

**BRAIN DRAIN, REMITTANCES AND ECONOMIC
GROWTH OF WEST AFRICAN COUNTRIES**

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APPROVAL

The research work titled: “**BRAIN DRAIN, REMITTANCES AND ECONOMIC GROWTH OF WEST AFRICAN COUNTRIES**” with Registration Number **PG/MSc/16/81890** has followed due process and has been approved to have met the minimum requirement for the award of the Master of Science degree in Economics, University of Nigeria, Nsukka.

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DEDICATION

This work is dedicated to the almighty God, the source of all things and to the lovers of knowledge.

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List of Acronyms

ADF	Augmented Dicky-Fuller
BD	Brain Drain
BOP	Balance of Payment
CBF	Congressional Budget Office
CD	Cross-sectional Dependence
ECOWAS	Economic Community of West African State
EDU	Education
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GLS	Generalized Least Square
GMM	Generalized Method of Moment
ILO	International Labour Organization
IMO	International Organization for Migration
INF	Inflation Rate
IPS	Im-Persiaran-Shin
LDCs	Less Developed Countries
LF	Labour Force
LLC	Levine-Lin-Chu test
Ln	Logarithm
MDCN	Medical and Dental Council of Nigeria
NMA	Nigerian Medical Association

OECD	Organization for Economic Cooperation and Development countries
OLS	Ordinary Least Square
PCI	Per Capita Income
PGR	Population Growth Rate
RE*ED	Remittances multiplied by Education
REM	Remittances
REX	Real Exchange Rate
RGDP	Real Gross Domestic Product
TO	Trade Openness
UNMDP	United Nation Millennium development Project
WHO	World Health Organization

ABSTRACT

This study examines the impact of brain drain and remittances on the economic growth of some selected West African countries. The 11 countries used in the study include Nigeria, Ghana, Senegal, Mali, Benin, Niger, Côte d'Ivoire, Gambia, Guinea Bissau, Burkina Faso and Sierra Leone. The data spanned from 1977 to 2016 (40 years). The Generalized Method of Moments (GMM) through the fixed and random effects estimation technique was applied in the data analysis. Pre-estimation and post estimation test were also carried out to ascertain the nature of the data and to examine the robustness of the regression result. The result shows that increase in stock of physical capital, inflation rate and labour force leads to reduction in brain drain, while increase in population growth and real exchange rate promote brain drain. The result also shows that brain drain has no significant impact on education and remittances within the period covered. More so, remittance was found to have indirect impact on economic growth of this region. The study therefore does not find the mitigating impact of remittances for brain drain in West African countries. Rather, a remittance was found to have positive indirect impact on economic growth. Hence, the study concludes that to harness the benefit of remittances, it must be channel to human capital development. In line with the above findings, the study recommends that proper orientations be given on the need to channel the realized remittances to human capital development, as this tends to generate positive impact on economic growth.

CHAPTER ONE

INTRODUCTION

1.1 Background of Study

Migration has turned the world into globalized settings with various dynamics and complexity, and the exodus of people, undoubtedly, brought about this complexity– in terms of globalization and financial interconnectedness (Manuel, Laura and Yansura, 2016). Overtime, economists had been on the quest to examine the source(s) as well as factors that propel the growth in economic output as well as economic development. But recently, more attention had been shifted to remittances, which is now taking a higher fraction of less developed countries Gross Domestic Product (GDP), as migration now creates a world system which interconnects different people in different region and has resulted in the expansion of the global market for goods and services (Manuel, Lindsay, Micah and Rachel, 2005).

Historical account on migration reveals that migration of people from one region to another improve the migrants' living standard, and tends to have advantage both on the source region– in terms of remittances and the destination region – in terms of labour supply (Anastasia and Christos, 2014; Thanh, 2008). This is attributed to the fact that migration is not all about physical change of environment, but, it improves the standard of living of the migrants' families in the source region. Therefore, remittances in recent years have also become a major source of income to different countries for socioeconomic finance, and as an instrument to facilitate economic growth and development in the long-run (Azam and Khan, 2005).

Migration is in different forms, which could be domestic/internal or international/foreign. A special form of migration which involves the exodus of skilled professionals from one country to another for better job opportunities, access to good technology and good working condition refers to human capital flight or brain drain (Iravani, 2011). Brain drain generally had been argued to have economic implications or cost on the source region, because the government of those countries – source countries –had invested in those workers, which will thereafter end being harnessed by other nations. The converse of brain drain is brain gain which arises when

there are technological diffusion, remittances and other benefits that accrue to the domestic economy due to migration.

According to Andrew and Baomin (2015), the term brain drain was first used in Britain to express the movement of highly skilled scientists and technologists from Canada and United Kingdom (UK) to the United State. Others gave some reasons due to the quest for better opportunities (Kaba, 2011), and access to good technology (Iravani, 2011). In general, Beine, Docquire and Rapoport (2008) explained that brain drain had been an age long phenomenon and most times involves the international migration of human resources (technical personnel) from developing countries to a developed counterpart.

For the past five decades, brain drain has significantly amplified. In 1960, world migration was estimated at 75 million. This value increased to 153 million in 1990, and further increased to 173 million in 2000. The value continued on its upward trend, as its value in 2010 was approximately 222 million, and this value has reached 247 million in 2017 (Migration and Remittances Factbook, 2011, 2017). This increasing trend in migration is expected to continue in the future due to a continuous increase in wage differential, high unemployment rate, increase in poverty, and political unrest prevailing in developing countries (Andrew and Baomin, 2015).

In 2000, high-income countries host 115 million migrants which indicate 67% of the world total migration. This value increased to 173 million in 2015 – which is almost equivalent to the total world migration population in 2000 – and it represents 71% of the total world migration in 2015. These values show that the number of migrant to high-income countries has increased over the years. Furthermore, in the Organization for Economic Cooperation and Development countries (OECD), total migration in 2000 was 84 million which represent 49% of the world total migration. This value increased to 124 million in 2015 which further indicate 51 percent of the total world migrants' population. The non-OECD members also experienced an increase in migration population as its value in 2000 was 31 million which represent 18 percent of the world total migration. The value increased to 49 million in 2015 which represents 20 percent of the world total migration. More also, in the middle-income countries, total migrations in 2000 was 41 million and this value skyrocket to 61 million in 2015 indicating 49 percent increase over 15 years. As at 2015, middle-income countries host 25 percent of the world total migration. The low-income countries do not show such huge increase in migration as its value in 2000 was 8

million and in 2015, it increased to 9 million which is just 13 percent increase over 15 years (United Nations International Migration Report (UNIMR, 2015).

In West Africa, Côte d'Ivoire has the highest number of immigrants from 2000 to 2015. In 2000, total immigrants' in Côte d'Ivoire was 2 million which represent 39 percent of the total migration to West African countries. In the same year, Guinea was the second country in West Africa with the total numbers of immigrants' population of 1 million, which is approximately 20 percent of the total immigrants' population in West Africa. Burkina Faso was the third country with the total immigrants of approximately 1 million, followed by Nigeria (488 thousand), Senegal (232 thousand) etc. From all indication, West African countries had been on disadvantaged in their net migration. Virtually all the West African countries suffer from brain drain menace, and it is more pronounced in Burkina Faso, Niger, Nigeria, Guinea, Mali, Guinea Bissau and Senegal. Nigeria over the last three decades has not experienced positive net migrants; this same trend was experienced by most countries in West Africa (UNIMR, 2015).

Remittances on the other hand, are proceeds from migration. Remittances are funds sent home by emigrants' population to their families. In a concise form, remittances can be described as the international flows of resources (usually measured in monetary terms) from migrants' population from various countries of residence to their relatives (families) at the source region (Congressional Budget Office (CBF), 2005). International remittances are also seen as the transfer of fund by migrants' population to their families or relatives which augment the depleted human capital stock in the source region resulting from migration/human capital flight (Frederic, 2014).

Remittances in the world represent one of the major international financial and development resources, which in developing countries sometimes exceed the flows of foreign direct investment (World Bank, 2017; Dietmar and Adela, 2013). In most countries, especially the LDC's, remittances represent one of the highest foreign exchange earnings in relative to other sources of revenue, which sometimes represent more than 10 percent of the LDC's GDP (Caitlinand Mohamed 2008, Diego, Claudia and Dean, 2010). In 2010, the total stock of remittances flow to developing countries was estimated at \$334 billion; and this value skyrockets to \$442 billion as at 2016 and its value further increased to \$146 billion in 2017 which indicates an average growth rate in remittance of 3.3% (World Bank, 2017).

Nepal for instance, in 2016 had its remittances amount to 31.2% of its GDP which represents the highest percentage in the world. Other countries with such high remittances fractions of their GDP than 20 percent include Haiti (29.4%), Kyrgyz Republic (30.04%), Moldova (21.7%), Gambia (21.5%), Liberia (26.1%), etc. Gambia and Liberia were the only West Africa countries with such a high value of remittances as a percentage of their income (GDP). Senegal which is the third largest percentage of remittances as a fraction of GDP has its value to be 13.7%. Other West African countries had their own share less than 10% in 2017 (World Bank; 2017).

Also, from the World Bank (2017) report, Nigeria currently has the highest remittances (in absolute term) in West Africa. Since 2000, the amount remitted on yearly basis had increased from \$1 billion to \$15 billion in 2005 and further increased to \$20 billion and \$21 billion in 2010 and 2015 respectively. Liberia accounts for the highest receiver of remittances as a percentage of their GDP. In 2015, Liberia attains the peak of 31.5% and this value decreases significantly to 26.1% in 2017, indicating 17.1% decrease. The Gambia, which had the second largest ratio of remittances to GDP, had been experiencing an upward trend in their remittances proportion to GDP over the years. Though there was a slight decrease in this ratio of her remittances to GDP in 2015 from 16.2% to 14.5% (indicating 10.5% decrease), this value increases to 21.5% (which is 48.3% increase) in 2016. There were no such huge inflows in Guinea and Mauritania as their remittances as a percentage of GDP never exceed 1.9% from 1980 to 2015.

A general overview of remittance flows to developing countries indicates that developing countries have been experiencing a high inflow of remittances overtime. From the World Bank estimates, 73% of world remittances flow to the developing countries. Even the shortfall in remittances does not exceed two years (2014-2015) as its value rose again in 2016. The decline in world remittances between 2014 and 2015 was attributed to declining in oil prices coupled with low pace of economic growth in the Gulf Cooperation Council (GCC) countries, as well as the recent toll taking by the Russian Federation on remittances flows to Asian countries. More also, the decline in remittances within the same period was also attributed to the slow growth experienced in Europe, which has also contributed to the reduced the flows of remittances to North America and African countries (World Bank, 2017). The analysis reveals that, the percentage of remittances flow to developing countries in 2010 is 72% of the total world remittances. Likewise, in 2016, the percentage of remittance that flows to developing countries

was 77% which is about 6.9% increase from 2010 to 2016. Therefore, we can conclude that the value of remittances flow to developing countries has increased over the years.

1.2 STATEMENT OF PROBLEM

The problem of human capital flight has reached quite disturbing proportion in Less Developed Countries (LDC's) with African countries in exceptional and this tends to be more detrimental in the LDC's because of weak institutional framework (Lalla; 2012). Though some researchers in the middle-income countries proved that brain drain generates higher income which helps in ameliorating poverty, improve health, promote educational outcomes, as well as promoting the economic development of those regions (Görlich and Trebesch, 2008; Borghi, 2013; Dietmar and Adela; 2013). Riccardo (2006) in his analysis strongly disagreed with such 'augmented effects' of remittances, as the researcher shows that the argument that the negative impact of brain drain could be mitigated by its associated remittances was not generally true. He showed that brain drain is associated with a lower rather than a larger flow of remittances. Other researchers like Banga and Sahu (2010) further argued that regardless of the usage of remittances – either for investment, consumption or in purchasing other assets – it has a positive impact on economic growth of the source countries by enhancing aggregate demand for goods and services. To them, migration creates an avenue for capital transfer – finance and physical technology which could influence the economic, political and social life of the people – to the source region, which has a developmental impact. Therefore, the real effects of brain drain and remittances have not received a clear cut.

As sound as some assertions of the mitigating impact of remittances appears, there are no such evidences in West African and other African countries, given the current indices of low investment, high rate of unemployment, increase in mortality rates, reduction in life expectancy, political instability and the problem of achieving meaningful economic growth among others.

To begin with the mitigating impact of remittances on poverty reduction (as reported by Muhammad, Arif and Quayyum, 2012; Muriel, 2015; Bogaards, 2016); Jordanna (2015) reveals that African countries accounted for 75% of the poorest countries of the world in spite of the huge remittances flow to the region. The hydra-headed monster of poverty in Africa endangers more than 500 million people suffering from water-borne diseases, with more than 50% of

Africans suffering from water-related diseases like cholera, and 109 million of Nigeria falls in this category (WHO, 2015). Nigeria is also ranked the fourth country in the world with the largest population without access to improved drinking-water despite being the highest African country with huge inflows of remittances. The educational sector also in Africa has not experienced any tremendous change due to remittances flow, as 80% of African women are without education (WHO, 2015). The World Bank (2013) research shows that poor education – among women in this region – make them more vulnerable to sickness like AIDS, and less likely to immunize their children due to illiteracy and ignorance.

Global Finance (2017) reveals that the ten countries with the highest population living in extreme poverty are located in sub-Saharan countries. The data shows that more than 414 million of the population of this region lives in abject poverty, which according to World Bank represents 49% of the population of sub-Saharan Africa (World Bank, 2015). The continuous increase in extreme poverty in Africa has led to approximately one in every three-people living in the region being undernourished (Jonathan, 2017). The problem of food insecurity in Africa still continues on an increase of more than 239 million people (approximately 30% of the population) is poorly fed. Africa has the highest percentage of people living in hunger in the world (Agriculture Organization, 2014).

More also, in terms of improved health outcomes resulting from remittances cannot be affirmed in Africa given the deteriorating state of health care facilities and health outcome in Africa. As estimated in the United Nation Millennium development Project (UNMDP, 2012), Malaria alone account for more than 1 million children's deaths in Africa. The malaria death recorded in Africa accounted for 90% of the cases of malaria's death in the world, and 80% of the victims are African children. Furthermore, it was also estimated in the millennium project that every 30 seconds, children in Africa die of malaria and approximately 3000 each day. Neonatal and post-natal mortality rate was on an increase verge in Africa also, as African women were estimated to be 230 percent likelihood to die during pregnancy and childbirth compared to 1/4000 women in North America. In sum, 1 out of 16 African women is likely to die during childbirth.

Driving home to West Africa, it has been a general belief that West African countries are fauteuil of high-risk market for investment because of factors such as bad governance, violent attack, and unstable macroeconomic policies among others. All these factors indicate that majority of the

income remitted to this region cannot be efficiently utilized due to weak institutional frameworks – poor political and social environment. Sani et al., (2012) argued that international agreement and migration policies, especially in the LDC's can leads to high rate of unemployment since many LDC's are large recipients of migrant's flow. In West Africa, for instance, the Economic Community of West African State (ECOWAS) – an international agreement formed by member states – permits members citizens to stay in another country within the region for a period of 90 days without an international passport, can lead to serious unemployment. Sani, therefore, argued that such migration will bring the challenges of integrating these migrants into the working economy. Such free migration will, in turn, result in job competition between the migrants' population and the domestic workforce. Free migration too is associated with fiscal costs on the host region – in the provision of social services to the people – which tends to incur more cost on the government.

At the peak of the problems of brain drain is the migration of medical and academics professionals in LDC's, and most especially West African countries. Ethiopia, Nigeria, Ghana, and Kenya were the highest countries affected with brain drain in sub-Saharan Africa (Jonathan, 2017). From 1993 to 2004, the number of Ghanaian's trained medical staff that left the country to work abroad was estimated at 68% of the total trained medical staff (Sani, Zuber, Stojilovska and Koneska, 2012). Also, Lalla (2012) posit that more than 10,000 academia in tertiary institutions in Nigeria left the country between 1986 and 1990. Furthermore, over 30,000 people left the industrial, public and private organization within the same period. His estimate revealed that 64% of Nigerians in USA age 25 and above have a university degree. This pinpoint to the fact that developed countries lived and harnessed the human capital from developing countries which should contribute to the growth of their domestic countries after much investment in terms of education funding by developing countries. These findings made some authors argue that brain drain is an obstacle to development in the LDCs (Adams, 2005). For example, migration of health workers has been held conventionally as being dangerous to the source countries development.

Also, in the medical sector of Nigeria for instance, New Telegraph (2007) reports that more than 500 medical professionals (doctors) emigrate to the country annually. The information obtained from the interview of Mike Ogirima – President of the Nigerian Medical Association (NMA,

2017), more than 10,000 doctors' currently practice outside the country. This conformed to the earlier proposition given by the Medical and Dental Council of Nigeria (MDCN) that more than 10,000 medical doctors are in the diasporas in search for greener pasture, and were now practicing medicine. The report also stated that about 90% of those working outside the country are trained in Nigeria where they obtained their capacity. Ogirima further said that Nigeria government has invested in the education of this people only to be harnessed by developed countries. He linked this menace to the poor working environment and lack of necessary technology for the doctors to work with and poor working conditions.

As reported in World Bank (2017), Nigerian living abroad, on the average, remits more than \$23,721.1million annually from 2010 to 2017, which is the highest remittances in West African countries as well as African counterpart, and the 7th largest in the world. Liberia on the other hand also had its remittances amount to \$508.6 million annually, and bearing in mind that on the average, Liberia has its average remittances as a percentage of GDP equals 18.5; and Gambia with the highest remittances as percentage of GDP of 19.8% and on the average of \$177 million remitted annually from 2010 to 2017. But despite these above data, West African countries are still wallow in abject poverty, high unemployment, low investment, lack of incentives to attract foreign investors, and these have transcendent to act as a cog to the wheel of economic growth and development in West Africa. Therefore, the huge remittances flow to West African countries had not shown a clear-cut impact on developmental indices of this region, hence the motivation for this study.

Congressional Budget Office (2005) therefore argued three reasons the actual increase in remittances value might not reflect the real value. To him, the increase could be due to inflation. Secondly, they suggested that it could be from the failure of the balance of payment account to fully account for remittances. They are of the opinion that BOP underestimates remittances as they only account for official transfer through official channels, and therefore exclude the flows through the unofficial channels. Finally, they suggest that several remittances flow across the globe which should be recorded as remittances were not recorded as such. Other researchers like Roberto et al., (2010) argued that most of the increase in remittances flow experienced over the years can simply be attributed to the improvements in the migrants' tendency to transfer funds through the official channels, which means that is an improvement in measurements (Roberto,

Sergio, Lindsay and Benavides, 2010). The improvements could be likened to the conveniences and the ease to send fund through the official means and the increasing tendency to use such means by migrants' population, such as money order, cable transfer, etc, rather than through unreported informal channels.

1.3 Research Questions

Based on the above assertions, this research posed the following questions which could act as a guide in the understanding of brain drain, remittances and economic growth in West African countries. They are as follows:

1. What are the determinants of brain drain in West African countries?
2. What is the impact of brain drain on education in West African countries?
3. What is the impact of brain drain on remittances in West African countries?
4. What is the impact of brain drain on economic growth in West African countries?
5. What is the impact of remittances on economic growth in West African countries?

1.4 Objective of the Study

On the aforementioned research questions above, the researcher in order to adequately and effectively answer the questions divide the objective into broad objective and subsidiary or specific objectives. The broad objective of the study is to examine brain drain, remittances and economic growth of West African countries. The specific objectives on the other hand are:

1. To examine the determinants of brain drain in West African countries.
2. To ascertain the impact of brain drain on education in West African countries.
3. To determine the impact of brain drain on remittances in West African countries.
4. To examine the impact of brain drain on economic growth in West African countries.
5. To ascertain the impact of remittances on economic growth in West African countries

1.5 Research Hypotheses

For statistical and analytical reasons, the following hypothesis will act as a roadmap to the above questions

H_{01} : There are no significant determinants for brain drain in West African countries

H_{02} : Brain drain has no significant impact on education in West African countries

H_{03} : Brain drain has no significant impact on remittances in West African countries.

H_{04} : Brain drain has no significant impact on economic growth in West African countries

H_{05} : Remittances has no significant impact on economic growth in West African countries.

1.6 Significance of the Study

The findings of this research work will transcend beyond mere academic brainstorming. It will be of immense benefits to federal government agencies and policymakers in formulating sustainable macroeconomic policies on migration and remittances and also help to identify the leakages as well as how to channel the realized remittances in propelling economic growth. It will also be of benefits to intellectuals and researchers' think tanks that occasionally prescribe and suggest policies option to the government on migration, transportation, and macroeconomic policy issues.

The present study will also be relevant in channeling a new path for promoting sustainable macroeconomic policies of growth and development in West African counties, by providing adequate information on output and financial interconnectedness of these countries and the rest of the world. It will be paramount in developing foreign policies measures which can influence the domestic economic productivity in the long-run. Policymakers on this note will find this research useful is striking a balance in West Africa, pertaining to brain drain, it impacts on education and economic growth and the efficiency level of remittances in West African countries which give a signal to policies matching in migration policies.

Furthermore, the current study will provide more insight to the existing literature on the understanding of brain drain, remittances and economic growth of West African countries and thus, this study will help individuals and scholars alike in broaden the current knowledge frontier on brain drain.

1.7 Scope of the Study

This present study will be done and restricted to West African countries alone and will be examined from 1980-2016. The choice of this period is informed by data availability. The variables to be employed are brain drain (proxy by net migration), gross domestic product (GDP), remittance inflows, school enrolment and other control variables such as FDI, trade openness, manufacturing share of GDP, and per capita income.

1.8 Structure of the study

The study is organized into five chapters. Chapter one provides the introductory aspect which covers Background of the study, statement of problem, the research objectives, questions and Hypothesis, significance of study and the scope. Chapter two focuses on the conceptual framework, Theoretical and Empirical literature. Chapter three covers the research methodology while chapter four deals with the presentation of estimation results and discussion of findings. The research work will be rounded up in chapter five with the summary of findings, conclusions and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Conceptual Framework

2.1.1 The Concepts of Human Capital Flight (Brain Drain)

Brain drain (human capital flight) simply refers to the migration of highly skilled or well-educated individuals for better opportunities. The benefits from skilled migration refer to as brain gain, and the cost is referred to brain drain. Human capital flight always involves the movement of skilled professionals from less developed countries to developed ones. Andrew and Baomin (2015) identified four factors of brain drain in Africa which are economic factors, social and educational factor, push factors and pull factors. The economic factor is due to the deterioration in the economic performance of LDC's (World Bank, 2011; Beine, Docquier and Rapoport 2008; Kwok and Leland, 1982). Social and educational factors are the migration due to advancement in education (Dodoo and Takyi, 2002). The pull factor is due to wage differential between the developed and developing countries (Freeman, Baumann, Blythe, Fisher and Akhtar and Danesh, 2012; Ngoma and Ismail, 2013), and the push factors are high rate of unemployment in the domestic countries, political instability, the high cost of running businesses, underdevelopment, lack of research facilities and institutes, political and social unrest, employment discrimination, economic lack of freedom, poor working conditions, etc (Kaba, 2011; Ngoma and Ismai, 2013).

2.1.2 Concept of Economic Growth

From various conventional views emanated from different economists, economic growth was viewed as a result of the transition of surplus labour from the capitalist sector and the subsistence sector (Lewis, 1954). To Harris and Todaro (1970) economic growth and development involves the movement of people from rural to the urban area due to expected income differentials between rural and urban. Solow (1956) and Swan (1956) on the other hand viewed growth in economic output as basically a function of the stock of capital (capital formation/accumulation), coupled with the growth rate in labour force and technological progress. Denison (1967) also buttresses the importance of capital accumulation in propelling economic growth. Romer (1986) considered the endogenous aspect of economic growth, and to him, economic growth hinged on

investment in human capital, innovation, and knowledge. Economic growth in the long-run to Romar was seen has been a function of investment in research and development which will increase the incentive for innovations. Other empirical work had also established economic growth to different factors such as foreign aids or foreign direct investment (Papanek 1973; Chinery and Strout, 1966; Victor 1987) foreign aid and investment (de Mello, 1999), human capital investment (Lucas, 1988), and political, institutional and the degree of accountability (Owen, 1987) among others as a source of economic growth.

2.1.3 Concept of Remittances

Remittances are the transfer of an asset, usually in monetary term from migrants' family living outside their countries to family members in the source countries. According to International Monetary Fund (IMF, 1999), remittances only account for migrants that have stayed up to one year in their destination region, while those below one year and the self-employed migrants are excluded. International Organization for Migration (IMO) 2006, broadly defined remittances as the financial flows associated with migration or migrants' workers or immigrants to a relative in the country of origin. On the other hand, International Labour Organization (ILO; 2000), defines remittances as the portion of migrant workers' earnings sent back from the country of origin.

Remittances in the world are now forming a huge source of income for developing countries (Caitlin and Mohamed, 2008). Arguably, remittances have been established globally as a key factor to reduce poverty because of its impact on micro and macroeconomic performance and development. One of the major reason why remittances were seen as a key factor in mitigating poverty is due to the fact money sent gets to the target people who need them most and the fund is well utilized in the fashion that results in the greatest benefits and betterment for individual recipient household. Also, remittances sent are at minimal cost with little waste of resources, and as such, it is conventionally believed that remittances can potentially be an ideal tool for economic development.

2.2 Theoretical Literature

2.2.1 Theories of Migration

The Neoclassical Theory of Migration

The neoclassical theory can be traced to the work of the founding fathers of economists, which finds its root in the work of Smith (1776) and Ravenstein (1889). To them, there exist markets for emigration (immigrants market) which exist between two countries. There is also a migration policy made by the host countries which were set up to attract migrants mainly for physical and human capital gain. With this policy structured, migrants aiming to maximize their utility subject to their budget constraint will seek the country whose international migration policy will maximize their standard of living. Though the immigration policy imposed by the source countries can also serve as a constraint to migration, the major arguments are that migrants seek those countries where their wage will be maximized.

New Economics of Migration Theory

This school of thought steeped further in migration theory by viewing migration as a joint decision making by households or family members or households (Stark and Bloom, 1985). The theory viewed migration in term of the family trying to maximize their income, and therefore tend to send some of the family members abroad where the wage is relatively higher. The theory envisages that the likelihood of family sending their relative abroad will be high when the amount of income earned abroad is higher and the disparity in income inequality is higher in source countries. (Stark and Bloom, 1985) further shows that the important factor in migration is absolute income and not relative income comparison. This conclusion was reached through the households' survey in Mexico.

The Human Capital Theory of Migration

The human capital theory approached the analysis of migration from the microeconomic sphere to explain the individual choice. The human capital theory takes cognizance of the economic and social factors as the major determinants in migration. The decision about migration is therefore embedded in such factor like the socio-demographic in determining migration (Munim, 2012).

According to this theory, there is a cost associated with changing of environment, and the migrants will estimate the cost (displacement cost) in comparison with the benefits they stand to get. The theory also identifies other factors that could be influenced by migration as age, sex, education, language, social status, preference, etc. All these factors increase the tendency of migration which would also influence the remuneration and employment rate of the host countries. Chiswick (1978) showed indigenes always on the average have less motivation to work compared to migrants' population. However, considering the educational attainment and the level of experience, it is likely that the migrants' population may be negatively selected.

The Network Theory of Migration

The network theory is a theory that based on migration as a result of the reduction in migrants' cost due to the interconnection that exists among migrants' overtime. Abe et al., (1995) posits that migration due to the migrants' family in the diaspora, create interconnection which leads to the reduction in cost, this, in turn, makes migration a self-perpetuating process. The networks formed by the migrants' population hence reduce the cost and the risk associated with migration which will invariably increase the net return in terms of benefits. The fact that there is an interconnection between the migrants' population in form of family ties, friendship, and shared community, there is a decrease in cost which hence reduces the displacement cost. The newer migrants are entering into the model, the more the associated cost reduced and the networks also expand. This number of migrants will increase up to a certain threshold, the associated cost of migrants' will experience a fall and the migrants' population will increase. In this theory, the effect of self-selection reduces overtime and the network of migrants is more representative of the sending country.

2.3.2 Theories of Remittances

The Classical Theory of Remittances

The classicalist school view industrialization from the positive aspect of brain drain, as they posit that developing countries will promote their economic development/modernization through large-scale technology transfer and industrialization from the developed ones. To the classists, modern knowledge, ideas, innovation, rational and democratic ideas needed to promote the

developing countries only flows from the developed countries. Therefore, the exposure of the traditional economy to acceleration stage involves the transfer of knowledge which is a product of migration. Hence, to the classical school of thought, remittances is a proceed from migration which occurs when people move from one region to the other due to industrialization in the destination region.

The Neoclassical Theory of Remittances

The neoclassical schools steep forward to posit that the marginal productivity of labour and subsequently domestic wage will increase when labour migrate. To this school, the migration of labour result to the scarcity of workforce in the source country, which in turn will lead to pressure on the demand for labour resulting from the low supply of labour. The marginal productivity will increase in this process and the pressure from demand will drive domestic wage higher. As against the capitalist view, remittances and foreign capital flow move in opposite direction with the equilibrium in the domestic economy until the developmental role of migration is fully utilized. To the neoclassical school, remittances will be neutralized in the long run, since the migrants are motivated by higher wage or wage differentials, their leaving will increase the source country's wage, and in the long run, the real wage differential will smoothen out.

The Neo-Marxist Theory of Remittances

The Neo-Marxist theory view migration remittances as the force behind the drive of the capitalist system. The capitalist exploits the excess labour from developing countries and underpay them. These remittances are sent to the migrant's family at the source region which in turn increases their wealth. The increase in wealth will cause an increase in the demand for foreign goods because of the high taste of the domestic countries for foreign goods. To them, there is an exploitation of the developing countries by the developed countries, and this will keep the developing countries at the mercy of the developed ones. Even the realization in term of remittances will still be used to increase the foreign market through the demand for foreign goods.

2.3.3 Theories of Economic Growth

The Classical Theory of Economic Growth

The theory of economic growth as posited by the classical school suggests that economic growth is a function of the relative share of capital in the economic output. To them, investment is the pioneer of economic growth, which is a function of the share of profits in the national income. Therefore, the theory considers economic growth as a linear function of investment, and hence a higher rate of investment will result in higher economic growth.

The major exponents of this theory are Adam Smith, J.S. Mill, and David Ricardo. The growth in economic output stated with Adam Smith's theory of division of labour, which he believes increases productivity and promotes specialization. To Smith, specialization coupled with growth in technology or capital will increase the wage, profit and in turn the economic growth. Furthermore, an increase in wages and profit would create more income and output which will offset the expansion of the population. This process will continue until the expansion in labour and capital meet up with the fixed factor (labour), and hence the economy witnesses diminishing return. The diminishing return experienced by the country will reduce wages and profit to subsistence level thereby leading to a fall in investment.

The Harrod-Dornar Growth Theory

The theory of economic growth advanced by two economists Harrod and Dornar views savings as a force that propels economic growth. To them, there exists a linear and direct relationship between savings and economic growth. The model considers economic growth as being a function of capital accumulation over time which is depending on the rate of saving. The national income of the country will experience a high rate of growth if and only if the rates of saving increase. This theory, on the other hand, negates income equality, as the poor tend to save less than the rich. If the rich have more disposable income, savings will increase which will also promote investment. Their postulations also assume a constant return to scale production function and fixed coefficient production function. Though Harrod (1936) focused on the accelerator principle, and Dornar (1946) focused on the multiplication effect, they converge to the same

conclusion that the rate of growth of output is determined jointly by national savings ratio and the national capital-output ratio (Anyanwu and Oikhenan; 1995)

The Neo-Classical Growth Theory of Solow-Swan Model

The neoclassical theory assumes three variables namely: output (Y), capital (K) and labour (L). The output is assumed to be a function of two factors of production, K and L. They further assume a constant return to scale production function and diminishing returns to factors input – labour and capital. Form the above assumptions, the Solow-Swan postulates that economic growth occurs when the relative share of capital increase than that of labour from the national income. To them, increase in capital relative to labour in national income creates economic growth since the productivity of labour will increase when more capital is given to them (i.e increase in capital per labour). More also, they posit that marginal productivity of labour is higher in the less developed economy, and therefore, increase in capital investment will produce higher returns than countries with large capital accumulation. This is because those countries with high capital accumulations will have higher break-even investment (i.e the investment that will be needed to keep the capital stock from falling). Lastly, because capital exhibit diminishing returns, the economy will grow and reach a point where an increase in capital will no longer yield increase in economic productivity. This stage is known as the steady state of the economy. The only force that can get the economy beyond the steady state is growing in technology.

The Endogenous Growth Model (New Growth Theory)

The new growth theory stems from the famous publications of Paul M. Roman titled "Increasing Returns and Long-run Growth" in 1986 and Robert Lucas work on "The Mechanics of Economic development" in 1988. Improving on Solow's model, they work to integrate economic growth as being a function of technology. The endogenous growth gives great attention to the place of technology advancement by developing the mathematical explanation of growth as depending on technological advancement. Their model also incorporates the aspect of human capital, skilled and knowledge as a major factor of growth. Unlike the Solow-Swan model, capital exhibits constant returns while the human capital exhibit increased rates of return. Therefore, the constant returns to capital prevent the economies from reaching a steady state. The type of capital a country invests in is of paramount importance in this growth theory, but growth in itself does not

fall as capital accumulates. Finally, promotion of research as development will also promote the advancement in technology, education, human capital, and innovation.

2.4 Empirical Literature Review

2.4.1 Migration and Remittances on Economic Growth

Adela and Dietmar (2016) based their study on the impact of remittances on economic growth of six highest remittances receiving countries of Macedonia, Albania, Bosnia Herzegovina, Moldova, Romania, and Bulgaria, using data from 1999-2013. Their result shows a positive and significant relationship with economic growth as well as an increase in growth in relation to the increase in remittances relative to GDP.

Other studies in the quest to examine the impact of remittances on economic growth posited by Salahuddin (2013), in their study of workers' remittances and economic growth in Azerbaijan and Armenia countries. Using the ordinary least squares (OLS) methodological approach, they found that remittances are significant and have a positive impact on economic growth and development for the area under study. Hence, they believed strongly that adequate macroeconomic policies that promote remittances will boost the economic growth and the efficient utilization of the remittances received will generate the same result.

Katsushi et al., (2011) also remittances, economic growth and poverty from Asian countries in order to re-examine the effects of remittances on the growth of GDP per capita used annual panel data from 24 Asian and Pacific countries. Their result shows a positive significant relationship between remittances inflows and economic growth. Furthermore, they also observed that volatility in capital outflow in form of remittances and foreign direct investment (FDI) is harmful to economic growth. This means that despite the beneficial impact of remittances on economic growth, they also saw as a source of output shocks. Moreover, it was also observed that remittances contribute to poverty reduction. Therefore, they conclude that remittances are a potentially valuable component of broad-based development efforts.

Akonji and Wakili (2013) in their study of the impact of net migrant remittances on economic growth in Nigeria employed the Error Correction Model and seemingly unrelated regression (SUR) analysis. Their result does establish a significant relationship between net remittance and

economic growth, but at the individual level, they observed that remittances provide immediate income for households at different levels. They, therefore, argued that the impact of remittance can only be more meaning and contribute to the economic growth of Nigeria if there are adequate measures to promote remittances flows. They also established that financial institutions play a vital role in reducing the cost of transferring funds through official channels.

Ikechi and Anayochukwu (2013) also provided an empirical support on the subject of remittances and economic growth. Focusing on the sub-Saharan African countries with evidence from Nigeria, South Africa, and Ghana, their result shows that migrant's remittances have a positive impact on economic growth of the aforementioned economies. Also considering the causal relationship between remittances and economic growth, remittances were found to Granger cause economic growth in Ghana and South Africa, but the report shows that the impact was felt more in South Africa than Ghana. The opposite was the case for Nigeria where remittances were not found to Granger causes GDP, rather economic growth was seen to granger causes remittances.

Bakare, Najimdeen and Durrani(2014) examined human capital flight and its impact on the economy, a case study of Pakistan. In their quest to examine whether there exists a correlation between human capital flight and government policy. With data from 1980-2011, it was found that workers' remittances have a positive impact on economic growth and per capita income.

Abdelbagi (2016) analyzed migration, remittances, trade openness and economic growth in Africa countries. Using the Generalized Method of Moment (GMM), the result reveals that outgoing migrant has a negative significant impact on economic growth of the region; migrants' remittances on the other hands was found to have a positive significant Impact on economic growth during the period. Finally, in their analysis, their result also found that trade contributes positively and significantly to economic growth in the continent.

Pernilla and Ångman(2014) in their study of remittances and development, with evidence from 99 developing countries, using annual panel data of these countries, the researchers aimed at answering the question of how impactful is remittances to the broader aspect of development? Using development index as part of their dependent variable, they found out that there exists a positive relationship between remittances and the level of human development in developing countries.

Achouak and Mohamed (2013) studied the effect of remittances on economic growth through education in Tunisia, with the aim of studying the effect of migrants' remittances on economic growth. To this end, the application of co-integration on the variables of interest shows a long run relationship in the variables of interest. The obtained result also indicates that the direct effect of remittances is negative, while the indirect effect induced by the inclusion of education is positive. This result conforms to what other researchers obtained in their studies such as Achouak, Mohamed and Mourad (2013) but contradict that of Giuliano and Arranz (2009), Chami et al (2005), Azam and Guber (2006), and other literature reviewed earlier.

Abu (2010) in his empirical analysis of remittances and economic growth with evidence from Bangladesh, India and Sri Lanka, employed the Granger-causality test approach to examine the causal link between remittances and economic growth in the three countries (Bangladesh, India and Sri Lanka). Using a time series data of 25 years for each country, the researcher found that growth in remittances does not lead to growth in Bangladesh. Furthermore, it was observed that there is no causality between remittances and economic growth in India; while Sri Lanka exhibit bidirectional causality between remittances and economic growth, meaning that economic growth and remittances influence each other. The result, however, conform to the one obtained by Chami et al. (2009), Babic (2006), Ratha and Mohapatra (2007), Thanh Le (2008), Karagoz (2009), and Khatiwada (2005); as well contradict the conclusion of Giuliano and Arranz (2009).

Muriel (2015) further examined the impact of remittances on economic growth in four selected countries of West Africa countries (Cameroon, Cape Verde, Nigeria, and Senegal) from 2000-2010. Remittances flow to Nigeria and Senegal was found to exert a positive impact on economic growth which conforms to the result posed by Achouak et al. (2013), and Barnes et al. (2015). On the other hand, remittances flow to Cape Verde and Cameroon was found to exert negative impact on economic growth which further support the result obtained by Barguelli, Zaiem and Zmami (2013), Chami et al. (2009), Babic(2011), Ratha (2007), Thanh Le (2008), Karagoz (2009), and Khatiwada (2005).

2.4.2 Migration, Remittances and Education

Wolfgang, Krieger and Meier (2007) in studying education, unemployment, and migration in India used a two regions model and took unemployment, education and interregional migration as being endogenous. The regions were divided into the poor region and the rich region. The poor region exhibits low wages and high rate of unemployment, and migrants to the rich region were disproportionately high skilled labour. They observed that brain drain from the poor region was motivated by strong incentives to acquire skills even for immobile workers. It was also observed that regional shocks tend to affect both regions in a symmetric fashion, and skilled-based technological change reduces wages of the unskilled. In conclusion, both education and migration decisions are found to be distorted by uniform unemployment compensation, which proves the corrective subsidization.

Akusoba (2014) examined "understanding brain drain in Nigerian universities" with the aim of analyzing factors responsible for skilled emigrants in Nigerian Universities. Push factors according to him drive migrants out of their home countries while pull factors are positive variables which attract and draws immigrants to receiving countries. The research identified push variables that exist in Nigerian Universities to include among others, poor working conditions and poor leadership, poor salaries and unemployment, lack of modern technology etc. these factors were seen as a force behind the emigration of Nigerian university workers to developed ones. They, therefore, opined that workers migration migrates because of a better offer, attractive incentives, and better wage.

Groizard and Llull (2007) investigate skilled migration and sending economies in the quest for testing brain drain and brain gain theories. Their results suggest a negative relationship between remittances and human capital stock, the result also shows that brain drain does not have an impact on remittances. They also found a positive effect of remittances on trade and foreign direct investment.

Yoko and Maurice (2008) in their study of whether remittances actually increase with migrants' education level, and considering the determinants of remittances as being a function of migration rate, migrants education level, source countries GDP, financial sector development and expected growth rate. Their finding shows that remittances decrease with the share of migrant's tertiary

education. This suggests that educational attainment has a negative relationship with remittances. The higher the education, the lower the remittances. This pinpoints the facts that a country will always prefer unskilled labour migrants to skilled migrants. However, remittances were shown to have a positive relationship with financial market development, source country's income, level and rate of migration.

Simon and Oded (2006) also examined international migration and educated unemployment, with the analysis that focused on the link in a simple job-search framework; they find out that an individual's reservation wage in the home labour market increases with the probability of working abroad. Hence, their model implies that such unemployment would be smaller in the absence of the migration possibility. Furthermore, they integrate their model into the recent literature of the beneficial brain drain. The analysis shows that a developing country may end up with more educated individuals despite the brain drain and educated unemployment.

Achouak and Mohammed (2013) further extend the issues of brain drain to education sphere in their study of 'remittances, education and economic growth using panel data analysis with sampling from developed and developing countries. The researcher employed the modified version of Giuliano and Arranz's model (2009) to determine the relationship between economic growth, remittances, and education. A panel-based data analysis of two groups of countries over the 1990-2006 periods seems to point to the existence of a relationship between the studied variable. The first groups of countries consist of the largest remittances-recipient countries as a percentage of GDP. The second group includes countries recipient of the largest remittances in amount (value). The obtained results point to a positive relationship, but not significant, between education and economic growth. However, they noted that remittances negatively act on economic growth, which contradicts the conclusion made by Giuliano and Arranz (2009), yet it conforms to the results obtained by Chami et al. (2005), Azam and Guber (2006), Ratha (2007), Thanh Le (2008) and Sharma (2006) and Khatiwada (2005). The introduction of the interactive term between remittances and education ($REM*EDU$), allows the researchers to conclude that remittances positively affect economic growth through its positive effect on education. The second sample consists of the largest remittances recipient countries in amount, and the result obtained for these groups indicates the presence of three variables likely to explain economic growth: delayed growth, openness to international trade and physical capital. However,

remittances and the interaction term between remittances and education prove contrary to the result earlier reported.

2.4.3 Migration and Remittances on Poverty And Health Outcome

Mckenzie (2012) in his study of the effects of migration on Mexican households, employed health outcomes, education mortality and other household issues as a benchmark to examine the impact of remittances on health. The result of the study shows that remittances improve child health outcomes by allowing the purchase of additional medical and nutritional inputs. It was also found that children with migration or migration tendency have less education as compared with children with no migration. Also, both the infant mortality and birth-weight results show some strong improvements in child health from migration after instrumentation. Children in migrant households are found to be 30 percent more likely to be delivered by a doctor, but 19 percent less likely to be breastfed and 11 percent less likely to receive all of their recommended vaccinations for tuberculosis, diphtheria, polio, and measles. It, therefore, seems that migrants' children are receiving less preventive health care in their infancy.

Anastasia and Christos (2014) investigate the macroeconomic effects of remittances in two small, transition emigration countries, namely Moldova and Albania, employed the Keynesian macroeconomic modeling, and examines the impact of remittances on three macroeconomics variables (consumption, imports and investment) of the aforementioned economy, in order to assess the use of the growth potential of remittances. Their results show that remittances exert a positive impact on consumption, import and investment in the two countries. Their result further shows that a remittance has a greater impact on Albania than Moldova but exert more impact on investment and import more in Moldova than experienced in Albania. They, therefore, conclude that both Albania and Moldova should focus on finding the utilization patterns of remittances that can bring the best results in terms of productive investments and long-term growth.

2.5 Summary of Literature

From the literature reviewed, remittances had been established as a major factor that promotes economic growth. Dietmar and Adela (2016), Katsuishi et al. (2011), among others claimed that remittances promote economic growth, either through direct investment or through the promotion

of the economic welfare of the source region. Akonji and Wakili(2013) also established that net remittances promote economic growth.

Other researcher had examined the impact of remittances on education, which can be seen in the empirical works of Wolfgang, Krieger, and Meier (2007), Akusoba (2014), Groizard and Llull (2007), Cinar and Docquier (2004) among others. It was claimed by the researchers that remittances have a positive impact on education either direct impact or indirect impact (through interaction effects), though David (2012) shows that children with migration or migrating tendency have less education as compared with children with no migration.

Furthermore, Mckenzie (2012), and Blouchoutzi and Nikas (2014) extend their research to another aspect of economic development with the inclusion of health outcomes. They observed that remittances exert a positive impact on health outcomes. David, using microeconomic data shows that remittances improve child health outcomes by allowing the purchase of additional medical and nutritional inputs reduces infant mortality and improves birth-weight.

Riccardo et al. (2006) in their empirical analysis shows that the argument that the negative impact of brain drain may be mitigated by its favorable effect on remittances was not generally true. They show that brain drain is associated with a lower rather than a larger flow of remittances. On remittance flow, therefore, Sobreviñas (2017) posit that sex is an important factor that determines remittances flow, and no further empirical works to support the fact that remittances flow can compensate for brain drain.

In conclusion, Fadinger and Mayr (2011) in their analysis tries to examine how skilled endowment can influence wage. They found that depending on the elasticity of substitution between skilled and unskilled workers, shows that an increase in the expected wage of the skilled and decrease the migration of skilled workers.

2.6 Limitations of Previous Studies and Value Added

Empirical studies of brain drain and remittances have not yielded decisive evidence as to the impact of brain drain and remittances in West African countries. Part of the difficulties arises from the problem of measuring brain drain costs precisely. The bulk of studies existing as regards

brain drain, remittances, and economic growth as reviewed in this study did not focus on West African countries, and their analysis also focused more on one aspect of the topic which is remittances. Their results, as shown above, reveals that remittances improve economic growth, foster higher education, improves health outcomes, and reduce poverty, but the impact of brain drain on economic growth and another aspect of economic development is yet to be established in West Africa.

On these above limitations, the current research will have focused more on brain drain by examining the stimulants of brain drain in West African countries, which will throw more light on the factors that aggravate brain drain in West Africa. This current research will also extend its base by considering the impact of brain drain on education in West Africa, this will help us to examine the detriments of brain drain on the educational sector as posit by Lalla (2012). This research will also investigate the impact of brain drain on remittances as well as economic growth of West African States, and finally, it will examine the direct and indirect impact of remittances on economic growth of West African countries.

CHAPTER THREE

METHODOLOGY

3.1 Theoretical Framework

The theoretical underpinning for this study is basically the Neoclassical growth model. The neoclassical growth theory of Solow (1956) or simply the classical growth theory postulates that economic growth occurs when the relative share of capital increase than that of labour from the national income. To them, increase in capital relative to labour in national income creates economic growth since the productivity of labour will increase when more capital is given to them (i.e increase in capital per labour). More also, they posit that marginal productivity of labour is higher in the less developed economy, and therefore, increase in capital investment will produce higher returns than countries with large capital accumulation.

Neoclassical model is built on four variables which are output (Y), capital (K), Labour (L), and Knowledge (A). At every point in time, it was assumed that capital, labour, and knowledge are combined to produce the economic output. The production function can be stated as:

$$Y(t) = F[(K(t), A(t)L(t))] \text{-----} (3.1)$$

The theory is built on three basic assumptions that labour force growth rate is given as $n(t)$ and the growth rate of knowledge is $g(t)$, investment and saving are considered to be a fixed proportion of output and the production function exhibit constant return to scale (CRS), capital and labour has perfect factor substitutability and diminishing marginal productivities.

From equation one, $A(t)L(t)$ is referred to effectiveness of labour and given assumption three above, we can write the production function in per capita form by dividing equation one through by $A(t)L(t)$ which gives:

$$y(t) = \frac{Y(t)}{A(t)L(t)} = F \left[\frac{K(t)}{A(t)L(t)}, 1 \right] = f \left[\frac{K(t)}{A(t)L(t)} \right] = f[k(t)]$$

$$y(t) = f[k(t)] \text{-----} (3.2)$$

Equation 2 gives output per man (effective labour) as a function of capital per unit of effective labour alone. And from equation 2, increasing capital and labour with the same proportion will not affect output per unit of effective labour. This corresponds to the assumption of CRS.

According to Solow (1956), since the economy may be experiencing growth over time, it turns out to focus on the dynamics of capital per unit of effective labour ($k(t)$). Defining $k(t) = \left(\frac{K(t)}{A(t)L(t)} \right)$, we can apply quotient rule to examine its dynamics. This gives:

$$\dot{k}(t) = \frac{\dot{K}(t)}{A(t)L(t)} - \frac{K(t)}{A(t)L(t)^2} [A(t)\dot{L}(t) + L(t)\dot{A}(t)] \quad (3.3)$$

From assumption 2, change in the capital at any point is simply investment less depreciation

$$\dot{K}(t) = sY(t) - \delta K(t) \quad (3.4)$$

Where δ is depreciation rate. Substituting equation 4 into 3 and Simplifying it gives the equilibrium in the neoclassical growth theory as:

$$\dot{k}(t) = sf(k(t)) - (n + g + \delta)k(t) \quad (3.5)$$

Equation 5 is the general equilibrium model of the neoclassical growth theory, and at equilibrium, $\dot{k}(t)$ is equal to zero, and $sf(k(t)) = (n + g + \delta)k(t)$, meaning that the actual investment is equal to the breakeven investment. When actual investment per unit of effective labour exceeds the investment needed to break-even, k is rising; and when actual investment falls short of breakeven investment, k is falling. When the two are equal, k is constant.

Therefore, economic growth occurs when an investment or capital stock is rising more than the breakeven investment, and that should be the states of the underdeveloped economy. From the second conclusion of Solow model, economic growth will also be faster in the underdeveloped countries because capita per unit of effective labour is low. This theory will, therefore, serve as the bedrock on which the model for this work will be established.

3.2 MODEL SPECIFICATION

Neoclassical school of thought forms the building block for the modeling structure of this work. The models for this work were structured in a way to empirically show brain drain, remittances and economic growth of West African countries.

Model 1: This model is used to examine the determinants of brain drain in West African countries. The neoclassical approach which can be traced to the work of Smith (1776) and Ravenstein (1889) posited a linear relationship between migration and wage. Hicks (1932, p.76) stated that differences in net economic advantages majorly wages are the main cause of brain drain. Based on the synthesis empirical works of some authors like Riccardo et al. (2006); Görlich and Trebesch (2008); methodological approach, the functional form of the model for the stimulants of brain drain in West Africa can therefore be stated as:

$$BD = f(GFCF, LF, PGR, RER, INF) \quad \text{--- (3.6)}$$

Where: BD - represents brain drain, GFCF – Stock of physical capital, LBF– Labour force, REX– the Real exchange rate of the domestic economy and INF – inflation rate. Gross fixed capital formation, labour force, population growth, real exchange rate and inflation are control variables in order to take care of omitted variable bias. specifically, to achieve the aim/objective of determining the stimulants of brain drain in West Africa, and also bear in mind the basic property of the linearity of the variables, we transform the above functional relationship model to econometric form, which gives:

$$BD_{it} = \alpha_0 + \beta_1 GFCF_{it} + \beta_2 LF_{it} + \beta_3 PGR_{it} + \beta_4 RER_{it} + \beta_5 INF_{it} + \mu_t + \eta_i + \varepsilon_{it} \quad \text{--- (3.7)}$$

Where α is the intercept for the country 'i', β 's- the slope, and μ_t, η_i , and ε_{it} – are the errors terms. 'I' represent individual countries and t represent the year in chronological order, and $t > 0$. The error term was decomposed as $\mu_{it} + \eta_i + \varepsilon_{it}$, while ε_{it} the standard or the stochastic error term, and it varies across different countries and years, η_i is a set of the group (country)specific characteristic or effect, which then refers to each country of the model, and μ_{it} is time-specific effects. Therefore, equation 8 is written as:

$$BD_{it} = \alpha_0 + \beta_1 GFCF_{it} + \beta_2 LF_{it} + \beta_3 PGR_{it} + \beta_4 RER_{it} + \beta_5 INF_{it} + \mu_{it} + \eta_i + \varepsilon_{it} \quad \text{--- (3.8)}$$

Brain drain (BD) or net migration of skilled labour is the rate at which people move into a country less the number of people that moves out of that country in a given year.

The variable GFCF represents the stock of physical capital consist of assets used in the production process. This study will use gross capital formation will be used as a proxy for capital in each country (Robert and Wadem, 2013; use the same). The coefficient of physical capital (β_1) should be negative in relation to brain drain because as the capital stock of a country increases, we expect the country to engage in more productive activities which will reduce the emigration rate (Robert and Wadem, 2013).

LBF is the stock of labour force that exists in a country. Labour force consists of all the able manpower, which are willing and able to work at a given wage rate and at a particular time. In the case of developing countries where wages are relatively low, we expect an increase in the labour force to yield a positive impact on brain drain. Therefore, the coefficient of the labour force (β_4) is expected to be positive.

Variable PGR represents population growth rate. Higher population is associated with high brain drain in the less developed countries. Hence, (β_3) is expected to be positively related to brain drain.

The coefficient RER represents the official real exchange rate of the domestic countries under considerations. A rise in the exchange rate of a country indicates depreciation of that country's currency, while a fall in exchange rate indicates an appreciation of the domestic currency. Ullar (2012) showed that depreciation of local currency results in higher flows of remittances, which result in higher migration. Following this empirical work, the coefficient of REX (β_4) should be positive.

Lastly, the variable INF represents inflation rate. Inflation rate represents the increase in the price level of the domestic economy. Increase in inflation rate could encourage migrant or discourage them. Hence the coefficient of inflation could be positive or negative. Therefore, (β_5) could be positive or negative. When it is positive, then it means that skilled migrants are motivated to travel, because the real purchasing power of their income falls as a result of the increase in price level.

MODEL 2: This model is used to examine the impact of brain drain of education in West African countries. The model is an extension of the methodology adopted by Wolfgang et al. (2007), and Groizard, and Llull (2007). The functional form of the model is:

$$EDU = f(BD, RGDP, PGR, PCI) \quad - - - - - (3.9)$$

Where: EDU – Education, BD – Brain Drain, RGDP – Real Gross Domestic Product, TO – Trade Openness, PGR– Population growth and PCI –Per Capita Income. Real GDP, trade openness, remittances and per capita income are control variables. The econometric form of the impact of brain drain on education can, therefore, be stated as:

$$EDU_{it} = \beta_0 + \alpha_1 BD_{it} + \alpha_2 RGDP_{it} + \alpha_3 PGR_{it} + \alpha_4 PCI_{it} + \mu_t + \eta_i + \varepsilon_{it} \quad - (3.10)$$

Where β is the intercept for the country ‘i’, α ’s- the slope, and ε –is the white noise error term. The error term captures other variables that are not specified in the model; ‘i’ represent individual countries and t represent the year in chronological order and $t > 0$. the error term was decomposed as $\mu_t + \eta_i + \varepsilon_{it}$, while η_i is time specific effect, while ε_{it} the standard or the stochastic error term, and it varies across different countries and years, is a set of group (country) specific characteristic or effect, which then refers to each country of the model, and μ_t is a time-specific effects, Therefore, equation 11 can be given as:

$$EDU_{it} = \beta_0 + \alpha_1 BD_{it} + \alpha_2 RGDP_{it} + \alpha_3 PGR_{it} + \alpha_4 PCI_{it} + \mu_t + \eta_i + \varepsilon_{it} \quad - (3.11)$$

The variable EDU signifies education of each country of interest. It indicates the wealth of knowledge obtained or acquired by an individual, through academics training from school. In this study, secondary school enrolment rate will be used as a proxy for education.

α_1 is the coefficient of drain. As explained earlier, brain drain represents the net migration. The coefficient of brain (α_1) is expected to be negatively related to education (school enrolment).

RGDP is gross domestic product adjusted for inflation. Based on a priori, an increase in the real income of a country should increase the education level of that country as many people tend to enroll in schooling. Therefore, the coefficient of RGDP (α_2) should be positively related to EDU.

Variable PGR represents the growth rate in population. Higher population is associated with higher education in theories. Hence, (β_4) is expected to be positively related to brain drain.

Lastly, the variable PCI represents per capita income. Per capita income of a country will be obtained by dividing the gross domestic product of each country by the number of people in that country. Per capita income shows the performance of a country, especially when comparing with other countries. An increase in PCI of a country should increase the education level of a country, and therefore, the coefficient of PCI (β_6) should be positive.

Model 3: This model is used to ascertain the impact of brain drain on net remittances of West African countries. The model will be an extension of Riccardo et al. (2006), and Dimitar (2012) empirical model. The functional form of the model is:

$$REM = f(BD, RER, EDU, PGR) \quad \text{--- (3.12)}$$

Where REM – Net Remittances, BD – Brain Drain, RER – Real Exchange Rate, EDU – Education, and PGR – Population Growth Rate. Form the above functional form, RER, EDU, and PGR are control variables. In order to account for the impact of brain drain on net remittances, we specify equation 8 in econometric form as:

$$REM_{it} = \beta_0 + \alpha_1 BD_{it} + \alpha_2 RER_{it} + \alpha_3 EDU_{it} + \alpha_4 PGR_{it} + \mu_t + \theta_{it} + \varepsilon_{it} \quad \text{--- (3.13)}$$

Also, the error term can be decomposed as $\mu_{it} = \theta_{it} + \eta_i + \varepsilon_{it}$, while η_i is time-varying effects, while ε_{it} the standard or the stochastic error term, and it varies across different countries and years, θ_{it} is a set of group (country) specific characteristic or effect, which then refers to each country of the model, and η_i is a time-specific effect. Therefore, equation 14 is re-written as:

$$REM_{it} = \beta_0 + \alpha_1 BD_{it} + \alpha_2 RER_{it} + \alpha_3 INF_{it} + \alpha_4 PGR_{it} + \mu_t + \eta_i + \varepsilon_{it} \quad \text{--- (3.14)}$$

The variable net migration is the difference between the remittances inflows and outflows. It shows the net gain from remittances and is useful in countries comparison.

BD is the brain drain or net migration variable. An increase in brain drain should increase the net remittances received. Therefore, the coefficient of BD (α_1) should be positive.

RER is the real exchange rate of the countries under consideration. A rise in the exchange rate of a country indicates depreciation of that country's currency, while a fall in exchange rate indicates an appreciation of the domestic currency. An increase in the real exchange rate should increase the net remittances flow. Therefore, the coefficient of RER (α_2) should be positive.

EDU represents education. This is captured by secondary, and therefore, the coefficient of education (α_3) should be positive.

PGR represents the population growth of the countries of consideration. Population growth rate is the rate at which the population of a country changes over a certain period. An increase in population growth should increase the net remittances receives, and therefore, the coefficient of PGR (α_4) should be positive.

MODEL 4: This model is used to examine the impact of brain drain on economic growth of West African countries. The model still follows the extension of the neoclassical growth theory and the empirical works of Thanh and Philip (2007) and Mohammed and Asmatullah (2011). The functional form of the model is:

$$\text{LnRGDP} = f(\text{BD}, \text{LnGFCF}, \text{Ln LF}, \text{INF}, \text{Ln PCI}) - \quad - \quad - \quad - \quad (3.15)$$

LnGDP – log of real Gross Domestic product, BD – Brain Drain, LnGFCF – log of the stock of physical capital, LnLF – log of labour force, INF – inflation, and LnPCI – log of per capita income. The econometric form of the model can be stated as:

$$\text{LnRGDP}_{it} = \beta_0 + \beta_1 \text{BD}_{it} + \beta_2 \text{LnPCP}_{it} + \beta_3 \text{LnLBF}_{it} + \beta_4 \text{INF}_{it} + \beta_5 \text{PCI}_{it} + \mu_{it} + \eta_i + \varepsilon_{it} \quad (3.16)$$

θ_{it} is a time-varying effect, η_i is an un-observed country-specific fixed effect and ε_{it} – stochastic error term. Also, decomposing the errors as $\mu_{it} = \theta_{it} + \eta_i + \varepsilon_{it}$, therefore, equation 17 can be written as:

$$\text{LnRGDP}_{it} = \beta_0 + \beta_1 \text{BD}_{it} + \beta_2 \text{LnPCP}_{it} + \beta_3 \text{LnLBF}_{it} + \beta_4 \text{INF}_{it} + \beta_5 \text{PCI}_{it} + \mu_{it} + \eta_i + \varepsilon_{it} \quad (3.17)$$

- RGDP is the growth rate of real income measured as the growth rate of GDP per capita
- BD indicates brain drain, and its coefficient is expected to be negative.
- PCP represent the stock of physical capital, and an increase in capital stock should increase the growth rate of income. Therefore, its coefficient (β_2) should be positive.
- LBF represents the labour force of the domestic country. An increase in the labour force should promote economic growth. Therefore, β_3 is expected to be positive.
- INF is inflation rate, and an increase in inflation rate should lead to a decrease in economic growth. Therefore, the coefficient of remittances should be negative
- PCI is the per capita income. An increase in per capita income should further increase the economic growth of the country. Therefore, β_5 is expected to be positive.

MODEL 5: This model is used to investigate the impact of remittances on economic growth of West African countries. It will be a synthesis of the neoclassical growth theory and the empirical work of Achouak et, al. (2013), and Garcia-Fuentes and Kennedy (2009) which suggest the impact of remittances on economic growth of the recipient countries through education, or human capital. In this line, we will like to examine the direct and indirect impact of remittances on economic growth.

The aim of the model stated below is to examine the direct and indirect impact of remittances on economic growth through education. This will be achieved through the interaction effect of remittances and education (RE*ED). The model is stated as:

$$\begin{aligned} \ln GDP_{it} = & \alpha_1 + \beta_1 \ln GDP_{t-1} + \beta_2 \ln REM_{it} + \beta_3 \ln GFCF_{it} + \beta_4 \ln LF_{it} + \beta_5 EDU_{it} \\ & + \beta_7 RE * ED_{it} + \mu_t + \eta_i + \varepsilon_{it} - - \end{aligned} \quad (3.20)$$

Equation 3.20 is therefore used to examine the indirect impact of remittances on growth through the interaction effect with education.

3.3 Model Justification

Panel data is often regarded as the best and efficient form of estimation technique in handling econometric data, most especially those that involve cross-sectional analysis (Gujarati, 2010). To

this end, panel data analysis has become a popular analytical means most especially among the social scientist mainly because it allows for inclusion of data across large sample of N individuals (households, firms, government/countries, etc), and across time T (say, daily, monthly, quarterly and yearly). The panel dataset comprises of a matrix of time series for each individual unit or cross-sectional member in a data and offers different estimation method. Cross-sectional data is a data of N observation of individual at the same point in time. But it should be noted that some cross-sectional data exist overtime so that such data form a series and a number of cross section sample taken at a different point in time.

3.4 Pre-Estimation Tests

3.4.1 Descriptive Statistics

In every empirical research, the first step that we should take into consideration is the description of basic variables used in each analysis in order to give an overall view of every researcher for the variables used. The descriptive statistics would be used to understand the nature of each data used in the model. The descriptive statistic also helps us to know the distributive nature of these data over time, which can be obtained through their averages (Gujarati, 2010).

3.4.2 Panel Unit Root Test

For the country-specific analysis, unit root would be conducted on the series. The essence of this is to verify if the variables could be trusted for the purpose of forecasting. The Augmented Dicky-Fuller (ADF) through the Levine-Lin-Chu test would be used in this section to verify the existence or not of a unit root in the individual series. With ADF being a unit root with null specified as unit root, its result would be confirmed by the LLC whose null states stationary. Thus, the model is treated as a time series. Given the various conditions that characterize the various panel unit root tests, under the general assumption of cross-sectional independence as applicable to first generation panels, the Im-Persiaran-Shin (IPS) test would be used in verifying the presence of unit root in the panel series. This test abhors the assumption of Levin-Lin-Chu test, that ρ_i must be the same for all series under the alternative hypothesis. The hypotheses to be tested are:

H_0 : The panel data has a unit root

H_1 : The panel data series has no unit root

The test statistics are given below as

$$T = \frac{1}{N} \sum_{i=1}^N tp_i - - - (3.21)$$

If $p < 1$, then the variable is time invariant and if $p = 1$, there is a unit root problem in the model

3.4.3 Panel Cointegration Test

If discovered that stationarity is achieved not only in levels, there would need to conduct a cointegration test, this is done in order to ascertain if there exists a long-run cointegrating relationship among the panel variables. The cointegration tests developed by Westerlund (2007) will be employed. This test for the absence of cointegration by determining whether there exists error correction for individual panel members or for the panel as a whole. The tests are general enough to allow for a large degree of heterogeneity, both in the long-run cointegrating relationship and in the short-run dynamics, and dependence within as well as across the cross-sectional units.

$H_0: \sigma_{ij} = 0 (ij)$. This means that there is no contemporaneous correlation between the errors; hence SUR estimation technique is not appropriate.

$H_1: \sigma_{ij} \neq 0 (ij)$. This means there exist a contemporaneous correlation, hence, SUR estimation technique is appropriate.

3.4.4 The Hausman Test

According to Dimitriou and Stephen (2007), the Hausman test was formulated in assisting choice making between the fixed effect estimator and the random effect estimator. Hausman (1978) adopt a simple test based on the notion or idea that under the assumption of no correlation, both OLS and GLS are consistent, but is inefficient, while under the alternative hypothesis, OLS is consistency, but GLS is not. More specifically, Hausman assumed that there

are two estimators $\hat{\beta}_0$ and $\hat{\beta}_1$ of the parameters of β and he added two hypothesis testing procedures.

Under the null hypothesis (H_0), both estimators are consistent but $\hat{\beta}_0$ is inefficient, and under the alternative hypothesis, (H_1), $\hat{\beta}_0$ is inefficient, but $\hat{\beta}_1$ is consistent.

3.5 ESTIMATION PROCEDURE

This study will employ the panel analysis of fixed and random effect estimation technique, as the model tends to yield efficient result in panel data analysis especially when the number of observations and years are large. If the assumption of no serial autocorrelation holds, the first difference transformation may consistently estimate equation by equation through instrumenting lagged differences with differences and levels of Y_{it} from earlier periods as proposed by Anderson and Hsiao (1982).

3.6 Diagnostics Tests

This section of the methodology outlines the various test to be conducted in order to ascertain the reliability of results obtained from the estimations.

3.6.1 Testing for Time-Fixed Effects

This test will be carried out to see if time fixed effect is needed in estimating the fixed effect models. It is a joint test to see if the dummies for all the years are jointly equal to zero. If this assumption holds, then it means that there is no time effect in the model. The decision rule here is that we reject the null hypothesis if the probability value estimated is less than 5 percent.

3.6.2 Test for Serial Correlation

Serial correlation tests apply to macro panels with long time series mostly over 20 years. This is not a problem in micro data with few numbers of years. Serial correlation causes the standard errors of the coefficient to be smaller than their actual values, and also over-estimates the R-squared. The null hypothesis here states that there is no serial correlation. We reject this hypothesis if the probability value estimated is less than 5 percent.

3.6.3 Heteroscedasticity Test

A test for heteroscedasticity is available for fixed effect model. The null hypothesis here is that the model is homoscedastic. We reject this hypothesis if the probability value estimate is less than 5 percent

3.6.4 Testing for Cross-Sectional Dependence – The Breush-Pagan Lm Test for Independence and Pasaran Cross-Sectional Dependence (CD) Test

According to Baltagi (2008), cross-sectional dependence is a problem in macro panels with long time series (over 20-30 years). Pasaran CD test is used to test whether the residuals are correlated across entities. Cross-sectional dependence can lead to bias in tests results (also called contemporaneous correlation). The null hypothesis is that residuals are not correlated. The test is applicable only to the fixed effect model alone. The result is presented in the table below.

3.7 Source of Data and Statistical Package

Panel data from 1975 to 2016 was used in this empirical analysis. The data was obtained for 11 West African countries from World Bank data base 2017. Statistical packages such as Stata 12 and Microsoft Excel were used in the analysis.

CHAPTER FOUR

PRESENTATION AND INTERPRETATION OF RESULTS

4.1 Introduction

This chapter focused on the presentation of the research findings. It gives the summary values of the regression analysis on which the objectives and hypothesis stated in chapter one shall be evaluated. This chapter also validates the theory/hypothesis based on the West African case, and to examine its applicability. The regression results shall also be subjected to the economic, statistical and econometric tests as stated in chapter 3.

4.2 Descriptive Statistics

This section examines the nature of the variables used in the work. The basic descriptive statistics of mean and the standard deviation of the variables are presented in the table below.

Table 4.2: Descriptive statistics table of the variables used in the model

Variables	Observations	Mean	Std. Dev.	Minimum	Maximum
REM	440	6.89e+08	3.14e+09	27072.38	2.11e+10
BD	440	-48139.86	490705.5	-9158800	854649
PCI	440	314313.5	313156.8	525.4869	1509192
GFCF	440	7.73e+11	1.55e+12	-1.02e+11	1.12e+13
TO	440	2930584	2686046	21.12435	1.33e+07
RER	440	59.15142	28.33704	.5467809	253.4922
LF	440	3192405	1.07e+07	1.047043	5.74e+07
PGR	440	2.345832	.927112	-0.5564091	4.780393

INF	440	13.75736	22.52373	-7.594284	165.6766
EDU	440	69.12751	19.41583	30.00909	99.92953
RGDP	440	5.30e+12	1.02e+13	6.25e+09	6.98e+13

Source: Authors computation from the result obtained in the appendix

The result presented above shows that 440 observations were used in all. The result also shows a balanced panel analysis – equal years and variables across the samples. In analyzing the various components of the table above, it is observed that the mean value of remittances flow to these countries is 685 million, while the standard deviation is given as 3 billion. This shows that there is high inflows of remittances and wide discrepancy in remittances flow to the region. Also, the mean value of brain drain is approximately 48 thousand. This means that on the average, 48 thousand people migrated from the region annually. The standard deviation for this variable is approximately 491 thousand, which actually means that there is high discrepancy in net migration across this region.

The average value of per capita income in this region is given as 314 thousand, which shows that this region is actually living in relative poverty. The standard deviation is 313 thousand which further shows that some countries relatively have low per capita income in the region. The mean value of gross fixed capita is 773 billion, which shows that capital formation is high in the region. The standard deviation of GFCF is 1.5 trillion. This shows that there is high disparity in gross fixed capital formation in the region. Trade openness on the average is 3 million. It shows that West African trade is highly liberalized. The standard deviation for this variable is also approximately 3 million. This therefore posits that there is much discrepancies in the degree of trade openness in this region.

Average real exchange rate in the region is approximately 59/\$ and the standard deviation is 28. There is no much discrepancy in real exchange rate within the region. Furthermore, average labour force in the region is 3 million. This shows a high active population in this region. The standard deviation is 11 million, which shows a high rate of discrepancy in labour force participation rate across this region. More also, average population growth is 2 percent, and the

standard deviation is given as 0.9 percent. It means that population growth is high in this region considering the size of their population. There is no discrepancy in population growth across this region. More also, average inflation rate is 13 percent with standard deviation of 23 percent. The result shows that inflation rate is high in this region and the variation is also wide across the region.

Also, average education (secondary school enrolment) is 69 percent with standard deviation of 19 percent. This shows that the rate of education participation is relatively low in this region and with little discrepancy in school enrolment across the region. Lastly, average real GDP in the region is 5 trillion and with standard deviation of 10 trillion. This shows that income is high in this region, but there is also wide gap in income across the region.

4.3 Panel Unit Root Result

The unit root test is carried out to examine the order of integration of the variables. The estimation used the Levin-Lin-Chu test which assumes a common autoregressive parameter for all panels. The Levin-Lin-Chu test with panel-specific means but no time trend requires that the number of time periods grow more quickly than the number of panels, so the ratio of panels to time periods tends to zero. The test involves fitting an augmented Dickey-Fuller regression for each panel; and it required that the number of lags to include be selected based on the AIC with at most 10 lags.

Table 4.3: Unit root test of the Variables

Variables	ADF Statistic at Level	Prob. Value	ADF Statistic at First Difference	Prob. Value	Order of integration
BD	-1.4472	0.0739	-3.8187	0.0001	I (1)
REM	1.2213	0.8890	-2.9386	0.0016	I (1)
PCI	0.0834	0.5332	-7.3197	0.0000	I (1)
GFCF	0.5679	0.7149	-5.2065	0.0000	I (1)

TO	-0.5274	0.2990	-11.9414	0.0000	I (1)
RER	-1.2500	0.1057	-8.0483	0.0000	I (1)
LF	-0.2890	0.3863	-9.5929	0.0000	I (1)
PGR	-0.3253	0.3725	-19.0942	0.0000	I (1)
EDU	0.0522	0.5208	-5.5012	0.0000	I (1)
RGDP	14.7290	1.0000	-3.2674	0.0005	I (1)

Source: Authors computation from the result obtained in the appendix

Hypothesis Testing

H₀: $\delta=0$ (the variables are non-stationary)

Decision Rule: reject H₀ if the absolute value of $ADF_{cal} > ADF_{tab}$ or $Pr < 0.05$.

The result Levin–Lin–Chu test in the table above shows that none of the variables was significant at the level form, but were all stationary at their first difference. Hence, all the variables used in the model are integrated of order one i.e I (1) process.

4.4 Cointegration Result

Since all the variables of interest are not stationary at order zero, there is need to conduct the co-integration test to ascertain their long-run relationship. The Westerlund technique developed in 2007 will be employed. The focus of this test is to examine the absence of cointegration by determining whether there exists error correction for the panel as a whole or for individual panel members. The test encompasses large degree of heterogeneity both in the short-run dynamics and the long-run cointegrating relationship, as well as dependence on within and across the cross-sectional unit (Persyn, 2010).

The Gt and Ga statistics test for the presence of short-run relationship or long-run cointegrating for at least one individual country. The statistics are computed using the weighted average of the

individually estimated t-ratio's in the model. On the other hand, the Pt and Pa test statistics examine the pool information across the sectional unit. The rejection of H0 suggests the rejection of the presence of cointegration for the model.

Table 4.4:Cointegration Test

MODELS	Statistic	Stat. Value	Z – Value	Prob. Value
Model 1	Gt	-2.304	0.397	0.654
	Ga	-0.421	5.342	1.000
	Pt	-1.574	4.588	1.000
	Pa	-0.134	3.740	1.000
Model 2	Gt	-1.581	2.014	0.978
	Ga	-1.417	4.452	1.000
	Pt	-4.081	1.767	0.961
	Pa	-1.544	2.706	0.997
Model 3	Gt	-1.188	3.294	1.000
	Ga	-21.988	-4.433	0.000
	Pt	-0.748	4.494	1.000
	Pa	-0.355	3.202	0.999
	Gt	-0.644	5.066	1.000

Model 4	Ga	-1.252	4.523	1.000
	Pt	-0.606	4.611	1.000
	Pa	-0.281	3.233	0.999
Model 5	Gt	-0.644	5.066	1.000
	Ga	-1.252	4.523	1.000
	Pt	-0.606	4.611	1.000
	Pa	-0.281	3.233	0.999

Source: Authors computation from the result obtained in the appendix

Hypothesis Testing

H₀: $\delta=0$ (No cointegration)

Decision rule: reject H₀ if Pr > 0.05

The cointegration result in table 4.4 shows that the Pr value for Gt, Ga, Pt and Pa are all greater than 0.05 for model 1, 2, 4 and 5. This therefore shows that there is long-run relationship in the models both for individual country and in the panel as a whole. The cointegration result for model 3 shows that the Pr value for Ga is statistically significant at 5% level. This shows that for the model of the impact of brain drain on remittances, some countries do not have short-run relationship. However, the Pr of Gt, Pt and Pa are all greater than 0.05. This therefore shows that there is long-run relationship in the panel as a whole.

4.5 The Hausman Result

In order to decide whether to employ fixed effect or random effect, we estimate the Hausman test. It basically tests whether the unique errors (*ui*) are correlated with the regressors, the null

hypothesis is they are not. The null hypothesis of this model is the preference of random effect to fixed effect against the alternative hypothesis of fixed effect (Greene, 2008).

Table 4.5: The Hausman Result

MODELS	CHI-SQUARE	PROBABILITY	DECISION
1	9.26	0.0260	FE
2	0.08	0.7759	RE
3	460.67	0.0000	FE
4	16.86	0.0008	FE
5	20.38	0.0000	FE

Source: Authors computation from the result obtained in the appendix

Hypothesis Testing

$H_0: \beta_0$ are consistence but not efficient, hence employ the fixed effect.

Decision rule: Accept H_0 of fixed effect if $Pr < 0.5$.

From the result of Hausman test above, the best model to be employed for model 1, 3, 4 and 5 is the fixed effect, since their probability level is less than 5%, we conclude that to obtain a consistence estimates, fixed effect should be employed. Also, since the Pr value of equation 2 is greater than 5%, we conclude that this model will necessitate the use of random effect.

4.6 Presentation and Interpretation of Regression Results

4.6.1 Model 1: Determinants of Brain Drain in West African Countries

This result shows the determinants of brain drain in West Africa. The result is presented in the table below.

Table 4.6.1: Determinants of brain drain in West Africa

Variables	Coefficient	t – value	Prob.
C	-284277.2	-2.78*	0.006

GFCF	-7.54e-08	-2.87*	0.004
LF	-0.0162024	-1.78**	0.076
PGR	82338.31	2.45*	0.015
RER	3847.912	2.96*	0.003
INF	-5425.006	-5.06*	0.000

Source: Authors computation from the result obtained in the appendix

* indicates that the t-stat is statistically significant at the 5% and ** indicates 10% level

Thus

$$DB = -284277.2 - 7.54e - 8GFCF - 0.016LF + 82338.3PGR + 3.847.9RER - 5425INF$$

The result above shows the macroeconomic determinants of brain drain in West Africa countries. The result shows that an increase in stock of fiscal capital reduces the rate at which skilled personnel migrated from the region. Also, it shows that labour force has a negative but insignificant relationship with brain drain. This shows that an increase in labour force will reduce the rate at which skilled professionals migrate from West African countries, but the result is only applicable at 7 percent level of significance.

Furthermore, population growth shows a positive and significant relationship with brain drain. This means that the higher the population growth, the higher the migration of skilled professionals. Real exchange rate is also another variable that determines the migration of people from West African countries. The result shows that an increase in real exchange rate (defined as domestic currency per unit of foreign currency) causes an increase in skilled migrants. This could be attributed to the fact that the real purchasing power of the domestic currency worsen when exchange rate increases – depreciate. Also, inflation rate shows a negative and significant relationship with brain drain within the years covered. The result shows that an increase in inflation rate will cause a decline in brain drain.

4.6.2 Model 2: Impact of Brain Drain on Education in West African Countries

This result examines the impact of brain drain on education in West African countries. The result is presented in the table below.

Table 4.6.2: Impact of brain drain on education in West African countries

Variables	Coefficient	t – value	Prob.
C	55.84412	4.83*	0.000
BD	-9.51e-07	-1.82**	0.076
RGDP	7.29e-13	7.81*	0.000
PGR	-2.365911	-2.66*	0.011
TO	3.46e-06	11.35*	0.000
PCI	.0000152	2.86*	0.007

Source: Authors computation from the result obtained in the appendix

* indicates that the t-stat is statistically significant at the 5% and ** indicates 10% level

Thus

$$EDU = 55.8 - 9.51e - 7BD + 7.29e - u13RGDP - 2.4PGR + 3.5e - 7TO \\ + 0.0000152PCI$$

The result above shows the impact of brain drain on education of West African countries. The result shows that holding other factors that influences education in this region constant, average school enrolment is approximately 56 percent. The result also shows that brain drain has a negative relationship with education, but this is only significant at 8 percent. Real GDP shows a positive and significant relationship with education. This posit that the higher the income of these West African countries, the higher the proportion of people that will enroll in schools.

Population growth shows a negative relationship with education of this region. The result shows that for a one percentage increase in the population growth of West African countries will leads to 2 percent decrease in school enrolment rate. This does not conform to it's a priori expectation, but it has been found by other authors such as Chami et al. (2005), Azam and Guber (2006), Ratha (2007), Thanh Le (2008) and Sharma (2006). Furthermore, the degree of trade openness shows a positive relationship with education. This means that trade openness could promote education participation due to the possibilities of knowledge transfer inherent in openness. More also, per capita income shows a significant relationship with education in this region. The result shows that a 1000 increase in the per capita income of these countries will leads to 2 percent increase in school enrolment rate.

4.6.3 Model 3: Impact of Brain Drain on Remittances in West African Countries

This result examines the impact of brain drain on remittances in West African countries. The result is presented in the table below.

Table 4.6.3: Impact of Brain Drain on Remittances in West African Countries

Variables	Coefficient	t-value	Prob.
C	-6.71e+09	-7.08*	0.000
BD	-350.248	-1.79**	0.082
TO	-460.5733	-5.07*	0.000
RER	7.06e+07	5.33*	0.000
EDU	5.89e+07	5.53*	0.000
PGR	2.05e+08	2.03*	0.049

Source: Authors computation from the result obtained in the appendix

* indicates that the t-stat is statistically significant at the 5% and ** indicates 10% level

Thus

$$REM = -6.71e + 9 - 350.2BD - 460.6TO + 7.06e + 7RER + 5.89e + 7EDU + 2.05e + 8PGR$$

The result above shows that brain drain is has a negative relationship with remittances. This result clearly shows that an increase in skilled migrants reduces the remittances inflow. This, therefore suggest that the huge remittances flow to the West African countries could be emanating from the unskilled migrants, though the result is not significant at 5 percent. Also, trade openness shows a negative relationship with remittances flow. This further shows that an increase in the degree of trade openness reduces remittances flow to this region by 461 (of the domestic currency). Real exchange rate also shows a positive relationship with remittances flow to West African countries. This means that depreciation of this region's currency will enhances more remittances inflow. This could be as a result of the increase in the value of the foreign currency in relative to the domestic currency.

Furthermore, education shows a positive impact on remittances flow to this region. This means that the higher the enlightenment rate through education, the higher will be the inflows of remittances. Finally, population growth rate also shows a positive relationship with remittances inflow. This shows that the higher the growth rate in population, the higher the inflows of remittances.

4.6.4 Model 4: Impact of Brain Drain on Real GDP in West African Countries

The result presented in this section examines the impact of brain drain on real GDP in West African countries. The result is presented in the table below.

Table 4.6.4: Impact of brain drain on real GDP in West African countries

Variables	Coefficient	t-value	Prob.
C	16.13837	67.23*	0.000
BD	-6.56e-10	-0.21	0.836

LGFCF	-0.0050437	-3.37*	0.002
LLF	-0.0169311	-6.36*	0.000
LPCI	0.9538139	46.13*	0.000
INF	.0005828	2.79*	0.008

Source: Authors computation from the result obtained in the appendix

*indicates that the t-stat is statistically significant at the 5% level

Thus

$$LRGDP = 16.14 + -6.56e - 10BD - 0.005LGFCF - 0.017LLF + 0.954LPCI + 0.0006INF$$

The result above shows that holding all other factors influencing RGDP constant, real GDP in West African countries is 16 billion. The result also shows that brain drain has a negative but insignificant impact on real GDP in this region. Also, stock of physical capital shows a significant negative relationship with economic growth as well as labour force. It further shows that economic growth is relatively inelastic to changes in stock of physical capital and labour force. These results do not conform to their a priori theoretical expectations, probably because of low capital formation and low human capital development in this region.

Per capita income shows a positive relationship with economic growth in West African countries. The result shows that a unit increase in per capita income will leads to 0.95 increase in income. Economic growth is relatively inelastic to per capita income. Inflation rate also shows a positive relationship with economic growth of this region. The result shows that a one percent increase in inflation will leads to 0.6 percent unit increase in income.

4.6.5 Model 5: Impact of Remittances on Economic Growth of West African Countries

This model examines the direct and indirect impact of remittances on economic growth. The result is presented in the table below.

Table 4.6.5: Indirect impact of remittances on economic growth

Variables	Coefficient	t-value	Prob.
C	0.833121	0.27	0.788
LRGDP-1	0.9619383	84.43*	0.000
LREM	-0.2039798	-2.93*	0.006
LLF	0.0011148	0.49	0.626
LGFCF	0.0090823	4.31*	0.000
EDU	-0.0028714	-2.39*	0.022
LREM*EDU	0.2090353	2.97*	0.005

Source: Authors computation from the result obtained in the appendix

* indicates that the t-stat is statistically significant at the 5% level

Thus

$$LRGDP = 0.833 + 0.962RGDP_{-1} - 0.204LREM + 0.001LLF - 0.003EDU + 0.209LREM * EDU$$

This result shows that previous values of real GDP are significant determinant of the current growth rate in real GDP. The result shows that a one percent increase in previous value of real GDP in West African countries will leads to 0.96 percent increase in real GDP.

Furthermore, remittances inflow shows a negative relationship with economic growth of this region. This result also conforms to the previous result obtained. Labour force shows a positive but insignificant relationship with economic growth. More also, education shows a negative relationship with economic growth, probably because of low academic attainment at secondary school level.

In conclusion, the parameter of interest – the indirect impact of remittances on education – shows a positive relationship with economic growth. This conform to the a priori expectation, and shows that remittances channeled to education has a long-run impact on growth in West African countries, despite remittances on its own shows a negative relationship.

4.7 Diagnostics Test

4.7.1 Test for Time Fixed Effect

This test was carried out to know whether time effects are needed in the estimated model. It only applied to the fixed effect model alone. The test examines whether the dummy variables apportioned to each year are jointly equal to zero. If they are, then there is no time effect in the model. This result is applicable to model 1, 3, 4 and five respectively as determined by the Hausman test – see the Hausman test in section 4.3 above.

Table 4.7.1: Test for time effect

Model	Fcal.	Prob.
Model 1	1.22	0.1746
Model 3	0.92	0.6193
Model 4	191.15	0.0000
Model 5	132.62	0.0000

Source: Authors computation from the result obtained in the appendix

Hypothesis Testing

$$H_0: \theta_{1t} = \theta_{2t} = \theta_{nt} = 0$$

Decision Rule: Reject H_0 is prob. < 0.05

The result above, the probability level for the time effect test is greater than 5 percent in model 1, 3 and 5b. Hence, we conclude that there is no time effect for this model. Hence the model is

estimated without time dummies. Conversely, model 4 and 5a shows a probability level below 5 percent. We reject the null hypothesis of no time effect. Hence the model was estimated with time effect (see appendix).

4.7.2 Testing For Random Effects: Breusch-Pagan Lagrange Multiplier (LM)

The LM test helps you decide between a random effects regression and a simple OLS regression. The null hypothesis in the LM test is that variances across entities are zero. That is, there no significant difference across units (i.e. no panel effect). If the variances are jointly equal to zero, then it means that OLS regression is more appropriate in the analysis. The result is presented in table 4.7.2 below

Table 4.7.2: Breusch-Pagan Lagrange multiplier (LM) test

Model 2	Chi-Square	Prob.
	2168.01	0.0000

Source: Authors computation from the result obtained in the appendix

Hypothesis Testing

$$H_0: \delta_{1t} = \delta_{2t} = \delta_{nt} = 0$$

Decision rule: Reject H_0 if Prob. < 0.05, otherwise do not reject.

From the result presented above, we reject the H_0 of zero variances across West African countries. Therefore, we conclude that random effect is more appropriate in estimating this model.

4.7.3 Testing For Cross-Sectional Dependence/Contemporaneous Correlation: Using Pasaran Cross-Sectional Dependence (CD) Test

According to Baltagi (2008), cross-sectional dependence is a problem in macro panels with long time series (over 20-30 years). Pasaran CD test is used to test whether the residuals are correlated across entities. Cross-sectional dependence can lead to bias in tests results (also called

contemporaneous correlation). The null hypothesis is that residuals are not correlated. The test is applicable only to the fixed effect model alone. The result is presented in the table below.

Table 4.7.3: Pasaran Cross-Sectional Dependence (CD) test

Model	Pasaran Stat.	Prob.
Model 1	0.746	0.4559
Model 3	-1.804	0.0712
Model 4	-3.799	0.0001
Model 5	2.435	0.0149

Source: Authors computation from the result obtained in the appendix

Hypothesis Testing

H0: $\mu_{i1t} = \mu_{i2t} = \mu_{int} = 0$ (No serial correlation)

Decision rule: Reject H0 if prob. < 0.05. Otherwise, do not reject.

From the result presented in table 4.7.3 above, we conclude that model one did not contain serial correlation. This is shown by the probability level of 0.45. On the other hand, model 3, 4, 5a and 5b shows the presence of serial correlation. This is shown by the probability level of 0.07, 0.000, 0.008 and 0.0149 in the table above.

To correct for the problem of serial correlation (cross-sectional dependence) in the model, the Driscoll and Kraay standard errors estimation was used in the estimation of the result presented in section 4.4 above (see appendix).

4.7.4 Testing for Heteroscedasticity

Modified Wald test for group wise heteroscedasticity in fixed effect regression model are invoked to examine whether the variances are constant overtime. The null hypothesis here is that the variances are constant overtime. The results are presented in the table below.

Table 4.7.4: Wald test for group wise heteroscedasticity

Model	Chi-Square	Prob.
Model 1	8.4e+06	0.0000
Model 3	2465.11	0.0000
Model 4	23919.56	0.0000
Model 5	218.29	0.0000

Source: Authors computation from the result obtained in the appendix

Hypothesis Testing

H0: $\delta^2_{1it} = \delta^2_{2it} = \delta^2_{nit} = \delta^2$ (Model is homoscedastic)

Decision Rule: Reject H0 is Prob. < 0.05, otherwise, do not reject.

From the result presented above, all the probabilities are less than 5 percent. Hence, we reject the H0 of homoscedastic, and we conclude that the models contain heteroscedasticity. To correct for this problem, the Huber/White or sandwich estimators was used to obtain the heteroscedasticity-robust standard errors (see appendix).

4.7.5 Testing for Serial Correlation

Serial correlation tests apply to macro panels with long time series (over 20-30 years). Not a problem in micro panels (with very few years). Serial correlation causes the standard errors of the coefficients to be smaller than they actually are and higher R-squared. The null is no serial correlation. The result is presented in the table below.

Table 4.7.5 Serial correlation test

Model	Fcal.	Prob.
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Model 1	17.301	0.002
Model 2	23.174	0.0007
Model 3	344.821	0.0000
Model 4	324.201	0.0000
Model 5	54.152	0.0000

Source: Authors computation from the result obtained in the appendix

HYPOTHESIS TESTING

H0: $\varepsilon_{1it} = \varepsilon_{2it} = \varepsilon_{nit} = 0$ (No serial correlation)

Decision rule: Reject H0 if Prob. < 0.05 percent. Otherwise, do not reject

Conclusion: Since the probability values estimated in the above table are all less than 0.05, we reject H0 of no serial correlation, and we conclude that the model contains first order serial correlation. This is due to the fact that these countries are connected through different international co-operations such as ECOWAS. The Huber/White or sandwich estimator was used to correct this problem (see appendix).

4.8 Evaluations of Research Hypotheses and Policy Implications

The results presented above can now be used to access the validity of the research hypothesis, as well as to analyze the policy implications of each hypothesis.

The first hypothesis posed in this work is that there is no stimulant to brain drain in West African countries. This hypothesis can be rejected based on the result obtained in table 4.4.1 above. The result shows that increase in stock of fiscal capital and inflation rate reduces brain drain, while population growth and depreciation in exchange rate encourages brain drain. The implication of this finding is that capital accumulation or better technology development is necessary to retain the skilled professionals in West African countries. Since capital formation is low in this region, to discourage brain drain will be a difficult task. Also, since inflation discourages brain drain, it

will be a great task for policy makers to target the inflation rate that will generate equilibrium in West Africa. Also, since population growth and depreciation of exchange rate encourages brain drain, it will be difficult to discourage brain drain in this region, since the region leave largely on imported goods and most of the time suffers deficit in their balance of payment.

The second hypothesis posed in this work is that brain drain has no significant impact on education in West African countries. With the result obtained in table 4.4.2, we do not reject this hypothesis, and we conclude that brain drain does not have impact on education. The implication of this finding is that the skilled migrant from this region does not affect their education. Furthermore, the tendency of achieving meaningful education may be limited in the future since the result is significant at 8 percent and negative. The tendency of education enrolment rate to fall in the future is high for this region.

The third research hypothesis states that brain drain does not have a significant influence on remittances in West African countries. Given the result obtained in table 4.4.3, we accept this hypothesis, and conclude that brain drain has no impact on remittances in West African countries. The implication of this finding is that the increase in remittances inflow cannot be attributed to current migration alone. It could be as a result of the recent improvement in the channel of sending money, or as a result of depreciation of exchange rate in the region. Hence, brain drain is actually a loss to this region since it doesn't lead to an improvement in remittances.

The forth hypothesis asserted that brain drain does not have a significant impact on economic growth in West African countries. With the result presented in table 4.4.4, we do not reject this hypothesis, and we conclude that brain drain has no significant impact on economic growth of this region. The implication is that this region will keep losing their skilled professionals to the developed countries. This is because their impact is not felt probably as a result of inadequate resources to harness their productivity in the region. We tend to measure them in numbers rather than their productivity.

Lastly, the fifth hypothesis states that remittances have no significant impact on economic growth of West African countries. With the result presented in table 4.5a and 4.5b, we reject this hypothesis and conclude that remittances have both direct and indirect impact on economic growth of West African countries. The implication of the result is that remittances on its own do

not yield a meaningful impact on economic growth of this region, probably because it is not being used in productive activities. But when interact with education, it yields a positive result. The implication of this is that for the impact remittances to be felt, large proportion of the remittances must be devoted to education. This has a positive impact on economic growth.

CHAPTER FIVE

SUMMARY OF FINDINGS, POLICY RECOMMENDATIONS AND CONCLUSION

5.1 Summary of Findings

This research work focused on brain drain, remittances and economic growth of West African countries. In order to achieve the above target, the study set up five objectives which could serve as a guide. The specific objectives include the assessment of the determinants of brain drain in West African countries, to examine the impact of brain drain on remittances, investigating the impact of brain drain on economic growth as well as examining the impact of remittances on economic growth in the region. The study employs panel analysis of 11 countries in the region which include Nigeria, Ghana, Senegal, Mali, Benin, Niger, Cote d'Ivoire, Gambia, Guinea Bissau, Burkina Faso and Sierra Leone. The data also spanned from 1977 to 2016 (40 years).

The result shows that stock of physical capital and inflation has a negative relationship with brain drain, while population growth and real exchange rate shows positive relationship with brain drain. Also, the result shows that brain drain has no significant relationship on education and remittances within the period covered. More also, remittance was found to have direct and indirect impact on economic growth of West African countries.

5.2 Policy Recommendation

Having observed the relationship that exists between brain drain, remittances and economic growth of West African countries, I will recommend the following policies to promote sustainable growth for this region.

1. Since the study found that an increase in stock of physical capital reduces the migration of skilled professionals from the region, the study therefore recommends that solid infrastructural development such as good workable conditions in our tertiary institutions be prioritized. Also, there should be access to better technology – through technological transfer –, rehabilitation of the class rooms to create good working conditions, pipe borne water; electricity; access road etc. Also, in the medical sector, there should be an improvement in the access to better technology given the current deterioration state of

health care services in the region. All these can be achieved if the ratio of capital expenditure improves in the budget.

2. More also, these professionals have invested their time and resources in different academic endeavours, and there should be a commensurate compensation for their services to discourage their migration.
3. To curb another push factor found in the result (depreciation of exchange rate), the study recommends that policies that encourages production be made to take the advantage of the current deteriorating state of exchange rate – as depreciation of exchange rate increase the demand to the domestic goods as experienced in China. This could be done through technological transfer, granting of loans – small, medium and long-term loan- to the manufacturing sector. This on its own will improve the income of the region and internally correct for exchange rate depreciation.
4. The study also recommends that proper orientations be enacted on the need to channel the realized remittances to human capital development, as this tends to generate positive impact on economic growth.
5. Finally, the study recommends that some international bodies formed by these countries employ exchange rate targeting just as the one being practiced in the European countries. This can be achieved through the introduction of common currency, and fixing the exchange rate to this currency. This, if achieved, will help in the will strengthens the region as a whole against external shocks.

5.3 Conclusion

This study examines brain drain, remittances and economic growth of West African countries, with data from 11 countries in the region. The countries used in the study include Nigeria, Ghana, Senegal, Mali, Benin, Niger, Cote d'Ivoire, Gambia, Guinea Bissau, Burkina Faso and Sierra Leone. The data also spanned from 1977 to 2016 (40 years). The Generalized Method of Moments (GMM) through the fixed and random effects estimation technique was applied in the data analysis. Pre-estimation and post estimation test were also carried out to ascertain the nature of the data and to examine the robustness of the regression result. The result shows that increase in stock of physical capital, inflation rate and labour force leads to reduction in brain drain, while increase in population growth and real exchange rate promote brain drain. The result also shows

that brain drain has no significant impact on education and remittances within the period covered. More also, remittance was found to have indirect impact on economic growth of this region. The study therefore does not find the mitigating impact of remittances for brain drain in West African countries. Rather, remittances was found to have indirect impact on economic growth. Hence, the study shows that to harness the benefit of remittances, it must be channelled to human capital development. In line with the above findings, the study recommends that proper orientations be given on the need to channel the realized remittances to human capital development, as this tends to generate positive impact on economic growth.

From the holistic study of previous literature and analysis obtained from this current study on brain drain, remittances and economic growth of West African countries, the study concludes that the results presented in this study are meaningful for policy making. The research equally concludes that remittances, if channelled to education, has the possibility of increasing the economic growth in the long-run, but brain drain has no significant impact on economic growth in the study.

5.4 Suggestions For Further Studies

This current study examines brain drain, remittances and economic growth of West African countries. However, there are some limitations encountered in the course of the study which future studies can actually improve on. The limitations spanned from the fact that the countries being studied are underdeveloped and lacked the necessary data needed for the analysis as suggested by theories. Some variables like domestic wage, technological change, tertiary school enrolment, total employment, poverty rate, human capital development index etc. are not available to the researcher.

Another limitation encountered in this study is incomplete data. Some countries do not have complete data and this may affect the conclusion of the research. Also, lack of information about the target population of people that receives remittances also posed some limitations to this current study. To crown it all, the researcher was not able to dissect the study to include primary data due to inadequate finance. Owing to these constraints, the researcher acknowledges any inadequacies or anomalies that might be encountered here in.

Based on the limitations encountered and some current gap uncovered in this study, other researchers could as well explore the following areas for better understanding of the impact of brain drain and remittances in West African countries. They are as follows:

1. The probability impact of brain drain on productivity in developing countries
2. The substitution effects of brain drain in West African countries
3. Impact of remittances on economic development of West African countries.
4. Brain drain, Unemployment and output growth of West African countries.
5. The shocks dynamics of brain drain on economic development in West African countries.

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APPENDIX

```

      _ _ _ _ _      _ _ _ _ _      _ _ _ _ _      _ _ _ _ _      (R)
     / _ _ / _ _ / _ _ / _ _ / _ _ / _ _ / _ _ / _ _ /
    Statistics/Data Analysis 12.1 Copyright 1985-2011 StataCorp LP
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```

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 PEP Network

Notes:

```

. edit

. *(11 variables, 440 observations pasted into data editor)

. encode country, gen (country1)

. drop country

. ren country1 country1country

. ren country1country country

. xtset country year
    panel variable:  country (strongly balanced)
    time variable:  year, 1977 to 2016
                  delta: 1 unit

. xtsum rem bd pci gfcf to rer lf pgr inf

```

Variable		Mean	Std. Dev.	Min	Max	Observations	
rem	overall	6.89e+08	3.14e+09	27072.38	2.11e+10	N =	440
	between		1.81e+09	1.79e+07	6.14e+09	n =	11
	within		2.62e+09	-5.45e+09	1.56e+10	T =	40
bd	overall	-48139.86	490705.5	-9158800	854649	N =	440
	between		203849.8	-307887.3	461093.3	n =	11
	within		450476.2	-8899053	968629.5	T =	40
pci	overall	314313.5	313156.8	525.4869	1509192	N =	440
	between		316900.2	775.1984	1085540	n =	11
	within		81013.13	-43153.95	739607.9	T =	40
gfcf	overall	7.73e+11	1.55e+12	-1.02e+11	1.12e+13	N =	440
	between		1.22e+12	2.13e+09	4.33e+12	n =	11
	within		1.02e+12	-2.39e+12	7.68e+12	T =	40
to	overall	2930584	2686046	21.12435	1.33e+07	N =	440
	between		2348696	50.61606	7539567	n =	11
	within		1479371	-2481516	8664047	T =	40
rer	overall	59.15142	28.33704	.5467809	253.4922	N =	440
	between		12.13524	40.69926	79.61875	n =	11
	within		25.86129	-9.182572	243.7629	T =	40
lf	overall	3192405	1.07e+07	1.047043	5.74e+07	N =	440
	between		1.05e+07	15.9349	3.49e+07	n =	11
	within		3701439	-1.75e+07	2.57e+07	T =	40
pgr	overall	2.345832	.927112	-.5564091	4.780393	N =	440
	between		.7239872	.800867	3.337683	n =	11
	within		.6180166	-.4145386	4.91463	T =	40
inf	overall	13.75736	22.52373	-7.594284	165.6766	N =	440
	between		11.65364	4.051029	32.5734	n =	11
	within		19.5851	-23.43554	148.2498	T =	40

.

UNIT ROOT TEST AT LEVEL

REMITTANCES

```
. xtunitroot llc rem, trend
```

Levin-Lin-Chu unit-root test for rem

Ho: Panels contain unit roots	Number of panels =	11
Ha: Panels are stationary	Number of periods =	40

AR parameter: Common	Asymptotics: N/T -> 0
Panel means: Included	
Time trend: Included	

ADF regressions: 1 lag
LR variance: Bartlett kernel, 10.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-3.5586	
Adjusted t*	1.2213	0.8890

BRAIN DRAIN

```
. xtunitroot llc bd
```

Levin-Lin-Chu unit-root test for bd

Ho: Panels contain unit roots	Number of panels =	11
Ha: Panels are stationary	Number of periods =	40

AR parameter: Common	Asymptotics: N/T -> 0
Panel means: Included	
Time trend: Not included	

ADF regressions: 1 lag
LR variance: Bartlett kernel, 10.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-3.2582	
Adjusted t*	-1.4472	0.0739

PCI

```
. xtunitroot llc pci
```

Levin-Lin-Chu unit-root test for pci

Ho: Panels contain unit roots	Number of panels =	11
Ha: Panels are stationary	Number of periods =	40

AR parameter: Common	Asymptotics: N/T -> 0
Panel means: Included	
Time trend: Not included	

ADF regressions: 1 lag
LR variance: Bartlett kernel, 10.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	0.0715	
Adjusted t*	0.0834	0.5332

GFCF

```
. xtunitroot llc gfcf
```

Levin-Lin-Chu unit-root test for gfcf

Ho: Panels contain unit roots	Number of panels =	11
Ha: Panels are stationary	Number of periods =	40

AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included

ADF regressions: 1 lag
LR variance: Bartlett kernel, 10.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	0.4865	
Adjusted t*	0.5679	0.7149

TO

```
. xtunitroot llc to
```

Levin-Lin-Chu unit-root test for to

Ho: Panels contain unit roots	Number of panels =	11
Ha: Panels are stationary	Number of periods =	40

AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included

ADF regressions: 1 lag
LR variance: Bartlett kernel, 10.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	0.8486	
Adjusted t*	0.9904	0.8390

EDU

```
. xtunitroot llc edu
```

Levin-Lin-Chu unit-root test for edu

Ho: Panels contain unit roots	Number of panels =	11
Ha: Panels are stationary	Number of periods =	40

AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included

ADF regressions: 1 lag
LR variance: Bartlett kernel, 10.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-1.9306	
Adjusted t*	0.0522	0.5208

RGDP

```
. xtunitroot llc rgdp
```

Levin-Lin-Chu unit-root test for rgdp

Ho: Panels contain unit roots	Number of panels =	11
Ha: Panels are stationary	Number of periods =	40

AR parameter: Common	Asymptotics: N/T -> 0
Panel means: Included	
Time trend: Not included	

ADF regressions: 1 lag

LR variance: Bartlett kernel, 10.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	10.0084	
Adjusted t*	14.7290	1.0000

UNIT ROOT AT FIRST DIFFERENCE

```
. xtunitroot llc drem, trend
```

Levin-Lin-Chu unit-root test for drem

Ho: Panels contain unit roots	Number of panels =	11
Ha: Panels are stationary	Number of periods =	39

AR parameter: Common	Asymptotics: N/T -> 0
Panel means: Included	
Time trend: Included	

ADF regressions: 1 lag

LR variance: Bartlett kernel, 10.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-14.5512	
Adjusted t*	-2.9386	0.0016

BRAIN DRAIN

```
. xtunitroot llc dbd
```

Levin-Lin-Chu unit-root test for dbd

Ho: Panels contain unit roots	Number of panels =	11
Ha: Panels are stationary	Number of periods =	39

AR parameter: Common	Asymptotics: N/T -> 0
Panel means: Included	
Time trend: Not included	

ADF regressions: 1 lag

LR variance: Bartlett kernel, 10.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-8.4597	
Adjusted t*	-3.8187	0.0001

PCI

```
. xtunitroot llc dpci
```

Levin-Lin-Chu unit-root test for dpci

Ho: Panels contain unit roots	Number of panels =	11
Ha: Panels are stationary	Number of periods =	39

AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included

ADF regressions: 1 lag
LR variance: Bartlett kernel, 10.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-13.5100	
Adjusted t*	-7.3197	0.0000

GFCF

```
. xtunitroot llc dgfcf
```

Levin-Lin-Chu unit-root test for dgfcf

Ho: Panels contain unit roots	Number of panels =	11
Ha: Panels are stationary	Number of periods =	39

AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included

ADF regressions: 1 lag
LR variance: Bartlett kernel, 10.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-10.6598	
Adjusted t*	-5.2065	0.0000

REAL EXCHANGE RATE

```
. xtunitroot llc drer
```

Levin-Lin-Chu unit-root test for drer

Ho: Panels contain unit roots	Number of panels =	11
Ha: Panels are stationary	Number of periods =	39

AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included

ADF regressions: 1 lag
LR variance: Bartlett kernel, 10.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-15.3689	
Adjusted t*	-8.0483	0.0000

Labour force

```
. xtunitroot llc dlf
```

Levin-Lin-Chu unit-root test for dlf

Ho: Panels contain unit roots	Number of panels =	11
Ha: Panels are stationary	Number of periods =	39

AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included

ADF regressions: 1 lag
LR variance: Bartlett kernel, 10.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-15.0799	
Adjusted t*	-9.5929	0.0000

TO

```
. xtunitroot llc lto
```

Levin-Lin-Chu unit-root test for lto

Ho: Panels contain unit roots	Number of panels =	11
Ha: Panels are stationary	Number of periods =	38

AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included

ADF regressions: 1 lag
LR variance: Bartlett kernel, 10.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-18.7911	
Adjusted t*	-11.9414	0.0000

EDU

```
. xtunitroot llc dedu
```

Levin-Lin-Chu unit-root test for dedu

Ho: Panels contain unit roots	Number of panels =	11
Ha: Panels are stationary	Number of periods =	39

AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included

ADF regressions: 1 lag
LR variance: Bartlett kernel, 10.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-10.3063	
Adjusted t*	-5.5012	0.0000

.

RGDP

```
. xtunitroot llc drgdp

Levin-Lin-Chu unit-root test for drgdp
```

```
Ho: Panels contain unit roots           Number of panels =    11
Ha: Panels are stationary               Number of periods =    39

AR parameter: Common                   Asymptotics: N/T -> 0
Panel means:   Included
Time trend:    Not included

ADF regressions: 1 lag
LR variance:    Bartlett kernel, 10.00 lags average (chosen by LLC)
```

	Statistic	p-value
Unadjusted t	-7.8871	
Adjusted t*	-3.2674	0.0005

COINTEGRATION TEST FOR MODEL 1

```
. xtwest bd rgdp rem gfcf lf rer edu, lags(2) leads(0 1)

Calculating Westerlund ECM panel cointegration tests.....

Results for H0: no cointegration
With 11 series and 6 covariates
Average AIC selected lag length: 2
Average AIC selected lead length: 1
```

Statistic	Value	Z-value	P-value
Gt	-0.972	4.728	1.000
Ga	-0.182	5.437	1.000
Pt	-0.853	5.192	1.000
Pa	-0.216	3.709	1.000

COINTEGRATION TEST FOR MODEL 2

```
. xtwest edu bd rgdp to rem pci, lags(2) leads(1)

Calculating Westerlund ECM panel cointegration tests.....

Results for H0: no cointegration
With 11 series and 5 covariates
```

Statistic	Value	Z-value	P-value
Gt	-1.679	1.693	0.955
Ga	-1.726	4.319	1.000
Pt	-4.087	1.762	0.961
Pa	-1.426	2.755	0.997

COINTEGRATION TEST FOR MODEL 3

```
. xtwest rem bd to rer inf pgr, lags(2) leads( 1)

Calculating Westerlund ECM panel cointegration tests.....

Results for H0: no cointegration
With 11 series and 5 covariates
```

Statistic	Value	Z-value	P-value
Gt	-1.188	3.294	1.000
Ga	-21.988	-4.433	0.000
Pt	-0.748	4.494	1.000
Pa	-0.355	3.202	0.999

COINTEGRATION TEST FOR MODEL 4

```
. xtwest rgdp bd gfcf lf rem pci, lags(2) leads(0 1)

Calculating Westerlund ECM panel cointegration tests.....

Results for H0: no cointegration
With 11 series and 5 covariates
Average AIC selected lag length: 2
Average AIC selected lead length: 1
```

Statistic	Value	Z-value	P-value
Gt	-1.061	3.708	1.000
Ga	-0.736	4.746	1.000
Pt	-0.670	4.558	1.000
Pa	-0.103	3.307	1.000

COINTEGRATION TEST FOR MODEL 5

```
. xtwest rgdp rem gfcf lf edu to, lags(2) leads(0 1)

Calculating Westerlund ECM panel cointegration tests.....

Results for H0: no cointegration
With 11 series and 5 covariates
Average AIC selected lag length: 2
Average AIC selected lead length: 1
```

Statistic	Value	Z-value	P-value
Gt	-1.206	3.236	0.999
Ga	-1.167	4.560	1.000
Pt	-2.892	2.740	0.997
Pa	-0.156	3.285	1.000

HAUSMAN TEST FOR MODEL 1

```
. hausman fixed random

Note: the rank of the differenced variance matrix (3) does not equal the number of coefficients being tested (5); be sure this is what you
expect, or there may be problems computing the test. Examine the output of your estimators for anything unexpected and possibly
consider scaling your variables so that the coefficients are on a similar scale.
```

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	(b) fixed	(B) random		
gfcf	-7.54e-08	-7.49e-08	-4.96e-10	1.43e-09
lf	-.0162024	-.0036079	-.0125944	.0065648
pgr	82338.31	60010.82	22327.49	9807.111
rer	3847.912	2433.197	1414.714	739.291
inf	-5425.006	-5340.488	-84.5174	142.143

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

Test: Ho: difference in coefficients not systematic

```
chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
        = 9.26
Prob>chi2 = 0.0260
(V_b-V_B is not positive definite)
```

HAUSMAN TEST FOR MODEL 2

```
. hausman fixed random
```

Note: the rank of the differenced variance matrix (1) does not equal the number of coefficients being tested (5); be sure this is what you expect, or there may be problems computing the test. Examine the output of your estimators for anything unexpected and possibly consider scaling your variables so that the coefficients are on a similar scale.

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	(b) fixed	(B) random		
bd	-1.01e-06	-9.51e-07	-6.15e-08	.
rgdp	7.58e-13	7.29e-13	2.89e-14	1.11e-14
pgr	-2.343776	-2.365911	.0221351	.0777459
to	3.48e-06	3.46e-06	1.84e-08	2.44e-08
pci	.0000166	.0000152	1.40e-06	1.99e-06

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

Test: Ho: difference in coefficients not systematic

```
chi2(1) = (b-B)'[(V_b-V_B)^(-1)](b-B)
        = 0.08
Prob>chi2 = 0.7759
(V_b-V_B is not positive definite)
```

HAUSMAN TEST FOR MODEL 3

```
. hausman fixed random
```

Note: the rank of the differenced variance matrix (3) does not equal the number of coefficients being tested (5); be sure this is what you expect, or there may be problems computing the test. Examine the output of your estimators for anything unexpected and possibly consider scaling your variables so that the coefficients are on a similar scale.

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	(b) fixed	(B) random		
bd	-476.7284	-1.43e-06	-476.7284	202.3837
to	-268.5233	3.34e-06	-268.5233	62.84925
rer	7.56e+07	.0879964	7.56e+07	3535471
inf	-3476173	.0050577	-3476173	4706886
pgr	1.03e+08	-1.894859	1.03e+08	1.43e+08

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

Test: Ho: difference in coefficients not systematic

```
chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
        = 460.67
Prob>chi2 = 0.0000
```

HAUSMAN TEST FOR MODEL 4

```
. hausman fixed random
```

Note: the rank of the differenced variance matrix (3) does not equal the number of coefficients being tested (5); be sure this is what you expect, or there may be problems computing the test. Examine the output of your estimators for anything unexpected and possibly consider scaling your variables so that the coefficients are on a similar scale.

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	(b) fixed	(B) random		
bd	94815.67	91825.75	2989.92	.
gfcf	1.56828	1.610546	-.0422657	.
lf	332296	376620.6	-44324.51	13802.32
rem	1075.203	1011.064	64.13874	16.49652
pci	2133104	2965070	-831965.9	367421.4

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

Test: Ho: difference in coefficients not systematic

```
chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
        = 16.86
Prob>chi2 = 0.0008
(V_b-V_B is not positive definite)
```

HAUSMAN TEST FOR MODEL 5

```
. hausman fixed random
```

Note: the rank of the differenced variance matrix (2) does not equal the number of coefficients being tested (5); be sure this is what you expect, or there may be problems computing the test. Examine the output of your estimators for anything unexpected and possibly consider scaling your variables so that the coefficients are on a similar scale.

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	(b) fixed	(B) random		
rem	1079.16	1006.099	73.06171	12.8354
gfcf	1.474601	1.576443	-.1018421	.
lf	332609.5	386028.8	-53419.27	12780.17
edu	2.29e+10	1.51e+10	7.76e+09	.
to	1984.674	22468.3	-20483.63	.

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

Test: Ho: difference in coefficients not systematic

```
chi2(2) = (b-B)'[(V_b-V_B)^(-1)](b-B)
        = 20.38
Prob>chi2 = 0.0000
(V_b-V_B is not positive definite)
```

MODEL ESTIMATION

MODEL 1

```
. xtreg bd gfcf lf pgr rer inf, fe
```

```
Fixed-effects (within) regression           Number of obs   =       440
Group variable: country                     Number of groups =        11

R-sq:  within = 0.1044                      Obs per group: min =        40
       between = 0.0040                      avg           =       40.0
       overall  = 0.0272                      max           =        40

                                           F(5,424)        =       9.89
corr(u_i, Xb) = -0.6937                     Prob > F         =     0.0000
```

bd	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
gfcf	-7.54e-08	2.62e-08	-2.87	0.004	-1.27e-07	-2.38e-08
lf	-.0162024	.0091055	-1.78	0.076	-.0340999	.0016952
pgr	82338.31	33566.98	2.45	0.015	16359.91	148316.7
rer	3847.912	1299.215	2.96	0.003	1294.208	6401.615
inf	-5425.006	1072.706	-5.06	0.000	-7533.489	-3316.523
_cons	-284277.2	102078.8	-2.78	0.006	-484920.8	-83633.57
sigma_u	333256					
sigma_e	433778.49					
rho	.37115942	(fraction of variance due to u_i)				

```
F test that all u_i=0:      F(10, 424) =    10.05      Prob > F = 0.0000
```

Model 2

```
. xtscd edu bd rgdp pgr to pci, re
```

```
Regression with Driscoll-Kraay standard errors   Number of obs   =       440
Method: Random-effects GLS regression           Number of groups  =        11
Group variable (i): country                     Wald chi2(5)      =    227.70
maximum lag: 3                                 Prob > chi2       =     0.0000
corr(u_i, Xb) = 0 (assumed)                   overall R-squared  =     0.0056
```

edu	Drisc/Kraay		t	P> t	[95% Conf. Interval]	
	Coef.	Std. Err.				
bd	-9.51e-07	5.22e-07	-1.82	0.076	-2.01e-06	1.05e-07
rgdp	7.29e-13	9.34e-14	7.81	0.000	5.40e-13	9.18e-13
pgr	-2.365911	.8899091	-2.66	0.011	-4.165922	-.5659002
to	3.46e-06	3.05e-07	11.35	0.000	2.85e-06	4.08e-06
pci	.0000152	5.31e-06	2.86	0.007	4.46e-06	.0000259
_cons	55.84412	11.55695	4.83	0.000	32.46798	79.22027
sigma_u	16.32203					
sigma_e	9.4163529					
rho	.75028554	(fraction of variance due to u_i)				

Model 3

```
. xtscd rem bd to rer edu pgr, fe
```

```
Regression with Driscoll-Kraay standard errors   Number of obs   =       440
Method: Fixed-effects regression                 Number of groups  =        11
Group variable (i): country                     F( 5, 39)        =    14.80
maximum lag: 3                                 Prob > F         =     0.0000
within R-squared =     0.5748
```

rem	Drisc/Kraay		t	P> t	[95% Conf. Interval]	
	Coef.	Std. Err.				
bd	-350.248	195.9181	-1.79	0.082	-746.5297	46.03374
to	-460.5733	90.89901	-5.07	0.000	-644.4339	-276.7127
rer	7.06e+07	1.32e+07	5.33	0.000	4.38e+07	9.73e+07
edu	5.89e+07	1.07e+07	5.53	0.000	3.74e+07	8.05e+07
pgr	2.05e+08	1.01e+08	2.03	0.049	1003740	4.09e+08
_cons	-6.71e+09	9.48e+08	-7.08	0.000	-8.62e+09	-4.79e+09

Model 4

```
. xi: xtscd lrgdp bd lgfcf llf lpci inf i.year, fe
i.year      _Iyear_1977-2016      (naturally coded; _Iyear_1977 omitted)

Regression with Driscoll-Kraay standard errors      Number of obs      =      439
Method: Fixed-effects regression                    Number of groups      =      11
Group variable (i): country                        F( 44,      39)      =      18581.27
maximum lag: 3                                    Prob > F              =      0.0000
                                                within R-squared      =      0.9867
```

lrgdp	Drisc/Kraay					[95% Conf. Interval]
	Coef.	Std. Err.	t	P> t		
bd	-6.56e-10	3.15e-09	-0.21	0.836	-7.04e-09	5.72e-09
lgfcf	-.0050437	.001497	-3.37	0.002	-.0080717	-.0020157
llf	-.0169311	.0026641	-6.36	0.000	-.0223196	-.0115425
lpci	.9538139	.0206781	46.13	0.000	.9119886	.9956392
inf	.0005828	.0002089	2.79	0.008	.0001603	.0010053
_Iyear_1978	.0242896	.0008211	29.58	0.000	.0226289	.0259504
_Iyear_1979	.0558005	.0018643	29.93	0.000	.0520296	.0595714
_Iyear_1980	.0653014	.0030878	21.15	0.000	.0590558	.071547
_Iyear_1981	.101789	.002816	36.15	0.000	.096093	.1074849
_Iyear_1982	.1313298	.002652	49.52	0.000	.1259657	.1366939
_Iyear_1983	.1483434	.0036402	40.75	0.000	.1409803	.1557064
_Iyear_1984	.1809086	.0031084	58.20	0.000	.1746214	.1871959
_Iyear_1985	.2189542	.0027837	78.66	0.000	.2133238	.2245847
_Iyear_1986	.2416423	.0039319	61.46	0.000	.2336894	.2495953
_Iyear_1987	.2605434	.0057654	45.19	0.000	.2488819	.272205
_Iyear_1988	.2992501	.0036972	80.94	0.000	.2917719	.3067284
_Iyear_1989	.3209415	.0041399	77.52	0.000	.3125679	.3293152
_Iyear_1990	.3589563	.0035241	101.86	0.000	.3518283	.3660844
_Iyear_1991	.3781659	.0054777	69.04	0.000	.3670861	.3892457
_Iyear_1992	.4086295	.0044404	92.03	0.000	.399648	.417611
_Iyear_1993	.4404225	.0038727	113.73	0.000	.4325893	.4482558
_Iyear_1994	.4615698	.0049564	93.13	0.000	.4515444	.4715951
_Iyear_1995	.4886835	.0051592	94.72	0.000	.478248	.4991189
_Iyear_1996	.523442	.0040571	129.02	0.000	.5152358	.5316482
_Iyear_1997	.5643436	.0043992	128.28	0.000	.5554454	.5732417
_Iyear_1998	.5825757	.0040824	142.71	0.000	.5743184	.5908331
_Iyear_1999	.6089509	.0037749	161.31	0.000	.6013154	.6165864
_Iyear_2000	.6359334	.0039949	159.19	0.000	.6278531	.6440138
_Iyear_2001	.6682482	.0040975	163.09	0.000	.6599601	.6765362
_Iyear_2002	.7006782	.0040701	172.15	0.000	.6924457	.7089107
_Iyear_2003	.7330597	.0043714	167.69	0.000	.7242177	.7419018
_Iyear_2004	.7652105	.0045411	168.51	0.000	.7560252	.7743957
_Iyear_2005	.7917858	.0045047	175.77	0.000	.7826743	.8008974
_Iyear_2006	.819675	.0045145	181.57	0.000	.8105436	.8288064
_Iyear_2007	.8542162	.0049387	172.96	0.000	.8442266	.8642057
_Iyear_2008	.8825788	.0050297	175.47	0.000	.8724053	.8927524
_Iyear_2009	.9140624	.0053794	169.92	0.000	.9031815	.9249432
_Iyear_2010	.9374998	.0056025	167.33	0.000	.9261676	.948832
_Iyear_2011	.969331	.0056313	172.13	0.000	.9579406	.9807213
_Iyear_2012	1.00326	.0062223	161.24	0.000	.9906744	1.015846
_Iyear_2013	1.037927	.0067615	153.51	0.000	1.02425	1.051603
_Iyear_2014	1.069607	.0070503	151.71	0.000	1.055346	1.083868
_Iyear_2015	1.095897	.0068049	161.04	0.000	1.082133	1.109661
_Iyear_2016	1.125968	.0072044	156.29	0.000	1.111396	1.14054
_cons	16.13837	.2400512	67.23	0.000	15.65282	16.62392

Model 5

(a)

```
. xi: xtscclrgdp lrem lgfcf llf lpci inf i.year, fe
i.year      _Iyear_1977-2016      (naturally coded; _Iyear_1977 omitted)

Regression with Driscoll-Kraay standard errors      Number of obs      =      439
Method: Fixed-effects regression                    Number of groups     =      11
Group variable (i): country                        F( 44,      39)      =      25952.83
maximum lag: 3                                     Prob > F              =      0.0000
                                                    within R-squared      =      0.9870
```

lrgdp	Drisc/Kraay					[95% Conf. Interval]
	Coef.	Std. Err.	t	P> t		
lrem	-.0065289	.0027086	-2.41	0.021	-.0120076	-.0010503
lgfcf	-.0062396	.0011907	-5.24	0.000	-.008648	-.0038311
llf	-.0157248	.0021072	-7.46	0.000	-.019987	-.0114625
lpci	.949308	.0193847	48.97	0.000	.9100988	.9885173
inf	.0005227	.0001476	3.54	0.001	.0002241	.0008212
_Iyear_1978	.0251501	.0008111	31.01	0.000	.0235095	.0267908
_Iyear_1979	.0588059	.0022412	26.24	0.000	.0542726	.0633392
_Iyear_1980	.0680698	.0025616	26.57	0.000	.0628884	.0732512
_Iyear_1981	.104083	.0022505	46.25	0.000	.099531	.108635
_Iyear_1982	.1324654	.0021331	62.10	0.000	.1281508	.13678
_Iyear_1983	.1508897	.0022774	66.25	0.000	.1462832	.1554963
_Iyear_1984	.1838258	.0026964	68.17	0.000	.1783718	.1892797
_Iyear_1985	.2226826	.0027291	81.60	0.000	.2171625	.2282027
_Iyear_1986	.2464628	.0028267	87.19	0.000	.2407452	.2521804
_Iyear_1987	.2664822	.0036744	72.52	0.000	.2590501	.2739143
_Iyear_1988	.3039067	.0032636	93.12	0.000	.2973054	.310508
_Iyear_1989	.3263982	.0032052	101.83	0.000	.319915	.3328813
_Iyear_1990	.3640058	.0035537	102.43	0.000	.3568177	.3711939
_Iyear_1991	.385567	.0035461	108.73	0.000	.3783943	.3927398
_Iyear_1992	.4164291	.0042777	97.35	0.000	.4077767	.4250816
_Iyear_1993	.449312	.0050541	88.90	0.000	.4390892	.4595348
_Iyear_1994	.4703774	.0045966	102.33	0.000	.46108	.4796749
_Iyear_1995	.5020403	.0056354	89.09	0.000	.4906415	.5134391
_Iyear_1996	.5363952	.0061601	87.08	0.000	.5239353	.5488551
_Iyear_1997	.5762006	.0058522	98.46	0.000	.5643633	.5880378
_Iyear_1998	.5962636	.0075034	79.47	0.000	.5810865	.6114406
_Iyear_1999	.6230661	.0074837	83.26	0.000	.607929	.6382033
_Iyear_2000	.6499117	.0066673	97.48	0.000	.6364259	.6633976
_Iyear_2001	.682759	.0069301	98.52	0.000	.6687415	.6967766
_Iyear_2002	.7164626	.0078292	91.51	0.000	.7006265	.7322987
_Iyear_2003	.7498882	.0083242	90.08	0.000	.7330509	.7667256
_Iyear_2004	.7834911	.0088025	89.01	0.000	.7656863	.8012958
_Iyear_2005	.8104858	.0083826	96.69	0.000	.7935304	.8274413
_Iyear_2006	.8405386	.0086582	97.08	0.000	.8230257	.8580514
_Iyear_2007	.876558	.0099053	88.49	0.000	.8565226	.8965934
_Iyear_2008	.9057516	.0096181	94.17	0.000	.8862972	.925206
_Iyear_2009	.9376605	.0104911	89.38	0.000	.9164403	.9588807
_Iyear_2010	.9630748	.0094671	101.73	0.000	.9439258	.9822238
_Iyear_2011	.9955056	.0106698	93.30	0.000	.9739239	1.017087
_Iyear_2012	1.029655	.010995	93.65	0.000	1.007416	1.051895
_Iyear_2013	1.064725	.0114695	92.83	0.000	1.041526	1.087924
_Iyear_2014	1.097714	.0119336	91.99	0.000	1.073576	1.121852
_Iyear_2015	1.126932	.0127234	88.57	0.000	1.101197	1.152668
_Iyear_2016	1.156886	.0127273	90.90	0.000	1.131143	1.18263
_cons	16.31591	.2162131	75.46	0.000	15.87857	16.75324

(5b)

```
. xtsccl lrgdp llrgdp lrem llf lgfcf edu lremedu, fe

Regression with Driscoll-Kraay standard errors   Number of obs   =       428
Method: Fixed-effects regression                 Number of groups  =       11
Group variable (i): country                     F(   6,   38)    =    9322.95
maximum lag: 3                                 Prob > F         =     0.0000
                                              within R-squared =     0.9853
```

lrgdp	Drisc/Kraay		t	P> t	[95% Conf. Interval]	
	Coef.	Std. Err.				
llrgdp	.9619383	.0113936	84.43	0.000	.9388733	.9850033
lrem	-.2039798	.0697117	-2.93	0.006	-.3451038	-.0628558
llf	.0011148	.0022713	0.49	0.626	-.0034832	.0057129
lgfcf	.0090823	.0021091	4.31	0.000	.0048127	.0133519
edu	-.0028714	.0012038	-2.39	0.022	-.0053082	-.0004345
lremedu	.2090353	.0704244	2.97	0.005	.0664686	.3516021
_cons	.0833121	.3077215	0.27	0.788	-.5396375	.7062618

Diagnostic Test

Testing for time-fixed effects

1

```
. testparm _Iyear*

( 1)  _Iyear_1978 = 0
( 2)  _Iyear_1979 = 0
( 3)  _Iyear_1980 = 0
( 4)  _Iyear_1981 = 0
( 5)  _Iyear_1982 = 0
( 6)  _Iyear_1983 = 0
( 7)  _Iyear_1984 = 0
( 8)  _Iyear_1985 = 0
( 9)  _Iyear_1986 = 0
(10)  _Iyear_1987 = 0
(11)  _Iyear_1988 = 0
(12)  _Iyear_1989 = 0
(13)  _Iyear_1990 = 0
(14)  _Iyear_1991 = 0
(15)  _Iyear_1992 = 0
(16)  _Iyear_1993 = 0
(17)  _Iyear_1994 = 0
(18)  _Iyear_1995 = 0
(19)  _Iyear_1996 = 0
(20)  _Iyear_1997 = 0
(21)  _Iyear_1998 = 0
(22)  _Iyear_1999 = 0
(23)  _Iyear_2000 = 0
(24)  _Iyear_2001 = 0
(25)  _Iyear_2002 = 0
(26)  _Iyear_2003 = 0
(27)  _Iyear_2004 = 0
(28)  _Iyear_2005 = 0
(29)  _Iyear_2006 = 0
(30)  _Iyear_2007 = 0
(31)  _Iyear_2008 = 0
(32)  _Iyear_2009 = 0
(33)  _Iyear_2010 = 0
(34)  _Iyear_2011 = 0
(35)  _Iyear_2012 = 0
(36)  _Iyear_2013 = 0
(37)  _Iyear_2014 = 0
(38)  _Iyear_2015 = 0
(39)  _Iyear_2016 = 0

F( 39,   385) =    1.22
Prob > F      =    0.1746
```

2

```
. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

edu[country,t] = Xb + u[country] + e[country,t]

Estimated results:

```

	Var	sd = sqrt(Var)
edu	376.9746	19.41583
e	88.6677	9.416353
u	266.4087	16.32203

```

Test:   Var(u) = 0
        chibar2(01) = 2168.01
        Prob > chibar2 = 0.0000

```

3

```
. testparm _Iyear*

( 1)  _Iyear_1978 = 0
( 2)  _Iyear_1979 = 0
( 3)  _Iyear_1980 = 0
( 4)  _Iyear_1981 = 0
( 5)  _Iyear_1982 = 0
( 6)  _Iyear_1983 = 0
( 7)  _Iyear_1984 = 0
( 8)  _Iyear_1985 = 0
( 9)  _Iyear_1986 = 0
(10)  _Iyear_1987 = 0
(11)  _Iyear_1988 = 0
(12)  _Iyear_1989 = 0
(13)  _Iyear_1990 = 0
(14)  _Iyear_1991 = 0
(15)  _Iyear_1992 = 0
(16)  _Iyear_1993 = 0
(17)  _Iyear_1994 = 0
(18)  _Iyear_1995 = 0
(19)  _Iyear_1996 = 0
(20)  _Iyear_1997 = 0
(21)  _Iyear_1998 = 0
(22)  _Iyear_1999 = 0
(23)  _Iyear_2000 = 0
(24)  _Iyear_2001 = 0
(25)  _Iyear_2002 = 0
(26)  _Iyear_2003 = 0
(27)  _Iyear_2004 = 0
(28)  _Iyear_2005 = 0
(29)  _Iyear_2006 = 0
(30)  _Iyear_2007 = 0
(31)  _Iyear_2008 = 0
(32)  _Iyear_2009 = 0
(33)  _Iyear_2010 = 0
(34)  _Iyear_2011 = 0
(35)  _Iyear_2012 = 0
(36)  _Iyear_2013 = 0
(37)  _Iyear_2014 = 0
(38)  _Iyear_2015 = 0
(39)  _Iyear_2016 = 0

F( 39, 384) = 0.92
Prob > F = 0.6193

```

4

```

. testparm _Iyear*

( 1)  _Iyear_1978 = 0
( 2)  _Iyear_1979 = 0
( 3)  _Iyear_1980 = 0
( 4)  _Iyear_1981 = 0
( 5)  _Iyear_1982 = 0
( 6)  _Iyear_1983 = 0
( 7)  _Iyear_1984 = 0
( 8)  _Iyear_1985 = 0
( 9)  _Iyear_1986 = 0
(10)  _Iyear_1987 = 0
(11)  _Iyear_1988 = 0
(12)  _Iyear_1989 = 0
(13)  _Iyear_1990 = 0
(14)  _Iyear_1991 = 0
(15)  _Iyear_1992 = 0
(16)  _Iyear_1993 = 0
(17)  _Iyear_1994 = 0
(18)  _Iyear_1995 = 0
(19)  _Iyear_1996 = 0
(20)  _Iyear_1997 = 0
(21)  _Iyear_1998 = 0
(22)  _Iyear_1999 = 0
(23)  _Iyear_2000 = 0
(24)  _Iyear_2001 = 0
(25)  _Iyear_2002 = 0
(26)  _Iyear_2003 = 0
(27)  _Iyear_2004 = 0
(28)  _Iyear_2005 = 0
(29)  _Iyear_2006 = 0
(30)  _Iyear_2007 = 0
(31)  _Iyear_2008 = 0
(32)  _Iyear_2009 = 0
(33)  _Iyear_2010 = 0
(34)  _Iyear_2011 = 0
(35)  _Iyear_2012 = 0
(36)  _Iyear_2013 = 0
(37)  _Iyear_2014 = 0
(38)  _Iyear_2015 = 0
(39)  _Iyear_2016 = 0

F( 39, 385) = 191.15
Prob > F = 0.0000

```

5a

```

. testparm _Iyear*

( 1)  _Iyear_1978 = 0
( 2)  _Iyear_1979 = 0
( 3)  _Iyear_1980 = 0
( 4)  _Iyear_1981 = 0
( 5)  _Iyear_1982 = 0
( 6)  _Iyear_1983 = 0
( 7)  _Iyear_1984 = 0
( 8)  _Iyear_1985 = 0
( 9)  _Iyear_1986 = 0
(10)  _Iyear_1987 = 0
(11)  _Iyear_1988 = 0
(12)  _Iyear_1989 = 0
(13)  _Iyear_1990 = 0
(14)  _Iyear_1991 = 0
(15)  _Iyear_1992 = 0
(16)  _Iyear_1993 = 0
(17)  _Iyear_1994 = 0
(18)  _Iyear_1995 = 0
(19)  _Iyear_1996 = 0
(20)  _Iyear_1997 = 0
(21)  _Iyear_1998 = 0
(22)  _Iyear_1999 = 0
(23)  _Iyear_2000 = 0
(24)  _Iyear_2001 = 0
(25)  _Iyear_2002 = 0
(26)  _Iyear_2003 = 0
(27)  _Iyear_2004 = 0
(28)  _Iyear_2005 = 0
(29)  _Iyear_2006 = 0
(30)  _Iyear_2007 = 0
(31)  _Iyear_2008 = 0
(32)  _Iyear_2009 = 0
(33)  _Iyear_2010 = 0
(34)  _Iyear_2011 = 0
(35)  _Iyear_2012 = 0
(36)  _Iyear_2013 = 0
(37)  _Iyear_2014 = 0
(38)  _Iyear_2015 = 0
(39)  _Iyear_2016 = 0

F( 39, 384) = 132.62
Prob > F = 0.0000

```

5b

```
. testparm _Iyear*

( 1)  _Iyear_1978 = 0
( 2)  _Iyear_1979 = 0
( 3)  _Iyear_1980 = 0
( 4)  _Iyear_1981 = 0
( 5)  _Iyear_1982 = 0
( 6)  _Iyear_1983 = 0
( 7)  _Iyear_1984 = 0
( 8)  _Iyear_1985 = 0
( 9)  _Iyear_1986 = 0
(10)  _Iyear_1987 = 0
(11)  _Iyear_1988 = 0
(12)  _Iyear_1989 = 0
(13)  _Iyear_1990 = 0
(14)  _Iyear_1991 = 0
(15)  _Iyear_1992 = 0
(16)  _Iyear_1993 = 0
(17)  _Iyear_1994 = 0
(18)  _Iyear_1995 = 0
(19)  _Iyear_1996 = 0
(20)  _Iyear_1997 = 0
(21)  _Iyear_1998 = 0
(22)  _Iyear_1999 = 0
(23)  _Iyear_2000 = 0
(24)  _Iyear_2001 = 0
(25)  _Iyear_2002 = 0
(26)  _Iyear_2003 = 0
(27)  _Iyear_2004 = 0
(28)  _Iyear_2005 = 0
(29)  _Iyear_2006 = 0
(30)  _Iyear_2007 = 0
(31)  _Iyear_2008 = 0
(32)  _Iyear_2009 = 0
(33)  _Iyear_2010 = 0
(34)  _Iyear_2011 = 0
(35)  _Iyear_2012 = 0
(36)  _Iyear_2013 = 0
(37)  _Iyear_2014 = 0
(38)  _Iyear_2015 = 0

F( 38, 372) = 1.67
Prob > F = 0.0094
```

Testing for cross-sectional dependence/contemporaneous correlation:Pesaran Cross-Sectional Dependence (CD) test

Model 1

```
. xtcsd, pesaran abs

Pesaran's test of cross sectional independence = 0.746, Pr = 0.4559

Average absolute value of the off-diagonal elements = 0.222
```

Model 3

```
. xtcsd, pesaran abs

Pesaran's test of cross sectional independence = -1.804, Pr = 0.0712

Average absolute value of the off-diagonal elements = 0.387
```

Model 4

```
. xtcsd, pesaran abs

Pesaran's test of cross sectional independence = -3.799, Pr = 0.0001

Average absolute value of the off-diagonal elements = 0.493
```

Model 5

```
Pesaran's test of cross sectional independence =    -2.650, Pr = 0.0080
Average absolute value of the off-diagonal elements =    0.418
```

5b

```
Pesaran's test of cross sectional independence =    2.435, Pr = 0.0149
Average absolute value of the off-diagonal elements =    0.139
```

Testing for heteroskedasticity

Model 1

```
. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

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

chi2 (11) =    8.4e+06
Prob>chi2 =    0.0000
```

Model 3

```
. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

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

chi2 (11) =    2465.11
Prob>chi2 =    0.0000
```

Model 4

```
. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

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

chi2 (11) =    23919.56
Prob>chi2 =    0.0000
```

5a

```
. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

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

chi2 (11) =    55553.63
Prob>chi2 =    0.0000
```

5b

```
. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

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

chi2 (11) =      218.29
Prob>chi2 =      0.0000
```

SERIAL CORRELATION TEST

MODEL 1

```
. xtserial bd gfcf lf pgr rer inf

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
F( 1,      10) =      17.301
Prob > F =      0.0020
```

Model 2

```
. xtserial edu bd rgdp to pci

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
F( 1,      10) =      23.174
Prob > F =      0.0007
```

Model 3

```
. xtserial rem bd to rer edu pgr

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
F( 1,      10) =      344.821
Prob > F =      0.0000
```

Model 4

```
. xtserial lrgdp bd lgfcf llf lpci inf

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
F( 1,      10) =      324.201
Prob > F =      0.0000
```

Model 5a

```
. xtserial lrgdp lrem lgfcf llf lpci inf

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
F( 1,      10) =      328.087
Prob > F =      0.0000
```

5b

```
. xtserial lrgdp llrgdp lrem lgfcf llf edu lremedu

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
F( 1,      10) =      54.152
Prob > F =      0.0000
```