irrespective of complicated land tenure systems, the cocoa markets did not perform abysmally either. Between 2005 and 2008, tourist sites in Ghana helped to attract foreigners around the world; tourism programmes occupied a strategic position in any development agenda, although hoteling encountered few bottlenecks (UNCTAD, 2003). In addition, the telecommunication industry often justified the flows of FDI into the country, although at certain times, there had been the lack of transparent regulatory framework.

From the corporate point of view, some lethargies may have remained quite pronounced, despite the somewhat resilient economic stance of the country to attract FDI; which is through long-established transnational corporations (TNCs), professionalism in mine-engineering and low cost of labour. For instance, after 2008, these lethargies may have been identified as inadequate networking, inadequate entrepreneurship and inadequate managerial expertise. In addition, the nature of standardization in producing quality products within Ghana may have obstructed the right amount of FDI from being channeled to most of her organizations.

By and large, the robustness and deficiencies in the potential of inward foreign direct investment in Ghana over the years, as demonstrated in Figure 2.1, are in consistence with the analogies provided by UNCTAD (2003). The current electricity challenges which have been raised in the introductory chapter of the present thesis are, by and large, the outcomes stemming from the deficient potential of foreign direct investment over the years; so, more foreign direct investment inflows must be encouraged to reverse such issues.

2.2.2.2 Demand-Side Factorial Analysis of FDI Trend in Ghana

What may be responsible for the expansion and contraction of FDI over the years in Ghana could be due to certain essential demand-side determinants of FDI which are intrinsically motivated.

In accordance with UNCTAD (1998), the demand-side factors which facilitate the attractiveness of FDI can be categorized into resource-seeking FDI, market-seeking FDI, efficiency-seeking FDI and strategic asset-seeking FDI. These are somewhat a mirror image of most supply-side determinants of FDI. For the resource-seeking FDI, where the host country is motivated to secure inexpensive inputs or factors of production unavailable at home, Ghana may have been inclined towards hinting on the quest for foreigners to invest into the economy in this vein. This may be the intuition behind the slight expansion in FDI inflows between 1990 and 1992, and its wide expansion between 1992 and 1994. This FDI by motivation may have been existent in the primary and manufacturing sectors of Ghana in these years. From 1994 to 1995, FDI may have been contracted in Ghana due to the possible fact that the motivation by her varied sectors to seek the required resources was not enough to attract FDI. Where there was not the urge for such resource-seeking FDI from 1995 to 1996, then Ghana may not only have had, in store, copious raw materials to attract FDI, but may have had available low cost of labour and valuable infrastructure needed to convert such raw materials; this can be detected from the slight expansion in FDI inflows within these years. For the efficiency-seeking FDI, which is prevalent in the manufacturing sector, Ghana may have aimed to attract FDI to effectively link her production, distribution and marketing activities whilst maintaining specializations. This could have been the reason behind the expansion in FDI inflows between 1997 and 2000 which did not last, since the amount of FDI was mostly contracted between 2000 and 2005. It implies that, between 2005 and 2008, since the amount of FDI expanded, the government of Ghana may have demonstrated strongly the need to operate such vertical strategy. In the absence of this vertical strategy of seeking FDI, Ghana may have been flooded with efficient skills in the labour market, and quality infrastructure, which are needed for the transformation of the economy. These tend to substitute for FDI. Unlike the efficiency-seeking FDI, the market-seeking FDI is the horizontal strategy where FDI connects the host country to newly introduced markets (UNCTAD, 1998). This demand-side driver is common in the secondary and tertiary sectors. Relating this philosophy to the case of Ghana over the years, it only means that the industrial sector in Ghana could have been struggling to allow itself to be introduced into diverse markets since 2008, as there are mostly seen to be declines of FDI inflows after this year. From the strategic asset-seeking FDI viewpoint, the reason for FDI to have increased over some years in Ghana, as depicted in Figure 2.1, may have been due to how the government of Ghana positioned itself to be assisted by FDI in the areas of innovation, and research and development.

The above economic intuitions behind the trend of FDI inflows in Ghana are in synchronization with the various paths as to how FDI is ultimately sourced or favourably triggered, and otherwise (Chen *et al.*, 2015). The World Bank Group noted that, whilst the efficiency-seeking FDI is occasionally observed to have the largest positive impact on economic growth, the market-seeking FDI is, at other times, perceived to be ranked at the top of such a hierarchy. Analyzing on sectoral grounds, manufacturing FDI is (generally) viewed to exert a relatively higher expansionary influence on economic growth. Even within the supply-side causative substructure, a factor empirically outweighs another; with respect to the power of coaxing foreigners to invest in the economy (Chen *et al.*, 2015). Despite the varied opinions surrounding the relative strengths of the factors, it seems Ghana has not really committed strongly to any of the factors, and this is what may be causing the unsteady pattern of the inflows of FDI over the years; to the extent where it has affected the power sector as well (as illustrated in the subsequent figures).

2.3 Electricity Consumption in Ghana

There are other energy types consumed in Ghana, besides electricity, which should be concisely discussed. The next few subsections discuss these energy (including electricity) types.

2.3.1 Energy Demand-Supply Outlook in Ghana

The energy demand-supply discussion looks at the distribution of useful energy products from the energy supply side to the energy demand side within the economy (Energy Commission, 2006). Thus, the integrated energy supply feeds the economic energy demand sector. In general, the schematic overview of the Ghanaian energy demand-energy supply system, provided from the 2018 Energy Outlook for Ghana (of the Energy Commission), is described in Figure 2.2.

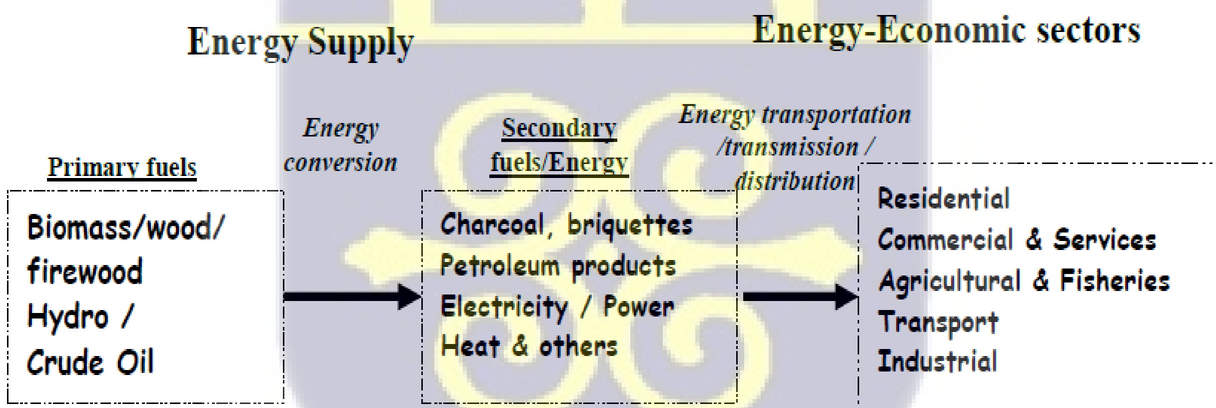


Figure 2.2: Schematic Overview of Energy Demand-Energy Supply System in Ghana

Source: Ghana Energy Commission, 2018

Whereas the energy supply side mainly consists of Electricity or Power, Solar, Biomass (Firewood and Charcoal) and Petroleum sources, the energy demand side is made up of the Residential or

Household sector, Transport sector, Industrial sector, Agricultural and Fisheries sector, and Commercial and Services sector (Energy Commission, 2006). The demand side can be further categorized distinctively. For the Residential sector, there are Rural and Urban areas. For the Transport sector, there are Air, Maritime, Road and Rail subsectors. The following fall under the Industrial sector classification: Construction, Utilities, Mining and Manufacturing. The Agricultural and Fisheries sector displays important activities such as Post-Harvest Processing, Livestock, Land Preparation and Harvest, and Irrigation. Tourism, Information Technology, Education, Health, and other development sections in the economy, are classified under the Commercial and Services sector.

About the time the government of Ghana was aware of the benefits of the Strategic National Energy Plan (SNEP), which will be explained later, some institutions contributed to the maintenance of the energy demand-supply structure. The Ministry of Energy has been a crucial agency which has assisted in the effective flow of energy resources to the nation (Hagan, 2015). Its duty is to supervise all the other energy-related sectors, and to guide the national energy administration. The Electricity Company of Ghana (ECG), the Volta River Authority (VRA), the Tema Oil Refinery (TOR), the Ghana National Petroleum Company (GNPC), the Northern Electrification Department (NED), GOIL, and the Bulk Oil Storage and Transportation (BOST) Company Limited, are the other important institutions within the energy sector (Hagan, 2015; Power Africa, 2018). The energy sector, during the beginning of the 2000s, also witnessed the regulatory roles played by the National Petroleum Authority (NPA), the Energy Commission, and the Public Utility and Regulatory Commission (PURC). They were also responsible for coordinating and monitoring oil prices and quantities, the provision of technical expertise, and the enforcement of tariffs on utilities (Hagan, 2015).

2.3.2 Past Energy Sector Development

According to Energy Commission (2006), ensuring the sustenance of the provision of energy to the citizenry requires cautious preparation of plans which would guide the country in the judicious use of energy resources. The Energy Commission of Ghana has been the mandated body to look to such plans. This includes advising the Minister of Energy on the effective distribution of the available energy resources in the nation, and providing recommendations on how local energy resources could be developed and utilized. This mandate has enabled the existence of the Strategic National Energy Plan (SNEP) to look to the adequate and efficient delivery of energy to the nation for 15 years. In the early years of the 21st century, rigorous collaboration of expertise from about 49 governmental and non-governmental bodies came to the fore of discussing the initiation of SNEP (Energy Commission, 2006). The smooth flow of their meetings was guided by a document which was better informed by the two-sided division of the energy sector, thus, the demand for energy and supply of energy. Volume One of the report covers the energy demand sectors of the economy (Energy Commission, 2006). Volume Two, which forms the other half of the division, elaborates on the supply of energy, and/or the previously-mentioned relevant energy resources.

Energy Commission (2006) reported that, prior to the enactment of SNEP, the guidance to the improvement of the energy sector was assisted by the Action Programme which was implemented in the 1990s, and whose purposes were encapsulated in the 'Issues, Strategies and Programmes in the Energy Sector under the ERP' document. Facilitated by the National Energy Board (NEB), the Action Programme gained recognition in the areas of developing renewable energy, and promoting the conservation of electricity and petroleum products. In the wake of some restraints, its exclusive power gradually declined, leaving the energy sector sitting on tenterhooks. Hence, to fill this gap of a defenseless energy system, the Strategic National Energy Plan for Ghana arose; the need for this was substantiated by the prevalent energy crises during the end of the 1990s (Energy Commission, 2006). This situation in energy spheres was aggravated by the over-reliance on hydroelectricity which eventually proved weak, on account that the rainfall pattern was not stable at the time (Energy Commission, 2006). Being clear of the vision to restore the economy to normalcy, Ghana, thus, sought help from the United States of America and Denmark. It was through their aid that the SNEP came to full realization in 2000 (Energy Commission, 2006). The philosophy of the SNEP had been for Ghana to effectively exploit the diverse natural resources of energy; for the purpose of sustaining the populace for a long period of time, and that, before the supply of energy would set in to meet the demand for energy, efficient use of energy should have been the order of the day. In accordance with Energy Commission (2006), two principal software were employed by SNEP for forecasting and planning analysis; the Integrated Resource Planning (IRP) and the Long-range Energy Alternative Planning (LEAP) respectively.

According to Energy Commission (2006), the relationship between economic development and energy demand has been increasingly studied, and it is widely known of the tight association which has existed between them in an economy over time, regardless of the development level of the nation. By and large, any energy-related problem of a nation may inform or reveal the status of development of that economy. The situation in Ghana is not much different; and the increase in her population, from 18 million in 2000 to about 30 million in 2020, tells some story as well. Due to the slow but assuring rate of the rise in population, it has been of necessity to reduce the alarming number of poor people as well, so that gradually everyone would have equal access to energy. In quest of improving the standard of living of the poor, the Ghana Poverty Reduction Strategy (GPRS) was also introduced in 2001 (Energy Commission, 2006). Crude oil did not perform greatly for Ghana in the 2000s, however, the trend reversed at the start of the following decade by directly improving Gross Domestic Product (GDP) through its tax expenditures.

The trend of energy consumption has been fluctuating, between (in approximation) 250 and 450 kg of oil equivalent per capita, over the years; and this is owed to the known adverse economic conditions which have been mentioned early on (World Bank, 2019). According to World Bank (2019), energy consumption consists of primary energy which is mostly transformed into electricity. It follows that biomass, of which a greater proportion of the populace has been accustomed to, was sometimes not in high supply. The government of Ghana, therefore, thought it prudent to come up with some economic reforms in the 1980s, such as the Economic Recovery Programme (ERP), in order to reverse the trend. Nonetheless, the ERP found it tough maintaining the level of energy consumption afterwards; even through the times the 1992 constitution was operational, following the desire of the previous military government to switch to civilian mode. So, throughout the first fourteen years of the millennium, there were disparities in the consumption patterns of the energy types within the Ghanaian economy (World Bank, 2019). Whilst the trend of renewable energy consumption declined, that of non-renewable energy consumption increased. According to Lora Shinn (2018) of the Natural Resources Defense Council (NRDC), renewable energy types are those which are continually replenished. Due to this nature, they exist in large quantities. Examples are solar energy and thermal energy. According to World Bank (2019), fossil fuel (which is non-renewable) consists of natural gas, petroleum, coal and oil. By 2000, renewable energy consumption surpassed fossil fuel energy consumption; with a remarkable difference (in total final energy consumption) of about 50%. Between 2000 and 2009, however, the gap between them started closing in (World Bank, 2019). It implies that oil exploration began taking the chunk of the energy supplies, thereby, gradually reducing the reliance on related renewables as electricity.

2.3.3 Trend of Total Electricity Net Consumption in Ghana

In accordance with United States (US) Energy Information Administration (2020), through the World Data Atlas resource, total electricity net consumption is computed as generation, plus imports, less exports, and less transmission and distribution losses. Thus, by and large, it is expected that electricity generated would result in equal amount of electricity consumed or demanded by firms and households within the economy. The trend of total electricity net consumption in Ghana is portrayed in Figure 2.3. It can be detected that electricity consumption has been unstable between, approximately, 1 and 10 billion kilowatthours. The economy witnessed a decrease in electricity consumption during the early part of the 1980s. It began to surge, however, after 1984; with quite a number of inconspicuous declines.

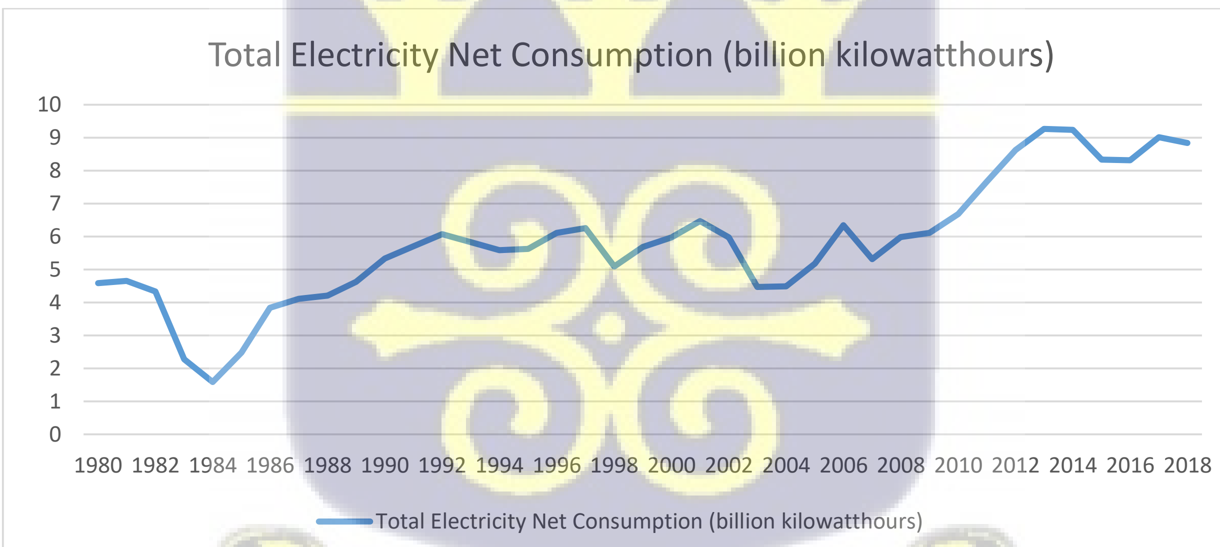


Figure 2.3: Trend of Electricity Consumption in Ghana

Source: The extraction of author based on data from US Energy Information Administration (2020)

Specifically, from Figure 2.3, it can be detected that electricity consumption decreased from about 4.6 billion kilowatthours in 1980 to about 1.6 billion kilowatthours in 1984. Electricity consumption expanded by more than 2 billion kilowatthours at the end of 1986. The steep slope recorded between 1984 and 1986 is informative of the rate pertaining to how electricity was highly demanded. Afterwards, electricity consumption rose to 4.2 billion kilowatthours and 6.1 billion kilowatthours in 1988 and 1992 respectively. This increase was not sustained, as after 1992, the consumption level declined to 5.6 billion kilowatthours by 1994. By and large, this can be attributed to the fact that the switch from military mode of governance to civilian may not have been smooth-sailing as desired; so the economy did not consume electricity as much as before within those few years. Having been acquainted with the adjustments, the economy began to consume more electricity. This pattern, however, was not sustained. From 1997 to 2018, there have been fluctuations in the electricity consumption level, although electricity consumption tended to expand between these years generally (US Energy Information Administration, 2020). Thus, electricity was much consumed at the latter part of the 1990s and well into the 2000s, relative to what was consumed in the 1980s. According to the International Energy Data Monthly Update of the United States Energy Information Administration (2020), the total electricity net consumption for Ghana turned out to be 8.8 billion kilowatthours in 2018.

To some extent, during the periods where electricity consumption increased, then it was the case that the effective roles of certain projects and programmes became observed. In accordance with Kumi (2017), the National Electrification Scheme enforced the National Electrification Master Plan for the purpose of reversing the low access to electricity status of the Ghanaian economy as at 1989. Also, in response to this low status, the Self-Help Electrification Program of the scheme managed to extend electricity to about 83% of the population in Ghana by 2016 (Kumi, 2017).

However, as illustrated in Figure 2.3, these projects and programmes have not been much of help in sustaining the level of electricity consumption over the years till now. The path in stabilizing the provision of electricity to the populace may have been rough for them. This is the reason for Kumi (2017) to have asserted that more efforts must be needed to guarantee widespread access to electricity by this time. Furthermore, there was the unavailability of most installed generation capacities to serve the increased electricity needs of the citizenry. Thus, between 2006 and 2016, the Ghanaian demand for electricity surged by nearly 52%; however, due to the fact that fuel supply, on which the installed generation capacities depend, was inadequate, the economy encountered pervasive electricity supply challenges (Kumi, 2017). This has widened the electricity insecurity gap in Ghana till now.

It is on these grounds, and other related issues which were stated in the problem statement, that the present thesis advocates for more inflows of FDI into the Ghanaian power sector to reverse such abysmal features. With the increase in FDI inflows through financial and technological means, reliable sources to fuel the installed generation capacities within the sector would be diversified in the first place; even as Kumi (2017) emphasized on this within the context of equipping the sector with the necessary and dependable resources from the West African Gas Pipeline.

2.3.4 Trend of Electric Power Transmission and Distribution Losses in Ghana

There have been times when Ghanaians had enough supply of energy to their homes and offices from renewable energy resources. They had enough supply of electricity from fossil fuel at other times (World Bank, 2019). Irrespective of these adequacies, there have also been recorded some electricity transmission and distribution losses over the years in Ghana; which, in fact, could have been reversed by the encouragement of inward FDI. These transmission and distribution losses are evident in Figure 2.4.

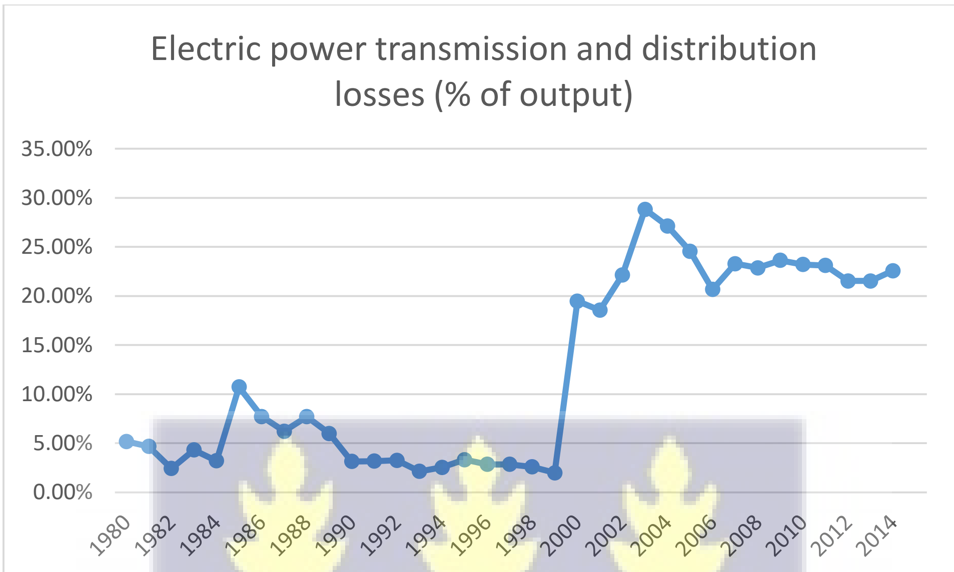


Figure 2.4: Trend of Electric Power Transmission and Distribution Losses in Ghana

Source: The extraction of author based on data from WDI of the World Bank (2020)

Between 1980 to 2000, the power sector in Ghana did not have much issues concerning how effectively electricity should be transmitted and distributed to the Residential or Household sector, Transport sector, Industrial sector, Agricultural and Fisheries sector, and Commercial and Services sector. This was because, out of the whole transmission and distribution processes which were carried out throughout these years, an average of 5% was lost. However, ever since the economy of Ghana was introduced into the 21st century, the power sector has been faced with severe losses; this was especially pronounced after 1999. Thus, from having lost about 2% of total electricity output in 1999, Ghana witnessed further huge losses of such by 2000. This was about 19.5%. For the subsequent years till now, it can be observed that the power sector has been trying hard to put in measures to curb the losses, as illustrated by the up-and-down pattern in Figure 2.4. The lowest number of losses which occurred at the beginning of the 21st century could not be compared to the highest number of losses which occurred prior to the onset of the 21st century. Thus, 10.7% in 1985 against 18.6% in 2001.

Worthy of note is that these persistent losses are, to some extent, in harmony with the lack of transparent procurement framework (and the poor financial health of the energy sector) raised in the problem statement; and which can still be overcome by FDI hereafter, as postulated in the present thesis.

2.3.5 The Management of Energy or Electricity Consumption in Ghana

The Strategic National Energy Plan (SNEP) identified a concept of managing the energy demand levels of the various sectors in Ghana. This is the Demand-Side Management (DSM) concept. To strengthen the concept of optimally utilizing energy in this regard, the ideas of energy conservation and energy efficiency were pursued (Energy Commission, 2006).

Specifically, energy efficiency programmes seek to introduce to consumers the appliances which could reduce the amount of energy used (Energy Commission, 2006). Energy efficiency is sometimes referred to as the ratio of the amount of primary or final energy demanded to Gross Domestic Product (GDP) or Gross National Product (GNP). On the other hand, energy conservation practices seek to decrease energy costs whilst sustaining the economy (Energy Commission, 2006). This is mainly done where consumers themselves, deliberately or consciously, reduce their utilization of energy. To a large extent, the practice of energy conservation does not only decrease the ratio of energy demand to total population, this leading to reversing the unnecessary growth in energy supply, but it also reduces the rate of importation of energy products; a practice that would have saved the economy throughout the 1970s.

The energy efficiency scheme was hindered by the inadequacy of donor funds. These funds were meant to encourage more capacity building and pilot projects which were initiated by the then famous National Energy Board (NEB). The energy efficiency scheme was also hindered by the government of Ghana, the unavailability of trained expertise in the area of energy efficiency, and the unavailability of energy-efficient technologies in the local market (Energy Commission, 2006). According to this source, since the collapse of the NEB, the energy efficiency programmes have been handled by the Volta River Authority, the Energy Foundation, the Electricity Company of Ghana, and the Industrial Energy Assessment Centre (IEAC).

As at 2006, it was estimated that a minimum of US$56 million would be needed to enforce the activities of the Demand-Side Management agenda (Energy Commission, 2006). Notable of inclusion was the minimal amount of US$4.5 million to promote grid-connected, distributed and co-generation systems. Examining the level of savings through an optimistic lens, however, it was projected that initiating the DSM agenda would positively and significantly influence energy consumption, and more specifically, electricity consumption in the long run.

Although this agenda has been pursued for some time now, FDI can also be of immense assistance in alleviating the prevalent challenges, since energy insecurity within the economy keeps surging.

2.4 Financial and Developmental Policies & Programmes for the Energy Sector in Ghana

World Bank (2012) reported Ghana to be one African nation which often created a conducive atmosphere for FDI, relative to her neighbours. For instance, her agenda to maintain a favourable environment for investment attracted a yearly amount of about US$3 billion from 2009 to 2012 (Power Africa, 2018).

In 2014, the Millennium Challenge Corporation (MCC) had a contract with the government of Ghana to help finance the activities of her energy sector with approximately US$500 million (Power Africa, 2018). As at 2015, the United States Agency for International Development (USAID), through the Power Africa initiative, advised that the government of Ghana had to take the overcoming of her infrastructural finance gap by FDI seriously. It supported the economy with US$1 billion. Since 2018, the Climate Investment Funds (CIF), through the Scaling Up Renewable Energy Programme (SREP), has been helping Ghana to expand her renewable energy system with an amount of US$40 million. Still in 2018, the African Development Bank (ADB), through the Sustainable Energy Fund for Africa (SEFA), infused the energy sector of Ghana with US$1.5 million which was needed to expand her renewable energy resources level.

Some developmental frameworks and policies, geared towards the energy sector within the Ghanaian economy over the years, have been the Ghana Shared Growth and Development Agenda, the National Energy Policy maintained by the Energy Sector Strategy and Development Plan, the Renewable Energy Act of 2011, and the Country Action Plan for Sustainable Energy for All of 2012 (Hagan, 2015). Outside the scope of the energy sector, however, the following policies were interested in the growth and exploitation of renewable energy resources within the economy; the Ghana Irrigation Development Agency (GIDA) of 2003, the second aspect of the Food and Agriculture Sector Development Policy (FASDEP) of 2007, the Science, Technology and Innovation Policy (STIP) of 2009, and the National Climate Change Policy of 2013 (Hagan, 2015).

2.5 Chapter Summary

Foreign Direct Investment (FDI) is viewed as a befitting measure to tackle the persistent electricity challenges within the Ghanaian economy. Nonetheless, this may only occur if (generally) infrastructure, on which FDI relies, is made available (Kumi, 2017; UNCTAD, 2003). Ghana is presently in dire need of infrastructure; comparing the Ghanaian situation with the rest of the world, especially within Africa, the generation of dependable infrastructure is very low (Foster & Briceño-Garmendia, 2010). However, with its availability, FDI will effortlessly address the current demands for electricity; through the promotion of more modern and efficient technologies (Buthelezi, 2019). Practically, the inflows of FDI to Ghana have been supportive of the growth of the economy over the years, yet it remains unstable and inconsistent. Its positive impact on crucial sectors of the economy, such as the power sector, has not been entirely felt. To some extent, this has contributed to Ghana being marginalized at the global level (Ndikumana & Verick, 2007). The quite few times the inflows of FDI rose, or when the economy of Ghana benefitted from such inflows over the years, it seems the power sector did not receive enough of it. It also seems that there has not been much attention paid to the importance of the FDI-electricity consumption nexus in Ghana. According to Buthelezi (2019), 90% of the 674 million people across continents, who do not have access to electricity, can be located in Sub-Saharan Africa. Ghana deserves enough FDI to positively alter the electricity situation of Sub-Saharan Africa as well, especially since the World Bank accounts of her relatively good investment performance to that of her co-African nations so far.

CHAPTER THREE

REVIEW OF LITERATURE

3.1 Introduction

This chapter discusses the various studies on the relationship between foreign direct investment (FDI) and electricity consumption. It highlights generally on the theoretical literature; but it espouses particularly on the various theories of FDI, including the theories which firmly establish the connection between FDI and electricity consumption. This chapter also highlights on the empirical literature. Finally, a chapter summary is offered.

3.2 Theoretical Literature Review

3.2.1 Theories of Foreign Direct Investment (FDI)

The theories of FDI essentially explain how FDI can be introduced into an economy. Thus, there are certain fundamental measures which can be put in place to encourage FDI, or which can aid in the adoption of FDI. Based on their unique descriptions, the present thesis itemizes these theories of FDI as Anti-Green or Non-Environmental Theories of FDI, and Green or Environmental Theories of FDI.

3.2.1.1 Anti-Green (Non-Environmental) Theories of FDI

The Anti-Green or Non-Environmental Theories of FDI, by and large, are theories which do not necessarily consider the fact that FDI can be attracted into an economy due to environmental reasons. For most economic analysts, FDI has been viewed to be quixotically contrived through the intertwining of three (3) separate but unique theoretical foundations. These are the Theory of the International Firm, the Theory of International Capital Markets and the Theory of International Trade (Tsikata *et al.*, 2000; Casson, 1990). However, these three foundations, which (by and large) explain the factors to be considered in determining the preference for particular host countries, the rationale to firmly establish production sites of transnational corporations overseas, and the justification for the 'Darwinism' of those institutions, can be summarized under the Anti-Green Theories of FDI; since they tend to warrant a great deal of focus in attracting FDI outside of the environmental context. It can be said that, without the notion of FDI being necessarily driven by environmental factors, the Anti-Green Theories of FDI serve as pedantic grounds (on which FDI-related studies may be founded) to discover other diverse schemes in drawing FDI into the economy.

Notwithstanding the above concerns, the specific theoretical arguments for FDI, which have been spearheaded by some economists, in this regard are; the 'Defensive Investment' Concept, the Product Life-Cycle Theory, the Resource-Based View Theory, the 'Vertical and Horizontal Integrations' Ideology, the Dunning Eclectic Paradigm, the 'Two-by-Two' Concept and the 'Profit Maximization' Concept. They are (each) succinctly explained below:

The 'Defensive Investment' Concept by Hymer (1960): -

The strong belief of 'Defensive Investment' proposed by Hymer, during the middle of the twentieth century, offers explanation to an oligopolistic or monopolistic foreign direct investor in the goods market. This theory by Hymer (1960) is an international facet to what Coase (1937) studied on the essence of the firm. Here, firms who endeavour in avoiding competition are also interested in fully utilizing for themselves the advantages which accrue to them in any venture they undertake (Hymer, 1960). Thus, Hymer (1960), who championed the analysis of the fundamental benefits of transnational-corporation activities, argues that it would be an obligation for that person to invest in foreign ventures even when it seems averagely lucrative for the purpose of shunning competition and securing market power. With this advocacy of borderless production, by and large, it is optional for the firm to produce and export, to be entitled to license production rights to another firm abroad, or to be located abroad (Hymer, 1960). In the end, the decision to take up FDI rests on the principle that the costs of losing to a prospective foreign investor some quantum of technical know-how, for instance, should not outweigh the conceivable benefits from that investment.

The Product Life-Cycle Theory by Vernon (1971): -

Another profound theory of FDI is the Product Life-Cycle Theory suggested by Vernon (1971). This theory is described in four (4) stages. These are the innovation, growth, maturity and decline stages. The innovation stage involves the creation of modern innovatory products by transnational corporations to not only meet the domestic needs of consumers in the country, but to also feed the foreign markets from the surplus of such output (Vernon, 1971). The growth stage is that stage where there is the eventual large growth in exports which propels the organization to build plants and machinery within the country. The country imports the innovative products in order to support primary industry activities. The Product Life-Cycle Theory describes that the incentive for organizations to involve themselves in the activities of FDI is substantiated, most prevalently, at the maturity stage of the product. The demand of the product of the organization is seen to greatly enlarge as the product gets to this stage (Vernon, 1971). Eventually, new companies come to be formed for the purpose of producing and competing on a likely product; through providing incentives, such as lower prices, to customers. Little by little, in order to also compete away these rivals, the organization will then be coerced to be more involved in the activities of FDI by the further prolongation of its production processes to other markets (Vernon, 1971). Consequently, the developing country, which basically imports these products, gets involved with markets which first encounter product standardization and market saturation, and later, cost pressures and price competition. It implies that the most prudent means for the organization to decrease cost is by investing in developing nations. These latter experiences, including the decrease in sales and profitability, occur at the decline stage of the Product Life-Cycle Theory (Vernon, 1971).

The Resource-Based View Theory: -

The predictive power of the Resource-Based View Theory, which enhances FDI decisions, rests on the ability of the organization which does not only own modern technology, but also possesses adequate unique resources such as managerial competences (Barney, 1991). These competences are needed to acquire some competitive edge over other organizations, and which enhances greater performances thereafter (Wernerfelt, 1984; Spender & Grant, 1996; Grant, 1991).

The 'Vertical and Horizontal Integrations' Ideology of Caves (1971): -

The works of Caves, especially in the 1970s, tackled the justification for the existence of both vertical and horizontal integrations (in the affairs of industrial economics) which have required considerable exploration, and/or have been deemed necessary to be studied over the years (Caves, 1971). Vertical integration is the practice where a firm develops into another production stage; with the rationale to reduce uncertainty and erecting barriers, instead of merging or acquiring another firm within the same production stage (Caves, 1971). On the other hand, horizontal integration is the means of undertaking the merger and acquisition process with competitors over a firm; with the intention to enjoy accompanied low marginal costs in the expansion of intangible assets, which may attract FDI, within a host nation (Caves, 1971).

The Dunning Eclectic Paradigm: -

The 1970s and 1980s, particularly, are noted as significant years in the historical advancement of a prospective overall theory of FDI. The Dunning Eclectic Paradigm, thus, was the theory developed to offer a broad-based package of ingredients or wide-ranging set of factors which contribute to the location, ownership and internalization advantages of transnational corporations (Dunning, 1973). Precisely, this theory is the product of the fusion of the trade and internalization theories which has been observed to thoroughly explain the conditions of FDI facility. Due to this feature, it has served as a bedrock on which many empirical models of the subject are examined. Here, these models incorporate essential drivers of FDI such as the degree of openness of the host country, the infrastructural development position, the stability of macroeconomic variables, the economic development stance of the host country, governance and institutional quality, and the market size (Dunning, 1981). To some degree, the classical formulation for the determinants of FDI, which is embedded in the Dunning Eclectic Paradigm or the Ownership, Location and Internalization (OLI) Framework, also emanates from the combination of the Resource-Based View Theory which has been mentioned early on, and the Institutional Theory. Categorically, the ownership aspect of the items of competitive advantages, dictated for an organization, emphasizes on the possession of intangible assets such as trademarks, patents, scarce natural resources (which permit the organization to permeate markets), knowledge and technology, size, and other closely related economies of scale (Dunning, 2000). In this way, the decision of an organization to undertake investment in a host country relies on the capability of that organization to attain particular assets which are unavailable to the other organizations of the host country. In specific terms, the tenet of ownership advantages is propagated by the Resource-Based View Theory; as it explains, into details, the positive characteristics an organization must have when attempting to invest into a new market. Conversely to the tenet of ownership advantages, that of the location advantages is reflective of the Institutional Theory; as it describes that the ability of an organization to be able to invest in a host country is contingent on the favourable laws and attractive macroeconomic variables, such as inflation and exchange rates, of the host country (Dunning, 1981). This element also captures the level of telecommunications and transportation, the political gains or investment incentive policies, the social benefits which emanate from attitudes towards aliens, cultural diversity, and the distance between home and abroad (Dunning, 1973; Tsikata *et al.*, 2000). To an extent, the favourable laws under the location advantages of this paradigm correspond with the less strict environmental standards for developing countries, under the Pollution Haven Hypothesis, which will be explained later. The dimension of internalization advantages describes the capability of firms to be able to operate abroad, devoid of partnership, by its resource-based benefits (Dunning, 2000). Thus, it explains how the use of these benefits within the organization is more lucrative than selling to other organizations.

The 'Two-by-Two' Concept by Casson (1990): -

Around the early 1990s, the debate of Casson in the formulation of a theory for FDI was firmly rooted in the unification of the Theory of the International Firm, the Theory of International Trade and the Theory of International Capital Markets. It was established that in a two-by-two manner, these should be capable of rendering rejoinders to salient issues surrounding FDI (Casson, 1990). For instance, the Theory of the International Firm would be informative of FDI matters pertaining to the location of the headquarters of the organization, the source of management, the country of registration of the organization, the location of control and the cultural affiliation of the organization. The Theory of International Capital Markets would also serve to provide a thorough groundwork for the issues of funding, utilization risks, ownership risks, origins of finance, as well as other risk-bearing matters.

The 'Profit Maximization' Concept by Lucas (1993): -

At the beginning of the 1990s, Lucas also advocated for a neoclassical derived-factor demand viewpoint in analyzing the rising of FDI (Tsikata *et al.*, 2000). Much as it was criticized for being theoretically preclusive of the conventional determinants of FDI, this approach is also known to be derived from the concept of profit maximization (which is subservient to some constraints). To an extent, the study of Lucas (1993) implies that any economy whose firms aim to attract FDI for onward progress must, in the first place, really be profit-oriented devoid of subjecting consumers to (excessive) exploitations.

3.2.1.2 Green (Environmental) Theories of FDI

The Green or Environmental Theories of FDI, in general, are theories which reflect the fact that FDI can be attracted into an economy owing to environmental factors. The Pollution Haven Hypothesis (PHH), the Environmental Kuznets Curve (EKC) and the Pollution Halos Hypothesis, which fall under this category, are explained below:

The Pollution Haven Hypothesis (PHH): -

One complicated matter which has been triggered by trade (to affect FDI) is the destruction of the environment. Culminated in greater cost, this has incentivized transnational corporations to extend their spatial coverage to other locations; for want to secure for themselves inexpensive functioning atmosphere (Jbara, 2007; Aliyu & Ismail, 2015). It is for this reason that the Pollution Haven Hypothesis (PHH) has been couched to prospectively capture the susceptibility of FDI to delicate environmental policies (Aliyu, 2005). In broad terms, very strict environmental laws may aggravate the cost of production for a firm in a particular country, which will thereafter (and with an automatic stimulus) encourage engagement in the abroad investment of 'dirty' products under less stringent standards (Keho, 2016). Over the years, dirty industries, such as the iron & steel industry, petroleum refineries, beverages and rubber industries, have involved themselves in these activities which contribute to the environment a considerable quota of pollution. In narrow terms, the hypothesis in discussion has three phases (Aliyu, 2005). The first phase involves large industries in the developed regions of the world, which heavily degrade the surroundings, expatriating to emerging economies whose environmental rules and regulations are less stringent. The second phase involves these industries of the developed world dumping toxic waste substances in the developing world. And the third phase entails the deliberate actions of the large industries in taking out the non-renewable natural resources, which facilitate production, from the emerging nations (Aliyu, 2005). So, the PHH is predictive of two similar outcomes; the outflows of FDI from developed nations being connected to the severity of the environmental standards, and the inflows of FDI to developing nations being related to the level of degradation. The low-income nations are labelled pollution havens because of their position in harbouring the activities of the industries from the high-income nations (Jbara, 2007).

Furthermore, FDI can be first drawn into any economy through preparing, implementing and regulating the stringency level of environmental policies such as production process standards, products standards, discharge standards, and water and air ambient quality standards (Aliyu, 2005). According to Aliyu (2005), utilizing environment-relaxed taxes, and paying close attention to the extent to which organizations partake in environmental agreements would help an economy (especially, a developing one) in adopting the right size of FDI for onward transmission into any sector. After all, the relative fragile environmental standards in developing nations have normally been viewed not to be detrimental, in the context that; these lend to developing countries a comparative advantage in capital-intensive dirty industries over a specific period of time (Aliyu, 2005). In similar analogy, any economy with less strict environmental standards would naturally have a comparative advantage in beckoning investment from foreign firms, and by and large, this would make the varied economic sectors in the host nation assured of receiving their respective shares eventually (Aliyu, 2005). In accordance with Aliyu (2005), however, after an economy (which is developing) harbours some pollution intensities from the foreigners, with time, she would be inclined to demand more of a highly-priced environment (the economic ‘normal good’ sense of environmental facilities).

The Environmental Kuznets Curve (EKC): -

The Environmental Kuznets Curve (EKC), developed by Simon Smith Kuznets in the 1950s, and redeveloped by Gene Michael Grossman and Alan Bennett Krueger in 1991, is the curve obtained by matching the pollution concentrations of various countries, which have unequal income, against their corresponding GDP per capita levels (Grossman & Krueger, 1991; Jbara, 2007). The EKC is the curve which responds to the theory that emerging economies are less polluted than industrialized economies. By its graphical representation or reversed U-shape, it means that as the GDP per capita of emerging economies increase, they are inclined towards experiencing heavy pollution till it gets to the point where, due to their increased wealth, they employ improved and cleaner energy-saving technologies (Jbara, 2007). With this curve, to some degree, the downward part or slope of the curve is also attributable to developed nations which specialize more in the production of goods of cleaner industries (Jbara, 2007). Here, besides the notion of the energy-saving devices, this is the second possibility of the prediction of the EKC. The prohibitive powers of developed nations, hereby, compel them to slow down on pollution. The PHH expounds the predictive power of this curve by suggesting that the emerging economies could be polluted heavily at their lowest phase of development; and this may be catapulted by industrialized economies when outwardly investing some goods of pollution-intensive industries (Jbara, 2007). And it is with this illustration that the PHH deems it largely possible for the inflows of FDI into less advanced nations to create an atmosphere of dirty production for them, but clean production for advanced nations (Jbara, 2007). In other words, the rising of cleaner surroundings in advanced nations at the cost of dirtier surroundings in less advanced nations (to an extent). So, the PHH implies that it is not necessarily about the developing countries being cleaner than the developed countries which is shown from the rising part of the EKC, but that the developing countries are compared to their own previous development stages over time (Jbara, 2007).

The Pollution Halos Hypothesis: -

The Pollution Halos Hypothesis propagates a similar story as the EKC on energy efficiency measures, but that FDI widens the opportunities for emerging economies to experience a safe environment through the use of amicable technology (Keho, 2016). Prospectively, however, the Pollution Haven Hypothesis (PHH) adds to it by positing that such occurs in the long run (Adom *et al.*, 2019).

So, practically, developed nations initially specialize in the goods of clean industries. In no time, after they are faced with pollution-intensive industries and obstructed by severe laws, they channel their investments to emerging economies. Later, these emerging economies transform to become developed nations which specialize in clean industries. This is how the PHH substantiates the second possibility of the downward part of the EKC occurring. And through confirming the first possibility of this part of the curve, the basis for some studies, such as Polat (2018), to have established that the Halo Effect of FDI inflows in lower-middle income nations has less significance than that of such investment in upper-middle income nations is obtained. Therefore, the PHH sums up the stances of the EKC and the Pollution Halos Hypothesis; even as it addresses their implicit weaknesses. Nevertheless, the neo-technological theory, which Aliyu & Ismail (2015) accorded to the Pollution Halos Hypothesis, becomes relevant for developing nations; since it assures them of later gaining a secured atmosphere (if they have not already) by utilizing friendly but effective technology in any sector.

Furthermore, if by any chance, it comes as an argument (against the predictive power of the PHH) that large foreign organizations (which are faced with stringent environmental policies in their developed countries) will as well be subjected to strict environmental conventions when they enter into any developing nation, it is worthy of note that such FDI flowing into that economy may have reached its peak. Thus, the attendant pollution activities may have come to attain a point where the conventions of that economy must step in to deter additional negative externalities. By this time, FDI may have been already quick enough to introduce certain vital opportunities into any economic sector. Hence, this new line of argument may be essential in the 'very long' run.

3.2.2 The Scale, Technique and Composite Effects Theory

A systemic connection is not more vividly and formally established in the relationship between FDI and its accompanied environmental pollution without the item of energy consumption being discussed (Aliyu & Ismail, 2015). In other words, the environmental impact of FDI can be analyzed through the influence of FDI on energy demand (Keho, 2016). On this note, all of these have been buttressed firmly through the Scale, Technique and Composite Effects Theory. So, the advantage this compound theory has over other models (specifically, the anti-green theories) is its ability to not condone the complicated extensions such as energy or electricity consumption (and the pollution of the environment). As a matter of fact, these effects tend to occur separately at different timeframes (Adom *et al.*, 2019).

The Scale Effect describes the impact of FDI on the discharge of global warming gases through economies of scale in general, or by expansion in real GDP per capita specifically (Aliyu & Ismail, 2015). With this effect, if FDI is encouraged in an economy, more hands will be required to ensure that the generation of energy or electricity supply is capable of addressing the energy or electricity needs of the populace. Employment levels will, thus, expand to allow for technological transfer and managerial competence across sectors, the energy sector being notably affected (Adom *et al.*, 2019). Out of this, an increase in production is realized for firms under the energy demand sector which, in turn, boosts the morale of workers at the energy or power facilities who made it possible for such turnout in the first place. These workers somewhat become the first to consume energy when harnessing the available resources prior to the final consumers acquiring their proportions as well. Besides rewarding an economy financially, it can be observed that the Scale Effect of FDI has a positive impact on the consumption of energy (or electricity) for firms; which positively affects their production and exports ultimately (Shahbaz *et al.*, 2018). Nevertheless, it adversely (relative to the Technique Effect) affects the environment through the pollution levels discharged from industries (Aliyu & Ismail, 2015). There is the tendency for this effect to be felt, most strongly, in the short run. The Scale Effect is illustrated in Figure 3.1.

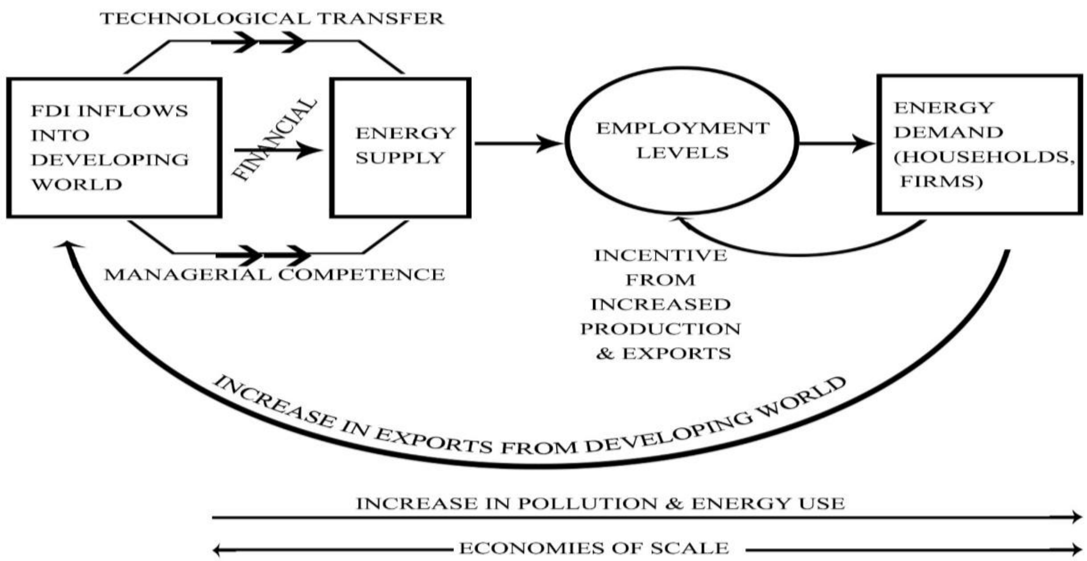


Figure 3.1: Scale Effect of FDI

Source: The compilation of author based on the Composite Effect Theory

In intensifying output, energy is observed to be highly consumed when using conventional technologies. On the other hand, the Technique Effect captures the adoption of leading-edge technologies which are energy-efficient (Shahbaz *et al.*, 2018; Adom *et al.*, 2019). The environment experiences less pollution levels in this way (Aliyu & Ismail, 2015). This effect increases market competition, and conversely to how FDI varies directly with energy or electricity consumption under the Scale Effect, the Technique Effect reveals an inverse relationship between these variables (Adom *et al.*, 2019). This effect tends to be operative in the same vein as the Halo Effect Hypothesis (also known as the Pollution Halos Hypothesis) which contends that, for multinational firms, energy efficiency is the hallmark; and thus, are able to be involved in green investments through their possession of superior technologies (Keho, 2016; Aliyu & Ismail, 2015). So, for the fact that foreign investors may introduce energy efficiency measures to their firms, thereby spilling over to the society at large, foreign direct investment may be termed as 'energy-reducing' (Shahbaz *et al.*, 2018; Adom *et al.*, 2019). It is important to know: this effect is most felt in the long run, or within a future timeframe. The Technique Effect is depicted in Figure 3.2.

It can be observed from Figure 3.2 that the efficiency of energy, emanating from the inflows of FDI into a host country (especially for a developing country), would first be experienced by the supply side of the energy sector (workers at the energy facilities); afterwards, the demand side of the same sector (households and firms) would consume efficient energy which it has been provided with (from the supply side). Whilst the workers at their facilities effectively harness the energy resources (for onward transmission to households and firms) through the assistance of capital injections or funds stemming from FDI (as illustrated by the 'financial' label), and by the support of efficient contrivances originating from FDI (as demonstrated by the 'efficiency' label), pollution may likely occur, but not as much; since the efficiency element may outweigh the financial element at this stage of the FDI effect. Therefore, it is possible to have a net pollution here. This is the intuition behind the arrowed labels ('pollution' and 'less pollution') which are attached to what FDI would do financially and efficiently within the energy sector of the host country. Again, although the inflows of FDI to the host country would be accompanied by pollution, the cost incurred should be exceeded by the benefits which emanate from FDI. In the case of electricity, and to an extent, this could come to bear when the efficiency aspect of FDI (through energy-saving devices), to support the supply process of extending the generation capacity (and related issues), overrides the financial aspect of FDI (although both dimensions can be welcomed by any nation). The mechanism of the Technique Effect pertaining to FDI, as earlier illustrated, is in synchronization with the assertion of Twerefou *et al.* (2018); and it extends to explain the 'economic development' dimension in Figure 3.2. In accordance with Twerefou *et al.* (2018), the availability of reliable supply of energy to meet the demands of the growing population in West

Africa is essential for achieving not only economic growth, but also meeting the sustainable development aspirations of the subregion. Here, FDI could help (in the first place) to efficiently exploit the abundant domestic energy resources to meet the needs of the populace. The sustainable development aspirations (as stated above) may be analogous to the 'economic development' dimension, and may even involve boosting the external sector of the economy. Thus, in the international limelight, recognition is awarded to such an economy when proceeds from FDI-facilitated exports are large enough to cater for payments accruing from imports; and for that matter, still having reserves. This becomes evident when the balance of payments stance for an economy is analyzed. Given what FDI is capable of doing, even for the external sector (as indicated above), it would then be a common interest for every nation to observe the advantages from the levels of FDI inflows outweighing greatly its possible interaction with pollution.

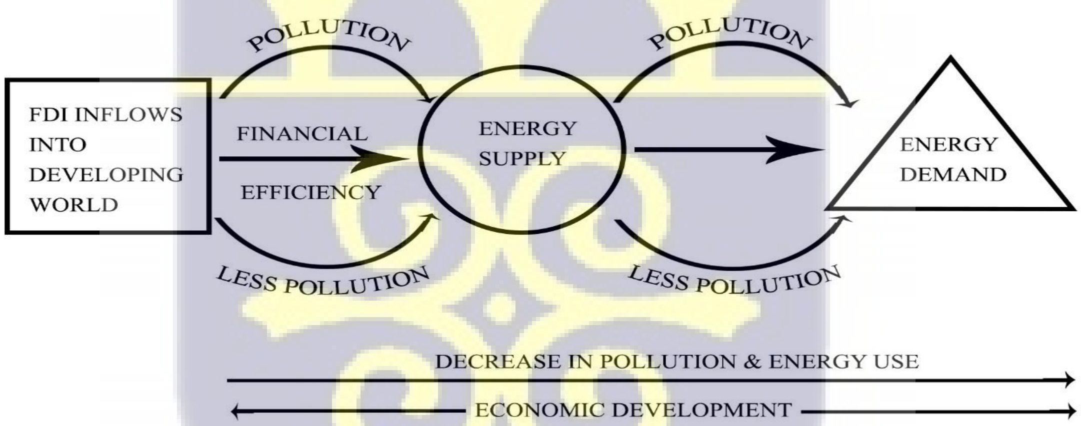


Figure 3.2: Technique Effect of FDI

Source: The compilation of author based on the Composite Effect Theory

As the name denotes, the Composite Effect of FDI is the combined effect of the Scale and Technique Effects of FDI. The Composite Effect describes how FDI first influences the production pattern of a host country, and then expands the production of those goods in which a country has comparative advantage (Shahbaz *et al.*, 2018). It captures that the sector which produces these goods will, by default, be held responsible for the emissions of global warming gases which correspond to the energy intensity of that sector. Furthermore, the Composite Effect depends not only on the sector which gains the most from the inflows of an output-boosting FDI, but it is also reliant on the stage of development, the adjustment cost, and the level of technology absorptive capacity of the host country (Adom *et al.*, 2019). How proficient an individual country becomes, in learning from FDI or taking advantage of external knowledge as far as FDI is concerned, is depicted by the level of her technology absorptive capacity (Adom *et al.*, 2019; Salim *et al.*, 2017). The responsiveness of output to changes in demand within a country is reflected in the adjustment costs which her firms incur (Adom *et al.*, 2019). The Composite Effect is depicted in Figure 3.3.

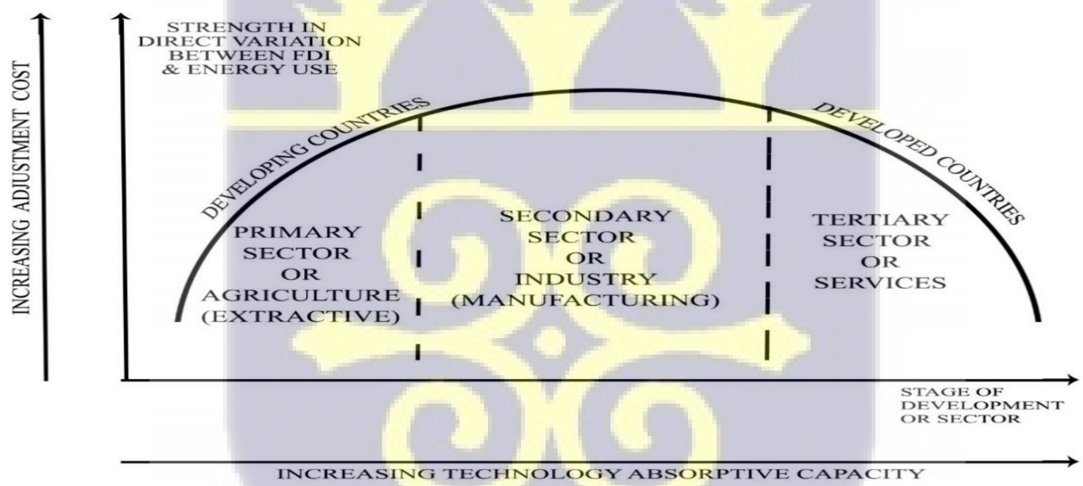


Figure 3.3: Composite Effect of FDI

Source: The compilation of author based on the Composite Effect Theory

It is often the case that an inverse connection exists between FDI and (any) energy consumption when the former is concentrated in the services sector (Shahbaz *et al.*, 2018; Adom *et al.*, 2019). Hence, the industry sector would comparably face less of the magnitude of the inversion. Also, to a great extent, since the technology absorptive capacity is higher for advanced countries than for their less developed counterparts, the effect of FDI on (any) energy consumption is nonlinear (Adom *et al.*, 2019). This implication of non-linearity for such heterogeneity is manifested in the adjustment cost as well. Here, where advanced countries are able to adopt new technology and learn quickly, their adjustment costs tend to decline (Sazali *et al.*, 2009; Adom *et al.*, 2019). On the contrary, less developed countries are faced with higher adjustment costs due to their relatively slow ability to learn, or their slow absorption of the technology process. There is a chasm which lies between the technical benefits associated with FDI in the two economies highlighted above (Lin *et al.*, 2002; Adom *et al.*, 2019). In parallel fashion, taking into terms the stages of the development process, the early stages of development can be said to follow the experience of less developed economies. Here, the property of the less inverse relationship between FDI and (any) energy consumption for less developed economies is distinguished from that for developed economies (Adom *et al.*, 2019). Since the less developed economies are at the early development stages, they are likely to defer the benefits obtained from saving energy to the later stages of development. Put in other words, at the later or future development stages (of which advanced countries are likened to), the inverse relationship between FDI and (any) energy consumption is manifested in the deferred energy-saving benefits (Lai *et al.*, 2006; Adom *et al.*, 2019). The idea of 'Positive Composite Effect' is a significant outcome in the transfer from an agrarian economy to an industrial sort, with this being at the early stages of development for a country (Shahbaz *et al.*, 2018). Consequently, this leads to higher energy use or consumption. There is the 'Negative Composite Effect' also, when an economy diverts from being industrially-focused to being services-concentrated, thus, at a matured level of development for the economy (Shahbaz *et al.*, 2018). Therefore, the sensation of the Composite Effect is pronounced at either the early timeframe or future timeframe depending on the above sectoral, technical and developmental factors.

The following subsections relate to the Composite Effect Theory, even as it (by and large) emphasizes on efficiency improvement and/or management of (any) energy consumption. For instance, it is important to note: the experience curve approach is, in part, a micro-foundation upon which the adjustment cost and the technology absorptive capacity of an economy, in the long-run relationship between FDI and energy consumption, are examined. Simply put, this conviction is stirred by the assertion of Weiss *et al.* (2010) that, "at the same time, the energy demand technologies are capable of improving energy efficiency; so they must be specially treated in forthcoming energy demand modeling".

3.2.2.1 Experience Curve Analysis for Energy Demand Technologies

In accordance with Weiss *et al.* (2010), to ensure the sustenance of a universal energy system, it is strategically prudent to promulgate energy efficiency, especially through renewable energy technologies, across all nations. This has been motivated, in part, by the increasing environmental issues which the contemporary energy system encounters (Weiss *et al.*, 2010). These researchers mentioned that investments into these modern technologies have frequently proven futile, since they are viewed to be exorbitantly priced at their commercialization stage. Nevertheless, Weiss *et al.* (2010) had been of the hope that such perception could be altered only through understanding the essence of technological learning. Over time, the incumbent technologies would then be less favoured by the existing energy markets which initially thought such technologies were less expensive (Weiss *et al.*, 2010). As it had been argued that distinct modern technologies in amassed production are bound to experience a fall in their costs overtime, the Experience Curve Theorem has been contrived to express the dynamic relationship between the said variables quantitatively. And to some degree, the learning rates are a true reflection of the experience curve. Weiss *et al.* (2010) were of the contention that, inasmuch as the experience curve notion is essential for forecasting energy patterns in terms of technology, and for implementing the right policies, it should not be only limited to analyzing energy supply technologies; the prospective fall in the cost of energy demand technologies should be appraised using this measure as well. However, it has been noted that any appliance with a high learning rate is prone to offer a decline in cost within the production process (Weiss *et al.*, 2010). For instance, consumer electronics and components have been known to be made up of modern materials which are capable of enhancing cumulative production, and thus, leading to cost reduction. These appliances also demand a relatively high level of integration, as compared to others, when they are manufactured; so, they exhibit such properties (Weiss *et al.*, 2010). For some studies, the potency of the experience curve method in projecting costs has been questionable. The issues range from 'whether this method would be made better by incorporating supplementary independent variables besides cumulative production' to 'whether to use energy consumption as a target variable rather than costs'. Other challenges have been the questioning of the suggested constant declines in costs. The uncertainties considered by Weiss *et al.* (2010), further, encompass limited data for exploration, the possible offsetting effects of knowledge transfer and management decisions over those of learning-by-using, learning-by-doing, research and development at the corporate level (and not to talk of the interactions of these endogenous instruments in manufacturing), and exogenous mechanisms, such as capital depreciation and overall scientific progress, prospectively determining the decrease in cost.

3.2.2.2 Energy Demand Reduction through Invisible Energy Policies

Royston *et al.* (2018) philosophized that, rather than dwelling much on the traditional ways of managing energy demand, such as through facilitating technological efficiency and other demand for energy-related mechanisms, there are other worth-concentrating policies beyond the energy scope which are capable of sufficiently reducing energy demand or consumption in the long run. These have been termed as 'non-energy' and 'invisible' policies, primarily, because they are not meant to apparently stimulate energy consumption; yet, they have the potential of strategically addressing the energy demands of the populace, and so must be utilized. In accordance with Royston *et al.* (2018), therefore, there must be the distinction between advocating for the non-energy effects of energy policy and that for the invisible effects of policies on energy consumption; the latter case is what these researchers claimed to be the novel agenda to mitigate energy problems. This area of policymaking has been viewed by Royston *et al*. (2018) as not much considered, and they built their debate on the social practice approach as well as on governance. Examples of non-energy policy are the liberalization of the United Kingdom labour market, the negotiation of trade agreements, and so on. Therefore, what the effects of these programmes on energy demand reduction might be was the central question posed by Royston *et al.* (2018). These researchers agreed that, to some extent, energy reduction is not an end in itself, but a means to controlling global warming. They, however, added that it goes beyond the imposition of energy taxes (also, investment and the likes) to foster such changes, and eventually tread on the usual paths of industrialized economies. Again, the translation for this assertion is that there are other directions which are concealed in plain view. For these researchers, non-energy policies are prone to influence energy demand slowly but assuredly; these policies are devised by domestic and foreign institutions; these policies take the geography and timing of energy demand into consideration; and mostly, the collaborative effect of more than one non-energy policy is desirable. It is worth to note that the above were precisely described as 'non-energy policy objectives', and somewhat were seen to be carried out through negotiating, coordinating, planning and associated activities which were generally labelled as 'non-energy policy processes'. According to Royston *et al.* (2018), the impacts of non-energy policies on energy demand reduction have been taken for granted due to disciplinary drivers such as unstable theoretical frameworks in analyzing energy demand at a large scale. The issues of practical concern are also that, despite their advocacies, these policies are complicated to handle by policymakers. Misplaced priorities at the national level tend to be a distorting factor as well (Royston *et al.*, 2018). Others also perceive the intentions behind the use of these policies as illegal social engineering. Nevertheless, and in accordance with Royston *et al.* (2018), the reduction of energy consumption could be mainstreamed within policy without it being an interference to attaining institutional goals, just as the targets of diversity and equalities have been in most recent businesses.

3.2.2.3 Reassessing the DSM Framework

In their article which concerns the reevaluation of the theoretical framework for managing energy at the demand side, Meyabadi & Deihimi (2017) thought it prudent to clarify certain concepts and terminologies which may be related to the broader principle, thus, Demand-Side Management (DSM), but are often inappropriately discussed. To these researchers, these concepts are seldom clearly defined, allowing them to be used interchangeably within the literature; and to fill the gap with respect to differentiating them, these researchers were obliged to devise an aggregated paradigm for the demand-side management of energy. In general, Meyabadi & Deihimi (2017) posited that such a major principle invented by Clark Gellings is an outcome from one of two strategies in the power system operation, thus, a managerial measure which is meant to tackle load demand (the other strategy is about manipulating the supply side of the energy sector). In particular, the DSM principle, in accordance with Meyabadi & Deihimi (2017), ensures the sustenance of energy (whilst allaying green-house effects) through scheming and implementing programmes which affect the utility and cost designs of consumers. For the revised theoretical framework of DSM, first of all, it is the goal of DSM to match the supply of electricity with the demand for electricity through two distinct strategies, thus, the improvement of efficiency and the decrease in consumption. In addition to their innovation, Meyabadi & Deihimi (2017) categorized DSM into two modalities, thus, Static DSM and Dynamic DSM. Furthermore, Electrical Load Management (ELM) and Energy Conservation (ENCON) have been considered to be the two methods in the DSM structure. Having been the first of the methods stated above, and often synonymized with DSM itself, the ELM has been thought to be the deliberate attempt to persuade customers into using electricity at specific intervals. Over time, it has been typical of ELM to take the forms of load shifting, valley filling and peak clipping, and in recent times, it usually exists as flexible load shape, strategic conservation and strategic load growth. Except for strategic load growth, these researchers classified the above contemporary forms of ELM as static modalities or actions which are intended to decrease electricity upon requirement, or when it becomes necessary to alter the load shape. Still under the theoretical framework, and specifically, in terms of the methods in the DSM structure which were earlier stipulated, ENCON is geared towards reducing energy losses in the energy system (Meyabadi & Deihimi, 2017). Therefore, in order to ensure that the input in the energy system (described as the Terminal Energy) amounts to, at least, equal output (described as the Useful Energy) proportionately or in terms of ratio, this measure should be of immense assistance in doing so. Efficiency is, thus, optimized. Nevertheless, generally, ENCON was regarded by Meyabadi & Deihimi (2017) to consist of two modalities as well; static and dynamic, each of which correspondingly comprises two strategies: Energy Consumption Management and Energy Efficiency Management. Furthermore, reliant on whether to reduce energy losses under either fixed Terminal Energy or Useful Energy, these strategies have extensions into three mechanisms within this paradigm, namely, Energy Saving, Energy Audit and Energy Recovery. These and other technical terms, such as Demand Response, Available Demand-Side Resource Capacity Control and Orderly Power Utilization, were structurally redefined; even as their scopes were explained in the DSM theoretical framework.

3.3 Empirical Literature Review

Research works conducted on some Sub-Saharan regions of Africa and beyond, concerning the relationship between energy consumption and FDI, have shown different impacts and causal linkages existing between these variables. This bone of contention may be present within the literature principally due to the dissimilar stages of development for countries (Salim *et al.*, 2017; Adom *et al.*, 2019). To some others, these variations could also be due to differences in their methodology, data, country selection, among others.

The actual findings by economic researchers, some of whom essentially intended on proving the existence of known theories or models which connect FDI to energy (and/or electricity) consumption, have been given through both multi-country studies and country-specific studies; although their reports vary from one another in terms of effects. Nevertheless, the subsequent subsections entail some contemporary worth-reviewing reports.

3.3.1 Multi-Country Studies

Aliyu (2005) conducted a panel data analysis, for the relationship between FDI and certain environmental variables, pertaining to 25 countries; and covering the timespan from 1990 to 2000. On the path to verify the conjectures which were made by the researcher, where the strict environmental laws correspond with FDI flowing from the advanced countries and FDI flowing into the less advanced countries corresponds with their pollution levels, Aliyu (2005) aimed to first disaggregate FDI into 'inflows' and 'outflows'; to cater for heterogeneity among the countries. Aliyu (2005) employed the Generalized Least Squares (GLS) criterion; where it was found that, for the advanced countries, their strict environmental laws are important drivers to increase FDI outflows. The researcher also found that FDI inflows do not count as important in deciding the levels of energy use and pollution for the less advanced or the 14 non-OECD countries[1]. For the advanced countries or the 11 OECD countries[2], environmental standard was seen to move in parallel fashion with the outflows of FDI. For these countries, FDI was reported to crucially affect the environment only through carbon dioxide fossil-fuel discharges (relative to energy use and total concentration of common pollutants). In accordance with the findings of Aliyu (2005), generally, the Pollution Haven Hypothesis (PHH) may be limited in explaining the story of less advanced countries which experience pollution only through carbon dioxide discharges; unless (perhaps) more meticulous works, using disaggregated FDI, prove otherwise.

Covering a period of 21 years, Aliyu & Ismail (2015) inquired into the linkages between FDI, environmental pollution and energy consumption for 19 African nations when testing the PHH.

[1] Argentina, Armenia, Brazil, Chile, Colombia, Indonesia, Kazakhstan, Mexico, Pakistan, Paraguay, Poland, Slovenia, Thailand, and Trinidad and Tobago

[2] Canada, Denmark, Finland, Germany, Iceland, Italy, Japan, Netherlands, Sweden, Switzerland and UK

Contrary to the environmental pollution level which was measured by energy use in accordance with Aliyu (2005), energy use was treated as a separate subject in the work of Aliyu & Ismail (2015). Aliyu & Ismail (2015) incorporated GDP per capita as an explanatory variable in order to capture the Scale Effect. They included the square of GDP per capita in the model for the purpose of fulfilling an income-activated Technique Effect; and with the essence that greater GDP per capita would lead to greater clean environment demand. Besides other relevant determinants of the pollution level, they incorporated the interactive term of relative per capita income and FDI for the purpose of propagating a possible Pollution Haven Effect. These analysts preferred and utilized the Pooled Mean Group (PMG) dynamic estimator of the Autoregressive Distributed Lag (ARDL) technique, and first reported a confirmed EKC hypothesis. Judging from the more-than-proportionate positive impacts of energy consumption and FDI on pollution, Aliyu & Ismail (2015) pointed out the occurrence of the Scale Effect. Domestic Investment was, however, not seen to be a good determinant of pollution. Furthermore, the PHH was ultimately verified by these researchers; the interactive term of FDI and real income per capita was found to be crucial in determining the quality of the environment.

In a growth framework (the Cobb-Douglas Production Framework in particular), and through simultaneous equation models of the Generalized Method of Moments (GMM), Abdouli & Hammami (2017) examined the interdependence between economic growth, energy consumption and FDI inflows, from 1990 to 2012, on seventeen (17) nations in the Middle East and North Africa (MENA) region[3]. In estimating the parameters of the structural simultaneous equations under their preferred GMM, energy consumption per capita was seen to influence GDP per capita for all the

[3] Algeria, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tunisia, Turkey, United Arab Emirates (UAE) and Yemen

MENA countries[4]. However, the significant influence was not observed for Morocco and Syria. Jordan was the least to have been reported with a strong influence of energy consumption per capita on per capita GDP among the countries. Notwithstanding this, a positive and significant effect of energy consumption per capita on economic growth was reported of the countries (altogether). With their second equation, FDI inflows per capita was seen to significantly and positively affect energy consumption per capita; first for Qatar, followed by Yemen, Kuwait, Lebanon, Egypt, and then Tunisia. There was no significant linkage, in this regard, found for the remaining individual MENA countries, as well as from a panel perspective.

Polat (2018) examined the impact of FDI on renewable and non-renewable energy demands of 85 advanced and less advanced nations, for 13 years, using the one-step system GMM dynamic panel data model. It was found that GDP per capita, a proxy for market size, significantly and positively influences renewable energy consumption for the advanced nations. Nevertheless, its significance was less than that of the non-renewable energy which was consumed the previous year for the advanced nations. Akin to what Abdouli & Hammami (2017) found for some MENA countries, here, FDI was seen to have a significant and positive impact on renewable energy consumption, and its significance was similar to that of the market size for the advanced nations. The impacts of FDI, trade openness and market size on renewable energy consumption were found to be insignificant for the less advanced nations. Polat (2018) also discovered the presence of Complementary and Substitution Effects; where the former captures that renewable energy may be the by-product from the production of non-renewable energy. For instance, natural gas may be

[4] ibid

transformed into electricity or hydro-electric power. And the latter captures that expensive non-renewable energy demand can be replaced by renewable energy demand.

Omri & Kahouli (2014) simultaneously estimated the effects of FDI, energy consumption and economic growth (among one another), from 1990 to 2011, by employing the dynamic GMM estimator on 65 nations first, and on nations differentiated on the basis of income. There was found to exist unidirectional and bidirectional causalities among the above principal variables. With the equation in which the influence on energy consumption was to be determined, the only variables with positive and statistically significant effects were economic growth, FDI, capital stock and financial development. Although labour force and population positively influenced energy consumption, their effects were found not to be statistically significant even at the 10% level. It was observed by Omri & Kahouli (2014) that the impact of FDI on energy consumption for the high-income nations is stronger, in terms of level of significance, than the impact of FDI on energy consumption for the middle-income nations. This implies that FDI was considered a very necessary tool to serve the energy demands of countries such as Spain, France and the United Kingdom. The impact of FDI on energy consumption for the low-income nations was not found to be stronger than the case for the high-income nations either. With energy consumption being considered for these countries, such as Ghana, Bangladesh and Nigeria, the other variables of similar influence were population, capital stock and financial development (Omri & Kahouli, 2014). Conclusively, besides FDI having had a statistically significant impact on energy consumption, there was reported to be a one-way causality running from the former to the latter for the nations altogether.

Faced with the problem of meeting an endless surge in energy consumption by selected South Asian Association for Regional Cooperation (SAARC) countries[5], which necessitated allotting for the provision of inexpensive energy, Alam *et al.* (2015) examined the salient roles of FDI, distinct financial development variables, such as domestic credit to the private sector and liquid liabilities, and economic growth (among others) on energy consumption in these parts of the world; and covering the timespan, from 1975 to 2011. After employing other techniques, such as the Pooled Least Square Regression and the Random Effect methods, and having passed some tests, it was found that the Fixed Effect Regression, which expressed futility of time effect for the variables but accounted for heterogeneity among countries, was paramount at helping the researchers to specify their model; with 99% confidence level. With this model, the researchers found that the most significant impacts of the regressors emanate from FDI and liquid liability; with no statistical significance reported of the influence of relative energy prices. By and large, they deemed it necessary for appropriate measures, such as a convenient atmosphere, to be put in place to attract FDI and other financial development items. They agreed that any energy consumption model must include the above items; to uphold conservation standards, and offer precise predictions. The link found between FDI and energy consumption is akin to that of Polat (2018).

Having had some knowledge from earlier works that developed nations implement very tight environmental standards which eventually enable them to exercise cleanliness of their surroundings, Jbara (2007) decided to look into the matter, particularly, as to the reason for some nations first encountering high pollution levels, and later encountering low pollution levels. The analyst, thus, attempted to investigate the causative interdependence between the EKC and the

[5] Bangladesh, India, Nepal, Pakistan and Sri Lanka

PHH, also knowing well that the possibility of the alteration in the environment could be due to the tradeoff of dirty industries among nations. For the EKC work of the analyst, the levels of GDP per capita were obtained from 18 developed and 18 developing nations, and for three (3) distinct years; 1990, 1995 and 2000. These years were considered in order to cater for alterations in the levels of pollution (Jbara, 2007). For that matter, sulphur dioxide per 1000 square kilometers (sqkm) was employed as a measure of the distinct pollution levels of the above nations whilst considering the land area element. More importantly, the square of GDP per capita was also included in the model based on the concave nature of the EKC (Jbara, 2007). In the PHH work of the analyst, the patterns of trade for 5 particular dirty manufacturing industries from the developed regions were studied over the earlier stipulated periods. Although the effects of GDP per capita and its square on the pollution emissions met the expectations of the analyst, they were not statistically significant enough to prove the existence of the EKC. According to Jbara (2007), some (if not all) developed nations might have been associated with untidy surroundings. Still, attempting to separate the curve, so that the upward sloping part would be analyzed for the developing nations and the downward sloping part would be scrutinized for the developed nations, did not meet expectations (Jbara, 2007). Realizing that the EKC could not take its full form, and endeavouring to find out if it was due to the PHH, Jbara (2007) reported that no PHH exists for both the developed and developing nations. It was acknowledged that, probably, the use of pollution concentration to measure pollution levels could have been of greater assistance towards confirming the EKC; since pollution discharges travel to adjoining nations.

For their study on selected Association of Southeast Asian Nations (ASEAN), and covering a timespan of 35 years, thus, from 1980 to 2014, Abidin *et al.* (2015) analyzed the relationship among FDI, energy consumption, financial development and trade. In particular, using time series data, and employing the ARDL testing approach and Granger Causality Test, Abidin *et al.* (2015) specified their model by treating energy consumption as the explained variable, and FDI, financial development and trade as the explanatory variables. The intuition behind this specification was based on the parallel association energy consumption has with economic growth and development, and on the fact that works conducted on the FDI-energy consumption nexus are scanty. Abidin *et al.* (2015) found that a 1% increase in FDI, financial development and trade would boost energy consumption by 0.325%, 0.043% and 0.024%, respectively, in the long run. In terms of causation, these researchers found a unidirectional link running from FDI to energy consumption, energy consumption to financial development, and energy consumption to trade in the short run.

Considering the period from 2000 to 2014, and selecting 27 African nations, Adom *et al.* (2019) executed sample sensitivity (on the basis of catering for biased outcomes); and employed the ideal dynamic simultaneous system GMM (which was eventually preferable over the Hausman-Taylor estimator, the Fixed Effect Panel Ordinary Least Square estimator and the Two-Stage Least Square method) to ascertain if the effect of FDI on energy consumption is indeed concave, and/or treads on contrasting routes. Adom *et al.* (2019) acknowledged that, especially for panel studies, it is important to enforce non-linearity in the FDI-energy consumption relationship (predominantly, in the short run) as opposed to the commonly-used linearity presumption. In the end, these analysts found that there exists a concave effect of FDI on energy consumption in Africa; only nations with high technology absorptive capacities are able to reap the technical advantages of FDI which arise in the form of energy efficiency. The reverse is true for nations which do not possess such features; developing or low-income economies. However, these low-income economies are likely to imitate the learning experiences which are accompanied by FDI flowing into high-income economies ultimately (Adom *et al.*, 2019).

Sampling six (6) countries in Sub-Saharan Africa, Keho (2016) tested the influence of FDI and trade on energy intensity. Using yearly time series data, spanning from 1970 to 2011, and employing the Granger Causality Test and Bounds Testing Approach to Cointegration of Pesaran *et al.* (2001), the analyst found that, whereas FDI decreases the energy intensity levels for Nigeria and Benin, FDI increases the energy intensity levels for Togo and Ivory Coast. In terms of trade, Keho (2016) observed that imports for Togo, Ivory Coast and Cameroon reduce their levels of energy intensity. Furthermore, in the short run, FDI flowing into the economies of Nigeria and Ivory Coast was seen to be a crucial driver of energy intensity when considering the Granger Causality Test (Keho, 2016). Also, for Nigeria and Cameroon, the intensity level of energy was seen to be significantly contributed by imports. In terms of their long-run coefficients, thus, 0.530 and 0.410, FDI was not found to significantly increase energy intensity for the Democratic Republic of Congo and Cameroon (Keho, 2016). With the 5% level of significance serving as a yardstick against which weights are measured, Togo and Ivory Coast were observed to obtain respective test values of 2.761 and 3.131 which revealed that FDI does not only increase their energy intensity, but does so significantly. Having been observed to be featured with test values of -2.199 and -2.133 for Benin and Nigeria respectively, FDI was found to significantly decrease their energy intensity levels (Keho, 2016). Running the Granger Causality Test, in the short run, FDI flowing into the economies of Nigeria and Ivory Coast was observed to crucially drive energy intensity (Keho, 2016). The results for Togo, Cameroon, the Democratic Republic of Congo and Benin were not as these. In the long run, however, FDI and the other regressors were perceived to be contributors in increasing energy intensity for all of these six countries in Sub-Saharan Africa (Keho, 2016).

3.3.2 Country-Specific Studies

Using annual time series data, spanning from 1970 to 2016, the principal intention for Mavikela & Khobai (2018) was to examine the long-run relationship, and to ascertain the direction of causality running among FDI, energy consumption and economic growth in Argentina. In the determination of the long-run relationship, Mavikela & Khobai (2018) made use of the ARDL model approach to cointegration. Their choice of the ARDL model rested on its capacity to tackle the issue of simultaneity by including limitless number of lags for the endogenous variable and exogenous variables in any empirical work. When testing for the stationarity of variables by using such tests as Dickey Fuller Generalized Least Squares, they found that energy consumption, economic growth and capital are integrated of order one. Nevertheless, FDI was found to be integrated of order zero. In ascertaining whether there exists cointegration, they found a long-run relationship among them when using capital, economic growth and energy consumption, except for FDI, as dependent variables. Except for capital, in accordance with Mavikela & Khobai (2018), economic growth and FDI had positive correlations with energy consumption, and statistically significant effects on it; both in the long and short runs. They also reported there to be a one-way causality running from capital and FDI to energy consumption. Lastly, their finding of the link between FDI and energy consumption is in tandem with that of Polat (2018) and Alam *et al.* (2015).

In accordance with Shahbaz *et al.* (2018), for any empirical work, neglecting structural breaks could alter the exact linkages foreign direct investments, foreign portfolio investments or foreign remittances have with energy consumption. Theirs was to find out if energy consumption is delicate to foreign capital inflows (which involved the financial items mentioned early on) and currency devaluation in Pakistan. Using real GDP per capita (which depicted economic growth effect) and real exports per capita, they employed the quadratic match-sum method by converting their yearly data, thus, from 1972 to 2014, into quarterly data in order to cater for seasonal differences. The long-run relationship among variables was determined through the Bounds Testing Approach to Cointegration. In accordance with Shahbaz *et al.* (2018), in terms of correlation, foreign capital inflows and currency devaluation inversely related with energy consumption, as their coefficients were -0.1889 and -0.2188 respectively. However, economic growth and exports had positive correlations with energy consumption (Shahbaz *et al.*, 2018). These researchers also found cointegration to exist among the variables.

For any economy, such as that of Pakistan, to be developed, Ali *et al.* (2020) maintained that FDI inflows, electricity supply and electricity consumption are driving forces. They were motivated that, regardless of the insufficient and volatile flows of FDI into Pakistan due to certain national impediments, FDI would go the way in alleviating the prevalent power deficiencies through introducing the appropriate technology; out of this, the desired level of economic growth and development would be met ultimately. For Pakistan, Ali *et al.* (2020), therefore, inquired into the interrelationships among inward FDI, electricity consumption and GDP per capita; using the Vector Error Correction Model (VECM) technique and Granger Causality Test, and covering the period from 1975 to 2014. Having identified the maximum order of integration for the variables as I (1) using the ADF test (and others), and being notified by the Johansen Cointegration Test that these variables are cointegrated, Ali *et al.* (2020) reported that a unit change in FDI leads to a 0.86-unit expansion in economic growth and development; also, a unit change in electricity consumption leads to a 0.82-unit increase in economic growth and development. When it came to the matter of causation, their results indicated that bidirectional connections exist between economic development and inward FDI, and electricity consumption and inward FDI. Moreover, the Conservation Hypothesis was verified to be that which existed between economic development and electricity consumption, as a one-way causal link was seen to run from the former variable to the latter variable (Ali *et al.*, 2020). Conclusively, these researchers suggested that corruption and/or mismanagement of resources (especially) must be overcome in order to strengthen developmental linkages which resulted from their study.

Following the rampant energy crises which Pakistan has been encountering recently, Latief & Lefen (2019) found it worthwhile to examine the causal relationships among energy consumption, economic growth, and FDI in the power and energy sector of Pakistan; from 1990 to 2017. In their review of literature, Latief & Lefen (2019) found (among other things) that, when FDI affects economic growth positively, thus, through technology transfer and skills upgrading, the Modernization Theory becomes fulfilled. And when FDI opposes the progress of an economy, for instance, through market competition and deliberate efforts to withhold knowledge to local firms, the connection tends to be in agreement with the Dependency Theory (Latief & Lefen, 2019). In addition, just as Ali *et al.* (2020) studied the energy economics literature, and realized there are the Growth, the Feedback, the Neutrality and the Conservation Hypotheses which are testable for the energy consumption-economic growth linkage, Latief & Lefen (2019) discovered essentially same phenomena. Having sourced the data to use from the World Bank and the central bank of Pakistan, and engaging the analytical powers of the Johansen Cointegration Test and VECM technique, Latief & Lefen (2019) found that, at the 95% and 99% confidence levels, there is the exhibition of the Feedback Hypothesis in the short run, as economic growth and energy consumption 'granger cause' each other. There was also seen to exist a neutral causality between FDI and energy consumption, and FDI and GDP in the short run, as well as in the long run.

For some time now, the Indian economy has been characterized by expansion in the importation level of energy, particularly, that of crude oil. Whilst this has been ongoing, the local energy sector has been dormant; a situation worth of endurance if not for the constant global oil price oscillations which have tended to affect vital economic variables. Accordingly, Sharma & Kautish (2019) were of the notion that depending on locally produced electricity would be the right direction for India to take; rather than further importing crude oil. Also, having considered FDI, economic growth, among others, as proven essential factors to stimulate electricity demand within the energy economics literature in both long run and short run, these researchers were of the view that splitting the effect of each variable into its 'positive' and 'negative' changes could provide a comprehensive story. In this vein, distorted outcomes would not be provided if separate guidelines or policies to quantify the distinct variations are implemented (Sharma & Kautish, 2019). It is worth of note: they utilized the Nonlinear Autoregressive Distributed Lag (NARDL) estimation technique, and their data spanned from 1980 to 2015. Sharma & Kautish (2019) reported that, after obtaining I (1) and cointegrated variables, both favourable and unfavourable changes in GDP per capita intensify electricity demand for India in the long run. Also, a positive shock in FDI was found to increase electricity demand; a negative shock in FDI was found to decrease electricity demand in the long run as well. The above effect of the positive shock in FDI translated that an increase in FDI would do well to harness resources for expanding the electricity consumption levels of the populace, even as the surge in oil prices on the global market renders cost-inefficient production. And the impact of the negative shock in FDI confirmed the cost and environment sensitivities of FDI. The impacts of the independent variables in the short run were found not to be different from their impacts in the long run. Analysis from the Granger Causality Test showed the existence of neutral causality between FDI and electricity demand in the short run.

3.4 Chapter Summary

For the present thesis, the power sector would be desirably affected when certain strategies and alternatives to attract FDI, which generally fall under both Anti-Green and Green theories of FDI, are known and adhered to. Thus, the conviction is that possessing the qualities (potentials), which most of them have accentuated on, would be strategic to attract the flow of FDI into the Ghanaian economy; to positively affect electricity production, so that the electricity consumption level would be appropriately affected eventually. After attention is paid to ascertain the relative differences in environmental features and/or stringency levels of standards across nations, the appropriate policies to fetch FDI for Ghana would not only be implemented, but the verified known models would be crucial in guiding subsequent environmental activities in Ghana when FDI attempts to fix the current electricity quagmire in the economy. There is also the Composite Effect Theory which firmly links the attracted FDI to electricity consumption within the host economy. Moreover, the debate for FDI to either expand or contract the levels of energy and/or electricity consumption in a host nation has been ongoing. Thus, whereas it is argued by a number of researchers that FDI enhances technologies which save energy and ultimately decrease energy consumption, other schools of thought vehemently establish that FDI rather increases energy consumption through the activities of foreign organizations. To some others still, and similar to the latter above, most emerging economies (which have not gained much from industrialization) may experience slow growth in absorbing modern energy-saving technologies from the developed nations; for that matter, this could be explained using the Composite Effect Theory. In this way, different possible effects of FDI on energy consumption have tended to surface in the literature. However, this thesis discovers a main gap in the literature; some studies employ wrong proxies for FDI, energy use and concomitant pollution, but this distorts expected results and policy directions.

CHAPTER FOUR

METHODOLOGY AND DISCUSSION OF RESULTS

4.1 Introduction

This chapter generally focuses on the econometric strategy employed in examining the relationship between foreign direct investment (FDI) and electricity consumption in Ghana. Here, the theoretical framework and the empirical model of the present thesis are provided. Also, this chapter details out the description and the data source of each variable included in the empirical model. Moreover, this chapter is informative of the specific estimation technique to be used in obtaining the empirical results which are thoroughly analyzed. In addition, this chapter provides the asymmetric graph for FDI effect, performs causality test, and offers the output from defined diagnostic tests. Finally, a chapter summary is appropriately given.

4.2 Theoretical Framework

The theoretical framework for this thesis is the theory of energy demand which was advanced, in part, by Kenneth B. Medlock III at the beginning of the 21st century. In the formulation of this theory, energy was identified with socioeconomic progress; for instance, any nation whose transportation system turns out to be more convenient, essentially, owes energy a great deal of indebtedness. For this reason, the theory of the demand for energy is fortified by the fact that energy demand is a derived demand; the capacity of energy to deliver the transportation services considered above is what defines the worth of energy. Precisely, at all levels, energy demand or consumption is the outcome from concurrently deciding on the efficient capital to use and the rate of capital utilization (Medlock III, 2009). These have been claimed to be the foundations on which

FDI could affect energy demand by means of improving efficiency in specific economic sectors of any nation.

Schematically, energy resources as hydro, which forms part of Total Primary Energy Requirement (TPER), are converted into finished forms as electricity, a particulate of Total Final Consumption (TFC); so that the energy demand sectors can benefit appropriately. It is at the conversion stage, thus, where the processing and refining activities take place, the role of FDI may be played. So, given that TPER is technically greater than TFC as energy is expended, with the disparity between them being referred to as distribution or conversion losses, this could be minimized by FDI which introduces efficient technology (and effective fuel types) into an economy. This is communicated through the energy accounting process and/or by the energy balance tables.

Algebraically, the impact of FDI on energy demand can be realized within the capital-energy consumption link. As said earlier, energy consumption is dependent on energy-efficient capital (and the operation scale), as well as the rate of capital utilization; so, it can be expressed as:

$$E = \frac{u}{\varepsilon} K \qquad (1)$$

where E, u, ε and K represent energy consumption (energy demand or energy use), rate of capital utilization, energy efficiency of capital, and capital stock respectively (Medlock III, 2009). The underlying assumption for the above is that it pertains to a particular capital equipment. Theoretically, an analogy can be said to exist for the above equation, especially as energy (output) ≡ energy (input). This analogy is buttressed by the scenario of vehicle fuel consumption; if the expressions for efficiency, utilization of capital, and capital stock units are kilometres per litre, kilometres per vehicle, and number of vehicles respectively, then litres (vehicle fuel consumption) ≡ [(kilometres/vehicle)/(kilometres/litre)] · vehicles. To be precise, the left-hand side of the identity (litres) is the energy output which results from the energy input at the right-hand side of the identity. More importantly, the energy output can be fully experienced through the services the vehicle renders, in the form of distances covered or in kilometres, and this can be seen in the readjustment of the above identity. This is the reason for referring to energy demand as a derived demand (the amount of vehicle fuel consumption required to attain a desired level of transportation).

Computation: -

$$litres = \left(\frac{\frac{kilometres}{vehicle}}{\frac{kilometres}{litre}}\right) \cdot \text{vehicles}$$

Caveat: - vehicle = vehicles & litre = litres

Dividing through by vehicles,

$$\frac{litres}{vehicles} = \frac{\left(\frac{\frac{kilometres}{vehicle}}{\frac{kilometres}{litre}}\right) \cdot \text{vehicles}}{vehicles}$$

$$\frac{litres}{vehicles} = \frac{kilometres}{vehicle} \div \frac{kilometres}{litre}$$

Now,

$$\left(\frac{litres}{vehicles} \times \frac{kilometres}{litre}\right) = \frac{kilometres}{vehicle}$$

Multiplying through by vehicle,

$$vehicle \cdot \left(\frac{litres}{vehicles}\right) \cdot \left(\frac{kilometres}{litre}\right) \equiv kilometres$$

Clearly, the energy efficiency component is the ratio of kilometres to litre, and implicitly, the capacity for capital utilization is the ratio of kilometres to vehicle(s). Therefore, for policy purposes, irrespective of either considering the energy consumption equation or the extended version of it, in terms of the transportation services rendered, the energy efficiency component must be as high as possible to be able to counterbalance any expansion in the number of capital stocks or vehicles, as well as any increase in the rate of capital utilization. Energy consumption (fuel consumption), thus, would be lessened, and/or great distances can be covered by the vehicle.

All of these tend to be observed at the macro level, where energy intensity, which is measured as the ratio of energy demand to output, is known to be inversely (negatively) related to economic development or GDP per capita in the long run; but positively related to industrial proportion of GDP over time (Medlock III, 2009). The favourable technological wind facilitates this economic spectacle. The tertiary sector, thus, will require the least input of energy to produce its output relative to the other sectors of the economy. In fact, these are what the Composite Effect and Dematerialization theories predict, where the latter theory is, in accordance with Bernardini & Galli (1993), explained as the eventual decline of energy and other raw material intensities of economic activities. The Dematerialization Theory also envisages that, if two nations are to be considered and one of them progresses at a faster rate than the other, the energy intensity of the nation which progresses faster will be observed to reach its peak before that of the other nation; and the peak for the nation which develops relatively slowly may be due to technological spillovers from the fast-developing nation (Medlock III, 2009). It means, therefore, that the energy intensity peak for the slow-developing nation would be lower than that for the fast-developing nation. To appreciate more of the usefulness of technology in alleviating energy consumption and/or energy intensity, the influence of the shift in economic structure on energy consumption and/or energy intensity may be first considered. So, given three economic sectors, A, B and C, whose energy consumption and output levels are E_A, E_B, E_C and Y_A, Y_B, Y_C respectively, the aggregate energy consumption can be represented as $E = E_A + E_B + E_C$, and the aggregate output can be signified as $Y = Y_A + Y_B + Y_C$. The aggregate energy intensity is then expressed as:

$$\frac{E}{Y} = \frac{E_A + E_B + E_C}{Y} \quad ; \quad \frac{E}{Y} = \frac{E_A}{Y_A} \cdot \frac{Y_A}{Y} + \frac{E_B}{Y_B} \cdot \frac{Y_B}{Y} + \frac{E_C}{Y_C} \cdot \frac{Y_C}{Y}$$

$$\frac{E}{Y} = \frac{E_A}{Y_A} \cdot \theta_A + \frac{E_B}{Y_B} \cdot \theta_B + \frac{E_C}{Y_C} \cdot \theta_C \qquad (2)$$

where θ_A, θ_B and θ_C are the proportions of each economic sector with respect to the aggregate output, and their summation amounts to 1 (Medlock III, 2009). Attaching an ordinal pattern to the energy intensities of each economic sector, it can be presumed that:

$$\frac{E_C}{Y_C} < \frac{E_A}{Y_A} < \frac{E_B}{Y_B}$$

From the above, differentiating the aggregate energy intensity with regard to the output share of Sector B demonstrates that the aggregate energy intensity can surge when Sector B grows quicker than Sector C; with a constant output share of Sector A. Thus,

$$\frac{\partial(\frac{E}{Y})}{\partial\theta_B} = \left(\frac{E_C}{Y_C} \cdot \frac{\partial\theta_C}{\partial\theta_B} + \frac{E_A}{Y_A} \cdot \frac{\partial\theta_A}{\partial\theta_B}\right) + \frac{E_B}{Y_B} > 0 \qquad (3)$$

Likewise, growth in Sector C, which is characterized by a relatively low energy intensity, should lead to a fall in aggregate energy intensity. Now, as stated earlier, the influence of technology can be more vividly seen through the combination of the energy-capital relationship and the impact of structural changes on energy demand in the economy. Simultaneously, Equations (1) and (2) yield:

$$\frac{E}{Y} = \frac{(u_A/\varepsilon_A) \cdot K_A}{Y_A} \cdot \theta_A + \frac{(u_B/\varepsilon_B) \cdot K_B}{Y_B} \cdot \theta_B + \frac{(u_C/\varepsilon_C) \cdot K_C}{Y_C} \cdot \theta_C \qquad (4)$$

Taking the derivative of Equation (4) with respect to energy efficiency within each sector shows that the implementation of modern technology will not only decrease the energy intensity of each sector, but will also decrease the aggregate energy intensity. For Sector C, for instance;

$$\frac{\partial(\frac{E}{Y})}{\partial\varepsilon_C} = -\frac{\left(\frac{u_C}{\varepsilon_C{}^2}\right) \cdot K_C}{Y_C} \cdot \theta_C < 0 \qquad (5)$$

Remarkably, the influence of technology will be at its greatest when it hits the economic sector which possesses the largest share of aggregate output. If Equation (5) is to be differentiated further, a positive result will ensue. The interpretation for this should be that: the declining effect on energy intensity is growing with the modernization which is associated with technology. As paradoxical as the above may seem, the intuition behind this is that: there is very likely to be the ripple effect of convenient technology emanating from, for instance, Sector C of the economy, to lower the energy intensity of another economy which is actually less developed. However, the discussion between energy intensity and energy efficiency must be treated with caution (Medlock III, 2009). The energy intensities between two nations could be compared, but this does not essentially imply that the nation with less energy intensity may have the higher energy efficiency level. The distinct economic structures of both nations should be duly considered. When one nation specializes in energy-intensive production, and the other nation concentrates to produce commodities which are not energy-intensive, they could efficiently trade off their goods and services between themselves; they may use this mutually advantageous strategy to adopt advanced technologies which optimize their individual energy efficiency levels. To some extent, the study of energy efficiency can be done for a particular nation when its varied economic sectors are comparatively scrutinized.

Furthermore, the investment behaviour or choice, which is appropriate to capture the long-run and short-run reactions of energy consumption to economic variations, can be analyzed from the perspective of either a dynamic or static framework of the firm or household (consumer), though the dynamic sort may be superior (Medlock III, 2009). Either ways, it is presumed that energy is a single commodity, so that certain complexities, such as observing crude oil prices in electricity demand model, may be avoided for the economic agent. Taking the static model of the firm into consideration, it must be of interest for such a firm to minimize costs subject to a level of output, as well as the energy consumption-capital identity of Equation (1). Thus, the objective function becomes $C = rK + wL + p_E E + p_M M$, where C, r, K, w, L, p_E, E, p_M and M denote costs, rent for capital, capital, wage for labour, labour, energy price, energy, materials price and materials respectively. And the constraints turn out to be $Q = f(K, L, E, M)$ and $E = \frac{u}{\varepsilon}K$, where the items in the brackets are the factors of production. The problem of the firm can be reorganized as:

$$\min_{K,L,M,u,\varepsilon} \left(r + p_E \frac{u}{\varepsilon}\right)K + wL + p_M M + \varphi\varepsilon + \vartheta\left[\boldsymbol{Q} - f\left(K, L, \frac{u}{\varepsilon}K, M\right)\right]$$

Consequently, the optimal demand for energy by the firm in the long run becomes dependent on the factor prices and output, and this is shown as:

$$E^{*} = E(\boldsymbol{Q}, r, w, p_E, p_M) \qquad (6)$$

Thus, for this model in the long run, capital and technology are considered to vary, so it is not expected of them to be explicitly seen within the function. The short-run static model of the firm is implicitly inclusive of capital and technology which are fixed, as they are represented by the varying energy cost of utilization, $p_E(u/\varepsilon)$, within the complete cost of capital. This is given as:

$$E^{SR*} = E(\boldsymbol{Q}, w, p_E, p_M, \boldsymbol{K}, \varepsilon) \qquad (7)$$

The dynamic energy demand framework integrates the intertemporal decisions which, for instance, the household makes across time when faced with an economic problem, and in this case, that of utility maximization. In this way, the transitioning process from the short run to the long run is well captured in this model for the consumer of energy who purchases and maintains energy-using capital equipment (Medlock III, 2009). The household aims to optimize the discounted present value of lifetime utility, thus, $\sum_{t=0}^{T} \beta^t U(C_t, E_t)$, subject to its income of the current period, and its savings of the previous period, thus, $p_{C,t}C_t + p_{E,t}E_t + p_{K,t}I_t + S_t \leq Y_t + (1 + r)S_{t-1}$. Here, the consumer smoothens his entire income over his lifetime in order to purchase energy and others; so that certain services can be met. These and the energy consumption-capital relationship, as well as the component of the investment function, $I_t = K_t - (1-\delta)K_{t-1}$, are binding on the household or consumer. The first-order condition for this optimization becomes:

$$U_K \frac{u_t^*}{\mathcal{E}_t} = U_Z \left[p_{E,t} \frac{u_t^*}{\mathcal{E}_t} + p_{K,t} - p_{K,t+1}\left(\frac{1-\delta}{1+r}\right)\right] \quad (8)$$

where the terms within the brackets are collectively known as the 'user cost of the capital stock'. It is an optimal decision for the household or consumer to choose capital utilization (u_t^*) in this regard. When the value for this component is 0, the remaining terms tend to be collectively known as the 'rental price of capital'. Besides capital utilization, it is optimum for the consumer to also choose the levels of capital stock, K_t^*, and efficiency, $\mathcal{E}_t$. Eventually, it becomes imperative for the consumer to demand for energy which tends to be contingent on income, price of energy, rental price of capital, and energy efficiency (Medlock III, 2009).

Therefore,

$$E_t^* = E(Y_t, p_{Z,t}, p_{E,t}, p_{R,t}, \mathcal{E}_t) \quad (9)$$

The significance of the dynamic framework can be sought largely when there is the imposition of tax, allowing energy prices to rise. The complete reaction of improved efficiency may become expensive, leading to a fall in the utilization of capital stock and economic activities. So, in order to lessen the impacts of the fallen capital utilization in the short run, more energy-efficient technologies may be promoted through subsidies; and this may be suggested especially when the normal adjustment period for the consumer is adequately long (Medlock III, 2009).

Conclusively, the efficiency element is how the theory of energy demand by Medlock III (2009) serves as the theoretical framework for the relationship between FDI and electricity consumption.

4.3 Empirical Model

The empirical model of this thesis is derived from the theoretical framework given above. It is evident that achieving the electricity needs of the Ghanaian populace is essential in stimulating economic growth and development sustainably. Therefore, it is imperative that policies be directed to ensure the stability of the Ghanaian electricity consumption; and this thesis finds inspiration that the effect of FDI could be assessed, through the Nonlinear Autoregressive Distributed Lag (NARDL) model, to demonstrate that such a vital instrument would indeed manage electricity consumption and introduce efficiency into the power sector (and/or economy). On this note, this thesis aims to express the asymmetric nature which the effect of FDI on electricity consumption may have in both long and short runs. It means that the degree of influence of FDI on electricity consumption may not be equal when comparing the positive cumulative sum of changes in FDI with the negative cumulative sum of changes in FDI. By and large, this is essential to undertake; as it helps in ascertaining, among others, the extent to which appropriate policies may handle any probable cost sensitivities of FDI. Therefore, will the difference between the coefficients of positive and negative changes concerning FDI be statistically significant? If it is ascertained that the degree of influence of FDI on electricity consumption is not equal on both paths of the change in each period, it should be conclusive that the influence is asymmetric.

Taking into consideration the asymmetric stance in the FDI-electricity consumption nexus within the model, or dealing with the presumption of symmetric relationships in the presence of statistically significant asymmetry, aids in rendering specification unbiasedness (Alkhateeb & Mahmood, 2019; Mahmood & Alkhateeb, 2018; Mahmood *et al.*, 2018; Siddiqui *et al.*, 2019); it is, therefore, prudent to utilize the NARDL model, which is the appropriate asymmetric tool, as opposed to the conventional Autoregressive Distributed Lag (ARDL) estimation technique.

The possible existence of asymmetry, thus, can be first examined through the general empirical model, as stated in Equation (10), which is based on the study by Sharma & Kautish (2019); these researchers particularly used electricity consumption, unlike the broad use of energy consumption by other studies.

Therefore, the general empirical model becomes:

$$\boldsymbol{EC_t = f(FDI_t, TR_t, GDP_t, INF_t)} \quad (10)$$

where EC stands for 'total electricity net consumption in billion kilowatthours', FDI is 'net foreign direct investment inflows as a share of GDP', TR is 'trade as a share of GDP', GDP is 'per capita GDP in constant 2010 US$' and INF is 'inflation (consumer prices) in annual percentages'. The subscript 't' refers to 'time'; and 'f' implies 'the function of'.

Specifically, the above empirical model takes the form of the NARDL model inspired by Shin *et al.* (2014):

$$EC_t = \gamma_0 + \alpha_T T + \gamma_1 FDI_t{}^{+} + \gamma_2 FDI_t^{-} + \gamma_3 TR_t^{+} + \gamma_4 TR_t^{-} + \gamma_5 lnGDP_t^{+} + \gamma_6 lnGDP_t^{-} + \gamma_7 lnINF_t^{+} + \gamma_8 lnINF_t^{-} + \mu_t \quad (11)$$

where the regressors, which FDI and the others are, become decomposed into their positive and negative partial sums. The term, $\alpha_T T$, relates to Restricted Trend. The variables above are also subjected to normality test; the ones which are not normally distributed undergo natural logarithmic transformation. This will be expounded under the descriptive statistics of variables segment. To some degree, it is imperative for this to be done; for the purpose of inhibiting heteroskedasticity (Tursoy & Faisal, 2016). That would not only eliminate the variations in time series data, but it would also provide reliable and suitable results (Tursoy & Faisal, 2016). In addition, the newly contrived variables in Equation (11), prior to their natural logarithmic transformations, have been technically defined as:

$$FDI_t^+ = \sum_{i=1}^{t} \Delta FDI_i^+ = \sum_{i=1}^{t} max(\Delta FDI_i, 0) \qquad (12)$$

$$FDI_t^- = \sum_{i=1}^{t} \Delta FDI_i^- = \sum_{i=1}^{t} min(\Delta FDI_i, 0) \qquad (13)$$

where Equations (12) and (13) represent the positive and negative changes in FDI_t respectively. For simplicity, it is worth noting: these definitions also apply to the other regressors. Finally, the NARDL model for which Equation (11) must be modified into, towards testing for cointegration, is provided as follows (where the symbols and alphabets denote their usual meanings):

$$\Delta EC_t = \varphi_0 + \alpha_T T + \delta_{EC} EC_{t-1} + \delta_{FDI}{}^{+} FDI_{t-1}{}^{+} + \delta_{FDI}{}^{-} FDI_{t-1}{}^{-} + \delta_{TR}{}^{+} TR_{t-1}{}^{+} + \delta_{TR}{}^{-} TR_{t-1}{}^{-} + \delta_{GDP}{}^{+} lnGDP_{t-1}{}^{+} + \delta_{GDP}{}^{-} lnGDP_{t-1}{}^{-} + \delta_{INF}{}^{+} lnINF_{t-1}{}^{+} + \delta_{INF}{}^{-} lnINF_{t-1}{}^{-} + \sum_{a=1}^{m} \mu_a \Delta EC_{t-a} + \sum_{b=0}^{n} \mu_b{}^{+} \Delta FDI_{t-b}{}^{+} + \sum_{c=0}^{o} \mu_c{}^{-} \Delta FDI_{t-c}{}^{-} + \sum_{d=0}^{p} \mu_d{}^{+} \Delta TR_{t-d}{}^{+} + \sum_{e=0}^{q} \mu_e{}^{-} \Delta TR_{t-e}{}^{-} + \sum_{f=0}^{r} \mu_f{}^{+} \Delta lnGDP_{t-f}{}^{+} + \sum_{g=0}^{s} \mu_g{}^{-} \Delta lnGDP_{t-g}{}^{-} + \sum_{h=0}^{t} \mu_h{}^{+} \Delta lnINF_{t-h}{}^{+} + \sum_{i=0}^{u} \mu_i{}^{-} \Delta lnINF_{t-i}{}^{-} + \varepsilon_t \qquad (14)$$

4.4 Description of Variables and Data Source

This segment of the chapter entails the explanations of variables which are provided by and/or in consistence with the metadata of the World Development Indicators (WDI) online database of the World Bank (2020), from which most variables for this thesis have been sourced, and the US

Energy Information Administration (2020). The selection of the variables, is propelled by theoretical economic constructions and extant empirical works, of which some will be attached to the individual explanation of variables. Moreover, the selection of the timeframe for this thesis (pertaining to Ghana) is contingent on the availability of data; an annual sort which ranges from 1980 to 2018. The important variables included in the empirical model are hereby explained:

Electricity Consumption: - Electricity (Net) Consumption, being one of the main variables for the empirical work, computationally alludes to the generation of electricity, together with its imports, and with the exception of its exports as well as transmission and distribution losses (US Energy Information Administration, 2020). By and large, it is expected that electricity generated equally amounts to electricity finally consumed.

Foreign Direct Investment (FDI): - Foreign Direct Investment, being the other principal variable for the empirical work, refers to the bundle of equity capital, retained profits which require reinvestment, and other long term capital as well as short-term capital which are prevalent in the balance of payment account (World Bank, 2020). With support from UNCTAD and IMF, the World Bank (2020) also posits that the internationally acknowledged definition of FDI entails equity investment (also, investment involved with equity which gives rise to control), investment in indirectly controlled establishments such as manufacturing facilities, fellow-enterprise investment, debt (excluding selected debt), and reverse investment. For the sake of simplicity, the transmission mechanism through which FDI affects electricity consumption can be illustrated by the Composite Effect Theory which has earlier been reviewed. In terms of the inclusion of FDI as an important variable within the electricity consumption specification model, the present thesis follows works of Sharma & Kautish (2019), Adom *et al.* (2019), Omri & Kahouli (2014) and Alam *et al.* (2015).

Trade: - Trade, being a control variable for the empirical work, refers to the ratio of exports and imports of goods and services to GDP; for that matter, this series is measured as a percentage of GDP (World Bank, 2020). Trade, in this case, is not different from trade openness. The transmission mechanism for trade to affect electricity consumption begins with the intuition behind trade, thus, it consists of the movement of goods produced in a nation into another nation (and vice-versa); for either consumption sake or to further production. With the latter actually depicting the essence of a resource, production in this new abode then requires energy, so that the finished good gets to the final consumer ultimately. This is the reason for which Shahbaz *et al.* (2014) asserted that trade facilitates domestic production. Unlike this positive relationship, sometimes trade could negatively affect electricity consumption when the economic status of the recipient country is harsh, and this is the reason for Shahbaz *et al.* (2014) to have mentioned that the economic condition of a nation is relevant in deciding the connection between trade and (any) energy consumption. Considering the inclusion of trade as an important variable within the electricity consumption specification model, the present thesis adopts the studies of Keho (2016), Abdouli & Hammami (2017) and Muhammad *et al.* (2012).

GDP per capita: - Another control variable for the empirical work is Gross Domestic Product (GDP) per capita. It refers to the computation where the GDP of a nation is divided by the population in that nation (World Bank, 2020). The transmission mechanism is highlighted as follows: due to the fact that high real income leads to high utilization of electricity-consuming gadgets at homes and workplaces, in accordance with Adom & Bekoe (2013), and for the fact that real income is equivalent to GDP per capita (as both determine the standard of living), then GDP per capita increases electricity consumption. The negative relationship steps in when real income is high enough to afford highly energy-efficient devices. By and large, this mechanism is corroborated by the Composite Effect Theory. So, both positive and negative effects can be expected. In terms of the involvement of GDP per capita as an important variable within the electricity demand specification model, the present thesis follows the works of Aliyu (2005), Mavikela & Khobai (2018), Alkhateeb & Mahmood (2019) and Sadorsky (2011).

Inflation: - Inflation is another control variable the present thesis will make use of. According to World Bank (2020), it can be obtained from the Consumer Price Index (CPI). Thus, it stems from the yearly percentage change of a fixed basket (or altered at specific intervals) of the consumer. As inflation is a price measure, and price varies inversely with demand (*ceteris paribus*), then it follows that inflation should be expected to negatively affect electricity demand or consumption. Taking into consideration the inclusion of inflation as an important variable within the electricity demand specification model, the present thesis adopts the works of Sadorsky (2011), Omri & Kahouli (2014), Adom *et al.* (2019) and Polat (2018).

Table 4.1 summarizes the regressors in terms of their indicator names and their signs of expectation based on the literature.

Table 4.1: Compendium of Regressors: - Their Indicator Names and their Signs of Expectation

Variable	Indicator Name	Expected Sign
Foreign Direct Investment	Foreign Direct Investment, net inflows (% of GDP)	Positive/Negative
Trade	Trade (% of GDP)	Positive/Negative
GDP per capita	GDP per capita (constant 2010 US$)	Positive/Negative
Inflation	Inflation, consumer prices (annual %)	Negative

Source: The compilation of author based on the literature

4.5 Estimation Technique

Firstly, this thesis employs time series data, spanning from 1980 to 2018 annually, which is then analyzed by utilizing the Nonlinear Autoregressive Distributed Lag (NARDL) model. This model is also referred to as the Unrestricted Error Correction Model or the Asymmetric Error Correction Model, since it separates the reactions of electricity consumption into positive and negative changes in the regressors (decomposition). At the right-hand side of Equation (14) which was earlier stated, the 3rd to 11th terms are actually the long-run terms (with no lags) of the model, and the 12th to 20th terms are the short-run terms (including any possible lags) of the model.

Just as with the ARDL Bounds Testing Approach to Cointegration, the NARDL Bounds Testing Approach to Cointegration could as well be the joint test of lagged one-period levels of the decomposed FDI and the other explanatory variables, as well as electricity consumption in the model. In the cointegration process, and accorded to Pesaran *et al.* (2001), the F-test value will be compared with the I (0) and I (1) critical values, or the lower-bound and the upper-bound values; mostly, at the 5% level of significance. Through this test, one of three decisions is likely to be taken; based on the null hypothesis. The first decision is failing to reject the null hypothesis of no cointegration if the F-test value lies beneath the I (0) critical value or the lower-bound value; which is an implication for the absence of a long-run relationship among variables (Pesaran *et al.*, 2001). The second renders inconclusive output. Here, put in a fix, one cannot know if to reject or fail to reject the null hypothesis when the F-test value lies between the lower-bound and upper-bound values. The third decision is rejecting the null hypothesis of no cointegration (should the F-test value lie above the I (1) critical value or the upper-bound value) which is an implication for the presence of a long-run relationship among variables. In this way, variables are said not to move away from one another. To a large extent, and in accordance with Inder (1993), this cointegration step is necessary towards the presentation of unbiased estimates of the long-run coefficients; even in the face of endogenous explanatory variables. Having highlighted on this important phase in estimations, below are the respective key null and alternative hypotheses for the present thesis:

$$H_0\colon \delta_{EC} = \delta_{FDI}{}^{+} = \delta_{FDI}{}^{-} \text{ (No Cointegration)} \qquad (15)$$

$$H_1\colon \delta_{EC} \neq \delta_{FDI}{}^{+} \neq \delta_{FDI}{}^{-} \text{ (Cointegration)} \qquad (16)$$

For the purpose of simplification, it is important to state that the appropriate hypotheses for the coefficients of the other variables have not been given; however, their hypotheses for the present thesis should follow the above usual format. Again, it must be clear that, if the null hypothesis of no cointegration is rejected in favour of the alternative hypothesis, it implies that the variables are cointegrated in the presence of asymmetry. Computationally, the NARDL long-run levels coefficients of asymmetry are obtained from the ratio of the negative of $\delta_{FDI}{}^{+}$ to δ_{EC}, and from the ratio of the negative of $\delta_{FDI}{}^{-}$ to δ_{EC}. If a long-run connection exists, which is contingent on the Bounds Testing Approach to Cointegration, then there is the need to test if the difference in the coefficients of asymmetry is statistically significant. Below are the null and alternative hypotheses for this:

$$H_0\colon \frac{-\delta_{FDI}{}^{+}}{\delta_{EC}} = \frac{-\delta_{FDI}{}^{-}}{\delta_{EC}} \text{ (Symmetry)} \qquad (17)$$

$$H_1\colon \frac{-\delta_{FDI}{}^{+}}{\delta_{EC}} \neq \frac{-\delta_{FDI}{}^{-}}{\delta_{EC}} \text{ (Asymmetry)} \qquad (18)$$

If the null hypothesis of symmetry is rejected in favour of the alternative hypothesis, it implies that there is long-run asymmetry (Shin *et al.*, 2014). Additionally, this thesis will present the Asymmetric Dynamic Multiplier Graph of FDI. This should show the pattern in which electricity consumption will adjust to its new long-run equilibrium after experiencing a positive shock or a negative shock in FDI (technically, this also applies to the other variables). The Cumulative Dynamic Multiplier Effects of FDI_t^+ and FDI_t^- on EC_t, for instance, are computed as:

$$m_h^+ = \sum_{i=0}^{h} \frac{\partial EC_{t+i}}{\partial FDI_t^+} \qquad (19)$$

$$m_h^- = \sum_{i=0}^{h} \frac{\partial EC_{t+i}}{\partial FDI_t^-} \qquad (20)$$

where h assumes infinite figures. If $h \rightarrow \infty$, then $m_h^+ \rightarrow \frac{-\delta_{FDI}{}^+}{\delta_{EC}}$ and $m_h^- \rightarrow \frac{-\delta_{FDI}{}^-}{\delta_{EC}}$. Furthermore, multiple causality checks using the Pairwise Granger Causality Test will be performed under this thesis. Here, in accordance with Gujarati & Porter (2009), causality could mean any of the following (among others) when, for instance, considering FDI and electricity consumption. Thus, FDI is a probabilistic cause of electricity consumption, FDI should occur either prior to or simultaneously with electricity consumption (but not afterwards), and past values of FDI predict future values of electricity consumption. The present thesis, accordingly, will be able to examine the short-run causal effects through the Pairwise Granger Causality Test (Gujarati & Porter, 2009). As a matter of fact, to an extent, the short-run causal effects for the present thesis can be analyzed through the t-statistics of the explanatory variables. Thus, if by this mode, the coefficients of the variables are found to be statistically significant, causality may be inferred. It also means to reject the null hypothesis if the prob-value is equal to or less than the prevalently-used 5% level of significance. These modes should serve as robustness checks for one another when attempting to find out if there exists unidirectional causality, bidirectional causality or independence among variables. By principle, the long-run causal effect may be inferred from the t-test value of the error correction term. Finally, the statistical software package to be used for the analysis of this thesis is EViews 10.

4.6 Diagnostic Tests

Some diagnostic tests, specifically, residual and stability tests, will be undertaken for the empirical model of this thesis. These tests are the heteroskedasticity test, the autocorrelation or serial correlation test, the normality test, the CUSUM test and the CUSUM Squares test. Here are some of the issues for which these tests were created:

Heteroskedasticity: - Heteroskedasticity refers to errors whose variances are not constant, this being in accordance with Gujarati & Porter (2009) and Mankiw (1990). This is an issue which arises following the violation of the assumption of the Ordinary Least Squares (OLS) method. Its notation, given as $var\ (u_i) = \sigma_i^2$, where 'i' signifies the unequal individual variances, is opposed to that of homoskedasticity which is represented as $var\ (u) = \sigma^2$. This issue may be caused, among others, by wrong data transformation, wrong model specification, the fact that one or more explanatory variables are not normally distributed, and poor data sampling method. All of these may eventually lead to Type 1 error where the null hypothesis, when true, may be rejected. Other consequences may also be found. Detecting heteroskedasticity may be done informally through the use of graphs. Formally, and much for this thesis, the Breusch-Pagan-Godfrey Heteroskedasticity Test will be used in detecting heteroskedasticity. If the Prob. F value is less than the 5% level of significance, the decision will be to reject the null hypothesis of homoskedasticity, and accordingly, certain measures such as the Generalized Least Squares or the Weighted Least Squares may be used to resolve the issue of heteroskedasticity; otherwise, the model is homoskedastic if the null hypothesis is not rejected (Gujarati & Porter, 2009).

Autocorrelation: - One assumption of the OLS method is that the successive values of the random term (u) are temporally independent, this being in accordance with Koutsoyiannis (1977), Gujarati

& Porter (2009), Mankiw (1990) and Asteriou & Hall (2007). The violation of this brings about autocorrelation. Its notation is given as $cov\,(u_i, u_j) \neq 0$, where 'i' and 'j' represent different periods. This issue may arise due to wrong specification of the model, interpolations in the statistical observations, omitted variable bias, and other factors (Asteriou & Hall, 2007). Generally, autocorrelation may yield inefficient estimates (Mankiw, 1990; Gujarati & Porter, 2009). Furthermore, this issue can be detected through certain econometric tests such as the traditional Von Neumann Ratio and the Durbin-Watson Test. However, the present thesis will utilize the Breusch-Godfrey Serial Correlation Test in this regard. The usual decision criterion is applied here as well.

4.7 Descriptive Statistics

The descriptive statistics of the variables (inclusive of their individual normality test which should lead to the decision as to whether to or not to transform the variables for the present thesis by natural logarithm), covering the period from 1980 to 2018, are given in Table 4.2.

Table 4.2: Descriptive Statistics of Variables, 1980 to 2018

Variable	Skewness	Kurtosis	Prob (Jarque-Bera)	Mean	Median	Standard deviation	Maximum	Minimum
Electricity Consumption	0.08	2.87	0.965	5.805	5.71	1.86	9.271	1.59
Foreign Direct Investment	0.793	2.304	0.088	2.964	1.73	2.959	9.467	0.045
Trade	-0.282	2.381	0.565	62.688	65.921	28.382	116.048	6.32
GDP per Capita	0.974	2.606	0.04	1066.954	941.591	325.536	1,808.327	693.949
Inflation	2.615	10.043	0.000	26.769	18.031	25.335	122.875	0.407

Source: The computation of author using EViews 10

From Table 4.2, it can be observed that the only variable which is negatively skewed is trade; since its skewness value is -0.282. It implies that the long left tail is the skewness or asymmetric design for this variable; most values of trade are clustered around the right tail of the distribution whilst the left tail of the distribution is longer. The reverse is true in the case of electricity consumption, FDI, GDP per capita and inflation which are all positively skewed; since they have skewness values of 0.08, 0.793, 0.974 and 2.615 respectively. The skewness or asymmetric design for these variables is the long right tail. Thus, none of the variables have a normal skewness. Furthermore, with the exception of inflation which is leptokurtic or whose distribution is peaked, the rest are platykurtic or flat in terms of the degree of sharpness. This is because, inflation has a kurtosis value of more than 3; and electricity consumption, FDI, trade and GDP per capita have kurtosis values of less than 3. The prob (Jarque-Bera) value best informs if a variable is normally distributed or not; when it is greater than the 5% level of significance, the decision is to fail to reject the null hypothesis. This means that the distribution of the variable is normal. The reverse is true in the case of the rejection of the null hypothesis. So, from Table 4.2, it stands that the variables which are normally distributed are electricity consumption, FDI and trade, since they have values of 0.965, 0.088 and 0.565; and the variables which are not normally distributed are GDP per capita and inflation, since they have values of 0.04 and 0.000. It implies that there may be outliers among the values of GDP per capita and inflation which are not normally distributed. Therefore, it becomes imperative to conform to the natural logarithmic transformations of GDP per capita and inflation.

The average values for electricity consumption, FDI, trade, GDP per capita and inflation, from 1980 to 2018, are 5.805, 2.964, 62.688, 1066.954 and 26.769 respectively. Besides this measure of central tendency for these variables, their respective standard deviations are 1.86, 2.959, 28.382, 325.536 and 25.335; the standard deviations measure the spread of the data distribution of each variable. The range (a measure of dispersion which is obtained from the difference of the maximum and minimum values) for electricity consumption is 7.681. That for FDI is 9.422. Trade, GDP per capita and inflation have ranges of 109.728, 1,114.378 and 122.468 respectively. The medians for each variable, as seen from Table 4.2, are descriptive of the middle values in the individual datasets when put in ascending order.

4.8 Estimation Results and Analyses

4.8.1 Unit Root Tests

Prior to running the regression for the empirical model, and in accordance with Gujarati & Porter (2009), it is imperative to perform some stationarity tests. This is done to have knowledge on the order of integration for each variable, and more importantly, to know the appropriate estimation technique to be employed. Again, as a prerequisite to obtain estimation results, this step is necessary to avoid spurious regression; or the R-Squared (R^2) should not be greater than the Durbin-Watson test value (Gujarati & Porter, 2009). There are other tests, such as the Kwiatkowski-Phillips-Schmidt-Shin Test, the Dickey-Fuller GLS (ERS) Test, however, the present thesis simply utilizes the Augmented Dickey Fuller (ADF) Test and the Phillips-Perron (PP) Test in testing against unit roots, and this is shown in Table 4.3. It is worth of knowledge that the variables are tested in their raw forms and transformed forms where required. Given the null hypothesis of the presence of unit roots, the decision is to either reject the null hypothesis if the relevant level of significance is greater than the prob-value for the variable under the unit root tests, or to fail to reject the null hypothesis if the relevant level of significance is less than the prob-value for the variable under these tests.

Table 4.3: Unit Root Test Results

Level (Trend and Intercept)		
Variable	**ADF Test (Prob-Value)**	**PP Test (Prob-value)**
Electricity Consumption	0.3324	0.2834
FDI	0.2141	0.3818
Trade	0.8013	0.8013
lnGDP per capita	0.2571	0.0841*
lnInflation	0.0035***	0.2510
1st Difference (Trend and Intercept)		
Variable	**ADF Test (Prob-Value)**	**PP Test (Prob-value)**
Electricity Consumption	0.0029***	0.0000***
FDI	0.0016***	0.0022***
Trade	0.0000***	0.0000***
lnGDP per capita	0.0291**	0.0533*
lnInflation	0.0374**	0.0000***

NB: *, ** and * denote 10%, 5% and 1% levels of significance respectively**

Source: The computation of author using EViews 10

From Table 4.3, except for the log of inflation which is stationary at level (with the trend and intercept specification), and in accordance with the Augmented Dickey Fuller (ADF) Test, it can be observed that all of the other variables are not stationary at level; these variables become stationary at 1st difference. Due to the fact that electricity consumption, FDI, trade and the log of GDP per capita become stationary at 1st difference, the order of integration for them is I (1) when utilizing the ADF Test. Using the Phillips-Perron (PP) Test, except for the rest of the variables, the log of GDP per capita is stationary at level; allowing its order of integration to be I (0). It also follows that the order of integration for the log of inflation is I (0) using the ADF Test, but I (1) using the PP Test. However, the outcomes of either tests illustrate that these variables are convenient for assessment under the NARDL model; since no variable has the I (2) order of integration.

4.8.2 Nonlinear Autoregressive Distributed Lag (NARDL) Regression Output and Analysis

4.8.2.1 Bounds Testing Approach to Cointegration (NARDL model) and R^2

Having observed that the ratio of the maximum lag structures concerning electricity consumption, FDI, trade, the log of GDP per capita and the log of inflation is determined as 3:1:1:2:1 respectively, and that of the model is ultimately obtained as (3,2,2,2,2,2,2,2,2) according to the Akaike Information Criterion, it is found that there happens to be cointegration among the variables. This is because, analyzing the F-Bounds Test, the F-statistic value of 3.65 is higher than the higher-bound value of 3.41 at the 5% level of significance. Thus, it implies that the variables move together in the long run. Table 4.4 illustrates the cointegration output.

Furthermore, the reversion to long-run equilibrium is at an adjustment speed of 150%. In other words, given the significant coefficient of the error correction term to be -1.499705, the interpretation is that the deviation of the previous period from long-run equilibrium is corrected in the current period at an adjustment speed of 150%. This can be inferred from Appendix 1.

Table 4.4: F-Bounds Test Results

Test Statistic	Value	Significance	I (0)	I (1)
F-statistic	3.65	5%	2.38	3.41

Source: The computation of author using EViews 10

Also, the goodness of fit for the estimated model can be justified by the R^2 of 0.94. This indicates that 94% of the variation in electricity consumption is well explained and/or predicted by the regressors. This and the Prob (F-statistic) value of virtually 0, to some extent, give a clear indication to progress with the model. This can be inferred from Appendix 1 as well.

4.8.2.2 Long-Run and Short-Run NARDL Regression Output and Analysis

Table 4.5 provides the long-run and short-run NARDL regression output. From this table, the long-run coefficient of FDI (positive), thus, -0.317647, which is statistically significant at 5%, means that a unit increase or a positive shock in FDI decreases electricity consumption by about 0.318 in the long run, *ceteris paribus*. The long-run coefficient of FDI (negative) or of the negative shock in FDI (which may be caused when the financial assistance and/or loans from the affiliate to its parent company outstrip the financial assistance and/or loans and equity capital provided by the parent company to the affiliate), thus, 0.045227, is not statistically significant. The negative shock in FDI may also be influenced by tax rate and ownership restrictions provided by government.

With a p-value of 0.3213 (from Table 4.5), which is greater than any of the levels of significance, trade (positive) cannot be seen as essential in influencing and/or decreasing the Ghanaian electricity consumption in the long run. The negative and statistically insignificant long-run effect of this positive shock in trade totally disagrees with the finding by Kwakwa & Aboagye (2014) who analyzed the case for the same country (Ghana). Furthermore, in the long run, trade (negative) significantly increases electricity consumption; since the p-value for its effect is 0.0647. With a p-value of 0.2270 (from Table 4.5), the log of GDP per capita (positive) in the long run cannot be seen as crucial in influencing or increasing the Ghanaian electricity consumption. And in the long run, the negative shock in the log of GDP per capita does not significantly increase electricity consumption. With a p-value of 0.3136, which pertains to the effect of the log of inflation (positive) in the long run, it can be said that inflation may not be a necessary factor to influence the Ghanaian electricity consumption in the long run (although such effect is found to be negative). Additionally, for Ghana the negative shock in the log of inflation does not significantly increase electricity consumption in the long run.

Table 4.5: NARDL Regression Output

Variable	Coefficient	t-Statistic	P-value
Constant	102.6362	9.141587	0.0000***
Restricted Trend	0.904041	2.592091	0.0358**
Long-Run Output			
Decomposed Variable	**Coefficient**	**t-Statistic**	**P-value**
$FDI_{t-1}{}^{+}$	-0.317647	-2.360492	0.0503**
$FDI_{t-1}{}^{-}$	0.045227	0.134325	0.8969
$TR_{t-1}{}^{+}$	-0.025775	-1.067200	0.3213
$TR_{t-1}{}^{-}$	0.047593	2.189961	0.0647*
$lnGDP_{t-1}{}^{+}$	8.615804	1.324373	0.2270
$lnGDP_{t-1}{}^{-}$	257.1874	0.455672	0.6624
$lnINF_{t-1}{}^{+}$	-1.316091	-1.085712	0.3136
$lnINF_{t-1}{}^{-}$	0.905926	1.274298	0.2432
Short-Run Output			
Variable	**Coefficient**	**t-Statistic**	**P-value**
ΔEC_{t-1}	0.437851	4.234222	0.0039***
ΔEC_{t-2}	0.649589	4.527120	0.0027***
Decomposed Variable	**Coefficient**	**t-Statistic**	**P-value**
$\Delta FDI_t{}^{+}$	-0.282669	-2.475178	0.0425**
$\Delta FDI_{t-1}{}^{+}$	0.474370	3.773078	0.0070***
$\Delta FDI_t{}^{-}$	-0.131836	-1.008503	0.3468
$\Delta FDI_{t-1}{}^{-}$	-0.737386	-5.383312	0.0010***
$\Delta TR_t{}^{+}$	0.017535	1.776083	0.1190
$\Delta TR_{t-1}{}^{+}$	0.034299	2.951359	0.0214**
$\Delta TR_t{}^{-}$	0.026643	2.622291	0.0343**
$\Delta TR_{t-1}{}^{-}$	0.013409	1.202072	0.2684
$\Delta lnGDP_t{}^{+}$	-0.320043	-0.092287	0.9291
$\Delta lnGDP_{t-1}{}^{+}$	-8.915027	-2.339146	0.0519*
$\Delta lnGDP_t{}^{-}$	384.3185	8.949252	0.0000***
$\Delta lnGDP_{t-1}{}^{-}$	18.69021	2.600722	0.0354**
$\Delta lnINF_t{}^{+}$	-1.075065	-3.891819	0.0060***
$\Delta lnINF_{t-1}{}^{+}$	-0.428631	-1.583661	0.1573
$\Delta lnINF_t{}^{-}$	0.694746	6.252586	0.0004***
$\Delta lnINF_{t-1}{}^{-}$	0.263521	1.185177	0.2746

NB: *, ** and * denote 10%, 5% and 1% levels of significance respectively**

Source: The computation of author using EViews 10

Also, the short-run coefficient of FDI (positive), thus, -0.282669, which is statistically significant at 5%, means that a unit increase or a positive shock in FDI decreases electricity consumption by about 0.283 in the short run, all things being equal. The short-run coefficient of FDI (negative), thus, -0.131836, is not statistically significant. With a p-value of 0.1190, the influence of trade (positive) in the short run, although positive, follows an insignificant pattern as well. In the short run, the negative shock in trade significantly increases electricity consumption; as the p-value for its effect is 0.0343. The influence of the log of GDP per capita (positive) in the short run, although negative, follows an insignificant pattern. However, in the short run, the negative shock in the log of GDP per capita significantly increases electricity consumption; since its coefficient and p-value are 384.3185 and 0.0000 respectively. The short-run effect of the log of inflation (positive) is not likened to the long-run effect of the same variable. Here, its p-value of 0.006 reveals such significant effect. Also, the coefficient of -1.075065 means that a 1% increase in inflation leads to a significant decrease in electricity consumption by an approximation of 0.011 ('logged' form) in the short run. Furthermore, the negative shock in the log of inflation significantly increases electricity consumption in the short run; this is unlike how it increases electricity consumption in the long run, since such effect is insignificant.

It can be said that, since in the short run, both positive and negative shocks in FDI decrease electricity consumption, and in the long run, the positive shock in FDI decreases electricity consumption whilst the negative shock in FDI increases electricity consumption, then FDI generally tends to decrease electricity consumption. This is because, for both periods, the magnitude of the positive shock in FDI outweighs the negative shock in FDI. Precisely, and/or automatically, the generalization of the negative effect may emanate from the short-run and long-run coefficients of the negative shock in FDI not being even found to be statistically significant. So, in reference to addressing one of the gaps in the literature, and given the long-run insignificant positive effect of the negative shock in FDI, it cannot be concluded that foreign investors are costinsensitive (especially within the power facility). To an extent, it implies that there is no basis for the government of Ghana to be bothered with implementing severe long-run policies to manage any sensitivity in cost which should suit the inflow of FDI. It is also not important for the supply of electricity not to be labelled as flexible, and cost- and environment- friendly; since the negative shock in FDI does not significantly increase electricity consumption in the long run. For the long run, the insignificant positive effect of the negative shock in FDI is not akin to the finding of Sharma & Kautish (2019); since they rather found a significant negative effect of the negative shock in FDI. Additionally, given the short-run insignificant negative effect of the negative shock in FDI, it cannot be conclusive that foreign investors are cost-sensitive (especially within the power facility). To some degree, it indicates that, should there have been the short-run significant negative effect, the government of Ghana would have rather been bothered with enforcing severe short-run programmes to handle any sensitivity in cost which should suit the inflow of FDI. Also, the supply of electricity would have been labelled as flexible, and cost- and environment- friendly; if due to the negative shock in FDI, electricity consumption significantly decreases in the short run (but this is not found to be the case).

Table 4.6: Asymmetry Tests

Decomposed Variable	Asymmetry Test
$FDI_{t-1}{}^{+}$ & $FDI_{t-1}{}^{-}$	0.3401
$TR_{t-1}{}^{+}$ & $TR_{t-1}{}^{-}$	0.5203
$lnGDP_{t-1}{}^{+}$ & $lnGDP_{t-1}{}^{-}$	0.2234
$lnINF_{t-1}{}^{+}$ & $lnINF_{t-1}{}^{-}$	0.3198
$(\Delta FDI_t{}^{+} + \Delta FDI_{t-1}{}^{+})$ & $(\Delta FDI_t{}^{-} + \Delta FDI_{t-1}{}^{-})$	0.6666
$(\Delta TR_t{}^{+} + \Delta TR_{t-1}{}^{+})$ & $(\Delta TR_t{}^{-} + \Delta TR_{t-1}{}^{-})$	0.6432
$(\Delta lnGDP_t{}^{+} + \Delta lnGDP_{t-1}{}^{+})$ & $(\Delta lnGDP_t{}^{-} + \Delta lnGDP_{t-1}{}^{-})$	0.0993*
$(\Delta lnINF_t{}^{+} + \Delta lnINF_{t-1}{}^{+})$ & $(\Delta lnINF_t{}^{-} + \Delta lnINF_{t-1}{}^{-})$	0.6141

NB: * denotes 10% level of significance

Source: The computation of author using EViews 10

Now, the results pertaining to the asymmetry tests for the long and short runs have been given in Table 4.6. Here, with F-statistic value of 0.3401, it must be informative that there exists long-run symmetry between FDI (positive) and FDI (negative) effects; since the degree of the change in electricity consumption is virtually equal when comparing the positive shock in FDI to the negative shock in FDI (in terms of their effects) in the long run. Additionally, for the short run, it should be known that there exists symmetry between FDI (positive) and FDI (negative) effects, together with those of their respective lagged terms; as the degree of the change in electricity consumption is virtually equal when comparing the positive shock in FDI to the negative shock in FDI (in terms of their effects) in the short run. This is indicated by the F-statistic value of 0.6666. The expression, thus, 'virtually equal', is emphasized on because, there is little amount of difference in magnitude between the effects of FDI (positive) and FDI (negative) in both periods.

In a nutshell, the general negative effect of FDI (as previously discussed) on electricity consumption in Ghana, for both long and short runs, is found to be in agreement with the Composite Effect Theory which defines their required relationship. Specifically, it is expected (in terms of sign) that the effect of FDI on electricity consumption in the short run would be, at least, positive and statistically significant to indicate the direct variation between them, and in doing so, to precisely demonstrate the Scale Effect (1st phase of the Composite Effect). Or, even if the short-run effect turns out to be negative, the long-run effect must also be negative; theoretically, the long-run effect should not be positive here. Fortunately, it is found that both short-run effect and long-run effect of the dominant positive shock in FDI are significantly negative, thus, having p-values of 0.0425 and 0.0503 respectively. It is the statistical significance of the less-than-proportionate negative effect, generally found in both periods, which lends the hint that the Technique Effect (2nd phase of the Composite Effect) will be gradually crawling into the economy (to introduce efficiency and to lessen the instabilities pertaining to electricity consumption), but for quite a long time. Again, the Technique Effect normally works for industrial and post-industrial economies; and this general statistically significant but less-than-proportionate negative effect, which has been empirically estimated for both long and short runs, shows that Ghana may belong to such manufacturing economies (totally at the apex gradient of the Composite Effect Curve), but it will take a 'very long' time for her to be characterized as post-industrialized. To some degree, this is the reason behind the current intermittent electricity challenges faced by the Ghanaian economy. Nonetheless, with respect to the transmission mechanism, the efficiency of electricity (stemming from the inflows of FDI into Ghana) will first be encountered by the supply side of the power sector (workers at the power facilities); subsequently, the demand side of the same sector (households and firms) will consume efficient electricity which it has been provided with (from the supply side). Whilst the workers at their facilities efficiently harness the energy resources (for onward transmission to households and firms) through the support of capital injections or funds stemming from FDI, and by the aid of efficient gadgets originating from FDI, pollution will likely ensue, but not as much; as the efficiency component (through energy-saving devices) will override the financial component at this phase of the FDI effect (by and large, when supporting the supply process of extending the generation capacity). At the end, the economic development stance of the Ghanaian economy will be comparably heightened. Intuitively, the present finding is supported by the finding of Adom *et al.* (2019); but it contrasts with that of Doytch & Narayan (2016).

From these findings, it also implies that trade (in general) increases electricity consumption; since, the negative shock in trade (which significantly increases electricity consumption) does not only overshadow the positive shock in trade (which insignificantly increases electricity consumption) in the short run, but it also overshadows the positive shock in trade (which insignificantly decreases electricity consumption) in the long run. The relative difference in the magnitude of effects tells the story; in fact, the inconspicuous magnitude (in both periods) is in harmony with the long-run symmetry and the short-run symmetry between the effects of positive and negative shocks in trade (as illustrated in Table 4.6), since the p-values are 0.5203 and 0.6432 respectively. This symmetry found of the effects of the decomposed trade variables in both periods is, by and large, in contrast to what Alkhateeb & Mahmood (2019) obtained whilst examining the relationship between trade and energy consumption for Egypt. To an extent, the effect of the lagged term of trade (positive) in the short run, which is positive and statistically significant (as its coefficient and p-value are 0.034299 and 0.0214 respectively), corroborates this general positive effect of trade on electricity consumption. All things being equal, this positive effect means that economic conditions within Ghana, such as the political atmosphere, will not have the tendency to threaten the transmission mechanism linking trade to electricity consumption; when trade brings into the Ghanaian economy the needed resources to facilitate production, the power sector will equitably benefit.

It can be established that GDP per capita generally increases electricity consumption; since the effect of the negative shock in the log of GDP per capita (which is positive and significant) does not only prevail over the effect of the positive shock in the log of GDP per capita (which is negative and insignificant) in the short run, but it also (with a positive and insignificant effect) overshadows the positive shock in the log of GDP per capita (which is positive and insignificant) in the long run. The relative difference in the magnitude of effects gives the hint; actually, the conspicuous magnitude (especially in the short run) is in harmony with the short-run asymmetry between the positive and negative shocks in the log of GDP per capita (as illustrated in Table 4.6), since the p-value is given to be 0.0993. The effect of the lagged term of the log of GDP per capita (positive) in the short run, which is positive and statistically significant, corroborates this general positive effect of the log of GDP per capita (which is only significant in the short run). Having obtained this optimistic light about the log of GDP per capita in the short run, it means that high real income will temporarily lead to high utilization of electricity-consuming gadgets at homes and workplaces in Ghana, and/or it will momentarily lead to low use of electricity-efficient gadgets; this conforms to the expected transmission mechanism which was supported by Adom & Bekoe (2013).

It is worth noting that, generally, inflation will decrease electricity consumption, but its effect will only be significant in the short run. The intuition is that the effect of the positive shock in the log of inflation (which is significant and negative) does not only exceed the effect of the negative shock in the log of inflation (which is significant and positive) in the short run; but it also (with an insignificant and negative effect) outstrips the effect of the negative shock in the log of inflation (which is insignificant and positive) in the long run. As usual, the relative difference in the magnitude of effects of the log of inflation demonstrates this analogy. The discreet magnitude is parallel to the symmetry found in both periods (as illustrated in Table 4.6). The general negative effect of inflation, although only significant in the short run, conforms to the expected inverse relationship between price and demand; and this is in tandem with the finding of Polat (2018).

4.8.2.3 Asymmetric Dynamic Multiplier Graph of FDI Effect

Generally, the Asymmetric Dynamic Multiplier Graphs show the design through which the predicted variable in a model adjusts to its new long-run equilibrium, amidst any possible existence of asymmetry, following positive or negative shocks in the predictors of that model (Shin *et al.*, 2014). The pattern through which electricity consumption adjusts to its new state in the long run, following the positive or negative shock in FDI (in the presence of symmetry for the model), is captured in Figure 4.1.

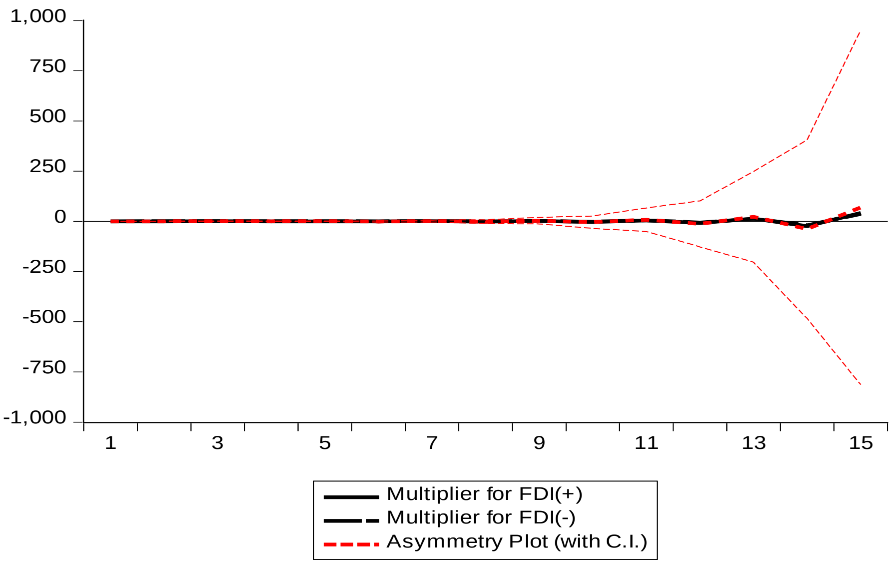


Figure 4.1: Asymmetric Dynamic Multiplier Graph of FDI Effect

Source: The extraction of author using EViews 10

The asymmetric dynamic multiplier graphs of all the regressors, as far as the response of electricity consumption is concerned, are identical. This can be inferred from the appendices. There should have been some conspicuous distinction between a thick-continuous black line and a thick-cutting or dashed black line in all the respective diagrams for the regressors typically, but this is not found to be the case. The thick-continuous black line in Figure 4.1, for instance, would have technically demonstrated how electricity consumption attempts to adjust over the horizon as a result of a positive shock in FDI, and the thick-cutting or dashed black line in the same diagram would have shown how electricity consumption tries to adjust over the horizon due to a negative shock in FDI. The thick-cutting or dashed red line is the asymmetry plot which does not reflect the disparity between the dynamic multipliers of positive and negative changes in FDI, judging from the fact that it is not clearly depicted to fall between the distinct black lines. More importantly, this is in concordance with the symmetry which has been found (in terms of effect) between the decomposed FDI variables. Even though it can be observed that the asymmetry plot in Figure 4.1 lies within the upper and lower bands of the 95% confidence interval, or between the thin-cutting red lines, the line at 0 lies within these bands; and this complies with the presence of symmetry. Furthermore, it can be observed that the regressand does not appear to respond as appropriately to the positive and negative shocks in FDI as it should; the supposed distinct black lines appear flat. For that matter, the response of electricity consumption to either FDI (positive) or FDI (negative) shocks in the long run is not more graphically noticeable than its counterpart in the short run. The asymmetry plot does not tend to gradually rise above or below the line at 0 for the purpose of illustrating which of the shocks is more pronounced in the long run; so, it can be said that symmetry exists here (Shin *et al.*, 2014). Therefore, it is must be noted that, to a large extent, there are positive and negative shocks in any variable whose effects need to be assessed; to justify the overall role of that particular variable in the economy.

4.9 Granger Causality Test (Pairwise)

It has been mentioned that causality, for instance, between FDI and electricity consumption, could mean that FDI is a probabilistic cause of electricity consumption, FDI should occur either prior to or simultaneously with electricity consumption (but not afterwards), among others (Gujarati & Porter, 2009). Under this test, a unidirectional causality is found to run from FDI (in general) to electricity consumption at the 10% level of significance. Therefore, it is very decisive that the expansion in FDI actually triggered the increase in the total installed generation capacity of 4,398.5MW. To an extent, this is what reflects from the significant effect of FDI (positive), which was earlier found for both long and short runs, when analyzing Table 4.5. The decomposition-exclusive account is provided in Table 4.7.

Table 4.7: Pairwise Granger Causality Test Results (Decomposition-Exclusive Account)

Null Hypothesis	P-value	Form of Causality
FDI does not granger cause EC *EC does not granger cause FDI*	0.0955* 0.4899	Unidirectional from FDI to EC
Tr does not granger cause EC *EC does not granger cause Tr*	0.4645 0.3743	Neutral
lnGDP does not granger cause EC *EC does not granger cause lnGDP*	0.0008*** 0.0776*	Bidirectional
lnInf does not granger cause EC *EC does not granger cause lnInf*	0.1115 0.3103	Neutral
Tr does not granger cause FDI *FDI does not granger cause Tr*	0.0131** 0.9766	Unidirectional from Trade to FDI
lnGDP does not granger cause FDI *FDI does not granger cause lnGDP*	0.5423 0.2361	Neutral
lnInf does not granger cause FDI *FDI does not granger cause lnInf*	0.1935 0.2563	Neutral
lnGDP does not granger cause Tr *Tr does not granger cause lnGDP*	0.7458 0.8147	Neutral
lnInf does not granger cause Tr *Tr does not granger cause lnInf*	0.8920 0.7829	Neutral
lnInf does not granger cause lnGDP *lnGDP does not granger cause lnInf*	0.1638 4.E-05	Neutral

NB: *, ** and * denote 10%, 5% and 1% levels of significance respectively**

Source: The computation of author using EViews 10

The decomposition account can also be inferred from Appendix 5. Furthermore, there is found to be neutral causality between trade and electricity consumption; to an extent, this illustrates the Neutrality Hypothesis. By and large, trade stands no chance at influencing electricity consumption directly. In addition, a bidirectional causality exists between the log of GDP per capita and electricity consumption; this is in concordance with the well-known Feedback Hypothesis, unlike the Conservation Hypothesis. This proven Feedback Hypothesis also implies that electricity consumption is not strictly a limiting determinant of GDP per capita (economic growth and development), contrary to the postulation of the Growth Hypothesis. Lastly, a neutral causality exists between the log of inflation and electricity consumption.

4.10 Results of Diagnostic Tests

4.10.1 Residual Tests (Normality, Heteroskedasticity and Autocorrelation) & Stability Tests (CUSUM and CUSUMSQ)

The output which illustrates that the model is normal, free from autocorrelation, homoskedastic, and stable (according to CUSUM & CUSUMSQ) are displayed in Appendix 6, Appendix 7, Appendix 8, Appendix 9 and Appendix 10 respectively. For the normality test, an attempt is made to examine if there is the normal distribution pattern of the residuals or the set of factors which was not accounted for in the empirical model but subsumed under the error term. The prob-value of Jarque-Bera, which shows 0.335257, provides the implication that the residuals are normally distributed, since it is greater than the required 5% level of significance. Thus, it becomes necessary not to reject the null hypothesis of normality of distribution. Moreover, using the Breusch-Pagan-Godfrey Test of Heteroskedasticity, the Prob. F value of 0.2263 indicates that the model of the present thesis is homoskedastic. This implies that the variance of the error term is constant. If this value was found to be less than the required level of significance, it would have been conclusive that the model is heteroskedastic. Furthermore, employing the Breusch-Godfrey Serial Correlation LM Test, the Prob. F value of 0.0584 is informative that the model is free from autocorrelation. This means that the successive values of the error term are independent of each other. Generally, if the 5% level of significance was found to be greater than this value, the conclusion would have been that the model of the present thesis is suffering from autocorrelation. In other words, the null hypothesis of no autocorrelation would have been rejected.

In addition, irrespective of the fact that the Cumulative Sum (CUSUM) test detects systematic modifications in regression coefficients, and the Cumulative Sum of Squares (CUSUMSQ) test pinpoints out rapid modifications from constant regression coefficients, the model for the present thesis is found to be stable. In this way, the CUSUM and the CUSUMSQ lines lie within the boundaries of the 5% level of significance. Had it been that any part of these lines reached beyond the boundaries, then it would have been of conclusion that there may be the presence of structural breaks, to some extent, which must be considered.

4.11 Chapter Summary

Foreign Direct Investment (FDI), an aspect of financial development, is well noted as a stimulator for growth to individual countries; through job opportunities creation, ease in technological transfer and improved capital stock (Omri & Kahouli, 2014). With Doytch & Narayan (2016), industrialization is heightened when FDI plays a crucial role in determining the consumption of energy. This thesis utilizes the theory of energy demand, which has been provided by Medlock III (2009), as its theoretical framework. From the empirical results obtained, particularly with respect to the symmetry which has been found of the nexus between FDI and the Ghanaian electricity consumption in the long and short runs, FDI (generally) is inclined towards decreasing electricity consumption in both periods; the long-run and short-run effects of FDI agree with the Composite Effect Theory. Additionally, that is even the reason for the presence of a unidirectional causality running from FDI to the Ghanaian electricity consumption. FDI will still secure the electricity needs of Ghana in both periods, except that the efficiency element is not fully underway yet. This causes Ghana to be positioned at the apex slope of the Composite Effect Curve; and this reveals the average development level of Ghana. More FDI resources are, thus, required to be channeled into the Ghanaian economy, specifically, the power sector; to make the livelihoods of the populace comfortable and risk-free. It must be noted, however, that the probable cause of the positive shock in FDI would imply the reverse cause of the negative shock in FDI (where discussed).

CHAPTER FIVE

SUMMARY, CONCLUSION, POLICY RECOMMENDATIONS AND LIMITATIONS

5.1 Introduction

This chapter offers the summary and conclusion of this thesis based on its empirical estimations. In this chapter, the appropriate policies and/or programmes are also advocated for. The restraints or limitations which were encountered during the course of this thesis, and from which areas for further research can be highlighted, are provided in this section as well.

5.2 Summary

Foreign Direct Investment (FDI) is a fulcrum in the transfer of technology and skills, the creation of employment and the formation of capital for an economy. FDI (net inflows) to Ghana has been supportive of the growth of the economy over the years, however, it remains unstable and inconsistent; its progressive impact on crucial sectors of the economy has not been entirely felt. By and large, this has contributed to Ghana being marginalized at the global level. The worse problem is, the quite few times FDI inflows rise or when the economy of Ghana benefits from such inflows, does the energy or power sector also receive enough of its share? Has there been much attention given to the importance of the FDI-energy consumption nexus in Ghana? The development of energy is also very important for the growth and development of an economy, particularly, where the supply of energy must coincide with or meet the energy demands (or consumption) of the growing population. Energy consumption has been a challenge on the global scene; to be able to attain this portion of the SDGs, the issue of 10% of the population in the world lacking access to electricity and 22% of it living in developing countries, in accordance with the International Energy Agency (IEA), must be overcome. Ghana is one of such countries, and it has been of high opinion that among the varied factors to influence her energy consumption status, FDI remains very integral, specifically, on the path to combat the prevalent unreliable and costly supply of power which have tended to limit the vision Ghana has in modernizing most of her sectors, and in supporting her growing population of more than 28.2 million (Power Africa, 2018). Also, with respect to its role in helping to expand the total installed generation capacity, and in ensuring sustenance.

Although studies point to the burgeoning impact of FDI on energy consumption in a country, a debate swirls in the literature; about whether FDI increases or decreases the level of energy consumption within a host country. To some others, FDI increases and decreases energy consumption (where the latter is due to technology absorptive capacity introducing efficiency into the economy), but such relies on the actual times the above major effect of FDI switches in its dichotomy. Therefore, for this thesis, it has been imperative to find answers to what the electricity consumption case might be for Ghana; especially where the literature, pertaining to the FDI-electricity consumption nexus, is scanty. There is also the matter of causation which needed to be clarified whilst considering the expansion of total installed generation capacity; this thesis identified this as a gap worth of filling, and attempted to inquire into it. Furthermore, the decrease in electricity consumption, especially for developing countries such as Ghana (for instance, in the short run), could sometimes be influenced by the decrease in FDI (thus, negative shocks in FDI); and this allows FDI to be labelled as cost-sensitive. Thus, this thesis attempted to investigate this situation. Besides the fact that virtually no study made for Ghana has added to the existing literature in empirically estimating the effect of FDI on electricity consumption, this thesis was motivated that all of the above issues could be best handled by the Nonlinear Autoregressive Distributed Lag (NARDL) model contrived by Shin *et al.* (2014), since it decomposes variables into their positive and negative cumulative sum of changes (whose effects need to be examined to justify the general role of that specific variable); and, in this vein, aids in discovering any presence of asymmetry for policy purposes. For that matter, it aimed to achieve the following: to examine the asymmetric stance for the FDI-Ghanaian electricity consumption nexus in both long and short runs, and to assess the direction of causality for these variables. This thesis selected data from the World Development Indicators (WDI) of the World Bank (2020) and the US Energy Information Administration (2020), and considered the period from 1980 to 2018 (based on data availability). The decomposed terms of trade, GDP per capita and inflation were also controlled for.

It was found that, for both long and short runs, FDI (in general) significantly decreases electricity consumption in Ghana; and this was supported by the prevailing (but unremarkable) negative effect of the positive shock in FDI over the distinct effect of the negative shock in FDI, leading to the symmetry found of the FDI-electricity consumption nexus in both periods. This implies that, for both periods, a positive shock in FDI sparks (almost) the same responsiveness from electricity consumption as what a negative shock in FDI experiences. This general inverse relationship was found to agree with the Composite Effect Theory which explains the favourable path to tread on; so that the required efficiency, to solve the current intermittent electricity anomalies, can be introduced. Since both short-run and long-run effects of FDI were found to be less-than-proportionately negative, it is predicted that Ghana will transform to become acquainted with industrialization which is necessary to avert further challenges. All of these tended to lead to FDI being explicitly found to 'granger cause' the Ghanaian electricity consumption. Thus, there was found to be a unidirectional causality running from FDI to electricity consumption in Ghana.

5.3 Conclusion

The linkage between FDI and electricity consumption in Ghana can be justified on the Latin aphorism, 'cui multum datum,' stated by Tsikata *et al.* (2000). The literal translation of this being, 'to whom much is given, much is expected,' it suggests that FDI is not an end in itself, but a means to an end. A medium having been determined by some factors, FDI facilitates the attainment of a couple of set targets as well; such as desirably impacting on electricity consumption. In their article, 'Harnessing FDI for job creation and industrialization in Africa,' Sutton *et al.* (2016) affirmed that economic policies which are enforced to enhance FDI, in general, must in turn exploit the many benefits which may accrue from FDI. The present thesis, in this way, claims that the level of electricity consumption in Ghana must be among such subjects to receive the necessary benefits. Taking the present empirical results into consideration, it looks as if the development level of Ghana is going to be average for quite a long time, since her technology absorptive capacity will not be adequate to introduce full efficiency and/or to avert the current intermittent electricity challenges. It implies that her efforts to serve the electricity demands of individuals through FDI need to shift from being gradual to being more progressive.

5.4 Policy Recommendations

The suitable policy recommendations for Ghana may include (but not limited to) the following:

Given the long-run and short-run coefficients of FDI (positive) as -0.317647 and -0.282669 respectively, which are less than 1 unit or which indicate the less-than-proportionate negative effects on electricity consumption, it implies that the regular adoption of FDI should be more strengthened and presented as the central theme within the Demand-Side Management (DSM) programme of the Energy Commission; since the notions of FDI and energy efficiency (with energy conservation) are analogous to each other. In other words, the Ministry of Energy must enact energy efficiency and conservation policies which should even render less wastage and associated pollution levels. It must ensure that there is the frequent conduction of such energy programmes by leaders at the regional and district levels as well.

Moreover, since trade and economic development (the log of GDP per capita) have been essentially found to have significant influences on electricity consumption for Ghana (to an extent), they should be encouraged to create a convenient atmosphere for FDI to first thrive in. Besides, unlike the log of GDP per capita (positive) which was not actually found to be a significant factor in influencing electricity consumption but may be seen to have a feedback connection with such consumption (from Appendix 5), trade could be observed to rather directly 'granger cause' FDI (instead of directly 'granger causing' electricity consumption). So, the barriers to trade, such as tariffs and embargos, should be made a bit more flexible. Here, the Ministry of Trade and Industry should ensure that restrictions on imports are less tightened, so that the expected effect on electricity consumption through FDI will be constantly and ultimately observed.

As it has been empirically found that FDI is yet to boost the Ghanaian electricity consumption in a more efficient manner, during these times of trade flexibility, the government of Ghana must also continuously ensure that the political atmosphere to attract FDI is convenient. In this vein, enforcing stringent laws to kick away any misappropriation of funds for political gains should be required, since it will help in guiding the effective distribution of FDI within the power sector.

In addition, the Ministry of Employment and Labour Relations should create the favourable avenue where the working conditions of those at the supply-of-electricity end become improved. Access to such vital input will not only motivate these existing workers to harness the requisite energy resources using available technology from FDI, but it will attract more workers into this field; to support the provision of efficient electricity in Ghana. Thus, more employment will be created.

Besides the creation of employment in this way, the Ministry of Environment, Science, Technology and Innovation should encourage more local academic and economic units to undertake adequate research and development on how to rightly attract investments into energy infrastructure. Ultimately, even essential economic frameworks, such as the Experience Curve which was advocated for by Weiss *et al.* (2010), may be analyzed and predicted for the local power sector in order to respectively ensure and handle cost effectiveness and sensitivities of investments.

Furthermore, the Ministry of Energy, in collaboration with the Ghana Investment Promotion Centre, should strive hard in encouraging more public-private partnerships (PPP) to explore and invest in modern and alternative sources of energy (more diversified renewable energy resources); so as to transform the description of the Ghanaian economy as one of higher development.

Likewise, Ghana can be assured of more effective energy or power security if she is integrated into any relevant international organization which intends on achieving a similar objective. According to Twerefou *et al.* (2018), the West African subregion can facilitate growth through their endowments in the diversified energy resources; so the countries within this region can form that network or organization needed to effectively exploit what they are endowed with.

Lastly, the role of FDI in securing efficient electricity for the populace in Ghana can be complemented with invisible energy policies which, although are not apparently meant to address electricity consumption issues, have the potential of strategically doing so. So, they must be mainstreamed within major policies without interfering with the achievement of institutional goals.

5.5 Limitations and Suggestion of Areas for Further Research

The timespan of the data for this thesis could have been a bit more extended, so that a more complete and comprehensive analysis can be made for Ghana. Upgrading of data is, thus, of relevance; especially when attempting to scrutinize a long-term relationship among key economic variables such as FDI and electricity consumption.

Also, due to insufficient or incomplete data for other variables, such as research and development, urbanization, labour productivity, and some key financial development indicators (all of which are deemed important in the literature to influence electricity consumption), this thesis was restrained in offering an extensive model. So, their full data must be made available for effective research to be undertaken.

Finally, the concepts of FDI and electricity consumption are somewhat broad here; a disaggregated analysis may be of better assistance for future research. In this way, distinguishing the study on the relationship between 'FDI flowing into home electricity consumption' and 'home electricity consumption' from the study (concordantly) relating to that of industrial electricity consumption, for instance, should be worthwhile for the sake of specific development. Slightly linked to the inquiry into the above relationships, analyses can be made at the micro level, that is firm (corporate) and regional levels (including the new sixteen regions), in order to execute contemporary reforms and provide some insights to contribute to the existing literature.

In spite of the above issues, the findings are still valid and credible, and important for policymaking. The findings also add to the empirical evidence, or body of literature, with regard to the effect of FDI on electricity consumption in Ghana.

REFERENCES

Abdouli, M., & Hammami, S. (2017). Exploring Links between FDI Inflows, Energy Consumption, and Economic Growth: Further Evidence from MENA Countries. *Journal of Economic Development*, *42*(1).

Abidin, I. S. Z., Haseeb, M., Azam, M., & Islam, R. (2015). Foreign direct investment, financial development, international trade and energy consumption: Panel data evidence from selected ASEAN Countries. *International Journal of Energy Economics and Policy*, *5*(3).

Adom, P. K., & Bekoe, W. (2013). Modelling electricity demand in Ghana revisited: The role of policy regime changes. *Energy policy*, *61*, 42-50.

Adom, P. K., Opoku, E. E. O., & Yan, I. K. M. (2019). Energy demand–FDI nexus in Africa: Do FDIs induce dichotomous paths? *Energy Economics*, *81*, 928-941.

Alam, A., Malik, I. A., Abdullah, A. B., Hassan, A., Awan, U., Ali, G., ... & Naseem, I. (2015). Does financial development contribute to SAARC′ S energy demand? From energy crisis to energy reforms. *Renewable and Sustainable Energy Reviews*, *41*, 818-829.

Ali, M. U., Zhimin, G., Xiong, W., & Rizwanullah, M. (2020). Electricity consumption, inward FDI, and economic development in Pakistan: VECM and causality analysis. *International Research Journal of Finance and Economics*, *178*(March 2020), 101-110.

Aliyu, A. J., & Ismail, N. W. (2015). Foreign direct investment and pollution haven: does energy consumption matter in African countries? *International Journal of Economics and Management*, *9*(2015), 21-23.

Aliyu, M. A. (2005). Foreign direct investment and the environment: Pollution haven hypothesis revisited.

Alkhateeb, T. T. Y., & Mahmood, H. (2019). Energy consumption and trade openness nexus in Egypt: Asymmetry analysis. *Energies*, *12*(10), 2018.

Amusa, K., Monkam, N., & Viegi, N. (2016). Foreign aid and Foreign direct investment in Sub-Saharan Africa: A panel data analysis. *Economic Research Southern Africa (ERSA)*, *612*, 1-23.

Asteriou, D., & Hall, S. G. (2007). Applied Econometrics: a modern approach, revised edition. *Hampshire: Palgrave Macmillan*, *46*(2), 117-155.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of management*, *17*(1), 99-120.

Bernardini, O., & Galli, R. (1993). Dematerialization: long-term trends in the intensity of use of materials and energy. *Futures*, *25*(4), 431-448.

Bilotta, N., & Colantoni, L. (2018). *Financing Energy Access in Sub-Saharan Africa*. Istituto Affari Internazionali.

Buthelezi, S. N. (2019). FDI in Africa: potential implications of Brexit on South Africa's financial sector. *Journal of Financial Regulation and Compliance*.

Casson, M. (1990). The Theory of Foreign Direct Investment [w:] International Investment, ed. P. Buckley.

Caves, R. E. (1971). International corporations: The industrial economics of foreign investment. *Economica*, *38*(149), 1-27.

Chen, G., Geiger, M., & Fu, M. (2015). Manufacturing FDI in Sub-Saharan Africa.

Coase, R. (1937). The theory of the firm. *Economica*, *4*(16), 386-405.

Djokoto, J. G., & Dzeha, G. C. (2012). Determinants and effects of foreign direct investment in Ghana–Review of literature. *Developing Country Studies*, *2*(2), 25-35.

Doytch, N., & Narayan, S. (2016). Does FDI influence renewable energy consumption? An analysis of sectoral FDI impact on renewable and non-renewable industrial energy consumption. *Energy Economics*, *54*, 291-301.

Dunning, J. H. (1973). The determinants of international production. *Oxford economic papers*, *25*(3), 289-336.

Dunning, J. H. (1981), International Production and The Multinational Enterprise. *London: Allen & Urvin*.

Dunning, J. H. (2000). The eclectic paradigm as an envelope for economic and business theories of MNE activity. *International business review*, *9*(2), 163-190.

Energy Commission. (2006). Energy Demand Sectors of the Economy. *Strategic National Energy Plan (2006-2020) Annex I of IV, Ghana*.

FocusEconomics. (2015). Consensus Forecast. Accessed on: http://www.focus-economics.com

Foster, V., & Briceño-Garmendia, C. (2010). *Africa's infrastructure: a time for transformation*. World Bank.

Ghana Investment Promotion Centre (GIPC) (1991). Investment Code *(Areas of Special Priority)* Instrument.

Grant, R. M. (1991). The resource-based theory of competitive advantage: implications for strategy formulation. *California management review*, *33*(3), 114-135.

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

Gujarati, D. N., & Porter, D. (2009). Basic Econometrics Mc Graw-Hill International Edition.

Hagan, E. B. (2015). Renewable energy policy review, identification of gaps and solutions in Ghana. *Energy Commission, ACCRA Institute of Technology*.

Hymer, S. H. (1960). The International Operations of National Firms. *Quarterly Journal of Economics, 80*, 190-207.

Inder, B. (1993). Estimating long-run relationships in economics: A comparison of different approaches. *Journal of econometrics*, *57*(1-3), 53-68.

International Energy Agency (2016). Key World Energy Statistics.

Islam, F., Shahbaz, M., Ahmed, A. U., & Alam, M. M. (2013). Financial development and energy consumption nexus in Malaysia: a multivariate time series analysis. *Economic Modelling*, *30*, 435-441.

Jbara, B. (2007). Exploring the Causality between the Pollution Haven Hypothesis and the Environmental Kuznets Curve. *Honors Projects, Paper21*.

Keho, Y. (2016). Do foreign direct investment and trade lead to lower energy intensity? Evidence from selected African countries. *International Journal of Energy Economics and Policy*, *6*(1).

Koutsoyiannis, A. (1977). Theory of Econometrics 2nd Ed Macmillan Press.

Kumi, E. N. (2017). *The electricity situation in Ghana: Challenges and opportunities* (p. 30). Washington, DC: Center for Global Development.

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

Kwakwa, P. A., & Aboagye, S. (2014). Energy consumption in Ghana and the story of economic growth, industrialization, trade openness and urbanization. *Asian Bulletin of Energy Economics and Technology*, *1*(1), 1-5.

Lai, M., Peng, S., & BAO, Q. (2006). Technology spillovers, absorptive capacity and economic growth. *China Economic Review*, *17*(3), 300-320.

Latief, R., & Lefen, L. (2019). Foreign Direct Investment in the Power and Energy sector, Energy consumption, and economic growth: Empirical evidence from Pakistan. *Sustainability*, *11*(1), 192.

Lee, J. W. (2013). The contribution of foreign direct investment to clean energy use, carbon emissions and economic growth. *Energy Policy*, *55*, 483-489.

Lin, C., Tan, B., & Chang, S. (2002). The critical factors for technology absorptive capacity. *Industrial Management & Data Systems*.

Lucas, R. E. (1993). On the determinants of direct foreign investment: evidence from East and Southeast Asia. *World development*, *21*(3), 391-406.

Mahmood, A., Javaid, N., Zafar, A., Riaz, R. A., Ahmed, S., & Razzaq, S. (2014). Pakistan's overall energy potential assessment, comparison of LNG, TAPI and IPI gas projects. *Renewable and sustainable energy reviews*, *31*, 182-193.

Mahmood, H., & Alkhateeb, T. T. Y. (2018). Asymmetrical effects of real exchange rate on the money demand in Saudi Arabia: A non-linear ARDL approach. *PloS one*, *13*(11), e0207598.

Mahmood, H., Alrasheed, A. S., & Furqan, M. (2018). Financial market development and pollution nexus in Saudi Arabia: Asymmetrical analysis. *Energies*, *11*(12), 3462.

Mankiw, N. G. (1990). *A quick refresher course in macroeconomics* (No. w3256). National Bureau of Economic Research.

Mavikela, N., & Khobai, H. (2018). Investigating the Link Between Foreign direct investment, Energy consumption and Economic growth in Argentina. Munich Personal RePec Archive. https://mpra.ub.uni-muenchen.de/id/eprint/83960.

Medlock III, K. B. (2009). Energy demand theory. *International handbook on the economics of energy*, 89-111.

Meyabadi, A. F., & Deihimi, M. H. (2017). A review of demand-side management: Reconsidering theoretical framework. *Renewable and Sustainable Energy Reviews*, *80*, 367-379.

Moosa, I. (2002). *Foreign direct investment: theory, evidence and practice*. Springer.

Moxon, James (1969) *Volta: Man's Greatest Lake.* London: Andre Deutsch Ltd.

Muhammad, S., Saleheen, K., & Mohammad, I. T. (2012). The dynamic link between energy consumption, economic growth, financial development and trade in China: Fresh evidence from multivariate framework analysis.

Ndikumana, L. (2003). Financial Development. *Financial Structure and Domestic Investment: International Evidence*, *52*.

Ndikumana, L., & Verick, S. (2007). The Linkages between FDI and Domestic Investment: Unravelling the Developmental Impact of Foreign Investment. *Economics Department Working Paper Series*, 25.

Omri, A., & Kahouli, B. (2014). Causal relationships between energy consumption, foreign direct investment and economic growth: Fresh evidence from dynamic simultaneous-equations models. *Energy Policy*, *67*, 913-922.

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

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics*, *16*(3), 289-326.

Polat, B. (2018). The Influence of FDI on Energy Consumption in Developing and Developed Countries: A Dynamic Panel Data Approach. *Journal of Yasar University*, *13*(49).

Power Africa. (2018). Ghana Factsheet. Retrieved from: https://www.usaid.gov/sites/default/files/documents/1860/Ghana_-_November_2018_Country_Fact_Sheet.pdf

Royston, S., Selby, J., & Shove, E. (2018). Invisible energy policies: A new agenda for energy demand reduction. *Energy Policy*, *123*, 127-135.

Sadorsky, P. (2011). Trade and energy consumption in the Middle East. *Energy Economics*, *33*(5), 739-749.

Salim, R., Yao, Y., Chen, G., & Zhang, L. (2017). Can foreign direct investment harness energy consumption in China? A time series investigation. *Energy Economics*, *66*, 43-53.

Sazali, A. W., Raduan, C. R., Jegak, U., & Haslinda, A. (2009). The Effects of Absorptive Capacity and Recipient Collaborativeness as Technology Recipient Characteristics on Degree of Inter-Firm Technology Transfer. *Journal of Social Sciences*, *5*(4), 423-430.

Sbia, R., Shahbaz, M., & Hamdi, H. (2014). A contribution of foreign direct investment, clean energy, trade openness, carbon emissions and economic growth to energy demand in UAE. *Economic modelling*, *36*, 191-197.

Shahbaz, M., Chaudhary, A. R., & Shahzad, S. J. H. (2018). Is energy consumption sensitive to foreign capital inflows and currency devaluation in Pakistan? *Applied Economics*, *50*(52), 5641-5658.

Shahbaz, M., Nasreen, S., Ling, C. H., & Sbia, R. (2014). Causality between trade openness and energy consumption: What causes what in high, middle and low income countries. *Energy Policy*, *70*, 126-143.

Sharma, R., & Kautish, P. (2019). Dynamism between selected macroeconomic determinants and electricity consumption in India. *International Journal of Social Economics*.

Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In *Festschrift in honor of Peter Schmidt* (pp. 281-314). Springer, New York, NY.

Shinn, L. (2018). Renewable Energy: The Clean Facts. NRDC. *Natural Resources Defense Council*, *15*.

Siddiqui, A., Mahmood, H., & Margaritis, D. (2019). Oil prices and stock markets during the 2014–16 oil price slump: Asymmetries and speed of adjustment in GCC and oil-importing countries.

Spender, J. C., & Grant, R. M. (1996). Knowledge and the firm: Overview. *Strategic management journal*, *17*(S2), 5-9.

Sutton, J., Jinhage, A., Leape, J., Newfarmer, R., & Page, J. (2016). Harnessing FDI for job creation and industrialization in Africa. *IGC Growth Brief, 27*.

Tsikata, G. K., Asante, Y., & Gyasi, E. M. (2000). *Determinants of foreign direct investment in Ghana* (pp. 70-80). London: Overseas Development Institute.

Tursoy, T., & Faisal, F. (2016). Causality between stock price and GDP in Turkey: an ARDL bounds testing approach. *Romanian Statistical Review*, *64*(4), 3-19.

Twerefou, D. K., Iddrisu, K. S., & Twum, E. A. (2018). Energy consumption and economic growth: evidence from the West African Sub region. *West African Journal of Applied Ecology*, *26*, 217-233.

UNCTAD. (1998). World investment report 1998: Trends and determinants.

UNCTAD. (2003). Investment Policy Review: Ghana.

UNCTAD, F. (2017). Foreign direct investment: Inward and outward flows and stock, annual, 1970-2016.

UNCTAD, S. (2013). UNCTAD statistical database.

United Nations. Department of Public Information. (2005). *The millennium development goals report 2005*. United Nations Publications.

United States Energy Information Administration. (2020). Datasets. Retrieved from: http://knoema.com/EIAINTL2018May/international-energy-data-monthly-update

Vernon, R. (1971). Sovereignty at bay: The multinational spread of US enterprises. *The International Executive*, *13*(4), 1-3.

Vision, G. (1995). The First Step: 1996-2000.

Weiss, M., Junginger, M., Patel, M. K., & Blok, K. (2010). A review of experience curve analyses for energy demand technologies. *Technological forecasting and social change*, *77*(3), 411 428.

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic management journal*, *5*(2), 171-180.

World Bank. (2012). World development indicators (WDI).

World Bank. (2016). World development indicators (WDI).

World Bank. (2019). World development indicators (WDI).

World Bank. (2020). World development indicators (WDI).

Yakubu, I. N., & Mikhail, A. A. (2019). Determinants of foreign direct investment in Ghana: a sectoral analysis.

APPENDICES

Appendix 1: Error Correction Form

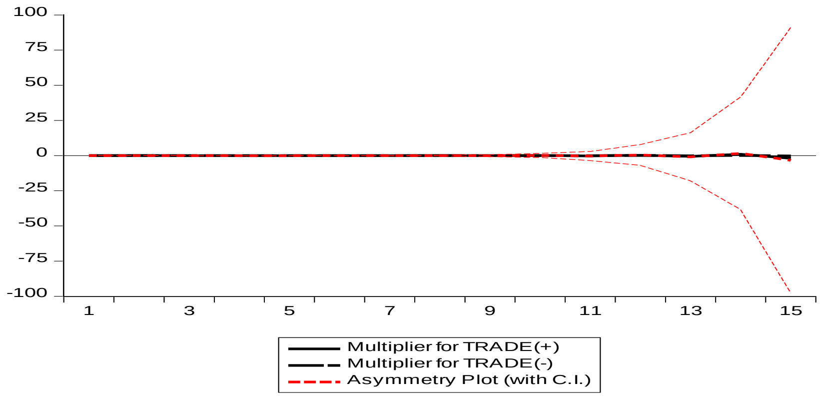
ECM Regression
Case 4: Unrestricted Constant and Restricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	102.6362	11.22740	9.141587	0.0000
D(EC(-1))	0.437851	0.103408	4.234222	0.0039
D(EC(-2))	0.649589	0.143488	4.527120	0.0027
D(FDI_POS)	-0.282669	0.114201	-2.475178	0.0425
D(FDI_POS(-1))	0.474370	0.125725	3.773078	0.0070
D(FDI_NEG)	-0.131836	0.130725	-1.008503	0.3468
D(FDI_NEG(-1))	-0.737386	0.136976	-5.383312	0.0010
D(TRADE_POS)	0.017535	0.009873	1.776083	0.1190
D(TRADE_POS(-1))	0.034299	0.011621	2.951359	0.0214
D(TRADE_NEG)	0.026643	0.010160	2.622291	0.0343
D(TRADE_NEG(-1))	0.013409	0.011155	1.202072	0.2684
D(LNGDPPC4_POS)	-0.320043	3.467900	-0.092287	0.9291
D(LNGDPPC4_POS(-1))	-8.915027	3.811231	-2.339146	0.0519
D(LNGDPPC4_NEG)	384.3185	42.94420	8.949252	0.0000
D(LNGDPPC4_NEG(-1))	18.69021	7.186545	2.600722	0.0354
D(LNINF1_POS)	-1.075065	0.276237	-3.891819	0.0060
D(LNINF1_POS(-1))	-0.428631	0.270658	-1.583661	0.1573
D(LNINF1_NEG)	0.694746	0.111113	6.252586	0.0004
D(LNINF1_NEG(-1))	0.263521	0.222347	1.185177	0.2746
CointEq(-1)*	-1.499705	0.164293	-9.128262	0.0000

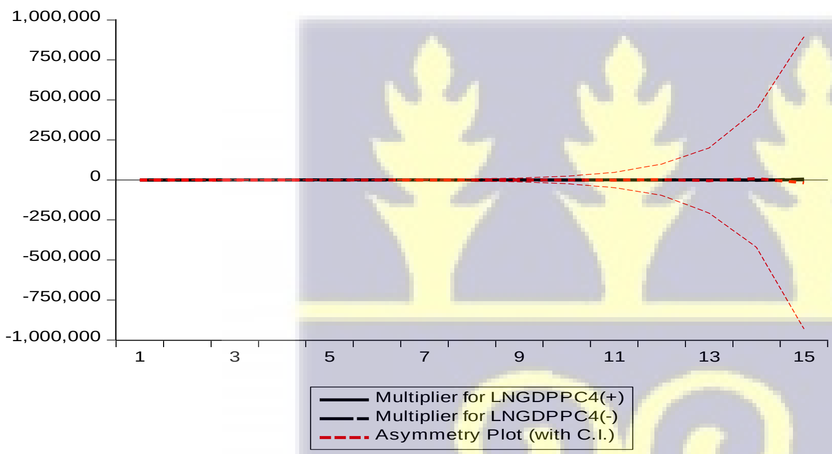
R-squared	0.941291	Mean dependent var	0.125094
Adjusted R-squared	0.871575	S.D. dependent var	0.756886
S.E. of regression	0.271241	Akaike info criterion	0.528563
Sum squared resid	1.177147	Schwarz criterion	1.408296
Log likelihood	10.48587	Hannan-Quinn criter.	0.835613
F-statistic	13.50173	Durbin-Watson stat	3.162232
Prob(F-statistic)	0.000002		

* p-value incompatible with t-Bounds distribution.

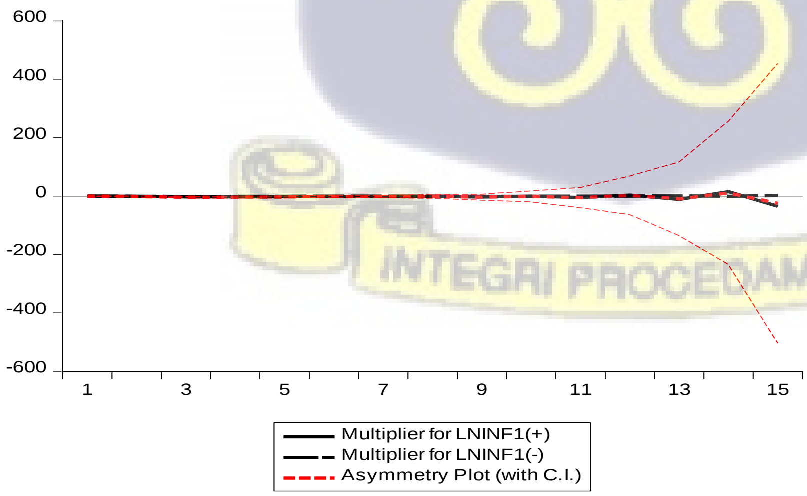
Appendix 2: Asymmetric Dynamic Multiplier Graph of Trade Effect



Appendix 3: Asymmetric Dynamic Multiplier Graph of GDP per capita Effect



Appendix 4: Asymmetric Dynamic Multiplier Graph of Inflation Effect

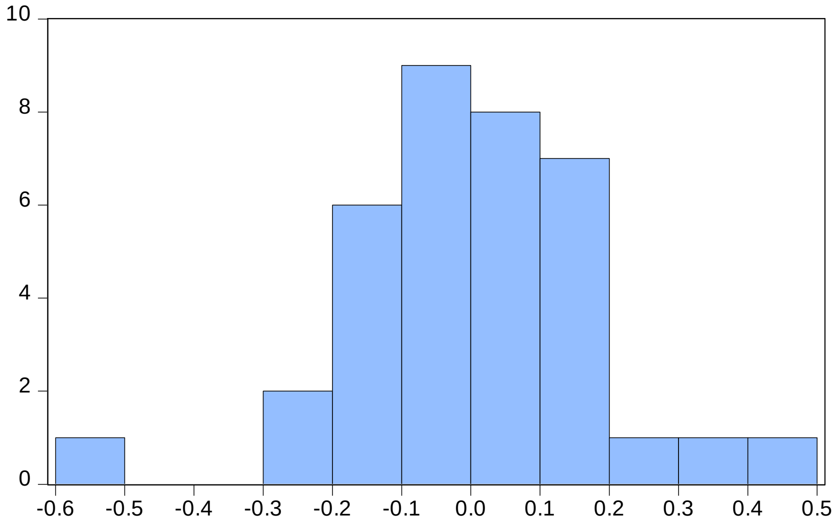


Appendix 5: Pairwise Granger Causality Test (Decomposition Account)

Null Hypothesis:	Obs	F-Statistic	Prob.
FDI_POS does not Granger Cause EC	35	2.23962	0.1056
EC does not Granger Cause FDI_POS		2.23709	0.1059
FDI_NEG does not Granger Cause EC	35	1.08023	0.3735
EC does not Granger Cause FDI_NEG		1.37597	0.2705
TRADE_POS does not Granger Cause EC	35	0.37808	0.7695
EC does not Granger Cause TRADE_POS		1.82675	0.1652
TRADE_NEG does not Granger Cause EC	35	3.46720	0.0293
EC does not Granger Cause TRADE_NEG		0.71581	0.5508
LNGDPPC4_POS does not Granger Cause EC	35	2.42363	0.0867
EC does not Granger Cause LNGDPPC4_POS		2.83774	0.0560
LNGDPPC4_NEG does not Granger Cause EC	35	0.67215	0.5763
EC does not Granger Cause LNGDPPC4_NEG		2.51969	0.0783
LNINF1_POS does not Granger Cause EC	35	1.00224	0.4064
EC does not Granger Cause LNINF1_POS		0.20419	0.8926
LNINF1_NEG does not Granger Cause EC	35	0.88174	0.4625
EC does not Granger Cause LNINF1_NEG		0.83864	0.4842
FDI_NEG does not Granger Cause FDI_POS	35	1.11423	0.3600
FDI_POS does not Granger Cause FDI_NEG		2.80491	0.0580
TRADE_POS does not Granger Cause FDI_POS	35	1.34533	0.2797
FDI_POS does not Granger Cause TRADE_POS		0.67834	0.5726
TRADE_NEG does not Granger Cause FDI_POS	35	3.21416	0.0379
FDI_POS does not Granger Cause TRADE_NEG		1.10386	0.3640
LNGDPPC4_POS does not Granger Cause FDI_POS	35	0.81975	0.4939
FDI_POS does not Granger Cause LNGDPPC4_POS		6.21352	0.0023
LNGDPPC4_NEG does not Granger Cause FDI_POS	35	0.27773	0.8410
FDI_POS does not Granger Cause LNGDPPC4_NEG		1.79369	0.1713
LNINF1_POS does not Granger Cause FDI_POS	35	1.95766	0.1433
FDI_POS does not Granger Cause LNINF1_POS		1.01241	0.4019
LNINF1_NEG does not Granger Cause FDI_POS	35	2.79390	0.0586
FDI_POS does not Granger Cause LNINF1_NEG		1.96358	0.1423
TRADE_POS does not Granger Cause FDI_NEG	35	3.23492	0.0371
FDI_NEG does not Granger Cause TRADE_POS		0.79262	0.5083
TRADE_NEG does not Granger Cause FDI_NEG	35	0.82938	0.4889
FDI_NEG does not Granger Cause TRADE_NEG		2.42283	0.0868
LNGDPPC4_POS does not Granger Cause FDI_NEG	35	2.65150	0.0681
FDI_NEG does not Granger Cause LNGDPPC4_POS		0.81564	0.4961

LNGDPPC4_NEG does not Granger Cause FDI_NEG	35	0.07249	0.9742
FDI_NEG does not Granger Cause LNGDPPC4_NEG		6.70188	0.0015
LNINF1_POS does not Granger Cause FDI_NEG	35	1.69305	0.1912
FDI_NEG does not Granger Cause LNINF1_POS		0.01149	0.9983
LNINF1_NEG does not Granger Cause FDI_NEG	35	1.22526	0.3190
FDI_NEG does not Granger Cause LNINF1_NEG		3.63124	0.0249
TRADE_NEG does not Granger Cause TRADE_POS	35	0.23758	0.8694
TRADE_POS does not Granger Cause TRADE_NEG		2.46225	0.0832
LNGDPPC4_POS does not Granger Cause TRADE_POS	35	0.11485	0.9507
TRADE_POS does not Granger Cause LNGDPPC4_POS		0.17981	0.9092
LNGDPPC4_NEG does not Granger Cause TRADE_POS	35	0.06856	0.9762
TRADE_POS does not Granger Cause LNGDPPC4_NEG		0.89154	0.4577
LNINF1_POS does not Granger Cause TRADE_POS	35	0.46547	0.7087
TRADE_POS does not Granger Cause LNINF1_POS		0.61704	0.6098
LNINF1_NEG does not Granger Cause TRADE_POS	35	1.29365	0.2960
TRADE_POS does not Granger Cause LNINF1_NEG		2.66239	0.0673
LNGDPPC4_POS does not Granger Cause TRADE_NEG	35	3.92863	0.0185
TRADE_NEG does not Granger Cause LNGDPPC4_POS		2.63410	0.0694
LNGDPPC4_NEG does not Granger Cause TRADE_NEG	35	0.49934	0.6858
TRADE_NEG does not Granger Cause LNGDPPC4_NEG		7.57890	0.0007
LNINF1_POS does not Granger Cause TRADE_NEG	35	1.09730	0.3666
TRADE_NEG does not Granger Cause LNINF1_POS		0.32894	0.8044
LNINF1_NEG does not Granger Cause TRADE_NEG	35	1.88058	0.1558
TRADE_NEG does not Granger Cause LNINF1_NEG		2.18668	0.1118
LNGDPPC4_NEG does not Granger Cause LNGDPPC4_POS	35	1.47624	0.2424
LNGDPPC4_POS does not Granger Cause LNGDPPC4_NEG		6.47614	0.0018
LNINF1_POS does not Granger Cause LNGDPPC4_POS	35	0.24660	0.8630
LNGDPPC4_POS does not Granger Cause LNINF1_POS		2.22856	0.1069
LNINF1_NEG does not Granger Cause LNGDPPC4_POS	35	0.55313	0.6503
LNGDPPC4_POS does not Granger Cause LNINF1_NEG		4.49485	0.0107
LNINF1_POS does not Granger Cause LNGDPPC4_NEG	35	1.34957	0.2784
LNGDPPC4_NEG does not Granger Cause LNINF1_POS		0.28642	0.8348
LNINF1_NEG does not Granger Cause LNGDPPC4_NEG	35	0.86360	0.4715
LNGDPPC4_NEG does not Granger Cause LNINF1_NEG		4.88261	0.0074
LNINF1_NEG does not Granger Cause LNINF1_POS	35	3.92541	0.0186
LNINF1_POS does not Granger Cause LNINF1_NEG		2.33222	0.0956

Appendix 6: Normality Test



Series: Residuals	
Sample 1983 2018	
Observations 36	
Mean	1.02e-14
Median	-0.000476
Maximum	0.473755
Minimum	-0.523957
Std. Dev.	0.183392
Skewness	0.073640
Kurtosis	4.198104
Jarque-Bera	2.185717
Probability	0.335257

Appendix 7: Autocorrelation (Serial Correlation) Test

Breusch-Godfrey Serial Correlation LM Test:

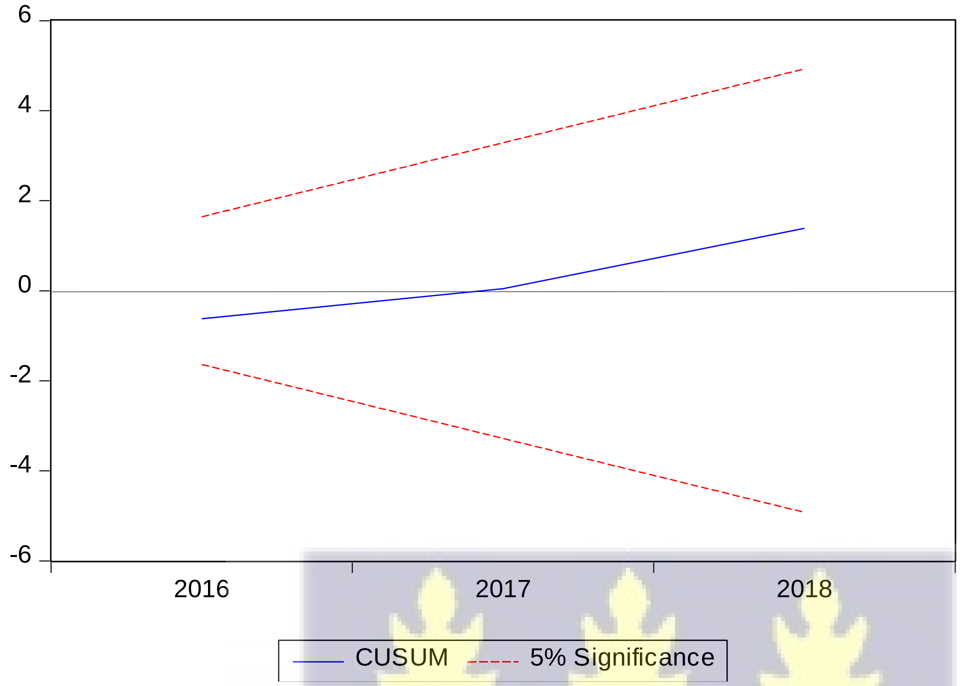
F-statistic	5.981144	Prob. F(3,4)	0.0584
Obs*R-squared	29.43767	Prob. Chi-Square(3)	0.0000

Appendix 8: Heteroskedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.753806	Prob. F(28,7)	0.2263
Obs*R-squared	31.50855	Prob. Chi-Square(28)	0.2950
Scaled explained SS	1.904943	Prob. Chi-Square(28)	1.0000

Appendix 9: Cumulative Sum (CUSUM) Test of the NARDL model



Appendix 10: Cumulative Sum of Squares (CUSUMSQ) Test of the NARDL model