DETERMINANTS OF GHANA'S BILATERAL EXPORT: DOES EXCHANGE RATE VARIABILITY MATTER?

BY

ISAAC ASANTE-NIMAKO, CEPA. (PG 2731414) (B.Ed. SOCIAL SCIENCES)

A Thesis Submitted to the Department of Economics, Kwame Nkrumah University of Science and Technology, in partial fulfillment of the requirements for the award of

MASTER OF SCIENCE degree in economics

Faculty of Social Science, College of Humanities and Social Sciences

JUNE, 2016.

DECLARATION

I hereby declare that this submission toward a Master of Science degree in Economics to the best of my knowledge is a study I have personally under my supervisor"s supervision undertaking. It comprehends no material formerly issued by another person nor substances which has been accepted for the award of any other degree of the University, except where due credit has been made in the writing.

ASANTE-NIMAKO, **ISAAC** (PG 2731414) …… …….

(Candidate) **(Signature)** **(Date)**

Certified by:

…… …….. ……

(Supervisor) **(Signature)** **(Date)**

…… …… ……..

(Internal Examiner) **(Signature)** **(Date)**

…….. …… ……..

(Head of Department) **(Signature)** **(Date)**

ABSTRACT

The purpose of this study was to empirically analyse the internal and external factors that drives Ghana‟s bilateral exports. This was to take a critical look at whether variability in Ghana‟s exchange rate really matters in Ghana‟s bilateral export flow. Since the external value of the Ghana cedi has been unstable and persistent increase depreciation against major currencies for the past two decades. The study employed a panel data spanning from 1995 to 2014 and observed 20 of Ghana‟s trading partners. An augmented Gravity model and panel data estimation techniques such as the Pooled Ordinary Least Squares (POLS), Fixed effects and Random effects models were the methodology used in the estimation. The result revealed that the real bilateral exchange rate is negative and insignificant, however, GDP is positive and statistically significant. Trade openness, infrastructure and Foreign Direct Investment (FDI) are all having positive relationship with total trade of export but not statistically significant. Distance and language as well as the population of Ghana all have negative relation with the total bilateral export flow. As implied by the results, Bank of Ghana must ensure that variations in exchange rate are relatively predictable, minimal and less detrimental. The country must envisage an economic growth and the reduction of trade barriers as well as improvement in infrastructure which are require to advance the export trade of the country.

DEDICATION

I humbly dedicate this thesis to Jesus Christ my Lord and King for His inspiration to completing this programme.

ACKNOWLEDGEMENTS

My profound gratitude goes to Dr. Daniel Sakyi and Mr. Isaac Bonuedi for their unconditional support in terms of devoted supervision combined with constructive suggestions and criticism which has put this work in a good shape.

Dr. George Adu cannot be forgotten because he contributed immensely to the genesis of this study. I will forever remember your inspirational motto: „confidence from below, authority from above". Thank you.

I am also very grateful to my family, especially my wife Davida Aba Mensima AsanteNimako and my children Isaac, Anna, and Jasper Asante-Nimako and Janet Wizzi for their love, financial support, encouragement and prayer support. God richly bless you.

To my parents, Mr. and Mrs. Asante-Krobiah, my siblings and in-laws, God richly bless you for your God-fearing and divine encouragements that also propelled me to go on. Indeed I"m very grateful to all of you for being there for me when I needed you all.

I express my sincere thanks as well to Maa Adwoba of „Adwoba"s kitchen", Beatrice Takyi Ntiamoah, Linda Akoto and Samuel Kwabena Obeng for their diverse support and contribution to the success of this work.

TABLE OF CONTENT

DECLARATION ii

ABSTRACT iii

ACKNOWLEDGEMENTS v

LIST OF TABLES ix

LIST OF FIGURES ix

CHAPTER ONE 1

INTRODUCTION .....

1

1.1 Background to the study..... 1

1.2 Statement of Research Problem 4

1.3 Objectives of the study .....
7

1.4 Research Questions .....
7

1.5 Justification for the study .....
8

1.6 The Scope and Methods of the Study. 8

1.7 Organisation of the Study. 9

CHAPTER TWO 10

LITERATURE REVIEW..... 10

2.0 Introduction 10

2.1 Review of Theoretical Literature 10

2.1.1 Review of Traditional Theories on the Reasons for International Trade. 11

2.1.2 The gravity model 15

2.1.3. Theoretical Justification of the gravity model. 18

Review of Empirical Literature on the Gravity Model 22

2.3. Trends in the composition and Direction of Ghana‟s Exports. 29

2.3.1. Trends in the Composition of Ghana‟s Trade 29

2.3.2 Trends in the Destination of Ghana‟s External Trade 31

Conclusion 34

CHAPTER THREE ..... 35 RESEARCH METHODOLOGY 35

3.0 Introduction 35

3.1 Model Specification 35

3.1.1 Gravity Model Specification 35

3.2 Description of Variables, Data Source and A prior Expectations 37

3.3 Estimation Strategy .....
41

3.3.1 Pooled Ordinary Least Squares (pooled-OLS) 42

3.3.2 The Fixed Effect Model 42

3.3.3 The Random Effects Model 43
3.3.4 Hausman Test 44

3.3.5 Breusch-Pagan Lagrange Multiplier (LM) Test 45

3.3.6 Test for Heteroskedasticity 45

3.3.7 Test for Serial Correlation 46

3.3.8 Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model 46

CHAPTER FOUR .....
47

PRESENTATION AND DISCUSSION OF RESULTS 47

4.0 Introduction .....
47

4.1 Analysis of the Descriptive Statistics of Variables 47

4.2 Trends in Ghana‟s Total Exports and Exchange Rate Volatility 49

4.3 Estimated Pooled-OLS, Fixed Effects and Random Effects Models 50

4.4 Diagnostic Test..... 60

CHAPTER FIVE 62

SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSIONS 62

5.1 Introduction 62

5.2 Summary of findings 62

5.3 Recommendations 65

5.4 Conclusions 66

REFERENCES 67

APPENDIX 73

LIST OF TABLES

Table 2.1. Ghana"s export to some trading partners, 2000-2014 (in million US$)..... 32

Table 4.1: Descriptive Statistics 47

Table 4.2 Estimated Results 51

Table 4.3 Diagnostic Test Results 60

LIST OF FIGURES

Figure 1.1 Monthly Variability in the Inter-Bank Exchange Rate of the Ghana Cedi against the US Dollar (GHC/US$) from January, 1990 – June, 2015 5

Figure 2.1 A schematic recapitulation of the theoretical justification of the gravity model 21

Figure 2.2 A chart involving the trade pattern and trade balance*Source: Author's construction. Data was obtained from Direction of Trade Statistic* 31

Figure 2.3 The Trend of Ghana‟s export destination from 2002 to 2014. 33

Figure 4.1 Scatter Plot of Ghana‟s Total Exports and Exchange Rate Volatility 49

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

There is a wide consensus in economic literature opening up the domestic economy to the international trade, typically by dismantling tariffs and removing other restrictive barriers, is one of the important drivers of economic growth in more advanced and recently industrialized countries around the world. As the economic reasoning goes, international trade confers a number of benefits, that ultimately foster economic growth and development, on the economies that actively and well-integrated in the global economy. These gains include: increased access to large foreign market for local firms and entrepreneurs; facilitate knowledge diffusion and the transfer of latest production technologies to the firms operating in these countries; increased efficiency through keener competition both in the domestic and global markets; creation of employment avenues in trade-related sectors and, among others, significantly contributing to the country‟s foreign exchange earnings.

Consequently, many developing economies, of which Ghana is no exception, have sought to achieve high rates of economic growth and an all-inclusive development through the promotion of exports and maintaining highly liberalized trade regimes. Evinced by the dramatic exports-driven growth experience of the Asian Tigers, this economic reasoning has been the motivating force behind the widespread adoption of the exports-led growth strategy, since the mid-1980s in the developing world. Ghana, just like other poverty-stricken and economically retarded developing economies, also adopted the exports-led

development model as part of a several economic and structural reforms implemented in the awake of the economic decadence of the early 1980s. These policies necessitate a paradigm shift in the countries trade disposition from high restricted and import-substitution industrialization regime of the 1960s and the 1970s to the present day largely liberalized trade regime characterized by reduction and in some cases removal of high import tariffs and quantitative restrictions. Particularly, since the mid-1980s the country‟s trade policy is rooted in two related development strategies, namely, an export-led and a domestic market-led industrialization strategy based on import competition.

On the back of these economic policies, Ghana‟s economic performance, as mirrored specifically by the positive trends in real GDP growth rate and trade-to-GDP ratios has been highly impressive since the mid-1980s. Partly buoyed by the boom in commodity prices, the economy grew remarkably from -6.92% in 1982 to 8.65% in 1984 before falling gradually to 5.08 in 1989. The average growth rates in the 1990s and 2000s are respectively 4.27% and 5.36%. In the past half-decade, that is, between 2010 and 2014 the average growth rate in economic activity is estimated to be around 8.51% (World Development Indicators, 2014). Annual growth in the values of exports and imports, following these outward-looking policies, have been very high too. After plunging by 46.6% in 1981 owing to the collapse of commodity prices, and the occurrence of droughts and bushfires, the growth rate in total exports rose impressively to 97.82% in 1986 before tumbling to 13.04% in 1990. The remainder of the 1990s witnessed Ghana‟s exports growing at an average rate of 11.30%. In the 2000s, the average growth rate in exports stood at 12.27%. In recent years, Ghana‟s total exports to the rest of the world grew at 16.89% on average between 2010 and 2014. The annual growth in the import bill

is not any different, averaging 11.5% in the 1990s, 12.31% in the 2000s, and 13.15% over the period 2010-2014 (World Development Indicators, 2014).

However, the picture is so different when one considers the relative contribution of exports and imports to the nation‟s output. With the exception of 1982, the period 19802014 have witnessed high and persistent trade deficits as a result of total exports (or the share of exports in GDP) incessantly lagging behind total imports (or the share of imports in GDP). Exports have increasingly contributed 11.71% to GDP in the 1980s, 26.08% in the 1990s, 29.6% in the 2000s and 32.73% between 2011-2014. Over this same periods, the share of the import bill in GDP has persistently been higher, averaging
15.4% in the 1980s, 38.87% in the 1990s, 43.51% in the 2000s and 47.51% between 2011 and 2014. This has persistently left the trade balance in deficits over postliberalization period. From the available statistics, the trade deficits as a percentage of GDP have worsened on average from 22.25% in the 1980s, 24.06 in the 1990s, 29.01% in the 2000s and 34.84% in the past 5 years (2011-2014) (World Development
Indicators, 2014).

Persistent trade deficits harm the domestic economy in a number of ways. In a layman‟s perspective trade deficit implies that the country is living beyond its means and, must borrow from its partners to pay the excess imports over its exports. Persistent deficits on the trade balances implies the country is accumulating debts over time, non-payment of which will result in the loss of credibility or creditworthiness in the international market, with adverse consequences for the domestic economy. It also has the consequences of losing domestic jobs to import partners through the inflow of import substitutes; depressing of domestic prices as domestic firms may be forced to cut down prices to

remain competitive; importing inflationary pressures from abroad, and last but not the least, destabilizing the exchange rate.

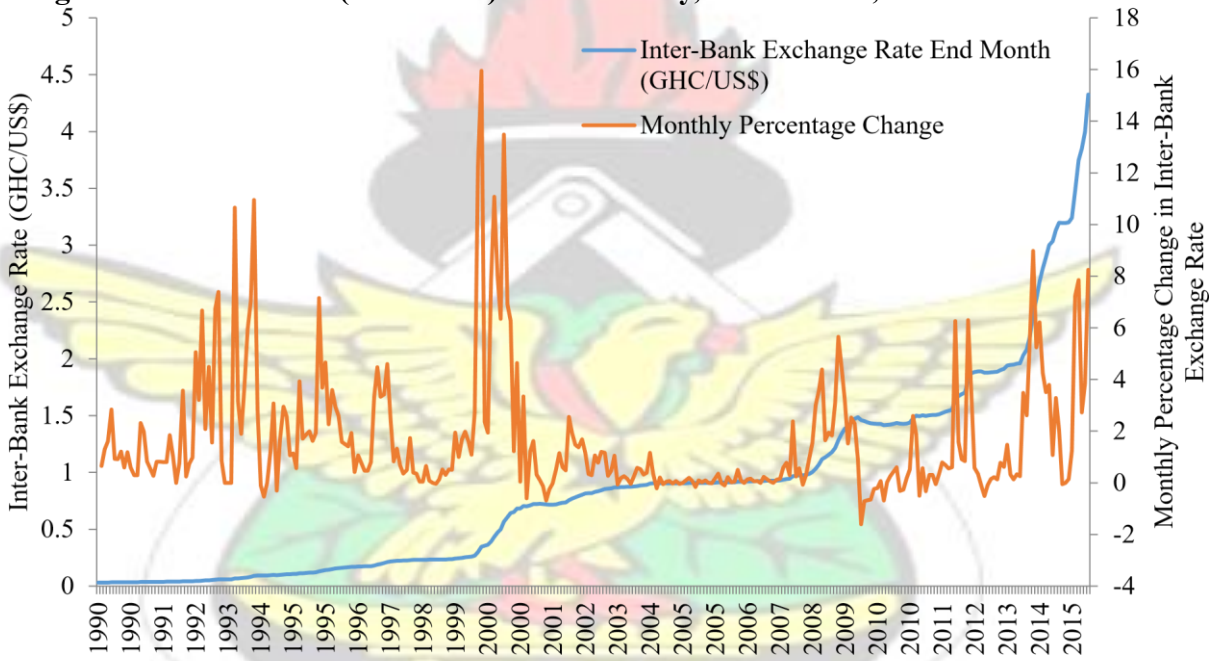
These ills, among several others, have detrimental effects on the country‟s economic outlook by adversely affecting employment, investment, balance of payment equilibrium and, ultimately, economic growth. In view of this, narrowing Ghana‟s trade deficits, at least to sustainable levels, through the expansion of exports cannot be overemphasized. In addition, exports growth remains one of the key sources of the needed growth in real GDP to bolster Ghana‟s development status from a lower-middle-income country to an upper-middle-income country over the medium run. Achieving high export growth also hinges on eliminating the supply side constraints on the exports sector as well as designing policies that will sustainably encourage foreign demand for the nation‟s exports. It is against this backdrop that this study seeks to investigate the internal and external factors that promote or impede Ghana‟s bilateral exports.

1.2 Statement of Research Problem

As we have extensively demonstrated in the background to this thesis, Ghana‟s trade balance has remained historically in deficits despite the concerted efforts of various governments to promote exports, and even diversify away from the few traditional exports – minerals (mainly gold, cocoa beans, and timber) – to a large number of nontraditional products including horticultural products, fish and seafood, prepared food and beverages, handicrafts and other manufactured items. Why these policies have not succeded in narrowing the gap between exports and imports remain an important question that must

be subjected to empirical investigations. In addition to the worsening trade balance position, one other key feature of Ghana"s external sector performance in the past two decades is the consistent and increased depreciation in the external value of the Ghana cedi against major currencies. Depicted in Figure 1 is the monthly movements in the inter-bank GHC/US$ exchange rate between January, 1990 and June, 2015 as reported by the Bank of Ghana.

Figure 1.1 Monthly Variability in the Inter-Bank Exchange Rate of the Ghana Cedi against the US Dollar (GHC/US$) from January, 1990 – June, 2015



Source: Author's computation and construct based on data from the Bank of Ghana Statistics Database

As illustrated in Figure 1.1, the Ghana Cedi has generally depreciated against the US dollar throughout the entire period, rising from 0.0306 GH₵ per US$ in January, 1990 to 0.7048 GH₵/US$ in December, 2000. The turn of the millennium witnessed an acceleration in the pace of depreciation with exchange rate reaching 0.9704 GH₵/US$ by December, 2007. The period after 2007 also saw the loss in the external value of the Ghana Cedi

against the US$ gathering much pace in some years and slowing in others, pointing to instability in the GH₵/US$ exchange rate over the period. The annual rates of depreciation stand at 4.1%, 20.9% , 15.4%, 1.3%, 8.3%, 15.9%, 12.8%, 32.5% and 15.7% in the years 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014 and 2015 respectively (Bank of Ghana online database, 2014). The monthly fluctuations or

volatility in the external value of the cedi is also illustrated in Figure 1.

The rates at which the Cedi has lost against the US$ and other major currencies and high volatility (instability) in the exchange rate are sources of serious concerns to investors, traders (exporters and importers), policymakers and the public at large. In theory, depreciation in the external value of the domestic currency is good for countries that seek to achieve export growth as well as economic growth. This is because a depreciating currency makes domestic goods relative cheaper and thus improves the external competitiveness of the economy in world market. In the light of this observation, the first question this study seeks to answer is: has the continual depreciation in the cedi, and its accompanying improvement in global competitiveness, played any role significant in boosting Ghana exports? Furthermore, unbridled fluctuations in the exchange rate heighten uncertainty or exchange-rate risk, which in turn increases transaction costs and reduces the gains from international transactions. Particularly, higher exchange risk is expected to increase the uncertainty of profits of export sales in foreign currency and, hence, lead risk-averse exporters to reduce their supply of exports. In view of this postulation, the second question this study aims to answer is: does the increasing variability or volatility in the exchange depress Ghana‟s bilateral exports? In addition to exploring the implications of exchange variability for Ghana‟s exports, this study in line

with the policy needs of the country will also investigate the internal and external drivers (or draggers) of bilateral exports in Ghana.

1.3 Objectives of the study

The overall objective of this study is to empirically investigate the drivers of Ghana‟s bilateral exports.

Specifically, the study is aimed at achieving the following objectives:

1. To assess the effects and implications of an exchange rate variation on Ghana‟s export.
2. To investigate the internal factors that drive Ghana‟s bilateral exports.
3. To look into the external factors that influences. Ghana‟s bilateral exports.

1.4 Research Questions

In order to achieve the stated objectives, the thesis adopts the appropriate empirical strategies to answer these research questions:

1. Does exchange rate variability matter for Ghana‟s bilateral exports?
2. Which internal and external factors matter for Ghana‟s bilateral exports?

1.5 Justification for the study

The bank of Ghana‟s monetary policy objective is to ensure that domestic prices as well as exchange rates are stabilized at levels that are consistent with the government‟s objectives of high employment, investment and growth. However as available data have shown (figure 1.1), exchange rate has not only depreciated consistently against major currencies, but it has also exhibited vehement fluctuations over the past three decades. This suggests that the central bank has not been so efficient or successful in achieving its objective of price and exchange stability. A major concern arising from this deviation from its policy target is whether or not, the ensuing volatility in the exchange rate has had detrimental effects on the economy.

By investigating the impact of exchange rate variability on Ghana‟s exports, this study will shed light on the developmental consequences of not maintaining the stable exchange rate by the central bank. The findings of the study will inform policy makers about whether unstable exchange rate is benign, harmful or good for export growth and economic growth in Ghana. The study will also reveal the internal and external factors that drag Ghana‟s bilateral export growth.

1.6 The Scope and Methods of the Study.

This study is focused on Ghana‟s export to the rest of the world – which spans from 1960 to 2014. These secondary data are compiled from the statistical database of the United Nations Conference on Trade and Development (UNCATAD stats.), International Monetary Fund (IMF). Data Warehouse: Direction of Trade Statistics (DOTS). Due to unavailability of data the exchange rate index from 1960 to 2013 will be

analysed and they may be sourced from statistical bulletins: Various issues (for 2006 to 2012) and an African Development Indicators 2007. All the necessary variables of the gravity model will be carefully sourced and the ideal macro-econometric methods are empirically applied.

1.7 Organisation of the Study.

This chapter reveals the introductory aspect of the study after which chapter two looks at the review of relevant theoretical and empirical literature on the determinant of Ghana‟s export trade and the implication of the exchange rate variations. Chapter three concentrates on the econometric that will be used. In chapter four, the focus is on the analyses of the result from the panel data where the pooled OLS, Fixed Effects and Random Effects are employed for the empirical diagnose. The last chapter expresses a summary of the salient findings of the study and recommendations for Ghana‟s bilateral trade policy to be made.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter looks at the review of relevant theoretical and empirical literature on the determinant of Ghana‟s bilateral trade and implications of exchange rate variations using a gravity model. This review is presented in three sections. The first section considers the review of theoretical literature on international trade: the theory of comparative advantage, comparative cost advantage and Hecksher –Ohlin theory as well as imperfect comparative market effects on international trade flows: (Marshallian, Chamberlinian, and Cournot approaches). The second section looks at the empirical literature on gravity model applications on Ghana‟s bilateral export. Lastly an overview of the changing pattern of Ghana‟s trade considering trends in terms of product composition and destination of export.

2.1 Review of Theoretical Literature

Under this sub–section, the study reviews the concepts and theory of international trade discussing the reasons for trade as well as joining an economic integration especially that within the West African sub-region.

2.1.1 Review of Traditional Theories on the Reasons for International Trade.

The writings of Adam Smith, David Ricardo and John Stuart Mill have been key in influencing the modern framework of the theory. The main objective of these classical economists on international trade theories was to explain the pattern of trade, that is, who

trades with who and in what do the nation‟s trade among themselves. Aside the composition and direction on international trade predicted, the number of theories that have been developed which also seek to assess the international trade flow impact on domestic welfare of consumers and the international and national trade policies that affect these trade flows, especially prices of the internationally traded products and the productive factors. These views still influence the modern trade policy and forms the foundation of contemporary trade theory. This section therefore closely reviews classical theories with respect to the causes of international trade flow.

The mercantilists‟ opinion about international trade and the role of the government brought in the classical economists such as Adam Smith (1723–1790) and David Ricardo (1772–1823). Smith‟s (1776) „*An inquiry into the Nature and causes of the Wealth of Nation*‟ was of the view that specialization does not apply to the firm setting only, but also to international trade. Smith (1776) argues that since countries differ in their ability to produce certain products which is as a result of resources endowments and technology, then international trade must be based on absolute advantage. He stated that nations should export products they have absolute advantage and import products they have disadvantage of. Thus, exports products in which the nation is more productive than other nations and import products for which the nation can produce less output per unit of input than other nations. Through these specialisation and division of labour, the world‟s output will increase and the nations involved in international trade will both consume more of both commodities after trade. This theory of absolute advantage by Smith (1776) is more appropriate in a situation where a nation‟s geographic, special skills and technology as well as the climate conditions gives its economic environment an absolute advantage

in the production of some commodities over the nations. However, this absolute advantage theory of trade could not explain why nations which are more efficient in the production of all commodities still trade (Carbaugh, 2006).

David Ricardo improved on the absolute advantage of Adam Smith to address that challenge by the concept of comparative advantage. According to Bonuedi (2013) comparative advantage explains that, there exists basis for mutuality beneficial trade even when one country is absolutely more efficient in the production of all goods than the others, provided that their costs in terms of labour inputs are different for two or more commodities. For instance, a nation with absolute disadvantage in two goods can still benefit from trade by trading the good with relatively smaller disadvantage because its relative price before trade will be smaller /lower than the trading nation abroad. In the same direction, a nation that has an absolute advantage in the two goods would benefit by specializing in the good which has relatively bigger/greater absolute advantage and import the other one with a relatively smaller or lower absolute advantage, because the real cost of producing it in the other country will be smaller /lower (Bonuedi, 2013).

Anderson, Dunn and Mutti, and Suranovic all support the idea that Ricardian theory of comparative advantage shows that, the difference between technologies of nations gives advantage to some nations in their production of some commodities more than others in their international trade. Although this theory by Ricardo is empirically verified, (Balassa, 1963; MacDougall, 1951; and Stern, 1962) to be based on the difference in labour productivity. The comparative advantage by Ricardo was criticised for its unattainable assumptions and insufficient explanation for the labour productivity differences between nations (Salvatore, 1998).

Heckscher and Ohlin at the School of Economics, Stockholin, Sweden, between the 1920s and 1930s, respectively built on Ricardo‟s Comparative advantage theory of international trade by introducing another factor input as capital and maintained that factor endowments influences, trade among nations. This led to the factor – endowment theory or Heckscher-Ohlin theory (H-O model). The H-O model explains that nations should export goods in which there is an intensive use of the factors input that is abundant and import the goods that they have less intensive use of the factor input. Bonuedi (2013) quoting Hill 2009 and Salvatore 1998, explains the H-O model as capital- abundant countries and other industrial economics should ex-port Capitalintensive goods and import labour–intensive products from labour – abundant countries. For instance, a less developed country like Ghana which is abundant in labour–intensive product must export such products to nations like the United States of America (USA) which is capital-intensive for most of their products.

Many economists have extended the H-O model of international trade but did not change the factor–endowment variable rather added real–world considerations to modify the model such as tariff. This is to increase the predictive chances of the model in discussing macroeconomic policy. Some of the neo–classical economists like Samuelson Paul, Jones Ronald and others contributed remarkably. At a point, it was known as HeckscherOhlin–Samuelson model.

Directly opposite to the supply side theories discussed above, is the demand side theory of international trade by Stefan Linder (1961). Linder argues that the direction of international trade of different manufactured commodities depends on demand side rather than supply side. According to him, nations with similar standard of living will tend to

demand similar commodities; for instance, a capital–intensive country tend to be richer than labour-intensive country. Thus, nations with similar features tend to have closely related standard of living which leads them to trade often amongst themselves than with others. Industrial or developed rich nations trade more with industrial nations and less developed nations also tend to trade more with each other.

From Bonuedi (2013), Linder‟s hypothesis contradicts the predictions of the H-O model. However, it provides explanation for the modern extensive trade observed among the industrial nations, which contributes significantly to the share of world trade. Again, the presence of intra-industry trade or the imperfect competition theory of trade where nations import and export similar products among themselves which is an important evidence in international trade also has some effect on international trade: Marshallian, Chamberlinian, and Cournot approaches. The Marshallian approach assumes constant returns at the firms level but increasing returns at the industry level, the Chamberlinian approach on the other hand assumes that an industry consists of many monopolistic firms and new firms are able to enter the market and differentiate their products from existing firms so that any monopoly profit at the industry level can be eliminated. The Cournot approach assumes a market with only a few imperfectly competitive firms where each takes each other‟s outputs as given. With any one of these three market structures, an opening of international trade will lead to larger market size, decreasing costs and more output and trade (Bathalomew, 2010).

Why do nations within the same regions with similar productivity trade among themselves? This has been researched into by Krugman (1983) as a response to the deficiency in the classical models. Krugman argues that the existence of economics of

scale gives advantage in trade among nations even if they have the same factor endowment with little difference in the comparative advantage. As indicated in Bonuedi (2013) that, Carbaugh (2006) explains Krugman‟s new trade theory as the increasing returns trade theory, where a nation can develop as an industrial economy when her economics of scale and products have quality at the least price and trade those least cost product price with other nations.

Government policies on Research and Development into trade, taxes, subsidies, loans will give a comparative advantage to a nation in production. These policies would create comparative advantage for the local economy with respect to time and the economy can enjoy a considerable level of productivity and be competitive in the world market. In Carbaugh 2006, the industrial policies especially of the nation Japan has successfully gained comparative advantage from most foreign markets which has led to the economic growth of their economy.

2.1.2 The gravity model

Jan Tinbergen in 1962 was the first to apply the gravity model in international trade analysis and since then, it has become the most widely used tool. Not just in international trade but also applied to bilateral data on migration, traffic, foreign direct investment, and all international relations in terms of treaties and alliances on trade. This model being a direct impulse on Newton‟s law of gravity which states that “any two bodies in the universe attract each other with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.”

$$F_{ij} = G \frac{M_i M_j}{D_{ij}^2} \quad \text{..... (2.1)}$$

Where i and j represents the two objects (bodies). F is the gravitational force which is directly proportional to the product of M (masses) of the bodies (M_i, M_j) and inversely proportional to the square of the distance D_{ij} that is between the two objects (bodies). G is then, the gravitational constancy which is empirically determined.

Tinbergen in 1962 assumed the following specification from the equation (2.1) and applied to international trade as:

$$T_{ij} = A\frac{Y_i^{\beta} Y_j^{\theta}}{D_{ij}^{\delta}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2.2)$$

As T represents the total trade flow between the two countries, i and j, and the exponent $\beta, \theta \; and \; \delta$ are the elasticity and take values different than 1. Y_i is the GDP (Y) of country i and Y_j the GDP (Y) of country j. The distance between the two countries D has elasticity δ. If i is the exporting country, then, the elasticity of the GDP is β and country j' s elasticity for importing will be GDP of (θ). According to Cobb Douglas production theory it implies that $\beta + \theta = 1$. The elasticity of distance δ is 2, which connects the Newton‟s gravitational force. Then Tinbergen‟s model is equal to the Newton‟s gravitational model.

According to Krugman et al (2012) the gravity model broadly works because large economies with huge income tends to spend so much in imports and attract large shares of spending from other countries because they produce a wide range of products. Geographical distance and GDP of countries are the major determinants of trade flow from the gravity model. However, using transportation cost as a proxy in this model, it implies that the shorter the distance, the more trade takes place. Example, about 63% of

EU‟s engages in intra trade for several reasons, primarily is the lower transportation cost. Krugman et al (2010) also argues that trade flow between countries are very strong when countries have close personal contacts, and economic ties. When these factors are weak, trade flows tends to be small especially when trading partners are far apart from each other too because of transportation cost trade is not appreciable.

The key advantage of this gravity model of trade ahead of the Ricardian model and the Heckscher – Ohlin (HO) model is that both supply and demand factors have been captured such as GDP and population, and trade resistance such as policies – barriers and tariffs and geographical distance as well as preference factors – monetary unions, common language, cultural differences have been employed by this model explaining a bilateral trade between countries. In addition, this model addresses both trade and non- trade policies which can impact negatively or positively in a bilateral trade flow. For this reason, the gravity model is the widely and approximately used model in analyzing the growth and changing pattern of trade globally.

2.1.3. Theoretical Justification of the gravity model.

The empirical success of the gravity model in its ability to precisely and accurately predict trade flow cannot be undermined. However, the model lacked the theoretical justification before the great work done by these economists (Anderson and Van Wincoop, 2003; James Anderson, 1979; Jeffery Bergstrand 1985, 1989 and Baier, 2007) as well as Elhanan Helpman and Paul Krugman in 1985 and 1987 among others who through their research work, help bridge the theoretical justification of the gravity model with the empirical success with the international trade.

In the Gravity with Gravitas by Anderson and van Wincoop 2003, the gravity model without theoretical justification implies that any estimation that uses this model suffers from omitted variables bias and unfounded cooperative statics analyses. In the work of Anderson (1979) which was based on the work by Armington"s (1969) assumption (Goods were differentiated by the country of origin). Anderson made the first attempt to provide the theoretical basis for the gravity model. He assumed that preferences for traded goods are identical across countries (identical homothetic preferences across countries). The constant elasticity of substitution (CES) utility function was developed. That is, regardless of income between countries in trade, at least each country consumes some of every good from each partner at given prices. Then in equilibrium, the national income will be the summation of domestic and foreign demand for the goods traded which each country uniquely produces. For this reason, developed countries imports and exports more (Bacchelta et al., 2012).

Additional work by Bergstrand (1989, 1990) and Deardorff (1995) all confirmed the CES preference structure and added Heckscher – Ohlin structure to explain specialization. In Bergstrand (1985), he found that imports were closer substitutes than local goods. This included price, therefore, he called it generalized gravity model. (Rahman 2007 Tri Do 2006).

The work by Helpman (1987) and Helpman and Krugman (1985) by far is the best that bridges the economic theory, with empirical results of the gravity model. As theories focus on comparative advantage, differences in production technology and factor endowment models, Helpman and Krugman (1985) assumes increasing returns to scale and a state of monopolistic competition between firms. This is especially used to explain intra- industry

trade (Krugman et. al., 2012). From Frankel (1997), countries with intra industry trade, thus similar technologies and demands, will automatically trade more among themselves in order to increase varieties available for consumption.

On the contrary, Alan Deardorff (1995) proved that the basic gravity model can be possibly derived from Heckscher –Ohlin, Staffan Linder and Helpman–Krugman‟s hypothesis. From the (HO) model and other models which are solely based on comparative advantage and perfect competition, the consumers and producers are indifferent in their trading, therefore, the absence of all trade barriers in homogeneous goods. From this assumption, Deardorff came up with two expected trade flows that linked to frictionless gravity model equation whenever preferences are identical. Deardorff describes each trade transaction as a choice of a world pool of product, where producers put their goods in the first place and consumers choose their goods from this pool accordingly. The second scenario is the presence of trade barrier (impediment). It is assumed that each commodity is produced by only one country, therefore bilateral trade patterns in the HO model are with differentiated commodities (Deardorff 1998).

Exchange rate and price level are among other variables that research have shown to have relationship in the gravity model , wherefore their significant variances are captured not in the basic gravity model. When trade barrier takes the form of prices, for instance, a country with relatively high average trade barrier will trade more with one that has a relatively low average bilateral barrier. Anderson and Van Wincoop (2003) in their research paper used a non–lineal system to account for the price terms in a trade liberalization policy. Therefore, the gravity model was used to solve the impact of barriers on prices.

A schematic recapitulation of the theoretical justification of the gravity model

Source:author's own construct

2.2 Review of Empirical Literature on the Gravity Model

The gravity model has been widely used for empirical analysis to determine trade flow and the pattern of trade. Therefore, a careful review of some studies will guide the researcher to appropriately select a model for this research.

In 1962, Jan Tinbergen was the first to have used gravity model on international trade flow in an econometric study. The research stem back from to 1958, where he collected data on 18 countries to find the relationship between income, distance and common border impact on international trade. Thus, the GDP and geographic distance between the common countries (a dummy for adjacency) and dummy for economic integration (British Commonwealth and Benelux membership). In his findings, income was positively related to total trade flow as distance had a negative relationship with international trade flow. However, these expected signs were statistically significant. Tinbergen concluded that there is a 5 percent and 2 percent higher trade flow with a country‟s membership in the British Commonwealth (Benelux FTA) and distance between trading partners respectively (Bonuedi 2013).

Another study using a heighten version of the gravity model to examine 15 OECD countries‟ determinant of bilateral exports in 1976 was conducted by Bergstrand (1985). In addition to Tinbergen‟s gravity model were variables like Exchange rate, GDP deflator in both countries, price indices for export and imports and dummies for adjacency to the economic integrations: European Free Trade Area (EFTA) and European Economic Community (EEC). The variables, import price index, economic size of both countries, adjacency and EFTA membership have a positive effect on export between a country and her trading partners. However the geographic distance between the country and her trading

partners had negative impact on the volume of exports. The exchange rate and other variables were not statistically significant.

However, Gani (2008) examined the determinants of international trade of Fiji and her trading partners in Asia. Using panel data for the period 1985 – 2002 over a crosssection of Asian countries where Gani made import model for these seven countries India, Japan, China, Singapore, Thailand, Hong Kong and Indonesia and five export model for China, Hong Kong, Japan, Singapore and Malaysia. From the gravity model, Gani (2008) postulated that exports to and import from Fiji to her Asian trading partners at *t*time are determine by their GDPs, the geographic distance between Fiji‟s port to the ports of her major trading partners. Other variables of importance too were infrastructure and Exchange rate. Gani (2008) findings from the panel data was that Fiji‟s imports from her Asian trading partners are significantly influenced by the population and infrastructure of the Asian countries as well as the distance between her port and the exporting countries in Asia. This result revealed that, Fiji‟s exports are significantly influenced by her real exchange rate, infrastructure and the distance to the exporting countries‟ market. For the GDPs in the import and export model for Fiji and her trading partners have correct signs on the coefficient and statistically insignificant. This study unveiled the importance of infrastructure development facilitating the bilateral trade of

Fiji but fails to address the role played by regional trade agreement on Fiji‟s bilateral trade flow.

In the same way, Rahman (2009) employed panel data method to investigate Australia‟s international trade opportunities with 57 trading partners stemming from 1972-2006. An augmented gravity model was used including GDP per capita of Australia and her trading

partners, the GDP per capita differential of Australia and her trading partners, dummies for common language, Regional Trade Agreement (RTA) and openness of her trading partners. The result revealed that Australia had trade potential with the USA, Canada, Mexico, Argentina, Brazil, Uruguay, Austria, New Zealand, Turkey, Japan, Pakistan, Chile, the Philippines, Spain, Hungry, India, Nepal, Peru, Brunei, Hong Kong, Kenya and South Africa.

The study further indicated that Australia‟s bilateral trade is positively affected by the openness of partners, common language, free RTA and income. However, it is negatively influenced by the distance between her and the trading partners as well as the GDP per capita differentials.

Roy and Rayhan (2011) used the same method as used by Rahman (2009) to determine the bilateral trade flow between Bangladesh and 13 other trading partners who have trade agreement with (South Asian Association for Regional Cooperation – SAARC).
The study observed data from 1991 to 2007 which revealed that Bangladesh‟s international trade flows are significantly determined by her economic size and that of her trading partners, exchange rate and openness of her trading partners‟ economy. Roy and Rayhan (2011) model random and cross-sectional effect in Bangladesh‟s trade which showed no significant impact on trade hindrance variable rather the crosssectional indicated that her membership with SAARC and border are significant determinant.

The gravity model have been used empirically to also analyze the bilateral trade flow of the some African countries and the impact of regional economic integration. Eita (2008) also used panel data approach with an extended version of the gravity model to study 39

countries from 1998-2006 of Namibian‟s determinants of export to these trading partners. In Eita‟s export model for Namibia the variable GDP and per capita GDP of trading partners, exchange rate, geographical distance and dummy for common border as well as belonging to European Union (EU) and Southern African Development Community (SADC). The findings showed that when both countries GDP rises there is a significant increase in the exports of the Namibian economy to her importing countries.

The real exchange rate of the trading partners and Namibia‟s GDP per capita have no significant impact on export. But as the gravity model reveals in its theory, distance negatively impacted export as well as the importer‟s per capita GDP. The study revealed that, thou Namibia‟s membership with EU and SADC and common border with some trading partners have positively and significantly impacted Namibia‟s export trade, the Nation has not fully and potentially exploited export trade to United Kingdom, Netherlands, Switzerland, Australia, and Kenya etc.

Another study was conducted by Taye (2009) on the determinants of Ethiopia‟s export in which the gravity model was estimated by using Generalized Two Stages Least Squares (G2SLS) method on a panel data from 1995 to 2007 (that is 12 years for 30 trading partners). The study decompose the growth in export performance into contributions from the internal supply-side (macroeconomic environment, real exchange rate, institutional quality, foreign Direct Investment, and infrastructure) and the external market access condition (geographical distance, transportation cost and tariffs and nontariffs) Bonuedi (2013). In Taye (2009)‟s gravity model, the variables were GDP of

Ethiopia and her importing partners, real exchange rate, institutional quality index, Foreign Direct Investment (FDI), infrastructure (internal transport), international trade

policy index and the weighted geographic distance between Ethiopia and her export destination. The result showed that the volume of Ethiopia‟s export was significantly determined by an increase in Ethiopia‟s GDP, infrastructure and a reliable institutional quality. On the contrary, real exchange rate and FDI have no statistically significant effect on her export. Geographic distance and import barriers of trading partners also affects the volume of export that Ethiopia can export.

The gravity model has extensively been used to analyze trade and Ghana‟s trade is not an exception. But the main empirical literature in the framework of gravity model on Ghana‟s external trade stems from the impact of devaluation of Ghana‟s trade balance (Agbola, 2004), the effect of exchange rate on the nation‟s trade balance (Bhattarai and Armah, 2005; Danquah, 2008). Amoah and Loloh in 2009, researched on the trade balance and trade policy efficiency, trade openness and economic growth (Asiedu, 2010; Sakyi, D. et al. 2015), export performance and economic growth (Ganiwu, 2012), and determinants of Ghana‟s bilateral trade flow: (Bonuedi, 2013) as well as others.

Marquez-Ramos (2007) analyze empirically what determines the trade flow for a developed African country-South Africa and developing African country-Ghana to the world in international trade. Marquez-Ramos used disaggregate data in a gravity equation to be able to control for sector-heterogeneity in the trade determinants analysis. In addition to the regular gravity model variables, Marques-Ramos added tariff rate and technological innovation in the importer country, and trade imbalances between the trading partners in the export model. There were also dummies for geographical distance (adjacency), cultural features (common language), sectoral-heterogeniety (high technological product), and economic integration (ECOWAS). The economic tool employed was the OLS method on

a cross-sectional data for 167 major importing nations. The result revealed that as the developing country Ghana exports more when they are exporting to countries with higher levels of economic freedom thus highincome European countries, then the developed nation South Africa, intensify her exports to other African countries considerably. Transport cost reduction was found to have no significant impact on African countries. Ghana‟s membership with WTO (multilateral liberalization) was not significant for her exports and for South African, it was negative. Expectedly importers income was found to be significant variable in fostering international trade but tariffs effect was shown to vary across the countries.

A recent work by Karamuriro and Karukuza (2015) on the determinants of Uganda‟s export. Used an augmented gravity model, employing a panel data set from 2008 to 2012 showed that Uganda‟s GDP, importer‟s GDP, importer‟s GDP per capita, per capita GDP difference between Uganda and its trading partners, real exchange rate, official common language, and contiguity were statistically significant and had a positive impact on Uganda‟s exports. Again her membership with the regional integration COMESA (Common Market for Eastern and Southern Africa) and EAC (East African Community) had had a positive impact on her exports. However,
Uganda‟s GDP per capita and geographical distance between Uganda and her trading partners revealed a negative effect on her export trades.

Although the earlier researchers discussed above have in their estimations fail to control for the non-stationarity of the variables entering the gravity model, the reported estimates could be spurious and thus give misleading implications for policy. In his paper on gravity models in integrated panels, Fidrmuc (2009) showed that standard gravity models of

foreign trade did not only include non-stationary variables, but were also characterized by inherited cross-sectional dependence between the panel units (country pairs). Comparing the outcomes of the fixed effects estimator, with those of the dynamic OLS (DOLS) and fully modified OLS (FMOLS) estimators, Fidrmuc concluded that the possible bias of studies based on fixed effects models due to the nonstationarity of gravity models is rather small.

Additionally, Faruqee (2004) also employed panel unit root and panel cointegration analysis to address the issues of non-stationarity of the European Monetary Union‟s (EMU) bilateral trade flows and its determinants. Faruqee (2004) found that EMU has had a positive impact on intra-area trade; boosting trade amid members to about 10 percent throughout euro‟s survival.

Finally, Geldi (2012) also examined the trade effects of regional integration (of The European Union (EU), The North American Free Trade Agreement (NAFTA), Mercado Común del Sur (MERCOSUR) and The Asian Free Trade Area (AFTA)) by using the FE estimator and panel cointegration analysis. Geldi concluded that, the descriptive influence of the final has succeeded that of the past. As of EU, the finding is that, the intra-union trade-creation effect was nearly 6 times greater than extra-union effects. In NAFTA, exports were significantly diverted. MERCOSUR, however, the outcomes indicated that the integration did not contribute to intra union trade. Her members are still significantly reliant on extra-union imports, as the members of AFTA.

2.3. Trends in the composition and Direction of Ghana's Exports.

This section present the trends of Ghana‟s external trade with special emphasis on exports, product composition, source and destination of the exports.

2.3.1. Trends in the Composition of Ghana's Trade

Ghana‟s export is basically divided into two: Traditional and Non-Traditional. The Traditional export according to the 1995 imports and exports Act 503 are Cocoa beans, Electricity, unprocessed gold and other minerals, logs and lumber among others. Whiles Non-Traditional exports involves all other products apart from the traditional exports mentioned earlier. They include all food processed, fish, seafood beverages, handicrafts and other manufactured products as stated by the Ghana Export Promotion Council (GEPC) Ghana‟s export has been raw materials for the industrial countries in the form of cocoa beans, timber logs, cola nut, minerals etc. which in the early years of 1950s to 60s was about 90 percent of Ghana‟s total export. A decade after Ghana becoming a Republic in the 1960, Ghana's exports and imports were about the same, although, imports were slightly higher than exports. During this period, total exports and imports averaged US$ 327.6 million and US$352.3 million respectively, thus creating a little over US$24 million trade deficit. This was the period when Ghana embarked on massive industrialization and development; and consequently created a number of import substitution industries. It was also the period when the Ghana Export Promotion Council was established whose main objective was to ensure that export trade plays a role in aiding the economic growth and development process of Ghana.

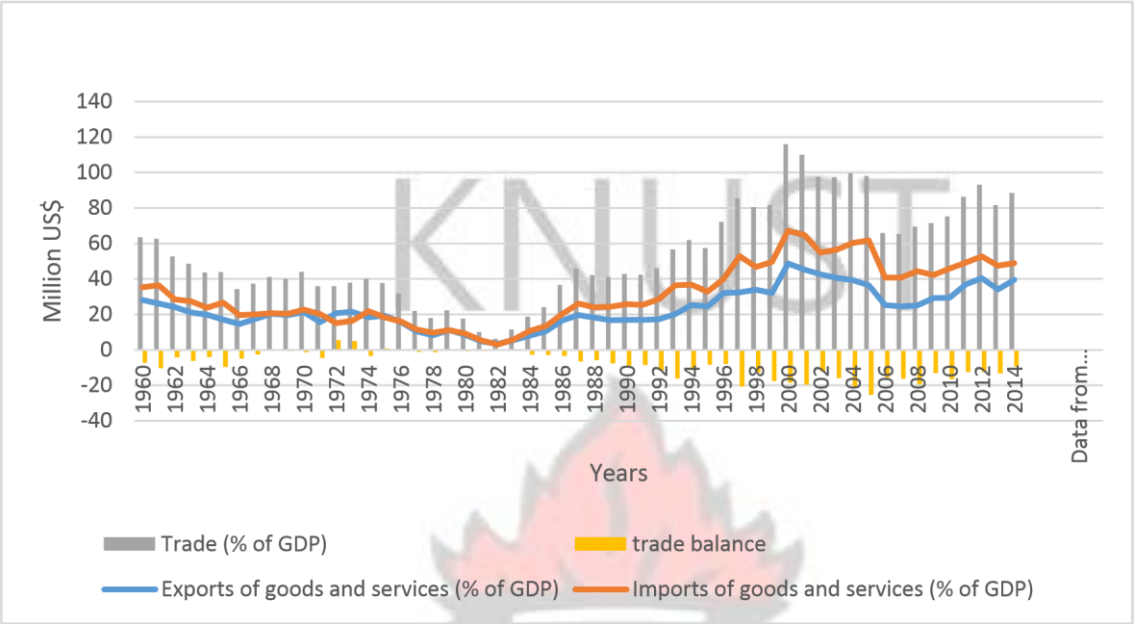
The diversification of the economy through industrialization in the 1970s resulted in the slim changes in the composition of Ghana‟s export trade. The export of raw product changed to processed raw material like plywood, veneer product, cocoa paste, butter, and

some manufactured product like aluminum material and textile (Baah-Nuakoh, 1993 and Aryeteey et. al., 2000). Within the period of 1970 to the 1980 Ghana‟ average export in terms of us dollars was slightly above her imports for the first time. (Average export was US$790.7 million and average imports US$707.1 million). This achievement recorded an average trade balance (surplus) of US$ 83.7 million.

The next decade of Ghana‟s international trade was when the nation experience a violent disturbance economically in the 1982-83. However, the implementation of Economic Recovery Programme (ERP) in 1983 substantially led to the fluctuation in both export and import with traditional export and the non-traditional export reacting significantly to this improved incentive structure. From the 1990s to the 2015 has seen tremendous growth in Ghana‟s trade with the trend not quite different from the previous decade. There were a number of fluctuations which is characterized by slow rising rates in exports and imports. However, trade has been consistently unfavourable as the gap between imports and exports keeps widening within this period. Basically, Ghana‟s dependence on imported goods in recent years has increased. For the entire period under consideration (1960 – 2015), and on per annum basis, exports grew by approximately

9.6 percent whereas imports grew by 11.2 percent.

Figure 2.2 A chart involving the trade pattern and trade balance



Ghana's Trade Pattern and Balance from 1960 to 2015

Source: Author's construction. Data was obtained from Direction of Trade Statistic

2.3.2 Trends in the Destination of Ghana's External Trade

In terms of directions of Ghana's trade, most have been highly concentrated amongst some few major trading partners. For the past fifteen years, Ghana's export destinations have mainly been France, Italy, Netherlands, United Kingdom and the United States of America. Conversely, Ghana's imports have mainly come from China, Netherlands, Nigeria, India, United Kingdom and the USA. Due to the recent expansion of the Chinese market, Ghana's imports from that market soared surpassing the volumes imported from the other markets. Also, Nigeria's contribution to Ghana's imports has been significant over the years and has remained an important trading partner. The countries presented in Tables 1 represent the trading partners that Ghana export to.

Table 2.1. Ghana's export to some trading partners, 2000-2014 (in million US$)

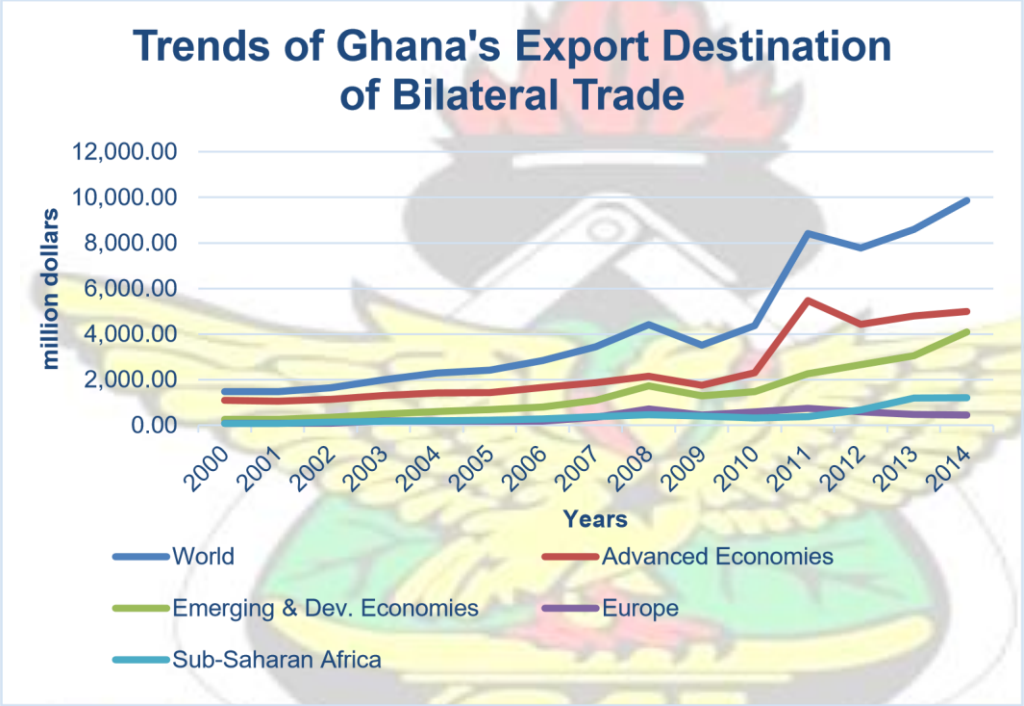
	2000	2002	2004	2006	2008	2010	2012	2013	2014
France	65.8	96.5	155.6	125.8	242.7	260.9	1076.8	1008.9	902.2
Italy	71.5	69.1	81.6	80.3	83.9	78.2	976.4	782.4	646.9
China	13.6	27.4	72.3	72.7	85.0	112.0	584.4	688.4	1071.4
Netherlands	250.1	246.9	279.2	320.6	576.5	532.3	702.0	636.5	734.7
S. Africa	3.6	6.7	9.9	12.0	16.0	11.8	220.2	635.6	663.7
Germany	112.0	108.0	103.1	109.2	121.7	154.1	343.3	386.6	179.2
U A E	0	0	13.8	21.7	35.6	38.3	49.2	55.1	52.5
U K	138.2	164.1	227.0	230.0	340.8	321.1	306.0	361.4	377.4
U S A	205.3	116.9	145.3	190.5	219.4	257.2	264.9	332.6	246.9
other nation	632.7	817.1	1300.0	1684.1	2698.5	2609.7	3263.4	3707.5	4990.2
World	1492.8	1652.8	2297.8	2847.0	4420.1	4375.7	7786.6	8594.8	9865.1

Source: Direction of Trade Statistics

Ghana‟s cocoa beans has greatly been export to the United Kingdom which approximately form about 50 percent of all cocoa beans exported. Germany and United States follows respectively as the most important destination of Ghana‟s export. Trade with the Communist countries of the eastern world, usually Eastern Europe was virtually zero whiles African countries like Nigeria, Cote d‟lviore among others received very small percentage of Ghana‟s export in the 1980s (Nyanteng, 1987).

In the 1990s, Ghana‟s export trade had a massive boost but the trend of her export did not change, rather followed the same pattern as it was in the 1980s with majority of the exports finding its way to the Developed economies and the Europeans Unions. There was an opposite trend in the exports of Ghana when the nation got to the 2000s. That is, Ghana‟s export to the Developing economies started appreciating whiles that of the Developed economies falling (in 1998 export was 80% but declined to 50% in 2008).

Figure 2.3 The Trend of Ghana's export destination from 2002 to 2014.



Source: Author's own construction. Data was obtained from UNCTAD Stat database

It is so obvious that Ghana‟s traditional export trade partners such as France, Belgium Germany, among others are losing their lump share of Ghana‟s export these days to china, Taiwan, Brazil, etc. as the percentage of Ghana‟s export in 2014 revealed that China, France, South Africa, Italy and Netherlands are the top five partners respectively in terms of export.

Ghana‟s total export to the world has tremendously increase since 2000 but the Developed economies still received the highest proportion as compared to the Africa not increasing significantly. The ECOWAS countries like Benin, Nigeria, Senegal, and

Togo have continue to remained major destination of Ghana‟s exports. South Africa and Ghana‟s bilateral relationship has receive massive growth which is reflected in the 2014 UNCTAD nations general profile as the third most important destination for Ghana‟s export overtaking Italy and the Netherlands who were ahead of her in the previous years (UNCTAD stat 2014).

2.4 Conclusion

By far the gravity model has proven to be the best tool for analysing the bilateral trade flow between countries and in explaining the variables used in determining trade. This chapter has reviewed the theoretical foundation and empirical application of the use of the gravity model in studying the bilateral trade flow of countries. Again, the trend and direction of Ghana‟s trade especially export over the years from 1960 to 2014 have been reviewed. Based on the reviewed done in this chapter, the appropriate model and variables are adopted for this study. Therefore we discuss the research methodology in the next chapter.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

In this chapter, the empirical technique employed to help us attain the objectives of this study is discussed. The first section of this chapter, present a concise description of the

variables employed and the source of the data used and how they were measured. The second section looks at the model specification and the theoretical framework for this study. Finally the econometric methodology such as Pooled Ordinary Least Square (OLS), Fixed Effects and Random Effects estimators among other test would be discussed to conclude this three-section chapter.

3.1 Model Specification

3.1.1 Gravity Model Specification

This section specifies the model for the volume of bilateral export trade between Ghana represented by i and her export trading partners as country j in the year$t$. We consider the baseline gravity model which postulates that the trade flows between two countries are an increasing function of the size of the countries, represented by their GDP, and a decreasing function of the cost of transportation, proxied by the distance between two countries. As analogous to Newton‟s law of gravity in physics, the functional form of the basic gravity model is given as:

$$T_{(X)_{ij,t}} = A\frac{Y_{it}^{\beta}Y_{jt}^{\theta}}{D_{ij,t}^{\delta}}e^{\varepsilon_{ij,t}} \qquad (3.1)$$

$T_{ij,t}$ represents the total export flow between county, i and j,at time t. The exponent $\beta, \theta \; and \; \delta$ are the elasticity coefficients to be estimated.ε_{ij} is the stochastic disturance term introduced. $Y_i$and Y_j are the GDPs of the countries income levels. The D_{ij} is the geographic distance between the two countries‟ economic centers (i.e. capital cities). Taking the natural logarithm of equation (3.0), we establish a linear relationship which

permits the interpretation of the coefficients as elasticities of exports with respect to the regressors (explanatory variable). The simple baseline model is as follows:

$$lnT_{(X)_{ij,t}} = \varphi + \beta lnY_{it} + \theta lnY_{jt} - \delta D_{ij} + \varepsilon_{ij,t} \quad (3.2)$$

Note $lnA = \varphi$.A lot of empirical studies has revealed that equation (3.1) best fits data well and gives sturdy and strong in form results. However, as reviewed in literature, there are other factors that influence trade flows but are excluded from this equation. In this study, an augmented version of the basic gravity model specified above is estimated by including infrastructural, competitiveness, external market condition and technological elements. The modified form of the gravity equation employed in this study is thus expressed as:

$$lnT_{(X)_{ij,t}} = \varphi + \gamma_{ij} + \mu_t + \beta_1 \ln(RBER_{ijt}) + \beta_2 \ln(GDP_{it}) + \beta_3 \ln(GDP_{jt}) + \beta_4 \ln(POP_{it}) + \beta_5 \ln(POP_{jt}) + \beta_6 \ln(TO_{it}) + \beta_7 \ln(INFRAS_{it}) + \beta_8 ln(FDI)_{it} + \beta_9 ln(DIST)_{ijt} + \beta_{10}(LANG)_{ijt} + \varepsilon_{ijt} \quad (3.3)$$

Where φ is the general intercept, γ_{ij} accounts for country-specific effects, including unobserved historical, institutional, political and cultural characteristics of a given country pair, that influence bilateral trade flows, and μ_t accounts time-specific effects and $\beta_1, \beta_2, \dots, \beta_8$ are all elasticity coefficients to be estimated. However, equation 3.3 is further divided into three models with the first model is as depicted in equation 3.3. The second model excludes $ln(RBER)$ and includes the first difference of $ln(RBER)$; thus $\Delta Ln(RBER)$ Whiles the third model includes the volatility of $ln(RBER)$, thus, $Ln(RBER)_{vol.}$

3.2 Description of Variables, Data Source and A prior Expectations

The long-run determinants of Ghana‟s bilateral exports using a modified version of the gravity model of trade are modeled. The study employs a panel dataset form 20 major exporting destinations of Ghana‟s export over a data spanning from 1998 to 2014. That is 16 years totally 400 observations. Basically, the choice of countries for the study was based on the volume of trade export to the specific destination as recorded by ISSER (2012; 2013 and 2014). Among these can be mentioned, Australia, Brazil, Burkina-Faso, China, Cote D‟Ivoire, France, Germany, India, Israel, Italy, Malaysia, Netherlands, Nigeria, Russian Federation, South Africa, Togo, Turkey, United Arab Emirates, United Kingdom and the Unites States. Another reason for the choice of the countries and sample period is due to the availability of data on all the variables as well as the congenial importance of the chosen country to Ghana‟s total export within the time. Data on variables included in the model was canvased from diverse secondary source.

In accordance to the theoretical model adopted, the study used three different sets of explanatory variables as the principal factors influencing Ghana‟s bilateral total exports (T_X). The first group of variables represents the exporting country's internal conditions of supply and the market conditions from the importing country, such as, gross domestic product (GDP), population (POP), real bilateral exchange rate $(RBER)$, trade openness (TO), foreign direct investment (FDI) and internal telephone infrastructure (INF) The next group of variable is the resistance factors of trade which is represented by the geographical distance between their capital cities that is Ghana and her trading partners $(DIST)$. The third group of variable is what is preferred to as preference factor of trade, thus the common language $(LANG)$.

In what follows is a brief description of the variables included in the estimable model and their expected signs:

Bilateral Total Export ($T_{(X)}$): This is a measure of the total value of export from Ghana to a specific trading partner, usually measured in US dollars. These goods and services are implicitly deflated using price to get the real values. Bilateral total export is the dependent variable. Data on bilateral exports was obtained from UNCTAD (2015); specifically the Online United Nations Conference on Trade and Development Statistics Database.

Real Bilateral Exchange Rate ($RBER$): The real bilateral exchange rate is simply the real exchange rate of the domestic country‟s currency (in this case Ghana (Ghana Cedi)) relative to that of its trading partners. Worded differently, it is the price of the domestic currency (Ghana Cedi) expressed in terms of the currency of each trading partner. The $RBER$ was calculated as the nominal bilateral exchange rate between the Ghana Cedi and each partner‟s currency ($E_{ij,t}$) multiplied by the ratio of foreign price index ($P_{j,t}$) to Ghana‟s price index ($P_{i,t}$). Thus,

$$RBER_{ij,t} = {(E_{ij,t}P_{j,t})}/{P_{i,t}} \quad (3.4)$$

Due to unavailability of nominal bilateral exchange rate of the Ghana cedi with each trading partner‟s currency, the study uses the cross-exchange rate (triangular arbitrage) technique to compute the nominal exchange rate index. Data on exchange rate (i.e. national currency per US dollar) and consumer price indexes were sourced from the World Bank, World Development Indicators online database, (2015). Again, to capture the effect of exchange rate on export flows, the study uses three measures real bilateral exchange rate including the actual computed$(LnRBER)$, the first-difference of the real bilateral

exchange rate variable $(\Delta LnRBER)$ and the real bilateral exchange rate volatility $(LnRBER_{vol})$. The generalized autoregressive conditional heteroskedasticity (GARCH) model was used to obtain real bilateral exchange rate volatility from the real bilateral exchange rate figures. In all three cases, it is expected that real bilateral exchange rate is negative, hence $\beta_1 < 0$.

Gross Domestic Product $(GDPs)$: Gross domestic product is the market value of total production of goods and services in a country over a period of time, usually one year. The study use the real GDP index, thus measured in real terms at constant 2000 US$ in account for inflation. Data for Ghana"s GDP and GDP_s of the selected trade partners was obtained the World Bank"s, World Development Indicators online database (2015). With regards to both GDP for the home country (Ghana) and partner countries, it is expected to be positive, hence $\beta_2 > 0$ and $\beta_3 > 0$.

Population (POP): Population is simply the total number of residents in a particular country irrespective of the legal-status or citizenship and excluding refuges that have not permanently settled in the country refuge. The study included both the total population of Ghana and the total population of the selected trading partner in the estimation. The study obtained data on population from the World Bank, World Development Indicators online database (2015). It is expected that the exporters population can be positive or negative, thus $\beta_4 > 0$ or $\beta_4 < 0$ whereas the population of the partner country is expected to be positive, hence $\beta_5 > 0$.

Trade Openness(TO): The trade openness of a country is simply a measure of

economic policies of a particular country to either restrict or encourage trade with the rest of the world. Trade openness is measured as total trade as a share of GDP. Data for trade openness was obtained from the World Bank‟s, World Development Indicators, (2015). It is expected that trade openness is positively related to total exports, thus

$\beta_6 > 0$.

Internal Infrastructure (INFRAS): This simply refers to the stock of streets, highways, rail lines, telephone lines, airports, waterways among many others that enable individuals across countries to easily access internal and global markets. The study uses the number of telephone lines as a proxy to measure internal infrastructure. Data was obtained from the World Bank‟s World Development Indicators (2015). The coefficient of internal infrastructure is expected to be positive, thus $\beta_7 > 0$.

Foreign Direct Investment(FDI): FDI can be defined as the long term involvement of a source country‟s management, joint venture, transfer of technology and expertise in a particular host. In other words, it refers to the situation whereby individual of a particular country, thus the source country acquire ownership for the purposes of controlling the production, distribution and other related activities of a firm(s) found in the host country. In this study, FDI is measured as the net FDI inflows. The study obtained data on FDI inflows to Ghana from online UNCTAD database (2015). The coefficient of FDI is expected to be positive, thus $\beta_8 > 0$

Distance($DIST$) : This is the geographical distance between the economic centers (i.e. capital cities) in Ghana and its trading partners, measured in kilometers (km) as the crow

flies. Data on distance is sourced from an online CPEII database (2015). The coefficient of distance is expected to obtain a negative sign, thus $\beta_9 < 0$.

Language($LANG$): This simply refers to the official language of the trading partners and Ghana. The study adopts the use of dummy variables for$LANG$. In the case where the partner country"s official language is English it is coded one (1), however if otherwise it is coded zero (0). Data was obtained from the Central Intelligence Agency (CIA) world fact book. The coefficient of language is expected to obtain a positive sign, thus $\beta_{10} > 0$.

3.3 Estimation Strategy

The study employs the use of the panel data estimation techniques for its estimations. This is basically due to the fact most modern researches adopted the use of panel data estimation techniques in analyzing the gravity model. Another reason for the choice of use of the panel data estimation techniques is due to the following reasons, including; i) it is accurate for controlling for individual heterogeneity as it allows for the inclusion of time-invariant variables and also allows for the use of individual specific variables; ii) it gives a more informative and efficient data, variables less correlated and more degrees of freedom as it is a combination of time-series and cross-sectional observations and iii) it is a suitable technique for studying dynamic changes. For the purposes of this study, the pooled ordinary least square (pooled-OLS), fixed effect and random effect estimators were employed.

3.3.1 Pooled Ordinary Least Squares (pooled-OLS)

The pooled-OLS is the simplest panel model with regards to various panel estimation techniques. Some researchers view this technique as naïve compared to other known panel estimators. Basically, this technique ignores the panel structure of the data which regards to the space and time dimensions of the pooled data and just conducts OLS estimation. The specification of the pooled-OLS is given as;

$$Y X_{it} \square_{it} \square \square \square\square \square_{it} \quad (3.5)$$

Where Y_{it} represents the observation on the dependent variable for cross-sectional unit (country), Xit represents the vector of regressors observed for country i in period$t$, t represents the time trend, $\square$ represents the intercept term and $\square$ is the Gaussian error term for country i in period t This approach assumes that the error terms are uncorrelated and as such are homogenous.

3.3.2 The Fixed Effect Model

The fixed effect model introduces an intercept term that is allowed to differ amongst the individual units but doesn‟t vary over time. This is done to recognize the fact that each individual unit has special characteristics of its own. The fixed effect estimator divides the error term three components namely, the time-invariant, observation-specific error term and unit-specific components. Therefore, the fixed effect estimator is specified as;

$$Y X_{it} \square_{it} \square \square \square\square \square_{iit} \quad (3.6)$$

Where Y_{it} is the dependent variable in country i at time t, X_{it} is the number of regressors in country i at time t, β is the coefficient of the regressors, α is an unknown intercept and ε is the Gaussian error term.

The estimated coefficient of the fixed effect estimator is unbiased since it controls for all time-invariant differences between individuals units such as culture, gender, religion and language. One short-fall of the fixed effect estimator is that, it does not allow investigating time-invariant causes of the dependent variable as the model assumes that the time invariant features of individual units are perfectly collinear. Considering the fact that fixed effect models are distinctively designed to investigate the causes of change within an entity, a time-invariant characteristic cannot cause any change as it is constant for each individual unit.

3.3.3 The Random Effects Model

The random effects estimator assumes that the intercept and a random component captures the heterogeneity effects, thus the individual effects which are identically and independently distributed over the individuals units. The Random effect model is give as:

$$Y X_{it} \alpha_{it} \beta \beta \beta \beta \beta \beta_i \quad _{it}$$

(3.7) Where Y_{it} is the dependent variable in country i at time t, X_{it} is the number of regressors in country i at time t, β is the coefficient of the regressors, α is an unknown intercept and ε is the Gaussian error term. The Generalized-Least Square (GLS) estimator is used for the random effect model. The error term consists of two components namely the

individual specific component which is time-invariant and the cross-section error component, assumed to be uncorrelated over time. A major advantage of the random effect estimator is that it allows the estimation of time-invariant variables and also allows the user to know whether the variations are from within the individual units or between the individual units.

3.3.4 Hausman Test

In order to decide between the random and the fixed effect model, an appropriate test is the Hausman test. Thus the Hausman test, test the null hypothesis that the preferred and appropriate model is random effect against the alternative hypothesis that the preferred and appropriate model is the fixed effect model. In other words, the Hausman test tests it the fixed effects and random effects estimator are significantly different. From the Hausman test results, if the probability value is lesser than 5 percent, then the null hypothesis is rejected and a conclusion can be drawn that the fixed effect estimator is the most appropriate. On the contrary, if the probability value if greater than 5 percent, causing the non-rejection of the null hypothesis, then a conclusion can be drawn that the random effect is the most appropriate estimator.

3.3.5 Breusch-Pagan Lagrange Multiplier (LM) Test

The Breusch-Pagan LM test helps to decide whether the random effect estimation is the most appropriate compared to the pooled-OLS estimations. In this case the null hypothesis that the OLS is the most appropriate estimator, hence the random effect estimator is not is tested against the alternative hypothesis that the random effect estimator is the most appropriate estimator. From the Breusch-Pagan LM results if the probability value is less

than 5 percent then the null hypothesis is rejected and a conclusion can be drawn that the random effect is the most appropriate estimator. On the other hand if the probability value is greater than 5 percent leads to the non-rejection of the null hypothesis, hence a conclusion can be drawn the random effect is not appropriate but rather OLS is appropriate.

3.3.6 Test for Heteroskedasticity

The study further tests for the presence of heteroskedasticity or otherwise in the model. The null hypothesis of no heteroskedasticity is tested against the alternative hypothesis of heteroskedasticity. If the probability value is less than 5 percent then the null hypothesis is rejected and a conclusion is drawn that there is the presence of heteroskedasticity in the model. On the other hand, if the probability value is greater than 5 percent causing the non-rejection of the null hypothesis, then a conclusion can be drawn that, there is no heteroskedasticity in the model.

3.3.7 Test for Serial Correlation

The study further tests for the presence of serial correlation in the model using the Lagram-Multiplier. The null hypothesis of no serial correlation is tested against the alternative hypothesis of serial correlation. If the probability value is less than 5 percent then the null hypothesis is rejected and a conclusion is drawn that there is the presence of serial correlation in the model. On the other hand, if the probability value is greater than 5 percent causing the non-rejection of the null hypothesis, then a conclusion can be drawn that, there is no serial correlation in the model.

3.3.8 Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model

The GARCH model was developed by Bollerslev (1986) based on the drawbacks of the specification ARCH model, which looked more like a moving average specification than an autoregression specification. In view of this the GARCH model included the lagged conditional variance term as autoregressive terms. The general form of the GARCH (p,q) is given as:

$$Y_t = \beta + \beta X_t + \varepsilon_t \quad (3.8)$$

The model expressed above says that, the value of the variance scaling parameter, h_t now depends on both the past values of the shocks which capture the past value of it which is captured by the lagged h_t terms and the lagged squared residual terms. The simplest form of the GARCH model is the GARCH (1,1) model, due to the fact that it has only three unknown parameters for which the variance equation has the form:

$$h_t = \alpha + \alpha_o + \alpha_1 h_{t-1} + \beta_1 u_t^2 \quad (3.9)$$

CHAPTER FOUR

PRESENTATION AND DISCUSSION OF RESULTS

4.0 Introduction

This chapter presents and analyses the estimated results of the gravity model of bilateral exports. Specifically, the chapter presents discussions on the descriptive statistics of the variables included in the model and further presents and discusses the estimated results obtained from the pooled OLS, fixed effect model and the random effect model. Finally, discussions on selected diagnostic tests are reported.

4.1 Analysis of the Descriptive Statistics of Variables

The study first investigates the descriptive statistics of the variables included in the model. The results are presented in Table 4.1

Table 4.1: Descriptive Statistics

Variable	Mean	Std. Deviation	Minimum	Maximum	Observations
	11.22953	3.801101	1.12298	27.91975	400
	3.465941	2.846389	-2.706031	11.84369	400
	23.12229	0 .3405273	22.63929	23.7419	400
	26.69006	2.209925	20.7688	30.32542	400
$LnPOPj$	16.86698	0.1444395	16.63457	17.10341	400
$LnDIST$	17.78537	1.55234	14.67001	21.03389	400
$LnINFRAS$	8.195314	1.140866	5.246913	9.64685	400
$LnTO$	12.27072	0.4964611	11.05195	12.8387	400
$LANG$	-0.5458116	0.527319	-1.859161	0.7903072	400
$LnFDI$	0.2475	0.4321001	0	1	400
	19.94419	1.519244	17.89186	21.93621	400

Source: Author

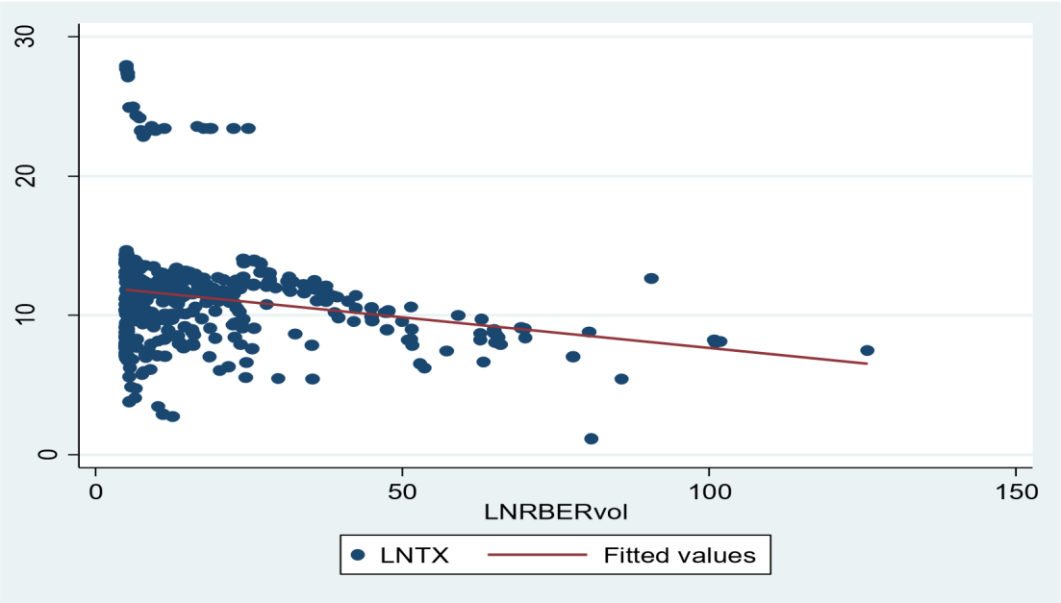
In all, there were 400 observations for the study. However, over the period under study, the growth rate in total exports averaged about 11.23% with that of real bilateral exchange rate averaging around 3.47%. Both domestic GDP and foreign GDP averaged around 23.12% and 26.69% respectively. Again, domestic country‟s population and foreign countries‟ averaged around 16.87% and 12.79% respectively. Trade openness had the lowest average of -0.55% which could have resulted from the higher demands for imports. Distance, infrastructure, language and FDI averaged around 8.20%, 12.27%, 0.25% and 19.94% respectively.

In terms of the standard errors, real bilateral exchange rate has the highest value (2.85), followed by foreign countries‟ GDP (2.21) with the lowest standard error value to be 0.14 for the domestic country‟s population. However, the lower the standard errors indicates less disparities of gains in the domestic and foreign countries. Per the period studied, the maximum growth rate of total bilateral exports was 27.92 whiles its minimum value was 1.12. This implies that, Ghana‟s highest earnings are about 27.92 percent from its bilateral total export flows whiles lower earnings accrued at about 1.12 percent. The maximum flow of FDI was 21.94 as against its minimum flow of 17.89. The difference between the maximum and minimum values give the range of the data. For instance, the range for real bilateral exchange rate is 14.549721 [11.84369 – (-2.706031)]. The range for FDI is 4.04435, whiles the ranges for domestic country‟s GDP and foreign countries‟ GDP are 1.10261 and 9.55662 respectively. Hence a wider variation in the gains from GDP of domestic and foreign countries.

4.2 Trends in Ghana's Total Exports and Exchange Rate Volatility

Figure 4.1 presents is a scatter plot of Ghana‟s bilateral total exports and its exchange rate volatility.

Figure 4.1 Scatter Plot of Ghana's Total Exports and Exchange Rate Volatility



From the diagram, there is clear visual representation and evidence that the relationship between exchange rate volatility and Ghana‟s total exports is negative. This could have resulted from the continuous depreciation of the domestic currency. Hence the greater the volatility in exchange rate, the lower would be Ghana‟s bilateral total exports.

4.3 Estimated Pooled-OLS, Fixed Effects and Random Effects Models

The study employs the pooled-OLS, fixed effects and random effects model investigate the relationship among the variables included the Augmented Gravity Model of Ghana‟s total export as in equation 3.3. The result for the pooled-OLS, fixed effect and random effect model are presented in column 1, column 2 and column 3 in Table 4.1 respectively.

The pooled-OLS shows that of all the different measures of real bilateral exchange rate, the coefficients were negative and highly significant. This result doesn‟t confirm the a

prior expectation and neither confirms the Marshal-Lerner condition since the coefficient is negative and in all three models the price elasticities are less than one. Again, Ghana GDP was found to have a positive but however insignificant relationship with bilateral trade exports as in model 1, model 2 and model 3. In contrast, the coefficient of GDP of the partner countries was positive and significant at 1% significance level in all three models. Besides, Ghana‟s population, the distance and language dummy was found to impede the bilateral export flows; of which Ghana‟s population was insignificant whereas language and distance were each significant at 1% error level. Again, though inflows of FDI to Ghana and the internal infrastructure were found to exert a positive effect on bilateral exports, their effects were insignificant as in all three models. The population of the trading partners and the openness to trade of the partner countries also obtained a positive and highly significant as in model 1, model 2 and model 3.

However, is should be noted that, the pooled-OLS has a major set-back as it only estimates the OLS regression and ignores the time and space dimensions of the pooled data. This implies that the pooled OLS disregards unobservable individual or countryspecific effects as it treats all observations for all time periods as a single sample and this may induce autocorrelation in the errors and consequently distort inferences drawn from the estimates. To address this issue, the study further employs the fixed effect and random effect models as both models consider the country-specific-effects as fixed and random respectively. Discussions on the fixed and random effect models are further outlined.

Table 4.2 Estimated Results

Variable	POOLED OLS ESTIMATOR			FIXED EFFECT ESTIMATES			RANDOM EFFECT ESTIMATES		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	-0.173***			-0.072			-0.075		
	(0.047)			(0.127)			(0.117)		

$_{ij}$		-1.110***			0.045			0.041	
		(0.470)			(0.183)			(0.188)	
			-0.026***			-0.009**			-0.010**
			(0.006)			(0.004)			(0.005)
	4.682	4.288	5.125	4.518**	4.369**	4.654**	4.459**	4.294**	4.613***
	(4.364)	(4.357)	(4.364)	(1.756)	(1.790)	(1.764)	(1.768)	(1.789)	(1.765)
	0.254**	0.293**	0.248**	1.684***	1.670**	1.627***	1.159**	1.0872**	1.115**
	(0.122)	(0.123)	(0.1207)	(0.555)	(0.585)	(0.550)	(0.479)	(0.485)	(0.468)
$LnRBER_{ij}$	-8.648	-5.594	-9.689	-9.426	-8.421	-9.607	-8.356	-7.167	-8.619
	(12.603)	(12.568)	(12.610)	(4.523)	(4.447)	(4.354)	(4.702)	(4.675)	(4.540)
$\Delta LnRBER$									
$LnRBER_{volij}$									
$LnGDP_i$									
$LnGDP_j$									
$LnPOP_i$									
$LnPOP_j$									
$LnTO_j$									
$LnINFRAS$									
$LnFDI_i$									
$LnDIST_{ij}$									
	0.596***	0.424***	0.556***	2.068***	2.019***	2.062***	1.377***	1.246***	1.380***
	(0.097)	(0.010)	(0.934)	(0.481)	(0.474)	(0.459)	(0.415)	(0.426)	(0.422)
	1.673***	1.430***	1.568***	0.649	0.683	0.6716	0.913*	0.968**	0.931*
	(0.310)	(0.334)	(0.307)	(0.523)	(0.504)	(0.513)	(0.483)	(0.464)	(0.479)
	0.048	0.283	0.185	0.862	0.162	0.134	0.078	0.154	0.130
$_i$	(0.7310)	(0.788)	(0.743)	(0.156)	(0.129)	(0.149)	(0.157)	(0.132)	(0.149)
	0.189	0.177	0.215	0.153**	0.147***	0.161	0.161***	0.155***	0.169***
	(0.297)	(0.300)	(0.298)	(0.156)	(0.048)	(0.005)	(0.060)	(0.483)	(0.051)
	-1.881***	-1.891***	-1.835***				-3.702**	-3.528**	-3.635**
	(0.198)	(0.206)	(0.198)				(1.568)	(1.536)	(1.564)
$LANG_{ij}$	-1.060***	-1.160***	-1.126***				-1.517	-1.660	-1.529***
	(0.3944)	(0.403)	(0.394)				(0.483)	(1.862)	(0.436)
Constant	44.283**	0.380**	49.748**	-19.069**	-32.812	-18.313	20.932***	6.541	21.51**
	(1.874)	(1.812)	(1.088)	(4.496)	(4.380)	(4.687)	(4.522)	(4.050)	(3.989)
R^2	0.7503	0.7470	0.7517	0.6951	0.6876	0.6692	0.6568	0.6508	0.6599
No. of Countries	20	20	20	20	20	20	20	20	20
No.of obs.	400	400	400	400	400	400	400	400	400

Source: Author"s own construction

Note: ***, ** and * represent significance at 1%, 5% and 10% respectively. In parenthesis are the robust standard errors

The estimates of the fixed effect model show that for model 1, the coefficient of real bilateral exchange rate had a negative but insignificant effect on bilateral exports. Worded differently, an increase in real bilateral exchange rate, thus depreciation of the Ghana cedi against the foreign currency reduces the flow of exports to the partner countries.

Specifically, a percentage increase in real bilateral exchange rate causes a decline in exports to partner countries by 0.072% at 1% significance level. Again for model 2 a percentage increase in the difference of bilateral exchange rate $(\Delta LnRBER_{ij})$ between Ghana and her trading partners causes a 0.045% improvement in export flows. The effect was however, statistically insignificant as in model 2. For model 3, a percentage increase in the real bilateral exchange rate volatility $(LnRBER_{vol})$ causes a 0.009 percent decline in export flows. In all three cases the price elasticities of the coefficient are less than zero and obtained a negative sign hence contradicting theory (Marshall-Lerner condition). In this case it implies that a successful deprecation of the Ghana cedi against the currency of the partner countries will not cause the demand for

Ghana‟s export to increase, thereby causing any improvement in the total bilateral exports. The fixed effect estimations showed that Ghana‟s GDP was positively related to bilateral exports in all three models. In model 1, a percentage increase in the Ghana‟s GDP causes a 4.518 percent increase in bilateral exports. Similarly for model 2 and model 3, a percentage increase in Ghana‟s GDP cause export flows to partner countries to increase by 4.369 percent and 4.654 percent respectively. The results obtained in all three models confirm the theoretical expectation. This implies that as the production capacity of

Ghana increases, it causes an increase in the volume of export goods hence increasing bilateral export flows, ceteris paribus. However, the results obtained with regards to all three models were statistically insignificant at 5% error level.

In the same vain, the GDP of partner countries in all three models obtained a positive relationship with export flows. For the first model, a percentage increase in the GDP of the partner countries causes 1.684 percent increase in bilateral trade export at 1% level of significance. In the model 2 and model 3, a percentage increase in the GDP of the partner

countries cause the bilateral export to increase by 1.670 percent and 1.627 percent at 5% and 1% level of significance respectively. This confirms the a prior expectations. The intuition here is that as the income levels of the partner countries increase they increase their demand for Ghana‟s exports. This could be attributed to the fact that the government in recent times has embarked on various strategies to help diversify and improve the standard and quality of exports on the international market.

Again, the fixed effect estimator showed that the Ghana‟s population exerted a negative effect on its bilateral exports in all three cases. Specifically, in Model 1 an increase in population caused a decline in exports by 9.246 percent whereas in Model 2 and Model 3, a percentage increase in population caused decline in export flow by 8.421 percentage and 9.607 percentage respectively. Though this confirms the a prior expectation and further confirms the absorption effect in Ghana, in all three cases the results were insignificant.

In contrast, the population of the partner countries was found to stimulate Ghana‟s bilateral exports in all three models. In model 1, a percentage increase in the population of partner countries caused a 2.068 percent increase in bilateral export at 1% level of significance. Model 2 also showed that a percentage increase in the population of partner countries causes 2.019% increase in bilateral export at 1% level of significance.

Similarly in model 3, a percentage increase in population of partner countries causes a 2.062% increase in bilateral exports at 1% level of significance. This confirms a prior expectation. Intuitively, an increase in the population size of partner countries implies that there is an expansion in their respective markets and as such there will be an increase in the demand for exports and imports from the rest of the world including that from Ghana. This in effect stimulates supply of Ghana‟s bilateral export as a result of the rising import demand of its trading partners.

Trade openness was found to stimulate Ghana‟s bilateral export in all three models. Worded differently, as the pattern countries open up to trade it causes an increase in Ghana‟s export flows. In the first model, a percentage increase in trade openness of the partner countries causes a 0.649% increase in bilateral exports. In the second and third models, a percentage increase in trade openness was found to stimulate export flows by 0.683% and 0.6716% respectively. The results imply that as the partner countries open up to trade, it stimulates Ghana‟s bilateral trade due to the fact that, their trading patterns with the rest of the world including Ghana, increases. The result further implies that an improved access of Ghana‟s exports to various international markets through various bilateral and multilateral agreements will stimulate Ghana‟s bilateral exports. However, in all three models, the results were statistically insignificant.

Again, the fixed effect estimates shows that though internal infrastructure obtained a prior sign, its effect was statistically insignificant. In all three models, the results showed that an increase in internal infrastructure development stimulates bilateral exports. In model 1, a percentage increase in internal infrastructure causes a 0.862% increase in bilateral export. Likewise in model 2 and model 3 a unit increase in internal infrastructure stimulates bilateral exports by 0.162% and 0.134% respectively. The insignificance of the results may be attributed to the fact that, Ghana has not obtained an adequate level of trade-related infrastructure development and such impedes the expansion of its export flows to partner countries. This results cross-border movements and as such causes the prices of Ghana‟s exports to be relatively expensive hence

deterring the volume and intensity of trade flows with the rest of the world.

The effects of distance and language were found to be negative but insignificant. Hence from the pooled OLS results, geographical distance and common official language do not influence Ghana‟s bilateral export flows (see; Marquez-Ramos, 2007).

Finally, foreign direct investment was found to stimulate Ghana‟s bilateral export. In model 1, an increase in FDI inflows causes a 0.153% increase in bilateral exports at 5% level of significance. For model 2 an increase in FDI inflows causes 0.147% increase in bilateral exports at 1% level of significance. Though the coefficient of model 3 obtained a positive sign, its effect on bilateral exports was insignificant. Specifically, a unit increase in FDI inflows causes a 0.16 unit increase in bilateral export. Generally, FDI inflows is expected to result in a more effective and efficient use of domestic resources and as such leading to increase in productivity especially in export sectors that the country has comparative advantage in. However, the insignificance of the results in model 3 may be due to the fact that a chuck of FDI inflows is diverted into nonproductive sector of the economy talk-less of tradable sectors. For this reason, the results obtained imply though FDI inflows are trending in Ghana; it doesn‟t have a significant impact on bilateral exports flows to partner countries.

It is worth noting that a major limitation of the fixed effect model is that it completely eliminates all time invariant variables during the within transformation. In this study, distance and language are two of such variables and as such eliminated from the fixed effects estimation; hence, the reason for the absence of their coefficients in Table 4.1.

Furthermore, the results from the random effect estimates depict that about 66%, 65% and 66% of the total variations in the dependent variable is explained by the independent variables in Models 1, 2 and 3 respectively.

As expected, the direct effects of real bilateral exchange rate and its first difference coefficients were negative but insignificant at 5 percent levels as shown in model 1 and model 2 respectively. However, the direct effect of its volatility coefficient is also negative and statistically significant at 5 percent level. Hence a percentage increase in real bilateral exchange rate volatility would lead to a fall in total export flows by about 0.01%. This implies that, deprecation of the Ghana cedi against its foreign partners increases the demand for Ghana‟s export, which enhances total bilateral exports. The results again contradicts the Marshall – Lerner condition. The result confirms the works by Gani (2008) and Taye (2009).

The coefficients of domestic GDP were found to be positive and significant at 5 percent level in all the models employed. A percentage increase in domestic GDP would lead to a percentage increase in total export flows by about 4.46%, 4.29% and 4.61% in models 1, 2, and 3 respectively. Hence as the domestic country experience higher growth, the better would be its total exports flows. In order words, as the production capacity of Ghana increases, it causes an increase in the volume of export goods hence increasing bilateral export flows, ceteris paribus. (See; Gani, 2008; Rahman, 2009; Bonuedi, 2013). The study also revealed that the GDP of foreign countries is an important determinant of total export flows. This is because the coefficients of foreign countries‟ GDP were found to be positive and significant at 5 percent level in all the models employed. A percentage increase in foreign GDP would lead to a percentage increase in total export flows by about 1.16%, 1.09% and 1.12% respectively. The intuition is that the income levels of partner countries influence demand for domestic country‟s exports (see; Gani, 2008; Rahman, 2009; Bonuedi, 2013). Again, this results from successful government strategies to diversify and improve the quality of exports on the international market.

On the other hand, the effect of domestic countries‟ population on total export flows shows that a percentage increase in the domestic country‟s population would reduce total export flows by 8.34%, 7.12% and 8.62% in all three models respectively. However, the effect is insignificant at 5 percent level. This indicates that the growth rate in population of the domestic countries does not influence its total exports flows. This results meets a prior expectation and also confirms the absorption effect in the country.

Again, the positive effect of domestic country‟s population supports absolute advantage as according to Smith (1776). However, since the effect is not significant, it might not be appropriate to consider Ghana to have an absolute advantage over its foreign counterparts in terms of labour productivity.

On the contrary, foreign countries‟ population influence Ghana‟s bilateral exports positively at 5 percent significant level as expected. The results suggest that when the population of partner countries increase by one percent, total export flows increase by about 1.38%, 1.25% and 1.38% as shown in models 1, 2 and 3 respectively. This implies that as the population size of partner countries increases, there is an expansion in their respective markets which enhances demand for exports and imports from the rest of the world. The results again indicates that foreign countries have absolute advantage in terms of their labour productivity hence, their export products to the country are more productive. This results support the absolute advantage principal as according to Smith (1776) and comparative advantage by Ricardo (1772 – 1823). Hence foreign counterparts have absolute advantage in terms of their labour productivity as well as comparative advantage since they are more efficient in their production of goods and services than Ghana. That is to say, differences in labour productivity affects a country‟s bilateral trade flows.

As expected, the effect of trade openness was found to be positive and significant at 5 percent level in model 2 but that of models 1 and 3 showed insignificant impacts. Hence a percentage increase in trade openness would lead a percentage increase in total export flows by about 0.97% in model 2. In other words, openness of partner countries to the rest of the world, stimulates Ghana‟s bilateral total exports. This results from lower trade resistance policies such as reduction in trade barriers and tariffs for partner countries. An improved access of Ghana‟s exports to various international markets through various bilateral and multilateral agreements will stimulate Ghana‟s bilateral exports. The results confirm works by Alemayehu and Haile (2002) and Rahman (2009).

The effect of infrastructure on total export flows also met a prior expectation with a positive but insignificant impact at 5 percent level. As a results, increase in infrastructure does not affect total export flows. The insignificance of the results may be attributed to the fact that, the level of infrastructural development is not enough or well improved and hence may inhibits significant expansion of Ghana‟s export flows to partner countries. The result also confirms the works by Gani (2008) and Taye (2009).

With a positive and significant impact of FDI on Ghana‟s bilateral total exports flows, a percentage increase in FDI would lead to a percentage increase in total export flows by about 0.16% in all the models. The results depicts that FDI inflows ensures a more effective and efficient use of domestic resources enhance productivity. As a result, the level of technological innovate from foreign investment improves the export sectors of the country and hence Ghana‟s bilateral export flows. This results support the Ricardian theory of comparative advantage as well as studies by Suranovic (2006), Dunn and Mutti (2005) and Anderson (2004).

The longer the distance level, the lower would be the total export flows. This is shown by a negative and significant impact of distance on total export flows at 5 percent level, such that a percentage increase in distance level would lead to a more than percentage fall in total export flows by about 3.70%, 3.53% and 3.64% as shown in models 1, 2 and 3 respectively. Another support for the absolute advantage theory by Smith (1776) is also confirmed from this results, since distance was used to capture the geographical area being considered. In this case, the geographical area in terms of distance, does not increase Ghana‟s bilateral total exports with its foreign counterparts. Again, if the level of economic ties between Ghana and its trade partners are weak, it does not enhance bilateral export flows (see: Bergstrand, 1985; Krugman et al, 2013; Bonuedi 2013; Karamuriro and Karukuza, 2015).

The effect of language on total export flows shows how countries with common language differs from countries with different languages. With a negative and significant (at 5percent level) coefficient of language on total export flows in model 3, countries with common language have lower export flows. On the other hand, results for models 1 and 2 showed insignificant impacts. As a result, the official language of trading partners does not affect Ghana‟s total export flows. But for model 3, the official language reduced Ghana‟s bilateral export flows by about 1.53%. Hence to some extent, the official language spoken affects a counties bilateral export flows. The results obtained is evidenced in the works of Marquez-Ramos (2007).

4.4 Diagnostic Test

The study further conducts specific diagnostic test to check if the models estimated are free from any econometric problems. The results are presented in Table 4.2.

Table 4.3 Diagnostic Test Results

TEST	MODEL 1	MODEL 2	MODEL 3
Hausman	14.06	13.54	13.47
	[0.1202]	[0.0945]	[0.1425]
Breusch-Pagan LM for	13.56	28.69	31.81
Random Effect	[0.0015]	[0.0025]	[0.0015]
Serial Correlation	17.55	-	37.61
	[0.5605]		[0.2369]
Heteroskedasticity	9.86	9.99	12.56
	[0.1230]	[0.3566]	[0.099]

Source: Author‟s own construction
Note: In Parenthesis are the probability Values

Diagnostic test was also conducted to determine the validity of the estimation technique employed. The Hausman test was used to determine which estimator was feasible for the study (whether the fixed effect or the random effect estimators). The results from the Hausman test for all the models were insignificant at 5 percent level. Hence the study did not fail to reject the null hypothesis that the difference in coefficients is not systematic. That is, if the probability value of the test statistic is less than 0.05, then the fixed effect estimator is appropriate. However, since the probability values (0.1202, 0.0945 and 0.1425) for all the models are greater than 0.05, the random effect estimator is the appropriate model for the study. One advantage of using the random effect model is its assumption that the entity‟s error terms are uncorrelated with the predictors hence allowing for time – invariant variables to play significant roles as explanatory variables.

Since the Hausman test confirmed the random effect over the fixed effect estimator, all the subsequent tests were done to determine the validity of random effect estimator. These tests include the Breusch – Pagan LM test, serial correlation test and heteroskedasticity test.

The Breusch – Pagan LM test helps to decide whether to choose between random effects estimator and the simple ordinary least squares regression. In this test, the null hypothesis of variances across entities is zero is test against its alternative hypothesis of variances across entities is not zero. If the probability value is greater than 0.05, then we fail to reject the null hypothesis and conclude that random effects is inappropriate. From the test results above, all the probability values are less than 0.05, we reject the null hypothesis hence the use of random effect is appropriate for the study.

The presence of serial correlation leads to higher R – squared and smaller standard error coefficients than they actually are. An insignificant error term depicts that the errors are correlated with the regressors in the fixed effect model but not correlated with regressors in the random effect estimator, hence makes the used of random effect valid. In order words, if the probability value obtained is greater than 0.05, then we fail to reject the null hypothesis of no serial correlation. Hence the data excludes first order autocorrelation.

However, the results from the heteroskedasticity test, were all insignificant at 5 percent levels. Hence the study again, did not fail to reject the null hypothesis of no heteroskedasticity. As a results the residuals in the model have constant variance (homoscedastic).

CHAPTER FIVE

SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSIONS

5.1 Introduction

This chapter summarizes the results obtained and discussed, and the findings made in the previous chapter. It also provides recommendations based on the findings made.

Finally, conclusions to the entire study are made here.

5.2 Summary of findings

The study set out to empirically analyze the determinants of Ghana‟s bilateral exports, particularly examining the relevance of exchange rate variability. Specifically, it examines the internal and external factors that drive Ghana‟s bilateral export trade. It also determines the implications of exchange rate variation on Ghana‟s export trade. Panel data for the period 1995-2014 was used. Data on 20 of Ghana‟s trading partners are adopted. Panel data estimation techniques such as the Pooled Ordinary Least Squares (POLS), Fixed effects, and Random effects models are used. An Augmented Gravity Model is used.

A scatter plot of total exports and exchange rate volatility shows a negative relationship between them. The study argues that the continuous cedi depreciation may have created the trend as determined. Therefore, greater exchange rate volatility is highly associated with lower bilateral exports.

From the POLS results, the different measures of real bilateral exchange rate have negative and statistically significant coefficients. The Marshal-Lerner condition is also absent for

Ghana since the coefficients are negative in all the models and the price elasticities are less than one. GDP has positive but insignificant relationship with bilateral trade exports. However, the coefficient of GDP of the partner countries was positive and statistically significant. Ghana‟s population, and the distance and language dummy was found to impede the bilateral export flows, even though the coefficient of the population variable was statistically insignificant. FDI inflows and internal infrastructure showed positive but statistically insignificant relationship with bilateral exports trade. The coefficients of the population of trading partners and the trade openness of partner countries were positive and statistically significant.

For the fixed effects model, the coefficient of real bilateral exchange rate had a negative but insignificant effect on bilateral exports for model 1. A positive but statistically insignificant relationship was also found between the difference of bilateral exchange rate and bilateral exports for model 2. In the case of model 3, a percentage increase in the real bilateral exchange rate volatility reduces export flows. All three cases do not provide evidence of the Marshall-Lerner condition. Ghana‟s GDP was positively related to bilateral exports in all three models even though all the coefficients are not statistically significant. The GDP of partner countries in all three models was also positive and statistically significant. Ghana‟s population exerted a negative effect on its bilateral exports in all three cases even though the coefficients are not statistically significant. The population of partner countries was found to stimulate Ghana‟s bilateral exports in all three models. Trade openness was found to stimulate Ghana‟s bilateral export in all three models, but none of the coefficients was statistically significant.

Internal infrastructure also showed positive but statistically insignificant relationship with export flows. Distance and language also had negative but statistically insignificant

relationship with export flows. FDI also stimulates bilateral exports trade even though the coefficient for model 3 was not statistically significant.

For the random effects model, the direct effects of real bilateral exchange rate and its first difference coefficients were negative but insignificant for models 1 and 2. Once again the results shows that higher exchange rate volatility impedes bilateral exports, as the coefficient of bilateral exchange rate volatility was found to be negative and statistically significance at 5 per cent. The coefficients of domestic output (GDP) were found to be positive and significant at 5 percent level in all the models. The coefficients of foreign countries‟ GDP were found to be positive and statistically significant in all models. The effect of domestic countries‟ population on total export flows shows that a percentage increase in the domestic country‟s population would reduce total export flows in all models. The population of foreign countries‟ population influence Ghana‟s bilateral exports positively. Trade openness also improves trade flows even though the coefficient is not statistically significant for models 1 and 3. Infrastructure also has positive effect on export flows even though the coefficient is not statistically significant. FDI also improves export trade flows. Distance is found to have a negative relationship with export flows. Languages negatively impact export flows.

The Hausman test revealed that the random effects model was appropriate since the probability value for all the models was greater than 0.05. In addition, the study also passes all diagnostic tests conducted.

5.3 Recommendations

The following recommendations are made based on the findings:

Policy makers must ensure exchange rates are kept at levels that are favorable to export flows. Since uncontrolled exchange rates volatility comes with greater uncertainty about export returns, which is likely to hamper production for exports, the Bank of Ghana must ensure variations in exchange rates are relatively predictable, minimal and less detrimental.

It is also necessary to ensure the necessary internal infrastructure development to support production for exports. Good roads and transport infrastructure, information and communication technology, research and development, among others are likely to create fertile grounds for export-based investments.

Given that an increase in domestic production (GDP) is found to promote exports, it is recommended that efforts are directed to promoting domestic production which is focused on export-oriented sector.

Government and policy makers as well as institutions such as the Ghana Investment Promotion Council (GIPC) must work hard at attracting more FDI to help support an export-led growth agenda given the positive FDI and exports relationship found.

Since distance reduces exports, barriers and bottlenecks to trade that arise from distances between Ghana and its trade partners may be reduced. This may require a review of trade tariffs and barriers, reduction of export times and paper works, improvement of infrastructure, reduction of corruption and bureaucracy, and ensuring an overall improvement in institutional quality.

5.4 Conclusions

The study examined the determinants of Ghana‟s bilateral exports, particularly examining the relevance of exchange rate variability, using panel data for the period

1995-2014, and 20 of Ghana‟s trading partners. An Estimation Augmented Gravity Model was adopted. Techniques used were the Pooled Ordinary Least Squares (POLS), Fixed effects, and Random effects models are used. The Hausman test showed the Random effects estimates were appropriate. Favourable mixed results are found, even though the Marshall-Lerner condition is absent. Appropriate policy recommendations are made based on the findings.

REFERENCES

1. Agbola, F. W. (2004). Does Devaluation Improve Trade Balance of Ghana? School of Policy, *University of Newcastle*, Callaghan, NSW 2308, Australia.

2. Alemayehu, G. and Haile, K. (2002). *Regional Economic Integration in Africa: A review of Problems and Prospects with a case study of COMESA,* Regional Economic Integration in Africa, Adisa Baba AU
3. Amoah, B., and Loloh, W. F., (2009) *Trade Balance and Policy Efficiency: Evidence from Ghana"* Monetary Policy Analysis and Financial Stability Department, Bank of Ghana, Working Paper Series: WP/BOG-2009/02.
4. Anderson, J. E. (2004). *International Trade Theory*. Boston College.
5. Anderson, J. E. (1979). A Theoretical Foundation for the Gravity Equation. *The American Economic Review,* American Economic Association. Vol. 69, No. 1, 106-116. Stable URL:http://links.jstor.org/sici=0028282%28197903%2969%3A1%3C106%3AATFFTG%3E2.0.CO%3B2-1
6. Anderson, J. E. and van Wincoop, E. (2003). Gravity with Gravitas: A Solution to the Border Puzzle. *American Economic Review* 93: 170–192.
7. Aryeetey, E., Harrigan, J., and Nisanke, M., (2000) *Economic Reforms in Ghana*. Oxford: James Currey and Woeli Publishers.
8. Asiedu, K. M., (2010). Trade Liberalization and Economic Growth in Ghana (1986 – 2007). A Thesis Submitted to the Department of Economics, KNUST, Kumasi-Ghana in May, 2010.
9. Baah-Nuakoh, A. (1997). *Studies on the Ghanaian Economy: The Pre-"Revolutionary" Years*. Volume 1; Ghana Universities Press, Accra.
10. Bacchetta, M., Beverelll, C., Cadot, O., Fugazza, M., Grether, J. M., Helble, M., Nicita, A., and Plemartini, R. (2012). *A Practical Guide to Trade Policy Analysis*. New York, United States of America, United Nations Publications.

11. Balassa, B. (1963). An Empirical Demonstration of Classical Comparative Cost Theory. *Review of Economics and Statistics* 45, 231-238.
12. Baier, S. L., and Bergstrand, J. H. (2007). Do Free Trade Agreements Actually Increase Members' International Trade? *Journal of International Economics*, 71, 72–95.
13. Baltagi, B. H. (2008). *Econometric Analysis of Panel Data* (Fourth Edition). John Wiley & Sons, Chichester.
14. Bhattarai, K. R., and Armah, M. K., (2005), "The Effects of Exchange Rate on the Trade Balance on Ghana: Evidence from Cointegration Analysis". *Research Memorandum Series,* Centre for Economic Policy, Business School, University of Hull, Cottingham Road, Hull HU6 7RX, United Kingdom. Available Online at: http://www.hull.ac.uk/hubs/research/memoranda.
15. Bank of Ghana(2015):*Bank of Ghana's statistical Bulletin* December 2015
16. Baxter, M., and Kouparitsas, M. A., (2006). What Determines Bilateral Trade Flows? *NBER Working Paper Series*, 12188. Available at: http://www.nber.org/papers/w12188.
17. Bergstrand, H. J. (1985). The Gravity Equation in International Trade: Some Microeconomics Foundations and Empirical Evidence. *Review of Economics and Statistics*, Vol. 67, No. 3, 474–81.
18. Bergstrand, H. J. (1989). The Generalized Gravity, Monopolistic Competition, and the Factor-Proportions Theory in International Trade. *The Review of Economics and Statistics*, MIT Press. Vol. 71, No. 1 (Feb., 1989), 143-153. Stable URL: http://links.jstor.org/sici?scici=00346535%28198902%2971%3A1%3C143%3A

TGGEMC%3E2.0.CO%3B2-9

19. Bollerslev, T. (1986). Generalized Autoregressive Conditional Heteroskedasticity. *Journal of Econometrics.*
20. Bonuedi, I. (2013*). Determinants of Ghana's Bilateral trade Flows: A Gravity Model Approach.* A Thesis Submitted to the Department of Economics, KNUST, Kumasi-Ghana in May, 2013.
21. Carbaugh, R. J. (2006) *International Economics, 10th Edition*. Canada, SouthWestern, Thompson.
22. Danquah, B. A., (2008). The Effects of Exchange Rate on Ghana‟s External Trade. A Thesis Submitted to the Department of Economics, KNUST, Kumasi-Ghana in September, 2008. Available on line at: http://hdl.handle.net/123456789/1187.
23. Deardorff, A. (1995). Determinants of Bilateral Trade: Does Gravity Work in a Classical World?. Paper Presented at Conference on *The Regionalization of the World Economy*, NBER, Woodstock, Vermont.
24. Dunn Jr R.M., Mutti J. (2000). *International Economics* 5th Edition, Routledge, London & New York. ISBN 0415208793.
25. Eita, J. H. (2008). Determinants of Namibian Exports: A Gravity Model Approach, *University of Namibia*, Namibia.
26. Faruqee, H. (2004). Measuring the Trade Effects of EMU. *IMF Working Paper,* WP/04/154.
27. Fidrmuc, J. (2009). Gravity Models in Integrated Panels. *Empirical Economics*, 37: 435446.

28. Frankel, J. A., and Romer, D. (1999). Does Trade Cause Growth? *The American Economic Review, (89)*3 pp. 379-399.

29. Gani, A. (2008). Factors Influencing Trade Between Fiji And Its Asian Partners. *Pacific Economic Bulletin* Volume 23 Number 2, The Australian National University.

30. Ganiwu, T. (2012). *Export Performance on Economic Growth in Ghana*. A Thesis Submitted to the Department of Economics, KNUST, Kumasi–Ghana in May, 2012.

31. Geldi, H. G. (2012). Trade Effect of Regional Integration: A panel Cointegration Analysis, *Economic Modelling, Elsevier,* Vol. 29(5), 1566-1570.

32. Helpman, E. and Krugman, P. (1985). *Market Structure and Foreign Trade, Increasing Returns, Imperfect Competition, and the International Economy*. MIT Press, Cambridge MA/London.

33. ISSER. (1995 – 2014). *The State of Ghanaian Economy*. Institute of Statistical, Social and Economic Research (ISSER), University of Ghana, Legon.

34. Karamuriro, H. T. and Karukuza, W. N. (2015). Determinants of Uganda‟s Export Performance: A Gravity Model Analysis. *International Journal Of Business and Economics Research.* (*4*) 2: pp 45-54.

35. Krugman, P. R., Obstfeld, M., and Melitz, J. M. (2012). *International Economics: Theory and Policy*, 9th Edition. Boston, Addison-Wesley.

36. Linder, S. B. (1961). An Essay on Trade and Transformation. New York: Wiley.

37. Loloh, F. W. (2014). Exchange Rate Pass-Through In Ghana. *Working paper – Bank of Ghana* WP/BOG-2014/03

38. MacDougall, G.(1951). British and American Exports: A Study Suggested by the Theory of Comparative Cost Part I; *The Economic Journal*, 61, 697-724.
39. Márquez-Ramos, L. (2007). Understanding The Determinants Of International Trade In African Countries: An Empirical Analysis For Ghana And South Africa. *Instituto de Economía Internacional*, Universitat Jaume I.
40. Nyanteng, V. K. (1997). Policies and Options for Ghanaian Economic Development. *Institute of Statistical, Social and Economic Research*, University of Ghana, Legon, Ghana.
41. Rahman, M. M. (2007). The Causative Factors of Bangladesh‟s Exports: Evidence from the Gravity Model Analysis. *The New Zealand Association of Economists 48th Annual Conference,* Christchurch, New Zealand, 27-29.
42. Rahman, M. M. (2009). Australia‟s Global Trade Potential: Evidence from the Gravity *Model Analysis Oxford Business and Economics Conference*. St. Hugh‟s College, Oxford University, Oxford, UK, ISBN: 978-0-9742114-1-9.
43. Roy, M., and Rayhan. (2011). Trade Flows of Bangladesh: A Gravity Model Approach. Economics Bulletin, Vol. 31 No.1 , 950-959.
44. Sakyi, D., Commodere, R., and Osei Poku E. E. (2015). Foreign Direct Investment Trade Openness and Economic Growth in Ghana: An Empirical investigation. *Journal of African business* 16: 1-2, and 1-15
45. Smith, A. (1776). An Inquire into the Nature and Causes of the Wealth of Nations. http://en.wikisource.org.
46. Stern, R. M. (1962). British and American Productivity and Comparative Cost in International Trade. *Oxford Economic Papers,* 14 275-296.

47. Suranovic, S. (2006). International Trade Theory and Policy: Introductory issues. The International Economic Center. #XA9; 19197-2006.

48. Taye, Y. T. (2009). Determinants of Ethiopia's Export Performance: A Gravity Model analysis BKP Development Research & Consulting, Trade and Development Discussion Paper No. 01/2009.

49. Tinbergen J. (1962). *Shaping the World Economy: Suggestions for and International Economic Policy*. New York, The Twentieth Century Fund.

50. UN Population Division, World Population Prospects, 2014.

51. UNCTAD Policy Brief. UNCTAD/Press/PB/2009/8.

52. UNCTAD. (2014). UNCTADStat – Statistical Database. Viewed Online at: http://unctadstat.unctad.org.

53. World Databank (2014) World Development Indicators. (2012).Washington D. C.

54. The World Bank. Viewed Online at: http://databank.worldbank.org.

55. World Trade Report. (2014). *International Trade Statistics 2014*. World Trade Organization

APPENDIX

1. DESCRIPTIVE STATISTICS

```
. Variable |       Obs        Mean    Std. Dev.       Min        Max ----
---------+--------------------------------------------------------
lntx |       400    11.22953    3.801101    1.12298   27.91975       lnrber
|       400    3.465941    2.846389  -2.706031   11.84369       lngdpi |
400    23.12229    .3405273   22.63929    23.7419       lngdpj |       400
26.69006    2.209925    20.7688   30.32542       lnpopi |       400
16.86698    .1444395   16.63457   17.10341 -------------+------------------
-------------------------------------      lnpopj |       400   17.78537
1.55234   14.67001   21.03389       lndist |       400   8.195314
1.140866   5.246913    9.64685    lninfrasi |       400    12.27072
.4964611   11.05195    12.8387         lntoj |       400   -.5458116
.527319  -1.859161   .7903072         lang |       400       .2475
.4321001          0          1 -------------+------------------------------
--------------------------         lnfdi |       400    19.94419    1.519244
17.89186   21.93621
```

2. POOLED-OLS RESULTS

```
regress lntx lnrber lngdpi lngdpj lnpopi lnpopj lntoj lninfrasi lnfdi lndist lang, r
Linear regression                                      Number of obs =     400
                                                       F( 10,   389) =   19.53
                                                       Prob > F      =  0.0000
                                                        R-squared     = 0.7503
                                                       Root MSE      =  3.1031

------------------------------------------------------------------------------
             |               Robust
        lntx |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lnrber |    -.172652    .0465852     -3.71    0.000     -.2642424    -.0810617
lngdpi |    4.681623    4.364262      1.07    0.284      -3.89887     13.26212
lngdpj |    .2540116    .1216356      2.09    0.037      .0148661     .4931571
lnpopi |   -8.647911    12.60268     -0.69    0.493      -33.4258     16.12998
lnpopj |    .5964828     .097438      6.12    0.000      .4049118     .7880538
lntoj |    1.673372    .3095248      5.41    0.000      1.064822     2.281923
lninfrasi |    .048303    .739624      0.07    0.948     -1.405858     1.502464
lnfdi |    .1890689    .2976432      0.64    0.526     -.3961217     .7742595
lndist |   -1.881156    .1976581     -9.52    0.000     -2.269768    -1.492545
lang |  -1.059604   .3944236    -2.69   0.008    -1.835073   -.2841352        _cons
|   44.28266   108.7377     0.41   0.044    -169.5045    258.0698
```

```
regress lntx D.lnrber lngdpi lngdpj lnpopi lnpopj lntoj lninfrasi lnfdi lndist lang, r
Linear regression                                      Number of obs =     380
                                                       F( 10,   369) =   17.09
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.7470
                                                       Root MSE      =  3.1049

------------------------------------------------------------------------------
             |               Robust
        lntx |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lnrber |
         D1. |  -1.110045   .4701582    -2.36   0.019     -2.03457   -.1855191
|
```

```
      lngdpi |    4.28792   4.357132     0.98   0.326    -4.280003    12.85584
lngdpj |    .2925621    .1227025      2.38    0.018       .0512782     .5338461
lnpopi |   -5.594231    12.56809     -0.45    0.656       -30.3083     19.11984
lnpopj |    .4241569    .0899407      4.72    0.000       .2472964     .6010175
lntoj |    1.429591    .3340819      4.28    0.000       .7726478     2.086534
lninfrasi |    .2829364    .7876069      0.36    0.720     -1.265825     1.831697
lnfdi |    .1764292    .3004315      0.59    0.557      -.4143434     .7672018
lndist |   -1.891284    .2057187     -9.19    0.000     -2.295812    -1.486756
lang |  -1.159633    .403023    -2.88   0.004    -1.952143   -.3671231       _cons
|   .3789426   108.1124     0.00   0.037    -212.2148    212.9727
```

```
regress lntx lnrbervol lngdpi lngdpj lnpopi lnpopj lntoj lninfrasi lnfdi lndist lang, r
Linear regression                                      Number of obs =     400
                                                       F( 10,   389) =   20.81
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.7517
Root MSE      =  3.0996

------------------------------------------------------------------------------
             |               Robust
        lntx |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lnrbervol |   -.0257529    .0062613    -4.11   0.000    -.0380631   -.0134427
lngdpi |     5.12515    4.364466     1.17    0.241    -3.455744     13.70604
lngdpj |    .2479538    .1207322     2.05    0.041     .0105845     .4853231
lnpopi |   -9.689239    12.61064    -0.77    0.443    -34.48277     15.10429
lnpopj |     .556158    .0933651     5.96    0.000     .3725946     .7397214
lntoj |    1.567288    .3071483     5.10    0.000     .9634095     2.171166
lninfrasi |     .184532    .742999     0.25    0.804    -1.276264     1.645328
lnfdi |     .215287    .2979922     0.72    0.470     -.3705898     .8011639
lndist |   -1.834817    .1980416    -9.26    0.000    -2.224183    -1.445452
lang |  -1.125727   .3941594    -2.86   0.005    -1.900676   -.3507775       _cons
|   49.73809   108.8419     0.46   0.048    -164.2538     263.73
```

---

3. FIXED EFFECT RESULTS

```
xtreg lntx lnrber lngdpi lngdpj lnpopi lnpopj lntoj lninfrasi lnfdi lndist lang, fe r
Fixed-effects (within) regression               Number of obs      =       400
Group variable: country1                        Number of groups   =        20

R-sq:  within  = 0.6617                         Obs per group: min =        20
       between = 0.6215                                        avg =      20.0
       overall = 0.6951                                        max =        20

                                                F(8,19)            =         .
corr(u_i, Xb)  = -0.8660                        Prob > F           =         .

                              (Std. Err. adjusted for 20 clusters in country1)
------------------------------------------------------------------------------
             |               Robust
        lntx |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lnrber |   -.0719069    .1271463    -0.57   0.578    -.3380271     .1942133
lngdpi |    4.517942    1.756103     2.57    0.019      .8423767     8.193508
lngdpj |    1.684431    .5555267     3.03    0.007      .5217005     2.847162
lnpopi |   -9.425688    4.523368    -2.08    0.051    -18.89321     .0418301
lnpopj |    2.067944    .4803865     4.30    0.000      1.062483     3.073404
```

```
lntoj |    .6487078    .5231982       1.24    0.230      -.4463586     1.743774
lninfrasi |    .0862443    .1561862      0.55    0.587     -.2406571     .4131458
lnfdi |     .153433    .0608349      2.52    0.021        .026104      .280762
lndist |          0  (omitted)
        lang |  -1.757073    .4189531    -4.19   0.000    -2.633952   -.8801944
_cons |  -19.06973   45.49648    -0.42   0.030     -114.295     76.1555 ------
-------+------------------------------------------------------------------
sigma_u |  7.5792497
     sigma_e |   .8548847
         rho |  .98743761   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

```
xtreg lntx d.lnrber lngdpi lngdpj lnpopi lnpopj lntoj lninfrasi lnfdi lndist lang, fe r
```

```
Fixed-effects (within) regression               Number of obs      =       380
Group variable: country1                        Number of groups   =        20

R-sq:  within  = 0.6565                         Obs per group: min =        19
between = 0.6291                                       avg =      19.0
overall = 0.6876                                       max =        19

                                                F(8,19)            =     54.72
corr(u_i, Xb)  = -0.8663                        Prob > F           =    0.0000

                              (Std. Err. adjusted for 20 clusters in country1)
------------------------------------------------------------------------------
             |               Robust
        lntx |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lnrber |
         D1. |   .0455647   .1826768     0.25   0.806    -.3367822    .4279116
             |
       lngdpi |   4.369483   1.790225     2.44   0.025      .622499    8.116467
lngdpj |   1.670532    .5849704     2.86   0.010      .4461748    2.894889
lnpopi |  -8.421143     4.44748    -1.89   0.074     -17.72983     .8875387
lnpopj |   2.018636    .4737532     4.26   0.000      1.027059    3.010212
lntoj |   .6826107    .5041715     1.35   0.192     -.3726324    1.737854
lninfrasi |   .1621605    .1292427     1.25   0.225     -.1083477    .4326686
lnfdi |   .1472601    .0483366     3.05   0.007      .0460905    .2484297
lndist |          0  (omitted)          lang |          0  (omitted)
        _cons |  -32.8123   43.80463    -0.75   0.463    -124.4964    58.87185
-------------+----------------------------------------------------------------
sigma_u |  7.5515903      sigma_e |  .85520158
         rho |  .98733732   (fraction of variance due to u_i)
```

```
xtreg lntx lnrbervol lngdpi lngdpj lnpopi lnpopj lntoj lninfrasi lnfdi lndist lang, fe r note:
lndist omitted because of collinearity
```

```
Fixed-effects (within) regression               Number of obs      =       400
Group variable: country1                        Number of groups   =        20

R-sq:  within  = 0.6645                         Obs per group: min =        20
between = 0.6207                                       avg =      20.0
overall = 0.6692                                       max =        20

                                                F(8,19)            =         .
corr(u_i, Xb)  = -0.8611                        Prob > F           =         .

                              (Std. Err. adjusted for 20 clusters in country1)
------------------------------------------------------------------------------
```

```
             |               Robust
        lntx |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   lnrbervol |   -.0092194   .0047116    -1.96   0.065     -.019081    .0006422
       lngdpi |    4.654119   1.763942     2.64   0.016     .9621469    8.346092
       lngdpj |    1.627008   .5502984     2.96   0.008     .4752196    2.778795
       lnpopi |   -9.607833   4.354489    -2.21   0.040    -18.72188   -.4937838
       lnpopj |    2.061768   .4593154     4.49   0.000      1.10041    3.023126
        lntoj |    .6716986   .5130165     1.31   0.206    -.4020572    1.745454
    lninfrasi |    .1341509   .1487599     0.90   0.378    -.1772071    .4455089
        lnfdi |    .1614508   .0514787     3.14   0.005     .0537046     .269197
       lndist |          0  (omitted)
         lang |  -1.765658   .358408    -4.93   0.000    -2.515814   -1.015501
        _cons |  -18.31345   41.68743    -0.44   0.065    -105.5662    68.93935
-------------+----------------------------------------------------------------
      sigma_u |  7.4606179      sigma_e |  .85126303
          rho |  .98714831   (fraction of variance due to u_i)
```

---

4. RANDOM EFFECT RESULTS

```
. xtreg lntx lnrber lngdpi lngdpj lnpopi lnpopj lntoj lninfrasi lnfdi lndist lang, re r
Random-effects GLS regression                   Number of obs      =       400
Group variable: country1                        Number of groups   =        20

R-sq:  within  = 0.6568                         Obs per group: min =        20
       between = 0.6696                                        avg =      20.0
       overall = 0.6568                                        max =        20

                                                Wald chi2(10)      =    373.24
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

                              (Std. Err. adjusted for 20 clusters in country1)
------------------------------------------------------------------------------
             |               Robust
        lntx |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       lnrber |   -.0746553    .1164193    -0.64   0.521    -.3028329     .1535224
       lngdpi |    4.459175   1.768187     2.52   0.012     .9935914     7.924758
       lngdpj |    1.158887   .4798913     2.41   0.016     .2183177     2.099457
       lnpopi |   -8.356534   4.702498    -1.78   0.076    -17.57326     .8601934
       lnpopj |    1.377851   .4154822     3.32   0.001     .5635206     2.192181
        lntoj |    .9133118   .4833431     1.89   0.059    -.0340234     1.860647
    lninfrasi |    .0788306   .1569487     0.50   0.615    -.2287831     .3864444
        lnfdi |    .1610295    .06041     2.67   0.008     .0426282     .2794309
       lndist |   -3.702468    1.56772    -2.36   0.018    -6.775143    -.6297928
         lang |   -1.51715   .4834427    -3.14   0.002    -2.464681   -.5696199
        _cons |   20.93299   48.25422     0.43   0.024    -73.64355    115.5095
-------------+----------------------------------------------------------------
      sigma_u |  3.6355434      sigma_e |   .8548847
          rho |  .94760341   (fraction of variance due to u_i)
------------------------------------------------------------------------------
. xtreg lntx D.lnrber lngdpi lngdpj lnpopi lnpopj lntoj lninfrasi lnfdi lndist lang, re r
Random-effects GLS regression                   Number of obs      =       380
Group variable: country1                        Number of groups   =        20

R-sq:  within  = 0.6508                         Obs per group: min =        19
       between = 0.6794                                        avg =      19.0
       overall = 0.6508                                        max =        19
```

```
                                                Wald chi2(10)      =     296.15
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =     0.0000

                              (Std. Err. adjusted for 20 clusters in country1)
------------------------------------------------------------------------------
             |               Robust
        lntx |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lnrber |
         D1. |   .0418669   .1879409     0.22   0.824    -.3264905    .4102243
             |
      lngdpi |   4.294059   1.789195     2.40   0.016     .7873002    7.800817
lngdpj |    1.087215    .4847065      2.24    0.025      .1372077     2.037222
lnpopi |   -7.168587    4.675226     -1.53    0.125     -16.33186     1.994689
lnpopj |    1.24641    .4260548      2.93    0.003      .4113584     2.081462
lntoj |    .9683505    .4644878      2.08    0.037      .0579711      1.87873
lninfrasi |    .1537755    .1318731      1.17    0.244     -.1046911     .4122421
lnfdi |    .1551107    .0483119      3.21    0.001      .0604211     .2498004
lndist |   -3.528454    1.536491     -2.30    0.022      -6.53992    -.5169882
lang |  -1.660263   1.862009    -0.89   0.373    -5.309734    1.989208       _cons
|   6.541982    45.0504     0.15   0.085    -81.75518    94.83915 ------------
-+-------------------------------------------------------------      sigma_u
|  3.4763412      sigma_e |  .85520158
         rho |  .94293449   (fraction of variance due to u_i)
------------------------------------------------------------------------------


xtreg lntx lnrbervol lngdpi lngdpj lnpopi lnpopj lntoj lninfrasi lnfdi lndist lang, re r
Random-effects GLS regression                   Number of obs      =       400
Group variable: country1                        Number of groups   =        20


R-sq:  within  = 0.6599                         Obs per group: min =        20
between = 0.6720                                       avg =      20.0
overall = 0.6599                                       max =        20


                                                Wald chi2(10)      =    347.46
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

                              (Std. Err. adjusted for 20 clusters in country1)
------------------------------------------------------------------------------
             |               Robust
        lntx |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lnrbervol |   -.0098707    .0047859     -2.06   0.039     -.0192509    -.0004906
lngdpi |    4.613035    1.765185      2.61    0.009      1.153336     8.072735
lngdpj |    1.115443    .4683386      2.38    0.017      .1975158     2.033369
lnpopi |   -8.619056    4.540666     -1.90    0.058      -17.5186     .2804857
lnpopj |    1.379939     .422209      3.27    0.001      .5524244     2.207453
lntoj |    .9307331    .4787182      1.94    0.052     -.0075373     1.869004
lninfrasi |    .1300917    .1497834      0.87    0.385     -.1634784     .4236619
lnfdi |    .1698253    .0513882      3.30    0.001      .0691063     .2705443
lndist |   -3.635802    1.564067     -2.32    0.020     -6.701316     -.570288
lang |  -1.529961   .4363917    -3.51   0.000    -2.385273   -.6746485       _cons
|   21.51369   43.08984     0.50   0.618    -62.94085    105.9682 ------------
-+-------------------------------------------------------------      sigma_u
|  3.6275655      sigma_e |  .85126303
         rho |  .94780647   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

5. HAUSMAN TEST

```
hausman fe re
```

```
                ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       fe           re         Difference          S.E. --------
-------------+------------------------------------------------------------
lnrber |   -.0719069    -.0746553        .0027484        .0080446       lngdpi
|    4.517942     4.459175        .0587678               .       lngdpj |
1.684431     1.158887        .5255439        .1797306       lnpopi |   -
9.425688    -8.356534       -1.069154               .       lnpopj |
2.067944     1.377851        .6900928        .2358707    lninfrasi |
.0862443     .0788306        .0074137               .         lntoj |
.6487078     .9133118        -.264604        .0677675         lnfdi |
.153433     .1610295       -.0075965               .         lang |   -
1.757073     -1.51715       -.2399231        .3592744 ------------------------
------------------------------------------------------
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(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       14.06
                Prob>chi2 =      0.1202
                (V_b-V_B is not positive definite) hausman
fe re

                ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       fe           re         Difference          S.E.
-------------+------------------------------------------------------------
D.lnrber |    .0455647     .0418669        .0036978               .
lngdpi |    4.369483     4.294059        .0754243               .       lngdpj
|    1.670532     1.087215        .5833168        .2015363       lnpopi |   -
8.421143    -7.168587       -1.252556               .       lnpopj |
2.018636     1.24641        .7722253        .2642428    lninfrasi |
.1621605     .1537755         .008385               .         lntoj |
.6826107     .9683505       -.2857397        .0711121         lnfdi |
.1472601     .1551107       -.0078507               . ------------------------
------------------------------------------------------
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(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       13.54
                Prob>chi2 =      0.0945
                (V_b-V_B is not positive definite)


hausman fe re

                ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       fe           re         Difference          S.E. --------
-------------+------------------------------------------------------------
lnrbervol |   -.0092194    -.0098707        .0006513               .
lngdpi |    4.654119     4.613035        .0410842               .       lngdpj
|    1.627008     1.115443         .511565        .1804618       lnpopi |   -
9.607833    -8.619056       -.9887769               .       lnpopj |
2.061768     1.379939        .6818294        .2335804    lninfrasi |
.1341509     .1300917        .0040592               .         lntoj |
.6716986     .9307331       -.2590345        .0672274         lnfdi |
.1614508     .1698253       -.0083745               .         lang |   -
1.765658    -1.529961       -.2356973        .3574532 ------------------------
------------------------------------------------------
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(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       13.47
                Prob>chi2 =      0.1425
                (V_b-V_B is not positive definite)
```

6. BREUSH-PAGAN LM TEST FOR RANDOM EFECTS

```
Breusch and Pagan Lagrangian multiplier test for random effects

        lntx[country1,t] = Xb + u[country1] + e[country1,t]

        Estimated results:
                         |       Var     sd = sqrt(Var)
---------+-----------------------------
lntx |   14.44837       3.801101                        e
|   .7308279       .8548847                       u |
13.21718       3.635543
        Test:   Var(u) = 0
                                chibar2(01)   =     13.56
Prob > chibar2 =   0.0015 Breusch and Pagan Lagrangian
multiplier test for random effects

        lntx[country1,t] = Xb + u[country1] + e[country1,t]

        Estimated results:
                         |       Var     sd = sqrt(Var)
---------+-----------------------------
lntx |   14.37356       3.791248                        e
|   .7313697       .8552016                       u |
12.08495       3.476341

        Test:   Var(u) = 0
                              chibar2(01)   =     28.69
Prob > chibar2 =   0.0025


Breusch and Pagan Lagrangian multiplier test for random effects

        lntx[country1,t] = Xb + u[country1] + e[country1,t]

        Estimated results:
                         |       Var     sd = sqrt(Var)
---------+-----------------------------
lntx |   14.44837       3.801101                        e
|   .7246488        .851263                       u |
13.15923       3.627565

        Test:   Var(u) = 0
                              chibar2(01)   =     31.81
Prob > chibar2 =   0.0015
```

7. SERIAL CORRELATION TEST

```
xtserial lntx lnrber lngdpi lngdpj lnpopi lnpopj lndist lninfrasi lntoj lnfdi lang
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,      19) =     17.556
           Prob > F =      0.5605
```



```
. xtserial lntx lnrbervol lngdpi lngdpj lnpopi lnpopj lndist lninfrasi lntoj lnfdi lang

Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(   1,        19) =       37.611
Prob > F =      0
```