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DEFENCE SPENDING AND ECONOMIC GROWTH: EMPIRICAL EVIDENCE FROM GHANA

MUHIBATU ABASS SEIDU
(10401054)

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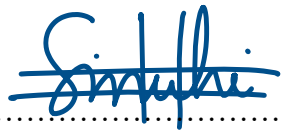
DECLARATION

I, MUHIBATU ABASS SEIDU, hereby declare that this thesis is my work, produced under supervision. It has not been submitted or published for an academic award in the University of Ghana or any other tertiary institution. I have also duly acknowledged all the references used in this study.

I bear sole responsibility for any shortcomings.



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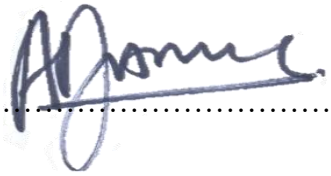

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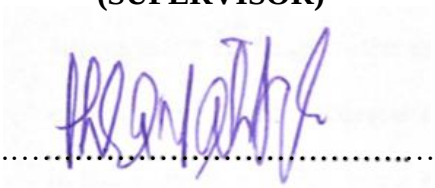
PROFESSOR AMOAH BAAH-NUAKOH (PhD) **DATE**

(SUPERVISOR)



…… 29TH JULY, 2020

ALFRED BARIMAH (PhD) **DATE**

(SUPERVISOR)

ABSTRACT

This study attempted to determine the relationship between real defence expenditure and real aggregate output for Ghana. The limited nature of existing literature for the case of Ghana and reducing defence expenditure over the years in the absence of pressing security issues are some of the reasons for undertaking this study. To achieve this, the Auto-Regressive Distributed Lag (ARDL) cointegration approach for time series analysis is employed on a data set from1980 to 2017. Before the ARDL model was employed, seasonality and unit-root tests were used to determine the specific characteristics of the variables. A cointegration relationship was found among the estimating variables, hence long and short run ARDL models were estimated. The error correction term in the short run model was negative, supporting the ARDL bounds test for cointegration. The results indicated an insignificant impact of defence expenditure on aggregate output in both periods. Although insignificant, it supported the findings of other studies.

Diagnostics test were used to confirm the stability and robustness of the model. A granger causality test was also employed to determine the direction of the causal relationship existing between the variables. This test supported the findings of the ARDL estimations by discovering that defence and government expenditure do not Granger cause output. However, in the long run model, interest rates, labour and the lag of output were the only positively significant variables. Whilst the past values of aggregate output were the only significant variable in the short run. It was recommended that the GAF increases services such as manufacturing, construction, education, and health. Since it has physical and human capital that may not be available to the civilian sector. The government was also advised to create an environment that promotes growth and development which will influence government expenditures which will then affect the economy of Ghana as postulated by Wagner's law.

DEDICATION

I humbly dedicate this piece of work to:

GOD

JESUS CHRIST

HOLY SPIRIT

THE SEIDU'S

Brig. Gen. WA, Hajia Washelatu, Wenu, Sakinatu, Samira and Khadija

Friends who are Family

John 1:1-5

ACKNOWLEDGEMENT

I bless **GOD** for His immense mercies and favour**.**

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To my parents, who taught me the important things in life. My father who instilled in me an appreciation for books, education, and knowledge. My mother, the epitome of 1 Corinthians 13:4-7. She has taught me more about love and sacrifice than any person or book could. I still have more to learn from you, may God keep and guide you forever.

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I am also grateful to the various authors whose scholarly works provided the necessary background information I needed for this study.

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The Best Is Yet to Come.

God Bless.

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LIST OF ABBREVIATIONS

AD	Aggregate Demand
AC	Autocorrelation (Function)
ADF	Augmented Dickey-Fuller
ARDL	Autoregressive Distributed Lag
AFRC	Armed Forces Revolutionary Council
AS	Aggregate Supply
ARDL	Auto-Regressive Distributed Lag
BOP	Balance of Payment
BGU	Border Guard Unit
CDS	Chief of Defence Staff
CPI	Consumer Price Index
CUSUM	Cumulative Sum (Recursive Residuals)
$CUSUM_{SQ}$	Cumulative Sum (Recursive Residuals) of Squares
DE	Defence Expenditure
ECM	Error-Correction Model
ECOMOG	Economic Community of West African States Monitoring Group
ERP	Economic Recovery Program
GAF	Ghana Armed Forces
GC	Granger Causality
GDP	Gross Domestic Product
GE	Non-Defence Government Expenditure

GGTE	General Government Total Expenditure
HDI	Human Development Index
IFS	International Financial Statistics
IMF	International Monetary Fund
LDCs	Least Developed Countries
MOD	Ministry of Defence
NDC	National Democratic Congress
NLC	National Liberation Council
NPP	National Patriotic Party
NRC	National Redemption Council
OLS	Ordinary Least Squares
PNDC	Provisional National Defence Council
PNP	People's National Party
POGR	President's Own Guard Regiment
PP	Phillips-Peron
PPF	Production Possibility Frontier
R&D	Research and Development
SSA	Sub-Saharan Africa
SIPRI	Stockholm International Peace Research Institute
UN	United Nations
UNDP	United Nations Development Program
WDI	World Development Indicators
WEO	World Economic Outlook

CHAPTER ONE

INTRODUCTION

1.1 Background

The UNDP (1994) reported that in 1993, seventy-nine (79) countries had a form of political unrest or conflict. Of the seventy-nine (79) countries, sixty-five (65) of them were developing countries. Of the (fifty-four) 54 African countries, forty-eight (48) saw a form of armed conflict post-independence (African Regional and Sub-Regional Organizations, 2008). Africa, the second largest continent in size and population is often characterized by conflict, poverty, illiteracy, and under-development. All of which influence the low Human Development Index (HDI) of African countries, relative to the world. According to the World Bank, in sub-Saharan Africa (SSA), 41% of its population is poor. Further supported by Ojo (2016) that, even though colonialism and slave trade hindered Africa's growth, systemic corruption and vampirism, political instability, neglect of democratic process, pervasive civil wars, and the 'sit-tight syndrome' (refusal of leaders to leave office).

This negative outlook has increased interest in the research of defence expenditure and economic growth relationships in Africa. Highlighted in Omitogun (2003) that the changed interest in Africa is the product of the relationships among resource use, deprivation, and conflict. The theoretical and empirical literature on the importance of defence expenditure in sustainable nation-building is a rising niche in defence economics. Such studies focus on the role of defence expenditure on economic growth, including its interactions with key micro and macro-economic variables. Benoit (1973) discovered the facilitating nature of military expenditure to economic growth. Citing boosts in production and investment activities by domestic and foreign investors for developing countries.

Where these economic boosts promote a peaceful environment, it raises curiosity on the outcome of this research area in individual countries. Dunne and Uye (2010) also show how interesting it is to consider the experience of the countries in SSA which are still affected by conflicts, despite the reduction in their numbers. It emphasizes that contributions to literary work focusing on the SSA region for periods after the cold war are low.

Other researchers believe that resources spent on the defence sector (arms) are resources lost to the civilian sector such as education, health, and infrastructure for development. "At the same time most countries need some level of security to deal with internal and external threats, but these have opportunity costs as they can prevent money from being used for others that might improve the pace of development" (Dunne *et al.*,2010, p. 2). However, defence expenditure contributes to national security and the economy through its traditional roles including the protection of sovereignty, citizens, and national interests. Peace dividends (increments in other government expenditures) increase when defence expenditure reduces, supporting the guns versus butter argument. An analogy used to describe the balance or combination of resources for a complex economy illustrated with a Production Possibility Frontier (PPF). The third assertion concerning this area of research is that defence expenditure has an insignificant effect on any economy. Further proven in studies by Alexander (1990), Batchelor, Dunne, and Lamb (2002), Henaku (2007) and Heo (2010).

Deger and Smith (1983) argue that a positive effect through modernization may be difficult to quantify in economic terms, due to the different outcome variables of defence and their measurability, certain outcomes may be omitted, hence reducing the effect of the defence spending. Governments aim to maintain peace and security by protecting its citizens. Hence, to

achieve economic growth and development, peace is necessary to maintain the citizens' and investors' security confidence, because reliable security encourages innovation, investment, and high productivity. This argument is supported by Dunne, Smith, and Willenbockel (2005) which states that "war and lack of security are some major obstacles to development." However, Collier (2006) argues that "even where military expenditure is not associated with conflict, it is a drag on development." Cognisant of these arguments, studies have discovered different relationships between economic growth and defence expenditure for different countries, economic regions or continents using time, panel, and cross-sectional data. The results discovered include a negative, bidirectional causal relationship, insignificant, and feedback relationships.

Governments and international organizations such as the United Nations (UN), the African Union (AU) and the Economic Community of West African States (ECOWAS) aim to promote and maintain peace in the world. They invest resources in forms of manpower, financial and logistical hoping to achieve their organizations' security goals, through peacekeeping missions and conferences. Since peace and security are necessary for development, countries devote resources to achieve these. Yet, "poverty and lack of development fuel hatred and escalate hostilities, and that improvements in such areas as nutrition, health, education, water, sanitation, and family planning would go far to reduce the underlying causes of so many wars" (UNICEF, 1996). Hence, peace and security depend not only on defence sector spending but through the provision of basic human needs. These spent resources may not have a short-term effect but have a long-term influence on the economy.

Harris (2004) maintains that "military expenditure has the potential to provide an immediate benefit in the form of greater perceived security which might encourage investment spending in a

country but is in itself a consumption item." Hence, the wrong motivation for military expenditures, prompted by self-seeking benefits rather than the need for national security, may be the fuel for wars and unrest in a country. Backed by Aizenman and Glick (2006) which showed that the economy grows with spending on the military in the face of higher threats whilst rent-seeking and corruption hurt growth. Stockholm International Peace Research Institute (SIPRI) acknowledges that between 1966 and 2017, although the absolute defence expenditure for SSA is lowest, it accounts for a substantial portion of the regions GDP and Government expenditures. The third highest (1.7% of GDP) military burden, only behind North Africa (3.6%) and the Middle East (5.2%).

Cognisant of this, Ghana's spending habit behaves contrary to that of the sub-region recording an average of 0.6% of GDP over the study period. The years before 1984 with negative economic growth rates had higher defence to GDP ratios compared to years after 1984 with positive economic growth. Indicating a shift in the country's governance and spending patterns, the ratio of defence expenditure to other government expenditures and GDP has declined over the years. It is also observed that election years and the productive capacity of the country influence defence spending. Irrespective of changes in the country's spending commitments, the defence of a country is a crucial backdrop which ensures that good governance leads to favourable economic outcomes.

1.2 Research Problem

"Human insecurity, it is clear, poses a far greater challenge to Sub-Saharan African (SSA) governments than traditional security" (UNDP, 2007). Prompted by the comparison of the Human Development Index (HDI) of Sub-Saharan African countries to that of the world. The UNDP states that Ghana's 2017 HDI value of 0.592 makes it the one-hundred and fortieth (140) country out of one-hundred and eighty-nine (189) countries. Although the 2017 HDI value lies above the average

for SSA countries, the country has growth potential. This is because the government uses fiscal and monetary policies as tools to achieve economic growth, an indicator of the HDI. Additionally, the country has faced fiscal deficit financing in most years except for 1986 to 1991 and 1994 to 1995. Therefore, for the Ghanaian economy to ensure efficient spending to achieve its development goals, there is a need to understand how its expenditure behaviours affect the economy. Since public expenditure is vast, it is imperative for policy and decision-makers to understand the components of government spending and their corresponding effects. Such knowledge aids effective policymaking to achieve short- and long-term developmental goals.

For this study, defence expenditure is the selected expenditure of interest despite literature's main interest in countries with security issues. Because, relative to other African countries, Ghana has not faced pressing security issues that have warranted high defence spending. Defence expenditure as a ratio of the national output shows downward movement with peaks and troughs in certain years. Since the year 2000, the ratio of defence expenditure to GDP has not increased above 0.8%, ranging from 0.4% to 0.8%. The reduction in the defence expenditure to GDP ratio despite increments in GDP growth rates over the years may indicate a changing economic landscape. However, the ratio of government spending to output is characterized by an upward-moving trend. But this increase is not reflected in defence expenditure. Therefore, the study attempts to explore the behaviour of defence expenditure in the absence of pressing security issues and the presence of economic expansion.

Additionally, despite the 10% increment in the average ratio of government expenditures to GDP post-ERP, defence expenditure has not reflected this growth. It has remained below the 0.8% of GDP threshold. Therefore, the possibility of discovering over one (1) causal relationship, a

bidirectional relationship, unidirectional relationships, or the absence of a causal relationship as seen in Chowdhury (1991) poses the need for estimating the Ghanaian case. This will establish the underlying nature of defence expenditure in Ghana and its effects on the economy. It also considers if the reduction in defence expenditure gives the country a peace dividend.

1.3 Research Questions

Arising from the research problem are some of the questions that need answering. This study seeks to provide answers to the following questions.

I. What type of relationship exists between defence expenditure and economic expansion?
II. What is the direction of causality between defence expenditure and economic growth?

1.4 Research Objectives

The key objectives of the study are:

I. To study the existing relationship between defence expenditure and economic expansion.
II. To examine the causal behaviour of aggregate defence expenditure and economic growth improvement.

1.5 Significance of the Study

This study focuses on Ghana, whilst using a different empirical model, econometric techniques, and additional data points. An Auto-Regressive Distributed Lag (ARDL) modelling technique will be used, different from the modelling techniques employed in similar research work for Ghana. It further examines the influence the nature of governance has on the economy. It employs a Granger Causality assessment which is absent from earlier works done for Ghana, to support the results

obtained in the empirical estimation. These results will be relevant as they employ efficient time-series modelling techniques to understand additional data on this research area.

1.6 Organization of the study

The study comprises five (5) chapters. Chapter one provides the background, research problem, research questions, objectives, methodology, contribution to literature, and organization of the study. The second chapter covers the overview of the Ghana Armed Forces, the economy of Ghana, defence spending and economic growth. A relevant literature review is in chapter three. Chapter four focuses on the methodology, data description, econometric analysis of the selected statistics and the discussion of the empirical results obtained. The conclusion of the study which summarizes the findings and limitations, and makes recommendations are discussed in chapter four. Suggestions are made for further research.

CHAPTER TWO

OVERVIEW OF DEFENCE EXPENDITURE AND ECONOMIC GROWTH IN GHANA

2.1 Introduction

The following section includes a discussion of the origin and history of the Ghana Armed Forces, its role in governance and defence expenditure in Ghana. Following this is a review of the Ghanaian economy for the period of study.

2.2 Defence Expenditure in Ghana

The Republic of Ghana is a democratic nation found in the SSA region, and a population of about 28.83 million (World Bank, 2017). In 1957, it became the first independent SSA country. Independence propelled the creation of the Ministry of Defence (MOD) in 1957 charged with defending the country from internal and external threats. This responsibility serves the economic and social function of the government by protecting citizens and property (national security interests).

The ministry also improves trade in Ghana and the sub-region by creating a peaceful environment and executing its mandate through the Ghana Armed Forces (GAF). GAF comprises the Army, Navy, and the Air Force, and is supervised and commanded by the Chief of Defence Staff (CDS) under the ministry. However, the President of Ghana is the overall Commander-in-Chief of the GAF, the "President's Own Guard Regiment" (POGR) and the Border Guard Unit (BGU). From 1966, the GAF has engaged in national politics through coup d'états, especially when some military personnel were dissatisfied with the economic situation and cuts in military privileges and

presidential activities. The first coup of 1966 against the Kwame Nkrumah regime, by the GAF and the police, led to the formation of the National Liberation Council (NLC).

The coup of 1981 was motivated by the country's downward economic health. Headed by Flight Lieutenant J.J. Rawlings, the Provisional National Defence Council (PNDC) was formed which ruled until 1993. He assumed civilian status in the last years of the PNDC and was elected in 1992 as a civilian president. He then led the country until 2001 by being re-elected in 1996. The National Patriotic Party (NPP) won the 2000 elections under the civilian leadership of H.E former president John A. Kufuor (Hutchful, 1997). J.A Kufuor ruled from 2001 to 2008, succeeded by J.E.A Mills of the National Democratic Congress (NDC) in 2009. John Dramani Mahama took over presidential roles when J.E.A Mills died in 2012. He then won the 2012 elections, ruled from 2013 and lost in 2016 to current president Nana Akuffo-Addo.

The GAF has other responsibilities aside from its primary role of providing security to the country. It provides disaster and humanitarian aid, security through peacekeeping and counter-insurgency operations (through the United Nations and the Economic Community of West African States Monitoring Group (ECOMOG) led operations. Arms of the GAF have different roles they undertake, some more specific to others. The Army is charged with roles such as patrolling, provosts, electoral observers, and de-miners. The Air Force maintains and provides defence in Ghana's territorial airspace, performs counter-insurgency operations, and provides logistic support to the army when the need arises. Whilst the Navy defends Ghana's territorial waters, protects ecological zones, and fights maritime criminal activities.

Ghana's waters, land and airspace are consistently monitored by security forces to protect the citizens against both internal and external attacks. The continuous actions of defence personnel

ensure that the state of security is maintained. By acting as a buffer during conflicts, prevention and stoppage of smuggling and illegal migration, protection of the citizenry and national borders from pirates or encroachers. These are activities undertaken by security forces to enable citizens to undertake their everyday activities. Although not all security activities are public knowledge, they contribute to the national economy. They are financed through budgetary allocations.

GAF, in addition to keeping its traditional roles, has provided educational and training services in the form of the provision of basic education schools, the GAF Military Academy, and the Kofi Annan International Peacekeeping Training Centre (KAIPTC). Provision of health services, contribution to national infrastructure, protection of national assets and territorial sovereignty and peacekeeping missions are some contributions made by the GAF. The military also contributes to the country's employment level through its annual recruitment for military and civilian employment. The 1992 constitution improved the democratic nature of defence policies arising from the need to reorganize the defence sector (Hutchful, 1997). Ensuring that budget allocations to the military are approved by parliament and the ministry which promote accountability.

2.2.1 Importance of Defence Expenditure

One definition of defence expenditure cannot be used for every country because the components of one country's defence expenditure may be non-existent for another. However, defence expenditure generally represents the amount of finance/resources a government dedicates to the running and maintenance of its armed forces. Commonly referred to as the defence or military burden of a country. However, equating this expenditure to what a country spends on weaponry and arms is an inaccurate representation of the military burden. This is because the spending activities of the military extends beyond weaponry and arms.

Omitogun (2003) highlights the importance of having access to impartial data on the military. Outlining these reasons, the promotion of democratic rule in the military, ease of communication between countries about shared security needs and the healthy discussion of resource allocation between sectors of the economy. It summarizes that the transparency of military expenditure is an important measurement tool for good governance and the interest of donors in providing aid. Additionally, military expenditure data can send a signal to the world regarding the state and strength of the country's defence. The presence of reliable data also allows the country to study history, make inferences, and understand how the economy works regarding defence expenditure.

However, despite the benefits every economic unit tries to derive from a corresponding economic activity, it comes at an opportunity cost. Military spending is no different in this case. Hence, finding the optimal level of military spending a country needs and commits is imperative. This because spending insufficiently or excessively may be a hindrance to the country's development.

2.2.2 Determinants of Defence Spending

Some determinants of military expenditure are often excluded from research studies because of the difficulty in representing them numerically (Harris, 2004). They include the quest for national prestige, accomplishing international duties (contribution to peacekeeping efforts), equating security to a strong military, pressure from domestic and foreign stakeholders (arms suppliers, beneficiaries) and the ability of the military to get budgetary allocations. The determinants included were postulated to be more than the numerical determinants outlined by earlier studies. The main determinants of military expenditure outlined included financial and economic factors (the ability for resource allocation), geostrategic considerations (perceived involvement or actual involvement in conflict) and previous levels of military expenditure.

The leadership and governance type of a country may significantly affect the resources dedicated to military activities. The priorities and goals of leadership also influence its policies and decision making. A country under military or autocratic leadership is more likely to invest more resources into the military sector than an elected government. As postulated by Collier (2006), "Military dictatorships have much higher military expenditure than democratic governments–an additional 2 per cent of GDP." The support of the military to any ruler/government increases the power of the leader in the country. Ceteris paribus, to maintain and increase their power, an undemocratic leader may use military force or backing to ensure that the ruling power is maintained. Hence the military must remain neutral in politics to ensure peace and prevent unrest among citizens.

Military expenditure could be influenced by the amount of wealth and resource abilities. Hence the resource ability of a country supports the bi-causal nature of the defence-growth nexus. Henaku (2007) also positions that for Least Developed Countries (LDCs), development priorities, socio-political stability, and political regimes account for spending on defence. Notwithstanding other findings, some studies have solely studied the drivers of military expenditure.

2.2.3 Defence Expenditure in Ghana

Ghana has active military personnel of about 15,500 and ranks 108 of 137 countries by assessing countries individually and collectively using indicators such as military manpower, equipment, natural resources, geography, financial strength and weaponry (naval, air and land strength) to create an effective and comparative index (Global Firepower, 2019). Ghana spends less than 5% of its Gross Domestic Product (GDP) on the military which shows that the country is less militarised compared to some African countries which spend about 5% or more. This is because

Ghana's average ratio of defence expenditure to GDP fell from 0.7% (1980 to 2000) to 0.5% (2001 to 2017), exhibiting a downward trend (see *Figure 2.1*).

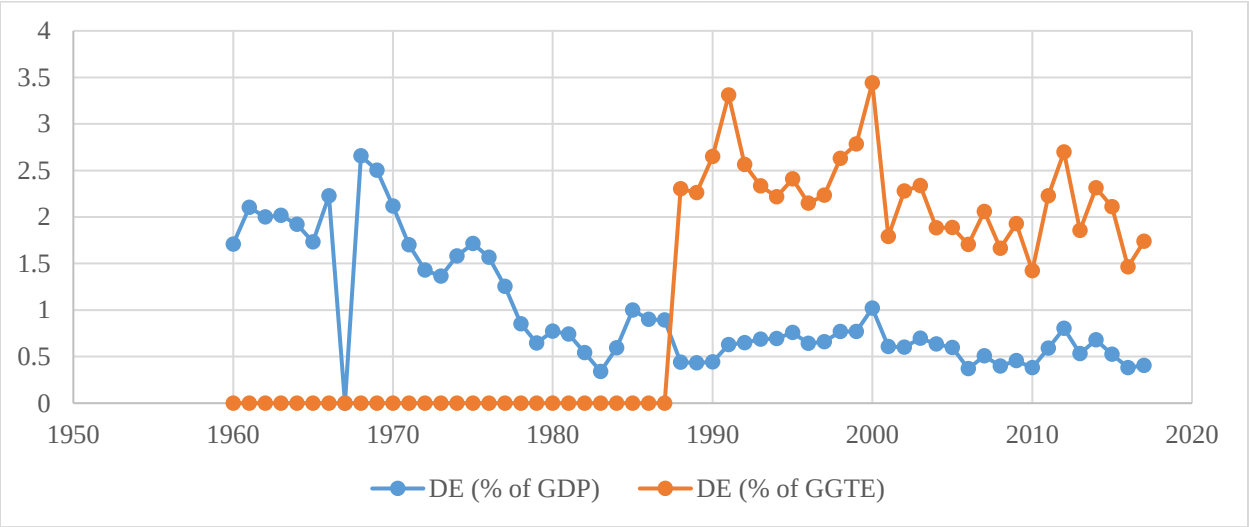

Figure 2. 1: Defence Expenditure as a ratio of GDP and Total Government Expenditure

Source: Author's estimation from the SIPRI database

Throughout the study, Ghana displayed an average of 0.62% and 2.22% of the defence burden on GDP and total general government expenditure. The defence burden exhibited a peak of 1% in 1985 and 2000. An all-time low of 0.34% in 1983. For the defence to total government expenditure ratio, the country has recorded an average of 2.22%. Defence expenditure recorded its lowest value of 9.4 million (constant US$) in 1983. Two major peaks of defence spending are in 2012 and 2014 with about 271.6 million and 267.7 million (constant US$) respectively. 1980 to 2000 exhibited a higher defence burden compared to that of 2000 to 2017 due to differences in government types.

H. E. Former President J. A Kufuor became president in 2001 from the 2000 elections. It is observed that defence expenditure jumped from US$ 49.9 million in 1999 to US$ 69.9 million in 2000. The 2000 elections may have influenced the expenditures since security measures are

increased during elections. It is observed that the years preceding elections saw a hike in expenditures from previous years. For the election years, it is noticed that there are increases in the preceding year's expenditure values (See *Figure 2.2*). The year 2011 recorded almost a double increase in expenditures from the year 2010. This boost may have originated from increments in the GDP (the boost from oil revenues), government revenue or election preparations. 1970 and 1975 exhibited peaks of defence spending which corresponds to periods of military rule and coup d'états.

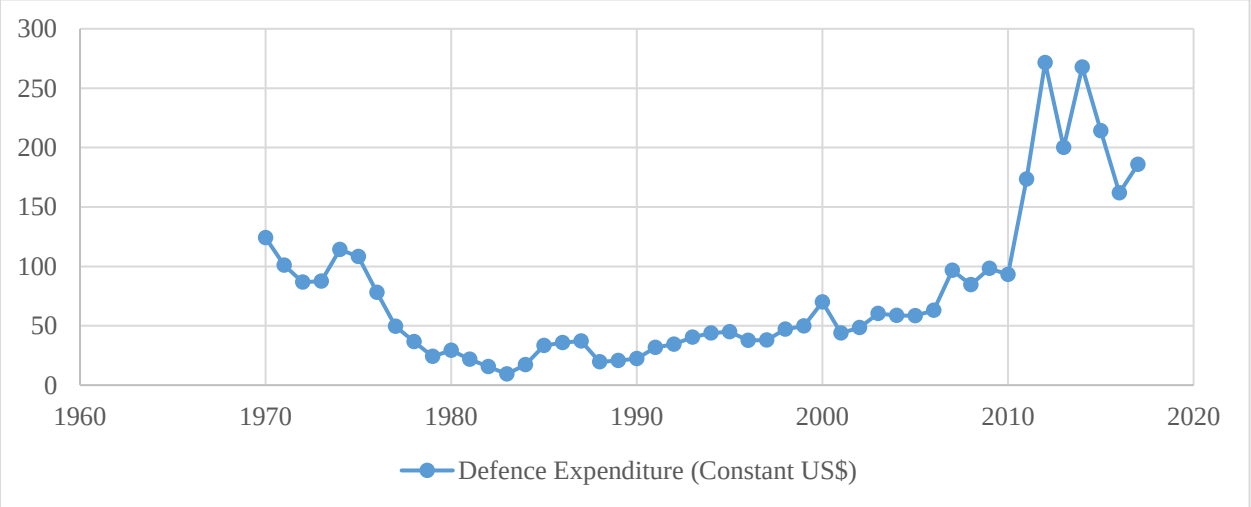

Figure 2. 2: Defence Expenditure for Ghana (1970-2017)

Source: Author's estimation from the SIPRI database

These observations show that the political environment is correlated with the number of resources dedicated to defence spending. It also shows that defence expenditure is not independent of GDP and that they may have an interdependent relationship. An empirical analysis must be done to understand the underlying relationship. Literature postulates that overspending on the military sector whilst depriving the civilian sector may be detrimental to the economy by crowding out the private sector. Just as any economic expenditure, it has either positive or detrimental effects on the

economy. Whether a productive effect or an inflationary effect is achieved depends on what the resources are used to finance.

2.3 Economy of Ghana

Ghana has experienced military rule directly and indirectly from 1966 to 2001 with short term civilian government rule. Under the leadership of Flight-Lieutenant Jerry Rawlings, the country's economic state was stabilized after the economic restructuring supported by the International Monetary Fund (IMF) and the World Bank. The Economic Recovery Program (ERP) was implemented in two phases (phase I and phase II). Before this, the economy's financial system was distorted and the economy was characterized with over-inflated exchange rates, Balance of Payment (BOP) deficits and inflation. The country then experienced growth levels which Alagidede *et al.* (2013) credited for introducing the new liberal economic policies. These policies then followed by aid and FDI led to increased investment in the public sector.

Before implementing the ERP in 1983, the country recorded negative growth rates of 3%, 7% and 5% for 1981, 1982 and 1983. (see *Figure 2.4*). The ERPs mandate was to reduce macroeconomic imbalances and to liberalize the external sector. Improvements were recorded in inflationary pressures, the balance of payments and the external sector. GDP averaged about 5% from 1985 to 1991 from a high growth rate of about 9% economic growth in 1984. However, inflation increased from 10% in 1985. Critics maintain that the ERP failed to transform the economy because it was still dependent on incomes from cocoa and the agricultural sector. Post-1990, changes and revisions were made to various laws and programs introduced with the ERP. Such policies included improving education and health care in the long run, strengthening public sector management and enlarging banking sector reforms.

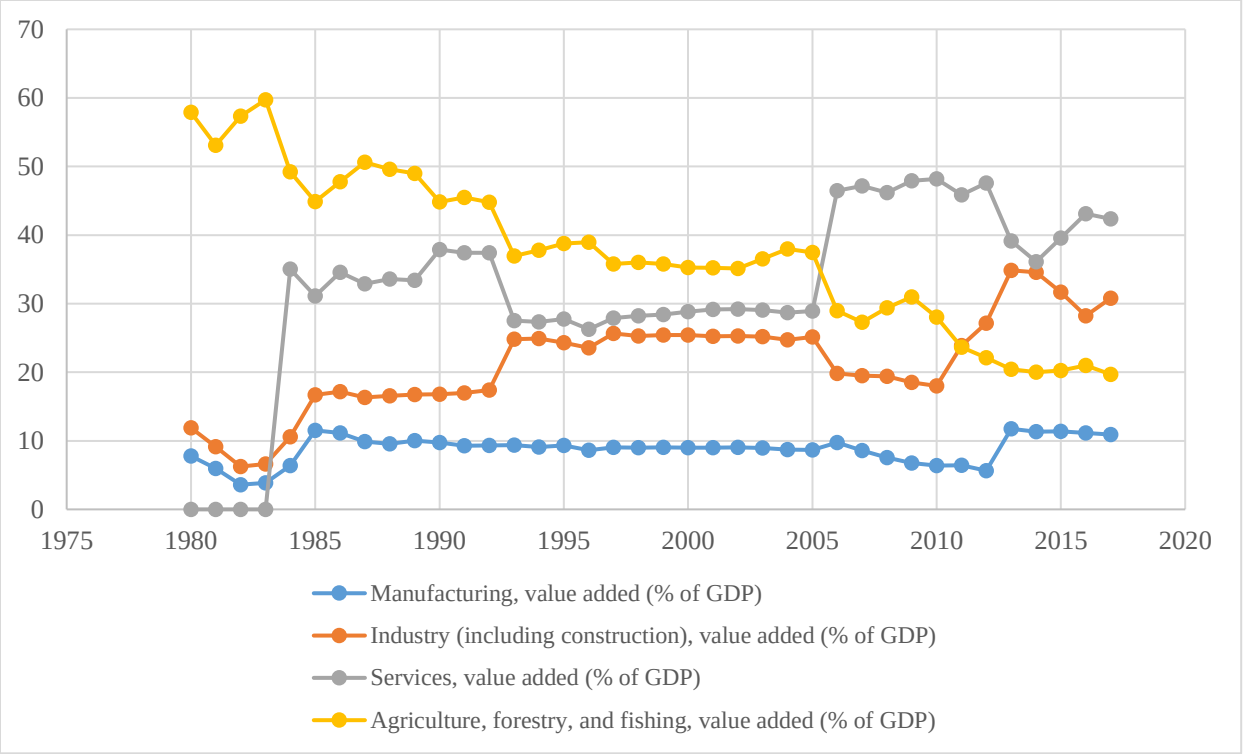

Figure 2. 3: Sectorial contribution to GDP

Source: Author's estimation from the WDI Database

The economy of Ghana is no stranger to changes in its trends and contributing factors. With different policies and recovery programs to boost economic growth, the economy has grown in various aspects. Previously dependent on the agricultural sector as a major contributor, the economy has evolved to a more service-oriented economy (see *figure 2.3*). Current growth targets of the industry and agriculture sectors are high due to programs set up by the government to boost them. The average contribution to GDP is led by agriculture, followed by services, industry and lastly by the manufacturing sector. The average contribution of agriculture to GDP remains the highest at 38% and services with 34%. This shows how much services have contributed to GDP despite starting contributions in 1984.

The service sector has grown faster than the agricultural sector. The highest contributor to GDP since 2005, whilst the industry sector overtook agriculture in 2011. The services contribution to GDP may have been spurred by the ERP's policies. GDP levels for Ghana display an upward moving trend. In 2017, high values of GDP represented a growth rate of 8.1%, an increase from 3.7% in 2016. GDP per capita income was GHS 7200, an increase from GHS 6000 in 2016. The World Bank attributed this to stable revenues from oil, gold and cocoa hence considered the Ghanaian economy as the second-fastest growing in Africa. The highest documented GDP growth rate of 14% was recorded in 2011. Oil revenues were a major contributor to the spike in the 2011 GDP value and growth (refer to Fig. 2.4). The inflation target rate currently lies between 6-10% which is about 7% to 10% points below those of 17% for 2015 and 2016.

2.4 Defence Expenditure and Economic Growth

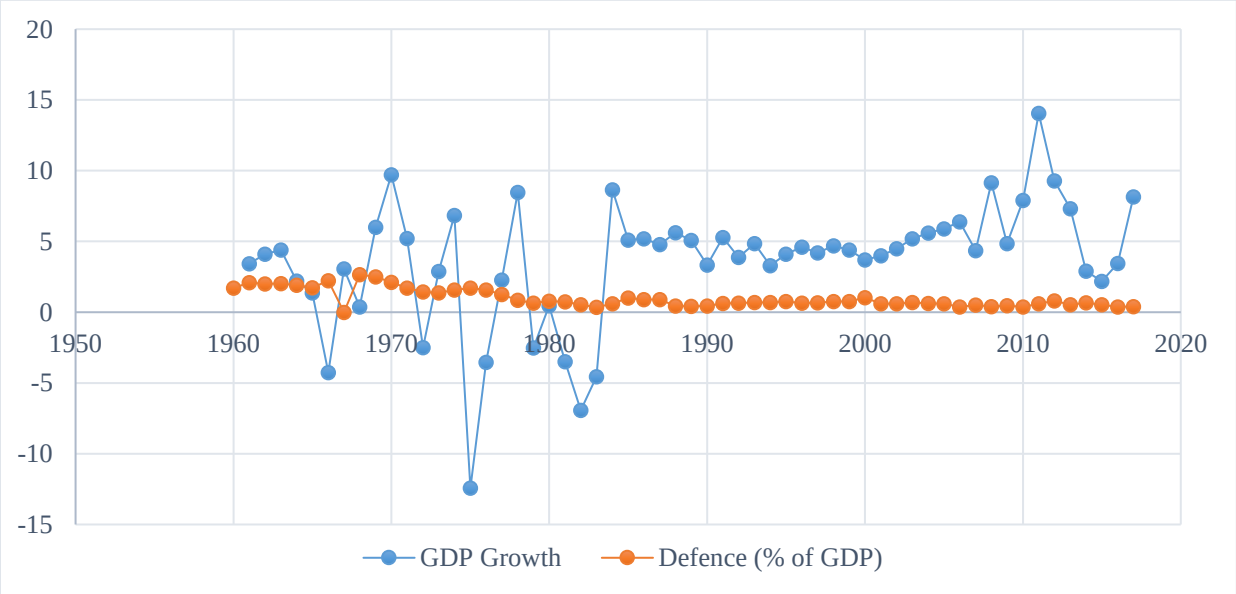

Figure 2. 4: Defence as a ratio of GDP and Economic Growth

Source: Author's estimation from the WDI Database and SIPRI

Despite dynamic changes in GDP growth rates, defence expenditure has not matched this level of growth. The defence to GDP ratio exhibits a downward trend with peaks and troughs in certain years. In the periods before 1984, the country recorded negative GDP growth rates.

Despite these negative, defence expenditure was comparatively higher than the periods after 1984. The period of study has shown constant and consistent spending on the defence sector irrespective of economic growth rates in the country. The levels of defence expenditure (as % of GDP) may be for the traditional role of the defence sector to promote peace and security and nothing more. Hence, this study seeks to determine whether this expenditure has influenced the economy and determine the direction of any underlying relationship.

CHAPTER THREE

LITERATURE REVIEW

3.1 Introduction

This chapter reviews the theoretical and empirical literature relevant to this study. It discusses the evolution of this area of research and its challenges. The first section looks at the theoretical underpinnings and models of economic growth. This section also discusses the underlying theories of the defence-growth nexus. The second section examines the empirical literature per their methodology, scope, results, and conclusions.

3.2 Theoretical Literature

Theoretical literature serves as a guide to the design and derivation of econometric models, used in empirical literature to make the analysis. Theories used by different researchers differ because of the different expected roles of the government. The beliefs held determine the corresponding expected effect of government spending on economic growth. This section discusses the theories used across the growth literature and how these theories are applied to the defence-growth literature.

Economic theory is necessary for building an empirical study; however, economic theory does not have an existing role for defence spending. A standard model where defence spending is considered an economic activity has not been found and agreed upon by economists. Existing literature, however, indicates that researchers followed the single-equation framework-based models in determining the relationship between defence expenditure and economic growth. These single equation models were the Keynesian and Classical models. From the single equation frameworks, some researchers introduced the simultaneous equation models, the second group of

empirical models. They were followed by the Barro endogenous-type model and the new macroeconomic model.

3.3 Theories of Economic Growth

Piętak (2014) discusses the difficulty in determining the determinants of economic growth and development. It asks, "If economic growth is a dynamic process, will the same factors in the same proportions determine its strength in the future?" Many theories were developed over the years to explore the channels and determinants of growth. Neo-classical economists postulated that economic growth happened through investment and the productive ability of an economy. They held labour and capital as the factors which promote economic growth, and any increments in these increase growth (true for capitalist countries). Robert Solow (1957) refuted the classicalist belief, stating that land, labour, and capital were insignificant in the growth of the US but iterated the significance of technological progress.

Contrary to the classicalists, Schumpeter (1934) focused on the importance of the entrepreneur or innovator in economic growth. He placed no importance on the role of capital as the classicalist did. This theory was developed based on the assumptions that private property, the efficiency of financial institutions and competitive markets which can support the introduction and production of new inventions this theory only thrives in countries which are democratic and economically developed. It was followed by Arthur Lewis (1954) theory which relied on savings, assuming that in maintaining a low level of spending in the short run, the savings will contribute and increase the stock of capital of the country. His study focused on poor countries which had a rich labour force. He dabbled with classicalist beliefs but did not agree with some of their methods. It made assumptions that were difficult to be accepted such as the reduction in current consumption to increase capital accumulation (having a dire effect on the poorest people).

Then came the "Kuznets's curve" developed in Blyth & Kuznet (1955) to contribute theoretically to the work of Lewis (1954). However, empirical tests demonstrated a positive relationship between the increasing share of population growth (urban) and economic growth. It proved the existence of disparities in the economy in the early stages of growth. Rostow (1960) also developed a theory of growth which highlighted the importance of capital accumulation for an economy's growth. He outlined five stages of growth and included a sixth stage which focused on the improvement of goods and services later. In its conclusion, poor countries struggled with "take-off' (the 3rd stage of growth) and proposed solving through capital accumulation. Rostow (1960) further showed that external help is helpful when the country cannot increase its capital stock accumulation.

The classicalist school of thought opined the importance of the supply on growth whilst Keynesians consider that of demand. Other economists changed existing theories by setting assumptions that were suitable and achievable for an economy. Some of these assumptions included education, institutional foundations, new growth factors (ideas, external economies, foreign investment, technology, and information).

3.4 Economic Growth Models

Piętak (2014) concludes that growth models can be classified into two, endogenous and exogenous models. He postulates that the exogenous models follow the neo-classical production function which assumes the decreasing productivity of the factors of production. Endogenous models otherwise hold that the productivity of factors of production is constant. Neo-classical models predict convergence between countries over time whilst the poorer countries are expected to grow faster than their rich counterparts. The other models hold a contrasting belief. Unlike the

exogenous growth models, government policies affect the long run permanent growth rate of the economy. In exogenous models such as the Solow model, government policies only affect the steady-state income per capita. Such neo-classical models include the Solow model and the Solow-Swan model. The Solow model is represented as Y (t) =F [K (t), A (t) L (t)]. Output depends on exogenous increases in the capital (K) and effective labour (AL), where A represents technology. Sometimes, natural resources are included as a contributing variable.

The common endogenous models in new growth literature include the AK, Human Capital and the Research and Development (R&D) models. These models hypothesize that even in the absence of exogenous technical progress, the GDP per capita still grows perpetually. The AK model is represented by Y (t) =AK (t) which is a limiting case of the Solow growth model. Its production function suggests that output depends on technical progress and capital. Output and capital grow permanently at a constant rate. The Human Capital model is represented by $\mathrm{Y(t)} = \mathrm{AH}(t)^{\alpha}[\mathrm{N(t)u(t)}]^{1-\alpha}$. Here, the output depends on human capital (H) in the absence of physical capital, technical progress (A), total population (N) and the time endowment per worker (u). The productivity of human capital accumulation is constant and permanent.

For the R&D model, R&D is represented by all innovative activities undertaken by the society. Its growth depends on the expansion and advancement of knowledge, level of human capital and resource availability. Holding a normal production function with technical progress, a different function is modelled to explain the technical progress. The production sector produces output using, $\mathrm{Y(t)} = K(t)^{\alpha}[\mathrm{A(t)N(t)u(t)}]^{1-\alpha}$ given a research (R&D) sector model of $A(t) = \theta A(t)^{\eta}[\{1 - u(t)N(t)\}^{\varphi}$. This implies that the level of knowledge A (t) is generated from R&D and increases when the population increases.

3.5 Theories/Channels of Defence Expenditure

The Guns versus Butter concept using the Production Possibility Frontier (PPF) is used to describe the trade-offs and opportunity cost of increments in defence spending. Following the traditional use of the PPF, points within the curve indicate the under-utilization of resources or inefficient utilization whilst points outside the curve are attainable. The only way a country can spend more than their available resources is by either increasing productivity or improving technology. Other than that, attaining points beyond the PPF is depends on borrowing or aid. In this case, where the resources come from and what they are used for financing, affect the economy. This is further highlighted in the channels through which defence expenditure affects the economy. Before empirical models are drawn from economic theory, the channels through which defence spending influences economic growth must be addressed. Three underlying theories are highlighted, including security, supply, and demand channels. The opportunity cost of increasing defence spending is a corresponding reduction in civilian spending.

Firstly, the security channel addresses the basic need for defence expenditure. The government spends on security in fulfilling its primary duty of protecting its citizens. A high sense of security has a positive effect on the market, social and investment environment. This implies that a country with high levels of security with no external or internal threat is more likely to increase output and growth. Besides, a country where the citizens believe themselves to be safe from all threats physical, social, and political influences the general perception of the country domestically and internationally. The effective role of government is clear in all Keynesian theories. They believe that government intervention is necessary to boost and drive the economy. However, Keynesian economists do not believe in the self-correcting nature of the economy and that is why government intervention is required in any economy. The government is needed to help navigate the rigidities

found in the labour market. Keynesian economists believe strongly in the role of expansionary fiscal policies in addressing the problem of recessions by either increasing spending or reducing taxes.

The Keynesian hypothesis focuses on the Keynesian multiplier effect, aggregate demand (AD) and its corresponding effects on the macroeconomy. This approach typically expects a positive return on economic growth because of defence spending. According to this theory, increments in government spending add to aggregate demand and increases the output levels, employment and economic growth through the multiplier effect. Per this theory, it is assumed that an increase in defence expenditure which is a component of government spending also increases economic growth. The ability to improve both physical and human capital by higher military spending in developing countries is a key contribution made by defence spending. This contributes to the economy by the training of skilled human capital which if used properly contributes to sustainable development.

The Keynesian approach presumes a positive effect of defence expenditure on growth, but the results may not always be the case because of the unpredictable nature of the market and the economy. Criticisms levied against the demand effects of defence spending include the crowding-out effect of an increment in defence spending. The crowding-out effect affects the private sector or investment through increases in the interest rates due to excess demand over supply for funds. Since an increment in defence spending is financed by borrowing, increasing taxes, cuts in other government expenditures (health, education, and infrastructure) or increasing the money supply. The crowding-out effect fully depends on how the resources are financed and used. Some studies which used the Keynesian approach include Smith (1980) and Faini, Annez and Taylor (2005).

The last channel through which defence expenditure affects growth focuses on classical economic theories. The neoclassical school of thought opposes the important role of the government in the economy. This is based on their strong assumption of the flexible nature of variables in the labour market which include prices and wages. Its self-correcting nature ensures that any situation other than the equilibrium is temporary and is expected to correct itself in the long run. They deem fiscal policies (government spending and taxation) ineffective due to the crowding-out phenomenon arising out of increments in the interest rates. They, therefore, view the effect of increased government spending to harm growth.

The neo-classical approach depends on the role of aggregate supply (AS) in the economy through factors of production as labour, human and physical capital, natural resources, and technology. It is believed that the combination of these factors decides the final output. There may be infrastructure and human capital externalities from the defence to the civilian sector. Research and development stemming from the military could also be a positive externality. However, it is further theorised that the military competes with the civilian sector for natural resources, human and physical capital, and technology, etc. This focus addresses the guns versus butter trade-off. Studies which used this approach include Alexander (1990) and Sezgin (2001).

3.6 Defence-Growth Empirical Models

Demand-side model

One type of the single equation model, the Keynesian model is also referred to as the demand-side model since it focuses only on the aggregate demand-side of the economy. This model has its foundations in the work of Smith (1980). However, this model was often criticized for its inability to consider supply-side issues. Its equations are derived from the Keynesian cross-function.

Studies such as Smith (1980); Shahbaz, Afza, and Shabbir (2013), Faini *et al.* (2005), and Lim (1983) followed this model.

Supply-side model

The neo-classical single equation model is also referred to as the supply-side or the Feder-Ram model. It is called the supply-side because of its dependence on the role of aggregate supply/aggregate production function (AS) and Feder-Ram because the model is inspired from the works of Feder (1983; 1986) and Biswas and Ram (1986). Biswas and Ram (1986) was the first to modify Feder's (1983) model of the export-growth nexus in a cross-country study by introducing the defence expenditure. The approach is seen to provide a formal justification to include military expenditure as an explanatory variable in a single-equation growth regression analysis, which is 'grounded in the neoclassical theory of growth (Mintz & Stevenson, 1995), or at least 'fairly well-grounded in the neoclassical production function framework' (Biswas & Ram, 1986).

The model is a two-sector empirical model where the civilian and military sectors are differentiated. The two sectors use similar labour and capital, and the civilian sector gets externality benefits from the military sector. It should be noted that some researchers in trying to achieve their objectives have changed it to be a three-sector model. Dunne *et al.* (2005) however suggest that "there seem to be strong theoretical and econometric reasons not to use the Feder-Ram model" and further postulate that the model was common in older literature because of its ability to provide a direct link from theory to empirical analysis. Studies such as Yildirim, Sezgin, and Öcal (2005) and Biswas and Ram (1986) used the Feder-Ram model in investigating the effect of defence expenditure on economic growth. Sandler and Hartley (1992) state that the nature of supply-side models causes them to have a positive effect on growth unless the net productivity

effect is negative. This only happens when the defence sector as compared to other sectors showcases high negative productivity.

Augmented Solow Model

The augmented Solow model was initially introduced by Mankiw, Romer, and Weil (1992). Dunne, Perlo-Freeman and Soydan (2004) indicate that the augmented Solow model was derived to address the static nature of the Feder-Ram model, reduce the occurrence of multicollinearity, exclude non-military expenditure and also remove the externality effect of defence expenditure on growth. The model revolves around a neo-classical production function with labour-augmenting technological progress. This model incorporates capital, labour and technological progress whilst keeping the standard Solow model assumptions. Technological progress is affected by autonomous technology and military expenditure. Military spending may have a permanent level effect on per capita income but not a long run effect on steady-state growth rate.it is a one-sector model as compared to the two-sector nature of the Feder-Ram model. Dunne *et al.* (2004) conclude that due to the tight nature of the empirical model some important variables are left out. They further state that military expenditure affects output in an ad hoc manner since military expenditures are not expected to affect technology.

Simultaneous Equation Model

This model is also called the Deger-type model based on the work by Deger and Smith (1983). It was introduced to overcome the respective problems of the single-equation framework models. These problems included the failure of the single-equation models to account for the simultaneous relationship between economic growth and defence expenditure. It incorporates the demand and supply sides from the aggregate production function in deriving a growth equation and model. This

model is often criticized for not analysing the long run relationship in its estimations because of the variables used. Halicioğlu (2010) criticizes this model for not including monetary policy effects on the economy.

Endogenous Model

An endogenous model follows that economic growth is an outcome of endogenous, not external forces. The Barro (1990) growth model is an endogenous model. It is a model which permits for different government expenditures financed by taxes. The model holds that government expenditure has a non-linear effect on the growth of the economy through the productivity-improving and tax altering effects of an increment in government spending. Aizenman and Glick (2006) used the Barro model in their paper by using the model solely to suggest the variables that were used in their analysis. Their model postulates that military spending caused by external threats increases output (through the increase of security) but spending for other non-threat reasons reduces economic growth. This is because spending not for external security reasons, but personal reasons shift productive resources from certain viable economic activities. The Barro model is preferred to the augmented Solow model as it has fewer variable restrictions. Aizenman and Glick (2006) conclude further that in the presence of a high threat, output increases and vice versa.

Macroeconomic Model Introduced by Atesoglu

The macroeconomic model derived by Atesoglu (2002) was introduced as an alternative to the Deger-type models. It was used to address the specification and econometric problems observed. As both theoretical and empirical models have evolved, the econometric estimations have also evolved. This model was inspired by the work of Romer (2010) and Taylor (2000). Jiang and Guo

(2014) also emulate this model in studying the relationship between defence spending and aggregate output in China.

3.7 Empirical Literature

Existing literature could be classified into those that found positive results and support the Keynesian point of view, those with negative results and refute the Keynesian point of view and those that resulted in insignificant or inconclusive conclusions. The diverse nature of the results is often contingent on factors such as externalities from defence expenditure, how the expenditure is financed and how it is used. The inability of literature to come to a single conclusion and the use of different empirical models show a need for further empirical studies until the most suitable model to explain this relationship is found. Reasons that were given to support positive results included the importance of national security to economic activities, the promotion of human and physical capital development through defence spending, the promotion of R&D, increment in aggregate demand and the spin-off effects of spending on technology and infrastructure.

Significant negative outcomes were attributed to the diversion of resources from productive to unproductive ventures, crowding out private investment, the reduction of productivity, deterioration of the fiscal situation (the use of foreign exchange to purchase arms) and the hindrance and reduction of domestic savings. Insignificant outcomes were explained by; defence spending not large enough to warrant a significant effect, the model could not fully explain the relationship accurately, defence expenditure did not affect the economy and the insignificant explanatory relationship among the independent variables. Tiwari and Shahbaz (2012) conclude that “However, from the empirical point of view, there is no clear-cut agreement among the researchers on the nature and extent of the growth effects of military spending.” Which further

highlights the importance of this study in re-analysing the defence expenditure-economic growth nexus for Ghana by using a different macroeconomic model and incorporates improved econometric tests.

The following is a summary, albeit short of some empirical defence literature since its first inquiry. The seminal work of Benoit (1973) involved the employment of the Spearman rank correlation and OLS (Ordinary Least Squares) techniques to explain the relationship and direction of causality between economic growth and military expenditure. He discovered in his paper that military expenditure had a positive effect on the economic growth of forty-four (44) LDCs for the period of 1950 to 1965. His results differed from what he had expected, he surmised that the negative effects he expected were offset by some unknown and unexpected positive effect of the contributions of the military. Benoit did not account for the simultaneity bias present as he questioned what the direction of causality (economic growth affecting military expenditures and vice versa) was for the variables under his study.

Stewart (1991) challenged the results of opposing economists by finding that defence and non-defence burdens had an increasing growth effect over a long period. He further stated that non-defence expenditure had a larger effect than defence spending. He concluded that generalizations could be made about the impact of defence spending by challenging economists who hold that the effects of defence on growth are not constant and consistent over different countries and continents. However, the estimating sample size was too small to make such a broad conclusion as his study only covered 13 African countries which are not representative of the continent. Mueller and Atesoglu (1993) further discovered a positive effect of military spending on growth for the US by incorporating technological change into a two-sector Feder-Ram model. Positive

outcomes were further supported by Narayan and Singh (2007) in their study of the Fiji Islands. They also established that there is a positive impact of defence spending on growth. They credited this positive impact on the export sector. They employed a production function within a multivariate framework and incorporated export as a new variable to achieve their objectives.

Atesoglu (2002) utilized an econometric model inspired by a macroeconomic theory and augmented for defence expenditure. The cointegration methodology introduced by Engle, Robert and Granger (1991) was used on quarterly defence expenditure data from the period 1957:2 to 2000:2. A cointegration model was used to extract the information in the time-series which was ignored in the models such as the Feder-Ram model. This was done to avoid spurious regressions and allow the estimation of the long run relationship that was absent from earlier time-series model estimation. His conclusion indicated that there was a significant positive effect of defence spending on the United States (US) macroeconomy. Changes in defence spending were expected to cause changes in the long run equilibrium with non-defence spending having a larger effect as compared to defence spending. His criticisms of Sezgin (2001) included the static nature of the Feder-Ram model and the exclusion of the effect of monetary policies on the economy.

Sezgin previously discovered a positive effect of military spending on economic growth in both the short and long run. Sezgin's (2001) study involved the re-estimation of his earlier work and was done by the addition of lags and the test for stationarity. The results of the study were significant and highlighted the positive relationship that existed between human capital and economic growth. Ando (2008) also discovered a significant positive relationship between economic growth and defence spending of 109 countries which included 30 OECD countries. The results indicated a growth effect of defence spending on the economy. This relationship was

studied using the Feder-Ram model which showed that, defence spending did not harm growth for the period of study. Halicioğlu (2010) used the macroeconomic theory which was introduced by Atesoglu and the Johansen (2006) multivariate cointegration technique. The period of study for Turkey from 1950 to 2002 led to the conclusion that "The impact of the military expenditures on real output level is strong and positive, half the size of the real non- defence expenditure."

Tiwari and Shahbaz (2012) also used different unit root tests, and the Autoregressive Distributed Lag (ARDL) cointegration bounds testing model to re-investigate the effect defence spending has on the economic growth of India. The results of the study highlighted a positive relationship between defence spending and economic growth although it was not positive beyond a certain threshold. All the variables exhibited a long run relationship. Investment and trade openness were positively related to economic growth whilst interest rate exhibited a negative relationship. A bidirectional relationship was also observed from the short run Granger causality test between economic growth and defence spending, between trade openness and defence spending.

Apanisile (2013) corroborates the work of Omitogun (2003) and Yildirim and Öcal (2016) who discovered a positive relationship between military expenditure and aggregate output. They used the ARDL bounds testing approach to cointegration to examine the effect of military expenditures on aggregate output in Nigeria. The results showed a significant positive long run and negative short run effect of military expenditure on output. They found a significant positive effect of labour and capital on output whilst a negative effect of inflation on output was discovered. They concluded by indicating that military expenditure contributes to the economy and highlighted the importance of human and capital development.

Benoit's work pioneered an increased level of enquiry into this area of research, as his results opposed the beliefs held by economists. This is seen in Smith (1980) who reported a strong negative effect of military expenditure on investments which in turn impeded growth. Before Benoit's (1973) study, most of the theoretical economists assumed the economic impact of military expenditure to be negative due to the expected trade-off with civilian expenditures and growth. His results which conflicted with the beliefs held at the time led to new contributions to this area of research. With some researchers taking an interest in the political and other macroeconomic aspects of this area study. His work was disputed by some economists such as Deger and Smith (1983) due to some econometric and theoretical problems they found.

In investigating the relationship between military expenditures and economic growth in 50 LDCs, Deger and Smith (1983) employed a cross-sectional estimation for the period of 1965 to 1975. They found a positive yet small effect of military spending on growth. They attributed this to modernization and a larger negative effect which outweighed the positive effect. Their results indicated a negative net effect of military spending on economic growth which was observed through the savings channel. Deger and Smith (1983) also argued that growth can be impeded by increases in military spending. An increasing balance of payment problems since most LDCs use foreign exchange to purchase arms from developed countries, the country suffers because of the opportunity cost (butter versus arms) of purchasing arms which could have been used in another economic activity.

Lim (1983) cross-sectional analysis indicates that defence spending negatively impacts economic growth. No significant relationship could be observed between the two variables in Asia, the Middle East and southern Europe. Dunne and Vougas (1999) studied the long run relationship

using causality techniques for South Africa for the period 1964 to 1996. They also concluded that there was a negative and significant impact of defence on growth. An inverse relationship between defence spending and economic growth is also observed in Klein (2004). Here, Deger type simultaneous equations were used to find the net effects of defence spending on the economy of Peru. The study indicated that the stride of economic growth was affected by defence spending as the overall effect was negative from the crowding-out effect.

The work of Gyimah-Brempong (1992) involved the study of 39 African countries within the period of 1973 to 1983 by examining how GDP growth rates were affected by an increase in the defence burden. His results indicated that; defence spending affected growth through the effects it had on the civilian sector through investment rates and skilled labour. He then concluded that economic growth was not affected directly by defence spending, by observing that the effect of defence spending was significantly negative. Huang and Mintz (1991) also attempted to study the causal relationship for the US by employing a three-equation model. They tried to determine if any externality effects came from defence expenditure to growth. The results of their study indicated a negative relationship between military spending and economic growth.

Oyinlola (1993) obtained mixed results, by observing a positive effect of the defence sector on growth of GDP while also showing a negative effect on the economy through the import sector. The net economic outcome observed for Nigeria was negative. Karagol and Palaz (2004) used the Johansen multivariate cointegration approach to examine the relationship between defence spending and economic growth for Turkey. They discovered a long run relationship and concluded that an increase in defence spending has a hindering impact on the economy of turkey. Birdi and Dunne (2016) further investigated for the case of South Africa, the relationship between military

spending and economic growth using the Feder-Ram model. They discovered a significant outcome between the two variables. They concluded that for South Africa, military spending impedes the economic performance for a short period with a feedback effect.

Knight, Villanueva, and Loayza (2014) explored the relationship between economic growth and military expenditure from 1970 to 1985 for 79 countries. Their results showed a negative and statistically significant relationship between military expenditure and economic growth. This conclusion was drawn by employing a panel analysis and regressing output levels to population growth rate, the ratio of investment to GDP, the ratio of military expenditure to GDP and openness of the economy. Abu-Bader and Abu-Qarn (2003) also investigated the relationship between military spending, government non-military expenditures and economic growth for Egypt, Israel, and Syria. The study aimed to determine whether the country enjoyed peace dividends by reducing military expenditures. By employing multivariate cointegration and variance decomposition techniques, their results indicated an inverse relationship and impeding behaviour of military spending on economic growth in all the countries. Although Israel and Egypt displayed a positive relationship between civilian government expenditures and economic growth.

Hou and Chen (2013) in their attempt to explore the effect of military expenditure on economic growth in developing countries in Africa, Latin America and South Asia used the Augmented Solow growth model. They studied 35 developing countries from 1975 to 2009 by employing the system Generalized Method of Moments (GMM) estimators and used the neoclassical growth model as a theoretical base. This panel study empirically resulted in a statistically significant and negative effect of defence expenditure on growth in the sample of developing countries. For the relationship between defence spending and economic growth in Pakistan, Shahbaz *et al.* (2013)

utilized the ARDL approach to cointegration. With an empirical analysis of data covering the period of 1972 to 2008, the results of the empirical analysis implied that: there was cointegration among the variables economic growth, military spending, government spending and interest rates. The empirical analysis indicated a negative coefficient of military spending and a positive impact of non-military spending on economic growth for the economy of Pakistan. An inverse relationship was observed between interest rates and economic growth whilst a causal relationship running from military spending to economic growth was observed.

By assuming that the relationship between growth and defence will be positive and statistically significant, Looney and Frederiksen (1986) extended the work of Benoit (1973). They used a three (3) sector Feder-Ram model to study the relationship between economic growth and defence expenditure based on resource constraints. They introduced a cluster analysis based on resource constraints which were used on the exact sample size, data, and method used by Benoit. The countries were grouped according to the availability of financial resources and used ridge regressions were employed to address multicollinearity issues. The outcome of their study differed from Benoit's (1973). Looney and Frederiksen (1986) conclude, "defence expenditure in countries which are comparatively resource unconstrained, compete less for scarce resources. Because of their other positive aspects (education, linkages with industry), defence expenditure may play an important and positive role in increasing growth. Countries suffering from a lack of foreign exchange and government revenues, experience the reverse."

Alexander (1990) also found no causal relationship by using a four-sector Feder-Ram model. The conclusion was drawn after a cross-sectional analysis of the relationship between military spending and economic growth for nine developed countries was investigated. Likewise, Deger and Sen

(1983) concluded that the positive spin-off effects of military expenditure on economic growth as suggested by some authors was overrated and that an increase in military spending plays an insignificant role on development. Dakurah, Davies and Sampath (2001) concluded that there was a lack of evidence to support a causal relationship between military spending and economic growth. This conclusion was made based on the outcome of their causal analysis study. Their study used the Granger causality test to a sample of 68 developing countries for 1975-1995. Evidence of a unidirectional relationship from military spending to growth and from growth to military spending for, different countries. Lack of evidence of a feedback relationship between the two variables in other countries led them to conclude that the lack of evidence may be due because of estimation and testing errors.

The study of Chowdhury (1991) investigated the causal relationship between defence expenditure and economic growth. Unlike previous studies, he used Granger causality tests for fifty-five (55) LDCs to study the existence and direction of causality among expenditure and growth. There were varying results for the countries with some showing a positive correlation between defence and economic growth and others showing a negative relationship. A single conclusion about correlation could not be made for all the countries due to differences in the economies and governments of countries. Positive causal relationship from defence spending to growth for 7 countries, 15 countries showed a causal relationship, 30 countries indicated no causal relationship and 3 countries showed a bidirectional causal relationship. Stroup, Michael and Heckelman (2001) used a Barro-type model which set controls for political and institutional variation across countries to study the effects of defence spending and military labour on growth. Their study involved 44 countries in Africa and Latin America from 1975 to 1989 whilst controlling for country-specific variations. They discovered that the effect defence expenditure has on growth is non-linear and

concave, implying that growth is positive at low levels of military spending but is negative at higher levels of military expenditure.

Heo (2010) empirically studied the relationship between defence spending and economic growth for the United States by employing both the Feder-Ram based model and the augmented-Solow model. A comparison of the results from both models was done which showed that defence spending did not have a significant effect on economic growth. He adopted the augmented-Solow model recommended by Dunne *et al.* (2005) because of weaknesses such as multicollinearity and simultaneity issues that were found in the Feder-Ram model. He tested the defence-growth nexus from 1954 to 2005. The results obtained from both models showed that defence spending did not have a significant effect on economic growth in the United States. Although both models faced multicollinearity issues, it did not influence the results obtained. This study concluded that "the relationship between defence spending and economic growth in the United States is statistically insignificant regardless of the models used to examine the relationship." Before this study, Heo (1999) used different versions of the Feder-Ram model. The results were still insignificant, the same as his recent findings for the US.

A study of the relationship between military expenditure and economic growth for South Africa by Batchelor *et al.* (2002) employed the neo-classical model backed by the theory of the aggregate production function. The results indicated an insignificant impact of military expenditure on economic growth. He assumed that the military sector had externality effects on the economy. The study showed that economic growth for South Africa was only partially explained by the postulated model. Jiang and Guo (2014) also discover that the effect of an increase in defence spending on the economy is dependent on the period. From 1952 to 1978 a positive effect is noticed

and the period of 1978 to 2009 showcased a significant negative effect. The long run relationship indicated an inverse relationship hence, they concluded that defence spending for China is important and sensitive to modelling and econometric techniques.

Addy (1998) used a simultaneous equation model to study economic growth and military expenditure in Ghana. The study covered the period of 1966 to 1995 and concluded that there was a positive relationship between real military expenditure and economic growth. The results showed that military expenditure had a positive effect on the growth of the country. The positive effects were attributed to improvement in human capital formation, skills and knowledge that were found in the military sector. He also concluded that military expenditure promoted growth by influencing productivity and efficient input-allocation in the private sector. He did not add the democratic state of the country into his analysis which opened a gap to be filled in future works of literature.

Henaku (2007) studied the relationship between economic growth and military expenditure for Ghana. He made provision for the endogenous nature of the variables under study by introducing simultaneous equations for both economic growth and military expenditure. His study covered the period of 1970 to 2007 by introducing the democratic nature of the country in his empirical analysis. He discovered in his analysis that there was a unidirectional causal effect of output (real GDP) levels to military expenditure. The insignificant effect of military expenditure on growth levels was attributed to the military not having given much attention, been under-resourced, equipment being outmoded or outdated despite the skills and know-how of the Ghanaian military. He also asserted that major projects undertaken by the military are financed with foreign funds. He concluded that the short run had a negative and statistically significant effect on growth whilst the effects of military expenditure are insignificant in the long run. The positive effect of output

(GDP) growth on military expenditure was higher and more statistically significant in the long run as compared to the short run.

This chapter provided a review of theoretical and empirical literature relevant to this area of research. The review of the literature indicated that empirical results are contentious since every study arrived at a different conclusion. This study differs from other literary work which focused on Ghana in terms of data, model, and methodology. Due to the conflicting nature of the results obtained by earlier studies like Alexander (1990), Addy (1998), Dakurah *et al.* (2001), Stroup *et al.* (2001), Henaku (2007), Tiwari *et al.* (2012), and Hou *et al.* (2013). This study seeks to reinvestigate the outcome of the defence-growth nexus by following Atesoglu's (2002) macroeconomic model. This study employs the ARDL modelling technique to address any endogeneity problem which Henaku (2007) addressed using simultaneous equations. A Granger-causality test which is absent from previous studies is used to determine the direction of any causal relationship.

CHAPTER FOUR

METHODOLOGY AND EMPIRICAL ANALYSIS

4.1 Introduction

Methodological assumptions and the approaches of the study are explored in this chapter. It provides data, estimation methods, research methods and expected outcomes of the relationship between defence spending and economic growth. This chapter focuses on the macroeconomic model used by Atesoglu (2002). It also discusses the estimation techniques employed in this study and the discussion of the results attained.

4.2 Econometric Framework

4.2.1 The Macroeconomic Model Augmented with Defence Expenditure

This model replaces the Investment Savings-Liquidity Preference Money Supply (IS-LM) and Aggregate Demand-Aggregate Supply (AD-AS) models by using the augmented Keynesian cross. Inspired by the work of Romer (2000) and Taylor (2000), it was introduced by Atesoglu (2002) and modified to accommodate defence expenditure as an independent variable. This model is used to determine the standalone effect of defence expenditure on aggregate output and to avoid the problems presented by the models employed in earlier studies. It follows the total identity approach which explains the circular flow of income in an economy. Total government expenditure is assumed to have two (2) major components including defence expenditure and non-defence expenditure (other government expenditures).

However, this model differs slightly from the traditional Keynesian cross model in the way it addresses variables such as interest rates and exports. As postulated by Atesoglu (2002), “In the traditional Keynesian cross model, investment is assumed to be a function of the nominal interest

rate rather than the real interest rate." In the traditional Keynesian cross model, net exports are assumed to be a function of real income rather than a function of real income and the real interest rate. Where the original version explores the endogenous nature of interest rates, this model assumes the exogenous role of interest rates to directly ascertain the effect of defence spending on aggregate output.

4.2.2 Model Specification

Following the work of Atesoglu (2002), the empirical equation is derived from the Keynesian cross model as in equation (4.1).

$$Y_t = C_t + I_t + X_t + GE_t + DE_t \quad (4.1)$$

Where, Y_t = real Aggregate Output (real GDP), C_t = Consumption, I_t = Investment, X_t = Net Exports (Exports minus Imports), DE_t= Defence Expenditure and GE_t= Non-Defence Government Expenditure in real terms.

In the derivation of the model, the equations for the endogenous variables are introduced into the model. Equations (4.2) to (4.5) represent the consumption, tax, investment and net export functions respectively. The variable T_t in equation 4.3 is real taxes, R_t in equations 4.4 and 4.5 represents interest rates whilst all the other variables remain as already defined.

Therefore,

$$C_t = a + b(Y_t - T_t) \quad (4.2)$$

$$T_t = c + dY_t \quad (4.3)$$

$$I_t = e - fR_t \quad (4.4)$$

$$X_t = g - hY_t - iR_t \quad (4.5)$$

4.2.3 Derivation of the New Macroeconomic Model

Substituting equations (4.2) to (4.5) into equation (4.1) to get 4.6,

$$Y_t = a + b(Y_t - c - dY_t) + e - fR_t + g - hY_t - iR_t + DE_t + GE_t \quad (4.6)$$

Making Y_t the subject, the reduced form equation is:

$$Y_t = \frac{1}{(1-b+bd+h)}[(a - bc + e + g) - (f + i)R_t + DE_t + GE_t] \quad (4.7)$$

$$Y_t = \beta_0 + \beta_1 DE_t + \beta_2 GE_t - \beta_3 R_t + \mu_t \quad (4.8)$$

Where; $\beta_0 = \frac{(a-bc+e+g)}{(1-b+bd+h)}$; $\beta_1 = \frac{1}{(1-b+bd+h)}$; $\beta_2 = \frac{1}{(1-b+bd+h)}$; $\beta_3 = \frac{-(f+i)}{(1-b+bd+h}$

Equation 4.8 is the reduced form equation to be used for estimation. $\beta_0, \beta_1, \beta_3 > 0$ and $\beta_3 < 0$. β_1, β_2 and β_3 are the coefficients determined from the reduced form equation for defence expenditure, government expenditure and interest rate respectively, and β_0 represents the intercept term. μ_t is the stochastic error term.

4.3 Estimating Equation

A political instability dummy is introduced into the reduced form equation (4.8) for the political state of governance. Henaku (2007) supports this addition as it can demonstrate the politico-economic nature of Ghana for the sample period. It also encourages the inclusion of labour and capital variables into equation 4.8 for model specification. The estimating variables are then specified in natural logarithmic forms to linearize the data, prevent spurious regressions and results. Emphasised by Karagol (2006) that simple linear specification provides inefficient and unreliable empirical results due to sharpness in time series in developing economies. However, the

interest rate(R_t), labour(L_t), capital(K_t), and political instability(POL_t) variables remain unlogged due to their respective percentage and dummy nature. To estimate the effects of defence expenditure on output, the following functional model is specified:

$$Y = f(DE, GE, R, L, K, POL) \quad (4.9)$$

Taking the logarithm of DE, GE, and Y.

$$lnY_t = \beta_0 + \beta_1 lnDE_t + \beta_2 lnGE_t - \beta_3 R_t - \beta_4 L + \beta_5 K - \beta_6 POL + \mu_t \quad (4.10)$$

4.4 Description and Measurement of the Estimating Variables

Gross Domestic Product (Y): Real aggregate GDP is the independent variable and a proxy for economic growth. Real GDP measures the productive ability of a country across the years and enables empirical comparisons. An increase in the real GDP implies that the economy has experienced some level of growth. It is expected that as GDP grows, the welfare and standard of living increases.

Defence Expenditure (DE): It represents the resources the country dedicates to the military and shows the amount of burden the military places on the government. It includes all current and capital expenditures on the armed forces such as peacekeeping forces, government agencies and ministries for defence (*see SIPRI definition*). The Keynesian hypothesis expects a positive effect on GDP. Whilst the neoclassical hold that, defence expenditure crowds out private sector investment by raising interest rates. Literature such as Smith (1980), Chowdhury (1991), Gyimah-Brempong (1992), Halicioğlu (2010) and Tiwari and Shahbaz (2012) have contrasting results.

Non-Defence Government Expenditure (GE): General government expenditures are expected to have a positive effect on GDP levels since it is a component of GDP computation. Nominal GE is

derived from subtracting DE from General Government Total Expenditure (GGTE). Literature, however, holds that government expenditure may or may not promote economic growth. The effect of GE depends on its activities. If used on productive activities, it will enhance growth, otherwise, it puts inflationary pressures on the economy. The expectation of this study is the positive effect of government spending on GDP per the Keynesian school of thought.

Interest Rates (R): The monetary policy rate is set by the Monetary Policy Committee (MPC) to achieve set economic goals the country seeks to attain. This policy rate is set by taking economic indicators such as inflation rates or the consumer price index (CPI) into consideration. It sets a base for all other interest rates used in the country. The real interest rate is computed by extracting the inflationary rates. Interest rates affect the investment capabilities of a country. High-interest rate reduces investment since it implies that the cost of borrowing has increased.

Labour (L): The annual population growth rate is used as a proxy for the labour force. As the population increases, more people join the labour force. However, for the population growth rate to influence economic growth, it must be supported by a skilled and knowledgeable labour force, and infrastructural development. Labour as a factor of production increases labour force due to population growth, hence the total output may increase which increases the GDP. When population growth induces growth in the labour force, it may cause wages to fall which reduces the cost of production and increases the profitability of firms.

Capital (K): Capital improves the productivity of labour and companies in economic activities. Hence it is expected to have a positive effect on GDP. It includes land improvements such as fences, ditches, drains; plant, machinery, equipment purchases; and the construction of roads, railways, schools, offices, hospitals, private residential dwellings, and commercial and industrial

buildings (WDI). The gross fixed capital formation (% of GDP) is used to estimate the level of investment of the country.

Political Instability (POL): This variable separates periods of democratic and military rule. Periods of military intervention/takeovers are represented by 1 whilst 0 is used to represent periods of democracy/governmental rule. Political instability is expected to have an impeding effect on the economy by negatively impacting on socio-economic environment and innovation. Peace and stability provide the freedom to undertake productive activities and improves investment.

Table 4. 1: Measurement and the expected a priori signs of the variables

Variables	Denotation	Unit	Expected sign
Gross Domestic Product	Y	GHS	
Defence Expenditure	DE	GHS	Positive (+)
Non-Defence Government Expenditure	GE	GHS	Positive (+)
Interest Rates	R	Percentage (%)	Negative (-)
Labour	L	Percentage (%)	Positive (+)
Capital	K	Percentage (%)	Positive (+)
Political instability (years before 1993)	POL	Dummy	Negative (-)

Source: Author's compilation

Note: Nominal variables are deflated using the consumer price index (2012=100)

4.5 Data Sources

Data are annual time series and slated for the period 1980 to 2017. This sample period is selected because of data availability. Data sources include the International Monetary Fund's (IMF's) *International Financial Statistics (IFS) various issues*, World Economic Outlook (WEO) Database and the Stockholm International Peace Research Institute (SIPRI). SIPRI provides data for military expenditures, the WEO provides data for Gross Domestic Product and General Government Total

Expenditure. Interest rate values are from the International Financial Statistics (IFS) database. World Development Indicators (WDI) database provided values for labour (annual population growth rate), capital, and sectoral contributions to GDP.

4.6 Estimating Procedure

Cointegration analysis is necessary for estimating both short and long run relationships. Hence, the study uses the Auto-Regressive Distributed Lag model (ARDL) cointegration bounds testing approach. It was developed by Pesaran *et al.* (2001) to avoid the problems associated with other cointegration techniques. It possesses certain estimation advantages over single-equation methods. Conventional cointegration methods estimate the long run relationships within a context of a system of equations whilst the ARDL method employs only a single reduced form equation (Pesaran & Shin, 1999).

This single equation approach is as an alternative to Engle and Granger's (1987) error correction mechanism. Endogeneity, serial correlation, and the inability to test the hypothesis on the coefficients, in the long run, are some problems avoided with the use of the ARDL. This approach exhibits good small sample properties which make it suitable for this study. Pesaran and Shin (1999) indicate that this technique solves the endogeneity problem provided an appropriate lag length is selected. The ARDL yields consistent and robust results for long and short run estimates. It does not require pre-testing the variables for unit roots and makes it possible for different variables to have different optimal lags.

The computed F-statistic is compared to that of the critical upper and lower bounds as tabulated by (Pesaran, Shin, & Smith, 2001). The null hypothesis postulates the absence of a long run relationship. Therefore, if the calculated F-statistic lies above (below) the F-critical, the null

hypothesis is rejected (fail to reject) which indicates that the variables are co-integrated (not co-integrated). However, if the F-statistic lies between the lower and upper bound, a decision on cointegration is inconclusive.

The ARDL representation of the unrestricted error correction model is,

$$\Delta Y_t = \alpha_0 + \sum_{j=1}^{a} \phi_j \, lnY_{t-1} + \sum_{j=1}^{b} \delta_j lnDE_{t-j} + \sum_{j=1}^{c} \gamma_j \, lnGE_{t-j} + \sum_{j=1}^{d} \theta_j \, R_{t-j} +$$

$$\sum_{j=1}^{e} \sigma_j \, L_{t-j} + \sum_{j=1}^{f} ¥_j \, POL_{t-j} + \sum_{j=1}^{g} \Omega_j \, POL_{t-j} + \eta_1 lnY_{t-1} + \eta_2 lnDE_{t-1} + \eta_3 lnGE_{t-1} +$$

$$\eta_4 R_{t-1} + \eta_5 L_{t-1} + \eta_6 K_{t-1} + \eta_7 POL_{t-1} + \varepsilon_t \qquad (4.11)$$

Where Δ represents the first difference operator, α_0 is the intercept/constant term, (a, b, c, d, e, f and g) represent the optimal lag length of the parameters and (ϕ, δ, γ, θ, ¥, Ω and σ) are the short run dynamics of the output model. The first part of the equation represents the short run dynamics of the model whilst the second part represents the long run dynamics of the model. The calculated F-statistic (Wald statistic) is compared to the critical values computed by Pesaran *et al.* (2001) and Narayan (2004).

$$\text{Null hypothesis: } H_O: \eta_1 = \eta_2 = \eta_3 = \eta_4 = \eta_5 = \eta_6 = \eta_7$$

$$\textit{Alternative hypothesis}: H_1: \ \eta_1 \neq \eta_2 \neq \eta_3 \neq \eta_4 \neq \eta_5 \neq \eta_6 \neq \eta_7$$

4.6.1 The Long run Model

Evidence of cointegration (long run relationship) based on the ARDL bounds test requires the estimation of a conditional long run model.

$$lnY_t = \alpha_1 + \sum_{j=1}^{a} \alpha_{2j}\, lnY_{t-1} + \sum_{j=1}^{b} \alpha_{3j} lnDE_{t-j} + \sum_{j=1}^{c} \alpha_{4j}\, lnGE_{t-j} + \sum_{j=1}^{d} \alpha_{5j}\, R_{t-j} +$$

$$\sum_{j=1}^{e} \alpha_{6j}\, L_{t-j} + \sum_{j=1}^{f} \alpha_{7j}\, K_{t-j} \sum_{j=1}^{g} \alpha_{8j}\, POL_{t-j} + \mu_t \qquad (4.12)$$

Before the ARDL model is estimated, an appropriate number of lags is to be selected for the variables. The order of the lags is selected using the Akaike Information Criterion (AIC) and the Schwarz Information Criterion (SIC). ARDL estimates $(r+1)^k$ as the number of regressions to determine the optimal lag length of the variables, where r is the maximum number of lags to be used and k represents the number of variables. However, Pesaran and Shin (1999) recommend a maximum of two (2) lags for minimizing the information criteria for annual time series data.

4.6.2 Unrestricted Error Correction Model

The ARDL specification of the short run dynamics is derived by constructing an error correction model (ECM) of the form.

$$\Delta lnY_t = \lambda_1 + \sum_{j=1}^{a} \lambda_{2j}\, \Delta lnY_{t-1} + \sum_{j=1}^{b} \lambda_{3j} \Delta lnDE_{t-j} + \sum_{j=1}^{c} \lambda_{4j}\, \Delta lnGE_{t-j} + \sum_{j=1}^{d} \lambda_{5j}\, \Delta R_{t-j} +$$

$$\sum_{j=1}^{e} \lambda_{6j}\, \Delta L_{t-j} + \sum_{j=1}^{f} \lambda_{7j}\, \Delta K_{t-j} + \sum_{j=1}^{g} \lambda_{8j}\, \Delta POL_{t-j} + \psi ECM_{t-1} + \mu_t \qquad (4.13)$$

Where Δ is the first difference operator, $\lambda_1$is the intercept/constant term, $(\lambda_{2,} \dots, \lambda_8)$ are the coefficients of the short run parameters, ψ is the speed of adjustment used to attain the long run equilibrium in the presence of a shock and ECM_{t-1} refers to the error correction term.

4.6.3 Test for Seasonality and Trend

Seasonality and trend are important to time series analysis. Seasonality in time series comes from fluctuations in seasonal data (annually, quarterly, economic landscape or weather) or other contributing factors. Trend, however, shows the long run movement (upward or downward) of a

data set over some time. However, not every long run movement is considered a trend. The direction of a trend may change depending on the season. Over time, the behaviour of a time series can be described by certain unique attributes, identified and grouped into four types (Lazim, 2007). These behaviours include the identification of trend, cyclical, seasonal or irregular components. Understanding the concept of seasonality and trends can help extract information which is used for forecasting and decision making.

Smoothing a data set provides actual gradual movement or changes in a data set that is often absent in curve-fitting. Seasonal and trend natures of time series data can be examined using correlograms. The correlogram uses graphical and numerical information in an Autocorrelation Function (ACF). Chatfield (1996) highlights that randomness in a data set are commonly tested using autocorrelation plots. Randomness is present if autocorrelations at additional lags are significantly close to zero. However, when significantly non-zero the data is non-random. The ACF is also a useful indicator of stationarity. The correlogram can determine characteristic features of the data set including oscillation, rising, and declining trend. For a given sample N, the correlation coefficient at lag k is:

$r_k = \frac{\sum_{t=1}^{N-k}(x_t-\bar{x})(x_{t+k}-\bar{x})}{\sum_{t=1}^{N-k}(x_t-\bar{x})^2}$, where $\bar{x} = \frac{1}{N}\sum_{t=1}^{N} x_t$ represents the overall mean. (4.14)

4.6.4 Test for Unit Root/Stationarity

Stationarity tests are requirements for econometric time series analysis because it ensures that parameter estimates are valid. As most time-series data are considered non-stationary, it is important to smoothen data. This to ensure that there are no spurious results. The Augmented Dickey-Fuller (ADF) or Phillips-Peron (PP) unit root tests are used. The ADF model not only determines the stationarity of the variables but also identifies the order of integration and removes

autocorrelation. The ADF tests involve the estimation of equations with the intercept and, the intercept & trend as proposed by Dickey and Fuller (1988). Equation 4.15 is the equation with intercept only whilst equation 16 shows intercept and trend. The following are the test equations used in the ADF test and the test hypotheses.

$$\Delta y_t = \alpha + \delta y_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta y_{t-1} + \varepsilon_t \quad (4.15)$$

$$\Delta y_t = \alpha + \beta T + \delta y_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta y_{t-1} + \varepsilon_t \quad (4.16)$$

$$\text{Null hypothesis: } H_O: \delta = 0 \; and \; \text{Alternative hypothesis: } H_1: \delta < 0$$

The test uses the t-statistic on the coefficient of the variable's lag (δ) by testing the null hypothesis of unit root/non-stationarity. Rejection of the null hypothesis leads to the acceptance of the alternative hypothesis which implies that the variable is stationary. The outcome of the stationarity tests indicates whether the variables are co-integrated. Any variable integrated at an order higher than zero is a non-stationary time series. Differencing is the most common technique used by researchers to transform non-stationary data.

4.6.5 Pairwise Granger Causality

A Granger Causality (GC) test determines the linear causal relationship between any two variables. The ability of the GC test to attain robust results irrespective of the sample size makes it the preferred causality test for econometric analysis. Studies such as Chowdhury (1991) and Dodzi *et al.* (2013) used Granger's test for causality for its superior nature. It undertakes a two-way causality enquiry to determine the direction of causality. The presence of a cointegration relationship indicates the presence of a causal relationship in at least one direction.

For the second objective, the GC test is used to determine the causal relationship between the variables. Using an optimal lag length, the test can provide results for pairwise causal relationships between every possible variable. This is because over-specifying and underspecifying lags result in unbiased but inefficient estimates and biased estimates (with smaller variance). Given a dependent variable Y and an independent variable X, X is said to Granger cause Y if the past values of X and Y could predict Y better than using the past values of Y. For the GC test, let X and Y be a pair of linear, covariance stationary time series. Hence X and Y are:

$$Y_t = \sum_{i=1}^{m} \alpha_i Y_{t-i} + \sum_{j=1}^{n} \beta_j X_{t-j} + e_{1t} \quad (4.17)$$

$$X_t = \sum_{i=1}^{u} \delta_i X_{t-i} + \sum_{j=1}^{v} \gamma_j Y_{t-j} + e_{2t} \quad (4.18)$$

Where, $e_{1t}\ and\ e_{2t}$ are the error terms and (m, n, u, and v) represent the number of lags. To study the GC relationship between Y and X, the following hypotheses are tested separately. $\beta_j = 0\ and\ \gamma_j = 0$. The GC test uses the F-statistic of the joint significance of the distributed lags coefficients for each variable. X granger causes Y if the latter hypothesis is rejected and vice versa. If both hypotheses are rejected, it implies a feedback effect between X and Y. However, failure to reject both hypotheses indicates that both variables are independent of each other.

4.6.6 Diagnostic Tests

These are important before and after cointegration tests. This is to ensure results are robust and that all estimations and interpretations are efficient. These include Breusch-Godfrey serial correlation, Breusch-Pagan Godfrey heteroscedasticity, Ramsey RESET, Augmented Dickey-Fuller stationarity, CUSUM and $CUSUM_{SQ}$ tests. They ensure that the model aligns with the inherent assumptions vital for the robustness and stability of the model and its parameters.

4.7 Empirical Estimation and Discussion of Results

4.7.1 Descriptive Statistics

Table 4.2 gives an overview of the variables under study. It summarizes key statistics such as mean, median, maximum, minimum, standard deviation and normality tests. Each variable has thirty-eight (38) observations with none missing. The Jarque-Bera probability values indicate that Y, DE, GE, R and L (except K) reject the normality hypothesis at the 5% significant level. All the variables are positively skewed except for real interest rates, and capital.

The correlation matrix reveals that the correlation between defence expenditure (0.935081) and output is positive. Government expenditure (0.990459), interest rates (0.323679), and capital (0.615868) are all positively correlated with aggregate output. All variables are negatively correlated with labour except for political instability. Whilst the correlation between political instability and all other variable are negative except labour. This characteristic of POL may be due to reduced production and investment during periods of election and political insecurity. Annually, an average of about GHS 34 billion worth of output is produced, GHS 160 million is spent on defence and about GHS 7 billion is spent on non-defence government expenditures.

Real interest rates, labour and capital have averaged about 3.89%, 2.65% and 18.8%. Aggregate output, defence expenditure and non-defence government expenditure recorded their maxima of about GHS 102 billion, GHS 606 million and GHS 25 billion respectively whilst the minimum amounts recorded were GHS 8 billion, GHS 18 million and GHS 578 million. Real interest rates, labour and capital recorded maxima of 20.17%, 3.48% and 30.927%, recording minimum values of -107.75%, 2.24% and 3.53% respectively.

Table 4. 2: Summary Statistics of Variables (1980-2017)

Statistics	Y	DE	GE	R	L	K	POL
Mean	3.36E+10	1.61E+08	7.36E+09	-3.892	2.6487	18.803	0.342105
Maximum	1.03E+11	6.06E+08	2.52E+10	20.175	3.4816	30.927	1
Minimum	8.96E+09	18743284	5.78E+08	-107.745	2.2367	3.531	0
Std. Dev.	2.74E+10	1.60E+08	7.88E+09	26.05408	0.3042	7.726	0.480783
Skewness	1.313374	1.601234	1.26076	-2.95178	1.2353	-0.584	0.665640
JB p-value	0.003777	0.000067	0.006463	0.000000	0.0029	0.201	0.036078
Correlation Matrix							
Y	1						
DE	0.935081	1					
GE	0.990459	0.959737	1				
R	0.323679	0.295043	0.310297	1			
L	-0.63208	-0.583287	-0.623718	-0.514626	1		
K	0.615868	0.598274	0.620716	0.609802	-0.7449	1	
POL	-0.553203	-0.505133	-0.556368	-0.482796	0.701588	-0.8946	1

Source: Author's estimation and compilation using EViews 9

4.7.2 Seasonality and Trend Tests

Based on the Correlogram's "autocorrelation (AC)" test results, the seasonality and trend features of the data are shown. Seasonality is said to be present if the graphical presentation of the variable does not move in one direction but varies/fluctuates across the years. Whilst a trend is established when the values of AC are declining with each additional lag. The table below provides a summary of the seasonality and trend analysis of the estimating variables of the study. Output, defence, non-defence expenditure, labour and capital displayed features of a trend.

Interest rate and political instability have seasonal features which are shown by their AC results. The variables were either seasonal without trend or exhibited trend with no seasonality. A trend is

established from the graphs of the estimating variables (see Appendix D). lnY, lnDE, lnGE, L and K showcase an upward moving trend over the years whilst R has no trend (shows seasonality). Their respective correlogram results point toward the presence of serial correlation with their lags. Political instability also exhibits trend-like features since the AC values decline with each additional lag due to democratic rule from the 1992 elections.

Table 4. 3: Seasonality and Trend Results

Correlogram Test Results		
Variables	**Seasonality**	**Trend**
LnY	No seasonality	Presence of trend
LnDE	No seasonality	Presence of trend
LnGE	No seasonality	Presence of trend
R	Seasonality	Absence of trend
L	No seasonality	Presence of trend
K	Some seasonality	Presence of trend
POL	Some seasonality	Presence of trend

Source: Author's estimation and compilation based on the Correlogram test using EViews 9

4.7.3 Unit Root Estimation

The ADF and PP test for stationarity were employed. Knowledge of the order of integration prevents the inclusion of a variable of order two [I (2)] or higher into the model. Based on the MacKinnon (1996) critical values, the null hypothesis of non-stationarity is rejected when the p-value is less than the significance level. We fail to reject the null when the reverse is true. The results of the unit root tests indicate that lnY, lnDE, lnGE, L, K and POL are non-stationary at levels and required first differencing to become stationary. The results for the unit root test for the variables are shown in *Tables 4.4 and 4.5*.

Table 4. 4: Augmented Dickey-Fuller Unit Root Results

AUGMENTED DICKEY-FULLER TEST

	Levels		First Difference		
Variables	**Intercept**	**Trend and Intercept**	**Intercept**	**Trend and Intercept**	**Order of integration**
lnY	0.214939	-1.306844	-5.111498*	-4.810169*	I(1)
lnDE	-0.624654	-3.732287*	-5.953998*	-5.732241*	I(1)
lnGE	-1.190853	-3.084890	-6.157541*	-5.803507*	I(1)
R	-3.733353*	-3.442326*			I(0)
L	-1.857102	-7.761605	-7.761605*	-7.818793*	I(1)
K	-1.786778	-2.791655	-7.193599*	-6.090516*	I(1)
POL	-1.375461	-1.375461	-6.000000*	-5.978815*	I(1)

Source: Author's computation. Sample levels: 1980-2017, Sample differences: 1981-2017.

Rejection of unit root hypothesis according to McKinnon (1996) one-sided p-values.

Table 4. 5: Phillips-Peron Unit Root Results

PHILLIPS-PERON TEST

	Levels (Adj. t-statistic)		First Difference (Adj. t-statistic)		
Variables	**Intercept**	**Trend and Intercept**	**Intercept**	**Trend and Intercept**	**Order of integration**
lnY	1.403687	-2.525594	-5.079865*	-4.783102*	I(1)
lnDE	-0.629697	-3.616502*	-5.716629*	-5.636393*	I(1)
lnGE	-0.046297	-4.543114*	-6.343585*	-6.015148*	I(1)
R	-4.091905*	-5.051472*			I(0)
L	-1.296422	-1.169850	-1.192177*	-0.801322*	I(1)
K	-1.574445	-2.665665	-7.866825*	-8.158085*	I(1)
POL	-1.373419	-1.654433	-6.000004*	-5.979814*	I(1)

Source: Author's compilation. Sample levels: 1980-2017, Sample differences: 1981-2017.

Rejection of unit root hypothesis according to McKinnon (1996) one-sided p-values.

However, R is an I(0) variable implying stationarity at levels. The results suggest that all other variables deviate from their means at levels but converge to long run equilibrium. The PP unit root test employed supports the results obtained in the ADF test. The mixed order of integration suggests an underlying long run relationship. Hence the use of the ARDL approach is justified.

4.7.4 ARDL Bounds Testing for Appropriate Lag Length

Before further estimations are done to determine the long run and short run coefficients of the parameters, an appropriate lag length is selected. Lag criteria of length one (1) is found to be the most optimal of all information criteria as seen in *Table 4.6* although Pesaran *et al.* (2001) encouraged the use of a maximum of two (2) lags.

Table 4. 6: Optimal Lag Selection Criteria for the ARDL model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	37.89807	NA	0.010072	-1.765604	-1.454534	-1.658223
1	70.08003	49.65218*	0.001700*	-3.54743*	-3.19192*	-3.424709*
2	70.12300	0.063831	0.001802	-3.492743	-3.092796	-3.354681
3	70.91604	1.132916	0.001832	-3.480916	-3.036531	-3.327515

*Source: Author's estimation and compilation from EViews 9. * is the optimal lag length.*

4.7.5 Cointegration Estimation (ARDL Bounds Test)

The condition for using the ARDL is satisfied. Hence, the cointegration bounds tests will be employed and the F-statistic will determine whether the variables have a long run relationship. ARDL integrates dynamics of the long run and short run without losing information about the long run. Evidence indicates that the calculated F-statistic, $F(\mathrm{Y} / \mathrm{DE}, \mathrm{GE}, \mathrm{R}, \mathrm{POL}) = 4.399341$. Since $F(\mathrm{Y} / \mathrm{DE}, \mathrm{GE}, \mathrm{R}, \mathrm{POL})$ > F-critical upper bounds at 2.5% and 5% and 10% significant levels. This leads to the rejection of the null hypothesis of no cointegration and a conclusion that there exists a

long run relationship among the variables of the estimated model is drawn. (See *Table 4.7*). Therefore, an error correction model must be estimated.

Table 4. 7: Cointegration F-Bounds Testing Results

Estimated model: $Y = f(DE, GE, R, L, K, POL)$ ARDL (1, 0, 0, 0, 0, 0, 0)			
Null Hypothesis: No levels relationship			
Level of Significance	**Lower Bound I(0)**	**Upper Bound I(1)**	**F-statistic (k=6 and n=37)**
1%	3.15	4.43	4.399341
2.5%	2.75	3.99	
5%	2.45	3.61	
10%	2.12	3.23	

Source: Author's estimation and compilation using EViews 9

4.7.4 Long Run Model Estimation

By recognizing the existence of a long run cointegration relationship between the variables of interest and economic growth, the study estimated the long run coefficients of the ARDL (1, 0, 0, 0, 0, 0, 0) selected based on the Schwarz Bayesian Criterion. Defence expenditure has an insignificant long run effect on GDP which is supported by the results of Henaku (2007) which also discovered an insignificant effect of military expenditure on economic growth. The model exhibits a strong predictive ability of 99% and a joint significance of the independent variables, with a significant F-statistic (p-value=0.0000).

Defence expenditure, non-defence government expenditure, capital and political instability are statistically insignificant in the long run at a 5% significance level. The independent variables that show a significant long run effect on economic growth are previous GDP values (0.0000), interest rates (0.0399) and labour (0.0012).

Table 4. 8: Estimated Long run Coefficients

Dependent Variable is LNY, ARDL (1, 0, 0, 0, 0, 0, 0).				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-2.446888	0.912382	-2.681870	0.0120
LNY(-1)	1.110086	0.119650	9.277811	0.0000
LNDE(-1)	-0.007242	0.040621	-0.178270	0.8598
LNGE(-1)	-0.030004	0.093787	-0.319916	0.7513
R(-1)	0.104844	0.048733	2.151396	0.0399
L(-1)	0.224582	0.062547	3.590627	0.0012
K(-1)	0.003986	0.003514	1.134509	0.2659
POL(-1)	0.001519	0.050384	0.030154	0.9762
R-squared=0.994807				
Adjusted R-squared=0.993554				
Akaike info criterion=-2.658779				
F-statistic=793.6436 (P-value=0.0000000)				
Durbin-Watson Statistic=1.449152				
37 observations after adjustments				

Source: Author's estimation and compilation using EViews 9

Political instability and interest rates have positive coefficients, deviating from their expected signs. Government and defence expenditure also deviate from expected signs to be negative. The significance of labour is high indicating that increasing population growth rates by 1% affects economic growth by 22% whilst a 1% increase in interest rates leads to a 10% increase in GDP. Previous GDP values have a significant effect on current GDP values, a 1% increase in the previous year's GDP leads to a 110% increase in current GDP values in the long run. To estimate the short run effects of the independent variables on economic growth, an error correction model will be used.

4.7.5 Short Run Model Estimation

Table 4. 9: Error Correction Representation for the selected ARDL Model

Dependent Variable is LNY				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	0.030369	0.017496	1.735762	0.0940
D(LNY(-1))	0.603142	0.327880	1.839523	0.0769
D(LNDE(-1))	0.036085	0.030853	1.169559	0.2524
D(LNGE(-1))	-0.027272	0.081958	-0.332753	0.7419
D(R(-1))	0.018720	0.033862	0.552837	0.5849
D(L(-1))	0.040663	0.100457	0.404785	0.6888
D(K(-1))	0.003433	0.003058	1.122596	0.2715
D(POL(-1))	0.023689	0.058651	0.403891	0.6895
ECM(-1)	-0.237713	0.309220	-0.768752	0.4487
R-squared=0.464680				
Adjusted R-squared=0.306066				
Akaike info criterion=-3.007296				
F-statistic=2.929635 (P-value=0.017168)				
Durbin-Watson Statistic=1.798707				

Source: Author's estimation and compilation using EViews 9

The short run relationship between the independent variable (Y) and the dependent variables is explained by estimating the ARDL Error Correction Model. *Table 4.9* summarizes the short run effects of changes in the independent variables on aggregate output. The model exhibits a moderate explanatory ability of 46 per cent. The ECM integrates the short run dynamics with the long run dynamics. The error correction term ECM_{t-1} indicates the speed of adjustment from a short run deviation to the long run equilibrium. The coefficient of the ECM_{t-1} is negative (-0.237713), supporting the ARDL bounds test result of cointegration. It indicates that about 23 per cent of the

previous year's deviation from the long run equilibrium will be restored within a year if the co-efficient was significant.

The only significant variable at a significance level of 10% in the short run model is the lag of aggregate output (0.076). Defence expenditure in the short run does not have any significant effect on output levels as indicated by its probability value (0.2524). This may be due to its small absolute values relative to other public expenditures. All other explanatory variables in the short run model are insignificant and do not have any effect on aggregate output. The signs of the variables are the same in both the long and short runs, except for defence expenditure where it is positive in the short run and negative in the long run. This insignificant outcome of defence expenditure contradicts that of Addy (1998), Sezgin (2001), Atesoglu (2002), Henaku (2007) and Apanisile (2013).

The results may be contradictory because these countries spend a lot on their defence sectors due to issues of unrest and high weapons production. Although the same model may have been used by other countries, their respective characteristics influence growth differently. Addy's (1998) discovery of a positive effect may be highly attributed to the period of study which was mainly characterized by political instability and military takeovers. The results of the study agree with earlier works of Heo (2010) and Dakurah *et al.* (2001) who discovered an insignificant impact of defence expenditure on economic growth. The insignificant outcome may be because defence expenditure to GDP ratios for Ghana are small which causes them to have an insignificant impact on output levels. This ratio has not deviated beyond the threshold for over twenty (20) years.

The GAF may be under-equipped and under-resourced which may be why its effects are insignificant. Due to the current nature of democracy, it may be difficult for defence expenditure

to influence growth. Owing to the low ratio of defence expenditure to GDP and the use of defence expenditure to maintain the basic need of the defence sector which is to protect the country from internal and external threats. The absence of unrest also supports the work of Aizenman and Glick (2006) which indicates that the defence spending in the absence of unrest may lead to insignificant outcomes on growth. The employment rate from the defence sector may not be enough to influence productive levels in the country. Infrastructural projects undertaken by the military are often financed through other income sources such as peacekeeping missions which are not captured by the defence expenditure. Hence, the contribution of the defence sector cannot be fully measured using defence budgets provided by the government.

Although the defence sector may contribute to the economy it is not observed because not all expenditures and incomes are public knowledge. This secretive nature and lack of transparency of all military expenditures may be the reason for its insignificance on the economy. Another reason for the insignificance of defence expenditure in Ghana may be because the country does not produce most of its equipment and weaponry. As most of the weaponry is imported or donated, the country is not able to enjoy from a defence industry which produces its equipment and weapons. Hence, a spill-over effect from the country's defence production ability is lost. The resources are used to import weapons which do not have an immediate effect on the infrastructure of the entire nation. The import behaviour of the GAF may be a drag on economic growth as it reduces the aggregate demand (AD).

4.7.7 Diagnostic tests

The tests for autocorrelation/serial correlation, heteroscedasticity, functional form specification normality and absence of an I(2) variable are necessary. Stability of the ARDL model is tested by using the recursive residuals (CUSUM) and the cumulative sum of squared residuals ($CUSUM_{SQ}$). The null hypothesis of the stability of the model parameters against the alternative of their instability. Heteroscedasticity tests include the Breusch-Pagan-Godfrey test, the ARCH LM test and the white heteroscedasticity test. Serial correlation and the functional form are tested using the LM serial correlation test and Ramsey's RESET test, respectively. These test results are summarized in *Table 4.10*. They are used to avoid specification problems and ensure the efficiency of the model.

Table 4. 10: Sensitivity and Stability Test Results

Results of the Diagnostic Tests				
Type of Test	**Diagnostic Test**	**Test Statistic (F-stat)**	**Probability value**	**Decision**
Serial Correlation	Breusch-Godfrey LM test	0.773524	0.3872	No serial correlation
Heteroscedasticity	Breusch-Pagan-Godfrey	0.261763	0.9730	No heteroscedasticity.
Functional form	Ramsey's RESET	0.715406	0.4054	No model misspecification

Source: Author's estimation and compilation using EViews 9

The p-values of the Breusch-Godfrey LM test (0.3872) for serial correlation indicates that there is no serial-correlation of the variables in the model at the 5% significance level. The conclusion on serial correlation is further supported by the DW statistic. Other tests for serial correlation include the Correlogram of Residuals test which indicates no serial correlation since its p-values are not

significant. The p-values of the heteroscedasticity (0.9730) and functional form (0.4054) indicate the presence of homoscedasticity and absence of model misspecification.

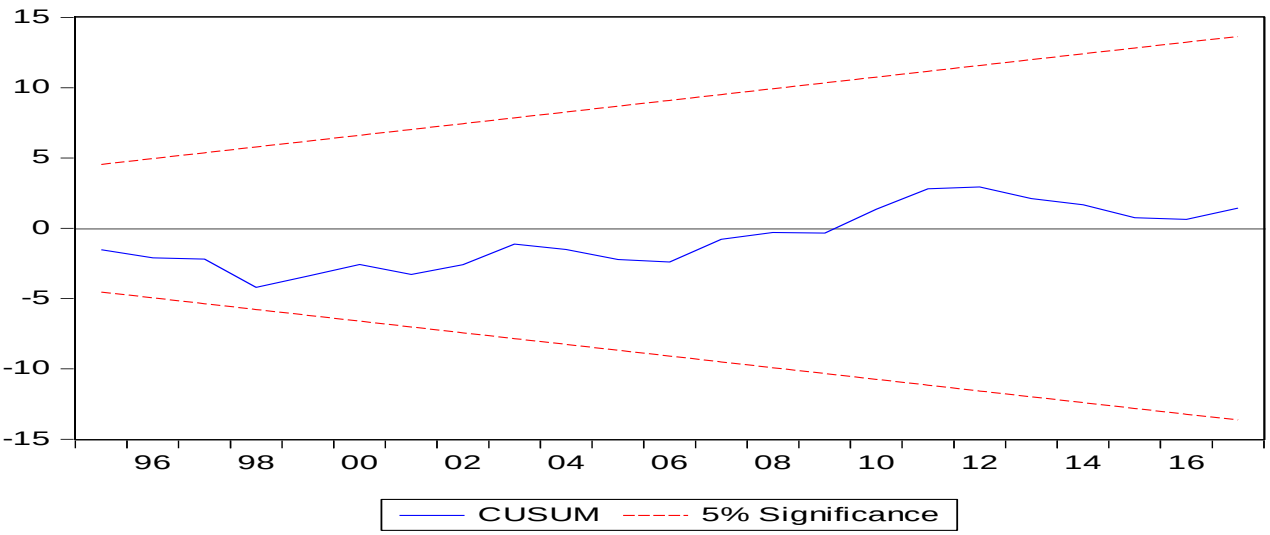

Figure 4. 1: Plot of Cumulative Sum of Recursive Residuals

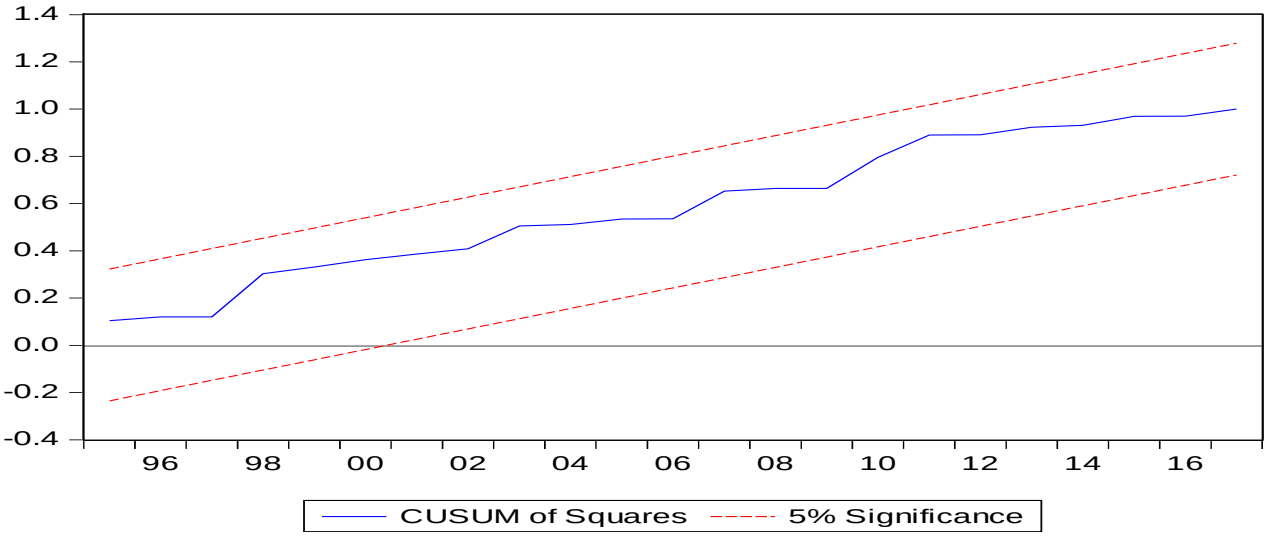

Figure 4. 2: Plot of Cumulative Sum of Squares of Recursive Residuals

The stability tests (CUSUM and $CUSUM_{SQ}$) indicate the stability of the coefficients in the model because the plots lie between the 5% critical lower and upper bounds (see *Figures 4.1* and *4.2*). Hence, the null hypothesis of stable coefficients and model are accepted at 5% significance level.

The CUSUM results indicate that there is enough evidence that the parameters are not structurally unstable.

4.7.8 Pairwise Granger Causality Estimation

The Granger-causality test will highlight causality between any two variables and indicates the direction/movement of the causal relationship. Causality may be absent, unidirectional, or bidirectional. *Table 4.11* summarizes the results of the granger causality test for output. This test is undertaken to achieve the third objective of this study. An assumption held is that the past can predict the future and not the other way around. This will create a clearer depiction of the existing relationship between the variables. The GC test is supported by the studies of Chowdhury (1991) and Dakurah *et al.* (2001). It should be noted that the presence of Granger causality does not imply that a variable is the causal outcome of the occurrence of another.

Table 4. 11: Granger Causality Results

Granger Causality Test Results				
Null Hypothesis	**Obs.**	**F-statistic**	**P-values**	**Decision**
LNDE does not Granger Cause LNY	37	0.07902	0.7803	Accept
LNY does not Granger Cause LNDE	**37**	**12.3751**	**0.0013**	**Reject**
LNGE does not Granger Cause LNY	37	1.16649	0.2877	Accept
LNY does not Granger Cause LNGE	37	2.85451	0.1003	Accept
POL does not Granger Cause LNY	37	0.00058	0.9808	Accept
LNY does not Granger Cause POL	37	0.64746	0.4266	Accept

Source: Author' compilation from EViews 9. See Appendix for full table

Defence expenditure, government expenditure, capital, and political instability do not Granger cause output in the short and long run. Although in the long run labour and interest rates affect output, only labour has a granger causal effect on GDP. However, output has a granger causal

effect on defence expenditure and labour. Which shows the bi-directional Granger causal relationship between labour and output in an economy. The Granger causal effect of output on defence expenditure is supported by Chowdhury (1991) who discovered a unidirectional relationship from economic growth to defence expenditure in the case of Ghana. The results differed for every country as seen in Dakurah *et al.* (2001) and no feedback relationship was observed. Defence expenditure may be caused by output since the spending ability of a country is often influenced by its productive ability. Defence expenditure granger causes only labour and can be attributed to the effect of maintained peace and security on the socio-economy. Since unrest reduces national confidence in safety, it negatively affects population growth rates.

There seems to be a bidirectional relationship between government expenditure and interest rates. Interest rates affect the borrowing and spending ability of the government whilst the government's borrowing activities influence overall interest rates, hence the bidirectional relationship observed. This is because interest rates have an influence on the saving behaviour of the citizens which determines the availability of funds for borrowing. This relationship is not shocking because countries use interest rates as a monetary policy to influence key macroeconomic indicators. Government expenditure has a unidirectional granger causal effect on defence expenditure. This granger causal impact on defence it is a component of government expenditure.

The Granger causal effect of non-defence government expenditure on defence expenditure may indicate that a reduction in defence expenditure leads to a peace dividend. This is because resources not spent on defence are spent on public expenditures. Political instability is also seen to have a bidirectional relationship with interest rates and a unidirectional relationship with labour. This may be because during periods of political instability there is associated insecurity in the financial

sector. All the variables granger cause labour, whilst there is a bi-directional relationship between labour and government expenditure. This is expected because all things being equal, a larger population calls for increased public spending. The impacts of defence and government expenditures contradict that of Atesoglu (2002) and Halicioglu (2010) who found positive effects of defence and government expenditures on economic growth. They maintained that government expenditures had a higher impact than defence expenditure.

Table 4. 12: Granger Causality Test Outcomes

Main Variable	**Secondary Variables**
Defence expenditure (DE) granger causes	L
Output (Y) granger causes	DE, L
Government expenditure (GE) granger causes	DE, R, L
Interest Rate (R) granger causes	POL, GE, L
Labour (L) granger causes	Y, GE
Capital (K) granger causes	R, L
Political instability (POL)	R, L

Source: Author's compilation using Eviews-9

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a summary of this research work and its findings. It also makes suggestions and policy recommendations based on the empirical results. It ends by highlighting the limitations of the study and suggesting areas for further research.

5.2 Summary of the Study

This study was undertaken to examine and determine the relationship between defence expenditure and aggregate output in Ghana. Theories and literature that have been developed to explain the underlying relationship have all resulted in different outcomes. Therefore, this study attempted to determine the type of relationship exhibited by defence expenditure and aggregate output by employing the macroeconomic theory and model introduced by Atesoglu (2002) to this research area. This was an attempt to establish the long run, short run and relationships to demonstrate the individual effects of the policy variables.

The study employed the Auto-Regressive Distributed Lag (ARDL) approach to cointegration and granger-causality test on key variables to address the objectives of the study. Secondary data spanning the period of 1980 to 2017 is compiled from different sources. The effect of the socio-economic environment, labour and capital on output are also studied to determine how the state of the country (social or economic), population growth and capital investment affect the aggregate output. The results indicated the presence of a long run relationship between the variables. However, defence expenditure had an insignificant effect on economic growth in the long run estimation. Therefore, a short run error correction ARDL model was estimated which also

indicated the insignificance of defence expenditure. Defence expenditure in the short run was found to have an insignificant effect on economic growth unlike Henaku (2007) who discovered a significant negative effect.

Despite this conclusion being contrary to that of Addy (1998) and Henaku (2007), the difference in conclusions arises from, the differences in the estimating models and the periods of study. The Granger causality test absent from these studies further supported the results of the ARDL long run and error correction models by indicating the absence of a predictive ability from defence expenditure to output. The absence of a significant impact of defence and government expenditure may be attributed to the small values of defence expenditure, democratic nature of the country, absence of a weapons manufacturing industries, and the inability of defence expenditure to explain the resources available to the defence sector. The expenditure budgeted for defence may not reflect the actual values, hence, the estimated impact of defence expenditure on economic growth may be far from the truth.

5.3 Key Findings

The study adopted the approach of Atesoglu (2002) and attempted to investigate the prevalent relationship between defence expenditure and output. Increasing government expenditures whether defence or non-defence in Ghana may not always be helpful to the economy as an insignificant impact is observed. In the short run, only the lag of output has a significant (positive) effect on output levels. All other variables are insignificant in the short run. Labour, interest rates and the lag of output are the only variables that display a long run effect on output. Defence expenditure was insignificant both in the short and long run model estimations. This insignificant effect of defence expenditure is supported by studies such as Dakurah *et al.* (2001), Knight *et al.*

(2014) and Heo (2010) who also discovered insignificant effects of defence expenditure on economic growth. The diagnostic tests estimated for the short run model indicated that the model had no serial-correlation and no heteroscedasticity. The parameters of the model estimated are also structurally stable.

A granger causality test was undertaken to achieve the second objective of the study. Defence expenditure does not granger cause output and the same goes for government expenditure. It is also observed that output has a unidirectional granger causal effect on defence and inflation. Labour was the only variable that granger causes output supporting its a priori expectation of an increase in population growth influencing output levels. The granger causality test further indicates that the state of the political environment affects the macroeconomy through interest rates and labour. Government expenditure was seen to have a causal effect on defence expenditure and interest rate through the budgeting process and the financial sector. This further supports the determination of defence expenditure through output levels (wealth or ability) and as a subset of government expenditure.

5.4 Recommendations

The findings of the study highlight key recommendations to policymakers, government, government bodies and researchers. To help improve contributions of defence expenditure to the economy, the Ghana Armed Forces (GAF) could scale up the services provided such as manufacturing, construction, building and technology. The GAF is known to have a body of knowledge and skilled human capital which could be lacking in the civilian sector. Collaborating with various government or civilian organisations could provide an infrastructure synergy effect. The military could also provide additional education and health services which could be exploited

and improved to ensure that the economy enjoys positive externalities. The GAF through its skilled capital and technology could improve R&D and innovation through undertaking projects that would have otherwise been outsourced. The engineering sector of the Army is known to provide construction (roads) and building (bridges) services is an example of how the country could benefit from defence expenditure.

Defence expenditure might not have an impact on the economy because the amounts spent may not be large enough to warrant an effect on the economy. Since Wagner's law holds that for every country, public expenditures are constantly affected by income growth expansion. The GC test shows that output causes defence expenditure which supports Wagner's law. Hence, the implementation of policies that will improve economic growth and development will have a corresponding effect on defence expenditure. An increase in defence expenditure allocation will improve peace and security which accelerates economic growth. This is because improvements in peace and security positively affect investment and productivity. After all, unrest impedes economic development which supports the point that development reduces hostility and hatred as implied by UNICEF (1996).

The inability of government expenditure to have a significant impact on output may be due to what the resources are used to finance. Finance of non-productive activities is a drag on the economy whereas spending on infrastructure and productive activities tend to promote growth and development. Hence, it is recommended that the government tries to prioritize spending activities and try to attain long run benefits from current spending. The state of the political environment affects the economy as it has a way to influence societal perception, business decisions and the macroeconomy. Maintaining a peaceful environment creates an atmosphere of innovation resulting

in increased investment opportunities and capabilities. The causal relationship from political instability to interest rates implies that the country and government should try as much as possible to maintain a democratic state to ensure steady growth and development.

We must be able to collect data for the whole security sector to allow proper analysis and understand the priorities of the country which will foster the ability to research into other areas of security. Improving the frequency and quality of data will help increase and improve the identification of problems. By so doing, appropriate measures can be put in place to solve them. Ministries can help by collecting and maintaining data over the years to prevent limitations faced in this study to be encountered in future studies. Although the study identified defence expenditure as an insignificant indicator of output in the short and long run, the GAF could also undertake in-house empirical analysis of its spending activities and outcome variables such as employment and infrastructure development. This will enable GAF to make informed and efficient decisions.

5.5 Limitations of the study

The main limitation encountered in this study was the difficulty in obtaining all the data used for analysis. Due to data restrictions, the study period started in 1980 instead of the intended 1960. This may have affected the results obtained differing from those of earlier studies. Since the data did not cover a longer period, especially periods were the country faced issues of security unrest, the actual effect of defence expenditure on economic growth may be understated.

Ball (1984) highlights that the availability and reliability of data are still problems facing developing countries. Data available must be used with discretion since sensitive data such as defence expenditure are influenced by political reasons, improper record-keeping, or the in-built secrecy of the sector.

5.6 Conclusion and Areas for Further Study

The study discovered an insignificant impact of defence expenditure on output levels in the short run. The insignificance of the results may be attributed to expenditures not been large enough and the absence of unrest in the country. Taking into consideration the reduction in defence expenditure as a percentage of GDP and total government expenditure over the years, the insignificance of defence expenditure on the economy is not shocking because of the peaceful nature of Ghana backed by reducing defence expenditure commitments. This argument is supported by (Deger & Smith, 1983) which argues that results are difficult to quantify in economic terms, due to the different outcome variables of defence and their measurability.

Data availability constraints caused difficulty in finding data for other defence sectors such as the police, prison service and fire service all of whom provide a different but necessary security service to the country. This difficulty impeded the study's ability to fully explore the influence of the entire security service on the economy. To further understand the effective role of security and its expenditures on the economy data availability must be improved. The study failed to analyse the effect of defence expenditure on debt and net exports as the defence sector is a known importer of arms and exporter of skills and manpower. As the country has a high Debt-GDP ratio, a study addressing the influence of imports of arms and the export of skilled manpower on trade incomes and the economy would be significant to literature.

Ghana was the focus of the study, hence, to give a detailed analysis and further insight into what is happening in the sub-region, panel or cross-sectional analysis must be done. Research focusing on certain sub-regions such as West Africa or Sub-Saharan Africa will be useful. This is because, the socio-political feature of a neighbouring or trading country could affect the political

environment of our country, hence affect the domestic economy. Other studies could focus on how the economy was affected during the two political phases by comparing the early military rule period and the post-democratic period. The comparison of two macroeconomic models could be used to estimate these variables.

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APPENDICES

Appendix 1: Brief Political History of Ghana

YEAR	CHARACTERISTICS
1957	Independence, Kwame Nkrumah (CPP) is the prime minister
1960	Ghana becomes a republic (1st July)
	Transition to the presidential system of rule
1966	The overthrow of the 1st republic by the GAF and police.
	Formed the NLC (ruled from 1966-1969)
1969	2nd republic, Dr Busia (PP) as prime minister and E.A Addo as president
1972	The overthrow of the 2nd republic by the NRC (ruled from 1972-1975)
	NRC name change to SMC
1978	SMC palace coup of the NRC
1979	A coup led by Flight Lieutenant Rawlings (AFRC formed)
	3rd republic, Hilla Limann (PNP)
1981	The overthrow of the 3rd republic headed by Flight Lieutenant Rawlings
	PNDC was formed (Ruled from 1981-2000)
1983	Attempted overthrow of the PNDC
1993	4th republic,
1996	J.J. Rawlings of NDC re-elected
2001	J.A. Kufuor (NPP) elected president.
2005	J.A Kufuor re-elected
2008	J.E. Atta Mills (NDC) elected president.
2012	John Dramani Mahama took office upon the death of President Mills.
	President Mahama elected as president (2013-2017)
2017	Nana Akuffo-Addo (NPP) sworn in as president.

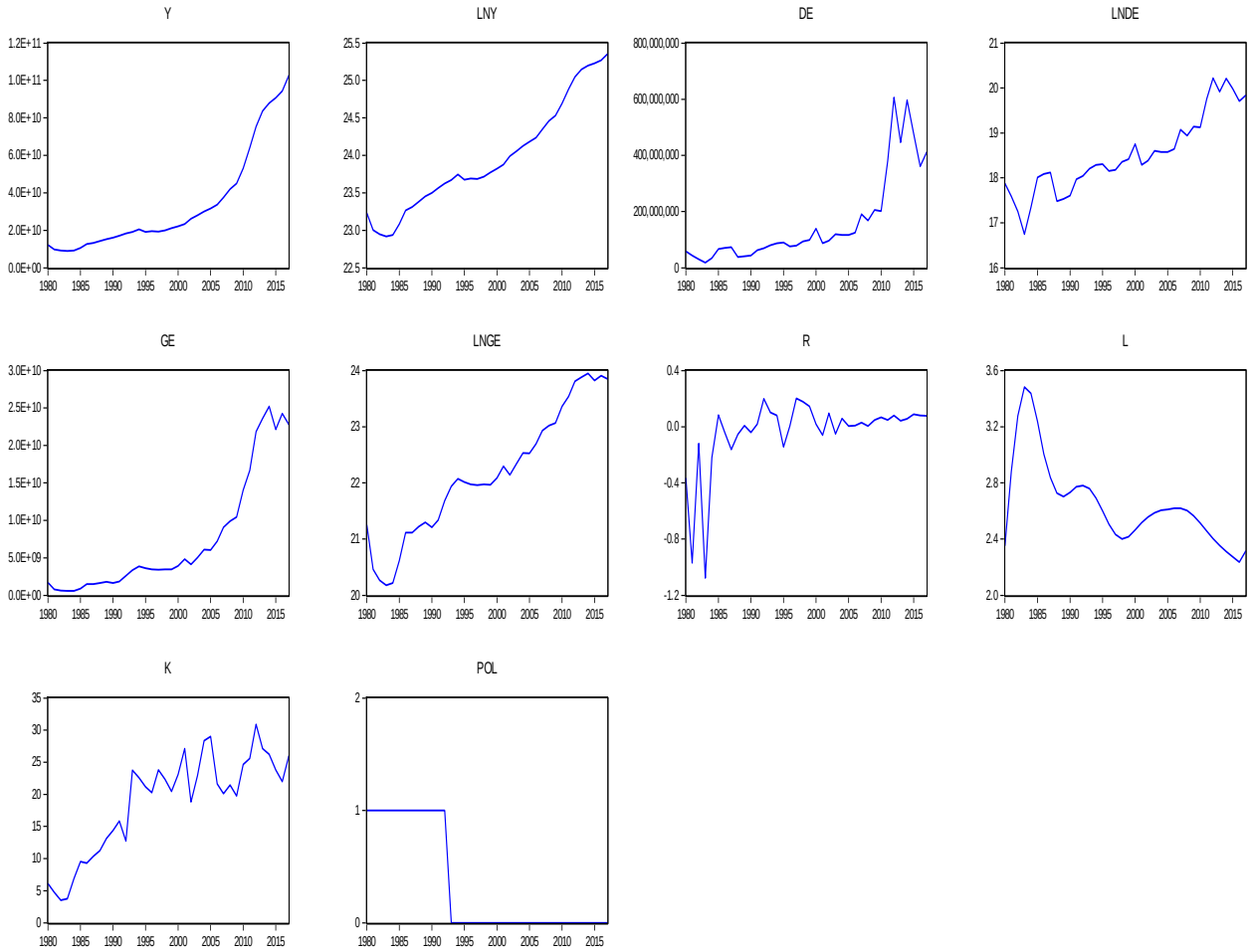
NOTE: Military rule- about 21 years and Multi-party system- about 18 years

Appendix 2: Inflationary Measures (1980-2017)

Year	Inflation	CPI (Base=2012)	Year	Inflation	CPI (Base=2012)
1980	50.005	0.057	1999	12.471	15.895
1981	116.504	0.123	2000	25.113	19.886
1982	22.485	0.151	2001	32.932	26.435
1983	122.245	0.335	2002	14.846	30.36
1984	40.03	0.469	2003	26.626	38.443
1985	10.301	0.518	2004	12.666	43.312
1986	24.539	0.645	2005	15.095	49.85
1987	39.758	0.901	2006	11.683	55.674
1988	31.369	1.184	2007	10.729	61.647
1989	25.237	1.483	2008	16.505	71.822
1990	37.241	2.035	2009	13.139	81.259
1991	18.097	2.403	2010	6.698	86.702
1992	10.049	2.644	2011	7.676	93.357
1993	24.942	3.304	2012	7.072	99.959
1994	24.874	4.126	2013	11.666	111.621
1995	59.317	6.573	2014	15.486	128.907
1996	44.487	9.497	2015	17.153	151.019
1997	24.825	11.855	2016	17.455	177.378
1998	19.208	14.132	2017	12.372	199.323

Source: Author's estimation and compilation

Appendix 3: Graphs Representing Raw and Logged Data



Appendix 4: ADF Unit Root Test Results

I. Level Variables

Null Hypothesis: Unit root (individual unit root process)
Series: LNY, LNDE, LNGE, R, L, K, POL
Date: 07/16/20 Time: 16:42
Sample: 1980 2017
Exogenous variables: Individual effects
User-specified lags: 1
Total (balanced) observations: 252
Cross-sections included: 7

Method	Statistic	Prob.**
ADF - Fisher Chi-square	39.4553	0.0003
ADF - Choi Z-stat	-1.50143	0.0666

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Intermediate ADF test results UNTITLED

Series	Prob.	Lag	Max Lag	Obs
LNY	0.9699	1	1	36
LNDE	0.7961	1	1	36
LNGE	0.6677	1	1	36
R	0.0076	1	1	36
L	0.0000	1	1	36
K	0.3599	1	1	36
POL	0.5695	1	1	36

II. First Difference Variables

Method	Statistic	Prob.**
ADF - Fisher Chi-square	126.261	0.0000
ADF - Choi Z-stat	-9.41256	0.0000

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Intermediate ADF test results D(UNTITLED)

Series	Prob.	Lag	Max Lag	Obs
D(LNY)	0.0186	1	1	35
D(LNDE)	0.0004	1	1	35
D(LNGE)	0.0012	1	1	35
D(R)	0.0000	1	1	35
D(L)	0.0000	1	1	35
D(K)	0.0000	1	1	35
D(POL)	0.0024	1	1	35

Appendix 5: Cointegration Test Results

ARDL Bounds Test
Date: 07/14/20 Time: 14:50
Sample: 1981 2017
Included observations: 37
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	**4.399341**	**6**

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.12	3.23
5%	2.45	3.61
2.5%	2.75	3.99
1%	3.15	4.43

Test Equation:
Dependent Variable: D(LNY)
Method: Least Squares
Date: 07/14/20 Time: 14:50
Sample: 1981 2017
Included observations: 37

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.446888	0.912382	-2.681870	0.0120
LNDE(-1)	-0.007242	0.040621	-0.178270	0.8598
LNGE(-1)	-0.030004	0.093787	-0.319916	0.7513
R(-1)	0.104844	0.048733	2.151396	0.0399
L(-1)	0.224582	0.062547	3.590627	0.0012
K(-1)	0.003986	0.003514	1.134509	0.2659
POL(-1)	0.001519	0.050384	0.030154	0.9762
LNY(-1)	0.110086	0.119650	0.920067	0.3651

R-squared	0.515013	Mean dependent var	0.057387
Adjusted R-squared	0.397947	S.D. dependent var	0.075093
S.E. of regression	0.058266	Akaike info criterion	-2.658779
Sum squared resid	0.098454	Schwarz criterion	-2.310472
Log likelihood	57.18741	Hannan-Quinn criter.	-2.535984
F-statistic	4.399341	Durbin-Watson stat	1.449152
Prob(F-statistic)	0.001967		

Appendix 6: Lag Length Selection

VAR Lag Order Selection Criteria

Endogenous variables: LNY

Exogenous variables: C LNDE LNGE R L K POL

Date: 07/16/20 Time: 16:59

Sample: 1980 2017

Included observations: 35

Lag	LogL	LR	FPE	AIC	SC	HQ
0	37.89807	NA	0.010072	-1.765604	-1.454534	-1.658223
1	**70.08003**	**49.65218***	**0.001700***	**-3.547430***	**-3.191922***	**-3.424709***
2	70.12300	0.063831	0.001802	-3.492743	-3.092796	-3.354681
3	70.91604	1.132916	0.001832	-3.480916	-3.036531	-3.327515

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Appendix 7: Long Run Model

Dependent Variable: LNY
Method: Least Squares
Date: 07/14/20 Time: 18:32
Sample (adjusted): 1981 2017
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.446888	0.912382	-2.681870	0.0120
LNY(-1)	1.110086	0.119650	9.277811	0.0000
LNDE(-1)	-0.007242	0.040621	-0.178270	0.8598
LNGE(-1)	-0.030004	0.093787	-0.319916	0.7513
R(-1)	0.104844	0.048733	2.151396	0.0399
L(-1)	0.224582	0.062547	3.590627	0.0012
K(-1)	0.003986	0.003514	1.134509	0.2659
POL(-1)	0.001519	0.050384	0.030154	0.9762

R-squared	0.994807	Mean dependent var	23.98424
Adjusted R-squared	0.993554	S.D. dependent var	0.725701
S.E. of regression	0.058266	Akaike info criterion	-2.658779
Sum squared resid	0.098454	Schwarz criterion	-2.310472
Log likelihood	57.18741	Hannan-Quinn criter.	-2.535984
F-statistic	793.6436	Durbin-Watson stat	1.449152
Prob(F-statistic)	0.000000		

Appendix 8: Short run Model

Dependent Variable: D(LNY)
Method: Least Squares
Date: 07/14/20 Time: 18:39
Sample (adjusted): 1982 2017
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.030369	0.017496	1.735762	0.0940
D(LNY(-1))	0.603142	0.327880	1.839523	0.0769
D(LNDE(-1))	0.036085	0.030853	1.169559	0.2524
D(LNGE(-1))	-0.027272	0.081958	-0.332753	0.7419
D(R(-1))	0.018720	0.033862	0.552837	0.5849
D(L(-1))	0.040663	0.100457	0.404785	0.6888
D(K(-1))	0.003433	0.003058	1.122596	0.2715
D(POL(-1))	0.023689	0.058651	0.403891	0.6895
ECM(-1)	-0.237713	0.309220	-0.768752	0.4487

R-squared	0.464680	Mean dependent var	0.065374
Adjusted R-squared	0.306066	S.D. dependent var	0.058073
S.E. of regression	0.048376	Akaike info criterion	-3.007296
Sum squared resid	0.063187	Schwarz criterion	-2.611416
Log likelihood	63.13133	Hannan-Quinn criter.	-2.869124
F-statistic	2.929635	Durbin-Watson stat	1.798707
Prob(F-statistic)	0.017168		

Appendix 9: Granger Causality Test

Pairwise Granger Causality Tests
Date: 07/14/20 Time: 18:58
Sample: 1980 2017
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
LNDE does not Granger Cause LNY	37	0.07902	0.7803
LNY does not Granger Cause LNDE		12.3751	0.0013
LNGE does not Granger Cause LNY	37	1.16649	0.2877
LNY does not Granger Cause LNGE		2.85451	0.1003
R does not Granger Cause LNY	37	2.17060	0.1499
LNY does not Granger Cause R		2.80773	0.1030
L does not Granger Cause LNY	37	11.6332	0.0017
LNY does not Granger Cause L		9.63988	0.0038
K does not Granger Cause LNY	37	0.44087	0.5112
LNY does not Granger Cause K		2.14071	0.1526
POL does not Granger Cause LNY	37	0.00058	0.9808
LNY does not Granger Cause POL		0.64746	0.4266
LNGE does not Granger Cause LNDE	37	7.64572	0.0091
LNDE does not Granger Cause LNGE		0.84277	0.3651
R does not Granger Cause LNDE	37	0.26778	0.6082
LNDE does not Granger Cause R		1.80165	0.1884
L does not Granger Cause LNDE	37	0.59704	0.4450
LNDE does not Granger Cause L		10.4120	0.0028
K does not Granger Cause LNDE	37	1.97521	0.1690
LNDE does not Granger Cause K		1.16535	0.2880
POL does not Granger Cause LNDE	37	1.45410	0.2362
LNDE does not Granger Cause POL		0.41857	0.5220
R does not Granger Cause LNGE	37	4.80138	0.0354
LNGE does not Granger Cause R		2.90964	0.0972
L does not Granger Cause LNGE	37	13.3627	0.0009

LNGE does not Granger Cause L		14.3645	0.0006
K does not Granger Cause LNGE	37	1.49628	0.2297
LNGE does not Granger Cause K		2.62565	0.1144
POL does not Granger Cause LNGE	37	0.12483	0.7260
LNGE does not Granger Cause POL		1.39947	0.2450
L does not Granger Cause R	37	0.67448	0.4172
R does not Granger Cause L		20.3714	7.E-05
K does not Granger Cause R	37	8.59338	0.0060
R does not Granger Cause K		2.61386	0.1152
POL does not Granger Cause R	37	3.36685	0.0753
R does not Granger Cause POL		3.56219	0.0677
K does not Granger Cause L	37	23.9781	2.E-05
L does not Granger Cause K		0.42588	0.5184
POL does not Granger Cause L	37	9.48603	0.0041
L does not Granger Cause POL		0.55075	0.4631
POL does not Granger Cause K	37	1.49172	0.2304
K does not Granger Cause POL		1.00097	0.3241

Appendix 10: Residual Diagnostic Tests

Serial Correlation Test Results

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.773524	Prob. F(1,26)	0.3872
Obs*R-squared	1.040090	Prob. Chi-Square(1)	0.3078

Heteroscedasticity Test Results

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.261763	Prob. F(8,27)	0.9730
Obs*R-squared	2.591171	Prob. Chi-Square(8)	0.9573
Scaled explained SS	2.744934	Prob. Chi-Square(8)	0.9493

Functional Form Test Results

Ramsey RESET Test
Equation: UNTITLED
Specification: D(LNY) C D(LNY(-1)) D(LNDE(-1)) D(LNGE(-1)) D(R(-1)) D(L(-1)) D(K(-1)) D(POL(-1)) RESID01(-1)
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.845817	26	0.4054
F-statistic	0.715406	(1, 26)	0.4054
Likelihood ratio	0.977179	1	0.3229