Sources of International Economic Spillovers to Ghana's Economic Growth

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ABSTRACT

In a world where policy co-ordination among countries is paramount, the growth of one depends on the behaviour of another in terms of policy instruments being pursued. One important question this study sought to answer was whether international economic spillovers emanating from all trading partners mattered for Ghana's growth. The study therefore investigated the spillover effects emanating from three of the eight key trading partners of Ghana, namely, U.S.A., China and Nigeria. The study was conducted over the variables; technology diffusion; inflation rates and GDP growth of trading partners; labour; and capital, using annual data from 1980 to 2009. The methodology used involved estimating a growth equation for Ghana, capturing the effects and specific sources of spillovers from trading partners. An autoregressive distributed lag (ARDL) model and a vector autoregressive (VAR) model were used in arriving at various spillover effects from trading partners.

The results showed that capital, inflation rates of U.S.A, and China's GDP contributed significantly to Ghana's GDP growth both in the long-run and the short-run. High spillover effects were observed to emanate from countries with high GDP growth. Another interesting result emphasized the fact that annual GDP growths are independent of each other. Finally, it was observed that spillover effects generally subsided after about fifteen years of persistent shocks.

Key Words: ARDL, Economic Growth, Ghana, International Economic Spillovers, VAR

JEL classification: F14, F15, F43

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1.0 INTRODUCTION

In the spirit of economic ideology, Kuznets (1973) defines economic growth as a long-term increase in capacity to provide an increasing variety of economic goods to a country's population, based on advancements in technology and the ideological and institutional adjustments that it demands. However, these adjustments are not the preserve of the countries that initiate them, but also, those of other economies who mostly inadvertently benefit or suffer the consequences of such adjustments. Over the years, Ghana has been involved in trade with several developed and developing countries. However, the direction of trade has been largely lop-sided as evident from the direction of trade statistics (DOTS, 2010). The actions of all or occurrences in all trading partner countries generate effects that spill over to Ghana and consequently impact her economic growth.

As put forward by Adam Smith (1776) in the wealth of nations;

"The savage injustice of the Europeans[2] rendered an event, which ought to have been beneficial to all, ruinous and destructive to several of those unfortunate countries"[3],

it is clearly noted that some countries definitely suffer injustice at the hands of others. This injustice, in the context of this study includes shocks in the economies of trading partners and their consequent spillover effects on the economic growth of Ghana. Although this phenomenon has long been in existence, its importance now is due to the growing internationalization of economic transactions among countries. Thus, the poor performance of most countries is partly due to the actions of their trading partners, other than their own mistakes. An immediate consequence is that governments lose the power to manipulate their own economies (Guitiàn, M. 1992). As individuals are moved by self interest (Smith, A. 1776), likewise, countries pursue policies that are best suited to solving their economic problems without regard for the consequences on other countries. This is succinctly captured by Adam Smith in the statement;

"It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own interest"[4].

These self interest-motivated actions yield spillover effects which could however be positive or negative. According to Aarle et al (2008), negative spillovers may arise if economic reforms are undertaken only in one country. However, these economic occurrences are mostly far from being reforms. Instead, they come as shocks to the economies of trading partners. Consequently, these shocks find their way into other countries, leading to adverse effects. This has led to what is known in the literature as *Economic Spillovers.* If spillover effects are received by other countries, then it is referred to as *International Economic Spillovers (IES).*

[2] Symbolizes trading partners in this study
[3] Italics mine.
[4] Italics mine.

International economic spillovers, as used in this study refer to the transmission of economic shocks from the economies of trading partners to other economies. In this study, a specific concern is attached to how economic shocks in the economies of trading partners affect Ghana's long-term growth. It is worth noting that spillover effects have been a recurrent problem and an issue of concern for policymakers in developing countries. In view of this, several studies have been done on international spillovers including De Bondt et al (1995), Funk M. (2001), Ono Yoshiyasu (2001), Conley T.G et al (2002), Hadass Y.S et al (2003), Wei Y et al (2006), Serletis et al (2010).

Although there have been increasing efforts at ensuring economic growth in Ghana since independence, this is being achieved at a snail's pace, if any at all. Until recently, not much attention was given to the impact of economic shocks on the economies of trading partners. During the Asian crisis in 1997, Ghana, just as any other country that relied on primary commodity exports, was affected in terms of the reduction in her growth rates. This was because prices of such primary commodities plummeted in the period (budget statement of Ghana, 2000). The recovery in crude oil prices in 1999 compounded the difficulties of non-oil producing countries such as Ghana (at that time). There was therefore the need to undertake measures to insulate the economy from further external shocks that impact on GDP growth. The government at the time sought to diversify the economy to break the jinx of over- dependency on the three major primary commodities namely, cocoa, timber and gold (budget statement of Ghana, 2000) for export revenues. Moreover, there was an emphasis on patronizing made-in-Ghana goods, all in an effort to reduce over-reliance on trading partners.

Contrary to the expectations of the policymakers who implemented measures to curb economic spillovers during the Asian crisis in the 1990s, Ghana's growth was hampered, albeit mildly, with the surfacing of the financial crisis in the United States of America in 2007/2008. This was attributed to the three major shocks experienced by the world economy between 2007 and 2008: a global financial crisis, an upward spiral in food prices and overshooting fuel prices (budget statement of Ghana, 2009). Once again, as in the periods of the Asian crisis, oil prices soared to $76 per barrel in November 2009, from a value of $36 in February 2009, putting pressure on non-oil producing countries such as Ghana.

In view of the above, the main thrust of this study is to look at the sources and impact of economic conditions as they prevail in the economies of trading partners on Ghana's growth.

2.0 OVERVIEW OF THE GHANAIAN ECONOMY

Until recently, economic growth rates in Ghana were largely inconsistent. This is evident from the sharp declines followed by gradual recoveries in most part of the 1960s and 1970s. This phenomenon could be partly blamed on the political instability in most part of the period prior to 1983. There was therefore no room for proper planning and implementation of economic

policies. As noted by Oduro A.D (2000), policies implemented prior to 1983 were inappropriate and inadequate. Thus, economic growth suffered the brunt of consequences from these failed policies. An abortive attempt at trade liberalization from 1978 to 1980 provides an overview of the situation as it prevailed in the period. With a growth rate of 1.37% in 1965 this dipped to -4.26% a year after in 1966. Subsequently, growth picked up steadily reaching as high as 9.72% in 1970. The 1970s saw periods of negative growth and in 1975 the worst growth rate since the 1960s was recorded as -12.43%. It is therefore not surprising that writers such as Aryeetey and Harrigan (2000) have described the period 1973-1982 as nothing short of unmitigated economic disaster. Economic conditions during the period contributed to a 139% devaluation of the currency (cedi) in 1978.

In addition, large balance of payment deficits characterised the early 1980s. Aryeetey and Harrigan (2000) assert that gross official foreign reserves were depleted in the period in addition to accumulation of external payment arrears, which was equivalent to 90% of export earnings by the end of 1982. Exogenous shock factors including oil price hikes in 1979 coupled with a combination of severe drought and forced repatriation of one million Ghanaians from Nigeria in 1983 pushed the government to approach the Bretton Woods institutions for help. Specifically, a structural adjustment package and stabilization were requested and these earned the accolade "Structural Adjustment Programme (SAP)" under the ERP. Thus, the inception of the ERP in 1983.The early 1980s also recorded some negative growth rates consistently. The diagram below shows trends in GDP growth from 1961 to 1982.

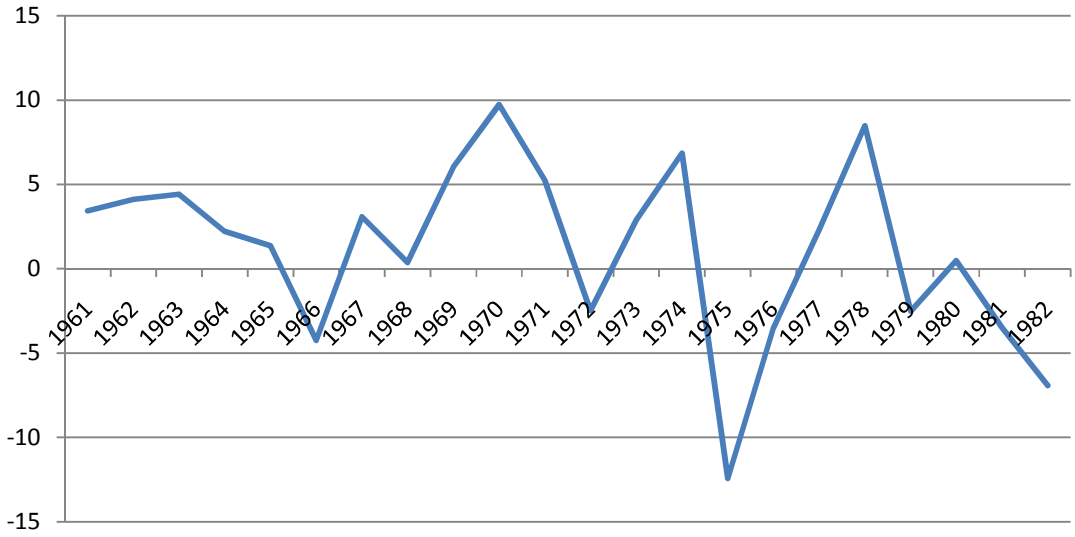


FIG. 1 TRENDS IN GDP GROWTH FROM 1961 TO 1982

The diagram shows clearly the pattern of GDP growth over the years. Sharp declines have been the most remarkable phenomena in the period interspersed with some sharp recoveries as well, especially in the 1970s.

Since the inception of the ERP in 1983 there has been consistent growth in the economy without sharp fluctuations. By 1984, glimpses of political stability were somewhat witnessed in the country. This provided a sound environment for the implementation of policies under phase one of the ERP. Among other policies, the ERP sought to realign relative prices in favour of productive activities and exports, liberalize controls, encourage private sector savings and investment, and rehabilitate the country's economic and social infrastructure. However, to achieve these, sound fiscal and monetary discipline had to be restored as well as liberalizing trades and payments. Inflation rates dropped to 20% and between 1983 and 1987, the economy was reported to have grown 6% per annum. Official assistance from donor countries to Ghana's recovery program averaged US$430 million in 1987 (more than double that of the preceding years). These achievements among several other factors contributed to a steady annual growth in the country's GDP as seen in the diagram below.

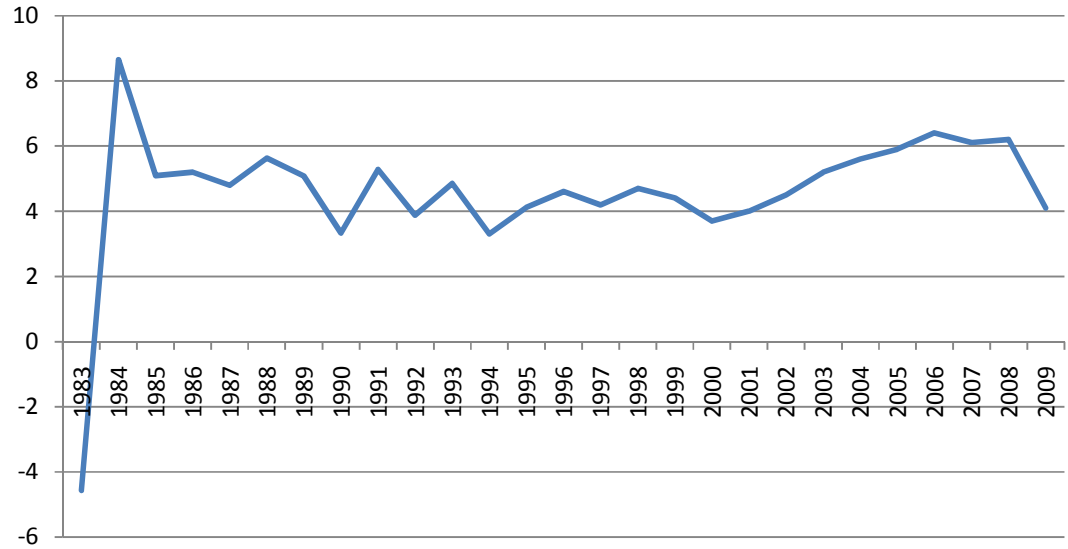


FIG. 2 TRENDS IN GDP GROWTH FROM 1984 TO 2009

Successful implementation of fiscal policies during the ERP regime contributed to steady growth patterns over the period under review. To encourage private sector participation in economic activities, fiscal deficits were to be reduced in order to help control inflation. Government revenue increased from 6% of GDP in 1983 to 15% in the second half of the decade. The government budget, narrowly excluding externally funded projects, registered a surplus by 1986 (Aryeetey and Harrigan, 2000). Thus, domestic debts were paid to the banks allowing for the movement of resources to the private sector. GDP growth therefore received a boost, albeit mildly. Moderate changes in GDP growth were experienced in the latter part of the 1990s, partly

due to the effects emanating from the Asian crisis of 1996. Improvement in resource allocation was partly achieved with monetary policies implemented under the ERP. The primary objective of this was for stabilization purposes. However, unlike fiscal policies, monetary policies were extremely disappointing, *ibid*. Money supply continued to grow at a rate of 50% on average, with inflation peaking at 60% in 1995.

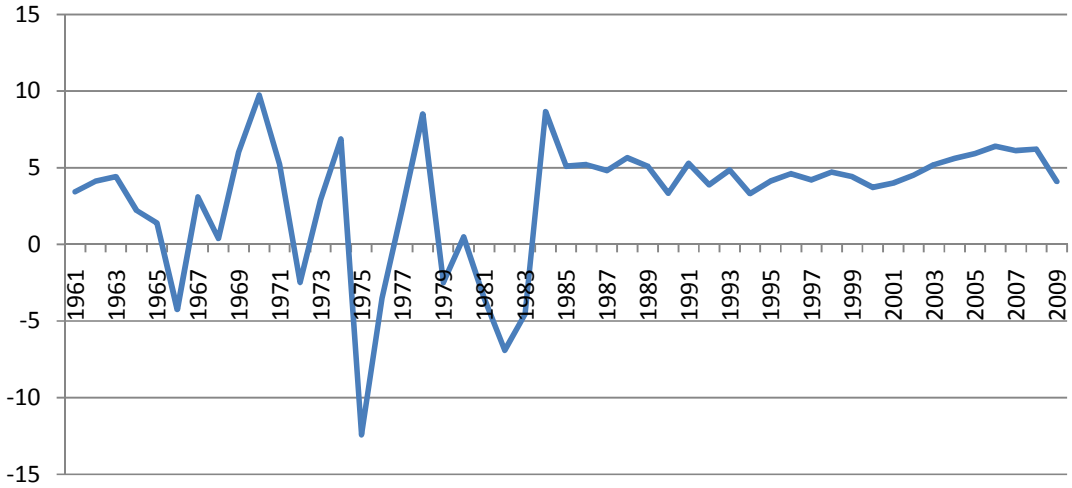


FIG. 2.3 TRENDS IN GDP GROWTH FROM 1961 TO 2009- A SUMMARY

The diagram shows that economic growth has been relatively stable since the inception of the ERP in 1983 up to 2009. Periods ranging from 1961 to 1983 have been relatively unstable with some sharp fluctuations in the growth rate. Thus, the implementation of the ERP may be justified in bringing to an end decades of uncertainty in economic growth. Since 2001, growth has been steady and commendable. The impressive performance of the economy in this period can be attributed to the increased capital inflows and the benefits accrued from HIPC[5] membership. Having joined HIPC in 2001, much of the capital inflows accrued thereof were used for infrastructural development and agricultural improvement. The ultimate purpose was to open up the economy for emerging growth opportunities. With an increase in the producer price of cocoa from GH₵ 347.5 in 2001 to GH₵ 900 in 2004 on the international market, increased revenue from this sector was in the offing. The eventual receipt of such revenues by the government helped in the improvement of agriculture and the provision of infrastructure to promote the sector. Economic growth consequently gained some points and the pattern has been consistent up to date, although international shocks have been quite rampant.

[5] Highly Indebted Poor Country

2.1 TRENDS IN IMPORTS FROM 1980 TO 2008

Due to the primary focus of the study (which is; investigating the effects of shocks emanating from foreign trading partners), this section analyses only trends in imports. This is informed by the fact that these external shocks travel through imports from trading partners. With an increasing openness of the Ghanaian economy to foreign trade, import volumes have subsequently increased at the expense of exports. In 2005, imports formed 51% of total GDP. This is evident from the fact that the economy was about 88% open to foreign trade in 2005 (ISSER, 2006). With an import value of USD1129.33million in 1980, this figure declined in the most part up to 1991. However, there has been a major reversal of the situation given that import values have been increasing significantly since 1992. This increase in imports led to increased revenues to government through import taxes. Consequently, other sectors of the economy benefitted from the use of such revenues leading to an overall GDP growth in most part of the 1990s.The diagram below depicts the trend in imports in millions of USD from 1980 to 2008.

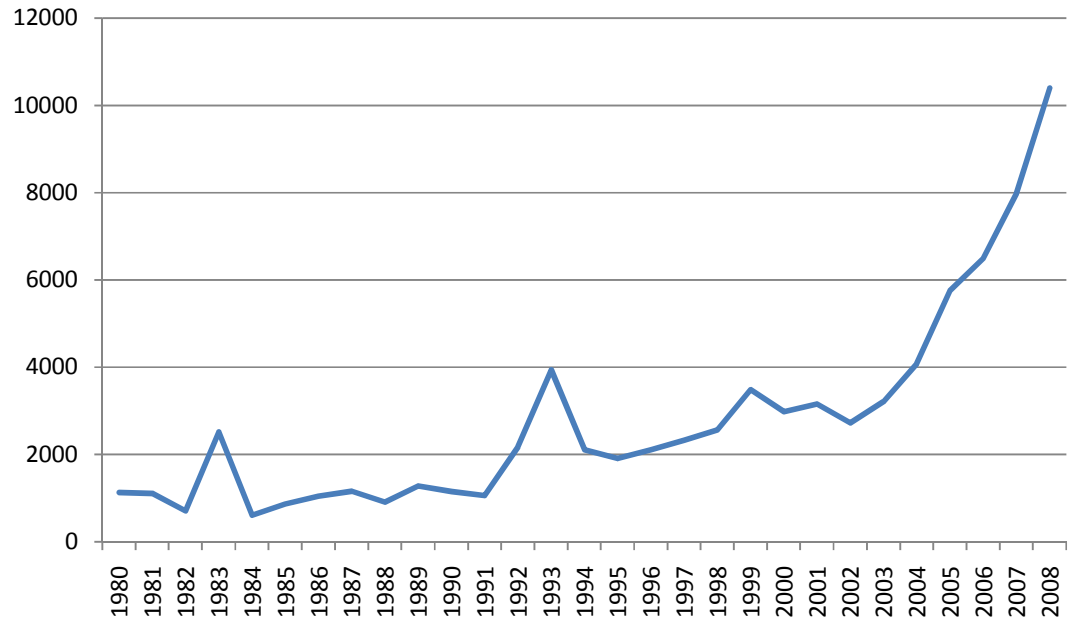


FIG. 2.4 TRENDS IN IMPORT VALUES FROM 1980 TO 2008 (MILLIONS, USD)

The diagram above shows that imports have been increasing over the years and thus, it is not surprising that GDP growth rate has been increasing consequently, although marginally. With the increasing import values in most part of the 2000s notwithstanding, paving the way for the transmission of external economic shocks into the Ghanaian economy, economic growth has however been relatively stable, without severe and sudden changes. This could be due to the implementation of sound economic policies within the period. Even in the face of global economic downturn, the economy of Ghana proved resilient to such shocks.

Although the effect of imports on GDP growth as espoused in this study may seem contrary to popular economic thought, due largely to the role of imports in the Keynesian macroeconomic framework, the difference lies in the contribution of trade openness, nature of imports, as well as the time span under consideration. Whiles increased openness ensures that imports grow; this may put a strain on economic resources (especially foreign exchange) in the immediate term. However, in the long-run this may tend to exert positive effects on economic growth. This effect could be due to the contributions of such imports to output production, especially when they come in the form of raw materials or capital equipment.

The above notwithstanding, increased openness leads to increased vulnerability to external shocks. Thus, there is the need to put policies in place to guard against sudden shocks. Undoubtedly, some of the pre-existing policies have led to the increased trade openness with trading partners.

3.0 REVIEW OF EMPIRICAL LITERATURE

Literature on the effects of international economic spillovers on the growth of trading partners is on the one hand sparsely documented, in terms of their emphasis on external economic shocks. A major task already accomplished by previous studies is to recognize trade as an “engine of growth”. A common view in the trade literature is that with a growing integration of world economies, economic developments in one country necessarily extend to another. Most studies of output growth use an augmented production function with capital and labour inputs as key variables. The advantage of such models is that they allow for the inclusion of other parameters that determine output growth in an economy. This study specifically focuses on that of Obiora (2009).

Empirical studies have largely observed financial, trade and commodity linkages as the main channels through which spillovers travel from one trading partner to the other. In a study by Obiora (2009) on spillovers to Nigeria, though he acknowledges financial linkages as important transmission channels of spillovers, he observes trade and commodity linkages as the most dominant. Coincidentally, these channels prove to be the very same through which trading partners impact one another. In order to capture the effects emanating from trading partners and the possible responses by the Nigerian economy, he adopted vector autoregressive (VAR) models in his analysis. The results confirm growing integration among countries and thus there are significant cross-country spillovers between trading partners. However, for such spillovers to materialise, increased openness to trade between trading partners is of paramount importance.

Other empirical studies have noted that the size of a country’s trading partners has a significant effect on its own economic growth rate. As reported by Sutter (2003), China alone contributed to about 5% of total world trade in 2002.This was due to her exertion of great importance and influence on world trade. With such influence, whatever China does or happens to her economy translates into other economies through trade.

The severity of spillovers from one trading partner to another seems to be affected by the geographical distance between them. The first empirical attempt to explain the effects of distance between trading partners on trade flows goes back to Tinbergen (1962) and Pöyhönen (1963). In terms of contagion effects, growth of neighbouring trading partners may be much less important for a country's growth than is sometimes claimed (Bleaney et al, 2007). In their analysis using pooled ordinary least squares (OLS) on a data set of five-year average growth rates of 101 countries from 1960 to 1999, they observed that variables such as the growth of trading partners appear to be statistically much significant when time-varying regional differences are ignored, but are much less significant when they are properly controlled. They however conclude that these variables reflect international business cycle correlations rather than the advantages of being close to a faster-growing trading partner. However, as argued by Wei et al (2006) in their study "Productivity Spillovers from R&D, Exports and FDI in China's Manufacturing Sector", spillover effects could be received first by neighbouring firms and later spread gradually to more distant ones. Considering individual countries as firms in one world, then, the same conclusion holds for such countries. Other things being equal, it will be more profitable to trade with close neighbours due to reduced transport cost and rapid movement of goods and services. However, in terms of spillover effects of external economic shocks, these neighbours may prove to be more harmful.

4.0 DATA AND METHODOLOGY

The study uses annual time-series data of two trading partners drawn from secondary sources over the period 1980 to 2009. This gives a total of 30 observations for each of the variables to be investigated per trading partner. The countries selected are three of the major trading partners of Ghana. The period 1980-2009 is chosen because it encompasses the two major economic crises in recent times (that is, the Asian crisis and the global financial crisis which started in the US in 2007) as well as the era of the Economic Recovery Programmes (ERP) in the 1980s. This was the period of increased trade liberalization which witnessed the removal of most trade restrictions. Data for the study will be compiled from the following sources;

- Africa Development Indicators (The World Bank Group), 2010
- World Development Indicators & Global Development Finance (The World Bank Group),2010
- World Economic Outlook (IMF),2010

Three of the eight major trading partners –China, USA, and Nigeria- of Ghana are considered in this study.

An endogenous growth model is specified in the foregoing. Thus, we state the following production function;

$$Y = f(A, K, L) \quad \text{..... (1)}$$

Where Y is the level of output, K is the capital input; L is the labour input and A represents total factor productivity which captures economic spillovers due to government policies. As noted by the endogenous growth theory, A is endogenously determined by economic factors (which may result from government policies). Thus, the obvious realisation is that spillovers occur through A which captures the effect of all other variables that affect economic output. Edwards (1998) reports that output growth in a country is also affected by changes in total factor productivity in the economies of trading partners. Notably, these changes could be due to factors such as technology diffusion from the economies of trading partners through foreign direct investments by multinational enterprises (MNEs) and inflationary (INF) dynamics within these economies (which takes care of persistent price changes that affect output production in the economy). Consequently, to fix ideas, we could model A as comprising only technology diffusion as shown below.

$$A = h(D) \quad \text{..... (2)}$$

Substituting (2) into (1) yields;

$$Y = f(D, K, L) \quad \text{..... (3)}$$

The following augmented Cobb-Douglass type of production function is subsequently specified.

$$Y = \alpha(D)^{\delta} K^{\varphi} L^{\eta} \quad \text{..... (4)}$$

Where α is a constant term, δ is the elasticity of output growth relative to technology diffusion, φ represents the elasticity of output growth relative to capital, and η represents the elasticity of output growth relative to labour. Taking natural logarithms of equation (4) results in;

$$\ln Y = \ln \alpha + \delta \ln(D) + \varphi \ln K + \eta \ln L \quad \text{..... (5)}$$

For uniformity, all parameters are changed to β so that we obtain;

$$\ln Y = \ln \beta_0 + \beta_1 \ln(D) + \beta_2 \ln K + \beta_3 \ln L \quad \text{..... (6)}$$

Chenery et al (1986) contend that in periods of disequilibrium, the macroeconomic variables which in addition to capital and labour determine growth rates may be added to the growth model. To this end, it has also been argued in the literature as noted above that economic growth is also affected by the rates of inflation as well as the annual growth rates of gross domestic product (GDP_g) of trading partners. Thus, we augment equation (6) by adding these variables as mentioned above. This results in;

$$\ln Y = \ln \beta_0 + \beta_1 \ln(D) + \beta_2 \ln K + \beta_3 \ln L + \beta_4 (INF) + \beta_5 (GDP_g) \quad \text{..... (7)}$$

Equation (7) represents the mathematical model. The econometric model which will be used in the estimation process is specified as follows;

$$\ln Y_t = \ln \beta_0 + \beta_1 \ln(D)_t + \beta_2 \ln K_t + \beta_3 \ln L_t + \beta_4 (INF)_t + \beta_5 (GDP_g)_t + \varepsilon_t \quad \text{..... (8)}$$

Where ε_t represents an error term, t represents time-period, and g represents growth rate.

Labour and capital are supposed to capture domestic effects on economic growth. The above equation can be re-written as follows;

$$gdp_t^{GH} = \beta_0 + \beta_1 (d)_t + \beta_2 k_t + \beta_3 l_t + \beta_4 (INF)_t + \beta_5 (GDP_g)_t + \varepsilon_t \quad \text{..... (9)}$$

Where lower-case letters represent natural logarithmic forms and $gdp_t^{GH} = \ln Y_t$. Following the nature of the study involving three trading partners (CHINA, NIGERIA, USA), equation (9) is augmented as follows;

$$gdp_t^{GH} = \theta_0 + \theta_1 d_t^{GH} + \theta_2 k_t^{GH} + \theta_3 l_t^{GH} + \theta_4 (INF)_t^{US} + \theta_5 (INF)_t^{CH} + \theta_6 (INF)_t^{NG} + \theta_7 (GDP)_{gt}^{US} + \theta_8 (GDP)_{gt}^{CH} + \theta_9 (GDP)_{gt}^{NG} + \varepsilon_t$$

..... (10)

Where θ_i represents regression coefficients with $i = 1, 2, ..., 7$ and

GH	.....	GHANA	CH	.....	CHINA
US	.....	USA	NG	.....	NIGERIA

The approach of incorporating different country-variables in one regression is adopted from Obiora (2009).

4.1 DEFINITION AND MEASUREMENT OF VARIABLES

4.1.1 TECHNOLOGY DIFFUSION

Technology diffusion, as used in this study refers to the transfer of technology from countries with relatively high technologies to those that are less endowed with such technologies. This transfer, as already noted occurs through foreign direct investments by multinational enterprises that move abroad to operate. To measure the spillover effects emanating from FDI inflows, this study uses FDI as a percentage of GDP as an appropriate proxy (Xu, 2000). Data to capture this effect is obtained from the Africa Development Indicators (2010).

4.1.2 GROSS DOMESTIC PRODUCT

The GDP of a country is the sum of total output by all resident producers. This serves as the dependent variable in the model. It captures GDP values of Ghana since 1980 up to 2009. Data on this variable is obtained from the World Development Indicators and Global Development Finance (2010), measured in current United States dollars.

4.1.3 INFLATION

Inflation refers to the sustained increase in prices of goods and services over a specified period of time in an economy. During inflation, everything gets more valuable except money. The most common measure of inflation is by use of the percentage change in consumer price index (CPI) relative to a base period. Others prefer using the percentage change in the producer price index relative to a base period. However, the approach used here is to measure inflation as the average annual percentage change in prices (PCPIPCH) as reported in the IMF's WEO (2010). Data on inflation as used in this study is obtained from the World Economic Outlook (2010).

4.1.4 GDP GROWTH RATE

The GDP growth rate of a country represents the annual change in the gross domestic product. Thus, it could take either a positive or negative value. The purpose of adding this variable is to trace the extent of impact emanating from each trading partner based on how their economies have been performing over the years. The World Development Indicators and Global Development Finance (2010) provide data on GDP growth of trading partners.

4.1.5 CAPITAL

The use of capital in this study refers to all plants and equipment used in the production of goods and services. These need maintenance and replacement over time. Gross domestic investment as a percentage of GDP is used as a proxy to capture the effect emanating from this variable (Asare, 2004). This is obtained from the Africa Development Indicators (ADI, 2010).

4.1.6 LABOUR

Labour involves all mental and physical abilities used in the production process. This is measured using the total labour participation rate as a percentage of the total population aged 15 and above (Asare, 2004). This is obtained from the World Development Indicators and Global Development Finance (2010).

4.1.7 DISTANCE

Although the effect of distance is not explicitly captured in the specified model, it is calculated using the formula below in order to trace its relevance in determining the intensity of shocks from trading partners. Distance, as used here refers to how far or close two trading partners are in terms of transporting traded goods and services across borders. This is usually termed economic distance. However, due to the lack of an acceptable measure, proxies are usually adopted. One such proxy is the geographic distance between the two trading partners. This is measured by noting the distance between the capital cities of the countries involved. Due to the purpose for which distance is being investigated in this study, geographic distance will be used.

Following the approach of Aten (1996) and Sohn (2005), we calculate the geographic distance between Accra and the capital city of each of the two key trading partners. To do this, the great circle distance (also called orthodromic distance) formula is adopted so that if $(lat_i, long_i)$ and $(lat_j, long_j)$ are the pairs of coordinates between two cities *i* and *j,* the distance (*Dis*) between them-measured in kilometres-is given by;

$$Dis_{ij} = Rad * \cos^{-1}[\sin(lat_i) * \sin(lat_j) + \cos(lat_i) * \cos(lat_j) * \cos(long_i - long_j)] \quad \text{..... (11)}$$

Where $Rad = 6378.7 kilometers$ and the arguments of the trigonometric functions are measured in degrees. *'Rad'* represents the radius of the earth. *'lat' and 'long'* represent latitudes and longitudes[6] respectively. The great circle distance as used in this study is defined as the shortest distance between the capital cities of Ghana and her trading partners along a specified path. Table 1 reports the distance between Accra and the capital cities of each trading partner.

TABLE 1: GEOGRAPHIC DISTANCE BETWEEN CAPITAL CITIES

COUNTRY	CAPITAL CITY	LATITUDE	LONGITUDE	DISTANCE FROM ACCRA (KM)
CHINA	BEIJING	39.92^0 N	116.33^0 E	675,886.73
NIGERIA	ABUJA	09.08^0 N	07.53^0 E	299,589.93
USA	WASHINGTON DC	40.52^0 N	77.03^0 W	487,661.13

KM = Kilometers, N = North, S = South, E = East, W = West. Coordinates for Accra= (5.58^0 N, 0.10^0 W). Source: Author's Own Calculations Based on Longitudes and Latitudes. Distance Accurate to 2 Decimal Places.

[6] Longitudes and latitudes were obtained from http://www.mapsofworld.com/utilities/world-latitude-longitude.htm.

4.2 TEST FOR STATIONARITY

This study adopts the KPSS test because of its proven suitability in terms of size and power. By size, we mean the likelihood of committing a Type 1 error while the power of the test refers to the likelihood of rejecting the null hypothesis when it is false. The KPSS test, introduced by Kwiatkowski, Phillips, Schmidt and Shin (1992) will ensure that stationarity is achieved for each of the non-stationary variables used in the study. The KPSS test proposes a null hypothesis which assumes stationarity and an alternative hypothesis which assumes non-stationarity. The approach involved in this test is to decompose a time-series into the sum of a deterministic time trend, a stationary error term (which may not be white noise) and a random walk component (Verbeek, 2004). The table below presents the results of the stationarity test.

TABLE 2: Results of the KPSS Unit Root Test

VARIABLE	KPSS TEST STATISTIC	COMMENT	BANDWIDTH (MAX. LAG)	ORDER OF INTEGRATION
GDP-G	0.186433	REJECT H_0		
GDP-G(-1)	0.118966	ACCEPTH_0^*	1	I(1)
TECH-DIFF	0.141151	ACCEPT H_0^*	1	I(0)
CAPITAL	0.549725	REJECT H_0		
CAPITAL(-1)	0.049169	ACCEPT H_0^*	0	I(1)
LABOUR	0.125236	ACCEPT H_0^*	2	I(0)
US-INF	0.113254	ACCEPT H_0^*	1	I(0)
CH-INF	0.138638	ACCEPT H_0^*	1	I(0)
NIG-INF	0.129728	ACCEPT H_0^*	1	I(0)
US-GDP	0.130354	ACCEPT H_0^*	1	I(0)
CH-GDP	0.074553	ACCEPT H_0^*	0	I(0)
NIG-GDP	0.101556	ACCEPT H_0^*	0	I(0)

*significant at 1%

The above table reports the results of the stationarity test conducted over the following variables; Ghana's GDP, technology diffusion, capital, labour, USA's inflation rates, China's inflation rates, Nigeria's inflation rates, USA's GDP, China's GDP, and Nigeria's GDP. The results show that Ghana's GDP and capital are non-stationary at the levels, at 1% level of significance. The non-stationarity of Ghana's GDP gives much support to the need for this study as well as determining why this is the case. The non-stationarity of these variables notwithstanding, differencing makes them stationary. Thus, they are integrated of order one [written I(1)]. The results also show that stationarity for Ghana's GDP is achieved at lag length one, whiles that of capital is achieved at lag length zero.

Further, all other variables, namely, technology diffusion, labour, USA's inflation rates, China's inflation rates, Nigeria's inflation rates, USA's GDP, China's GDP, and Nigeria's GDP are found to be stationary at levels with lag lengths 1, 2, 1, 1, 1, 1, 0, and 0, respectively. The dependent variable was found to be trended in earlier experimentation with the dataset.

4.3 TEST FOR COINTEGRATION: AUTOREGRESSIVE DITRIBUTED LAG (ARDL) APPROACH

In ARDL multiple regression models, lagged dependent variables as well as lagged explanatory variables are introduced as additional regressors that explain the variable of interest. The ARDL approach to cointegration is a combination of autoregressive models and distributed lag models. Here, a time series variable is regressed on its own lagged values as well as current and lagged values of some other explanatory variable(s). The pre-condition for cointegration using the ARDL approach is that all series must be integrated, within certain bounds. Most importantly, the dependent variable must be integrated of order one (I(1)) and none of the independent variables should be integrated of more than the second order.

The ARDL framework for cointegration is as follows;

$$\begin{aligned}\Delta gdp_t^{GH} = {} & \pi_0 + \partial_0 T + \sum_{i=1}^{p} \beta_i \Delta(gdp)_{t-i}^{GH} + \sum_{i=0}^{q} \delta_i \Delta d_{t-i} + \sum_{i=0}^{r} \phi_i \Delta k_{t-i} + \sum_{i=0}^{s} \varphi_i \Delta l_{t-i} + \sum_{i=0}^{v} \lambda_i \Delta(INF)_{t-i}^{US} + \\ & \sum_{i=0}^{w} \varpi_i \Delta(INF)_{t-i}^{CH} + \sum_{i=0}^{z} \Phi_i \Delta(INF)_{t-i}^{NG} + \sum_{i=0}^{h} \Theta_i \Delta(GDP)_{t-i}^{US} + \sum_{i=0}^{j} \Upsilon_i \Delta(GDP)_{t-i}^{CH} + \\ & \sum_{i=0}^{e} \mathrm{A}_i \Delta(GDP)_{t-i}^{NG} + \sum_{i=1}^{p} \theta_i (gdp)_{t-i}^{GH} + \sum_{i=0}^{q} \gamma_i d_{t-i} + \sum_{i=0}^{r} \rho_i k_{t-i} + \sum_{i=0}^{s} \psi_i l_{t-i} + \sum_{i=0}^{u} \omega_i (INF)_{t-i}^{US} + \\ & \sum_{i=0}^{v} \xi_i (INF)_{t-i}^{CH} + \sum_{i=0}^{w} \Im_i (\mathrm{inf})_{t-i}^{NG} + \sum_{i=0}^{z} \zeta_i (GDP)_{t-i}^{US} + \sum_{i=0}^{h} \vartheta_i (GDP)_{t-i}^{CH} + \sum_{i=0}^{e} \lambda_i (GDP)_{t-i}^{NG} + \varepsilon_t \end{aligned}$$

. ..... (1)

Where ε_t is assumed to be a white-noise error term. To establish the existence of a long-run relationship we test the null hypothesis that $H_0 : \gamma_i = \psi_i = \omega_i = \xi_i = \Im_i = \zeta_i = \vartheta_i = \lambda_i = 0$, against

an alternative of $H_1 : \gamma_i \neq \psi_i \neq \omega_i \neq \xi_i \neq \Im_i \neq \zeta_i \neq \vartheta_i \neq \lambda_i \neq 0$ in equation (1). The F-test is adopted to achieve this. The *F-test* follows no standard distribution and depends on whether variables are I(0) or I(1), the number of regressors in the model, and whether the model contains an intercept and/or a trend. Two sets of critical value bounds are generated by the test with one set representing I(1) variables and the other representing I(0) variables. The critical values for the I(0) series are referred to as the lower bound critical values, while those of the I(1) series are referred to as the upper bound critical values.

If the *F*-statistic lies above the upper bound critical values, then we reject the null hypothesis of no cointegration. Otherwise, we fail to reject the null hypothesis. However, if it lies within the lower and upper critical bound values, then we cannot draw any conclusive inference without knowing the order of integration of the variables involved.

If there is evidence of the existence of a long-run relationship between variables, then the following long-run model is estimated;

$$gdp_t^{GH} = \alpha_0 + \partial_0 T + \sum_{i=1}^{p} \theta_i (gdp)_{t-i}^{GH} + \sum_{i=0}^{q} \gamma_i d_{t-i} + \sum_{i=0}^{r} \rho_i k_{t-i} + \sum_{i=0}^{s} \psi_i l_{t-i} + \sum_{i=0}^{u} \omega_i (INF)_{t-i}^{US} +$$
$$\sum_{i=0}^{v} \xi_i (INF)_{t-i}^{CH} + \sum_{i=0}^{w} \Im_i (\inf)_{t-i}^{NG} + \sum_{i=0}^{z} \zeta_i (GDP)_{t-i}^{US} + \sum_{i=0}^{h} \vartheta_i (GDP)_{t-i}^{CH} + \sum_{i=0}^{e} \lambda_i (GDP)_{t-i}^{NG} + \varepsilon_t$$

..... (2)

Where $p, q, r, s, u, v, w, z, h,$ and e are lag lengths to be determined. This gives an ARDL($p, q, r, s, u, v, w, z, h, e$)model. $\alpha_0, \theta_i, \gamma_i, \rho_i, \psi_i, \omega_i, \xi_i, \Im_i, \zeta_i, \vartheta_i,$ and λ_i are coefficient estimates. T denotes a trend term with coefficient ∂_0. The inclusion of the trend term is informed by the fact that the dependent variable (Ghana's GDP) was found to be trended. Equation (1) represents the long-run relationship between the dependent variable and the set of regressors. The corresponding ARDL specification of the short-run relationship is shown below.

$$\Delta gdp_t^{GH} = \chi_0 + \partial_0 T + \sum_{i=1}^{p} \beta_i \Delta (gdp)_{t-i}^{GH} + \sum_{i=0}^{q} \delta_i \Delta d_{t-i} + \sum_{i=0}^{r} \phi_i \Delta k_{t-i} + \sum_{i=0}^{s} \varphi_i \Delta l_{t-i} + \sum_{i=0}^{v} \lambda_i \Delta (INF)_{t-i}^{US} +$$
$$\sum_{i=0}^{w} \varpi_i \Delta (INF)_{t-i}^{CH} + \sum_{i=0}^{z} \Phi_i \Delta (INF)_{t-i}^{NG} + \sum_{i=0}^{h} \Theta_i \Delta (GDP)_{t-i}^{US} + \sum_{i=0}^{j} \Upsilon_i \Delta (GDP)_{t-i}^{CH} + \sum_{i=0}^{e} \mathrm{A}_i \Delta (GDP)_{t-i}^{NG} +$$
$$\Omega ecm_{t-1} + u_t$$

. . . . (3)

Where Δ represents the first difference of relevant variables in the model and $\chi_0, \beta_i, \delta_i, \phi_i, \varphi_i, \lambda_i, \varpi_i, \Phi_i, \Theta_i, \Upsilon_i,$ and A_i are coefficient estimates. Ω represesents the coefficient of the error correction term which is the lagged error term estimate from equation (2). This

coefficient denotes the speed of adjustment to equilibrium when there is a shock to the system. All coefficients of the short-run model represent short-run dynamics of the model's adjustment to equilibrium.

5.0 RESULTS

Given the *F*-statistic in table 3 below and the upper bound of both 5% and 10% levels of significance, there is a high support for cointegration between variables in the ARDL model. Thus, the null hypothesis of no cointegration is rejected. This implies that there exists a long-run equilibrium relationship between the variables under investigation.

TABLE 3: RESULTS OF COINTEGRATION TEST

F-STATISTIC	**5% LEVEL OF SIGNIFICANCE**		**10% LEVEL OF SIGNIFICANCE**	
	LOWER BOUND I(0)	UPPER BOUND I(1)	LOWER BOUND I(0)	UPPER BOUND I(1)
23.65	2.43	3.56	2.16	3.24

Once cointegration has been achieved, then, the relationship between these variables can be expressed as an error correction model (ECM), according to the Engel-Granger Representation Theorem (1987). This gives the short-run dynamics in the model, showing how variables adjust to changes in the short-run.The long-run estimates of the ARDL model are represented in the following table (4).

TABLE 4: ESTIMATED LONG-RUN COEFFCIENTS: ARDL (1, 1, 0, 0, 1, 1, 1, 1, 0, 1) SELECTED BASED ON AKAIKE INFORMATION CRITERION. DEPENDENT VARIABLE: GDP-GH

VARIABLE	**COEFFICIENT**	**t-STATISTIC**	**PROBABILITY**
TECH-DIFF.	0 .082632	2.0609	0.064**
CAPITAL	0.44047	3.4061	0.006*
LABOUR	0.033549	1.3864	0.193

US-INF	0.080563	4.9920	0.000*
CH-INF	0.0032054	0.34032	0.740
NG-INF	-0.0082739	-2.0567	0.064**
US-GDP	-0.040480	-1.6258	0.132
CH-GDP	0.023556	2.1481	0.055**
NG-GDP	0.011314	1.1345	0.281
CONSTANT	21.0008	59.0524	0.000*
TREND	0.025736	3.7439	0.003*

*Significant at 1% ** Significant at 10%

This is shown in the equation below.

$$gdp_t^{GH} = 21.0008 + 0.025736T_t + 0.082632d_t + 0.44047k_t + 0.033549l_t + 0.080563(INF)_t^{US} + 0.0032054(INF)_t^{\mathrm{CH}} - 0.0082739(INF)_t^{NG} - 0.040480(GDP)_t^{US} + 0.023556(GDP)_t^{CH} + 0.011314(GDP)_t^{NG} + \varepsilon_t \quad \text{.....(5)}$$

Notably, a significantly high R^2 value gives much credence to the fact that variations in Ghana's GDP growth are largely influenced by variations in the explanatory variables which include effects in other countries.

The results show that in the long-run technology diffusion affects Ghana's GDP growth, though less significantly. A percentage change in technology diffusion through multinational enterprises (MNEs) leads to about 0.08% change in GDP growth, in the same direction. This conclusion is in agreement with that of Kuznets (1973), who notes technology as the source of economic growth, though not sufficient in itself. The argument here is that as an additional MNE invests in Ghana, then, the introduction of a new technology to their production process gives other existing enterprises the opportunity to learn and adopt such technology to enhance their productive capacity. This supports the view held by Fagerberg (1994). This is largely possible given the fact that technology, once introduced becomes a public good and thus becomes non-rival, barring the presence of any patents.

Further, capital is found to significantly affect GDP growth in the long-run. A percentage change in current period's capital leads to a 0.44% change in GDP growth in the current period. This figure appears high and thus gives support to the increasing role played by the involvement of capital in GDP growth. The positive contribution of capital to GDP growth confirms theoretical

predictions by the neoclassical growth models. Empirical findings by Beck et al (2000), Wang et al (2003), and De Long et al (1991) are also reinforced by the finding of this work. Capital, as used in this study caters for some domestic effects that affect GDP growth in the long-run.

Though the effect of U.S.'s inflation on Ghana's GDP growth is highly significant, its impact can be deemed small. Consequently, a unit change in U.S.'s inflation leads to about 8% change in Ghana's GDP. Thus, conditions in the United States of America (USA), notably inflation, tend to affect Ghana's GDP growth through international trade.

Unlike U.S's inflations rates, Nigeria's inflation rates affect GDP growth in Ghana negatively. This is supported by arguments in the empirical literature, notably, Li (2006) and Bullard and Keating (1995), which note that high and low rates of inflation lead to contrary results on GDP growth. Whiles low rates of inflation lead to positive effects on GDP growth, high rates on the other hand, lead to negative effects on GDP growth. Since available data show that Nigeria's inflation rates far exceed those of the U.S.A, then this conclusion holds. A unit change in Nigeria's inflation leads to about 0.8% change in Ghana's GDP in the opposite direction, in the long-run. The insignificance of the effect emanating from China's inflation rate can be explained by the fact that it has maintained relatively low rates of inflation (such that prices are almost constant on annual basis), especially in recent times, and thus does not contribute to GDP growth in Ghana.

On the other hand, China's GDP appears to exert a positive impact on Ghana's long-run GDP growth. The result shows that a unit change in China's GDP leads to about 2.4% change in Ghana's GDP. This conclusion confirms that of Arora and Vamvakidis (2005) who noted that it is worth trading with fast-growing countries. The insignificance of U.S.A's GDP and Nigeria's GDP to Ghana's GDP growth confirms earlier results obtained by Clemens and Williamson (2004).

Time is also observed to contribute significantly to GDP growth in Ghana. Any additional year leads to about 2.6% increase in Ghana's GDP growth, resulting from the overall impact of all variables in the model.

Thus, the results show that technology diffusion, capital input, U.S.A's and Nigeria's inflation rates, and China's GDP growth affect Ghana's GDP growth in the long-run.

Lastly, the effect of distance does not seem to have a consistent role in the intensity of spillovers. From table 4.1, it is observed that China is the farthest country from Ghana whiles Nigeria is the closest, however, it is rather the U.S which has the highest inflationary spillover effect on Ghana's GDP growth, followed by Nigeria. With respect to GDP, the order is no different. Thus, contrary to the assertion by Wei et al (2006) that distance does matter in issues relating to spillovers, the reverse is found in this study. The obvious reason is that spilllovers do travel through trade from one country to the other directly and thus, their intensities do not weaken with distance. In fact, their intensities from the country of origin are the same as in the country of destination, barring the role of transit trade items.

Also, given the recent high GDP growth of China relative to those of U.S.A and Nigeria, the above results give support to the fact that high spillover effects emanate from countries with relatively high GDP growth. This is highly evident from the insignificant coefficients of U.S.A's GDP and Nigeria's GDP.

All other variables namely; labour input, U.S's GDP, China's inflation rates, and Nigeria's GDP prove insignificant in determining Ghana's GDP growth over time. Results for the error correction model are reported in the below.

TABLE 5.6: ESTIMATED SHORT-RUN ERROR CORRECTION MODEL (ECM): ARDL (1, 1, 0, 0, 1, 1, 1, 1, 0, 1) DEPENDENT VARIABLE, ΔGDP-GH

REGRESSOR	COEFFICIENT	t-STATISTIC	PROBABILITY
ΔTECH-DIFF.	0.026561	0.62677	0.539
ΔCAPITAL	0.56208	3.1686	0.006*
ΔLABOUR	0.042812	1.3802	0.185
ΔUS-INF	0.051488	4.3506	0.000*
ΔCH-INF	-0.045961	-5.3705	0.000*
ΔNG-INF	-0.0012674	-0.38186	0.707
ΔUS-GDP	0.015977	0.76799	0.453
ΔCH-GDP	0.030060	2.0767	0.053**
ΔNG-GDP	0.033368	4.1722	0.001*
ΔCONSTANT	26.7989	6.8271	0.000*
ΔTREND	0.032842	3.6526	0.002*
ECM(-1)	-0.761	-7.1295	0.000*

Δ=Change in Relevant Variable $R^2 = 0.94$ R^2-Adjusted = 0.84
*Significant at 1%. ** Significant at 10%

The above results can be shown in the error correction equation as below.

$$\Delta gdp_t^{GH} = 26.7989+0.032842\Delta T_t - 1.2761 ecm_{t-1} + 0.026561\Delta d_t + 0.56208\Delta k_t + 0.042812\Delta l_t + 0.051488\Delta(INF)_t^{US} - 0.045961\Delta(\mathrm{INF})_t^{\mathrm{CH}} - 0.0012674\Delta(INF)_t^{NG} + 0.015977\Delta(GDP)_t^{US} + 0.030060\Delta(GDP)_t^{CH} + 0.033368\Delta(GDP)_t^{NG} + u_t$$

..... (6)

The *ECT* in equation (6) is defined as below;

$$ecm_{t-1} = gdp_t^{GH} - 21.0008 - 0.025736T_t - 0.082632d_t - 0.44047k_t - 0.033549l_t - 0.080563(INF)_t^{US} - 0.0032054(INF)_t^{\mathrm{CH}} + 0.0082739(INF)_t^{NG} + 0.040480(GDP)_t^{US} - 0.023556(GDP)_t^{CH} - 0.011314(GDP)_t^{NG}$$

. . .

. ..... (7)

The error correction term shows the speed of adjustment to equilibrium in the dynamic model. The coefficients of the ECT in the ECM show how quickly variables return to their equilibrium states in periods of disequilibrium. If the error correction term (ECT) is non-zero, then the model is out of equilibrium.

The error correction term appears to be highly significant with a negative sign. This is a further proof of the existence of a stable long-run relationship between variables in the model. From equation (7) above, we observe that the coefficient of the error correction term is correctly signed and is highly significant at 1% and 10% levels. The long-run growth rate in Ghana's GDP deviation is corrected by the ECT value of 0.761over time, signifying a high degree of adjustment. This value indicates that given a shock in the short-run, forces within the economy ensure that equilibrium is restored at a very high speed of about 76%.

Estimates for the error correction model in the table above indicate that short-run changes in capital input result in positive effects on GDP growth. This conforms to the theoretical conclusions of the neoclassical model of growth. Contemporaneous changes in China's and U.S.A's inflation rates also spillover to output growth in Ghana.

China's GDP growth and Nigeria's GDP growth also contribute immensely to the growth rate of Ghana's GDP in the short-run. Though it appears that innovations in Nigeria's GDP growth impact Ghana's GDP growth more than the effects of innovations in China's GDP growth, hypothesis testing results using Wald's test suggests that there are no significant differences in these effects.

Finally, the fact that lagged dependent variables are not captured in the short-run estimates denotes that GDP growth in year one does not contribute to GDP growth in the second year. In other words, this study observes that annual GDP growth rates are independent of each other.

5.1 *DIAGNOSTIC TESTS*

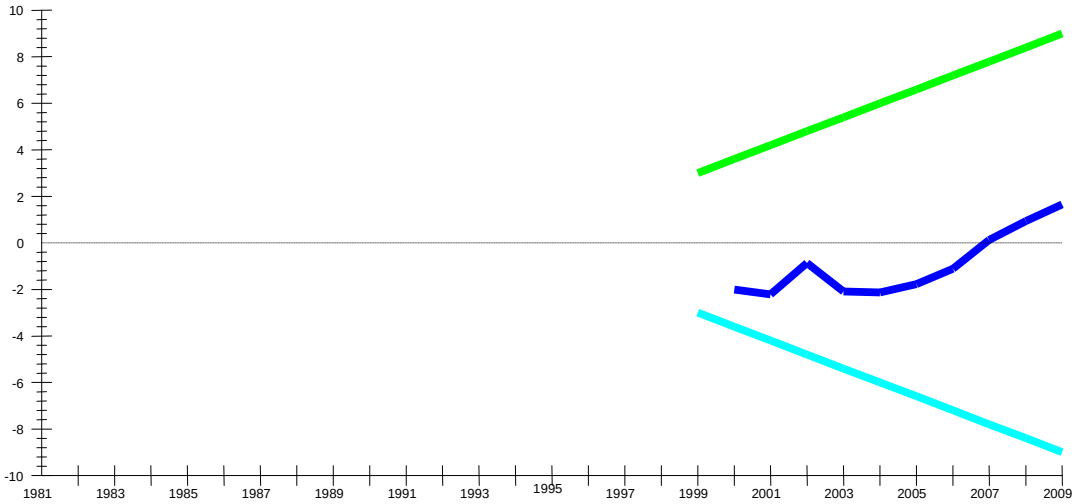
This involves testing the above model for the satisfaction of autocorrelation, model specification, normality, and heteroscedasticity. Results of these tests are shown in the table below and they report that the model passes all these tests.

TABLE 5: RESULTS OF DIAGNOSTIC TESTS

AUTOCORRELATION	CHSQ(1) = 0.43271	(0.511)
	F(1, 10) = 0.15147	(0.705)
FUNCTIONAL FORM	CHSQ(1) = 5.7619	(0.016)
	F(1, 10) = 2.4795	(0.146)
NORMALITY	CHSQ(2) = 1.2538	(0.534)
	NOT APPLICABLE	---------
HETEROSCEDASTICITY	CHSQ(1) = 2.0512	(0.152)
	F(1, 27) = 2.0551	(0.163)

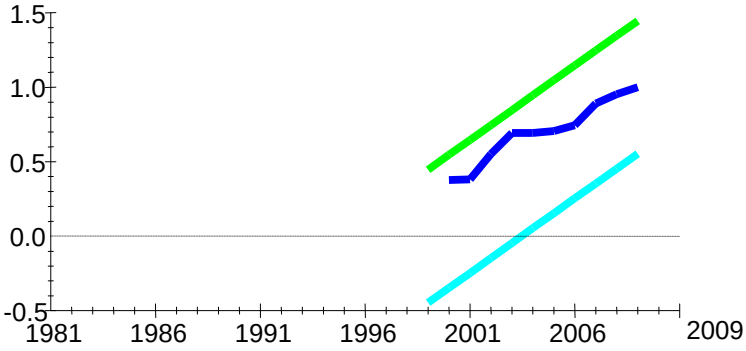
5.2 STABILITY TESTS

To test for the stability of the regression model, the cumulative sum (CUSUM) and cumulative sum square (CUSUM Square) tests as proposed by Brown et al. (1975) are used. This involves a plot of residuals of the regression model. Here, the straight lines represent critical bounds of 5%, so that if the meandering line falls within this bound then, the variables in the model are considered to be stable. This is shown in the diagrams below.



The straight lines represent critical bounds at 5% significance level

FIGURE 4: PLOT OF CUMULATIVE SUM OF RECURSIVE RESIDUALS



The straight lines represent critical bounds at 5% significance level

FIGURE 5: PLOT OF CUMULATIVE SUM OF SQUARES OF RECURSIVE RESIDUALS

The diagrams above show that the estimated model is stable, for the reasons noted above.

6.0 THE VECTOR AUTOREGRESSIVE (VAR) MODEL

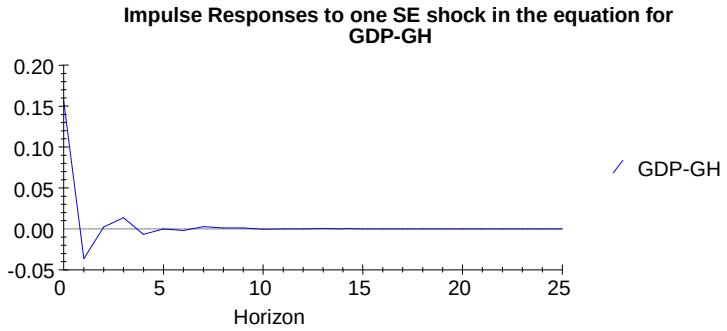
To complement the above results, a vector autoregressive model is used in this study to capture the time effect (span) of international economic spillovers of macroeconomic distortions on

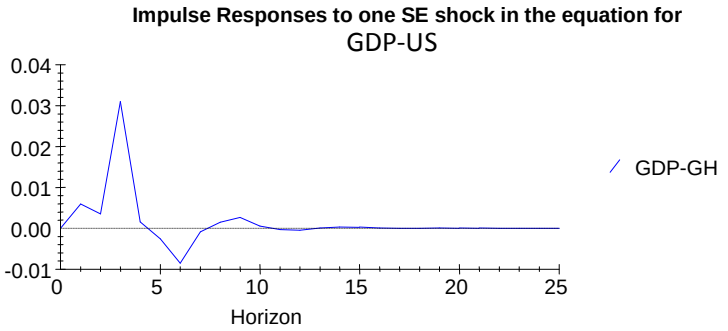
Ghana's growth, as used by Clarida and Gali (1994). This approach portrays how the economy adjusts to standard economic shocks: namely; changes in technology diffusion, changes in capital input, changes in labour input, inflation, as well as changes in GDP growth rate of trading partners.

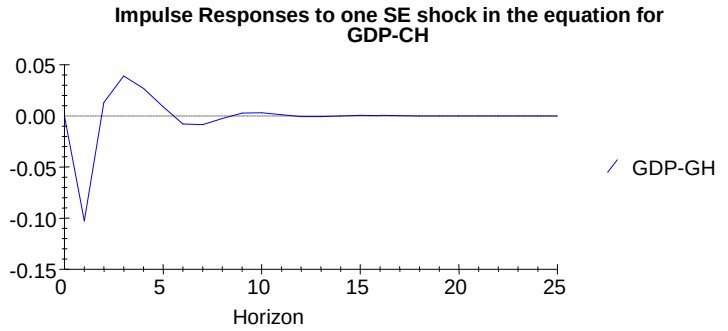
Further, the VAR model helps compute impulse response and variance decompositions which serve as tools for evaluating the dynamic interactions and intensity of causal relations among variables in the model. However, in doing this, it should be noted that contemporaneous correlations may exist among variables in the VAR model. That is, a shock in one variable may manifest through contemporaneous innovations in another. Thus, Lutkepohl (1991) notes that responses of a variable to innovations in another variable of interest cannot be represented adequately, since isolated shocks to individual variables cannot be identified.

To solve this identification problem, we invoke the Cholesky decomposition as used by Obiora (2009). The approach here is to specify the correct ordering of variables to be included in the VAR model. Variable ordering is started with the most exogenous to the most endogenous in the model. As noted by Duasa (2007), results from impulse response functions and variance decompositions may be sensitive to variable ordering unless the contemporaneous correlations of error terms are low. To take care of the variable ordering problem, contemporaneous correlations of the error terms in the VAR model are computed and the appropriate conclusions are drawn accordingly. Having done this, it is realized that variables in the VAR model should be ordered as Consequently, variables in the VAR model are arranged in the order; GDP^{US}, GDP^{CH}, INF^{US}, CAPITAL, TECH-DIFF., INF^{NG}, GDP^{NG}, LABOUR, INF^{CH}.

Figure 5.3 and Table 5.8 represent the results of the impulse response functions and variance decompositions, respectively.




Impulse Responses to one SE shock in the equation for
GDP-US
0.04
0.03
0.02
0.01
0.00
-0.01
0
5
10
15
20
25
Horizon
GDP-GH


Impulse Responses to one SE shock in the equation for
GDP-CH
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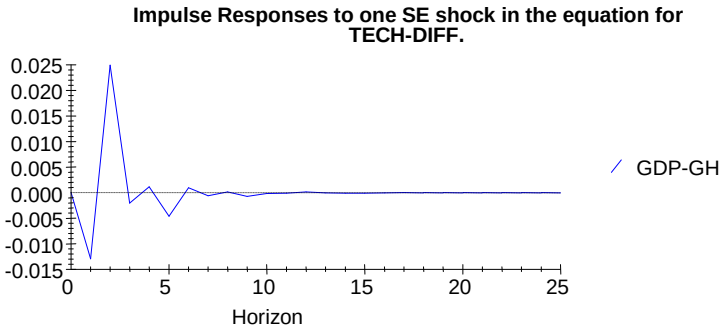
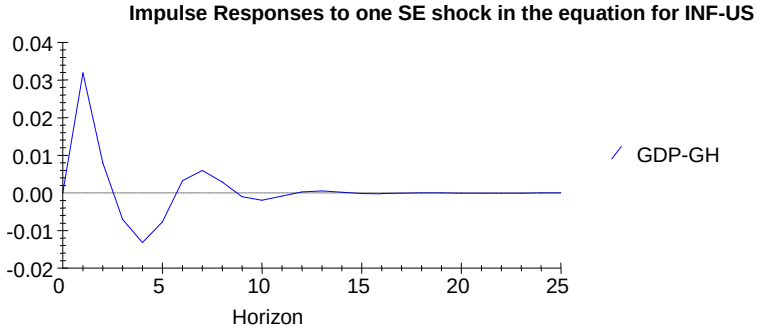
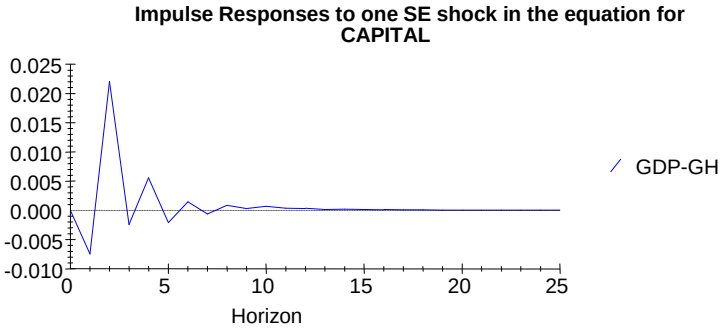
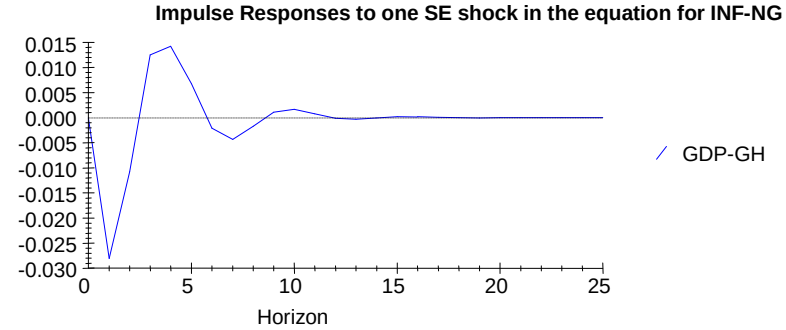
0.00
-0.05
-0.10
-0.15
0
5
10
15
20
25
Horizon
GDP-GH


Impulse Responses to one SE shock in the equation for
TECH-DIFF.
0.025
0.020
0.015
0.010
0.005
0.000
-0.005
-0.010
-0.015
0
5
10
15
20
25
Horizon
GDP-GH


Impulse Responses to one SE shock in the equation for INF-US
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
0
5
10
15
20
25
Horizon
GDP-GH


Impulse Responses to one SE shock in the equation for
CAPITAL
0.025
0.020
0.015
0.010
0.005
0.000
-0.005
-0.010
0
5
10
15
20
25
Horizon
GDP-GH


Impulse Responses to one SE shock in the equation for INF-NG
0.015
0.010
0.005
0.000
-0.005
-0.010
-0.015
-0.020
-0.025
-0.030
0
5
10
15
20
25
Horizon
GDP-GH

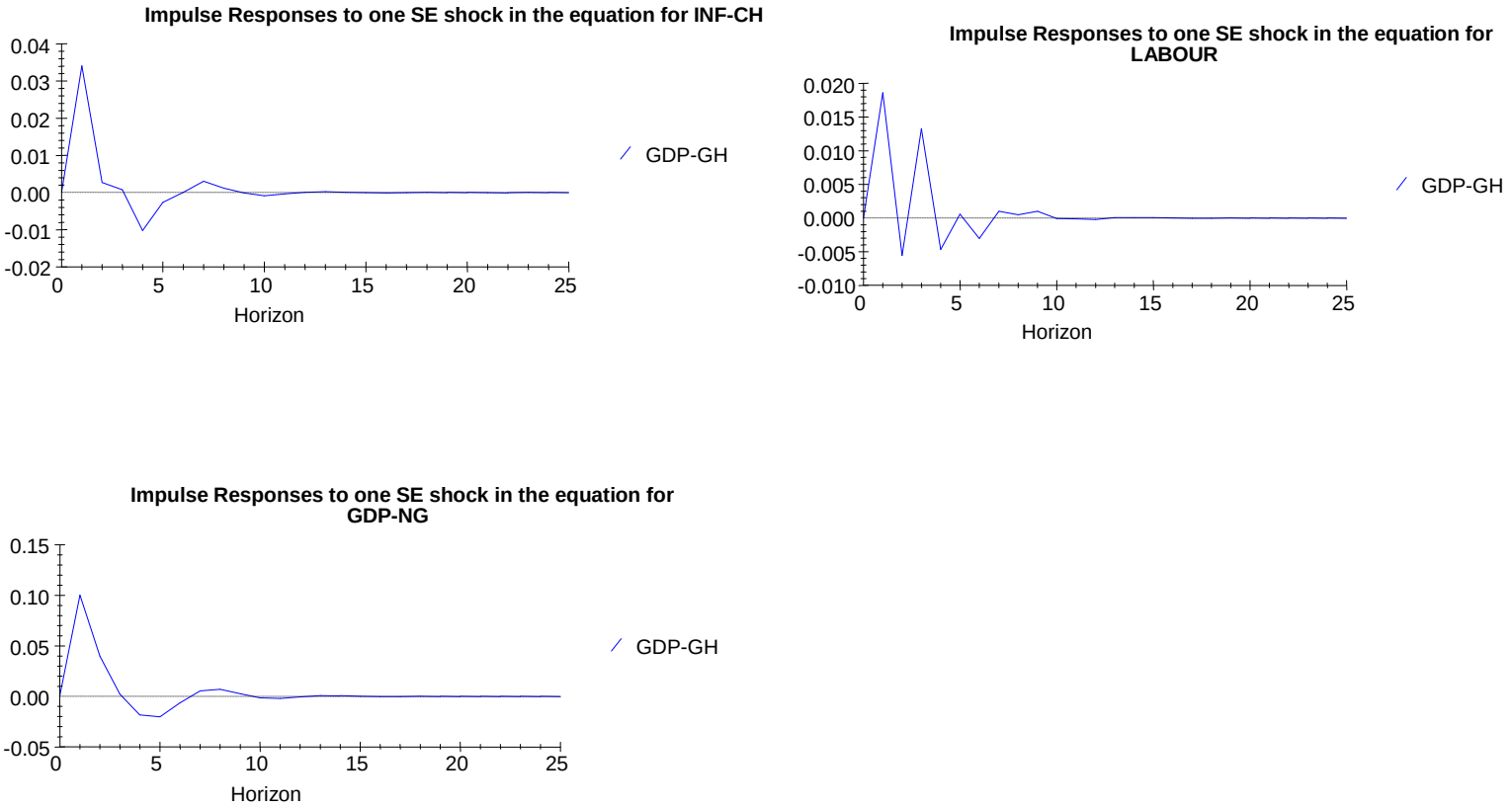


FIGURE 6: IMPULSE RESPONSE FUNCTIONS OF GHANA'S GDP TO 1 STANDARD DEVIATION INNOVATIONS IN VARIABLES

The impulse response functions above portray the time paths of Ghana's GDP to shocks from all other variables in the VAR model. Interestingly, it is observed that a shock to any particular variable in the system produces responses which subside to zero over time. This phenomenon gives evidence to the fact that the VAR system is stable. This is in consonance with results obtained under the ARDL model.

Furthermore, the directions of variables' responses to innovations in the system are in the most part reasonable. Innovations in GDP growth of Ghana contribute positively to overall GDP growth during the first horizon, but thereafter contribute to negative responses up to year two. It stabilizes afterwards as it subsides to zero in the seventh year. The negative contribution of innovations in Ghana's GDP growth in the second year could be due to the consequences of over-heating in the economy as a result of a mis-match between demand and supply. High economic growth could lead to increased income levels ensuring increased demand for goods and services. When supply becomes deficient, increased inflationary pressures occur with their attendant effects on economic growth in subsequent periods.

Innovations in U.S.A's GDP growth contribute positively to Ghana's GDP growth up to year four, falls to negative effects and thereafter picks up slowly to subside to zero in year twelve. Similar effects are observed from spillovers emanating from innovations in China's GDP. Positive contributions of innovations in technology diffusion, capital and labour support the neo-classical theory which suggests a positive relationship between output growth and such variables. The negative response of Ghana's GDP growth to innovations in Nigeria's inflation in the first horizon confirms the result obtained by Fischer (1993) in a pooled regression model. Positive results of responses to innovations in inflation are obtained for all other countries. Thus, the exact contribution of inflation to GDP growth seems fragile, as observed by Li (2006).

TABLE 6: VARIANCE DECOMPOSITION FOR GHANA'S GDP GROWTH

% OF FORECAST ERROR VARIANCE EXPLAINED BY INNOVATIONS IN

HORIZON (YEARS)	GDP-GH	GDP-US	GDP-CH	INF-US	CAPITAL	TECH-DIFF	INF-NG	GDP-NG	LABOUR	INF-CH
1	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	46.24	1.80	21.80	2.02	0.97	1.41	1.88	20.80	0.99	2.09
5	44.52	1.74	22.31	2.34	1.00	1.40	2.24	21.29	0.98	2.18
10	44.16	1.87	22.39	2.42	1.00	1.39	2.27	21.31	0.99	2.20
15	44.15	1.87	22.39	2.42	1.00	1.39	2.27	21.32	0.99	2.20
20	44.15	1.87	22.39	2.42	1.00	1.39	2.27	21.32	0.99	2.20
25	44.15	1.87	22.39	2.42	1.00	1.39	2.27	21.32	0.99	2.20

Values Accurate to 2 Decimal Places

The variance decomposition of a variable determines how much of its forecast error variance is explained by innovations to each regressor in the system. Usually, in variance decompositions as shown in the table above, own shocks tend to explain most of the forecast error variance, although the shock will also affect other variables in the system.

Table 6 shows the significant contributions by all variables in the system in accounting for fluctuations in Ghana's GDP growth over time. During the first horizon, the results show that Ghana's GDP growth explains 100% of its own forecast error variance. Thus, there is no contribution from all other variables during this period. However, during the third horizon, the fraction of Ghana's GDP growth forecast error variance attributable to U.S.A's GDP growth, China's GDP growth, U.S.A's inflation, capital input, technology diffusion, Nigeria's inflation, Nigeria's GDP growth, labour input, and China's inflation are 1.80%, 21.80%, 2.02%, 0.97%, 1,41%, 1.88%, 20.80%, 0.99%, and 2.09% respectively.

As time goes on, beyond the fifth horizon, contributions to Ghana's GDP growth by all other variables, except technology diffusion, strengthen. This is shown by a high explanatory power for all the explanatory variables in the system at the tenth horizon. Technology diffusion however records a slight decline in its explanatory power of the forecast error variance in Ghana's GDP growth.

At a longer time horizon, fluctuations in Ghana's GDP growth are largely explained by China's GDP growth, followed by Nigeria's GDP growth. These variables explain 22.39% and 21.31%, respectively, of the total forecast error variance of Ghana's GDP growth at the tenth horizon. Beyond this period, the system stabilizes as all variables record constant percentage contributions to the total forecast error variance in Ghana's GDP growth. The results in the table give support to the earlier result that U.S.A's GDP growth, Nigeria's inflation, labour input, and technology diffusion are insignificant in determining Ghana's GDP growth in the short-run. However, in the longer horizon (long-run), it is U.S.A's GDP growth, China's inflation, and labour input which prove insignificant in explaining the fluctuations in Ghana's GDP growth.

7.0 POLICY RECOMMENDATIONS

This study has extensively been able to verify the main sources of international economic spillovers to Ghana and how they affect her GDP growth. A careful scrutiny of the results thus obtained point to the fact that after all, Ghana has not de-coupled from her trading partners. What happens in the economies of trading partners equally affect Ghana's GDP growth. Due to the above conclusions based on results of empirical estimates, the following policy recommendations could be regarded.

First of all, Ghana should be concerned about what happens in the economies of her trading partners and subsequently create possible buffer strategies to avert strangulating shocks from these economic situations. This seems to be in keeping with the argument that all countries interact in a closed economy, which is the world itself. Thus, policy co-ordination among countries seems pivotal as it ensures that the growth of one depends on the behaviour of another in terms of policy instruments being pursued. The developed world appears to be well aware of this fact as it tries to be abreast of situations in other countries and how they could possibly be solved before they could spread to other countries.

Secondly, Ghana should trade with relatively rich economies since they contribute most to GDP growth in the long-run compared to relatively poor ones. These countries are well financed to purchase goods and services from Ghana which could go a long way in improving Ghana's balance of payments. To ensure this, conditions of trade should be attractive enough to entice such rich economies. In this regard, Ghana should improve on the quality of her exports - both goods and services; increase the volume of her exports to increase revenue, and also seek to provide a reliable source of supply for such rich economies. Since the prices of most of Ghana's major exports, namely, cocoa, gold, timber, and crude oil are determined on the international market, this should be capitalised on to increase output in order to increase revenue for development.

Furthermore, the use of capital equipment in the production process should be encouraged. Mechanisation of agriculture should be of prime concern as Ghana's economy is largely agrarian. This will ensure improved and increased output production for the local and international markets. Increased mechanisation will also ensure efficient production as there will be little wastage of resources. Common human errors will be avoided and thus minimize losses.

It should also be the concern for government to create the necessary environment to attract foreign direct investments into the country. As this study has shown, multinational enterprises (MNEs) introduce exotic technologies into various industries which are copied by local firms to improve their productive capacities. In this regard, laws which seem to deter foreign enterprises from operating profitably or make doing business rather difficult should be revised. Ghana dropped from her 87th position in 2009 to 92nd in 2010 in the World Bank's Doing Business (2010) report. This is not encouraging and thus the necessary amendments should be made to correct it. Again, business registration procedures should be improved so that it will be relatively easier and cheaper for all potential businesses. The possible solution to all bureaucratic processes of business registration is to bring all stakeholders involved in registration procedures under one umbrella. The strategy of Portugal could be adopted by way of setting up 'Business Formalities Centres (BFCs)' so that all business registration procedures could be completed under one roof in a shorter period. This will help ensure the coming in of foreign enterprises whose state of the art approaches to doing business could be beneficial to Ghana's growth.

The study also observes that the participation rate of labour in economic activities do not contribute significantly to Ghana's GDP growth. Thus, the recommendation to government will be to concentrate on training labour to gain the relevant skills needed in their respective fields of work. This is essential because the contribution of one skilled labour at a time may prove beneficial than that of an unskilled labour who works for longer periods. To this end, more training and educational institutions (usually technical based) should be set up with well qualified instructors. Also, less functional ones should be revamped to cater for the technical needs of the labour force. Government should also seek to limit trade with countries with high levels of inflation. This is because high inflation rates increase the cost of Ghana's imports from such countries, thus, worsening her balance of payment situation. This is in conformity with results obtained in the empirical literature concerning the different effects from low and high levels of inflation. Scarce foreign exchange is spent on these imports leaving little or no revenue to undertake other development programmes. Also, continued trade with such countries leads to imported inflation, so that local prices also begin to jump up which gradually spill over to all other sectors of the economy. Consequently, growth suffers the brunt of these shocks which were received from abroad.

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