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DEPARTMENT OF ECONOMICS

DETERMINANTS OF GHANA'S BILATERAL TRADE FLOWS: A GRAVITY MODEL APPROACH

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DECLARATION

I hereby declare that this submission is my own work towards the Master of Philosophy degree and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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DEDICATION

"If it had not been the LORD who was on our side, now may Israel say…"

(Psalm 124:1).

I whole-heartedly dedicate this Thesis to the Glory of THE ALMIGHTY GOD, my Heavenly Father and my All in All.

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ABSTRACT

This study seeks to identify the internal and external factors that matter for Ghana's bilateral exports and total trade flows within the framework of an augmented gravity model. Utilizing a panel data covering 25 major trading partners of Ghana from 1995 to 2011, the study employs panel cointegration analysis, aside the conventional fixed effects and random effects estimators, to establish the existence of and to estimate the long run relationship among Ghana's bilateral total trade and exports and their respective determinants. The empirical results reveal that improvement in Ghana's GDP and that of its partners, growth in foreign population, depreciation in real bilateral exchange rate, higher trade freedom of partners, and the inflow of foreign direct investment are robust positive and significant determinants of Ghana's bilateral exports and total trade. Geographical distance, Ghana's population and internal transport infrastructure are found to have significantly deleterious impact on Ghana's bilateral trade flows. It is also found that the level of Ghana's institutional quality and sharing common language with partners exert positive but statistically insignificant impact on the nation's bilateral trade flows. The study concludes that the current government's budgetary focus of massively expanding, upgrading and modernizing trade-related infrastructure in Ghana is a stride in the right direction and must be anchored with policies aimed at improving the overall efficiency and effectiveness of domestic institutions so as to create the needed incentives for economic agents, both at home and abroad, to engage in trade and invest in Ghana's exports sectors.

TABLE OF CONTENTS

LIST OF TABLES

Table: **Page**

LIST OF FIGURES

Figure: **Page**

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Foreign trade is understood as a country's trade with other countries. It is the exchange of capital, goods, and services across international borders or territories in a legal fashion. A nation's trade with others consists of imports and exports flowing in and out of the country respectively. International trade arises because no country can be completely self sufficient. Trade between countries is therefore essential to ensure the supply of a country's needs. There is unequal distribution of productive resources by the nature on the surface of the earth. Countries differ in respect of climatic conditions, availability of cultivable land, forests, mineral products, labour, capital, technology, and entrepreneurial skills. Given the diversities of resource endowment, no country has the potential to produce all the commodities at the least cost. Through international trade nations are able to specialize in those goods they can produce most cheaply and efficiently. They export such products to others and in return import those products in which they have comparative cost disadvantage in the production.

By importing the required raw materials, intermediate and capital goods and consumer goods and services, a country is able to enlarge its productive capacity, foster export growth, meet the growing domestic demand and raise the living standards and economic well-being of its populace, if these goods and services are not domestically available. Exports, on the other hand, are important for the process of growth. Exports generate the foreign exchange necessary to increase the import capacity of the country, boost its industrialization and overall economic activities, which in turn, augments its economic growth. Exports also enable them to expand their markets and hence take advantage of the economies of scale. Over the years,

not only has the growth in world merchandise trade persistently outpaced the growth in the world output, but it has also been the key driver of the economic growth and development of the world's advanced, emerging and developing economies. In 2010, world trade recorded its largest ever annual increase as merchandized exports surged 14.5 percent. This was buoyed by a 3.6 percent recovery in global output, after it took a major tumble in 2009, declining by 12 per cent, with world gross domestic product (GDP) also waning but at a much lower rate of 2.4 per cent (World Trade Report, 2011).

Growth in world trade is in turn the result of both technological developments and concerted efforts to reduce trade barriers (IMF, 2001). Openness to trade (and foreign direct investment) has been an important element in the economic success of countries in East Asia (i.e. Korea, Taiwan, Singapore, Hong Kong, Thailand, Indonesia and Philippines), where the average import tariff has fallen from 30 percent to 10 percent over the past 20 years, with an impressive average growth rate of 8 percent per year (Rispens, 2009). In the words of Ward (2001) the "miraculous of growth and economic development of the East Asian countries is the natural result of their liberal trade, outward-looking and market oriented policies." While expanding export markets are widely accepted as beneficial, increases in imports can be seen as threatening, replacing domestic production with goods and services from abroad (Amoah and Loloh, 2009). As result, some countries, both developed and developing, have not opened their own economies to take full advantage of the opportunities for economic development through trade; with most of the trade barriers in developed countries concentrated in the agricultural products and labor-intensive manufactured products in which developing countries have a comparative advantage (Amoah and Loloh, 2009; IMF, 2001).

Not only has world merchandise witnessed momentous growth over the past several decades, but the global trade pattern has also witnessed dramatic shifts, as developing and emerging economies have moved from peripheral players to major centers of global trade. In the early 1970s, trade was largely confined to a handful of advanced economies, notably the United States, Germany, and Japan, which together accounted for more than a third of global trade (Cherunilam, 2008). By 1990, the global trading landscape had become more diversified to include several developing and emerging economies, especially in East Asia. In 2011, total exports from these economies reached 42.75% of world trade, steadily rising from 24.17% in 1990 (UNCTAD Stats, 2012). While developed economies, or the North, remain a significant market for exports from the South, a prominent feature of this unprecedented rate of trade expansion has been the growing importance of trade among developing countries (South-South trade), at a pace faster than the global average (UNCTAD Policy Brief, 2009). In 2011, 54.90% of their exports went to other developing countries, compared to 40% in 2000, 42.55% in 1995, and less than 25% in 1960. On the other hand, the proportion of their imports originating from other developing economies also grew steadily from 18.54% in 1970, to 28.7% in 2000 and then to 39.83% in 2011 (UNCTAD Stats, 2012). Another important feature has been the emergence of large and fast-growing developing economies, notably China, as the principal trading partner of an increasing number of developing countries. At the global level, Africa's share in global exports has also increased slightly from 2.9% in 2007 to 3.24% in 2011 after taking a downturn from 5.53% in 1960 to 3.02% in 1990 and further down to 2.4% in 2000 (UNCTAD Stats, 2012).

In small open economies like Ghana, external trade is an integral component of the nation's growth and development agenda. Consequently, the promotion of foreign trade has been central to all government policies since 1956. Akin to other developing economies,

particularly in Africa, Ghana's exports are traditionally dominated by a few primary products, namely, cocoa, timber, and unprocessed mineral resources (gold, diamond, bauxite and manganese), whilst imports are dominated by capital goods (such as machinery, transport equipment, chemicals and other intermediate inputs), foodstuffs, and fuels. Owing to the persistent decline in foreign exchange earnings from the principal exports, mainly due to sectoral and market constraints (Buatsi, 2002), the non-traditional exports sector has been accorded an unparalleled attention in attaining economic growth and development since 1986. As part of the external sector reforms implemented under the Economic Recovery Program (ERP) and Structural Adjustment Policy (SAP), the trade restrictive, import-substitution development strategy of the 1960s and 1970s was gradually replaced by a more liberalized, outward oriented and export-led growth strategy, with serious governmental efforts towards diversifying and broadening Ghana's export base into non-traditional items like pineapples, yams, handicrafts, canned and smoked fish, processed foods, and wood products etc. The openness of Ghana's external sector, as measured by the share of export plus imports in GDP, has been rising since 1982 from 0.06 in 1982 to 0.46 in 1992, to 116 in 2000 and then to 0.703 in 2010 (Amoah and Loloh, 2009; WDI, 2010). However, it has not succeeded in spurring exports growth over the growth in imports, leaving the balance of trade in deficits for most of the years between 1982 and 2010.

Along with an increase in overall trade volume resulting from the trade liberalization and trade promotion, the direction of Ghana's bilateral trade is fast changing towards the South. Whilst Emerging and Developing Economies have been receiving an increasing share of Ghana's exports, Advanced Economies have been receiving a decreasing share. From 1990 to 2010, Advanced Economies' share of Ghana's export declined sharply from 81.6% to 54.7%, while the share of imports reduced from 62.5% to 41.0% during the same period. Between

2003 and 2010, the share Ghana's exports to the Emerging and Developing Economies has increased from 25.1% to 33.5%; and the share of imports rising 50.4% to 57.8% over the same. In particular, the European Union (EU), which is Ghana's most important export destination, had their share of Ghana's exports declined from nearly 73% in 2000 to 41.2% in 2010. Again, the EU's share of import dropped from over 43% in 2000 to 230.7% in 201 and remained Ghana's most important source of imports. At the same time as Ghana's bilateral trade with the EU declines, the share of imports originating from China increased from 3% in 2000 to 17% in 2010 while India increased its share from less than 2% to 3.6% over the same period. In addition, whilst Africa's share in Ghana's imports has been declining marginally from 25.1% in 2003 to 24.3% in 2009 and that of exports has been increasing negligibly from 8.3% to 9.9%, Ghana's bilateral trade with South Africa and Nigeria is consistently rising (IMF, Direction of Trade Statistics Yearbook on CD-ROM, 2009, cited in ISSER, 2010 & 2011).

In spite of government's massive export promotion campaign over the past fifty years, it has not succeeded in increasing exports over imports. The country suffers from a chronic deficit in her balance of payments. Ghana's share in the world's trade is not only small but it is also worsening. As Ghana aspires to improve its middle-income status with an annual real growth rate of 8 percent by 2015, there is an indispensable need to expand the volume of Ghana's trade with the rest of the world and to explore its trade potential with its partners so as so to maximize its gains from trade and boost the pace of the nation's economic growth.

1.2 Statement of Research Problem

Conventionally, the pattern of Ghana's trade has been explained using the classical (Recardian and H-O) trade theories, since the trade is between Ghana and the advanced countries that have different technologies and different resource endowments. However, it is evident from the statistics presented in the previous section that the trade pattern in Ghana has been shifting towards emerging and developing economies with similar factor endowments and technologies, as those of Ghana. The question is what accounts for the changing trade patterns of Ghana? Why does Ghana trade more heavily with one country while it does less with another? What are the factors influencing the nation's bilateral trade flows? Do taste and distance play any role in determining Ghana's bilateral trade flows? Does Ghana's membership of regional trade agreements affect its bilateral trade? Finding empirical answers to these questions is what accentuates and motivates this study.

The gravity model has assumed great prominence in explaining the trade pattern in emerging economies, especially in Asia and Latin America, as it provides a practical framework for analyzing the changing pattern in global trade and growing intra-developing economies trade. By taking into account both trade and non-trade policy issues that might either impede or facilitate bilateral trade flows, but had long been disregarded by traditional trade theorists, the gravity model remains at the center of applied research on international trade and is widely recognized as the workhorse for explaining international trade volumes. Unfortunately, this model has not been used by most empirical studies in Africa and Ghana in particular. Therefore, this thesis attempts to investigate the applicability of the gravity model in explaining the pattern of Ghana's bilateral trade flows.

1.3 Objectives of the Study

The general objective of this study is to empirically analyze the trade pattern of Ghana using the gravity model and to suggest possible ways to expand trade. The specific objectives of the study are to:

1. Identify which factors matter for bilateral trade flows in the case of Ghana.
2. Find out which hypothesis, Heckscher-Ohlin (H-O) hypothesis versus Linder hypothesis, best explains the pattern of Ghana's bilateral trade.
3. Examine the effect of regional trade agreement (ECOWAS) on trade flows in Ghana.

1.4 Statement of Hypotheses

In line with the objectives of the study, the following hypotheses are tested:

1. **H_0**: The pattern of Ghana's bilateral trade is consistent with the Heckscher-Ohlin hypothesis rather than the Linder hypothesis.

2. **H_0**: Ghana's institutional quality exerts negative influence on its bilateral trade flows

3. **H_0**: Internal infrastructure positively impacts on Ghana's bilateral trade flows.

4. **H_0**: The trade policy (openness) of Ghana's trading partners has positive effect on its bilateral trade flows.

5. **H_0**: Regional trade agreement does not matter for Ghana's bilateral trade.

1.5 Justification for the Study

With the increasing volume of trade among developing and emerging economies in Africa, Asia and Latin America and among the industrialized countries (instead of between advanced economies and developing economies), the classical trade theories are increasingly failing to explain the pattern of contemporary trade among economies with similar technologies and factor endowments. However, the gravity model of trade provides a practical framework for analyzing the factors that explain the changing pattern of trade in recent years. In spite of the copious evidence of a strong theoretical and empirical success of the gravity model in fitting the flow of international trade in many countries in Europe, Asia, Middle East, North and South America and a few countries in Africa, a little has been done with regards to explaining the recent pattern of Ghana's trade using the gravity model of trade. The novelty of this study is its contribution to applied international trade literature by filling the knowledge gap in the case of Ghana through modeling the determinants of Ghana's bilateral trade flows within the framework of the gravity model.

Apart from bridging the research gap with respect to the application of the gravity model in Ghana, the results of the study will be very useful for policy purposes. As Ghana seeks to expand its exports base to stimulate economic growth and accelerate the improvement in its status from being a lower middle income country to upper middle income country, this findings of this study will provide empirical evidence on factors that enhance or impede trade flows of Ghana.

1.6 The Scope and Methods of the Study

Because of difficulty in accessing the relevant data, the study is confined to analyzing bilateral flows of merchandise exports and total trade between Ghana and twenty-five (25) of its main trading partners over the sample period 1995–2011, compiled from the statistical database of United Nations Conference on Trade and Development (UNCTADStats). Data on other macroeconomic variables entering the gravity models are collated from various secondary sources, as described in the third chapter of the thesis.

1.7 Organization of the Study

After this introductory chapter, the rest of the study is organized as follows: chapter two concentrates on the review of relevant theoretical and empirical literature on the gravity model and its application to international trade analysis. Chapter three focuses on the methodology, main econometric issues and data sample used in the estimation of the gravity equations of Ghana's trade flows. Chapter four analyses the empirical results of the estimated gravity equations of trade between Ghana and its trading partners. Finally, chapter five presents a summary of the major findings of the study, recommendation for policy considerations and conclusion of the study.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This Chapter presents a review of theoretical and empirical literature on the international trade with particular emphasis on the gravity model of trade. The chapter is organized in three main sections. The first section is devoted to the review of theoretical literature on international trade. Presented in this section include classical and contemporary theories on the causes of trade, the theoretical justifications of the gravity model as the motivation for regional trade integration in the West Africa sub-region. Empirical literature on recent applications of the gravity model is summarized in the second major section of the chapter. The last section gives an overview of the changing pattern of Ghana's trade by focusing on the trends in the composition and direction of Ghana bilateral trade flows.

2.1 Review of Theoretical Literature

This sub-section reviews the concept and theory of trade. It discusses the theories of trade and reasons for trade as well as economic integration of the West African sub-region. A detail theoretical analysis of the gravity model is also presented.

2.1.1 Review of Traditional Theories on Why Countries Trade

Modern trade theory is the product of an evolution of ideas in economic thought. In particular, the writings of the mercantilists, and later, those of the classical economists – Adam Smith, David Ricardo, and John Stuart Mill – have been instrumental in providing the

framework of modern trade theory. The major pre-occupation of these international trade theorists was to explain the pattern of trade (i.e. which country trades in what good with which country). In addition to predicting and explaining the composition and direction of international flows of goods and services, the array of trade theories that have been developed over the years also sought to assess the impact of trade flows on domestic welfare and to predict how national policies affect these flows, the prices of traded commodities, the prices of productive factors and, through them, domestic welfare of consumers. Since these early views on trade form the foundation of contemporary trade theory, and some of these views still influence present-day trade policy from time to time, in this section, we present a concise overview of these classical theories in terms of their views on the causes of international trade.

The ideas of Adam Smith, David Ricardo, and other classical economists emerged in reaction to the mercantilists' view on trade and on the role of the government. Adam Smith demonstrated that the potential to gain from specialization applies not only to the assignment of tasks within a firm but also to trade between countries. Smith reasoned that trade between countries is based on absolute advantage, which exists when countries differ in their ability to produce commodities arising from differences in technology. According to Smith, a country should export products in which it is more productive than other countries (that is, goods for which it can produce more output per unit of input than others can and in which it has an absolute advantage) and import those goods where it is less productive than other countries and has an absolute disadvantage. With free trade and government pursuing laissez-faire policies, Smith argued that world output will rise; because of more efficient utilization of productive resources resulting from specialization and division labour. Both nations will, then, end up consuming more of both commodities after exchanging (through trade) part of its

output with the other nation for the commodity of its absolute disadvantage (Carbaugh, 2006; Dunn & Mutti, 2005; Salvatore, 1998).

The theory of absolute advantage seems to make sense in situations where the geographic, climatic conditions, special skills and techniques, and the economic environment give natural or acquired absolute advantage to some countries in the production of certain goods and services over the others. However, Adam Smith's absolute advantage can explain only a very small part of the world trade today because, it is unable to explain why nations which are more efficient in the production of *all* the traded goods still trade with partners which have absolute disadvantage in the production of all the traded goods (Carbaugh, 2006; Salvatore, 1998).

Dissatisfied with this looseness in the absolute advantage theory, David Ricardo (1772–1823) extended the insight from Smith's free trade theory into the concept of comparative advantage to demonstrate that there exists basis for mutually beneficial trade, even when one country is absolutely more efficient in the production of all goods than the other, provided that their relative costs, that is, the ratios of their real costs in terms of labor inputs, are different for two or more commodities. Ricardo posited that, a country that is less productive in two goods still can gain from trade by exporting the good in which its relative disadvantage is smaller, because its relative price of this good before trade will be lower than abroad. A country that has an absolute advantage in both goods gains by specializing in the production of the good in which its relative advantage is greater. It can gain from trade by importing the product in which its relative advantage is smaller, because the foreign opportunity cost of producing it is lower. Thus, Ricardian model demonstrates that it is the difference in technology between the nations that give comparative advantage to some countries in the production of certain goods

over others and motivates advantageous international trade (Anderson, 2004; Dunn & Mutti, 2005; Suranovic, 2006). Although empirical verifications (MacDougall, 1951; Balassa, 1963; and Stern, 1962) confirm Ricardo's postulation that comparative advantage is based on a difference in labor productivity, the Ricardian trade model was criticized for its unrealistic underlying assumptions and its inability to neither explain the reason for the difference in labor productivity across nations nor the effect of international trade on factor earnings (Salvatore, 1998).

To explain the source of international differences in productivity – the factor that determines comparative advantage and the pattern of international trade –, two Swedish economists, Eli Heckscher (1919) and Berlin Ohlin (1933) extended the Ricardian trade model into what has become known as the Heckscher–Ohlin (H-O) theory by introducing one more input, namely, capital, in addition to labour in the Smithian and Ricardian models. Heckscher and Ohlin argued that comparative advantage arises from differences in national resource or factor endowments. The more abundant a factor is, the lower is its cost, giving the country the proclivity to adopt a production process that uses intensively the relatively abundant factor. By assuming that different commodities require that factor inputs be used with varying intensities in their production, the H-O model postulates that countries will export goods that make intensive use of those factors that are locally abundant, and import goods that make intensive use of factors that are locally scarce. In other words, capital-abundant countries like the U.S.A, and other industrial economies should export capital-intensive products, and import labor-intensive products from labor-abundant countries like Ghana and other developing economies (Hill, 2009; Salvatore, 1998).

In view of Wassily Leontief (1953)'s paradoxical finding regarding the pattern of trade in United States, and the inconclusive findings from many other empirical studies[1] which tested the predictions of the H-O model in other countries, alternative theories of comparative advantage have been developed to explain the great deal of contemporary trade (between similar countries) that is left unexplained by the H-O theory. The sources of comparative advantage in these new trade theories are based on tastes and preferences, economies of scale, imperfect competition, and differences in technological changes among nations.

In contrast to the usual supply side theories (which tend to explain why production costs are lower in one country that in another), Stefan Linder (1961) presenting his similarity of preferences (or overlapping demands) theory, argued that an explanation for the direction of trade in differentiated manufactured products lies on the demand side rather the supply side. Linder hypothesized that countries with similar standards of living (proxied by per capita GDP) will tend to consume similar types of goods. Since the standards of living are determined in part by factor endowments, Linder argued that capital abundant countries tend to be richer than labour abundant countries. Thus, there should be a considerable volume of trade between countries with similar characteristics. Implicatively, rich (developed or industrial) countries should trade more with other rich countries, and poor (or developing) countries should trade with other poor countries. Whilst this implication of Linder's hypothesis sharply contravenes the predictions of the H-O theory (in which countries with dissimilar factor endowments would have the greatest incentives to trade with each other, due to disparity in pretrade relative prices), it provides explanation for the extensive trade observed among the rich countries, which makes up a significant share of world trade. In

[1] Tatemoto and Ichimura (1959), Stolper and Roskamp (1961) Bharadwaj (1962), Hong (1975) Bowen, Leamer and Sveikauskas (1987) and Trefler (1993, 1995)

addition to this, it provides explanation for the existence of intra-industry trade, an important feature of international trade which involves the simultaneous import and export of similar types of products by a country. Studies like Jerry and Marrie Thursby (1987) and Bergstrand (1990) have reported evidence in favour of Linder's theory.

Raymond Vernon (1966) proposed the hypothesis that new products pass through a series of stages in the course of their development, and the comparative advantage of the producers in the innovating country will change as products move through this product cycle. The theory, often referred to as the "Vernon product cycle," applies best to trade in manufactured, as opposed to primary, products (Dunn & Mutti, 2005).

Paul Krugman also developed a new trade theory in 1983 in response to the failure of the classical models to explain why regions with similar productivity trade extensively. Krugman's new trade theory suggests that the existence of economies of scale (or increasing returns to scale) in production is sufficient to generate advantageous trade between two countries, even if they have similar factor endowments with negligible comparative advantage differences (Suranovic, 2006; Carbaugh, 2006). As explained by Carbaugh (2006), the increasing-returns trade theory, asserts that a nation can develop an industry that has economies of scale, produce that good in enormous quantity at low average cost, and then trade those low-cost goods with other nations. By doing the same for other increasing-returns goods, all trading partners can take advantage of economies of scale through specialization and exchange.

Finally, the existence of government policies, such as government tax, Research and Development (R&D) subsidies, antitrust immunity, loan guarantees, low-interest-loans and trade protection policies, can be sufficient to generate comparative advantages in production

of certain products. Proponents maintain that government should actively enact policies that encourage resources to move towards the development of emerging, "sunrise" (i.e. hi-tech), industries identified with strong linkages with the rest of the economy, strong future competitiveness, and highest growth prospects. Over the course of time, these policies would create a dynamic comparative advantage for the domestic economy, allowing it to enjoy a higher average level of productivity and be more competitive in the world markets. Today, every industrialized country and many less-developed countries use industrial policies to develop or revitalize basic industries, including, steel, chemicals, autos, transportation and other essential manufactures. Advocates of industrial policy typically cite Japan as a nation that has been highly successful in penetrating foreign markets and achieving rapid economic growth (Carbaugh, 2006).

2.1.2 The Gravity Model of Bilateral Trade

The gravity model has been the workhorse of empirical studies since its first application to analyzing the determinants of bilateral trade flows by its pioneers, Tinbergen (1962) and Pöyhönen (1963). As a reminiscence of Newtonian theory of gravitation, the basic form of the gravity model of trade assumes that, just as planets are mutually attracted in proportion to their sizes and proximity, countries trade in proportion to their respective GDPs and proximity (Bacchetta et al., 2012). Worded differently, the gravity model assumes that the bilateral trade between any two countries is, all other things being equal, directly proportional to their economic size (i.e. their "masses" proxied by the respective GDPs) and diminishes with the distance between them.

Krugman *et al* (2012) defined the basic form of the gravity model as:

$$T_{ij} = A\frac{Y_i^a \times Y_j^b}{D_{ij}^c} \quad \text{.....} \quad (2.1)$$

Where A is the gravitational constant of proportionality, T_{ij}, is the value of trade (i.e. sum of exports and imports) between country i and country j, the Ys are their respective GDPs, D_{ij} measures the distance between the two countries' capitals (or economic centres). a, b, and c are estimable parameters. Equation (2.1) says that the three factors that determine the volume of trade between country *i* and country *j* are the size of two countries' GDPs and the distance between the countries.

To Krugman *et al* (2012), the gravity model works because large economies tend to spend large amounts on imports because they have large incomes. They also tend to attract large shares of other countries' spending because they produce a wide range of products, and have large domestic market. So the trade between any two economies is larger, the larger is either economy.

On the other hand, the geographical distance between countries trade impedes trade flows. As a proxy of transportation costs, the further apart countries are, the higher are the costs (i.e. shipping costs, time-related costs, and costs of cultural unfamiliarity) associated with transporting the goods and services. This consequently reduces the gains from trade and, therefore, the volume of trade between the countries (Baxter and Kouparitsas, 2006). Krugman *et al* (2012) also noted that trade tends be intense when countries have close personal contact, and close economic ties and these contact and ties tend to diminish when distances. Thus, when trading partners are located far apart from each other, the higher will be

the required costs in their bilateral trade, which erodes possible gains from trade and consequently discourages trade.

One prominent feature of the gravity model is that, unlike the supply-side classical models such as the Ricardian model (which relies on differences in technology across countries to explain trade patterns), and the Heckscher-Ohlin (HO) model (that relies on differences in factor endowments among countries as the basis for trade), the gravity model of trade takes into account both supply and demand factors (GDP and population), as well as trade resistance (geographical distance, trade policies, uncertainty, and various bottleneck) and trade preference factors (preferential trade agreements, monetary unions, political blocks, common language, common borders, and cultural differences) in explaining the bilateral trade flows between countries (Luca De Benedictis and Vicarelli, 2004; Bacchetta *et al*., 2012).

By taking into account both trade and non-trade policy issues that might either impede or facilitate bilateral trade flows, which had long been disregarded by the conventional trade theorists, the gravity model remains at the center of applied research on international trade and is widely recognized as the workhorse for analyzing the changing pattern in global trade and growing trade among emerging and developing economies in Asia, Latin America, and Africa.

2.1.3 Theoretical Justification of the Gravity Model

Although the gravity model has been widely used because of its empirical success in explaining bilateral trade flows, the model had lacked rigorous theoretical underpinnings, and was long criticized for being ad hoc. This criticism had casted aspersion on the respectability of the gravity model of trade (Frankel, 1997). However, with the increasing importance of

geographical factors in international trade theory, the gravity model started to attract a reawakening interest in the late 1970s to provide theoretical explanations to it. Among the works that greatly contributed to the establishment of a theoretical foundation for the gravity model, one can cite Anderson (1979), Bergstrand (1985, 1989), Helpman and Krugman (1985, 1987), Deardorff (1995), and Anderson and van Wincoop (2003). These works showed that the gravity equation can be derived from a number of different international trade models including the Ricardian model, Hecksher-Ohlin model, and new trade theories of economies of scale, monopolistic competition and intra-industry trade.

The first important attempt to provide a theoretical basis for gravity models was the work of Anderson (1979) based on the Armington (1969) assumption. Anderson (1979) assumed that products are differentiated by the country of origin and consumers have preferences defined over all the differentiated products. Anderson (1979) adopted a linear expenditure system in which the each good is produced by only one country, and preferences for a country's good are assumed to be homothetic, and uniform across importing countries, approximated by a constant elasticity of substitution (CES) utility function. Thus in trade, at given prices, a country will consume at least some of every good from every country, regardless of incomes. When all countries engage in trade, and all goods are traded, then in equilibrium, national income is the sum of home and foreign demand for the unique good that each country produces. For this reason, larger countries import and export more (Bacchetta et al., 2012).

Bergstrand (1985) used a microeconomic foundation of simple monopolistic competition models to explain the gravity model. Bergstrand (1985) assumed a more flexible utility function that allowed him to find evidence that imports were closer substitutes for each than

for domestic goods. He called his equation a generalized gravity model because it also included price terms (Frankel, 1997; Rahman, 2007, Tri Do, 2006).

The best-known theoretical rationale for the idea that bilateral trade depends on the product of GDPs comes from the works of Helpman (1987) and Helpman and Krugman (1985). As in El-Sayed (2012) and Frankel (1997), according to the authors, under the imperfect substitute model, where each firm produces a product that is an imperfect substitute for another product and has monopoly power in its own product, consumers show preference for variety of products they consume. When the size of the domestic economy (or population) doubles, consumers increase their utility, not in the form of greater quantity but of greater variety. International trade can provide the same effect by increasing consumers' opportunity for even greater variety. Therefore, when two countries have similar technologies and preferences, they will naturally trade more with each other in order to expand the number of choices available for consumption. The authors argued that the classical H-O theory does not have this property that bilateral trade depends on the products of incomes, as it does in the gravity model (Frankel, 1997).

In contrast, Deardorff (1995) showed that the gravity model can be derived from several variants of the Heckscher-Ohlin (H-O) model based on comparative advantage and perfect competition if it is properly considered. He showed that the absence of all barriers to trade in homogeneous products causes producers and consumers to be indifferent to the trading partners, both domestic and foreign, so long as they buy or sell the desired goods. Based on this assumption, he derived expected trade flows that correspond exactly to the simple frictionless gravity equation whenever preferences are identical (Jordaan and Makochekanwa, *n.d.*).

While the derivation of a proportionate relationship between trade flows and the country size is an important foundation, the theories of Helpman (1987) and most of the other authors cited above do not include a role for distance and thus cannot properly be called foundations of the full gravity model. However, some works in literature on the theoretical foundation of the gravity equation have highlighted the fact that relative as well as absolute distance matters for bilateral trade flows (Sohn, 2005). These include Bergstrand's (1985) version of the imperfect-substitutes theory which incorporated a role for shipping costs proxied by distance. Particularly important has been in this respect the contribution of Anderson and van Wincoop's (2003) paper, where they show that controlling for relative trade costs is crucial for a well-specified gravity model. They argue that trade between two regions is decreasing in their bilateral trade barrier relative to average barrier of the two regions to trade with all their partners. This average trade barrier is referred to as "multilateral resistance". If a country has a relatively high average trade barrier, it will trade more with a country with which it has a low bilateral barrier, The rationale is that, ceteris paribus, two countries surrounded by other large trading economies, will trade less between themselves than if they were surrounded by oceans (or by vast stretches of deserts and mountains) (Bacchetta et al., 2012). Anderson and van Wincoop argued that multilateral resistance cannot be measured using remoteness variables based on measures of distance because this does not capture border effects, rather the gravity model must be solved by taking into account the impact of barriers on prices.

2.1.4 The Motivation for Free Trade and Regional Economic Integration in West Africa

Over the past several decades, the global scene of international trade has witnessed a significant lowering of trade restrictions by both advanced nations and emerging and transition economies. Such a momentous trend in trade liberalization has stemmed from two

approaches. The first approach is inherently multilateral and it involves a reciprocal reduction of trade barriers on a nondiscriminatory basis, as embodied in the General Agreement on Tariffs and Trade (GATT) —– and its successor, the World Trade Organization (WTO), and the second approach, through the formation of regional trading arrangement (or trade blocs) by a small group of nations, typically on a regional basis (Carbaugh, 2006).

Regional trade agreements (RTAs) involve a preferential agreement between a group of countries, on account of which member nations concur to pursue free trade internally by imposing lower barriers to trade within the group than to trade with nonmember nations. Each member nation continues to determine and maintain its domestic policies, but the trade policy of each includes a preferential treatment for group members. Since trade bloc usually comprises neighbouring or geographically close countries, it is referred to as a 'regional trade (or integration) agreement' or a 'natural' trade bloc to underline the fact that the preferential trade is between countries that have presumably low transport costs or trade intensively with one another (Sanoussi, 2001). This is further testament to the importance of closeness and proximity in establishing network structures. Proximity in this case refers to geographic as well as economic and social similarities among countries. Such trade and economic conglomerations give the group a bigger role in the world economy, and ensures that smaller member countries are not marginalized (Frankel, 1997).

With the continued increase in the number and size of RTAs throughout the world, nearly all countries, including those in Sub-Saharan Africa (SSA) now participate in at least one bilateral and RTA (Yang & Gupta, 2005; Keane, Cali & Kennan, 2010). As in Carbaugh (2006), a motivation of virtually every RTA has been the prospect of enhanced economic growth, through an expanded regional market which allows economies of large-scale

production, fosters specialization and attracts foreign investment. This impetus for regional integration draws its rationale from the standard trade theory, which states that free trade is superior to all other trade policies (Alemayehu and Haile, 2002).

As Ogunkola (1998) noted, external and internal motivation has been the major factor in the evolution and development of regional bodies in developing countries, especially bodies that are devoted to regional integration. After independence, African countries found the need (both political and economic) to associate with one another. This stemmed from the belief that for their economies to develop, certain obstacles had to be removed. Regional bodies were created to take advantage of economies of scale in production and consumption, which are the fruits of effective and efficient regional integrations. On the external front, these economies believed that their coming together under a regional body would be an effective means of asserting their economic independence. On the other hand, economies of scale, poor resource endowment and under- development, just to mention a few, have been adduced as economic arguments for the establishment of regional bodies. It is believed that regional integration would obviate these difficulties, which are the bane of isolated and poor economies in the sub-Saharan African (SSA) countries and pave the way for sustainable growth and development (Ogunkola, 1998).

In the West African region, the desire to overcome the constraint of small economic size, which was hindering their ability to efficiently industrialize, coupled serious difficulties in penetrating the international markets in the North due to trade barriers, especially non-tariff barriers (especially regulatory controls such as standards, health and phytosanitary system, subsidies, etc.) led to the formation of Economic Community of West African States (ECOWAS).

The Treaty formally establishing the ECOWAS was signed in 1975. The Community is currently composed of 15 member countries[2] in West Africa. As noted in the Community's profile, ECOWAS aims to promote co-operation and integration in economic, social and cultural activity, ultimately leading to the establishment of an economic and monetary union through the total integration of the national economies of member states. It also aims to raise the living standards of its peoples, maintain and enhance economic stability, foster relations among member states and contribute to the progress and development of the African Continent. More specifically, The mandate given to ECOWAS under its Treaty was as follows: (1) the elimination of customs duties and other charges of equivalent effect in respect of the importation and exportation of goods between member states; (2) the abolition of quantitative and administrative restrictions on trade among the member states; (3) the establishment of a common external tariff and a common commercial policy towards third countries; (4) the removal of obstacles to the free movement of persons, services and capital; (5) the harmonization of agricultural policies and the promotion of common projects notably in the fields of marketing, research and agro-industrial enterprises; (6) development of joint transport, communication, energy and other infrastructural facilities as well as the evolution of a common policy in these fields; (7) the establishment of a Fund for Cooperation and Development; and (8) such other activities that could further the aims of the Community as may from time to time be undertaken in common by member states.

From the above, it could be observed that the Treaty adopted the classical model of economic integration, envisaging the establishment of an economic community through a gradual

[2] Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, Ghana , Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, The Gambia, and Togo.

process of tariff elimination leading to the establishment of a free trade area, a customs union and a common market.

2.2 Review of Empirical Literature on the Gravity Model

In view of the extensive use of the gravity as an empirical strategy in analyzing the pattern and the determinants of trade flows of countries particularly in Europe, Latin America, and Asia, the objective of this section is to review some of these studies[3] as a guide to the choice of appropriate model and variables to be used in this study.

Nobel Laureate Jan Tinbergen (1962) was the first to publish an econometric study using the gravity equation for international trade flows. In his first study involving data on 18 countries in 1958, the volume trade between two countries was specified to be proportional to the product of an index of their economic size, and the factor of proportionality depended on measures of trade resistance between them. Among the measures of trade resistance he included the geographic distance between them, a dummy for adjacency (common borders), and dummies for British Commonwealth and Benelux memberships. Tinbergen found that both incomes and distance had their expect signs and were statistically significant. He also found that adjacency and membership in the British Commonwealth (Benelux FTA) were significantly associated with 2 percent and 5 percent higher trade flows respectively.

Bergstrand (1985) applied an augmented version the gravity equation to analyze the determinants of bilateral exports among 15 OECD countries in 1976. In addition to the conventional gravity variables, Bergstrand included exchange rate, price indices for exports and imports, GDP deflators in both countries, and dummies for adjacency, European

[3] See Appendix for a summary of other empirical studies.

Economic Community (EEC) and European Free Trade Area (EFTA) memberships, among the explanatory variables. Bergstrand found that the economic size of both countries, import price index, adjacency and EFTA membership had significantly positive effects on exports between two trading countries, whilst the geographic distance between them was found to reduce the volume of exports of these countries. The other variables were found to be statistically insignificant.

In a recent study, Gani (2008) examined the factors influencing trade between Fiji and its Asian partners, using a panel data for the period 1985 to 2002 over a cross-section of seven Asian countries (i.e. China, Hong Kong, India, Indonesia, Japan, Singapore and Thailand) for the import model and five (i.e. China, Hong Kong, Japan, Singapore and Malaysia) for the export model. Within the framework of the gravity model, Gani (2008) postulated that Fiji's imports from and exports to its Asian partners at time *t* are determined by their GDP_s the geographic distance between Fiji and the major port of entry of an Asian country, and other possible influences such as the exchange rate and infrastructure. The results obtained from the panel data estimation procedure indicate that imports by Fiji from Asia are significantly influenced by the population and the infrastructure of the Asian countries and the distance between Fiji and the exporting country. The results also suggest that Fiji's exports are significantly influenced by Fiji's infrastructure, the distance to export markets, and the real exchange rate. While Fiji's and its partners' GDPs have the correct sign on their coefficients in both models, they are statistically insignificant. In spite of its novelty of highlighting the importance of infrastructural development in facilitating Fiji's bilateral trade, the study, however, fails to account for the possible influence of regional trade agreement on Fiji's bilateral trade flows.

In a similar study, Rahman (2009) applied generalized gravity models to explore Australia's global trade potential with its 57 trading partners for the period of 1972-2006. In this study, the standard gravity model was 'augmented' by including GDP per capita of Australia and its partners, the per capita GDP differential between Australia and its partners, openness of its partners and dummies for common language and RTA membership. By employing panel data estimation techniques to estimate the specified model, the estimated coefficients were then used to predict Australia's trade potential. The results revealed that Australia's bilateral trade is affected positively by income, openness of trading partners, common language and free trade agreement, and negatively by the per capita income differential (thus providing evidence for the Linder hypothesis) and distance between Australia and trading partners. The results indicated that Australia has notable trade potential with Mexico, Argentina, Uruguay, Austria, Peru, India, the Philippines, Brazil, Chile, the USA, New Zealand, Greece, Japan, Turkey, Nepal, Kenya, Spain, Hungary, Brunei, Hong Kong, South Africa, Pakistan and Canada.

In a similar study, Roy and Rayhan (2011) analyzed the determinants of trade flows in Bangladesh through gravity model panel data approach. This study covered a total of 14 countries including Bangladesh and other 13 countries that have bilateral trade agreement with Bangladesh, namely South Asian Association for Regional Co-operation (SAARC). The data collected for the study spanned from the period of 1991 to 2007 (17 years). From the results of the study, both basic and extended gravity models were established, which implied that Bangladesh's trade flows are significantly determined by the size of Bangladesh's economy and that of its partners, openness of the partner's economy and exchange rate; whereas random effect model and cross-sectional effects do not show any significant impact of trade impediment factor in Bangladesh trade. In addition, the cross-sectional results

showed that membership of SAARC and border are significant determinants of Bangladesh's trade flows.

In Korea, Sohn (2005) explored the extent to which the gravity model fit Korea's bilateral trade flows and to extract implications for Korea's trade policy. In this paper, new explanatory variables, such as the Trade Conformity Index (TCI) and Asia-Pacific Economic Cooperation (APEC) membership, were also included in order to examine the peculiarity of Korea's trade patterns – whether they follow the Heckscher-Ohlin model or the differentiated product model – and to estimate the influence of a regional economic bloc on Korean bilateral trade flows. The study was based on a 1995 cross-country data on bilateral flows between Korea and its major 30 trading partners their GDPs, their per capita GDPs, and distance between them. According to the regression results, it was found that Korea's bilateral trade patterns fit the basic gravity model well. The coefficient of Korea's trade structure variable (TCI) was found to be significantly positive suggesting that inter-industry trade, as explained by the Heckscher-Ohlin model, is prevalent in Korea's international trade. APEC variable showed a significant positive effect on Korea's trade volume. It was also found that Korea has significant unrealized trade potentials with Japan and China, suggesting that there are significant trade barriers between Korea and these countries. Therefore, by promoting a deeper form of trade liberalization with both Japan and China, Korea is expected to fully exploit its trade potentials and maximize the gains from trade.

Several empirical studies have been carried out to analyze the determinants of bilateral trade flows of African countries and the performance of regional trade blocks in Africa, using the gravity model framework. In investigating the determinants of Namibian exports, Eita (2008) employed an extended version of the gravity model, using a panel data covering 39 countries

for the period 1998-2006. In this study, Eita (2008) modeled Namibia exports as a function of its GDP and per capita GDP and those of its major importers, the distance between them and exchange rate. Dummy variables were also incorporated in the Namibia's export model to capture the effects of sharing a common border with Namibia, and belonging to the Southern African Development Community (SADC) and EU. The results showed that an increase in importer's GDP and Namibian GDP is associated with an increase in Namibian exports. Importer's GDP per capita was found to have a negative impact on export, while real exchange rate and Namibia's GDP per capita do not have significant impact on exports. As per the theoretical expectations, distance was found to be associated with a decrease in exports. Membership of SADC, EU and sharing a border with Namibia were found to positively and significantly promote Namibia's in exports. The study showed that Namibia has unexploited export potential with, Australia, Belgium, Kenya, Mauritius, Netherlands, Portugal, South Africa, Switzerland and the United Kingdom, among others.

A similar study was conducted in Ethiopia by Taye (2009). The study examined the determinants of Ethiopia's export performance by first decomposing the growth in Ethiopia exports into the contribution from internal supply-side conditions (i.e. domestic transport infrastructure, macroeconomic environment, real exchange rate, foreign direct investment and institutional quality) and external market access conditions (i.e. tariff and non-tariff barriers, transportation costs, and geographical location). Within gravity model framework, Ethiopia's export was assumed to depend on its GDP, importer's GDP, FDI, internal transport infrastructure, real exchange rate, foreign trade policy index, institutional quality index and the weighted distance between Ethiopia and her trading partners. The model was estimated by applying the Generalized Two Stages Least Squares (G2SLS) technique on a panel data covering 30 Ethiopia's trading partners spanning for the period 1995–2007. Growth in

domestic national income, good institutional quality and internal transport infrastructure, were found to significantly determine Ethiopia's export performance. With respect to foreign market access conditions, the results indicated that distance and import barriers imposed by Ethiopia's trading partners do play an important role in determining the volume of Ethiopian exports.

The literature on gravity model in the case of Ghana is limited, notwithstanding the growing interest of researchers and policymakers in the subject and the vast number of empirical applications in trade literature. Whereas majority of empirical literature on Ghana's external trade focus on the effects of exchange rate on the nation's trade balance (Bhattarai & Armah, 2005; Danquah, 2008), the impact of devaluation on Ghana's trade balance (Agbola, 2004), trade balance and policy efficiency (Amoah & Loloh, 2009), trade openness and economic growth (Asiedu, 2010; Sakyi, 2011) and export performance and economic growth (Ganiwu, 2012) among others, none of these studies, with the exception of Marquez-Ramos (2007), analyzed the factors that influence the pattern and the volume of bilateral trade flows between Ghana and its trading partners.

Within the framework of the gravity model, Marquez-Ramos sought to understand the determinants of international trade in African countries in terms of what goods and with which countries developed and developing economies in Africa trade. From an empirical perspective, two African economies, South Africa (a developed economy) and Ghana (a developing country) were analyzed. To control for sector-heterogeneity in the empirical analysis of trade determinants in African countries, a gravity equation was estimated with disaggregate data. Aside the gravity variables, tariff rates in the importer country for each commodity, technological innovation in the importer country, and the trade imbalance

existing between trading partners were also incorporated within the specified exports model. In addition, a number of dummies representing geographical (i.e. landlockedness, and adjacency), cultural characteristics (i.e. common language, colony, and index of economic freedom), sectoral-heterogeneity (i.e. high technology goods and for referenced and homogeneous goods) and integration dummies (i.e. ECOWAS and WTO) to analyze the impact of a RTAs and multilateral liberalization on international trade were also included in the regression. The estimation was done using the OLS method on a cross-sectional data on 167 major importer countries for the year 2000.

Results show that determinants of trade have a different behaviour in developed and developing African countries. Technological innovation, geographical and social factors play a key role on trade relationships in South Africa, whereas Ghana's exports are higher when they are addressed to countries with higher levels of economic freedom. Ghana exports more than expected to high-income European countries, whereas the intensity of exports from South Africa is considerably higher with other African countries. The importer's income was found to be a relevant variable to fostering international trade flows, however, the effect of tariffs varies across countries. Marquez-Ramos found that transport cost reductions do not have a significant effect on exports from African countries. ECOWAS was found not to foster exports from Ghana and the effect of multilateral liberalization on international trade (in the form WTO membership) was not significant for Ghana and it was negative for South Africa.

Although most of the empirical applications of the gravity model employ the fixed effects model, recent trade literature have increasingly paid critical attention to heterogeneity cross sectional units, and the properties of the time series components of the macroeconomic variables entering the regressions, worrying about nonstationarity, spurious regressions and

cointegration (Baltagi, 2008). This in turn produces biasedness in the fixed effects estimates. As such, several unit root and cointegration tests applied in the time series literature have been extended to panel data analysis.

In examining the impact of European Economic and Monetary Union (EMU) on bilateral trade flows within the euro area, with a panel data for 22 industrial countries, Farque (2004) employed panel unit root and panel cointegration analysis to address the issues of nonstationarity of EMU area's bilateral trade flows and its determinants. The LLC, IPS and Hadri panel unit root tests, showed that key variables such as trade, incomes and per capita incomes were nonstationary. Pedroni's (1999) cointegration test strongly suggested that bilateral trade, GDP and GDP per capita between country trading pairs are cointegrated. Farque (2004) then relied on the panel dynamic OLS (DOLS) estimation to generate reliable point estimates in the presence of non-stationary data and possible simultaneity bias as a check on the standard OLS estimates. Controlling for the influences of economic size, population, and other factors, it was found that EMU has had a positive impact on intra-area trade, boosted trading among member states by roughly 10 percent during the euro's existence.

Fidrmuc (2009) addresses these issues in his paper on gravity models in integrated panels. For a sample of OECD countries between 1980 and 2002, Fidrmuc showed that standard gravity models of foreign trade did not only include non-stationary variables (bilateral trade and GDP of trading partners), but were also characterized by inherited cross-sectional dependence between the panel units (country pairs). These results were based on a battery of panel unit root tests including LLC, IPS tests and cross-sectionally augmented Dickey-Fuller (CADF) tests. Pedroni's panel cointegration tests also confirmed the existence of a cointegrating

relationship between trade and output. Nevertheless, Fidrmuc found that, the fixed effects estimator is similar to the dynamic OLS (DOLS) or fully modified OLS (FMOLS), which take into account the non-stationarity of analyzed macroeconomic variables as well as possible endogeneity between output and trade. The author concluded that the possible bias of studies based on fixed effects models due to the non-stationarity of gravity models is rather small.

Finally, in a recent study, Geldi (2012) examined the trade effects of regional integration (of EU, NAFTA, MERCOSUR and AFTA) by estimating the gravity model of trade through fixed effects model and panel cointegration analysis. It was found that the explanatory power of the latter has superseded the former one. For the case of EU, it was found that the intra-union trade-creation effect was approximately six times larger than extra-union effects. In NAFTA, exports to outside countries were significantly diverted. For MERCOSUR, on the other hand, the results indicated that the integration did not contribute to intra-union trade. The members are still significantly dependent on extra-union imports, just like the members of AFTA.

2.3 Trends in the Composition and Direction of Ghana's External Trade

In this section, we present the structure of Ghana's international trade in terms of product composition and source and destination of our imports and exports respectively.

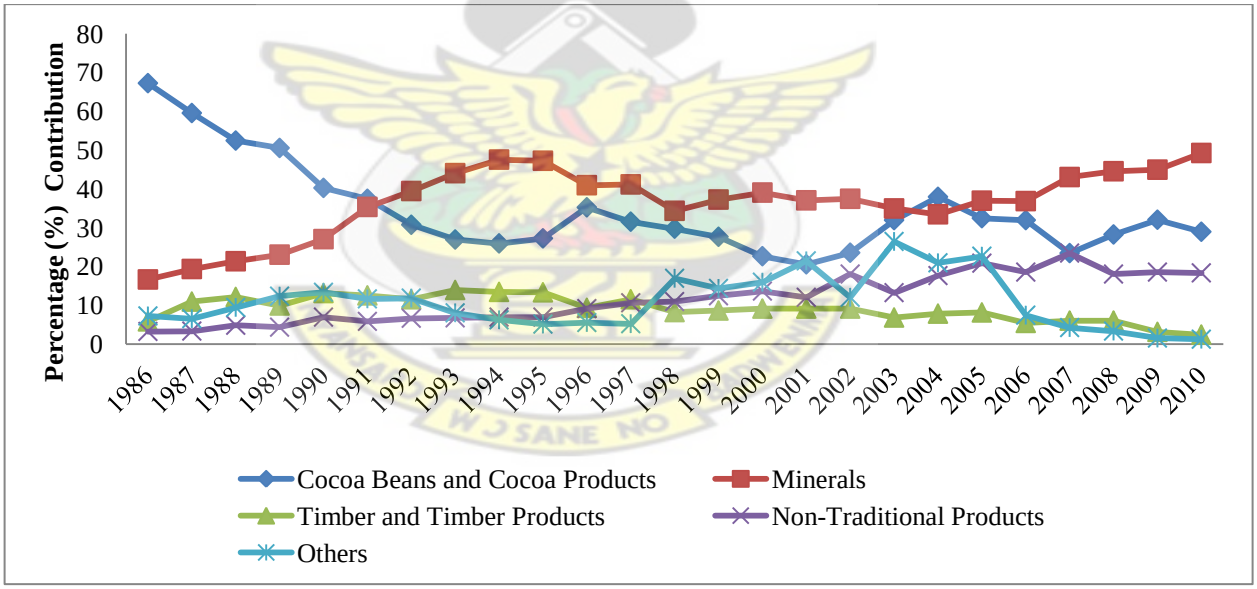
2.3.1 Trends in the Composition of Ghana's Trade

As an indicator of the structure and level of economic development of a country, the composition of a country's trade in simple terms refers to the type of goods and services that a country's imports and exports. Ghana's exports may be divided into two parts namely: traditional and non-traditional exports. Traditional exports are defined by the Import-Export Act of 1995 (Act 503) as cocoa beans, logs and lumber, unprocessed gold and other minerals and electricity. Non-traditional exports are defined by the Ghana Exports Promotion Council (GEPC) as all products other than cocoa beans, logs and lumber, unprocessed gold and other minerals and electricity. They include horticultural products, fish and seafood, prepared food and beverages, handicrafts and other manufactured items (Buatsi, 2002).

Ghana's major exports, between the 1950s and 1960s were mainly raw materials in the form of cocoa beans, minerals, timber logs, and cola nuts; which together constitute on average about 90% of Ghana's total export receipts. These primary products were unprocessed and served as raw materials for the industrialized countries. Ghana's anxiety to diversify the economy through industrialization in the 1970s resulted in some slight changes in the composition of Ghana's export trade, with a gradual change from the export of pure primary products to the export of processed raw materials such as sawn timber in the form of plywood and veneer products, and cocoa products comprising cocoa paste and butter and some amount of manufactured products like aluminum products, materials, and textiles (Baah-Nuakoh, 1993 & Aryeteey et. al., 2000).

Following the implementation of various trade policies under the Economic Recovery Program (ERP) in 1983, there was substantial across-board rise in exports between 1983 and 1990s, with principal exports and non-traditional exports responding positively to the improved incentive structure. Whilst there was very little change in the number of non-traditional products exported and their export values between 1990 and 1995, some diversification in the structure of nontraditional exports occurred with the share of agricultural and handicrafts exports declining from 74.8% in 1986 to 3.2% in 1994. This decline was, however, more than compensated for by a 33% rise in the value of processed and semi-processed products from $77.8 million in 1994 to $130.2 million in 1995 (ISSER, 1991 and 1996).

Figure 2. 1: Contribution of major exports to total exports values, 1986-2010



Source: Compiled from various issues of Bank of Ghana Statistical Bulleting and ISSER

As shown in Figure 2.1, the rest of the 1990s witnessed declension in the joint-share of cocoa beans and cocoa products, minerals and timber and timber products in total exports value from from 74% in 1996 to 66.7% in 2001 (ISSER, 1995 & 2005); whereas the share and value of non-traditional exports and other export products continued to rise significantly. The

growth in other export products was mainly driven by the phenomenal growth in tourism industry with annual growth rate of over 40% between 1990 and 1992, thereafter, dropping to 4.6% in 1996 and bouncing back in 1997 with a growth rate of 19.8% (ISSER, 1998).

Between 2000 and 2010, the main components of Ghana's exports continue to be gold and cocoa, and cocoa derivative products followed by timber and timber derivative products. The poor performance of the principal export items in the late 1990s was, however, reversed over the period, with the joint contribution of gold and cocoa to total exports ranging from 58.9% in 2000 to 75.5% in 2010 (ISSER, 2000-2010). The unparalleled growth in the non-traditional exports continued throughout the period 2000-2010, contributing on average 17.4% per annum to total export earnings (ISSER, 2000-2010). This persistent growth in the importance of the non-traditional exports as a foreign exchange earner has been the result of diverse efforts of various governments in collaboration with Ghana Export Promotion Council (GEPC) to increase Ghana's exports.

2.3.2 Trends in the Composition of Ghana's Imports

According to the Bank of Ghana's annual reports and ISSER's annual issue of *State of the Ghanaian Economy*, Ghana's imports are mainly categorized into two, namely, oil imports and non-oil imports. Oil imports constitute crude oil, petrol and lubricating oil and other petroleum products. Non-oil imports comprise of transport equipment and other capital goods, raw materials and intermediate goods, chemicals and related products, food and beverages and other consumer goods.

After independence and particularly in the 1960s Ghana's main imports were mostly manufactured goods, made up of consumer items and some capital goods, especially,

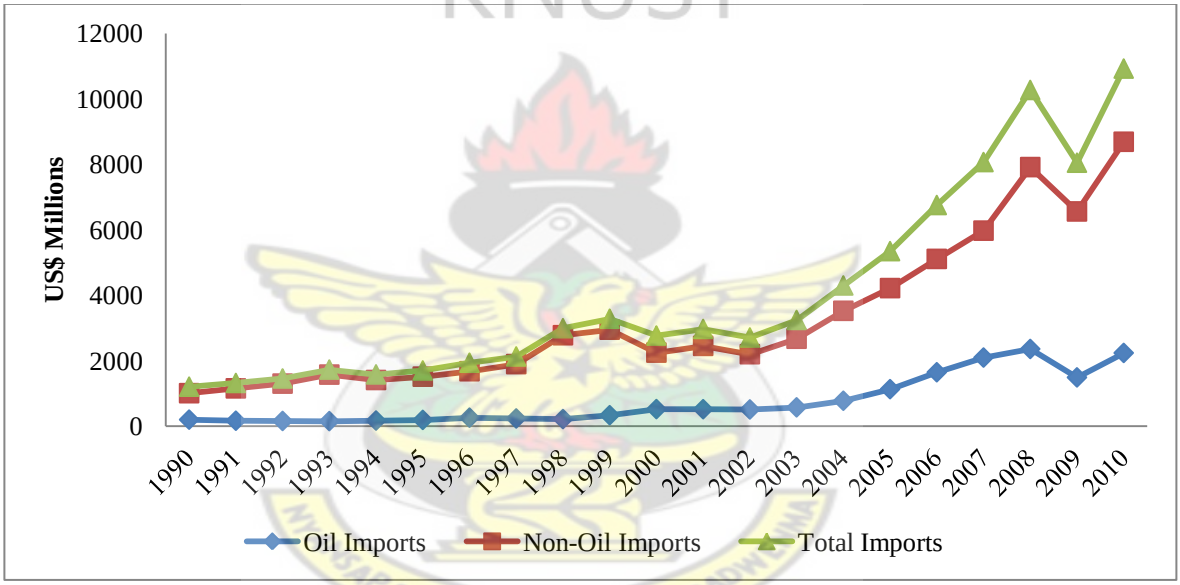
constructional equipment for railways, ports and roads. These items were imported in greater quantities due to the establishment of domestic industries to produce import substitutes. There was a significant decline in the share of consumer goods and an increase in the share of producer goods between 1961 and 1966. By 1966 consumer goods imports were equivalent to 30.9% of total imports compared with 49.4% in 1961, while the share of producer goods rose from 46.4 to 64.8% in the same period (Jebuni et al, 1994).

In the early years of the 1980s, especially, after the launching of the Economic Recovery Programme (ERP), with its trade liberalization policy, the doors of the country became widely opened to all kinds of goods including durable and non-durable goods, capital equipment, spare parts and mineral oil. The liberalization period of 1986-88 has been accompanied by a surge in the share of consumer goods; with a continuous a decline in the share of producer goods. This however, was reversed in 1986 (Jebuni *et al.*, 1994).

Throughout the 1990s, fuel, energy and other petroleum products continued to dominate the nation's oil imports, whilst capital goods, intermediate goods and consumer goods remained the country's dominant non-oil imports. Oil imports accounted for 11.15% of total import bill in 1994; by 1998 its share has risen to 18.39%. Capital goods (mainly machinery and transport equipments) accounted for 42.23% of non-oil imports in 1994; however, by 1998 this share has dropped to 39.21%. Total imports continue to surge throughout the period, with its growth outpacing the growth in exports. Conditions in the international commodity market gave rise to a disappointing international trade and payments in the 2000 to 2006 period. Cocoa prices continued to decline and petroleum prices continued their surge. Figure 2.2 shows the composition of Ghana imports in terms of oil and non-oil imports from 1990 to 2010.

Whilst in 2000 total merchandise imports declined by 12% from its level in 1999, the value of oil imports almost doubled from US$333.3 million in 1999 to US$520.1 million in 2000. By the end of 2005 the value of oil imports has risen to US$1091.9 million, indicating an increment of over 100% between 2000 and 2006. However, in percentage terms, the share of petroleum and petroleum products (oil imports) in total merchandize imports fell from 21.3% in 2000 to 14.4% in 2006. The shared of non-oil imports increased to 85.02 per cent over the corresponding period of 2000-2006.

Figure 2. 2: Value of Oil and Non-Oil Imports for Ghana, 1990-2010



Source: Compiled from various issues of Bank of Ghana Statistical Bulleting and ISSER

Most non-oil imports were manufactured products, mainly electronics and electronic gadgets, machinery, transport equipment, and semi-manufactures and agricultural goods. Between 2005 and 2010, the growth in merchandise imports braked sharply as imports declined by 22% in 2009, with share oil imports in total imports continuously declining over the period, averaging 19% of total imports per annum. This development in the composition of Ghana's imports between 2005 and 2010 was a reflection of the relatively lower prices for oil imports

and sluggish domestic demand for much of the period, as well as, the lower volume of crude oil imports by the Volta River Authority (VRA), due to increase in the hydro component of power generation. As such, the share of oil imports in total imports continued its downward trend, which commenced in 2008 from 24% to 19% in 2010, while non-oil commodities continue to account for the increase in Ghana's imports bill (ISSER, 2009 & 2010).

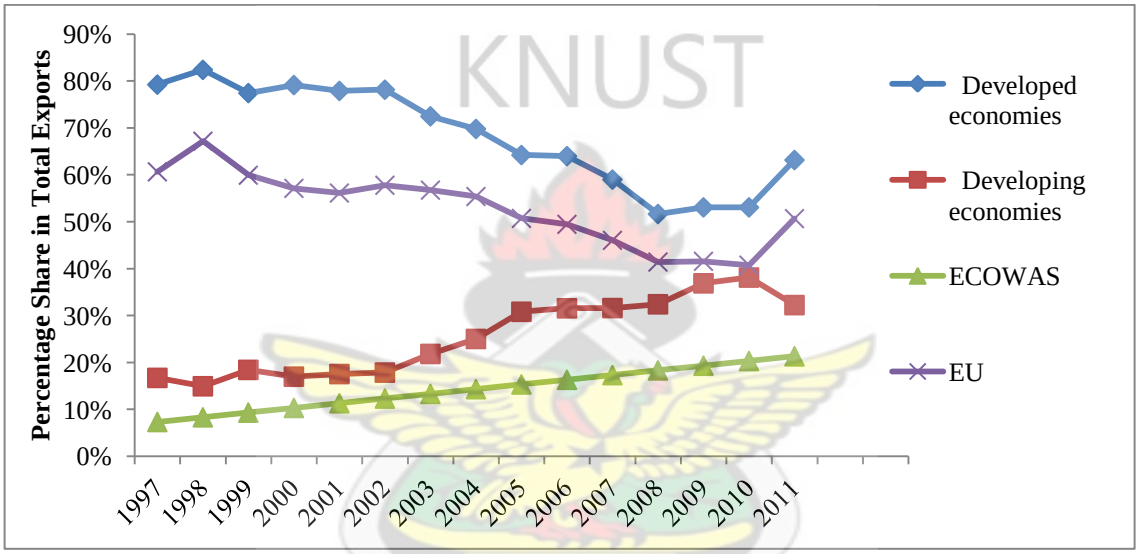
2.3.3 Trends in the Destination of Ghana's Exports

The direction of trade refers to recipient or destination countries of a country's exports and the source or originating countries of a country's imports. This indicates how geographically diversified a country's market is and the kind of economic relations that exist between a country and the rest of the world.

Several significant changes have taken place in the destination of Ghana's exports since independence. Until mid-1990s, Ghana trades primarily with the member countries of European Union, particularly Germany, the United Kingdom, the United States, France, Italy, Belgium, Spain and the Netherlands, which together absorbed over 60% of Ghana's exports since the 1970s. Over this period, The United Kingdom remained the principal market for Ghana's cocoa beans, absorbing approximately 50 percent of all cocoa beans exported. Germany was the second most important destination of Ghana's exports, followed by the United States. These three countries consistently received close to 40% of Ghana's exports. Over this period, trade with Eastern bloc was totally absent (Nyanteng, 1987), whilst African countries took a very small percentage (i.e. less than 2%) of Ghana's exports. Togo, Cote d'Ivoire and Nigeria were the major recipients of Ghana's exports in Africa.

Contrastingly, a cursory look at trade statistics after the mid-1990s reveals some dramatic changes in the destination of exports from Ghana. Figure 2.3 graphically depicts the changing trends in the destination of Ghana's exports between 1997 and 2011. In terms of economic classification, we observe a persistent decline in the share of Ghana's exports destined for markets in the developed economies, from over 80% in 1998 to 50% in 2008 and then picking up to about 62% in 2011.

Figure 2. 3: Trends in the Destination of Ghana's Exports



Source: Author's Construct. Data was obtained from UNCTADStat Database.

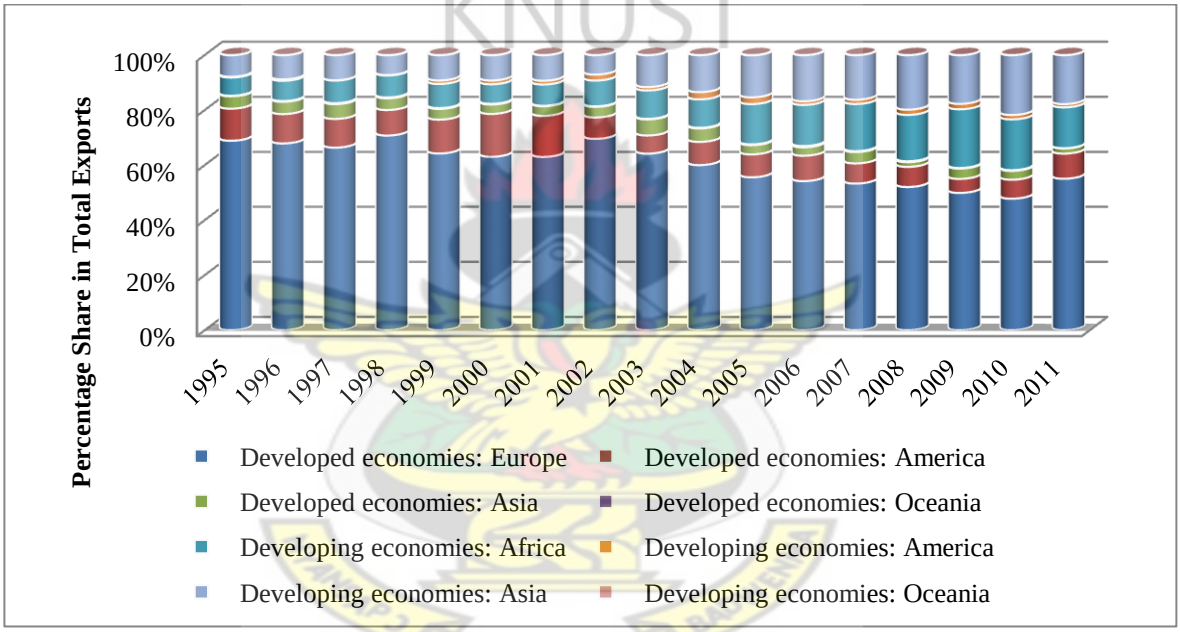
On the contrary, the destination of Ghana's has expanded beyond the traditional markets toward the developing economies, with their share of total exports from Ghana rising from below 20% in 1997 to 40% in 2010, and then dipping to 30% in 2011. Based on regional trade agreements, it is observed that the EU market received less and less of Ghana's exports, whilst the ECOWAS market steadily increased its absorption of Ghana exports, from below 10% in 1997 to over 20% in 2011.

Figure 2.4 shows that the destination of Ghana's exports has actually shifted from the Developed Economies in Europe, Asia and America, to the Emerging and Developing

Economies in Asia and Africa, although the Advanced Economies remained Ghana's principal exports markets.

According to the IMF Direction of Trade Statistics Yearbooks in 2009 and 2010, as reported in ISSER (2009 & 2010), Ghana's main export partners, Belgium, France, Germany, Japan, United States and United Kingdom have been receiving a dwindling share of Ghana's exports over the period 1995-2010.

Figure 2. 4: A Breakdown of the Destination of Ghana's Exports by Regions



Source: Author's Construct. Data was obtained from UNCTADStat Database.

In contrast, Netherlands, Japan, India, Malaysia, Ukraine, China, Turkey and the Commonwealth of Independent States (CIS) and Mongolia have been consistent recipients of increasing share of exports from Ghana over the same period. Although total exports from Ghana to the rest of the world have almost doubled since 2000, the proportion going to Africa has not increased significantly, at less than 10% of total exports, with ECOWAS countries mainly accounting for the changes in Africa's share of Ghana's exports. Among the

ECOWAS countries, Benin, Nigeria, Togo, and Senegal remained the major destinations of exports from Ghana. The past years have also witnessed the bilateral relations between Ghana and South Africa being strengthened, with South Africa receiving between 3% and 8% of total exports from Ghana between 2001 and 2010, and thus becoming an important destination of Ghana's exports in Africa.

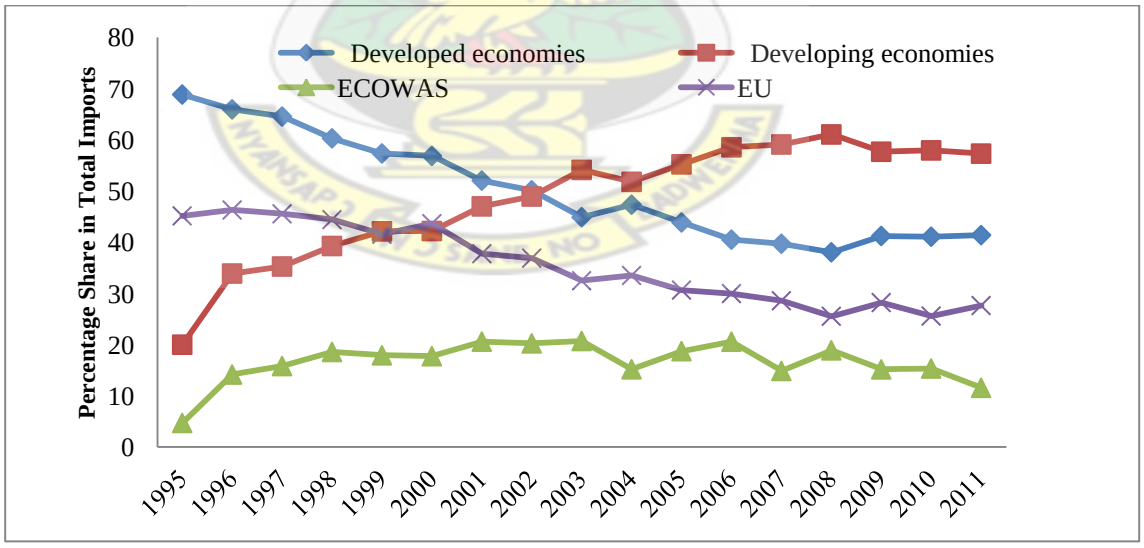
2.3.4 Trends in the Origin of Ghana's Imports

During the post-independence years prior to the launching of the Economic Recovery Programme (ERP) in 1983, there was no significant divergence between the destination of Ghana's exports and the origin or source of its imports. As a developing country, Ghana's imports largely consisted of manufactured products from the industrialized nations, mainly from Great Britain which supplied between 42% and 56% of total imports in the early 1950s (Leith, 1974). The 1960s and 1970s saw the source of Ghana's imports changing from the West to Eastern European countries chiefly Russia (the Soviet Union), China and Japan and then to the West again by the end of the 1970s. As detailed in Baah-Nuakoh (1993), although Britain remained Ghana's major import partner, its share in Ghana's total imports plummeted to 20.2% by 1979, whilst the Union of Soviet Socialist Republics (USSR), China and other European countries as a group showed a sharp increase in their exports to Ghana, with their share rising from 4.3% in 1960 to 26.3% in 1965 and then tumbling to only 4% by 1977. The share of imports originating from the American continent to Ghana also increased from 8.3% in 1960 to 21.4% in 1970 but has declined since then to 10.7% in 1979. In Africa, Nigeria was Ghana's main import partner, originating as much as 92.4% of Ghana's imports from the continent, in the form of crude oil (Huq, 1989).

In the 1980s, the bulk of Ghana's imports originated from the developed countries in Europe especially, the member countries of the EU, with their share increasing from 60% in 1983 to 66.5% in 1987. United Kingdom originated 41.4% of Ghana's imports in 1987 compared to 27.1% in 1983. United States supplied about 90% of total imports originating from the American continent over this period. In Asia, Japan continued to be the dominant source of Ghana's imports; providing on average 5% per annum of Ghana's total imports. Over the same period, Africa experienced a decline in their share in total imports of Ghana, supplying only 3.5% of the total imports of Ghana, compared to 18% in 1983 (Huq, 1989).

During the period between the 1990s and 2000s, the direction of Ghana's trade, in terms of the origin of its imports, begun to shift remarkably from the developed (or industrialized) economies to the developing economies. This recent trend in the origin of Ghana's imports is shown in Figure 2.5 below.

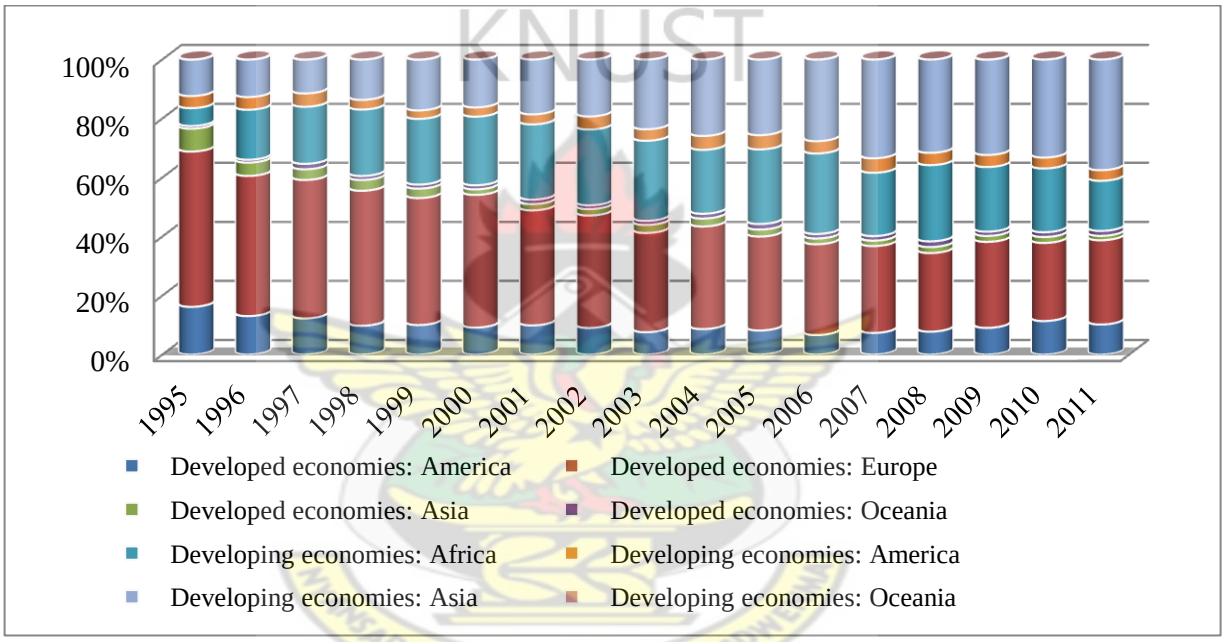
Figure 2. 5: Trends in the Origin of Ghana's Imports



Source: Author's Construct. Data was obtained from UNCTADStat Database.

At the disaggregated level, Figure 2.6 shows that whilst the continuous decline in the share of advanced economies in Europe, America and Asia culminated in the overall decline in the importance of advanced economies as the source of Ghana's imports, the divergence in the origin of imports towards the emerging and developing economies is due to the persistent growth in the bulk of Ghana's imports originating from the developing economies in Asia, and Africa.

Figure 2. 6: A Breakdown of the Origin of Ghana's Imports by Regions



Source: Author's Construct. Data was obtained from UNCTADStat Database.

Particularly, the share of imports (mainly light manufactures or electronics) originating from China increased from 3% in 2000 to 17% in 2010 while India increased its share from less than 2% to 8.3% in 2007% before declining to 5.7% in 2010. In Africa, Nigeria remained the major source of Ghana's imports (mainly oil) followed by Cote d'Ivoire and South Africa.

2.4 Conclusion

The gravity model has proven to be an effective tool in explaining bilateral trade flows as a function of exporter's and the importer's characteristics, together with factors that aid or restrict trade. This chapter presented a review of literature on studies establishing the theoretical foundations of the gravity model and empirical literature on the application of gravity model to study trade flows of many developed, developing and emerging economies in Europe, Latin America, Asia and Africa. In addition, we also examined the trend in the structure (composition) and direction of Ghana's exports and imports over the past five decades. As indicated earlier, the main objective of this chapter is to review some of these studies as a guide to the choice of appropriate model and variables to be used in this study. In the chapter that follows, we discuss the research methodology adopted in this study on the basis of the literature reviewed in this chapter.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

The principal aim of this chapter is to present the empirical strategy employed in this study toward the attainment of the objectives of the study. The chapter is presented in three main sections. In the first section of this chapter, we present a brief description of the variables utilized in the study, how they were measured and the sources from which they were derived. Model specification and the theoretical framework of the study were presented in the second section of the chapter. Issues relating to the econometric methodology including, pooled, fixed effects and random effects estimators, panel unit roots and cointegration tests, and the estimation of long-run relationships were discussed in the final section of the chapter.

3.1 Description of Variables and Data Source

To analyze the determinants of Ghana's bilateral trade flows within the framework of the gravity model, this study employs a panel dataset of annual observations on a cross-section of 25 major trading partners[4] of Ghana over a period of 17 years between 1995 and 2011 collated from different secondary sources. The choice of the sample period and countries in the cross-section in this study is influenced by the availability of data on all the variables used in the study and the relative importance of each country (measured in terms of its percentage share) in Ghana's total merchandise trade over the sample period.

With reference to the theoretical model adopted in this study, we have employed three sets of explanatory variables as the determinants of Ghana's bilateral exports (X), and total trade

[4] *See appendix for list of sampled countries*

(TT). The first group of variables accounts for internal supply conditions in the exporting country, and the external market conditions in the importing country, namely, gross domestic product (GDP), population (POP), real bilateral exchange rate (RBER), internal transport infrastructure (INF), foreign direct investment (FDI), and institutional quality (IQ) and foreign trade policy index (FTPI). The second group of variables is a trade resistance factor, namely the geographical distance between the economic centers (i.e. capital cities) in Ghana and its trading partners (DIST). The last set of variables is trade preference factors, specifically, common membership regional trade agreements (ECOWAS), and common language (LANG. Outlined below is a brief description of the variables employed in this study:

Bilateral exports (X), Imports (M) and Total Trade (TT): Bilateral exports are measured as the total value of all goods and services in U.S. dollars flowing out from Ghana to a given partner. Bilateral imports are measured as the total value of all goods and services in U.S. dollars flowing in from a given partner to Ghana. Total trade is the sum of bilateral exports and imports. These values were deflated using the implicit price deflator to obtain the real values. Data on bilateral exports and imports were obtained from UNCTAD, *United Nations Conference on Trade and Development Statistics Database Online*[5]. Data on the implicit price deflator(s) was obtained from the *National Accounts Main Aggregates Database* of the *United Nations, Department of Economic and Social Affairs, Statistics Division*[6].

Gross Domestic Product (GDPs): Gross domestic product is the market value of total production of goods and services in a country. It is measured in real terms at constant 2000

[5] Available online at: *unctadstat.unctad.org.*
[6] Viewed online at: *www.ustats.un.org/unsd/naama*

US$ to account for inflation. Data on GDPs was obtained from the World Bank, *World Development Indicators online database*[7].

Population (POP): According to the United Nations Population Division's *de facto* definition, total population counts all residents regardless of legal status or citizenship-except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of their country of origin. Data on the total population of the selected countries was obtained from *UN Population Division, World Population Prospects, 2012* via the World Bank, *World Development Indicators online database.*

GDP per capita differential (GDPPCD): This is computed as the absolute value of the difference between Ghana's GDP per Capita and that of its partners; where GDP per capita is the gross domestic product (constant 2000 US$) divided by total population. Data on GDP per capita was sourced from the World Bank, *World Development Indicators* online database.

Distance (D): 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 distance calculator website.[8]

Real Bilateral Exchange Rate (RBER): The real bilateral exchange rate is real exchange rate between the Ghana Cedi and the currency of the trading partners. It is thus the price of the Ghana Cedi expressed in terms of the foreign currency of the each trading partner. We calculated the RBER as the nominal bilateral exchange rate between the Cedi and each partner's currency (e_{ijt}) multiplied by the ratio of foreign price index (P_j) to Ghana's price index (P_{it}). That is,

[7] Available online at: databank.worldbank.org.
[8] http://distancecalculator.globefeed.com/Country_Distance_Calculator.asp.

$$RBER_{ijt} = \frac{e_{ijt}P_{jt}}{P_{it}} \quad (3.1)$$

Since the available data expresses nominal exchange rate as national currency of each country per US dollar, we compute the nominal bilateral exchange rate between the Cedi and the national currency of partners using the triangular arbitrage technique. Data exchange rate (i.e. national currency per US dollar) and consumer price indexes were sourced from the World Bank, *World Development Indicators* online database.

Institutional Quality (IQ): This is an aggregated measure of six (6) worldwide governance (institutional quality) indicators[9]. This encompasses (i) *Voice and Accountability* which reflects perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media; (ii) *Political Stability and Absence of Violence* which reflects perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism; (iii) *Government Effectiveness* which reflects perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies; (iv) *Regulatory Quality* which reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development; (v) *Rule of Law* which reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract

[9] The six governance indicators are measured in units ranging from about -2.5 to 2.5, with higher values corresponding to better governance outcomes. We develop an aggregate measure of institutions based on the individual indicators which is intended to provide an aggregate measure of institutional development rather than relying on each single measure.

enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence; and (vi) *Control of Corruption* which reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests. Data on these institutional quality indicators was sourced from *The World Bank's Worldwide Governance Indicators* online database[10].

Foreign Trade Policy Index (FTPI): This is proxied by trade freedom index which is a composite measure of the absence of tariff and non-tariff barriers that affect imports and exports of goods and services. It is incorporated to capture the degree of openness of trade partners to the flow of goods and services from around the world and the citizen's ability to interact freely as buyer or seller in the international marketplace. The index ranges from 0 to 100. A trade freedom score of 100 indicates that the country imposes zero tariffs and non-tariff barriers and thus signifies an environment that is most conducive to trade. Data on trade freedom was taken from the database of the *World Heritage Foundation*[11].

Foreign Direct Investment (FDI) inflows: This is the total annual inward flow of FDI. FDI flows are defined as investments that acquire a lasting management interest (10 percent or more of voting stock) in a local enterprise by an investor operating in another country. Such investment is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments and both short-term and long-term international loans. Data on FDI inflows to Ghana was sourced from the World Bank, *World Development Indicators* online database.

[10] www.govindicators.org
[11] www.heritage.org/research/features/index/downloads

Internal Transport Infrastructure (INF): This refers to the stock and quality of roads, streets, and highways, rail lines, airports and airways, ports and harbours, waterways and other transit systems to facilitate the movement of goods and enable people to access internal and global markets. This is proxied by the percentage of paved roads out of the total roads. A higher rating indicates a better infrastructure. Better infrastructure should lead to higher trade and therefore more exports from Ghana. Data on the percentage of paved roads in Ghana was sourced from the World Bank, *World Development Indicators* online database.

ECOWAS: This is a dummy variable for regional trade agreement and it is equal to 1 if a country is a member of the Economic Community of West African States (ECOWAS) and 0 if otherwise. The information on ECOWAS membership was obtained from the Community's website[12].

Language (LANG): This refers to the official (commercial) language of Ghana and its trading partners. It is a dummy variable, constructed such that, LANG is equal to 1 if the official language a given partner is English and LANG is equal to 0 if otherwise. Data on the official language of the sampled countries was sourced from the *Central Intelligence Agency (CIA) World Fact Book*.

[12] *www.ecowas.int*

3.2 Model Specification and Theoretical Framework

3.2.1 Specification of the Gravity Model

We begin this section with the specification of the general framework for analyzing panel data which allows the researcher great flexibility in modeling differences in behaviour of *N* cross-section units (i, j: 1, 2, …, *N*) over *T* years (t: 1, 2, … , *T*). The basic framework for the discussion in this section is a regression model of the form:

$$y_{it} = \alpha + X_{it}^{'}\beta_i + \varepsilon_{it} \qquad (3.1)$$

where y_{it} is the regressand or dependent variable, i is the cross-section dimension for individuals countries, t is the time series dimension of the data, α represents the intercept; where appropriate the intercept/country-specific fixed-effects (α_i) is extended to include time trends. In addition, the intercept, time trends and the slope coefficients (β_i) are allowed to vary across individual countries. The inclusion of country specific fixed-effects and time trends allow us to capture any omitted variables assumed to be stable in the long run relationship (Sakyi, 2011b). $\beta_i = (\beta_{1i}, \beta_{2i}, \beta_{3i}, \ldots, \beta_{Ki})$ is a vector of $K \times 1$ coefficients and $X_{it} = (X_{1i}, X_{2i}, X_{3i}, \ldots, X_{Ki})$ is the itth observation on K explanatory variables and ε_{it} is the disturbance term.

To define our dependent and independent variables, 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 GDPs and a decreasing function of the cost of transportation, which is represented by the distance between two countries. The basic gravity model, which is analogous to Isaac Newton's law of gravity in physics, takes the functional form:

$$TT_{ijt} = \alpha\left(\frac{GDP_{it}^{\beta_1} \times GDP_{jt}^{\beta_2}}{D_{ij}^{\beta_3}}\right) \quad (3.2)$$

where α is the gravitational constant, TT_{ijt}, is the value of total bilateral trade (measured as the sum of exports and imports) between country *i* and country *j* at time *t*, the GDPs capture their "economic masses", D_{ij} the distance between the two countries' capitals (or economic centres). β_1, β_2 and β_3 are coefficients to be estimated.

Equation (4.2) says that the value of trade between any two countries is proportional, other things being equal, to the product of two countries' GDPs, and diminishes with the geographical distance between the two countries.

Taking the natural logarithm of both sides of equation (4.2), we obtain the following stochastic log-linearized form of the baseline model:

$$\ln TT_{ijt} = \delta + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} + \beta_3 \ln D_{ij} + \varepsilon_{ijt} \quad (3.3)$$

where *ln* is the natural logarithm operator, $\delta = \text{Log}\,\alpha$ and ε_{ij} represents the white-noise error term. Using the log-linear form allows the interpretation of the coefficients as elasticities of trade flow with respect to the explanatory variables.

Many empirical studies have reported that equation (3.3) fits data well and gives robust results. However, as reviewed in literature, there are other factors that influence trade flows but are excluded from this equation. In this study, we estimate an augmented version of the basic gravity model specified in (3.3). This is done by incorporating other factors that facilitate or inhibit trade flows between pairs of countries. The augmented gravity equation employed in this study is expressed as follows:

$$\ln TT_{ijt} = \delta + \varphi_{ij} + \gamma_t + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} + \beta_3 \ln D_{ij} + \beta_4 \ln POP_{it} + \beta_5 \ln POP_{jt} + \beta_6 \ln GDPPCD_{ijt} + \beta_7 IQ_{it} + \beta_8 \ln FDI_{it} + \beta_9 \ln RBER_{ijt} + \beta_{10} \ln INF_{it} + \beta_{11} \ln FTPI_{jt} + \beta_{12} ECOWAS_{ij} + \beta_{13} LANG_{ij} + \xi_{ijt} \quad (3.4)$$

All variables are as defined in the previous section. δ is the general intercept, φ_{ij} accounts for country-specific effects, including unobservable characteristics, associated with a given country pair that have historically affected bilateral trade flows, and γ_t accounts time-specific effects and $\beta_1, \beta_2, \ldots, \beta_{10}$ are all elasticity coefficients. In an alternative specification, we estimate (3.4) with the log of bilateral exports (*lnX*) as the regressand with the purpose of analyzing the distinctive impact of these internal and external factors on Ghana's bilateral exports over the study period.

3.2.2 Theoretical Justification and a priori Expectation

The GDPs of the home and host countries provide a standard way of capturing the "mass" (i.e. economic size) of the two countries in the gravity model. In the home country *i* (Ghana), the larger its GDP (GDP_i), the larger its production capacity, the more likely it is to attain economies of scale and increase its exports supply on the basis of its comparative advantage. In the host country *j* (Ghana's trading partners), a larger GDP (GDP_j) is suggestive of the existence of larger income and higher ability to demand more imports from the rest of the world including those from country *i* (Ghana). Therefore, growth in their GDPs is expected to increase the amount of bilateral trade between them. Hence, we expect their estimated coefficients to be $\beta_1 > 0$ and $\beta_2 > 0$.

The estimated coefficient of distance is anticipated to have a negative sign ($\beta_3 < 0$). The reason being that, as a proxy for transportation costs, time-related costs and cultural costs, the greater the geographic distance between pairs of trading partners, the higher will be the associated transaction costs. This will increase products' prices and subsequently erode their competitiveness and gains from trade. This reduces the extent to which they trade with each other.

An exporting country with a huge population size is expected to produce and export more due to economies of scale resulting from 'cheap' labour. However, it can also export less due to higher domestic absorption effect of larger population size. Hence, the coefficient of exporter's population can be positively or negatively signed ($\beta_4 \gtrless 0$). On other hand, an importing country with a huge population size is indicative of potentially larger market size and is expected to import more. Hence, the coefficient of the partners' population is expected to be positively signed ($\beta_5 > 0$).

The coefficient of per capita income differential between partners, is expected to be ambiguous ($\beta_6 \gtrless 0$). The per capita income differential between country pair does not only reflect the differences in factor endowment between trade pair, but it is also represents differences in preferences, which constitute a significant trade barrier between countries. According to Linder (1961), the more similar the demand structure of the two countries the more intensive potentially is the trade between these two countries. The traditional way of testing the similarity of demand structure or preferences, as suggested by Linder, is by comparing the average (per capita) income of each country. The smaller the difference in their per capita incomes, the more similar will be their preferences or demand structure and the higher the expected trade. On the other hand, H-O postulates that trade patterns are

determined by comparative advantage arising from differences in the relative factor endowments of different nations. This difference in factor endowments of nations, in turn, produces differences in average income across countries. Thus, by predicting that nations with dissimilar factor endowment will trade more intensively with each other than countries with identical resource endowment, deductively, the Heckscher-Ohlin hypothesis also predicts that countries with dissimilar levels of per capita income will trade more than countries with similar levels of per capita income. To sum up, in this study, a negative effect of per capita GDP differential between Ghana and its partners on Ghana's bilateral trade (i.e. ($\beta_6 < 0$) suggests that Ghana's trade pattern follows the Linder hypothesis, whilst a positive effect (i.e.$\beta_6 > 0$) implies Ghana's trade pattern follows the H-O hypothesis.

Domestic institutional quality matters a lot for bilateral trade as it affects the production and export supply capacity of a country. Institution embodies several elements: formal and informal rules of behaviour, ways and means of enforcing these rules, procedures for mediation of conflicts, sanctions in the case of breach of the rules, and organizations supporting market transactions. The quality of institutions in the domestic economy can create or destroy incentives for individuals to engage in trade, and invest in human and physical capital. Contract enforcement, property rights, investor protection, and the like, matter because they allow agents to overcome frictions that arise when two parties with competing interests enter into a production relationship. Even if a country lowers its trade barriers, for instance, partners may be reluctant to trade with the country if they do not believe contracts can be enforced. Thus, the better the quality of domestic institutions, the larger will be the volume of the country's bilateral trade and a deterioration of the quality of a country's institutions should result in a reduction of its exports, and the volumes of it bilateral trade. We, therefore, expect the coefficient of institutional quality to be positive ($\beta_7 > 0$).

Empirical studies on the importance of the inflow of FDI in host countries suggest that it promotes capital formation in the host country by augmenting the supply of funds for investment. In addition, it is an important vehicle for the transfer of technology, the introduction of new processes, managerial skills and know-how in the domestic market, employee training, international production networks, and access to markets. These have direct impact on the host country's volume of trade as they stimulate domestic production and increase the host country's export capacity, especially when the FDI is directed to the export sectors to take advantage of the host country's comparative advantage. Thus, the coefficient of FDI is expected to have a positive sign ($\beta_8 > 0$).

The real bilateral exchange rate is incorporated as a proxy for the relative price of foreign goods in terms of domestic goods. The real bilateral exchange rate measures the international competitiveness of goods produced domestically. An increase in the real exchange (or real depreciation) means that it takes fewer units of foreign currency to buy one unit of domestic currency. This makes domestic goods relatively cheaper, leading to an increase in exports due to higher foreign demand. On the other hand, when the real exchange rate decreases (there is a real appreciation) our economy loses competiveness because it now requires more units of foreign currency to buy one unit of domestic currency. This raises the price of exported goods and lowers that of imported goods, leading to increase in imports due to higher domestic demand. Thus, coefficient of RBER can be positive or negative ($\beta_9 \gtrless 0$) in the bilateral trade model. However, in the exports model it is expected to be negative ($\beta_9 < 0$).

The quality of physical infrastructure is not only crucial for the export supply capacity of the economy but it also directly influences the competitiveness of its exports by affecting the transport costs of moving the goods and services from the exporting country to the importing

country, the risk of loss, damage and spoilage to goods in transit and the timelines of delivery. Improvement in the quality and quantity of trade-related internal infrastructure in the form of better paved roads and highways, railroads, air and sea ports, and telecommunication services is a cost-effective means of lowering trade costs, promoting bilateral trade and enhancing trade facilitation and regional integration. Thus, we expect the coefficient of INF to be ($\beta_{10} > 0$).

Foreign trade policy index (FTPI) reflects an economy's openness to the flow of goods and services from around the world and the citizen's ability to interact freely as buyer or seller in the international marketplace. Trade restrictions can manifest themselves in the form of tariffs, export taxes, trade quotas, or outright trade bans. However, trade restrictions also appear in more subtle ways, particularly in the form of regulatory barriers. The degree to which government hinders the free flow of foreign commerce has a direct bearing on the ability of individuals to pursue their economic goals and maximize their productivity and well-being. Tariffs, for example, directly increase the prices that local consumers pay for foreign imports, but they also distort production incentives for local producers, causing them to produce either a good in which they lack a comparative advantage or more of a protected good than is economically efficient. This impedes overall economic efficiency and growth. Thus, the more open an economy is, as indicated by high trade freedom rating, the more it is expected to trade with other economies. Hence we expected the coefficient of FTPI to be positive ($\beta_{11} > 0$).

The formation of a regional economic agreement increases the market size of member countries and attracts non-member countries to transact business in the region. Regional trade blocs and preferential trade agreements are found to be trade enhancing in many empirical

studies. In this study, ECOWAS is a dummy variable introduced to control for the effects of regional trade agreements on Ghana's bilateral trade. The ECOWAS dummy is equal to one when a trading partner belongs to ECOWAS as Ghana and zero otherwise. We expect its coefficient to be positive ($\beta_{12} > 0$).

Sharing common language (LANG) is a proxy of historical and cultural links, which are particularly important at reducing the cost of unfamiliarity in international trade. Sharing similar culture not only reflects the high propensity of the people in two countries to consume similar goods but indicates a lower cost of doing business for firms from one country in another. Thus, sharing common language helps to facilitate and expedite trade negotiations, reduce transaction costs and increase the level of trade between both countries. Thus, its coefficient is expected to be positive ($\beta_{13} > 0$).

3.3 Econometric Methodology

3.3.1 Panel Data Framework

As reviewed in the previous Chapter, early empirical studies employed cross-section data to estimate gravity models. However, most contemporary researchers use panel data (which pools together cross-sectional observations over several time periods) to estimate gravity models. Baltagi (2008) provides a detailed explanation of the advantages and disadvantages of using panel data. Some of the merits of using panel data include the following: (i) it provides a more accurate way of capturing controlling for individual heterogeneity[13] by allowing for

[13] In cross-section analysis unobserved individual (country)-specific or time-invariant variables are necessarily captured by the error term. Since these variables are likely to be correlated with explanatory variables, the usual least square estimator is inconsistent, owing to omitted variable bias in time series regressions.

individual-specific variables; (ii) by combining time series of cross-section observations, panel data give more informative data, more variability, less collinearity among variables, more degrees of freedom and more efficiency; and (iii) by studying the repeated cross section of observations, panel data are better suited to study the dynamics of change. However, the use of panel data has some limitations including (i) the 'poolability' (homogeneity) assumption, although there are formal tests to evaluate its validity; (ii) potential cross-sectional dependence, which complicates the analysis; (iii) some tests and methods require balanced panels; and (iv) cross country data consistency (Baltagi, 2008).

Having acknowledged the advantages and limitations of using panel data, we now proceed with a discussion of the alternative estimation techniques that have been utilized within the panel data framework.

3.3.1.1 Pooled Ordinary Least Squares (OLS)

The simplest, and possibly naïve, estimator for panel is the pooled OLS estimator, which proceeds by essentially ignoring the panel structure of the data (the space and time dimensions of the pooled data), and just estimate the usual OLS regression. The pooled specification may be written as:

$$y_{it} = X_{it}\beta + \alpha + u_{it} \tag{3.5}$$

Where y_{it} is the observation on the dependent variable for cross-sectional unit (country) i in period t, X_{it} is a 1 × K vector of explanatory variables observed for country i in period t, β is a K ×1 vector of parameters, and u_{it} is an error or disturbance term specific to country i in period t. This approach assumes that the intercept (α) and all the coefficients (β) are constant or identical for all individuals across time and that $u_{it} \sim iid(0, \sigma_u^2)$ for all i and t, implying the

observations are serially uncorrelated; and across individuals and time, the errors are homogenous. As Gujarati (2004) indicated these assumptions are highly restrictive, as the pooled regression ignores the "individuality" of each country and distorts the true picture of the relationship between the dependent and independent variables.

3.3.1.2 The Fixed Effects Estimator

In recognition of the fact that each cross-sectional unit might have some special characteristics of its own, in the fixed effect model (FEM) the intercept in the regression is allowed to differ among individual units but each individual intercept does not vary over time. In the specification of the FEM, we decompose the error term u_{it} into a unit-specific and time-invariant component, α_i, and an observation-specific error term, ε_{it}; yielding $u_{it} = \alpha_i + \varepsilon_{it}$. Thus the basic FEM is of the form:

$$y_{it} = X_{it}\beta + \alpha_i + \varepsilon_{it}, \qquad \varepsilon_{it} \sim iid(0, \sigma_\varepsilon^2) \tag{3.6}$$

The α_is are then treated as fixed parameters, which are to be estimated. This can be done by including a dummy variable for each cross-sectional unit (and suppressing the global constant). Hence, this is sometimes called the Least Squares Dummy Variables (LSDV) method. Alternatively, one can subtract the group mean from each of variables and estimate a model without a constant, using the "de-meaned data". This is known also as the *within transformation* and the OLS estimator for β obtained from this transformed model is often called the *within estimator or fixed effects estimator*. The within transformation helps eliminate the endogeneity problem that would bias the OLS estimates (Mili & Rayhan, 2011). However, the fixed estimator has some problems. For instance, the introduction of too many dummy variables may pose problems of the low degrees of freedom, possibility of

multicolinearity and inability to identify the impact of time-invariant variables on the dependent variable (Gujarati, 2004).

3.3.1.3 The Random Effects Model

In contrast to the fixed effects model, the random effects model (REM) assumes that the individual (heterogeneity) effects are captured by the intercept and a random component, ε_{it}, which is independently and identically distributed over individuals. That is, this random component is not associated with the regressors on the right hand side and part of the error term. The structure of the REM can be written as:

$$y_{it} = X_{it}\beta + \mu + \alpha_i + \varepsilon_{it}, \qquad \varepsilon_{it} \sim iid(0, \sigma_\varepsilon^2); \qquad \alpha_i \sim iid(0, \sigma_\alpha^2) \tag{3.7}$$

where $\alpha_i + \varepsilon_{it}$ is treated as an error term consisting of two components: an individual specific component, which does not vary over time, and a combined time series and cross-section error component, which is assumed to be uncorrelated over time. The General Least Square (GLS) Estimator, which is a weighted average of between and within effects, is used to estimate the random effects model. It tells us where the variation comes from e.g. from within the individuals or between the individuals. An advantage of the REM is that it allows us to estimate the effect of time-invariant variables which cancel out in a fixed effects estimation.

According to Greene (2008), the crucial distinction between fixed and random effects is whether the unobserved individual effect embodies elements that are correlated with the regressors in the model, not whether these effects are stochastic or not. In order to decide between the two models we test for the null hypothesis that the explanatory variables and the individual effects are uncorrelated using a Hausman test. That is, The Hausman test thus tests whether the fixed effects and random effects estimator are significantly different. The null is

that the two estimation methods are both consistent and that therefore they should yield coefficients that are "similar". The alternative hypothesis is that the fixed effects estimation is consistent and the random effects estimation is not; if this is the case, then we would expect to see differences between the two sets of coefficients. This is because the random effects estimator makes an assumption (the random effects are orthogonal to the regressors) that the fixed effects estimator does not. If this assumption is wrong, the random effects estimator will be inconsistent, but the fixed effects estimator is unaffected. A large and significant Hausman statistic means a large and significant difference, and so we reject the null that the two methods are consistent in favour of the alternative hypothesis that one is consistent (fixed effects).

3.3.2 Panel Unit Root and Panel Cointegration Tests

Notwithstanding the fact that most empirical studies that use the gravity model to analyze the determinants of trade flows, including those surveyed in the empirical review of the previous chapter, utilize the fixed effects and random effects models, recent studies (see Baltagi and Kao (2000), Pedroni (2001), Choi (2001), Smith *et al.*, (2004), etc.) have increasingly considered the non-stationarity and issues of heterogeneity in the panel data. The fact that growth in world trade has persistently outpaced the real growth in world output in the past decades implies that the level of interdependence between countries is also increasing strongly. As such, the possibility of cross-sectional dependence in cross-sectional panels, resulting from unobserved common shocks that become part of the random error term, has been strongly emphasized in literature (Sakyi, 2011b, Baltagi, 2008). In addition, since the estimable gravity model includes international macroeconomic variables tend to be nonstationary overtime, due to the strong influence of global economic shocks (i.e. business

cycles of large economies, and oil prices), the traditional fixed effects (FE) estimator is subject to large potential bias and yield misleading results.

In order to avoid the possibility of spurious regression normally associated with the time series component of panel data and heterogeneity translating into biased estimates of bilateral trade relationships, we employ the panel unit root and cointegration tests to ascertain the stationarity properties of the time variant variables in the data series and to test for cointegrating properties of the relationships among all these variables in the data whilst taking into consideration the problem of cross-sectional dependence.

3.3.2.1 Panel Unit Root Test

Panel unit root testing requires analyzing the stationarity properties of the variables as it is believed that most macroeconomic variables exhibit trends in them. In this study, we employ the panel unit root tests developed by Levin, Lin and Chu, (2002) (hereafter LLC), and Im, Pesaran and Shin (2003) (hereafter IPS) to test for the order of integration of variables entering the gravity equation.

The LLC test developed by Levin et al. (2002) is a generalization of the augment Dickey-Fuller (ADF) individual country unit root test to a common panel unit root test. The idea is that this panel unit root will be more powerful than performing individual unit root tests for each cross-section. The LLC test evaluates the null hypothesis that each individual time series in the panel contains a unit root against the alternative hypothesis that all individual unit root of the panel is stationary. The resulting panel version of the ADF test takes the form:

$$\Delta y_{it} = \rho_i y_{it-1} + \sum_{j=1}^{p_i} \theta_{ij} \Delta\, y_{it-j} + \emptyset_i Z_{it} + \varepsilon_{it} \qquad (3.8)$$

Where ρ is the autoregressive (AR) coefficient, Z_{it} is the vector of deterministic variables including fixed effects or joint intercept, linear time trends and time dummies which capture cross-sectional heterogeneity and $\emptyset_i$ is the corresponding vector of coefficients. Since the lag length of the lagged difference terms (p_i) is unknown, Levin et al. (2002) suggest the following three-step procedure to implement their test[14]: (i) Perform separate ADF regressions for each cross-section and generate two orthogonalized residuals; (ii) Estimate the ratio of long-run to short-run standard deviations for each individual (iii) Compute the pooled t-statistics, with the average number of observations per individual and average lag length. Since the AR coefficient ρ is constrained to be the same across individuals (i.e. $\rho_i = \rho$ for all i), the null hypothesis of the LLC test assumes all cross-sections are non-stationary ($H_0: \rho_i = \rho = 0$) against the alternative hypothesis that each time series is stationary ($H_1: \rho_i < 0$ for all individual units i). The pooled t-statistic has been shown by the authors to have a limiting normal distribution as $N \to \infty$ and $T \to \infty$ and is recommended for panels of moderate size, especially for N > 10 and T > 25. The performance of the LLC test, thus, has poor power and may be problematic for panels with small time dimension (i.e. when T is small), as it is common in gravity models.

The Levin, Lin and Chu test is restrictive in the sense that it requires ρ to be homogeneous across *i*. Im et al. (2003) address this homogeneity issue, proposing a heterogeneous panel unit root test (IPS test) based on individual ADF tests. They allow for a heterogeneous coefficient of y_{it-1} and propose an alternative testing procedure based on averaging ADF individual unit root test statistics, which can be normalized to a normal distribution. The null hypothesis is that each series in the panel contains a unit root, i.e., $H_0: \rho_i = 0$ for all i and the alternative hypothesis allows for some (but not all) of the individual series to have unit roots,

[14] See Baltagi (2008) for detailed discussion on this test and derivation of the test statistic.

i.e., $H_0: \rho_i < 0$ for at least one i. The IPS t-bar statistic is defined as the average of the individual ADF statistic as:

$$\bar{t} = \frac{1}{N}\sum_{i=1}^{N} t_{\rho_i} \tag{3.9}$$

where t_{ρ_i} is the individual t-statistic for testing the null hypothesis. IPS show that a properly standardized $\bar{t}$ has an asymptotic N(0, 1) distribution, given as:

$$t_{IPS} = \frac{\sqrt{N}\left(\bar{t} - \frac{1}{N}\sum_{i=1}^{N} E[t_{iT}|\rho_i = 0]\right)}{\sqrt{\frac{1}{N}\sum_{i=1}^{N} var[t_{iT}|\rho_i = 0]}} \Rightarrow N(0,1) \tag{3.10}$$

as $T \to \infty$ followed by $N \to \infty$ sequentially. IPS show that if a large enough lag order is selected for the underlying ADF regressions, then the small sample performance of the t-bar test is reasonably satisfactory and generally better than the LLC test (Baltagi, 2008).

3.3.2.2 Panel Cointegration Tests

Balgati (2008) noted that panel cointegration models are directed at studying questions that surround long-run economic relationships typically encountered in macroeconomic and financial data. Such a long-run relationship is often predicted by economic theory and it is then of central interest to estimate the regression coefficients and test whether they satisfy theoretical restrictions. In this section, we discuss the panel cointegration test proposed by Pedroni (1999, 2004), which has been employed in this study to establish the cointegrating properties of the long-run equilibrium relationship among all the time-variant variables entering the estimable gravity model.

Following Pedroni (1999), we consider the following model:

$$y_{it} = \alpha_i + \beta_i t + \gamma_{1i}x_{1i} + \gamma_{2i}x_{2i} + \gamma_{3i}x_{3i} + \cdots + \gamma_{Mi}x_{Mi} + e_{it} \tag{3.11}$$

For i = 1, 2, …,N cross-sections; t = 1, 2, …, T observations over time; and m = 1, 2, …, M regressors (x_s); and $e_{it} = \rho_i e_{it-1} + \varepsilon_{it}$.

In the above equation, α_i represents the individual-specific (fixed) effect intercept that is allowed to vary across individual cross-sectional units; β_i is the time effect modeled heterogeneously in the same way as the α_i; and $\gamma_{1i}, \gamma_{2i}, \dots, \gamma_{Mi}$are the slope coefficents

In the Pedroni's cointegration tests the value the AR(1) coefficient (ρ_i) is tested for the presence of unit root as in the Engle-Granger (1987) two-step approach to cointegration in time series analysis.

Pedroni developed two main types of test statistics, namely within-group test statistic (which assumes homogeneity of the AR term) and between-group test statistic (which allows for heterogeneity). Pedroni tested the null hypothesis of no cointegration through seven panel cointegration test statistics[15] using the residuals from the long-run regression (3.13). Four of them are pooled statistics (based on the within dimension approach), also referred to panel test statistics. The remaining three are group cointegration tests (based on the between-dimension); they less restrictive as they allow for heterogeneity of the AR term.

The first statistic (v-statistic) is analogous to the long-run non-parametric variance ratio statistic for time series, while the second statistic (panel ρ statistic) is equivalent to the semi-parametric 'rho' statistic of Phillips and Perron (1988). The other two are panel extensions of the (non-parametric) Phillips-Perron and (parametric) ADF t-statistics, respectively. These tests allow for heterogeneous slope coefficients, fixed effects and individual specific deterministic trends, but are only valid if the variables are I(1). These tests are based on the

[15] See Pedroni (1999) for the derivation of these statistics.

null hypothesis of no cointegration, $H_0 : \rho_i = 1$, against the homogenous alternative $H_1 : \rho_i = \rho < 1$ for all panel units *i*. The parametric statistics use the fully specified panel ADF, while the non-parametric statistics do not include lagged differenced residuals (Fidrmuc, 2009).

Finally, the group mean statistics are defined similarly for heterogeneous group mean estimates (i.e., average of parameter estimations for the separate units). In this case, the alternative hypothesis is more general, $H_1 : \rho_i < 1$ for all *i*, which may be preferable for standard empirical applications (Fidrmuc, 2009).

Pedroni (1999) noted that the panel-ADF and the group-ADF tests of these seven tests have better small sample properties than the other statistics. Thus, this study depends on these two tests to establish the cointegrating properties of the time-variant variables in the gravity model.

To ascertain the robustness of the cointegration results, we employ another residual-based tests proposed by Kao (1999).The Kao tests are similar to Pedroni's, but Kao considered an initial panel regression model with individual intercepts (fixed effects), no deterministic trend and homogeneous regression coefficients. The test is based on the following:

$$y_{it} = \alpha_i + x'_{it}\beta + e_{it} \qquad e_{it} \sim iid(0, \sigma_e^2) \qquad (3.12)$$

Where α_i are fixed effects and y_{it} and x_{it} are *I* (1). Kao (1999) proposed DF and ADF-type unit root tests for the residual (e_{it}) as a test for the null of no cointegration. The tests are computed based on the fixed effects residuals of the form: $e_{it} = \rho e_{it-1} + v_{it}$. Thus the null hypothesis of no cointegration can be written as H_0: $\rho = 1$. Details on the computation of test statistics can be found in Kao (1999) and Baltagi (2008).

3.3.3 Estimation of the Long-Run Relationship

To estimate the long-run relationship between the variables in the gravity models, we employ pooled mean group (PMG) and panel dynamic OLS (DOLS) cointegrating estimators due to Pesaran, Shin and Smith (1999) and Kao and Chiang (2000) respectively.

The PMG estimator was developed by Persaran *et al.*, (1999) offers a new technique for estimating nonstationary dynamic heterogeneous panels, and it relies on a combination of pooling and averaging of coefficients across groups (Blackburne III and Frank, 2007). The procedure proposed by Persaran *et al.*, (1999) follows an autoregressive distributed lag (ARDL) ($p, q_1, \ldots, q_k$) dynamic panel specification of the form

$$y_{i,t} = \sum_{j=1}^{p} \lambda_{ij} y_{i,t-j} + \sum_{j=1}^{q} \delta_{ij}' X_{i,t-j} + \mu_i + \epsilon_{i,t} \qquad (3.13)$$

where the number of groups $i = 1, 2, \ldots, N$; the number of periods t = 1, 2,…,T; X_{it} is a $k \times 1$ vector of explanatory variables; δ_{it} are the $k \times 1$ coefficient vectors; λ_{ij} are scalars; and μ_i is the group-specific effect. Time trends and other fixed regressors may be included. An important feature of the cointegrated variables is their responsiveness to any deviation from the long-run equilibrium. As such, the PMG estimator provides useful way of capturing the short-run dynamics of the variables in the system by estimating an error correction equation of the ARDL specification in (3.13) in the form

$$\Delta y_{it} = \phi_i \left(y_{i,t-1} - \theta_i' X_{it-1} \right) + \sum_{j=1}^{p-1} \lambda^*{}_{ij} \Delta y_{i,t-j} + \sum_{j=1}^{q-1} \delta_{ij}'^{*} \Delta X_{i,t-j} + \mu_i + \epsilon_{it} \qquad (3.14)$$

The parameter ϕ_i is the error-correcting speed of adjustment term. If $\phi_i = 0$ 0, then there would be no evidence for a long-run relationship. This parameter is expected to be

significantly negative under the prior assumption that the variables show a return to a long-run equilibrium. Of particular importance is the vector θ_i', which contains the long-run relationships between the variables (i.e. long-run coefficients) and $\delta_{ij}'^{*}$ incorporates the short-run relationships. Pesaran, Shin, and Smith (1999) develop a maximum likelihood method to estimate the parameters through iterative processs until convergence is achieved. The parameter estimates from iterated conditional likelihood maximization are asymptotically identical to those from full-information maximum likelihood (Blackburne III and Frank, 2007).

We also employ a panel dynamic OLS estimator (DOLS) proposed by Kao and Chiang (2000), who found that the DOLS outperforms the fixed effects (OLS) estimator and tends to be more promising in cointegrated panel regressions (Fidrmuc, 2009 & Baltagi, 2008). The DOLS estimator, favoured by Kao and Chiang (2000), is a panel extension of the method originally proposed by Saikkonen (1991) and Stock and Watson (1993) for time series regressions. The basic DOLS specification takes the form:

$$y_{it} = \alpha_i + \beta' X_{it} + \sum_{j=-q}^{q} \delta_{ij}\, \Delta X_{i,t+j} + \varepsilon_{it} \qquad (3.15)$$

where *X it* is a vector of explanatory variables, β the estimated long-run impact, q the number of leads and lags of the first-differenced data, and δ_{ij} the associated parameters. In this study, we employ the following DOLS gravity equation[16]:

$$\ln(\mathrm{TT})_{\mathrm{ijt}} = \alpha_i + \beta \mathrm{Z}_{\mathrm{ijt}} + \sum_{k=-m}^{m} \delta_{\mathrm{ij}}\, \Delta \mathrm{Z}_{\mathrm{ij,t+k}} + \gamma_1 \mathrm{ECOWAS}_{\mathrm{ijt}} + \gamma_2 \mathrm{LANG}_{\mathrm{ijt}} + \varepsilon_{\mathrm{ijt}} \qquad (3.16)$$

[16] *This specification was also employed by Geldi (2012) and Farquee (2004).*

where Z_{ijt} is the vector of integrated regressors consisting of the logs of GDPs, population, per capita differential, real exchange rate, distance, FDI, internal infrastructure, institutional quality and foreign trade policy index and $\sum_{k=-m}^{m} \Delta Z_{ij,t+k}$ is the sum of leads and lags of the differenced regressors. By including leads and lags of the differenced explanatory variables as additional regressors in gravity equation, the panel DOLS addresses the potential endogeneity bias as well as the presence of serial correlation produced by the OLS estimates. The standard errors, moreover, are adjusted to provide interpretable test statistics with the standard limiting distributions.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

4.0 Introduction

The main concern of this chapter is to present and analyze the estimated results of the gravity models of bilateral trade flows. The empirical analyses and discussions in this chapter are presented in two main sections. The first section presents the preliminary results of the pooled OLS, fixed effects (FE) and random effects (RE) estimators. The section is also devoted to the choice of the appropriate estimator based on the Hausman test and discussion of the results. In the second section, we examine the stationarity and cointegrating properties of the panel series using panel unit root and panel cointegration techniques. Finally, we present and discuss the estimated results of the long-run and short-run relationships among the variables entering the gravity models of bilateral trade and exports for Ghana.

4.1 Analysis of the Estimated Pooled OLS, Fixed Effects and Random Effects Models

In view of the nature of dataset employed in this study, it is imperative that we select an appropriate estimation method which accounts for the heterogeneity in the gravity models resulting from the presence of individual and time effects in the panel data. In so doing, we first estimate the pooled OLS model, fixed effects (FE) and random effects (RE) models, with total bilateral trade and bilateral exports as the regressands. The preliminary results of these models are presented in Table 4.1 below.

Table 4.1: Pooled OLS, Fixed Effects (FE) and Random Effects (RE) Estimates of the Augmented Gravity Models of Ghana's Total Trade and Exports, 1995-2011

Estimated Method	Pooled OLS		Fixed Effects (FE-WG) Model		Random Effects (RE-GLS) Model	
Dependent variables	**ln TT_{ijt}**	**ln X_{ijt}**	**ln TT_{ijt}**	**ln X_{ijt}**	**ln TT_{ijt}**	**ln X_{ijt}**
$lnGDP_{it}$	2.361**	3.728**	2.321**	4.054***	2.248**	3.906***
	(0.0124)	(0.035)	(0.020)	(0.002)	(0.030)	(0.004)
$lnGDP_{jt}$	1.142***	0.491***	2.113***	1.996***	1.009***	0.872***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$lnPOP_{it}$	-1.691	-5.596	-3.885*	-9.233***	-1.770	-6.385**
	(0.633)	(0.169)	(0.098)	(0.003)	(0.4610	(0.041)
$lnPOP_{jt}$	-0.339***	0.179	0.698	1.352**	0.004	-0.112
	(0.001)	(0.138)	(0.172)	(0.045)	(0.981)	(0.564)
$lnGDPPCD_{ijt}$	-0.484***	0.0299	-0.096	-0.215*	-0.1548*	-0.181*
	(0.000)	(0.734)	(0.254)	(0.052)	(0.063)	(0.088)
$lnRBER_{ijt}$	0.133***	0.048	0.449***	0.423**	0.173	0.085
	(0.001)	(0.283)	(0.000)	(0.012)	(0.064)	(0.437)
$lnINF_{it}$	-0.149	-0.673*	-0.211	-0.832***	-0.135	-0.707***
	(0.618)	(0.052)	(0.299)	(0.002)	(0.513)	(0.008)
$lnFTPI_{it}$	0.123	0.830***	0.254	0.585***	0.479***	0.841***
	(0.505)	(0.000)	(0.106)	(0.005)	(0.002)	(0.000)
IQ_{it}	0.0972	0.099	0.0085	0.0374	0.072	0.102
	(0.595)	(0.636)	(0.944)	(0.814)	(0.561)	(0.529)
$lnFDI_{it}$	0.0415	0.0459	0.047	0.0862	0.026	0.055
	(0.617)	(0.630)	(0.395)	(0.237)	(0.649)	(0.455)
Constant	-13.511	24.486	-33.728	8.615	-15.312	30.571
	(0.671)	(0.504)	(0.111)	(0.757)	(0.483)	(0.280)
			Auxiliary Regression			
$lnDIST_{ijt}$	-1.142***	-1.724***	-2.380***	-2.808***	-1.643***	-1.728***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ECOWAS	-0.564	-2.707***	5.388***	3.817***	0.00523	-1.581
	(0.115)	(0.000)	(0.000)	(0.000)	(0.996)	(0.185)
LANG	0.409***	0.032	0.326	0.151	0.439	-1.728
	(0.000)	(0.781)	(0.201)	(0.578)	(0.137)	(0.857)
Constant	---	----	17.697***	21.681***	----	----
			(0.000)	(0.000)		
R^2	0.805	0.749	0.712	0.646	0.691	0.625
No. of countries	25	25	25	25	25	25
No. of observ.	425	425	425	425	425	425
Hausman [χ^2]	----	----	---	---	30.16	29.62
					(0.0008)	(0.001)

***,**, and * indicate statistical significance at 1%, 5% and 10% error level respectively. The values in parenthesis are the p-values of associated with the parameters. Results were obtained with the aid of Eviews7 and Stata12.

According the pooled OLS results, the trade and exports elasticities of all the conventional gravity variables — domestic income (GDP_i), foreign incomes (GDP_j) and geographical distance (DIST) — have their theoretically stipulated signs and were highly statistically significant at 1% error level.

That is, Ghana's bilateral exports and total trade flows are positively and significantly determined by Ghana's GDP (i.e. its productive capacity) and the GDP (i.e. incomes) of its partners, and both diminish significantly with the geographical distance between Ghana and its trading partners. Besides, Ghana's population, internal transport infrastructure and ECOWAS membership are found to exert negative effects on Ghana's trade flows; with internal transport infrastructure and ECOWAS being statistically significant at 10% and 1% error levels respectively. Again, whereas foreign trade policy, Ghana's institutional quality and inflows of foreign direct investment are consistently found to have positive but statistically insignificant impacts on both bilateral trade flows, the population of partners, per capita income differential, real bilateral exchange rate and language dummy are found to have mixed impacts on Ghana's trade flows, with regards to their signs and statistical significance.

Nevertheless, a major shortcoming of the pooled OLS (POLS) estimator is that it disregards the panel structure (time and space dimensions) of the pooled data and just estimates the usual OLS regression. That is, the POLS regression treats all the observations for all time periods as a single sample, without regard for unobservable individual or country-specific effects. This disregard for the effects of unobserved heterogeneity on bilateral trade flows induces autocorrelation in the errors and substantially distorts the inferences one draws from the estimates. Serlenga and Shin (2004) and Cheng and Wall (2005) demonstrated that ignoring heterogeneity translates into biased estimates of bilateral trade relationships.

To address this concern of biased estimates of the POLS estimator due to the omission of country-specific effects, we also present the results using the fixed effects (or within group (FE-WG)) and random effects (generalized least squares (RE-GLS) estimators in Table 4.1. In estimating the FE and RE models, we treated the country specific-effects as fixed under the former and as random under the latter. In general, it is observed from Table 4.1 that the magnitude of the coefficients of the FE models of total trade and exports are larger (in absolute terms) than those of their counterpart RE models. To ascertain whether or not this observed differences between the coefficients of the FE and RE estimators are statistically significant, we perform the Hausman specification test to compare the FE and RE estimates of coefficients. From the results, the Hausman χ^2 statistic for the trade model is 30.16 (with a *p*-value of 0.0008) and that of the exports model is 29.62 (with a *p*-value of 0.001). Since the associated *p*-values are less that 1 percent error level, the Hausman test strongly rejects the null hypothesis that both estimators are consistent and that there is no significant difference between their respective coefficients. Worded differently, this leads to strong rejection of the null hypothesis that RE estimator provides consistent estimates. Thus, on the basis of the Hausman test, we conclude that the FE estimator is appropriate for the estimation of the trade and exports models. Consequently, the remainder of this section is devoted to analyzing the results of the gravity models of bilateral trade and exports as yielded by FE estimator.

According to the FE estimates, Ghana's bilateral trade (i.e. TT and X) flows increase significantly with the economic masses of Ghana and its partners (as measured by their GDPs) and reduce significantly with the distance between them. These results fittingly concur with the theoretical postulation of the gravity model of trade. Specifically, the results show that a 1 percent increase in domestic GDP significantly increases Ghana's total bilateral trade by 2.3 percent and its bilateral exports by 4.1 percent, whilst the same percentage in the GDP

of trading partners, increases total trade by 2.11% and Ghana's exports by almost 2 percent. This suggests that Ghana's elasticities of trade and exports with respect to domestic and foreign incomes are highly elastic and that Ghana, like many other countries, tends to trade more with larger economies, than undersized ones.

Ghana's population is found to have negative and statistically significant effect on bilateral trade flows in Ghana. The coefficients of Ghana's population (-3.885 and -9.233) imply that, all other things being equal, a 1 percent growth in Ghana's population reduces its total bilateral trade by 3.55 percent (which is significant at 10% error level), and bilateral exports by 9.233 percent (which is highly significant at 1% error level). These yield a strong evidence for the existence of the absorption effect of increasing population in the case of Ghana. As argued by Oguledo and Macphee (1994), a negative relationship between exports and population is an indication of the absorption effect of expanding domestic markets. That is, increasing population results in an increase in the absorption capacity of the domestic market of produced goods (i.e. domestic consumption), and consequently, a decline in the country's exports.

In contrast, it is found that increasing population of trading partners positively influences the bilateral trade flows of Ghana. Comparably, the unique impact importers' population on total trade (0.698) is inelastic and statistically insignificant, but that on bilateral exports (1.352) is more elastic and statistically significant at 5 percent error level. Implicatively, increasing population size of partners is an indication of expansion in the size of international markets and growing demand for goods and services from the rest of the world including those from Ghana. This stimulates expansion in Ghana's bilateral exports supply to match the rising imports demand from its trading partners.

Interestingly, the coefficient of per capita income differential showed up to be negatively signed in both trade flows models — -0.096 for total trade and -0.215 for exports. This suggests that Ghana's total trade with and exports to its trading partners decline as the difference between its per capita income and that of its trading partners increases. Thus, the greater the divergence in the per capita incomes, the lower is the volume of trade flows between Ghana and such a partner. This rejects the Heckscher-Ohlin hypothesis (which predicts that countries with dissimilar levels of per capita income will trade more than countries with similar levels of per capita income) in favour of the Linder hypothesis (which posits that the smaller the difference in their per capita incomes, the more similar will be their preferences or demand structure and the higher the volume trade between them). However, this evidence is only strong or significant for the exports model at 10 percent error level. This perhaps explains and reflects the changing pattern in the direction of Ghana's trade flows from high income countries towards low and middle income countries, and emerging and transition economies with similar factor endowments and income levels.

Depreciation in Ghana's real bilateral exchange rate is found to significantly heighten the volume of bilateral trade flows in Ghana. From the results, a 1 percent depreciation in the Ghana cedi against the foreign currency of trading partners, enhances the relative competitiveness of Ghana's exports on the world market and leads to a 0.449 percent rise in total bilateral trade and 0.423 percent rise in bilateral exports. Although these price elasticities of trade and exports are found to be statistically significant 1 percent and 5 percent error levels respectively, they are essentially less than one; reflecting the inelastic nature of the demand for imports by Ghanaians and demand for Ghana's exports by foreigners. In essence, the Marshall-Lerner-Robinson condition for successful devaluation (depreciation) is not satisfied in the Ghanaian case, as both trade flows are less responsive to changes in relative

prices of domestic and foreign goods as mirrored by movements in the real bilateral exchange rate between the cedi and foreign currencies.

The coefficient of internal transport infrastructure is found to be incorrectly signed in both models, but only highly statistically significant in the gravity model of bilateral exports. This outcome points to the negative impact of poor trade-related infrastructural development in Ghana and most African countries on trade flows. This has been a major impediment to expanding intra-regional trade and sustainable development in Africa. This is due to the fact that, lack of quality and adequate trade-related infrastructure raises not only the transport costs of cross-border movement of tradable goods and services, but also the risk of loss, damage and spoilage to goods in transit and lowers the timelines of delivery. This consequently makes exported goods expensive and uncompetitive in the global market, and therefore, dampens the volume and intensity of trade flows with the rest of the world.

The openness of trading partners to the flow of goods and services from Ghana and the rest of the world is found to positively influence Ghana's bilateral trade flows. A 1 percent increase in trade freedom index of Ghana's trade partners, which is manifested in lower tariff and non-tariff barriers that restrain bilateral trade flows, is revealed to increase Ghana's total trade by 0.254 percent and its exports by 0.585 percent. The latter is found to be highly statistically significant at 1 percent error level, suggesting that the improved access gained by Ghanaian exporters to international markets through various bilateral and multilateral trade agreements and economic partnerships with different trading partners over the years has been particularly beneficial to Ghana's bilateral exports.

Another vital internal factor that affects the export supply capacity of a country and its bilateral relations is its institutional quality. From the results, the overall quality of Ghana's

institutions, which encompasses government effectiveness, regulatory quality, control of corruption, the rule of law, political stability and democratic accountability, is found to positively impact on Ghana's bilateral trade flows, especially, Ghana's bilateral exports (although it statistically insignificant). Although these indicators of institutional quality are still low, this outcome is an indication that Ghanaian institutions, coupled with stable macroeconomic policies and relative political stability, are becoming more effective, efficient and trade enhancing. The ensuing reduced-overall costs of transactions, apparently boosts investor confidence, and makes the country more competitive in terms of creating incentives for individuals to engage in trade and investment in human and physical capital in Ghana.

Foreign direct investment is found to exert positive but insignificant impact on Ghana's bilateral trade flows. By increasing capital stock and enhancing the transfer of technology, new processes, managerial skills and know-how in the domestic market, FDI is expected to result in a more efficient utilization of domestic resources, and higher absorption unemployed resources. This will, in turn, lead to increased productivity, especially of the country's comparative advantage exports products. However, the increasing inflow of foreign capitals to Ghana over the years, according to this result, does not appear to have any significant impact on Ghana's trade flows. A possible reason for this result is that a chunk FDI in Ghana goes to non-manufacturing sectors of the economy, particularly services sector for which reason FDI will not make any significant impact on industrial productivity, exports growth and economic growth (Adenutsi, 2008).

A major limitation of the FE estimator is that, due to the complete elimination of all time invariant variables during the within transformation, one is unable to straightforwardly estimate the unique effects of such variables on trade flows within the specified gravity

models. In the present study, distance (DIST), and the dummies for regional trade agreement (ECOWAS) and common official language (LANG) are such variables. However, this problem is easily remedied by running a secondary regression with the country-specific fixed effects (φ_{ij}) (i.e. the estimated individuals intercepts of the gravity models of trade and exports) as the dependent variable and distance and the dummies as the regressors.

From the results of the FE models, the country-specific fixed effects (see Appendix) are found to be positive for some trading partners and negative for others. By implication, on one hand, the positive effects suggest the existence of individual specific factors that enhance the flow of bilateral between Ghana and those trading partners, and on the other, the negative effects indicate the presence of individual specific factors in those countries that restrict or obstruct their respective bilateral trade with Ghana.

Reported in Table 4.1 are the results of the auxiliary regression of the FE models. Distance is found to significantly have deleterious effects on Ghana's total bilateral trade and exports, with each flow reducing by 2.38 percent and 2.81 percent respectively, whenever the remoteness of a partner from Ghana widens by 1 percent. This relationship is not only consistent with the theoretical predictions of the gravity model of trade but it is also significantly different from zero at 1 percent error level. As a proxy for trade costs, the farther apart countries are from Ghana, the greater the associated transaction costs, and the smaller gains from trade. This reduces the volume of Ghana's bilateral exports and trade with its trading partners. Thus, transportation costs and other trade-related transactions costs are major factors inhibiting trade flows between Ghana and its trading partners over the period under study.

Interestingly, regional integration is found to significantly foster bilateral trade and exports from Ghana. The coefficients on the ECOWAS dummy (i.e $e^{5.388} - 1 = 218.76$ for total trade and $e^{3.817} - 1 = 44.47$ for exports) are found to be positive and highly statistically significant at 1 percent level. The results show that Ghana's bilateral trade and exports with ECOWAS members are respectively 218.76 percent and 44.47 percent higher than those with non-ECOWAS members. Thus the volume of Ghana's bilateral trade flows with other ECOWAS countries is positively influenced, as theory predicted, by such a preferential trade agreement. Deductively, this gives indication that the diverse efforts geared towards promoting intra-regional trade in the ECOWAS sub-region are having significantly positive effects on the trade flows of the member countries.

As expected, the effect of common language on bilateral trade flows is found to be positive. However, it is not statistically different from zero at 5 percent error level. Hence, although Ghana tends to trade more with and exports more to countries with which it shares a common language (English), than non-English speaking countries, the results show that language (which captures the influence of similar culture, legal system, religion, tastes and preferences and historical ties) is not a significant determinant of Ghana's bilateral trade and exports over the study period.

4.2 The Estimated Results of the Gravity Models in Integrated Panels

Whereas the FE estimator provides a handy means for controlling for heterogeneity in the gravity models of trade, it is unable to cater for potential endogeneity of trade flows (TT and X) with respect to domestic output (Ghana's GDP), as well as the presence of panel unit roots in the macroeconomic variables entering the gravity models. When variables are nonstationary cointegration analysis is a more appropriate and robust estimation procedure than other panel estimation techniques (including the FE estimator). Therefore, following recent literature (see Faruqee, 2004 and Fidrmuc, 2009 among others), this study resorts to panel unit root and panel cointegration techniques to examine the integrational properties of the panel series and the long run relationships among the variables employed in the study.

4.2.1 Results of Panel Unit Root Tests

As a prerequisite for panel cointegration tests, we ascertain the stationarity or integrational properties of the time variant variables that enter the gravity model, namely, incomes, population, exports, imports, total trade, GDP per capita differential, real bilateral exchange rate, foreign trade policy index, infrastructure, institutional quality and foreign direct investment. This is achieved by employing Levin Lin Chu (LLC) and Im, Pesaran and Shin (IPS) panel unit root tests on the variables over 1995-2011. Whereas, the LLC test is based on the common unit root process assumption that the autocorrelation coefficients of the tested variables across cross sections are identical (indicating an alternative hypothesis of stationarity in all panel units), the IPS test relies on the individual unit root process assumption that the autocorrelation coefficients vary across cross sections. Individual intercepts, and individual intercepts plus deterministic time trend were included in all the test

specifications. To determine the country-specific lag length for the ADF regressions, the Schwarz-Bayesian Information Criterion (BIC) was used with a maximum lag of 2 regarding the LLC and the IPS tests. The test results are presented in Table 4.2.

Table 4.2: Panel Unit Root Tests Results

	LLC		IPS		LLC		IPS	
	Level		Level		First-Difference		First-Difference	
Variables	**Constant**	**Constant + Trend**	**Constant**	**Constant + Trend**	**Constant**	**Constant + Trend**	**Constant**	**Constant + Trend**
X	11.554	5.469	12.639	7.625	-4.355***	-2.093**	-4.429***	-3.747***
M	-0.745	-10.053***	5.246	-0.64042	-11.434***	-8.131***	-10.898***	-10.931***
TT	14.259	4.776	14.265	6.097	-5.699***	-3.901***	-3.724***	-6.371***
GDP	8.768	0.327	10.129	2.369	-8.258***	-10.612***	-7.162***	-7.028***
RBER	-6.421***	-6.438***	-3.115***	-1.774***	---	---	---	---
POP	15.707	-8.567***	15.449	-1.365	-3.3235	2.212***	-1.0189	-4.586***
INF	-1.176	-4.0667***	-1.206	-2.947***	---	---	---	---
IQ	-1.929**	-11.906***	-0.635	-6.827***	---	---	---	---
FTPI	0.247	-7.144***	3.091	-3.253***	---	---	---	---
FDI	10.161	0.441	12.458	6.781	-12.283***	-14.025***	-2.837***	-3.420***
GDPPCD	2.855	6.926	8.8334	9.511	-4.149***	-2.886***	-2.631***	-4.599***

** and *** represent significance at 5% and 1% levels respectively.
The test statistics were computed with the aid of Eviews7.

The results of the LLC panel unit root test show that all the variables, save real bilateral exchange rate (RBER) and institutional quality (IQ), are non-stationary at the level with an individual intercept. With the inclusion of a deterministic trend, the LLC test reveals that whereas bilateral imports (M), real bilateral exchange rate (RBER), population (POP), internal transport infrastructure (INF), institutional quality (IQ) and foreign trade policy index (FTPI) achieved stationarity at their levels, bilateral exports (X), total trade (TT), income (GDP), foreign direct investment (FDI) and GDP per capita differential (GDPPCD) remain non-stationary, indicating the presence of unit root in the variables. With the exception of M

and POP, the IPS test, under the same specifications with and without time trend, also yielded parallel results as the LLC test.

Also presented in Table 4.2 are the results of the LLC and IPS tests for unit root after first differencing the data series, whilst allowing for individual effects (constant) and individual effects plus a deterministic time trend. In the first case, when we allowed for only individual effects, both LLC and IPS tests respectively rejected the null hypothesis of common unit root and individual root in all (with the exception of POP) the panel data series at 1 percent significance level. Intuitively, this suggests that, on the basis of LLC and IPS tests, there is a very strong evidence these variables are integrated of order one (i.e. I(1)). However, after including a time trend, it is found that both tests significantly rejected the null hypothesis of panel unit root in all the variables, suggesting the existence of stationarity in all the variables.

The overall conclusion drawn from the results of the LLC and IPS panel unit root tests is that, there is a mixed evidence of non-stationarity in all the variables that are time variant. Whereas, some of them are stationary at the level with constant plus time trend (and are therefore *I*(0)), all of them achieved stationarity after first differencing with constant plus time trend (and are therefore, *I*(1)). The implication of these results is that, estimating the specified gravity model using the OLS estimator will yield biased and inconsistent estimates. It is therefore, imperative to determine the existence of the stable long-run (cointegrating) relationship among the variables. Specifically, the variables are said to be cointegrated if a linear combination of the variables turns out stationary error terms. In this study, we employ the residual based Pedroni's (2000, 2004) test to test the null hypothesis of no cointegration among the variables. The robustness of the Pedroni test result was ascertained by an alternative, Kao (1999) test, which is also based on the residuals of the static long-run

regression. The results of the cointegration tests are presented and analyzed in the next section.

4.2.3 Presentation and Analysis of Panel Cointegration Test Results

Table 4.3 reports the results of the test for the existence of a long-run stable relationship among the *I(*1) variables, as proposed by Pedroni (2000, 2004) and Kao (1999).

Table 4.3: Panel Cointegration Tests Results

Dependent Variable	**Log of Total Trade (lnTT)**		**Log of Exports (lnX)**	
Pedroni's Panel Statistics	**Statistic**	***p*-value**	**Statistic**	***p*-value**
Panel *v*-Statistic	-2.801	0.9975	-2.585	0.9951
Panel *rho*-Statistic	3.602	0.9998	4.211	1.000
Panel *PP*-Statistic	-15.603***	0.0000	-12.706***	0.000
Panel *ADF*-Statistic	-11.952***	0.0000	-9.587***	0.000
Group *rho*-Statistic	6.205	1.000	6.623	1.000
Group *PP*-Statistic	-18.838***	0.0000	-18.219***	0.000
Group *ADF*-Statistic	-11.238***	0.0000	-7.754***	0.000
	ADF t-Statistic	***p*-value**	**ADF t-Statistic**	***p*-value**
Kao's *t*-Test	-4.0883***	0.000	-9.727***	0.000

*** indicates statistical significance at 1% level. Whilst Pedroni's panel cointegration tests do not allow for the inclusion of linear time trend, the Kao t-test allows for both intercept and linear time trend. The regressors were logs of GDPs, RBER, IQ FTPI, INF, FDI, POPs and GDPPCD. DISTANCE, ECOWAS, and LANG were excluded from the tests. Automatic lag length selection was based on SIC with a max lag of 2 and Newey-West automatic bandwidth selection and Bartlett kernel was used. All the tests were obtained under the null hypothesis of no cointegration among the variables. Both test results were generated from Eviews7.

The seven tests for null hypothesis of no cointegration in a panel data model, as developed by Pedroni (2000, 2004), are presented in the third row of the first column of Table 4.3 above. As

discussed in the previous Chapter, these tests are classified into two categories – panel statistics consisting of the first four tests, and group panel statistics, constituted by the last three statistics. In the case of panel statistics, as explained by Ramirez (2006), the first-order autoregressive term is assumed to be the same across all the cross sections, while in the case of group panel statistics the parameter is allowed to vary over the cross sections. If the null is rejected in the panel case, then the variables of the gravity model of total trade (TT) and exports (X) are cointegrated for all the trading partners. On the other hand, if the null is rejected in the group panel case, then cointegration among the relevant variables exists for at least one of the trading partners.

From Table 4.3, two (2) (i.e. panel Philips-Perron *(PP)*- and augmented Dickey-Fuller *(ADF)*-statistics) out of the four (4) panel statistics, strongly rejected the null hypothesis of no cointegration among the variables at 1% significance level, considering the logarithms of total trade and exports as dependent variables. On the other hand, two (2) (i.e. group *PP*- and *ADF*-statistics) out of the three group panel statistics, strongly rejected the null hypothesis at 1% level of significance for both total trade and exports models. Thus, out of the seven test statistics, four (4) of them strongly rejected the null hypothesis, in favour of the alternate hypothesis of panel cointegration among the variables. The existence of a cointegrating relationship among the variables entering the gravity equations is also corroborated by the results of the Kao's *t*-test statistics, which are found to be highly statistically significant at 1% level. In other words, the Kao test also strongly rejected the null hypothesis of no cointegration among the variables.

The implication of these results is that there is a strong evidence that there exists a significant long-run equilibrium relationship between total trade and exports and their respective

covariates. Thus, while the tests for stationary provided evidence in support of trends in the data, the outcome of the panel cointegration tests indicates that these trends have cancelled out each other, thereby producing stationary residuals. In sum, the real incomes, populations, real bilateral exchange rate, foreign direct investment, internal transport infrastructure, institutional quality, foreign trade policy index and per capita income differential are long-run determinants of Ghana's bilateral exports and total trade. The estimates of the related long-run parameters are presented and analyzed in the section that follows.

4.2.4 Estimation and Interpretation of the Long-Run Relationship

In estimating the long-run parameters of the gravity models of Ghana's total trade and exports we applied the panel dynamic OLS (DOLS) due to Kao and Chiang (2000) and the pooled mean group (PMG) proposed by Pesaran, Shin and Smith (1999). The panel DOLS estimation involves the estimation of the static long-run relationship augmented by the leads and lags of the first-differenced regressors in order to address the potential endogeneity bias as well as the presence of serial correlation produced by the OLS estimates. Though this strategy improves the efficiency of the long-run estimates, it does not capture the short-run behaviour. As a result we also utilized the PMG estimator. The PMG estimator is a panel extension of the single equation ARDL model with an error correction representation, which conveniently allows for the efficient estimation of the long-run coefficients whilst providing information about the short-run behaviour. Presented in Table 4.4 are the results of long-run coefficients from the panel dynamic OLS (DOLS) and pooled mean group (PMG) estimators.

From the long-run results, all the coefficients of the baseline gravity variables are robustly found to be consistent with the predictions of the gravity model of trade flows. In particular,

the results of both panel DOLS and PMG estimates confirm that both domestic and foreign real GDP have a highly positive significant impact on bilateral trade and exports and that distance (from the panel DOLS results) exerts significantly negative impact on both bilateral trade flows. Thus improvements in domestic and foreign economic activities are considerably beneficial for Ghana's bilateral trade flows.

Table 4.4: Panel Cointegration Estimation of the Long-Run Coefficients Using the Panel DOLS and Pooled Mean Group (PMG) Estimators

Regressand	**$lnTT_{ijt}$**		**lnX_{ijt}**	
Estimator	**Panel DOLS**	**Pooled Mean Group (PMG)**	**Panel DOLS**	**Pooled Mean Group (PMG)**
Regressors	**Model 1**	**Model 2**	**Model 3**	**Model 4**
lnGDPit	0.752***	3.099***	0.832***	2.710***
	(0.000)	(0.000)	(0.000)	(0.000)
lnGDPjt	0.778***	0.247	0.625***	1.110***
	(0.000)	(0.337)	(0.000)	(0.000)
lnGDPPCDijt	-0.299***	-1.553***	-0.106**	-0.210***
	(0.000)	(0.000)	(0.0129)	(0.007)
lnRBERijt	0.0972***	-0.321***	0.011	0.250**
	(0.0002)	(0.005)	(0.634)	(0.021)
lnINFit	-0.609**	0.119	-0.602***	-0.473*
	(0.024)	(0.467)	(0.0074)	(0.06)
lnFTPIit	0.573***	-0.060	0.909***	0.350
	(0.000)	(0.802)	(0.000)	(0.139)
IQit	0.115**	0.0161	0.105	-0.111
	(0.034)	(0.738)	(0.213)	(0.258)
lnFDIit	0.132**	0.166***	0.211***	-0.054
	(0.000)	(0.000)	(0.0003)	(0.262)
lnDISTij	-1.346***		-1.749***	
	(0.000)		(0.000)	
ECOWAS	-0.854***		-2.927***	
	(0.0008)		(0.000)	
LANG	0.402***		0.0245	
	(0.000)		(0.7910)	
Constant		-27.103***		-38.05***
		(0.000)		(0.000)

***,**, and * indicate statistical significance at 1%, 5% and 10% error level respectively. The values in parenthesis are the p-values of associated with the parameters. Results of the PMG models were obtained with the aid of the "**xtpmg**" command in Stata12 and the panel DOLS estimates were obtained from Eviews7. POPs were dropped in the long-run models due to (1) observed multicolinearity with GDPs as they are used in other studies as an instrumental variable and/or measure of the "economic mass" of countries in the gravity model and (2) difficulties of the PMG maximum likelihood algorithm in achieving convergence due to many explanatory variables.

The coefficients of real GDP per capita differential (GDPPCD) in both gravity specifications are similarly found to be negative and significant for both long-run estimates. This result does not only confirm that of the FE estimate, but also yields strong evidence in support of the Linder's (1961) hypothesis that the intensity and volume of trade flows are smaller the greater the dissimilarity between two countries in terms of their relative per capita income and demand structure (which are determined by their relative factor endowments).

Real bilateral exchange rate (RBER) proves to be a significant determinant of both total bilateral trade and exports, as it showed up as having consistently positive and statistically significant coefficients in most of the long-run estimations, with the exception of the bilateral exports specification in model 3. This finding supports the expenditure switching effects of exchange rate depreciation (or devaluation) of the domestic currency on the country's exports and total trade, all other things being equal. However, the coefficient of RBER was found to be highly statistically significant and negatively signed for total bilateral trade specification in model 2.

Internal transport infrastructure (INF) also shows up as exerting robust negative effect on both trade flows. The coefficient of infrastructure is found to be negative and statistically significant in the long-run, although its effect is positive and statistically insignificant under the PMG estimate for total trade (model 2). This finding is, nonetheless, inconsistent with priori expectation, suggesting that inadequacy of better quality trade-related transport infrastructure in Ghana portends deteriorating trends in the volume of Ghana's bilateral trade flows, especially of exports in the long run.

In consistence with theoretical expectations, foreign trade policy index (FTPI) is found to have a robust positive effect on total bilateral trade and exports in the long run. Apart from its

coefficient being negative and statistically insignificant in model 2, the coefficient of foreign trade policy index (a measure of the degree of trade openness of trading partners) showed up to be rightly (positively) signed in the remaining gravity specifications. This also confirms the earlier finding based on the FE estimator. The results of the panel DOLS estimation showed that its coefficients in both trade and export models (1 and 3) were highly statistically significant in the long run.

With assent to the FE results, the long-run estimates proved that domestic institutional quality (IQ) is robustly a positive determinant of bilateral trade flows in Ghana, although its impact is found to be negative for the bilateral exports in model 4. Excluding the coefficient on institutional quality in the panel DOLS estimate of the total trade model, all the remaining coefficients are statistically insignificant in all the other specifications. Intuitively, the message of this outcome is that, gains from bilateral trade will be optimized if the quality of institutions in Ghana is improved substantially. Thus, better government effectiveness, high transparency and accountability, less corruption, better political stability, better and effective enforcement of contracts, property rights and lower regulatory burden, and better rule of law have the potential of increasing the gains from bilateral trade to Ghana in the long run.

In line with FE estimates, foreign direct investment (FDI) is established to robustly have positive impact on both bilateral trade flows in all the long run models, with the exception of model 4. In the latter, FDI was found to have adverse but statistically insignificant effect on bilateral exports. This result goes to substantiate our earlier stance that FDI have high prospects of enhancing Ghana's productive and exports supply capacity in the long run, when these foreign capital inflows are channeled to comparatively advantaged exports sectors.

We now turn to the long-run impacts of regional trade agreement and common language on bilateral trade flows. We are unable to obtain the PMG estimates of the coefficients of DIST, ECOWAS and LANG because the PMG approach considers only time-varying but not time-invariant policy and institutional variables as regressors. The panel DOLS yielded interestingly a rather unexpected result. The ECOWAS dummy is found to be incorrectly signed but remained statistically significant. Whereas this finding contradicts that of the FE estimator in terms of magnitude and expected signs, this result suggests that Ghana's total trade with and exports to non-ECOWAS members are significantly higher than with member countries in the long run. In other words, regional integration in West Africa (in the form of ECOWAS) has not significantly fostered trade flows from Ghana. This result portrays the negative effects of the several problems that inhibit the Community's commitment to trade liberalization among member states.

According to Ogunkola (1998), this negative coefficient for the ECOWAS variable, may not imply that ECOWAS efforts have not affected the intra-regional trade flows; rather, it may suggest that the regional body started from a very high intra-regional trade barriers and its efforts so far have been able to reduce such barriers to what was captured by the model, an insignificant trade restraint. Hoppe and Aidoo (2012) also noted that both the processes and degree of regional integration of ECOWAS states remains weak, due to the persistent tariff barriers and substantial non-tariff barriers and disagreement at the ECOWAS level on the precise structure of the common external tariff to non-ECOWAS. The existence of these and other trade barriers by reduces gains from free trade to member states and undermines all efforts aimed at increasing intra-regional trade through trade liberalization.

Lastly, the language effect on bilateral trade flows remained robustly positive in the long run and highly statistically significant at 1 percent error level for only the total bilateral trade model. Thus, common language, by facilitating trade and reducing transactions costs, exerts positive influence on bilateral trade flows between Ghana and its trading partners. Implicatively, the results reveal that, on average, Ghana trades more with countries that have the same linguistic ties than those with different linguistic characteristics.

4.2.5 Presentation of the Short-Run Coefficients and the Error Correction Model of the Pooled Mean Group (PMG) Estimator.

In this section we present and discuss the short-run impacts of the variables entering the gravity models on the bilateral flows of total trade and exports in Ghana. The analysis in this section aims at providing an important information about the speed of convergence to the long-run equilibrium (steady state) following a short-run shock in the system. The PMG estimates of the short-run parameters are reported in Table 4.5 below.

From the short-run results, a boost in domestic economic activity (income) is found to positively affect total bilateral trade whilst reducing the country's exports supply, probably due to a high domestic absorption effect. However, the observed short-run influences on bilateral trade flows are statistically insignificant at chosen error levels. Contrary to theoretical expectation, growth in foreign income reduces Ghana's the volume bilateral trade flows in the short-run, although it is shown to be statistically insignificant.

The sign of the coefficients on GDP per capita differential provides evidence in support of the Heckscher-Ohlin (H-O) hypothesis in the short-run, suggesting that Ghana trades more with

trading partners with divergent levels of per capita income than countries with similar levels of per capita income. However, this short-run evidence is not statistically significant at the chosen error levels.

Table 4.5: The Short-Run Coefficients and the Error Correction Model of the Pooled Mean Group (PMG) Estimator

	Dependent variables	
Independent variables	**ln TT_{ijt}**	**ln X_{ijt}**
$\Delta lnGDP_{it}$	0.496 (0.985)	-30.228 (0.402)
$\Delta lnGDP_{jt}$	-7.249 (0.584)	-2.245 (0.890)
$\Delta lnGDPPCD_{ijt}$	10.689 (0.642)	35.668 (0.260)
$\Delta lnRBERi_{jt}$	0.070 (0.411)	-0.403*** (0.004)
$\Delta lnINFi_{t}$	-0.156 (0.123)	0.084 (0.636)
$\Delta lnFTPI_{it}$	-1.383 (0.106)	0.225 (0.827)
ΔIQ_{it}	0.076* (0.068)	0.243*** (0.000)
$\Delta lnFDI_{it}$	0.005 (0.96)	0.057 (0.294)
ECM_{t-1}	-0.605*** (0.000)	-0.555*** (0.000)
Log Likelihood	171.828	63.024
No. of Observations	400	400
No. of groups	25	25
Observations per group	16	16

***, and * indicate statistical significance at 1%, 5and 10% error level respectively. The values in parenthesis are the p-values of associated with the parameters. Results were obtained with the aid of the "xtpmg" in command in Stata12.

Depreciation in the external value of the Ghana Cedi is found to insignificantly increase Ghana's total bilateral trade flows in the short-run. However, it is found to significantly reduce Ghana's exports supply in the short-run; yielding strong evidence of a possible existence of the J-curve effect (the phenomenon of the trade balance deteriorating following currency depreciation before improving in the long run) in Ghana.

Trade-related infrastructure retains its negative impact on total trade in the short-run, although it is now statistically insignificant. With respect to bilateral exports, infrastructure shows up with the right sign, reiterating its supportive role in facilitating and increasing bilateral exports in the short-run. Nonetheless, it is not statistically different from zero at the selected error levels.

In the same vein, foreign trade policy is proved to insignificantly inhibit Ghana's total bilateral trade with the sampled partners. Contrarily, foreign trade policy is found to expand Ghana's bilateral exports in the short-run, even though it is also not statistically significant.

The individual impacts of institutional quality and foreign direct investment on both bilateral trade flows are obtained to be trade-augmenting (positive), with only the former being statistically significant in the short-run.

Of primary interest to the analysis in this sub-section, as well as the entire study, are the estimated coefficients of the error-correction term (ECM_{t-1}) of the gravity models. The speed of adjustment estimates from each model imply considerably different short-run dynamics— -0.605 and -0.555 from the total trade and exports models respectively. Both coefficients are signed correctly (negative) and statistically significant at 1 percent level, guaranteeing convergence to equilibrium in the long-run following a sudden shock in the short-run. Intuitively, the coefficients of ECM_{t-1} (-0.605 and -0.555) suggests that following a deviation from the long-run in the previous period, adjustment to the long-run steady state are corrected by 60.5 percent and 55.5 percent in the current year in the total trade and exports gravity models respectively.

CHAPTER FIVE

SUMMARY OF FINDINGS, RECOMMENDATIONS, AND CONCLUSION

5.0 Introduction

The aim of this concluding chapter is to present the empirical findings of study and for policy purposes put forward some recommendations that would help improve Ghana's trade position. The chapter is in four main sections. Section 5.1 presents a summary of the findings. Policy recommendations are given in section 5.2 and the limitations of the study and a suggestion for further research is offered in section 5.3. Lastly, section 5.4 summarizes and concludes the study.

5.1 Summary of Research Findings

This study sets out to analyze the determinants of Ghana's bilateral trade flows within gravity model of trade, using panel data covering a cross-section of 25 major trading partners of Ghana for the period 1995—2011. Following standard theoretical and empirical literature on international trade, the study estimates an augmented version of Tinbergen's (1962) and Pöyhönen's (1963) gravity model of trade, with the aid of fixed effects, panel DOLS and PMG estimation techniques. Outlined below are key findings of the study.

1) The empirical results show that the gravity model is very successful in explaining the pattern of Ghana's bilateral trade flows. This is because the coefficients of the standard gravity variables (domestic and foreign incomes and distance) were found to be robustly consistent with the predictions of the gravity model. Specifically, Ghana's

bilateral exports and total trade flows were found to significantly increase with improvements in domestic and foreign incomes and diminish significantly with distance.

2) The pattern of Ghana's bilateral trade flows was found to strongly follow the Linder hypothesis, instead of the Heckscher-Ohlin hypothesis. This finding is based on the fact that, the coefficient of per capita income differential robustly showed up to be negative and statistically significant in all the models estimated. This suggests that Ghana exports to and trades more intensively with countries with similar per capita income, factor endowments and demand structure than partners with dissimilar per capita income, factor endowments and demand structure.

3) A strong evidence of the existence of absorption effect of increasing population on Ghana's bilateral trade flows was found by the study, as Ghana's population showed up to be negative and statistically significant. Contrarily, growth in the population of trading partners was found to significantly stimulate Ghana's bilateral exports supply, due to the accompanying growth in foreign demand as well as the size of international markets.

4) Real bilateral exchange rate was found to be a robust positive and significant determinant of Ghana's bilateral trade in the long run. However, the elasticities of trade and exports with respect to real bilateral exchange rate were found to be consistently small; reflecting the price inelastic nature of imports demand and exports supply in Ghana. In addition, the existence of the J-curve effect is suspected to be

present in Ghana, as real depreciation in the Ghana Cedi against the foreign currency was found to significantly reduce bilateral exports in the short run

5) Internal transport infrastructure was found to be significantly deleterious to Ghana's bilateral trade and exports.

6) It was found that improvement in the trade policy of Ghana's trading partners, which is manifested in lower tariff and non-tariff barriers and increased access to foreign markets through economic partnership agreements, exerts significantly positive impact on Ghana's bilateral trade and exports.

7) The improvement in the quality of domestic institutions was found to enhance Ghana's bilateral trade flows. Although, its impact remained insignificant statistically in the long run, it was found to be statistically significant in the short run.

8) The inflow of foreign direct investment was found to have robustly positive impact on Ghana's bilateral trade flows. It was found to play a significant role in enhancing Ghana's productive capacity and boosting its bilateral trade flows in the long run.

9) Intriguingly, mixed results were obtained regarding the impact of regional integration on Ghana's bilateral trade flows. On one hand, the results showed that ECOWAS membership fosters bilateral trade and exports from Ghana, indicating the existence of potential for gains from intensifying intra-ECOWAS trade. On the other hand, it was found that in the long run, Ghana trades less with other ECOWAS countries than with countries outside the Community, suggesting the existence of barriers that

substantially undermine the Community's efforts promoting intra-regional trade through economic integration and trade liberalization.

10) Finally, sharing common (official or commercial) language with trading partners was found to have expansionary effects on Ghana's bilateral trade flows, although, its impact is robustly statistically insignificant.

5.2 Policy Recommendations

The key findings of this study, as summarized above, have important implications for trade policy in Ghana. On the basis of these key findings, the following recommendations are advanced for trade policy configuration and formulation aimed at expanding the volume of Ghana's trade with the rest of the world so as so to maximize its gains from trade and boost the pace of the nation's economic growth.

Firstly, to improve consumer and investor confidence in the economy and to maintain Ghana's external competiveness, it is highly recommended that the monetary authorities remain vigilant in managing the exchange rate by adopting the appropriate blend of fiscal and monetary policies to achieve stability in the external value of the Ghana Cedi. This can be anchored with aggregate demand management policies coupled with supply enhancing policies targeted at removing supply-side constraints and perking up productive efficiency comparative advantaged exports sectors. These policies will improve the productivity and competitiveness of the economy in the long run, which will in turn, eventually reduce the pressure on the domestic currency from depreciation and bring the desired stability to the economy.

Secondly, the detrimental impact of current level of infrastructural development on Ghana's bilateral trade flows, as found in this study, accentuates the urgent need to radically expand, improve and modernize trade-related infrastructure in Ghana. The current government's focus on infrastructural development is a stride in the right direction as this will not only facilitate Ghana's external trade, but will also enhance export supply capacity, reduce transportation and other transactions costs and increase the relative competitiveness of made-in-Ghana goods on the global market in the long run.

Thirdly, the triviality of the positive impact of institutional quality on Ghana's bilateral trade flows imply that although Ghanaian institutions are becoming more effective, efficient and trade enhancing, trade-inhibiting obstacles do remain, and particular institutions need development and reform. For instance, according to the Economic Freedom Index Report (2013), property rights are poorly protected, and high levels of corruption persist due to overall weakness in the rule of law and the overall investment regime lacks efficiency and transparency. It is, therefore, highly recommended that policies and legislative reforms aimed at promoting transparency, accountability and integrity in our institutions be austerely pursued. In addition, market-friendly regulatory policies (aimed at removing impediments to domestic and foreign private investment, streamlining and simplification of regulations and procedures for doing business by new entrants), strengthening of property rights and contract enforcement, and improvement of trade policy regime to facilitate exports and promote outward oriented growth are highly recommended. Once again, this has the long run benefit of improving consumer and investor confidence in the economy by creating incentives for individuals to engage in trade, and invest in human and physical capital.

Fourthly, government supply-side policies (such as government subsidies, tax rebates, lower tariffs on imported inputs etc.) are also recommended to attract and channel the foreign direct investment (FDI) to more productive and comparative advantaged exports sectors, so as to augment the productive and exports supply capacity of domestic producers, and increase their level of efficiency.

Fifthly, in order to deepen the degree of integration and increase intra-regional trade flows, there is an urgent need for the removal of trade barriers at the various borders of the member states of the ECOWAS sub-region. Non-tariff trade barriers including excessive documentation, cumbersome procedures, unnecessary checkpoints and roadblocks, and persistent harassments of truck drivers by security agencies at custom check points, alongside the numerous tariff barriers have been often cited by many investors and stakeholders as negative tendencies which have not only resulted in unpredictable dwell times for cargo trucks and shipping times in the sub-region, but also in wastage of resources and higher consumer prices. It is, therefore, recommended that ECOWAS member states should accelerate their efforts at resolving these issues, which have thus far, deterred trade flows within that Community and to quickly, uniformly and fully implement the series of protocols, decisions, and resolutions to ensure the free movement of goods, vehicles and people across the region as agreed on under the ECOWAS Trade Liberalization Scheme (ETLS).

5.3 Limitations and Suggestion for Further Research

The empirical analysis and results presented in this study are not without limitations. A major limitation of the study is that it examined the determinants of Ghana's bilateral trade flows using an aggregated data on bilateral exports, imports and total trade. However, an effective implementation of the supply side policies recommended in this study requires identification and a detailed understanding of factors that significantly affect the productive capacity of particular exports sectors in Ghana. Thus, analyzing Ghana trade bilateral flows within the gravity model using a disaggregated data specific sectors can be also be considered in future studies.

Another limitation of the study is that it failed to examine Ghana's trade potential with it partners. That is, this present study is unable to indicate with which countries Ghana has unexploited trade potentials and those with which it has exhausted its trade potential. A consideration of this in future studies will help the nation to identify the countries in which it there exist high prospects for expanding Ghana's exports in order to maximize its gains from bilateral trade.

Furthermore, although the study analyzed the impact of regional trade agreements and regional integration on Ghana's bilateral trade flows it failed to investigate the trade creation and trade diversion effects of ECOWAS membership on trade flows in Ghana. Analyzing this in future studies will be beneficial for trade policy makers in Ghana and the Community as a whole.

Finally, the analysis and findings of the study are likely to be affected by the relative small number of countries and short time period of data used in the study. Of course, Ghana's key

trading partners are more than 25 countries, and these bilateral trade relationships have spanned beyond 17 years. However, limited availability of data on bilateral trade flows and other variables for all the countries for a longer period of time imposed a constraint on the sample size of the study.

5.3 Conclusion

Traditionally, trade has been explained by the so-called classical models. However, since mid-1980s, there has been a substantial growth in the amount of trade occurring among countries that are geographically adjacent, and also have similar levels of GDP and factor endowments. This observation in the global trade pattern contravenes the predictions of the traditional theories of trade. Therefore, the attention of many trade economists was shifted to investigating whether geography and relative size of GDP are reasons for countries to trade using the gravity model of trade. This provides a motivation for this study. Given the changing pattern in Ghana direction of bilateral trade from the traditional developed economies toward other emerging and transition economies, to study examines how the gravity model can be used to explain Ghana's bilateral trade flows. In addition to identifying the factors that matter for trade flows in the case of Ghana, the study found out that there is evidence that the gravity model explains significant amount of trade between Ghana and other countries.

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APPENDICES

Appendix I: Preliminary Results for Pooled, Fixed Effects and Random Effects Models

Appendix I1: Pooled OLS Estimates For The Gravity Model of Total Trade

```
. reg  tt gdpi gdpj dist popi popj rber dgdppc fdi inf iq ftpi ecowas lang

      Source |       SS       df       MS              Number of obs =     425
-------------+------------------------------           F( 13,   411) =  130.11
       Model |   1088.1421    13  83.7032382           Prob > F      =  0.0000
    Residual |   264.39872   411  .643305889           R-squared     =  0.8045
-------------+------------------------------           Adj R-squared =  0.7983
       Total |  1352.54082   424  3.18995476           Root MSE      =  .80206

------------------------------------------------------------------------------
          tt |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        gdpi |    2.361457   1.532118     1.54   0.0124    -.6503086    5.373222
        gdpj |    1.142323   .0962441    11.87   0.000     .9531305    1.331515
        dist |   -1.528523   .1034571   -14.77   0.000    -1.731894   -1.325152
        popi |   -1.691494   3.535193    -0.48   0.633    -8.640809    5.257821
        popj |   -.3397292   .1049705    -3.24   0.001    -.5460752   -.1333832
        rber |    .1326237   .0392246     3.38   0.001     .0555178    .2097296
      dgdppc |    -.484239   .0767027    -6.31   0.000    -.6350176   -.3334604
         fdi |     .041539   .0829951     0.50   0.617    -.1216089    .2046869
         inf |   -.1498239   .3002868    -0.50   0.618    -.7401134    .4404656
          iq |    .0972085   .1829285     0.53   0.595    -.2623837    .4568006
        ftpi |     .123032   .1845226     0.67   0.505    -.2396938    .4857577
      ecowas |   -.5639612   .3570133    -1.58   0.115    -1.265761    .1378387
        lang |    .4094722   .0995613     4.11   0.000     .2137593    .6051851
       _cons |   -13.51103   31.81168    -0.42   0.671    -76.04494    49.02287
------------------------------------------------------------------------------
```

Appendix I2: Pooled OLS Estimates For The Gravity Model of Exports

```
. reg  x gdpi gdpj dist popi popj rber dgdppc fdi inf iq ftpi ecowas lang

      Source |       SS       df       MS              Number of obs =     425
-------------+------------------------------           F( 13,   411) =   94.38
       Model |  1043.10672    13  80.2389784           Prob > F      =  0.0000
    Residual |  349.437498   411  .850212889           R-squared     =  0.7491
-------------+------------------------------           Adj R-squared =  0.7411
       Total |  1392.54422   424   3.2843024           Root MSE      =  .92207

------------------------------------------------------------------------------
           x |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        gdpi |    3.728085   1.761357     2.12   0.035     .2656931    7.190476
        gdpj |    .4910712   .1106443     4.44   0.000     .2735718    .7085706
        dist |   -1.724309   .1189365   -14.50   0.000    -1.958108   -1.490509
        popi |   -5.596187   4.064136    -1.38   0.169    -13.58527    2.392898
        popj |    .1793866   .1206764     1.49   0.138    -.0578333    .4166065
        rber |    .0484844   .0450935     1.08   0.283    -.0401582     .137127
      dgdppc |    .0299737   .0881792     0.34   0.734    -.1433647    .2033121
         fdi |    .0459613    .095413     0.48   0.630    -.1415971    .2335198
         inf |   -.6727193   .3452163    -1.95   0.052    -1.351329    .0058905
          iq |    .0996079   .2102986     0.47   0.636    -.3137872     .513003
```

```
        ftpi |   .8301558   .2121312     3.91   0.000     .4131583    1.247153
      ecowas |   -2.70706   .4104304    -6.60   0.000    -3.513865   -1.900255
        lang |   .0318864   .1144579     0.28   0.781    -.1931094    .2568823
       _cons |   24.48605   36.57141     0.67   0.504     -47.4043     96.3764
------------------------------------------------------------------------------
```

Appendix I3: Fixed-Effects (Within) Regression For The Gravity Model of Total Trade

```
. xtreg  tt  gdpi gdpj  popi popj rber dgdppc fdi inf iq  ftpi, fe

Fixed-effects (within) regression               Number of obs      =       425
Group variable: id                              Number of groups   =        25
R-sq:  within  = 0.7117                         Obs per group: min =        17
       between = 0.5512                                        avg =      17.0
       overall = 0.4605                                        max =        17
                                                F(10,390)          =     96.26
corr(u_i, Xb)  = -0.9793                        Prob > F           =    0.0000

------------------------------------------------------------------------------
          tt |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        gdpi |   2.320848   .9961587     2.33   0.020     .3623349    4.279361
        gdpj |     2.1131   .2660277     7.94   0.000     1.590072    2.636128
        popi |  -3.885013   2.340233    -1.66   0.098    -8.486065    .7160383
        popj |    .697974   .5096194     1.37   0.172     -.303971    1.699919
        rber |   .4496132   .1267648     3.55   0.000     .2003853     .698841
      dgdppc |  -.0955118   .0836673    -1.14   0.254    -.2600073    .0689836
         fdi |   .0470124   .0552354     0.85   0.395    -.0615839    .1556087
         inf |  -.2108413   .2025749    -1.04   0.299    -.6091168    .1874342
          iq |   .0085225   .1206309     0.07   0.944    -.2286457    .2456908
        ftpi |   .2537419   .1567454     1.62   0.106    -.0544298    .5619136
       _cons |  -33.72803   21.13841    -1.60   0.111    -75.28753    7.831471
-------------+----------------------------------------------------------------
     sigma_u |  6.1079427
     sigma_e |  .52068305
         rho |   .9927854   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(24, 390) =     69.17                 Prob > F = 0.0000
```

Appendix I4: Fixed-Effects (Within) Regression For The Gravity Model of Exports

```
. xtreg  x  gdpi gdpj  popi popj rber dgdppc fdi inf iq  ftpi, fe

Fixed-effects (within) regression               Number of obs      =       425
Group variable: id                              Number of groups   =        25

R-sq:  within  = 0.6463                         Obs per group: min =        17
       between = 0.4507                                        avg =      17.0
       overall = 0.3440                                        max =        17
                                                F(10,390)          =     71.26
corr(u_i, Xb)  = -0.9794                        Prob > F           =    0.0000
------------------------------------------------------------------------------
           x |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        gdpi |   4.054254   1.313343     3.09   0.002     1.472137    6.636372
        gdpj |   1.995988   .3507328     5.69   0.000     1.306424    2.685551
        popi |  -9.232623   3.085381    -2.99   0.003    -15.29868   -3.166564
        popj |   1.351587   .6718859     2.01   0.045     .0306152    2.672558
```

```
        rber |   .4227832   .1671276     2.53   0.012     .0941994    .7513669
      dgdppc |  -.2150516   .1103076    -1.95   0.052    -.4319236    .0018204
         fdi |   .0861737   .0728227     1.18   0.237    -.0570005    .2293478
         inf |  -.8315005   .2670762    -3.11   0.002     -1.35659   -.3064113
          iq |   .0373749   .1590407     0.24   0.814    -.2753094    .3500592
        ftpi |   .5852516   .2066542     2.83   0.005     .1789558    .9915473
       _cons |   8.614722   27.86904     0.31   0.757    -46.17762    63.40707
-------------+----------------------------------------------------------------
     sigma_u |  6.6221101
     sigma_e |  .68647227
         rho |  .98936809   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Appendix I5: Random-Effects GLS Regression For The Gravity Model of Total Trade

```
. xtreg  tt  gdpi gdpj  popi popj rber dgdppc fdi inf iq  ftpi  dist ecowas lang,
re

Random-effects GLS regression                   Number of obs      =       425
Group variable: id                              Number of groups   =        25

R-sq:  within  = 0.6905                         Obs per group: min =        17
       between = 0.8168                                        avg =      17.0
       overall = 0.7776                                        max =        17
                                                Wald chi2(13)      =    949.06
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
          tt |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        gdpi |   2.248202   1.035331     2.17   0.030     .2189901    4.277415
        gdpj |   1.009325   .1546941     6.52   0.000     .7061302     1.31252
        popi |  -1.770156   2.398654    -0.74   0.461    -6.471431     2.93112
        popj |   .0039583   .1686087     0.02   0.981    -.3265086    .3344252
        rber |    .173447   .0935869     1.85   0.064      -.00998     .356874
      dgdppc |  -.1540181   .0827294    -1.86   0.063    -.3161648    .0081285
         fdi |    .025823   .0567385     0.46   0.649    -.0853824    .1370284
         inf |  -.1353086   .2067788    -0.65   0.513    -.5405876    .2699704
          iq |   .0722701   .1243462     0.58   0.561    -.1714439    .3159841
        ftpi |   .4792305   .1552063     3.09   0.002     .1750318    .7834292
        dist |  -1.642589   .3536083    -4.65   0.000    -2.335648    -.949529
      ecowas |   .0052325   1.107988     0.00   0.996    -2.166383    2.176848
        lang |   .4386905   .2953264     1.49   0.137    -.1401386    1.017519
       _cons |  -15.31611   21.80963    -0.70   0.483    -58.06219    27.42997
-------------+----------------------------------------------------------------
     sigma_u |  .69318517
     sigma_e |  .52040865
         rho |   .6395394   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Appendix I6: Random-Effects GLS Regression For The Gravity Model of Exports

```
. xtreg  x  gdpi gdpj  popi popj rber dgdppc fdi inf iq  ftpi  ecowas lang dist, re

Random-effects GLS regression                   Number of obs      =       425
Group variable: id                              Number of groups   =        25

R-sq:  within  = 0.6246                         Obs per group: min =        17
       between = 0.8093                                        avg =      17.0
```

```
       overall = 0.7375                                        max =        17

                                                Wald chi2(13)      =    724.24
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
           x |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        gdpi |    3.90575   1.348551     2.90   0.004     1.262639    6.548862
        gdpj |   .8723335   .1806229     4.83   0.000     .5183192    1.226348
        popi |  -6.385213   3.121519    -2.05   0.041    -12.50328   -.2671477
        popj |  -.1124639   .1947188    -0.58   0.564    -.4941058     .269178
        rber |   .0846654    .108836     0.78   0.437    -.1286492    .2979799
      dgdppc |  -.1806971   .1060173    -1.70   0.088    -.3884872     .027093
         fdi |   .0550552    .073722     0.75   0.455    -.0894372    .1995476
         inf |  -.7070114   .2681703    -2.64   0.008    -1.232615   -.1814074
          iq |   .1019153   .1617341     0.63   0.529    -.2150776    .4189082
        ftpi |    .840836   .2003572     4.20   0.000     .4481431    1.233529
      ecowas |  -1.581242   1.194038    -1.32   0.185    -3.921513    .7590298
        lang |  -.0581185   .3231819    -0.18   0.857    -.6915433    .5753063
        dist |   -1.72759   .3730337    -4.63   0.000    -2.458723   -.9964575
       _cons |   30.57103   28.28256     1.08   0.280    -24.86177    86.00383
-------------+----------------------------------------------------------------
     sigma_u |  .71798921
     sigma_e |  .68735348
         rho |  .52178912   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Appendix II: Results of the Hausman Test

Appendix II1: Hausman Test for the Gravity Model of Total Trade

```
                ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fe (tt)      re (tt)       Difference          S.E.
-------------+----------------------------------------------------------------
        gdpi |    2.320848     2.248202        .0726456                .
        gdpj |      2.1131     1.009325        1.103775          .2164265
        popi |   -3.885013    -1.770156       -2.114858                .
        popj |     .697974     .0039583        .6940157           .480919
        rber |    .4496132      .173447        .2761662          .0855032
      dgdppc |   -.0955118    -.1540181        .0585063          .0124929
         fdi |    .0470124      .025823        .0211894                .
         inf |   -.2108413    -.1353086       -.0755328                .
          iq |    .0085225     .0722701       -.0637476                .
        ftpi |    .2537419     .4792305       -.2254886          .0219119
------------------------------------------------------------------------------
                           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(10) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       30.16
                Prob>chi2 =      0.0008
                (V_b-V_B is not positive definite)
```

Appendix II2: Hausman Test for the Gravity Model of Exports

```
                 ---- Coefficients ----
              |      (b)          (B)            (b-B)     sqrt(diag(V_b-
V_B))
              |   exfixedall   exrandall      Difference          S.E.
--------------+----------------------------------------------------------------
---
         gdpi |    4.054254      3.90575        .1485039               .
         gdpj |    1.995988     .8723335        1.123654        .3006474
         popi |   -9.232623    -6.385213        -2.84741               .
         popj |    1.351587    -.1124639        1.464051        .6430515
         rber |    .4227832     .0846654        .3381178         .126832
       dgdppc |   -.2150516    -.1806971       -.0343545        .0304647
          fdi |    .0861737     .0550552        .0311185               .
          inf |   -.8315005    -.7070114       -.1244891               .
           iq |    .0373749     .1019153       -.0645404               .
         ftpi |    .5852516     .840836        -.2555844        .0506258
------------------------------------------------------------------------------
---
                           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(10) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       29.62
                Prob>chi2 =      0.0010
```

Appendix III: Cointegration Test Results

Appendix III1: Pedroni Cointegration Tests Results for Total Trade Model

Pedroni Residual Cointegration Test
Series: LTT LGDPI LGDPJ LGDPPCD LRBER LFTPI
LFDI LINF IQ
Date: 03/27/13 Time: 04:16
Sample: 1995 2011
Included observations: 425
Cross-sections included: 25
Null Hypothesis: No cointegration
Trend assumption: Deterministic intercept and trend
Automatic lag length selection based on SIC with a max lag of 5
Newey-West automatic bandwidth selection and Bartlett kernel

Alternative hypothesis: common AR coefs. (within-dimension)

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	-2.801295	0.9975	-3.352129	0.9996
Panel rho-Statistic	3.601983	0.9998	5.309940	1.0000

Panel PP-Statistic	-15.60323	0.0000	-12.47406	0.0000
Panel ADF-Statistic	-11.95166	0.0000	-8.753399	0.0000

Alternative hypothesis: individual AR coefs. (between-dimension)

	Statistic	Prob.
Group rho-Statistic	6.205351	1.0000
Group PP-Statistic	-18.83818	0.0000
Group ADF-Statistic	-11.23773	0.0000

Appendix III2: Pedroni Cointegration Tests Results for Exports Model

Pedroni Residual Cointegration Test
Series: LX LGDPI LGDPJ LRBER LGDPPCD LFTPI LFDI
IQ LINF
Date: 03/27/13 Time: 05:41
Sample: 1995 2011
Included observations: 425
Cross-sections included: 25
Null Hypothesis: No cointegration
Trend assumption: Deterministic intercept and trend
Use d.f. corrected Dickey-Fuller residual variances
Automatic lag length selection based on SIC with a max lag of 2
Newey-West automatic bandwidth selection and Bartlett kernel

Alternative hypothesis: common AR coefs. (within-dimension)

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	-2.585246	0.9951	-4.561533	1.0000
Panel rho-Statistic	4.211365	1.0000	5.358670	1.0000
Panel PP-Statistic	-12.70612	0.0000	-12.82376	0.0000
Panel ADF-Statistic	-9.586999	0.0000	-7.408815	0.0000

Alternative hypothesis: individual AR coefs. (between-dimension)

	Statistic	Prob.
Group rho-Statistic	6.623015	1.0000
Group PP-Statistic	-18.21958	0.0000
Group ADF-Statistic	-7.754023	0.0000

Appendix III3: Kao Residual Cointegration Tests For Total Trade Model

Series: LTT LGDPI LGDPJ LGDPPCD LINF LFDI LFTPI IQ LRBER
Date: 03/25/13 Time: 17:56
Sample: 1995 2011
Included observations: 425
Null Hypothesis: No cointegration
Trend assumption: No deterministic trend
Automatic lag length selection based on SIC with a max lag of 2

Newey-West automatic bandwidth selection and Bartlett kernel

	t-Statistic	Prob.
ADF	-4.08829	0.0000
Residual variance	0.191622	
HAC variance	0.172056	

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID)
Method: Least Squares
Date: 03/25/13 Time: 17:56
Sample (adjusted): 1998 2011
Included observations: 350 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID(-1)	-0.481571	0.052296	-9.208652	0.0000
D(RESID(-1))	-0.058248	0.055530	-1.048956	0.2949
D(RESID(-2))	0.143868	0.041935	3.430696	0.0007

R-squared	0.278985	Mean dependent var	0.008280
Adjusted R-squared	0.274829	S.D. dependent var	0.389967
S.E. of regression	0.332084	Akaike info criterion	0.641679
Sum squared resid	38.26718	Schwarz criterion	0.674747
Log likelihood	-109.2939	Hannan-Quinn criter.	0.654842
Durbin-Watson stat	1.976875		

Appendix III4: Kao Residual Cointegration Tests For Total Trade Model

Kao Residual Cointegration Test
Series: LX LGDPI LGDPJ LGDPPCD LRBER LFDI
LFTPI IQ LINF
Date: 03/27/13 Time: 05:43
Sample: 1995 2011
Included observations: 425
Null Hypothesis: No cointegration
Trend assumption: No deterministic trend
Automatic lag length selection based on SIC with a max lag of 2
Newey-West automatic bandwidth selection and Bartlett kernel

	t-Statistic	Prob.
ADF	-9.727222	0.0000
Residual variance	0.337106	
HAC variance	0.282585	

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID)
Method: Least Squares
Date: 03/27/13 Time: 05:43
Sample (adjusted): 1996 2011
Included observations: 400 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID(-1)	-0.517789	0.035377	-14.63623	0.0000

R-squared	0.349022	Mean dependent var	-0.012970
Adjusted R-squared	0.349022	S.D. dependent var	0.591928
S.E. of regression	0.477586	Akaike info criterion	1.362354
Sum squared resid	91.00743	Schwarz criterion	1.372332
Log likelihood	-271.4707	Hannan-Quinn criter.	1.366305
Durbin-Watson stat	1.692854		

Appendix IV: ESTIMATED LONG-RUN GRAVITY MODELS

Appendix IV1: Pooled Mean Group Estimates for the Gravity Model of Total Trade

```
. xtpmg d.tt d.gdpi d.gdpj d.rber d.inf d.ftpi d.dgdppc d.iq, lr(l.tt gdpi gdpj
rber inf ftpi dgdppc
>  iq) ec(ec1)

Iteration 0:   log likelihood =  151.68723  (not concave)
Iteration 1:   log likelihood =   159.6567  (not concave)
Iteration 2:   log likelihood =   163.3382
Iteration 3:   log likelihood =  169.17745  (not concave)
Iteration 4:   log likelihood =  169.78061  (not concave)
Iteration 5:   log likelihood =  170.02781  (not concave)
Iteration 6:   log likelihood =  170.26098  (not concave)
Iteration 7:   log likelihood =  170.46855
Iteration 8:   log likelihood =  171.08449  (backed up)
Iteration 9:   log likelihood =   171.7966
Iteration 10:  log likelihood =  171.82824
Iteration 11:  log likelihood =  171.82828
Iteration 12:  log likelihood =  171.82828


Pooled Mean Group Regression
(Estimate results saved as pmg)

Panel Variable (i): id                          Number of obs      =       400
Time Variable (t): year                         Number of groups   =        25
                                                Obs per group: min =        16
                                                               avg =      16.0
                                                               max =        16
```

```
                                                  Log Likelihood     =  171.8283
------------------------------------------------------------------------------
        D.tt |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
ec1          |
        gdpi |   3.099403   .2339067    13.25   0.000     2.640954    3.557851
        gdpj |   .2470552    .257172     0.96   0.337    -.2569927    .7511032
        rber |  -.3205688   .1140703    -2.81   0.005    -.5441424   -.0969952
         inf |   .1185792   .1630871     0.73   0.467    -.2010656     .438224
        ftpi |  -.0604408   .2405488    -0.25   0.802    -.5319077    .4110262
      dgdppc |  -1.553029   .1840187    -8.44   0.000    -1.913699   -1.192359
          iq |   .0161053     .04816     0.33   0.738    -.0782865    .1104971
         fdi |   .1655546   .0343639     4.82   0.000     .0982026    .2329066
-------------+----------------------------------------------------------------
SR           |
         ec1 |  -.6050999   .0869147    -6.96   0.000    -.7754495   -.4347503
             |
        gdpi |
         D1. |   .4961529   25.95422     0.02   0.985    -50.37319     51.3655
             |
        gdpj |
         D1. |  -7.248851   13.22908    -0.55   0.584    -33.17738    18.67968
             |
        rber |
         D1. |   .0703972   .0856901     0.82   0.411    -.0975522    .2383467
             |
         inf |
         D1. |  -.1564269   .1015104    -1.54   0.123    -.3553835    .0425298
             |
        ftpi |
         D1. |  -1.382957   .8549285    -1.62   0.106    -3.058586    .2926722
             |
      dgdppc |
         D1. |   10.68885   22.97416     0.47   0.642    -34.33968    55.71737
             |
          iq |
         D1. |   .0755729   .0413769     1.83   0.068    -.0055242    .1566701
         fdi |
         D1. |  -.0050842   .0479304    -0.11   0.916     -.099026    .0888577
             |
       _cons |  -27.10338   4.117156    -6.58   0.000    -35.17285    -19.0339
------------------------------------------------------------------------------
```

Appendix IV2: Pooled Mean Group Estimates for the Gravity Model of Exports

```
Iteration 0:   log likelihood =  44.609828  (not concave)
Iteration 1:   log likelihood =  56.008308  (not concave)
Iteration 2:   log likelihood =  58.937765  (not concave)
Iteration 3:   log likelihood =   60.48427
Iteration 4:   log likelihood =   61.84443
Iteration 5:   log likelihood =  62.207703
Iteration 6:   log likelihood =  62.437666
Iteration 7:   log likelihood =  62.545302  (not concave)
Iteration 8:   log likelihood =   62.76572
Iteration 9:   log likelihood =  62.950831
Iteration 10:  log likelihood =  63.023583
Iteration 11:  log likelihood =  63.023733
Iteration 12:  log likelihood =  63.023733
```

```
Pooled Mean Group Regression
(Estimate results saved as pmg)

Panel Variable (i): id                          Number of obs      =       400
Time Variable (t): year                         Number of groups   =        25
                                                Obs per group: min =        16
                                                               avg =      16.0
                                                               max =        16

                                                Log Likelihood     =  63.02373
------------------------------------------------------------------------------
         D.x |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
ecm          |
        gdpi |   2.710151   .4959898     5.46   0.000     1.738029    3.682273
        gdpj |   1.110144   .2935392     3.78   0.000      .534818    1.685471
        rber |   .2500578   .1081492     2.31   0.021     .0380893    .4620264
          iq |  -.1109349   .0981725    -1.13   0.258    -.3033494    .0814796
        ftpi |   .3503658   .2370264     1.48   0.139    -.1141974    .8149289
         inf |  -.4733862   .2512603    -1.88   0.060    -.9658473     .019075
      dgdppc |   -.210091   .0773183    -2.72   0.007     -.361632     -.05855
        dfdi |  -.0537458   .0479479    -1.12   0.262    -.1477219    .0402302
-------------+----------------------------------------------------------------
SR           |
         ecm |  -.5547045   .0827856    -6.70   0.000    -.7169613   -.3924477
             |
        gdpi |
          D1.|  -30.22875   36.04436    -0.84   0.402    -100.8744    40.41689
             |
        gdpj |
          D1.|  -2.244798   16.26488    -0.14   0.890    -34.12338    29.63378
             |
        rber |
          D1.|  -.4032766   .1418534    -2.84   0.004    -.6813041    -.125249
             |
          iq |
          D1.|      .2429   .0594293     4.09   0.000     .1264208    .3593792
             |
        ftpi |
          D1.|   .2248952   1.032043     0.22   0.827    -1.797872    2.247662
             |
         inf |
          D1.|    .083546   .1766787     0.47   0.636    -.2627378    .4298298
             |
      dgdppc |
          D1.|   35.66823   31.63497     1.13   0.260    -26.33517    97.67163
             |
        fdi  |
          D1.|   .0565819   .0539543     1.05   0.294    -.0491665    .1623303
             |
       _cons |  -38.04669   5.653503    -6.73   0.000    -49.12736   -26.96603
------------------------------------------------------------------------------
```

Appendix IV3: Panel Dynamic OLS Estimates for the Gravity Model of Total Trade

Dependent Variable: LTT
Method: Panel Least Squares
Date: 03/25/13 Time: 17:46
Sample (adjusted): 1997 2010
Periods included: 14

Cross-sections included: 25
Total panel (balanced) observations: 350
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank
Linear estimation after one-step weighting matrix

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDPI	0.752235	0.063330	11.87805	0.0000
LGDPJ	0.778452	0.027045	28.78334	0.0000
LFTPI	0.572826	0.120049	4.771591	0.0000
LRBER	0.097262	0.025965	3.745927	0.0002
IQ	0.114853	0.051570	2.227103	0.0266
LD	-1.345602	0.071549	-18.80685	0.0000
LINF	-0.608851	0.267862	-2.273004	0.0237
LGDPPCD	-0.292739	0.031277	-9.359417	0.0000
LFDI	0.131727	0.062020	2.123924	0.0344
ECOWAS	-0.854817	0.253196	-3.376114	0.0008
LANG	0.402095	0.067269	5.977423	0.0000
D(LGDPI(-1))	-13.18980	7.441456	-1.772476	0.0773
D(LGDPI(1))	-2.404483	2.545334	-0.944663	0.3455
D(LGDPJ(-1))	0.290264	0.826788	0.351075	0.7258
D(LGDPJ(1))	1.509520	0.910873	1.657223	0.0984
D(LFTPI(-1))	0.037464	0.197829	0.189374	0.8499
D(LFTPI(1))	0.262266	0.224350	1.169004	0.2433
D(LINF(-1))	-0.212946	0.311216	-0.684240	0.4943
D(LINF(1))	-0.047211	0.345454	-0.136665	0.8914
D(LRBER(-1))	0.054789	0.273812	0.200098	0.8415
D(LRBER(1))	0.103399	0.288908	0.357896	0.7207
D(IQ(-1))	-0.205192	0.172142	-1.191992	0.2341
D(IQ(1))	-0.010390	0.149090	-0.069689	0.9445
D(LGDPPCD(-1))	0.141835	0.097522	1.454391	0.1468
D(LGDPPCD(1))	-0.074243	0.099220	-0.748264	0.4548
D(LFDI(-1))	0.153275	0.121311	1.263485	0.2073
D(LFDI(1))	0.021449	0.088217	0.243136	0.8081

Weighted Statistics

R-squared	0.868093	Mean dependent var	35.45015
Adjusted R-squared	0.857475	S.D. dependent var	18.83246
S.E. of regression	0.720938	Sum squared resid	167.8799
Durbin-Watson stat	0.328348		

Unweighted Statistics

R-squared	0.788939	Mean dependent var	25.41713
Sum squared resid	213.8629	Durbin-Watson stat	0.217226

Appendix IV4: Panel Dynamic OLS Estimates for the Gravity Model of Total Trade

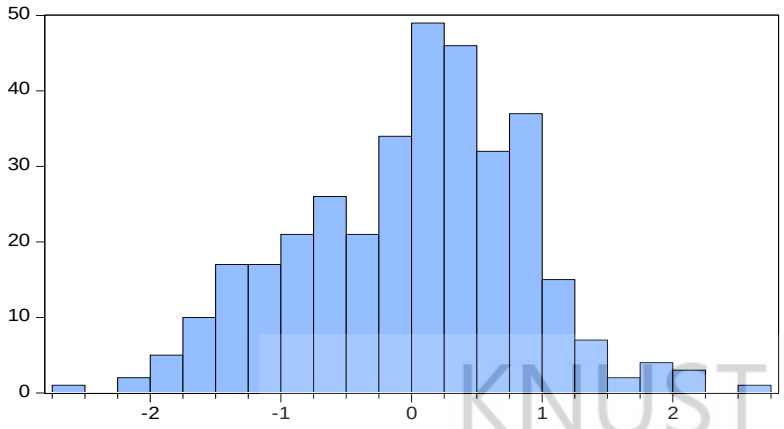
Dependent Variable: LX
Method: Panel Least Squares
Date: 04/01/13 Time: 13:19
Sample (adjusted): 1997 2010
Periods included: 14
Cross-sections included: 25
Total panel (balanced) observations: 350
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDPI	0.832379	0.074899	11.11332	0.0000
LGDPJ	0.624515	0.034196	18.26258	0.0000
LFTPI	0.909846	0.199849	4.552670	0.0000
LRBER	0.010634	0.022311	0.476594	0.6340
IQ	0.105024	0.084197	1.247352	0.2132
LINF	-0.601830	0.223154	-2.696923	0.0074
LD	-1.749484	0.130690	-13.38655	0.0000
LFDI	0.211171	0.057930	3.645254	0.0003
LGDPPCD	-0.105632	0.042243	-2.500549	0.0129
ECOWAS	-2.926606	0.301308	-9.713016	0.0000
LANG	0.024507	0.092420	0.265175	0.7910
D(LGDPI(1))	0.517282	2.060867	0.251002	0.8020
D(LGDPI(-1))	-13.93610	5.978611	-2.330993	0.0204
D(LGDPJ(1))	2.304968	1.643659	1.402340	0.1618
D(LGDPJ(-1))	1.428967	0.917198	1.557970	0.1202
D(LFTPI(1))	0.123489	0.356091	0.346789	0.7290
D(LFTPI(-1))	-0.412886	0.256745	-1.608159	0.1088
D(LRBER(1))	-0.312128	0.463588	-0.673287	0.5012
D(LRBER(-1))	-0.030612	0.258477	-0.118431	0.9058
D(IQ(1))	0.061365	0.095372	0.643430	0.5204
D(IQ(-1))	-0.179621	0.057385	-3.130123	0.0019
D(LINF(1))	-0.020311	0.381892	-0.053185	0.9576
D(LINF(-1))	0.095572	0.115298	0.828908	0.4078
D(LFDI(1))	0.132343	0.063930	2.070123	0.0392
D(LFDI(-1))	0.136188	0.062048	2.194902	0.0289
D(LGDPPCD(1))	-0.041223	0.092184	-0.447184	0.6550
D(LGDPPCD(-1))	0.097415	0.064110	1.519490	0.1296

R-squared	0.760160	Mean dependent var	24.39258
Adjusted R-squared	0.740854	S.D. dependent var	1.710653
S.E. of regression	0.870832	Akaike info criterion	2.635270
Sum squared resid	244.9467	Schwarz criterion	2.932882
Log likelihood	-434.1723	Hannan-Quinn criter.	2.753730
Durbin-Watson stat	0.342815		

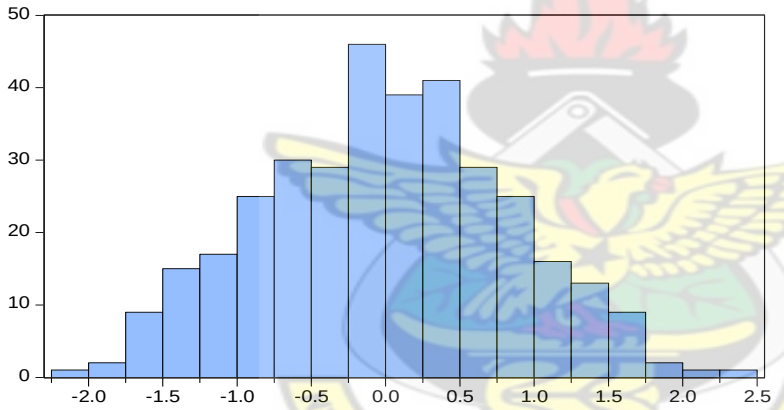
Appendix V: TESTS FOR NORMALITY

Appendix V1: Gravity Model of Total Trade DOLS Residuals



Series: Standardized Residuals	
Sample 1997 2010	
Observations 350	
Mean	-6.84e-14
Median	0.140795
Maximum	2.707208
Minimum	-2.664626
Std. Dev.	0.869466
Skewness	-0.202293
Kurtosis	2.905719
Jarque-Bera	2.516770
Probability	0.284112

Appendix V2: Gravity Model of Exports DOLS Residuals



Series: Standardized Residuals	
Sample 1997 2010	
Observations 350	
Mean	-9.01e-07
Median	0.005651
Maximum	2.437892
Minimum	-2.012576
Std. Dev.	0.837767
Skewness	0.025912
Kurtosis	2.565874
Jarque-Bera	2.787623
Probability	0.248128

Appendix VI: Summary of Findings from Literature on Gravity Model Estimations

Author(s)	Objective of the Study	Country and Time Coverage	Variables Used to Augment the Standard Gravity Model	Estimation Technique	Results
Nikbakht & Nikbakht (2011)	To analyze the bilateral trade among D8 members	The D8 group consist of eight developing Muslim countries, namely, Iran, Turkey, Pakistan, Bangladesh, Malaysia, Egypt and Nigeria (1985-2007).	Populations, Openness, Similarity in Economic Structure, & lagged Trade Policy indicator.	Panel unit root cointegration approach; OLS for Pooled data, and FEM & REM, but, the restricted F-test and Hausman test showed FEM results to be better than the OLS & REM results.	The GDP of home and host countries (+/sig); the population of home (host) country (-(+)/sig.); similarity in economic structure (-/sig.) and the economic openness degree of importer countries (+/sig); and distances among capital of D8 members (-/sig).

Gul & Yasin (2011)	To estimate Pakistan's trade potential.	Panel data across 42 countries within SAARC, ASEAN, EU, Middle East, Far East, Central and South America for the period 1981-2005.	Per capita GDP differential, openness, exchange rate and dummies for Language, border, ECO and SAARC.	Panel data analysis	With the exception of GDPs, Distance and per capital differential, all other variables were found to be insignificant. Pakistan's trade potential is highest with Japan, Sri Lanka, Bangladesh, Malaysia, the Philippines, New Zealand, Norway, Sweden, Italy, and Denmark.
Batra (2004)	To estimate India's global trade potential	Cross-sectional data on 146 countries for the year 2000.	Per capita GDPs, and dummies for Border, language, common colonial link, colony, landlocked, island, and membership of Bangkok Agreement and SAARC.	OLS & IV method. India's trade potential was analyzed with countries within SAARC, ASEAN and Gulf Cooperation Council (GCC).	GDPs (+/sig.), Distance (-/sig.), per geographical proximity, Per capita GDPs differential (+/sig.) All dummies were found to have positively significant impact on India's bilateral trade flows. India's trade potential is maximum in the Asia-Pacific region followed by Western Europe and North America
Thapa (2011)	To examine the determinants and the potentiality of Nepal's foreign trade.	Cross-sectional data for 19 major trading partners of Nepal for the year 2009.	Per capita incomes of Nepal and its 19 trading partners	OLS	GDPs (+/sig.) Distance (-/sig.), and per capita income (+/insig.). Nepal has exceeded trade potentiality with her 10 trading partners, including India and China, and there remains trade potentiality with 9 trade partners including Bangladesh.
Dilanchiev (2012)	To analyze Trade Pattern of Georgia	Panel data covering a cross-section of 35 countries for the period 2000-2011	Population of Georgia and its partners, Foreign direct investment (FDI), and dummies for common history and common EU membership	OLS	The size of the economies, GDP per capita, common history and EU membership were found to be significant factors influencing Georgia's trade pattern. Distance (-/sig.) and FDI (+/sig.).
Tri Do (2006)	To analyze the factors influencing the level of Vietnam trade with 23 European countries in OECD.	Panel data covering 23 European countries in OECD for the period 1993 to 2004	Population of Vietnam and its partners, real exchange rate, and a dummy for common colonial ties.	Panel Data approach.	Economic size, market and real exchange rate were found to significantly affect Vietnam's bilateral trade. Distance and history were found to be insignificant.

+: means positive impact of the variable(s) on trade flows.
- : means negative impact of the variable(s) on trade flows.
sig.: means statistically significant impact.
insig.: means statistically insignificant impact.

Appendix VII: List of Sampled Ghana's Major Trading Partners and Country Specific-Fixed Effects (FE)

Country	Country Code	FEs for Exports Model	FEs for Total Exports Model	Country	Country Code	FEs for Exports Model	FEs for Total Exports Model
Australia	1	-5.46135	-4.33828	Netherlands	15	-1.29497	-2.11474
Belgium	2	-1.13351	-1.66421	Nigeria	16	2.603315	4.161775
Benin	3	9.98824	9.418278	Sierra Leone	17	8.772161	8.420761
Burkina Faso	4	8.975257	8.848412	Singapore	18	-1.54683	-1.44109
China	5	-6.60163	-5.01982	South Africa	19	-1.07082	-0.17306
Cote d`Ivoire	6	5.678817	7.457005	Switzerland	20	-1.61217	-2.61916
Croatia	7	2.033079	1.113586	Togo	21	10.68089	11.12067
France	8	-2.0469	-2.44926	Turkey	22	-2.79268	-3.28256
Germany	9	-5.54028	-5.98563	Ukraine	23	1.623927	1.206875
India	10	-2.83895	-2.37042	United Kingdom	24	-4.52794	-5.06663
Italy	11	-4.64733	-5.02655	United States	25	-8.84071	-9.1877
Japan	12	-6.20836	-6.55855				
Malaysia	13	-0.84781	-0.9314				
Mali	14	6.65654	6.481671				

The Country Specific-Fixed Effects were obtained from Eviews7.