Exchange Rate Volatility, Earnings Uncertainty and Bidirectional Trade Flows: Empirical Evidence on Ghana

Abstract

Although the empirical findings on the impact of exchange rate volatility on trade is diverse, the growing consensus in the literature appears to suggest that for developing economies, the theoretically expected negative relationship almost always exists. The paper takes a different approach to empirically assess this relationship by analysing the impact of exchange rate volatility independently on total trade, imports and exports. The intuition behind this approach is to assess exactly how exporters and importers are incentivized (differently or similarly) by exchange rate volatility costs. Whereas adequately risk aversed Ghanaian exporters in the presence of higher exchange rate volatility and absence of hedging facilities effectively compensated against exchange rate risk by increasing volume of exports, import decisions were to some extent (although not effectively) negatively affected by exchange rate volatility. The different responses by Ghanaian exporters and importers to higher exchange rate volatility costs are reflected in the relationship between volatility and total trade. The useful policy lessons and the challenges that the empirical evidence present are discussed.

Keywords: Exchange rate volatility; bilateral trade; gravity model, Ghana

JEL Codes: F31; F14; F17; C21; O55.

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1. Introduction

Developing economies[1] have come a long way in terms of their exchange rate determining policies; years of currency mismanagement have given way to flexible regimes. This steep rise in the number of developing economies switching to flexible exchange rate regimes is documented by Broda (2004). The merits of adopting a flexible exchange rate as argued by Friedman (1953) include reducing the impact of exogenous shocks and enabling policymakers to pursue their stabilization policies effectively. Flood (1981) as well as Flood and Rose (1999) document that the Post-Bretton Woods experience however show that Friedman (1953) underestimated the excessive volatile tendency of the float system when he made the case for it; the potential of excessive exchange rate volatility[2] impacting on economic performance cannot therefore be underestimated.

Unequivocally, the value of a nation's currency is very important in determining international trade. For instance Arize, Osang, and Slottje (2000) explains that risk-averse traders associate higher exchange rate volatility with higher expenditure and risk which end up lowering their urge for international trade. Thus one major channel through which exchange rate volatility can impact on economic performance is through trade[3]; empirical findings on this relationship are however diverse (See for instance Bacchetta and van Wincoop, 2000). Ozturk (2006) in his survey on the relationship between exchange rate volatility and trade identified that empirical findings may be sensitive to the group of countries considered

[1] Developing countries (as defined by the World Bank and the UN World Economic Situation and Prospects report) include Low and Middle income countries whose individual GNI per capita is less than $12,475.
[2] Extent to which exchange rate fluctuates around expected values over time and thought to reflect market uncertainty.
[3] For instance the impact on net export is directly reflected in a country's GDP calculation. Also, the effects on exports and imports have second round effects through their impacts on consumption, investment and production.

(developed vs. developing). On the one hand, the IMF empirically analysed data from G-7 countries for the period between 1969 and 1982 and observed no significant impact of exchange rate volatility on trade; Arize, Osang, and Slottje (2000) on the other hand empirically analysed data from thirteen Less Developed Countries (LDCs) for the period between 1973 and 1996 and observed a statistically significant and negative impact of exchange rate volatility on bilateral trade. Findings by Sauer and Bohara (2001) further reinforce the developed vs. developing debate; using data spanning twenty years (1973-1993) from ninety-one countries (made up of sixty-nine developing and twenty-two developed countries) they observed that negative effects of exchange rate volatility on trade exists particularly for LDCs from Africa and Latin America.

The two main motivations informing this paper are therefore;

- To analyse the impact of exchange rate volatility on trade in the post-1980[4] era in Ghana, and-
- To analyse whether Ghana[5] as a developing country identifies with the 'developed vs. developing' country debate strand for the period under consideration.

This paper analysed the impact of exchange rate volatility on international trade between Ghana and seven of her trade partner countries namely China, the EU, India, Japan, Nigeria, the UK and the US; the period of interest of study being 1980 to 2005. A gravity model that is also augmented with regressors that take into account economic size, same language and distance between Ghana and her trade partners is used for this analysis. Heterogeneous trade-pair relationships and time specific effects were accounted for by

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[4] Ghana began the implementation of the structures (based upon recommendations from IMF and the World Bank) needed for a flexible exchange rate system in the early 1980s. Ghana Currently adhere to the IMF convention of free current account convertibility and transfer have accepted Article VIII of IMF "Articles of Agreement"

[5] Ghana's GNI per capita for 2014 was $1620. Available data GNI per capita averaged approximately $400 for our period of study. (Source World Bank)

applying a fixed effects estimation technique to the gravity model. The paper observed that exchange rate volatility has a positive but no significant impact on total trade (i.e. sum of exports and imports) for Ghana and each trade partner considered.

On the face of this initial result, one may be tempted to draw a bold conclusion and propose a laissez-faire policy to bilateral trade between Ghana and the trade partners' considered. However if the empirical exercise is replicated by isolating the impact of exchange rate volatility independently on exports and imports, the paper observed positive (and statistically significant) relationship between exchange rate volatility and exports but a negative (but statistically insignificant) relationship between imports and exchange rate volatility. These findings give us an important insight on how the direction of trade plays an important role in trade decisions by international market agents in their response to trade costs (emanating from exchange rate volatility). For a country like Ghana and other similar developing countries, this paper advocates that the potential consequence of exchange rate volatility on economic performances via volatility feedback effects, persistent external debts and deficits as well as currency problems should be of concern to policy makers.

The rest of the paper is organised as follows: In Section 2, the gravity model for trade is discussed: Section 3 presents the variables, data and estimation technique: Section 4 presents analyses on findings and Section 5 concludes this paper.

2. The Gravity Model for Trade Analysis

The gravity model for trade analysis (henceforth gravity model) has emerged as arguably the most applied econometric toolkit to empirically explain country-trade pair bilateral trade relationships. As the name indicates, the model has its origins from Newtonian mechanics; universal gravitational law proposed by Sir Newton is mathematically modelled as:

$$G\,\frac{M_1 M_2}{Dist^2} \tag{1}$$

In Sir Newton's model, the force of attraction between two bodies depends directly on their masses (M_1, M_2) and inversely on the square of distance between them ($Dist^2$); G is the gravitational constant. Analogously, Nobel Laureate Tinbergen (1962) and Poyhonen (1963) independently developed the econometric framework of international trade interactions based on the universal gravitational law; the basic form of the gravity model proposed by Tinbergen (1962) and Poyhonen (1963) is similar to;

$$B_{Trade_{ijt}} = \frac{\beta_0\,(GDP_{it}GDP_{jt})}{Dist_{ij}^{\beta_2}} \tag{2}$$

Log-linearizing Equation 2 above yields;

$$LogB_{Trade_{ijt}} = \beta_0 + \beta_1\,Log\big(GDP_{it}GDP_{jt}\big) - \beta_2 LogDist_{ij} \tag{3}$$

$B_{Trade_{ijt}}$ represents bilateral trade between countries i and j with GDP_{it} and GDP_{jt} representing their respective gross domestic product, and $Dist_{ij}$ the distance between them. From Equation 3, it can be deduced that increasing economic sizes of country trade-pairs increases bilateral trade whilst distance between countries has the potential to reduce trade.

The initial empirical success of the gravity model in explaining bilateral trade relationships was equally met with criticism; these criticisms were mainly directed on the theoretical underpinnings of the model until Anderson (1979)[6] formally developed the theoretical foundations that were consistent with existing international trade theories. Other notable contributors to the theoretical underpinnings of the gravity model for trade include Bergstrand (1985) who theoretically justified the inclusion of exchange rate and price inputs; Deardoff (1995) who used Ricardian and Heckschser-Ohlin models with the assumption of

[6] By assuming a Cobb-Douglas expenditure system, constant elasticity of substitution preferences and product differentiation from source country.

frictionless trade and product differentiation from source country; and more recently the refinement of Anderson (1979) by Anderson and Van Wincoop (2003) which included multilateral trade barriers as a determinant of bilateral trade between country trade-pairs: This paper accommodated multilateral trade barriers by using a trade-pairs fixed effect estimation.

The usual practise (in both past studies and contemporary literature) in the empirical applications of the gravity model is to augment the basic gravity model with a number of time variant and invariant regressors to measure their impact on trade; this paper took advantage of this versatile characteristic of the gravity model to analyse the impact of exchange rate volatility on trade for Ghana and some of its biggest trade partners. The next section discusses the variables, data and estimations techniques applied.

3. Variables, Data and Estimation Techniques

This section discusses the variables the data and estimation techniques used in the gravity model for Ghana and the trade partners considered.

3.1 The Variables

In this paper, bilateral trade relationships are specified using regressors that included economic sizes of Ghana and the trade partners considered (proxied by trade-pairs GDPs and per capita GDP), exchange rate volatility proxy (generated by the ARCH estimation technique), distance between Ghana and each of her trade partners considered and a dummy component to analyse the impact of common language on Ghanaian bilateral trade. The inclusion of the chosen regressors is informed by underlying theory and the practice in similar studies[7]. Variables are measured as follows;

[7] Dell'Ariccia (1999) included a common language dummy variable in a gravity model for his analysis on impact of exchange rate volatility on trade among 15 Western European economies between 1975 and 1994; Similarly

3.1.1 Sizes of Trade-Pairs

In the literature (for instance Rose 2000) sizes of trade partners are proxied by GDP, per capita GDP and population: Undoubtly, multicollinearity problem could arise if all three are included in gravity regression. Since new trade theories suggest that similar countries (in terms of economic size) trade more with each other, thus with most studies in the literature (for instance Rose 2002 and Sohn 2005), this paper uses GDP and per capita GDP to proxy sizes of trade pairs; GDP proxies economic size whereas per capita GDP represents elements of economic size that are not fully contained in the GDPs of trade partners. They can be seen as proxies for income levels and/or purchasing power of trade-pairs (Sohn, 2005) or crude proxies for development and or political stability (Gao, 2009). Also per capita income can be used to test for the Linder effect between trade partners. Total GDPs (measured in constant 2000 US dollars) of trade-pairs *i* and *j* at any specific time (in logarithm) is calculated as;

$$LogGDP_{ijt} = Log(GDP_{it} \times GDP_{jt}) \quad (4)$$

Where GDP_{it} *and* GDP_{jt} are as already defined earlier. Per capita GDPs (measured in constant 2000 US dollars) of trade-pairs *i* and *j* at any specific (in logarithm) is calculated as;

$$LogGDPPC_{ijt} = Log\left[\left(\frac{GDP_{it}}{POP_{it}}\right) \times \left(\frac{GDP_{jt}}{POP_{jt}}\right)\right] \quad (5)$$

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and more recently Baak (2004) also augmented the basic gravity model with a dummy variable that caters for common language in his analysis of the impact of exchange rate volatility on trade among 14 Asian Pacific economies between 1980 and 2002; both findings indicated a negative and significant impact of exchange rate volatility.

3.1.2 Distance

Distances($Dist_{ij}$) between largest seaports destinations for Ghana and each trade partner are used (See Table 1): In the case of bilateral trade analysis between Ghana and EU-12[8] this paper averaged distances between Ghana and each member country of the EU-12 countries considered.

3.1.3 Common Language

A dummy variable ($D1_{ij}$) is used to capture the influence of common language on the flow of trade in the estimated gravity model. Common language is given a score of one; otherwise we give a score of zero. Countries sharing a common language (English) with Ghana include UK, the USA and Nigeria and India (See Table 1).

3.1.4 Exchange Rate Volatility

The Auto Regressive Conditional Heteroscedastic (ARCH) technique[9] is used to generate exchange rate volatilities (Vol_{ijt}) over the estimation period: This paper favoured this technique over others as they are widely documented to utilize the inherent properties of financial time series and empirical regularities of exchange rate (and similar financial markets) volatility to produce robust volatility forecasts[10]. To estimate robust ARCH volatility estimates for each exchange rate series, the time series properties[11] of their percentage change series[12] are first tested and upon observing the series stationary, the paper applied the Box-Jenkins technique to experiment with different Auto Regressive Integrated Moving Average (ARIMA) estimates based on the following general specification;

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[8] The EU-12 (2004 EU member states include Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain

[9] See Engle (1982)

[10] See for instance West and Cho (1995), Andersen and Bollerslev (1998), and Hansen and Lunde (2005)

[11] Statistics on Augmented Dickey Fuller on unit root tests for stationarity available upon request.

[12] Percentage change (r_t) is estimated as $\Delta LogFx_t$; where Fx_t represents daily exchange rate.

$$\alpha(L)\alpha_S(L^S)(1-L)^d(1-L^S)^D r_t = b(L)b_S(L^S)\varepsilon_t \quad (6)$$

S represents the seasonal component that can be factorized and together with D (the number of seasonal differencing) cater for existence of monthly seasonal effects. d is the number of ordinary differencing needed to make the series stationary, $\alpha(L)$ is the non-seasonal Auto Regressive (AR) polynomial of order p, $b(L)$ the Moving Average (MA) polynomial of order q, $\alpha_S(L^S)$ is the seasonal AR polynomial of order P, and $b_S(L^S)$ is the seasonal MA polynomial of order Q; ε_t is assumed to be homoscedastic. The compact form of Equation 3 can be written as:

$$r_t \sim ARIMA(p,d,q) \times (P,D,Q)_S \quad (7)$$

From the experiments the ARIMA model (See Table 1) that best represent the data generation process of r_t were selected for each series.

The estimation process of the ARIMA representations for each percentage change series was based on the assumption of variance in the error term (ε_t) being homoscedastic. The ARCH-LM[13] tests however rejected the homoscedastic assumption: ARCH effects in each estimated time series are catered for by the appropriate and best fitting ARCH family member. Thus a summary of the volatility models estimated for each series is as follows;

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[13] To test for ARCH of order q, regress square of residuals $\hat{\varepsilon}_t^2$ (obtained from fitted model) on previous lags; that is $\hat{\varepsilon}_t^2 = \vartheta_0 + \vartheta_1\hat{\varepsilon}_{t-1}^2 + \ldots + \vartheta_q\varepsilon_{t-q}^2 + \nu_t$, ν_t is iid. The test statistics is defined as TR^2 which is $\chi^2_{(q)}$ distributed on the null; T being number of observations and R^2 coefficient of determination from the fitted model. The test is formulated as $H_0 : \vartheta_0 = \vartheta_1 = \ldots\vartheta_q = 0$ (That is testing for conditional variance been homoscedastic) against $H_1 :$ At least one ϑ_i is different from 0., i = 1,2,3,…q (Conditional variance is heteroscedastic and generated by ARCH process) . If the value from the test statistics is greater than the critical value from the χ^2 distribution, then the null hypothesis is rejected. Statistics on ARCH-LM heteroscedasticity tests available upon request.

I. Volatility in both the Renminbi and Yen independently captured by: **MA(1)-EGARCH (1, 1)** : modelled as;

$r_t = \mu + \varepsilon_t + \theta\varepsilon_{t-1}$ *and* $Log\sigma_t^2 = \alpha + \beta Log\sigma_{t-1}^2 + \omega\frac{\varepsilon_{t-1}}{\sigma_{t-1}} + \left|\lambda\frac{\varepsilon_{t-1}}{\sigma_{t-1}}\right|$

II. Volatility in the Euro captured by **AR (1)-GARCH (1, 1)** : modelled as;

$r_t = \mu + \varphi r_{t-1} + \varepsilon_t$ *and* $\sigma_t^2 = \alpha + \omega\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2$

III. Volatility in the Rupee captured by **AR (1)-GARCH (1, 1)**: modelled as;

$r_t = \mu + \varphi r_{t-1} + \varepsilon_t$ *and* $\sigma_t^2 = \alpha + \omega\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2$

IV. Volatility in the Naira and the Pound independently captured by: **AR(1)-ARCH (1)** modelled as; $r_t = \mu + \varphi r_{t-1} + \varepsilon_t$ *and* $\sigma_t^2 = \alpha + \omega\varepsilon_{t-1}^2$

V. Volatility in the dollar captured by **ARMA (1, 1)-ARCH (1):** modelled as**;** $r_t = \mu + \varphi r_{t-1} + \theta\varepsilon_{t-1} + \varepsilon_t$ *and* $\sigma_t^2 = \alpha + \omega\varepsilon_{t-1}^2$

Monthly volatility forecasts from the obtained volatility models were then annualized[14] by averaging the twelve-month estimates for each year.

3.1.5 Exports, Imports and Bilateral Trade (Real Terms)

Similar to the common econometric practise in the gravity model estimation technique, [15]annual real value of bilateral trade ($B_{Trade_{ijt}}$) between Ghana and each trade partner is estimated (in logarithm) as;

$$LogB_{Trade_{ijt}} = Log\ (RExp_{ijt} + RImp_{ijt}) \quad (8)$$

[14] As volatility characteristics in financial data tend to aggregate and become less pronounced (Diebold 1988) ; monthly volatility measurements may represent real-world market uncertainty relatively better than annual measurements .

[15] See for instance Sohn (2005)

Where $RExp_{ijt}$ and $RImp_{ijt}$ are real export and import annual values with both respectively measured as;

$RExp_{ijt} = \frac{Exp_{ijt}}{USGDP_t} \times 100$ and $RImp_{ijt} = \frac{Imp_{ijt}}{USGDP_t} \times 100$; $USGDP_t$ represents annual US GDP deflator values[16].

3.2 Data Analyses

For Ghana and each trade partner considered, annual nominal bilateral trade data were obtained from the Direction of Trade Statistics (DOTS) of the International Monetary Fund (IMF); annual GDPs, annual population and monthly exchange rate series used were all obtained from the United States Department of Agriculture (USDA) database; finally distance between Ghana and each trade partner were obtained from the World Ports distances website.

With the exception of Japan, the UK and the US, bilateral trade generally followed an upward trend (Figures 1 and 2). All the bilateral trade data also reveal a number of patterns common to all and some unique to specific trade partners. For instance, all the bilateral trade series follow a general downward trend[17] from 1980 to 1983; a sluggish upward trend in mid-1980s and an unusual steep downward trend in the early 1990s Some of the patterns that were observed to be unique to Ghana and some specific trade partners included the dip in bilateral trade with the US between 2003 and 2004 whereas for the same period bilateral trade appeared to be generally exhibiting a general upward trend for the other partners.

Figures 1 and 2 also appeared to indicate that apart from 1980-1983 (which was a reflection of the prevailing economic conditions), GDPs of Ghana and each trade partner

[16] Similar to Eichengreen and Irwin (1996) and also Baak (2004) , US GDP deflator are used to adjust nominal exports values to real terms due to unavailability of bilateral export price indices..
[17] May be due to the worst recessions in history experienced between 1980 and1983 (Clausen 1984); 1990 also saw a relatively less severe recession (McNees 1992).

followed an upward trend. Trend analyses between incomes and bilateral trade revealed diverse patterns; whereas in pre-1983, GDPs and bilateral trade both dipped, the post-1983 era generally appeared to suggest that increasing GDPs generally reflected positively on trade with China, the EU-12, India, and Nigeria, but bilateral trade with Japan, the UK and the US appeared to show no suggestive pattern with increasing income. Per Capita GDPs for Ghana and all the trade partners was observed to generally follow an upward trend for the period under consideration (Figures 3 and 4); trend patterns between Per Capita GDPs and bilateral trade is not much different from that for GDP. Exchange rate volatility in each trade partner bilateral trade currency does not specifically appear to mirror their respective bilateral trade series (Figures 5 and 6): For instance between 1994 and 1998, bilateral trade between Ghana and the EU-12 appears to increase with increasing volatility in the euro, however in the same period, volatility in the yen appeared to move in opposite direction to Ghana-Japan bilateral trade; whereas in the same period a sluggish trade growth for Ghana and Nigeria appears to reflect a seemingly stable naira. The next section explains how most of the observed data characteristics are accommodated in the gravity model estimation process.

3.3 Estimation Processes of Trade Relationships

The paper first analyses the impact of exchange rate volatility on total volume of trade by regressing bilateral trade ($LogB_{Trade_{ijt}}$) on the exchange rate volatility proxies and other explanatory variables included in the augmented gravity model. This is exercise is then replicated for exports and imports to assess whether exporters and importers reacts similarly (differently) to exchange rate volatility.

The fixed effect pooled cross sectional estimation applied to the three gravity regressions is of the type;

$$LogT_{ijt} = \alpha_0 + \alpha_t + \beta_{0_{ij}} + \beta_{1_{ij}} LogGDP_{ijt} + \beta_{2_{ij}} LogGDPPC_{ijt} + \beta_{3_{ij}} LogDist_{ij} + $$
$$+\beta_{4_{ij}} LogVol_{ijt} + \beta_{5_{ij}} D1_{ij} + \varepsilon_{ijt} \quad (9)$$

Where T_{ij} is the trade variable to be modelled.

To control for variations that are expected to have similar impact on bilateral trade relationships, the intercept α_0 and the coefficients of the explanatory variables $\beta_{1_{ij}}, \beta_{2_{ij}}, \beta_{3_{ij}}$, $\beta_{4_{ij}}$ *and* $\beta_{5_{ij}}$ were allowed to remain common to all years and all Ghana-trade partners pair throughout the estimation process; the intercept α_t is allowed to vary each year to control for specific annual world events that generally impacted on the trade variable under consideration and the intercept $\beta_{0_{ij}}$ accounts for the specific factors that determined trade flow between Ghana and each trade partner across time (accounting for heterogeneity and multilateral trade barriers). ε_{ijt} is assumed to be independently and identically distributed. It is also assumed that the disturbances are pairwise uncorrelated and all other classical assumptions of the disturbance term hold which allowed for the application of the Ordinary Least Squares (OLS) technique in the estimation of fixed effects cross-sectional gravity model. Since distance and common language are time invariant, the fixed effect models are initially estimated without the two; the obtained coefficients estimates ($\beta_{0_{ij}}$) are then regressed on distance and common language dummies using a regression of the form:

$$\beta_{0_{ij}} = \gamma LogDist_{ij} + \vartheta D1_{ij} + \epsilon_{ij} \quad (10)$$

Since the number of observations is few, the regression above is estimated using OLS with robust errors (similar to Wall and Cheng, 2005) their impact on the trade variables were then analysed.

3.4 A Priori Expectations of Signs on Coefficients of Explanatory Variables

Generally, on the basis of economic theory and past observations, the coefficients on explanatory variables are a priori signed as follows;

- *Ceteris Paribus* $\beta_{1_{ij}} > 0$: Bilateral trade between any trade-pair is expected to be higher, the higher their incomes.
- *Ceteris Paribus* $\beta_{2_{ij}}$ may possess different signage. It may help to explain whether similar countries (in terms of per Capita GDP) trade more than countries with dissimilar levels of wealth (the Linder effect) ; whether wealth of trade partners affect trade (Sohn, 2005); or whether the level of development affects trade relationships (Gao, 2009).
- *Ceteris Paribus* $\beta_{3_{ij}} < 0$: Bilateral trade is expected to be higher the lesser the distance or the closer the trade pairs are.
- *Ceteris Paribus* $\beta_{4_{ij}} < 0$: For each trade-pair, bilateral trade is expected to be higher when exchange rate volatility is low.
- *Ceteris Paribus* $\beta_{5_{ij}} > 0$: Bilateral trade is expected to be higher if trade-pairs share homogenous culture, share same language, have colonial relationships or share borders.

4. Analysis of Results

Table 2 (see Appendix) shows results from estimations between the trade variables considered and the regressors included in the augmented gravity model (from Equation 9). Table 3 (see Appendix) contains the estimated results from the regressions (from Equation 10) between the estimated fixed effects coefficients ($\beta_{0_{ij}}$) from the gravity equations and the time in-variant regressors ($LogDist_{ij}$ and $D1_{ij}$).

4.1 Impact of Exchange Rate Volatility on the Trade Variables

The estimated coefficient which is of particular interest here (for all the three estimated fixed effect gravity models) is $\beta_{4_{ij}}$. The results show $\beta_{4_{ij}}$ is negative but statistically insignificant[18] if bilateral trade (export and import) is considered in a gravity model. However, the results are significantly different if the exercise is replicated using exports or imports independently in a gravity model: It is observed that estimated coefficient $\beta_{4_{ij}}$ is positive and statistically significant for the estimated export equation but negative and statistically insignificant for the estimated import equation[19].

The positive impact of exchange rate volatility on exports (as observed in the export equation) is consistent with some of the new theories and proposals in the budding and active literature explaining the diverse empirical findings on the trade-exchange rate volatility nexus. One of such proposals argues that that exchange rate volatility may not necessarily affect trade if hedging opportunities exists (Baron 1976): However his proposition may not be plausible for a developing country like Ghana where exchange rate risk is not generally hedged and also where forward markets are usually not available to many exporters[20]. One plausible explanation that can best describe the observed behaviour of Ghanaian exporters in presence of high volatility is the theory exposited by De Grauwe (1988): He attributed this to how adequately risk-averse exporters behave, ensuring their marginal utility of revenue increases as earnings uncertainty (as a result of exchange rate volatility) increases. Thus in an environment where hedging opportunities are almost non-existent, the exporter mitigates the potential adverse effects exchange rate uncertainties on export earnings by increasing the volume of exports.

[18] Attributable to aggregation and net effects of exchange rate volatility on exports and imports
[19] For the import equation, $\beta_{4_{ijt}}$ is only significant at the 10% level.
[20] For the few traders that are able to access forward markets, limitations such as the size of the contracts needed for hedging and short term maturity for some of the hedge funds makes hedging difficult (Arize, Osang, and Slottje 2000)

This increase may have more than proportionally countervailed the potential negative effect of exchange rate volatility on their export earnings.

The observed negative impact of exchange rate volatility on imports could be attributed to how earning uncertainty (in the presence of higher exchange rate volatility) affects the Ghanaian importer trade decisions: Importers generally settle their trade contracts on an agreed exchange rate and payments usually made after imports delivery. In between the time the exchange rate is agreed and goods delivery, there is a possibility of exchange rate varying with time. This has the potential to affect earnings, planning and payments to trade partners. Thus higher volatility leads to higher expenditure for risk-aversed importers which lowered their urge to import (Arize, Osang, and Slottje 2000).

So why was the negative effect of exchange rate volatility statistically insignificant in determining imports in Ghana? The answer could lie in the composition of imports and the financing instruments available to finance imports: Ghana has less advanced technological and manufacturing capabilities and the composition of its imports varies from basics and necessities to sophisticated manufactures and intermediate capital goods. Ghana relies mostly on primary commodity exports[21] for its foreign exchange needs. Primary commodities however have low elasticities relative to manufactures, thus it is not unusual to observe imports outstripping exports in primary commodities exporting countries: In fact, trade data show that Ghana has a history of experiencing sustained periods of trade deficits (see Figure 7 in appendix) with exports receipts not enough to meet import costs (see Figure 8 in appendix). It is however amply documented that developing economies use aid, loans and other favourable trade financing instruments to finance developing countries' trade deficits (See works by Movavcsik

[21] Main traditional primary exports over the decades are gold and cocoa,

1989, Radelet 2006 and Opoku-Afari 2007). Thus the availability of aid, loans and other favourable trade financing instruments may have contributed to mitigate the expected negative effect of currency uncertainty on bilateral trade.

Persistent inability of export earnings to finance import costs in the presence of persistent volatile currency costs should present challenges to the policymaker. Persistent trade deficits induce persistent depreciation[22] which is widely believed to in turn induce higher volatility compared to an appreciation of the same magnitude (Christie, 1982). If the expenditure switching effects that normally follows nominal exchange rate depreciation is not enough to balance trade deficits then even mildly induced currency volatility should result in higher persistence in currency volatility (Krugman, 1989). It is not unusual for a vicious cycle of trade deficits, depreciation and volatility to ensue. This relationship if not broken with credible macroeconomic policies may consequently have second round negative impacts on external debt management (Esquivel and Larrain 2002), currency management (Edwards 2002) and the real sector (Filardo, Ma and Mihaljek 2011)

4.2 Impact of Incomes of Ghana and its Trade Partners on the Trade Variables

Here, the estimated coefficient of interest (for all the three estimated fixed effect gravity models) is $\beta_{1_{ij}}$. The results show that the estimated coefficient $\beta_{1_{ij}}$ is positive and statistically significant in all three regressions. This observation is consistent with many theories and empirical findings on the relationship between economic growth and international trade.

Findings from the estimated export regression confirm that economic growth stimulates exports in Ghana. For a developing country like Ghana, economic growth does not only allow it to realize the static gains from exporting its traditional comparative advantage commodities

[22] Figures 7 and 9 show Ghanaian persistent trade deficits and depreciations experience for the period of interest.

(mainly primary): Earnings from exports could be used to import or accumulate intermediate capital inputs for production of exports or import substitutes manufacture or to enhance the value of primary exports. Further, findings from the estimated import regression also confirm the positive impact of growth on imports. Thus growth allows Ghana to consume more from its trade partners. The increased imports induced by growth have the potential of further growth. This should happen if growth proportionally induces an increase in imports of intermediate goods: A feedback from imports to exports should allow the realization of the dynamic benefits of Ghana's comparative advantage. Since both exports and imports are positively impacted by economic growth, the net effect is an increase in bilateral trade as confirmed by the bilateral trade regression.

4.3 Impact of Per Capita Incomes of Ghana and its Trade Partners on the Trade Variables

The estimated coefficient of interest here is $\beta_{2_{ij}}$. The results show that the estimated coefficient $\beta_{2_{ij}}$ is negative and statistically significant in all three regressions. As stated earlier in Section 3.4, the relationship between trade and per capita income is a reflection of many factors including the level of attractiveness of trade between similar/ dissimilar economies (the Linder effect); the wealth of trade partners; or the comparable levels of development of trade partners. Thus the coefficient of per capita income possessing a negative sign may be interpreted to reflect how the disparities between economic sizes, wealth and development affect trade between Ghana and the trade partners included in this study. Further in-depth analyses of available data however reveal this is not the case.

Of the total trade value (for Ghana and its trade partners included in this study), bilateral trade with the highly industrialized countries (i.e. the EU, Japan, UK and the US) accounted for 85% (See Figure 10 in Appendix); these countries also accounted for the majority of Ghanaian export earnings (97% of all exports earnings to Ghana flowed from these four industrialized nations compared to the three included developing countries , see Figure 11 in Appendix) and the source countries for most of Ghanaian imports costs (these countries accounted for 78% of Ghanaian import cost compared to the three included developing countries, see Figure 12 in Appendix). The negative signage on $\beta_{2_{ij}}$ is therefore an indication of how mutual gains of trade are still enjoyed by countries who are very dissimilar (i.e. developing versus highly industrialized nations) which Linder hypothesis fails to explain (Carbaugh 2012). Since Ghana mainly exports primary commodities and imports intermediates, capital goods and manufactures, then it can be concluded that most of the exchanges between Ghana and its trade partners are characterized by distinct products (inter-industry type trade) as opposed to trade in similar products (intra-industry type trade).

4.4 Impact of Distance between Ghana and its Trade Partners and Shared/ Similar Culture on the Trade Variables

The estimated coefficients of interest here are respectively $\beta_{3_{ij}}$ and $\beta_{5_{ij}}$; $\beta_{3_{ij}}$ is negative for the three trade regressions indicating the negative impact of distance on trade earnings. This negative impact is however only significant for the estimated bilateral trade and export gravity regressions and not for the import regression. The estimated shared culture coefficient ($\beta_{5_{ij}}$) is negative but not statistically significant for all three estimated regressions; thus differences in culture or ways of doing businesses did not influence trade relationships.

5. Conclusion

Despite the merits of the flexible exchange rate system, the post-Bretton Woods experience is widely accepted to be characterised by high persistent volatility. Exchange rate volatility is thought to reflect market uncertainty and as the exchange rate plays an important role in international trade, a higher volatility has the potential to negatively affect trade. The empirical findings on the nature of this relationship are however not clear-cut.

The growing consensus in the literature however seems to suggest that empirical findings are sensitive to a number of factors including the classification (i.e. developed vs. developing) that a country falls under; with the negative impact of exchange rate volatility on bilateral trade comparably more pronounced in studies involving developing economies. This is attributed to the observation that most developing economies (especially the ones within sub-Saharan region) have less advanced capital, financial and currency markets and almost non-existing derivative markets. In the absence of structured hedging opportunities, some adequately risk-aversed exporters may compensate against the costs associated with foreign exchange risk or volatility by increasing the volume of exports.

Although trade relationships are bidirectional yet it is not a common practice to see similar empirical examination analysing the impact of volatility independently on total trade, imports and exports in a single study as performed in this paper. The intuition behind this approach is to assess exactly how Ghanaian traders are incentivized (differently or similarly) to exchange rate volatility costs. The paper first analysis the impact of exchange rate volatility on total trade and then replicated the exercise for exports and imports separately.

Synthesizing the evidence from the empirical exercise, the paper concludes that adequately risk aversed Ghanaian exporters in the presence of higher exchange rate volatility and absence of hedging facilities effectively compensated against exchange rate risk by increasing volume of exports. On the contrary although import decisions were to some extent negatively affected by exchange rate volatility, this did not effectively lower imports. The paper attributes this to Ghana's less advanced technological and manufacturing capabilities: The need to import basics, sophisticated manufactures as well as intermediate and capital goods dominated trade decisions. The different responses by Ghanaian exporters and importers to higher exchange rate volatility costs are reflected on the relationship between volatility and total trade. Although the impact is negative (reflecting the dominance of the response of imports to the cost associated with exchange rate volatility), the effect is statistically insignificant.

This empirical evidence presents challenges to policymakers. For primary commodities exporting developing countries like Ghana, it is usual to observe the costs of basics, manufactures and intermediate import exceeding export earnings. This has a potential to negatively affect economic performance via volatility feedback effects, currency problems, sustained trade deficits and persistent external debt especially if the expenditure switching effects that accompanies depreciation and exchange rate volatility costs are not effective in restoring trade balance.

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Figure 1: Bilateral Trade vs. GDPs

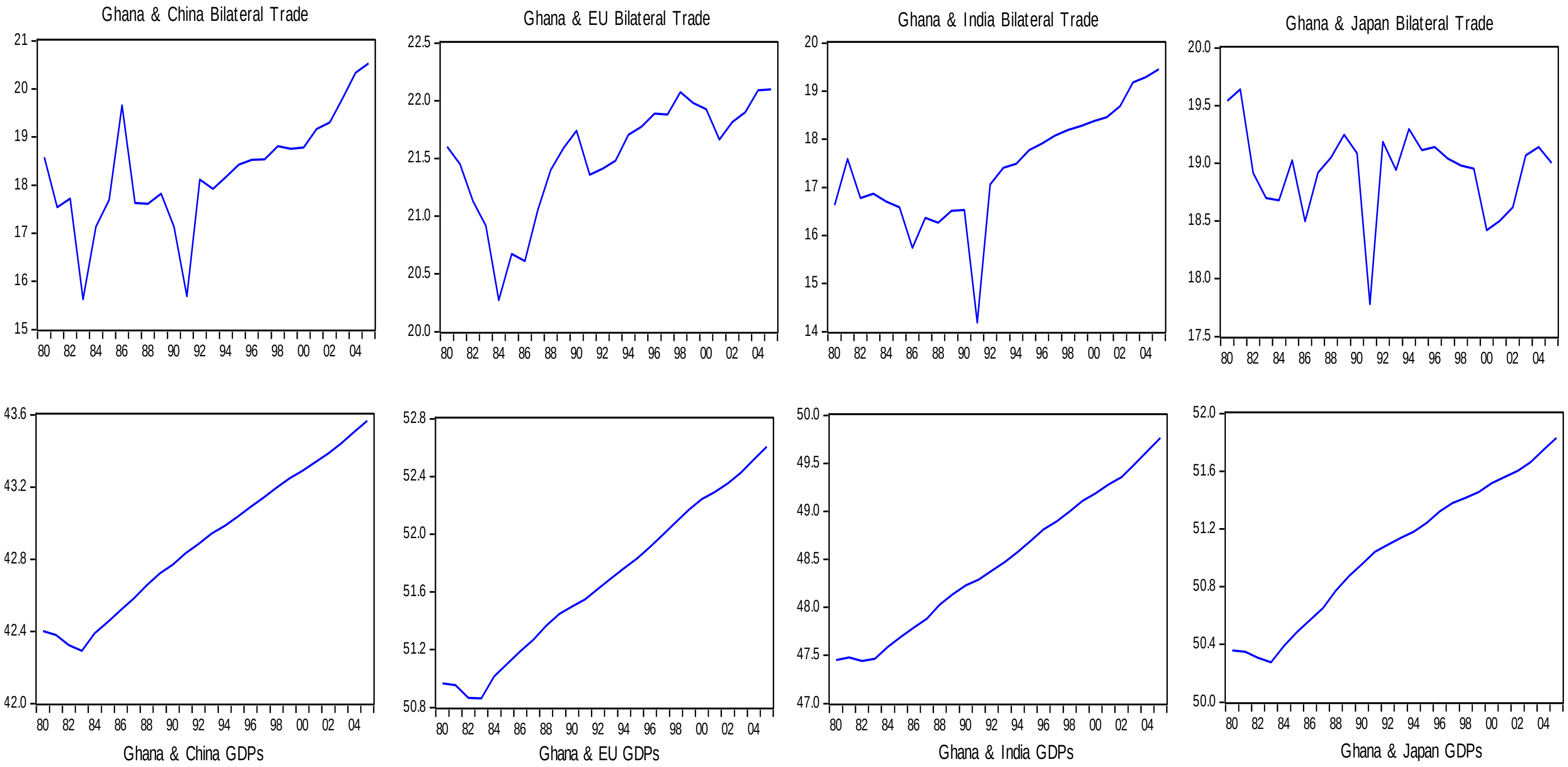

Figure 2: Bilateral Trade vs. GDPs (Continued)

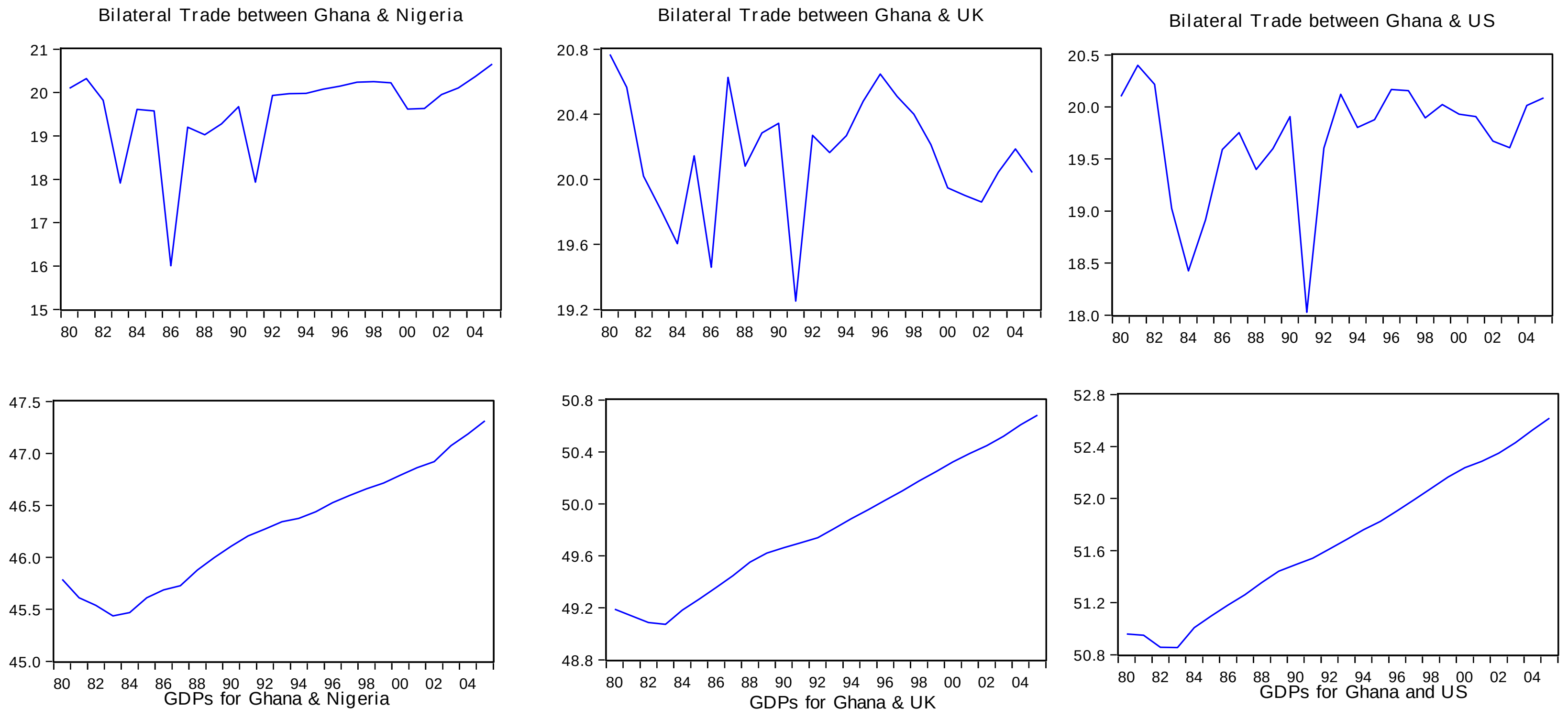

Figure 3: Bilateral Trade vs. Per Capita Income

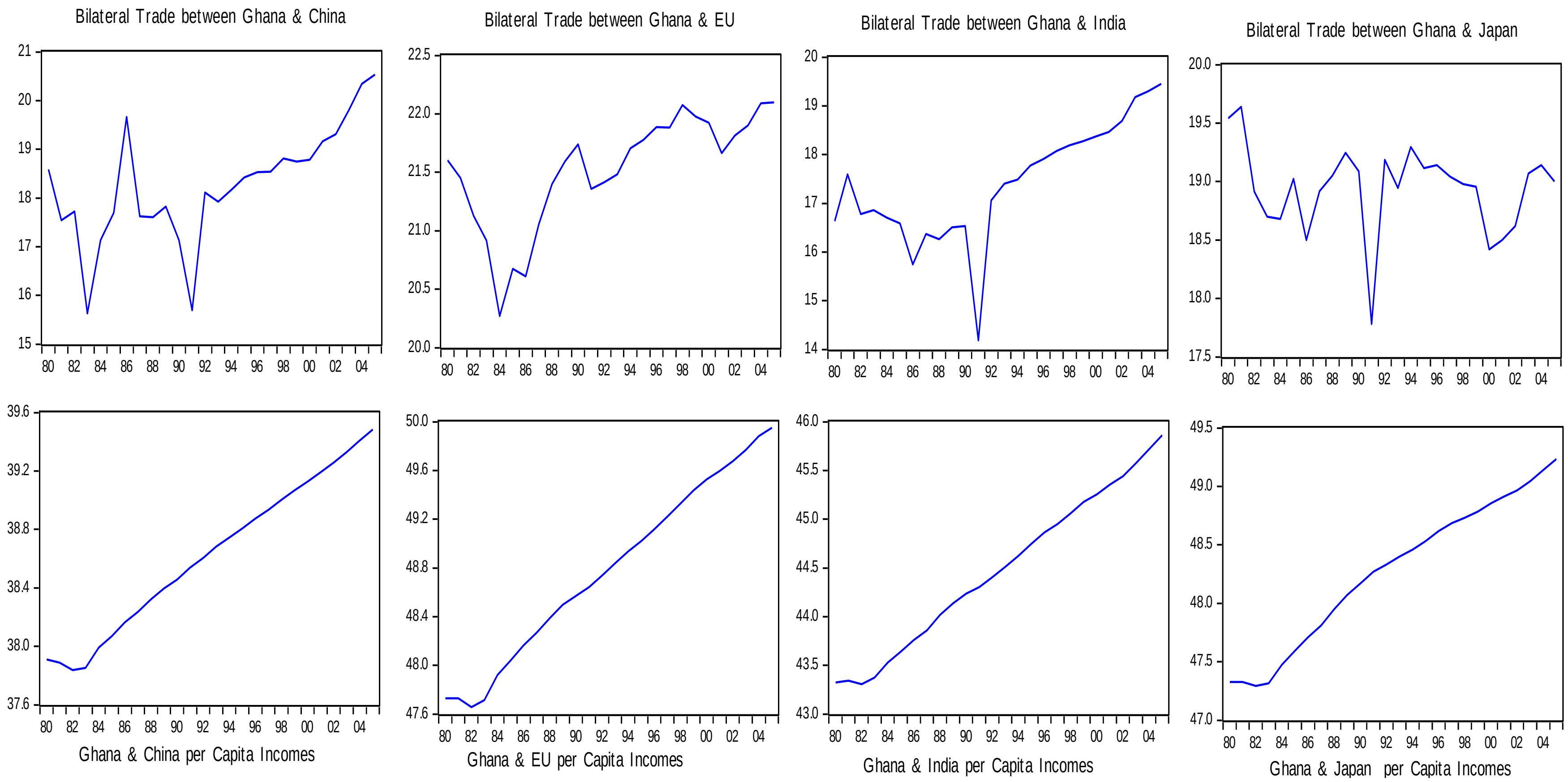

Figure 4: Bilateral Trade vs. Per Capita Income (Continued)

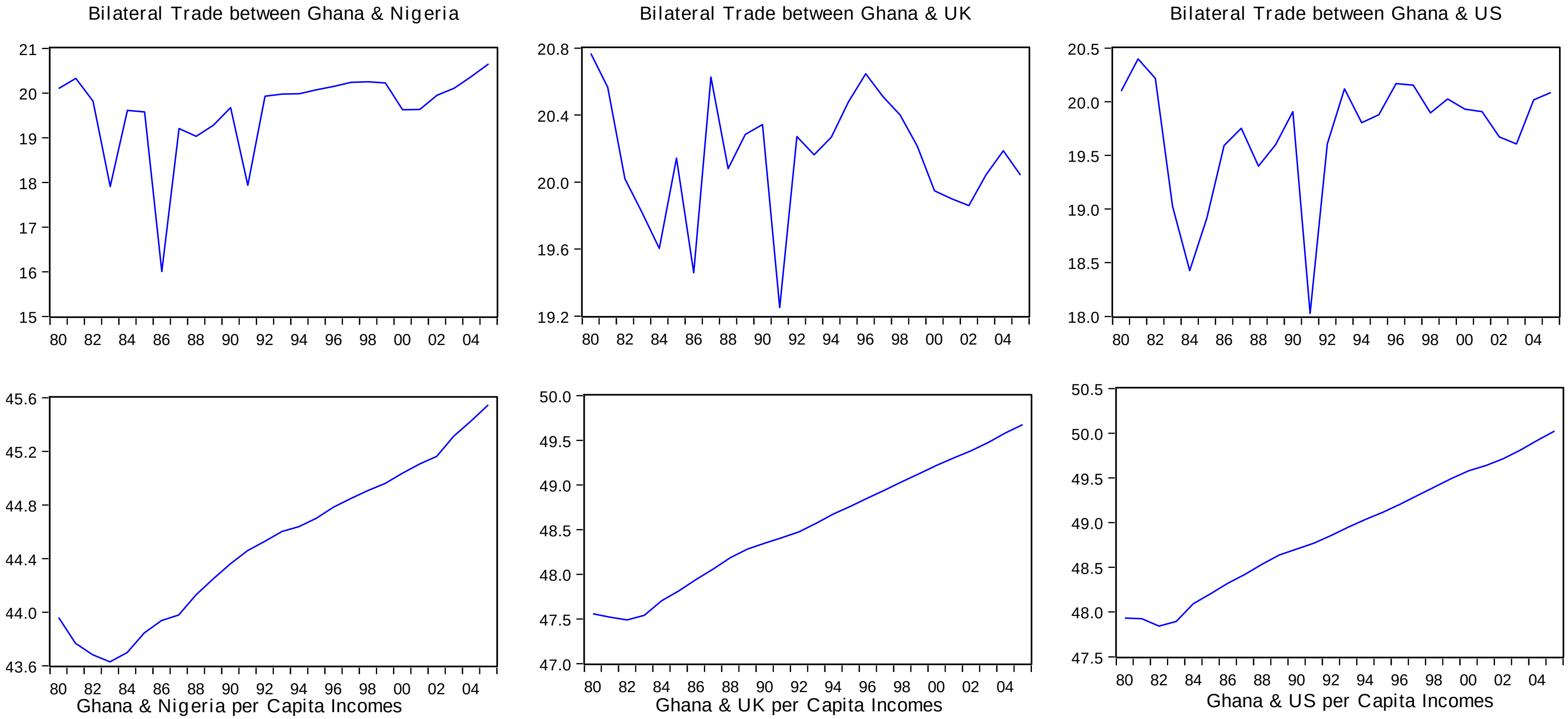

Figure 5: Bilateral Trade vs. Exchange Rate Volatility

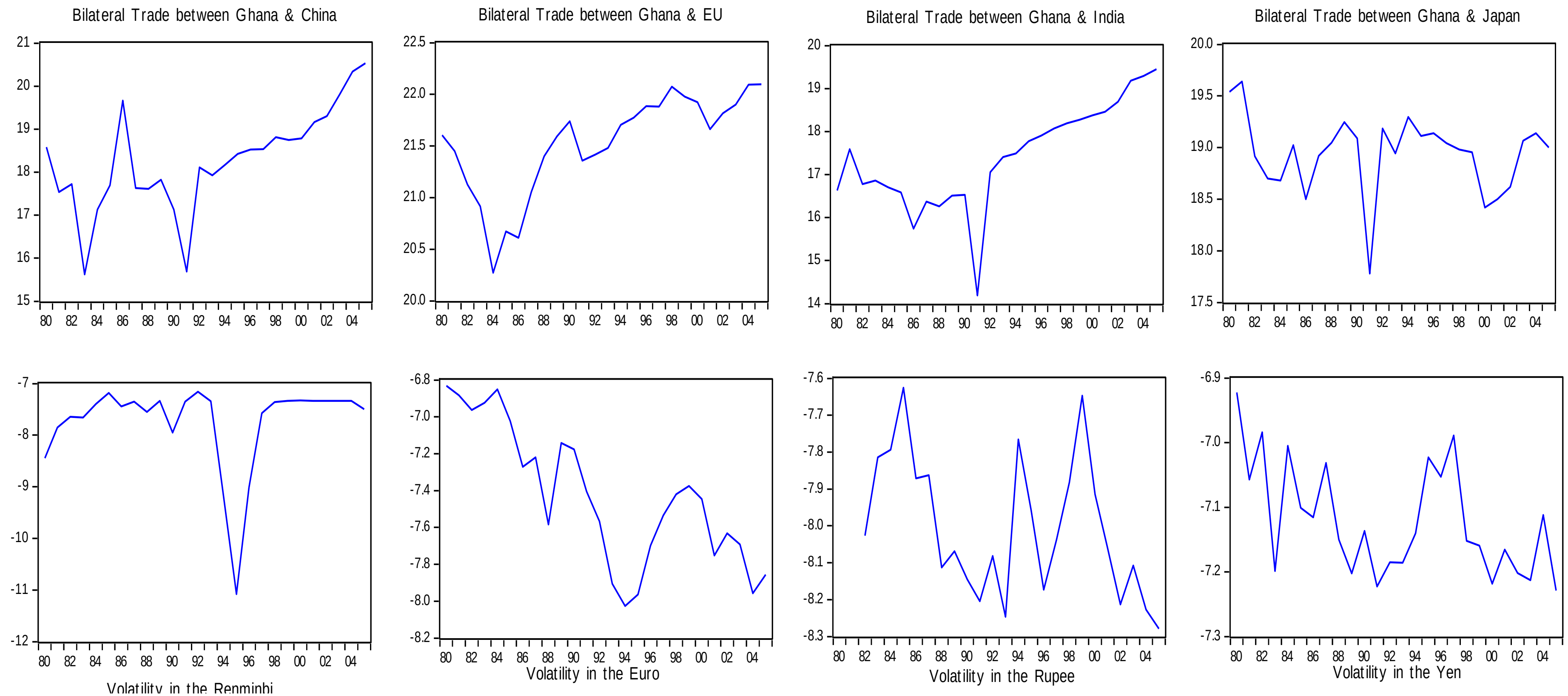

Figure 6: Bilateral Trade vs. Exchange Rate Volatility (Continued)

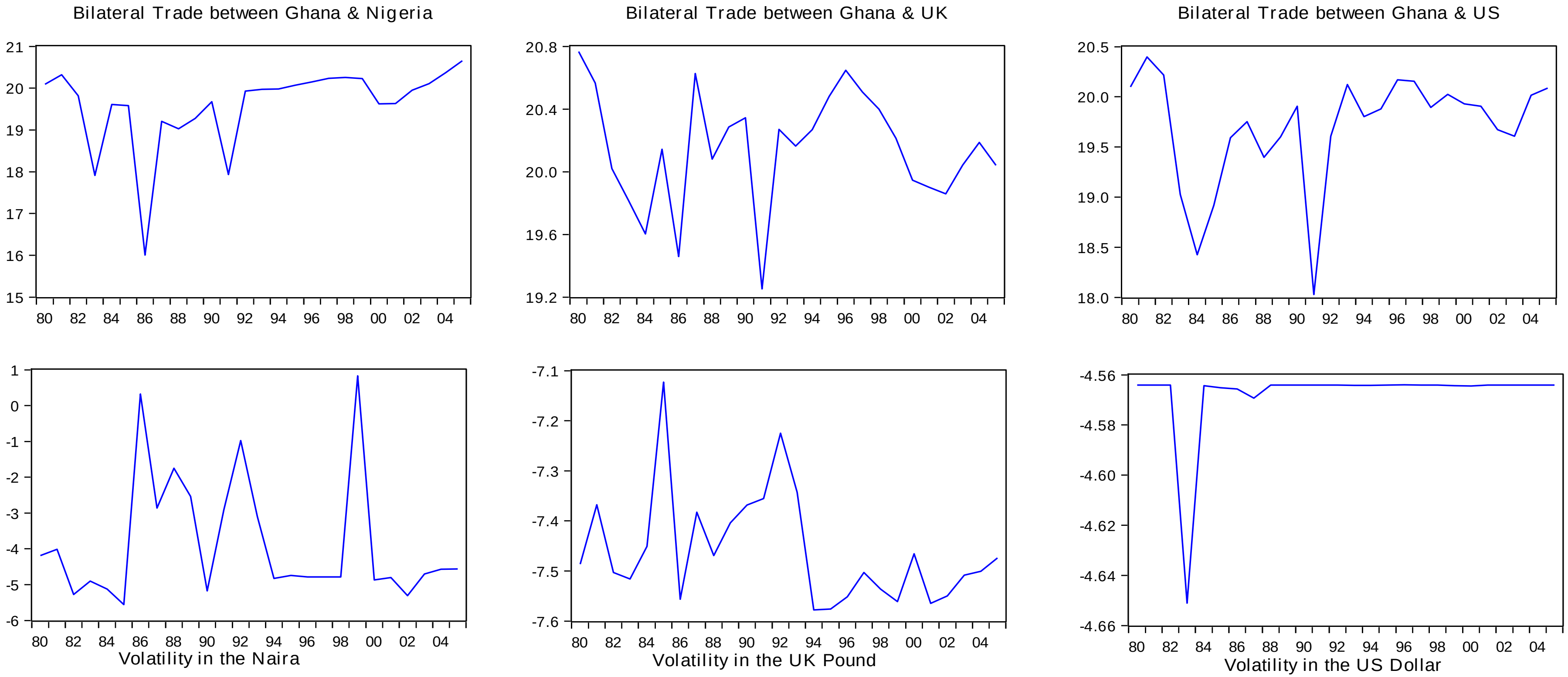

Figure 7: External Balances on Goods and Services (as a Percentage of GDP)

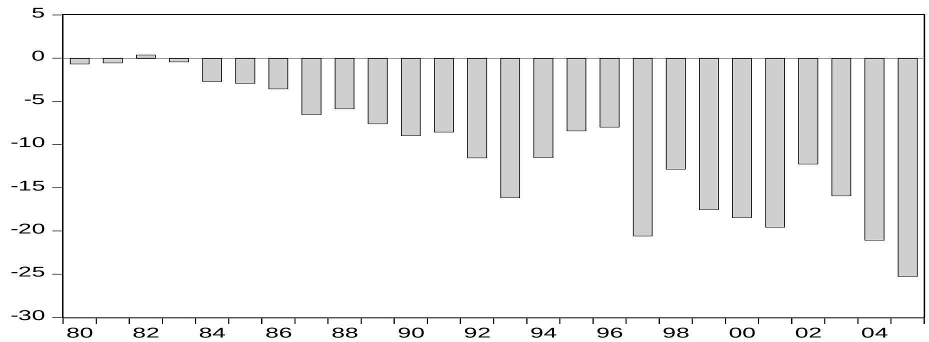

Figure 8: External Debt Stock (as a Percentage of Exports)

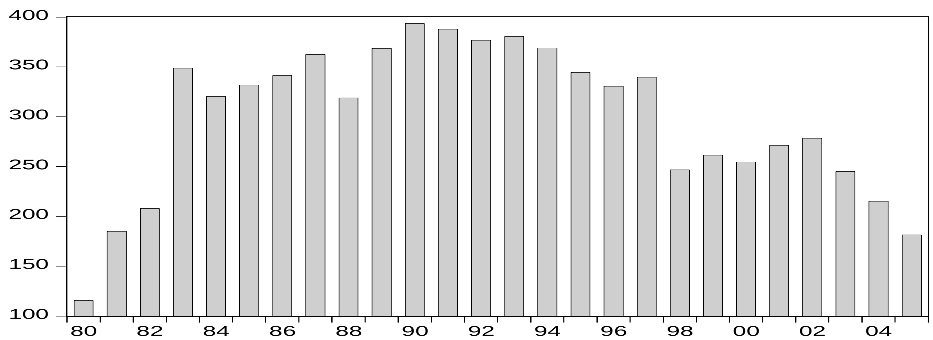

Figure 9: Year-on-Year Currency Depreciation

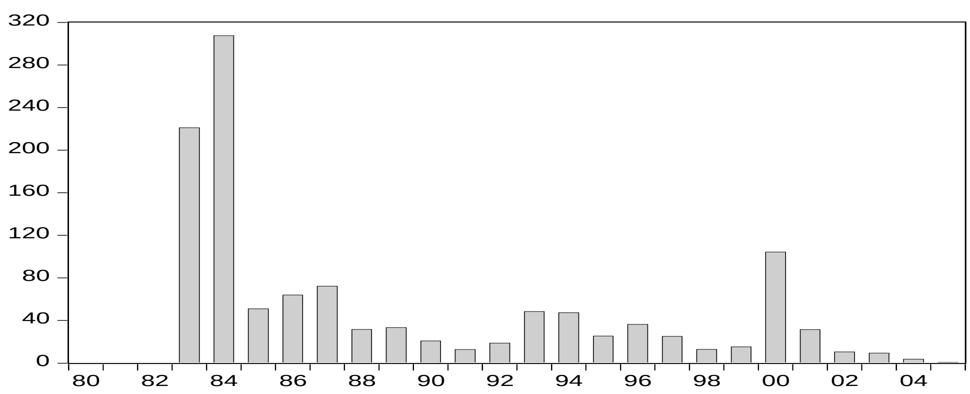

Figure 10: Percentages of Ghana Trade Partners' Share of Total Trade

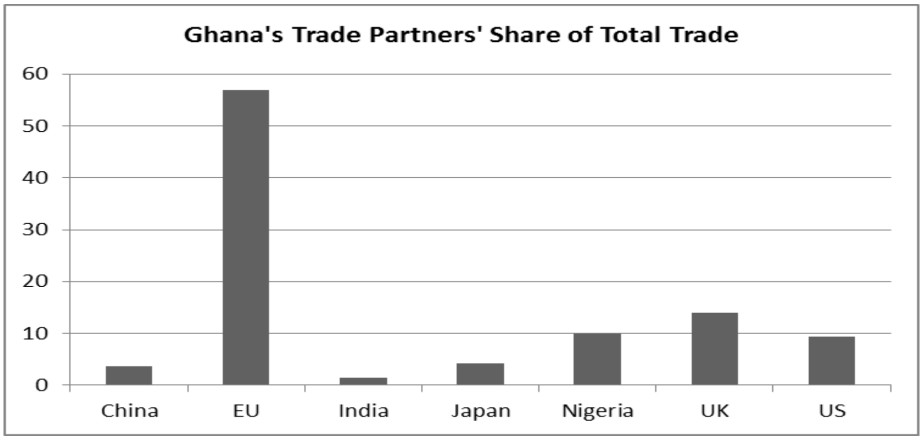

Figure 11: Trade Partners' Share (Percentage) of Ghana Exports

Figure 12: Trade Partners' Share (Percentage) of Ghana Imports

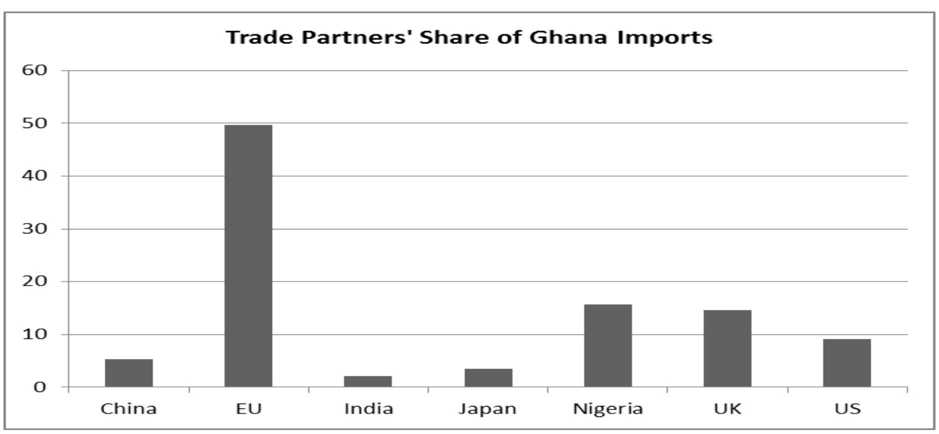

Table 1: ARCH Models, Distance (km) and Language Dummies

	Ghana		
	Volatility Model	$Dist_{ij}$	$D1_{ij}$
China	MA(1)-EGARCH(1,1)	19,038	0
EU-12	AR(1)-GARCH(1,1)	7,213	0
India	AR(1)-EGARCH(1,1)	13,296	1
Japan	MA(1)-EGARCH(1,1)	20,266	0
Nigeria	AR(1)-ARCH(1)	420	1
UK	AR(1)-ARCH(1)	7,252	1
US	ARMA(1,1)-ARCH(1)	8,622	1

Table 2: Gravity Regressions Results

Estimated Coefficients	Bilateral Trade Regression	Exports Regression	Imports Regression
Intercepts	-27.987	-171.898***	10.543
	(-1.157)	(-3.306)	(0.398)
$LogGDP_{ijt}$	2.713***	12.246***	2.001**
	(3.192)	(6.710)	(2.151)
$LogGDPPC_{ijt}$	-1.864**	-8.829***	-1.958**
	(-2.175)	(-4.780)	(-2.088)
$LogVol_{ijt}$	-0.105	0.335**	-0.125*
	(-1.567)	(2.336)	(-1.715)
R-Square	86.423	79.401	83.207

T-statistics in (); ***, **and * respectively represents significance at 1%, 5% and 10% levels

Estimated Coefficients	Bilateral Trade Regression	Exports Regression	Imports Regression
Intercepts	17.485***	49.225***	13.500
	(4.367)	(4.552)	(1.376)
$LogDist_{ijt}$	-1.888***	-5.396***	-1.518
	(-4.915)	(-5.786)	(-1.443)
D_1	-1.2660	-2.317	-0.039
	(-0.590)	(-0.290)	(-0.014)
R-Square	55.699	39.657	41.728

Table 3: Estimated Coefficients of Time In-Variant Variables Using Robust Errors

T-statistics in (); ***, **and * respectively represents significance at 1%, 5% and 10% levels