Revisiting the Diverse Empirical Findings on the Impact of Exchange Rate Volatility on Trade: Some Comparable Evidences from Ghana and Two other Developing Economies

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Abstract

Although theories suggest that exchange rate volatility negatively affect international trade yet empirical studies on this relationship have produced mixed results. Guided by the growing consensus in the literature that empirical results may be sensitive to the class of countries considered as well as the proxy of exchange rate volatility used, this paper empirically examines this relationship for Ghana by augmenting a gravity model (that controls for fixed and events specific effects) with historical volatility forecasts (which are generated using three different estimation techniques). It was observed that between 1980 and 2005, exchange rate volatility did not impact on bilateral trade for Ghana and its trade partners considered. Comparable empirical experiments conducted on Mozambique and Tanzania showed similar relationship between exchange rate volatility and bilateral trade. Evidently these empirical findings present challenges to policymakers. The paper advocates that even though a number of reasons contributed to these observations, yet the overall potential consequences of exchange rate volatility on economic performances via volatility feedback effects, currency problems as well as persistent trade deficits should be of concern to policymakers. The useful policy lessons from the empirical findings may be obvious and debated widely but are relevant more than ever today since most sub-Saharan developing countries are still burdened with persistent external debts, deficits and currency problems even after enjoying a decade of stable and favourable commodity prices between 2000 and 2010.

Keywords: Exchange Rate Volatility, Bilateral Trade, Gravity Model, Sub-Saharan Africa

JEL Codes: F31, F17, C21, O24, O55

1. Introduction

Proponents of flexible exchange rate argue that since they are determined by market forces of demand and supply, they adjust to dampen the impacts of real exogenous shocks as well as restoring a country's balance of payments to equilibrium. In contrast to what Friedman (1953) envisaged, departures from the expected levels of exchange rates and persistence in volatility have been experienced by many economies that have adopted the flexible exchange rate system in the post Bretton-Woods era. Exchange rate volatility induced by domestic currency fluctuations is widely accepted to affect economic growth through net export which is directly reflected in GDP calculation. Also, the effects of a volatile currency have may have second round effects; for instance a volatile exchange rate may exert inflation volatility.Previous empirical evidence however does not lead to a clear cut consensus on the relationship between exchange rate volatility and trade (See Bacchetta and van Wincoop 2000).

Using data from the G-7 countries (UK, Canada, France, Germany, Italy, Japan and the USA) for the period between 1969 and 1982, the IMF (1984)[1] observed no significant effect of exchange rate volatility on trade among the developed G-7 countries. Aristotelous (2001) used an augmented gravity model to explore the effects of exchange rate volatility[2] on the volume of UK exports to the USA for the period

[1] Most of the studies on the effect of exchange rate volatility on trade emanates from the IMF (1984) research for the General Agreement on Tariffs and Trade (GATT) in the Post-Bretton Wood era. The model used for this work is based on the Cushman (1983) technique where bilateral export regressions were estimated with explanatory variables being real Gross National Product (GNP), real bilateral exchange rate, exchange rate volatility measured (measured as a standard deviation of the percentage changes in exchange rates over the preceding five years) and relative capacity utilization)

[2] Following Arize, Osang, and Slottje (2000), Aristotelous (2001) estimated time-varying exchange rate volatility using moving standard deviation of real effective exchange rate growth.

1889 to 1999 and also observed no significant effect between these two variables. Also, using the augmented gravity model of trade, Dell' Ariccia (1999) investigated the effects of exchange rate volatility[3] on trade flows for fifteen western European countries and Switzerland for the period 1975 to 1994 and observed that exchange rate volatility has a small but significant negative effect on trade.

Arize, Osang, and Slottje (2000) applied a traditional specification of the long-run export demand equations and cointegration analysis on thirteen developing countries and observed that for the period between 1973 and 1996, exchange rate volatility negatively and significantly affects export flows. Sauer and Bohara (2001) used similar long-run export demand equation to Arize, Osang, and Slottje (2000), but went step further and compared findings between sixty-nine developing and twenty-two developed and industrialized countries from 1973 to 1993. To allow for cross-country structural and policy differences that may affect export performance, they applied fixed and random effects estimation technique. They applied three different proxies of exchange rate uncertainty measurement including an Autoregressive Conditional Heteroscedasticity (ARCH) generated variances of the real exchange rate, a moving standard error of the estimate of a first order geometric autoregressive process of the real exchange rate and a moving standard error of the estimate from a second order linear time trend of the logarithm of real exchange rate. They observed a negative and significant relationship between exchange rate volatility and trade when all the ninety-one countries were considered as one entity. Interestingly, when the task was divided into sixty-nine developing and twenty-two developed countries exchange

[3] Proxies for exchange rate volatility included standard deviation of the differences of logarithm of monthly average bilateral spot rate, sum of squares of forward errors, and the percentage changes between the maximum and the minimum nominal spot rates.

rate volatility was observed to negatively affect trade in all the export demand equations that were specified for developing countries and not for the twenty-two developed countries (only three out of the eighteen specified export demand equations show evidence of negative and significant effect of exchange rate volatility on trade). Among the developing countries, the effects of exchange rate volatility (on bilateral trade) was negative and significant for the African and South American countries but not for Asian countries.

Observations from previous empirical surveys by Baum, Caglayan, and Ozkan 2004 as well as Ozturk (2006) have added other dimensions to this mixed empirical findings; they observed that apart from the class of countries under consideration (developed versus developing), empirical findings can be sensitive to other factors including exchange rate volatility proxies used. Consequently, this paper is motivated in two parts which are:

1. Whether findings on Ghana together with Mozambique and Tanzania[4] support the growing consensus in the empirical literature (since findings suggest that the negative impact of exchange rate volatility on bilateral trade is relatively more pronounced in studies involving developing economies)

2. Whether findings are sensitive to different proxies of volatility

Three different measurements for exchange rate volatility (for each of the three developing countries under consideration) are used to investigate the nature of relationship between exchange rate volatility and trade in an augmented gravity model:

[4] These three countries were chosen because they have gone through comparable policy engagements with the IMF, have followed similar floating exchange rate regimes and currently all adhere to the IMF convention of free current account convertibility and transfer.

The estimation process also controlled for heterogeneous trade relationships and event specific effects. Results from this empirical exercise showed that the impact of exchange rate volatility was not statistically significant in determining trade relationships for the three Sub-Sahara countries considered. This paper argues that firstly, adequately risk-aversed exporters may have responded well against earnings uncertainty during periods of excessive volatile domestic currency by increasing their volume of exports: This response effectively cushioned them against the negative effects of exchange rate volatility on their exports earnings. Secondly, since these countries are developing countries with less-advanced manufacturing sector, the need to import both finished products for domestic consumption as well as intermediate, technological and capital inputs for production, dominated trade decisions. The rest of the paper is organised as follows: In Section 2, the gravity model, the variables, data and estimation techniques applied are presented; Section 3 presents comparative analyses on findings and Section 4 concludes this paper.

2. The Gravity Model of Trade, Variables Measurements, and Estimation Techniques

In this section, the gravity model as applied to trade is introduced. Also, how the variables are measured in this exercise and estimation techniques used are also discussed.

2.1 The Gravity Model of Trade

The idea of using the gravity model[5] to explore relationships in the social sciences is attributed to Stewart (1941, 1947) and more pertinently to international trade by Tinbergen (1962) and Poyhonen (1963). Analogous to the Newton Gravity model, Tinbergen (1962) and Poyhonen (1963) proposed that bilateral trade between two countries will depend directly on the sizes (usually either economic and/ population sizes[6]) and inversely on the distance between them.

The Basic form of the gravity trade model for international bilateral trade proposed by Tinbergen (1962) and Poyhonen (1963) is similar to;

$$B_{Trade_{ijt}} = \frac{\beta_0 \left(GDP_{it} GDP_{jt}\right)}{Dist_{ij}^{\beta_2}} \qquad (1)$$

$B_{Trade_{ijt}}$ 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. Log-linearizing Equation 1 above yields;

$$LogB_{Trade_{ijt}} = \beta_0 + \beta_1 Log\left(GDP_{it} GDP_{jt}\right) - \beta_2 LogDist_{ij} \qquad (2)$$

[5] As its name suggests, the gravity model originated from the Newtonian Law of Universal Gravitation, expressed mathematically as - $F = G\frac{M_1 M_2}{Dist^2}$. *F* represents the force of attraction between two masses M_1 and M_2 and $Dist$ represents the distance separating the two masses; *G* is the gravitational constant.

[6] Linnemann (1966) proposed the inclusion of population as another input to cater for the size of the economy

From Equation 2, 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 trade model in describing international trade by Tinbergen (1962) and Poyhonen (1963) encouraged other researchers to improve and enhance the model. Although empirically, the gravity model has been successfully applied to international trade, critics questioned the theoretical underpinnings of the model until Anderson (1979)[7] formally developed most of the theoretical foundations. Most of the underlying theories of the gravity models conforms in many ways to existing international trade theories. For instance Anderson (1979) used properties of expenditure functions in countries and justified the application of gravity model by assuming a Cobb-Douglas expenditure system and constant elasticity of substitution preferences. He assumed products are differentiated from their source countries. Bergstrand (1985) also justified the basis of the gravity model on similar arguments to Anderson (1979). Bergstrand (1985) argued for the inclusion of exchange rate and price in the gravity model as they play important role to trade. Deardoff (1995) observed that the gravity model conforms to the Ricardian and Heckschser-Ohlin models[8] with the assumption of frictionless trade and different

[7] This has since been refined by Anderson and Van Wincoop (2003). They proposed that multilateral trade barriers also serve as a determinant of bilateral trade between country trade-pairs. One way of accommodating for multilateral trade barrier in regression is by controlling for heterogeneity between trade-pairs

[8] The Ricardian and Heckschser-Ohlin trade models are built on the theory that factor endowment determines the pattern of trade between two countries. Countries tend to export goods whose production utilizes the factors they have in abundance, and import the goods that utilize the countries less abundance factors of production.

countries producing different goods. The gravity model applied in this paper is the augmented gravity trade model[9]. In the next section we explain the relevance of the variables used in our study and how they were measured.

2.2 The Variables

This section explains how the variables used in the augmented gravity trade models for Ghana, Mozambique and Tanzania were estimated.

Bilateral trade

Real bilateral trade (in logarithm) between country trade-pairs is calculated as

$$LogBTRADE = Log\left[\left(\frac{EXP_{ijt}}{USGDPD_t}\times 100\right)\times\left(\frac{IMP_{ijt}}{USGDPD_t}\times 100\right)\right] \quad (3)$$

Where EXP_{ijt} and IMP_{ijt} respectively represent the nominal values of exports and imports (in US dollars) between countries i and j; $USGDPD_t$ represents US GDP deflator[10].

Size of a Country

Two variables are used to proxy the sizes of country trade-pairs; these are annual GDPs (in constant 2000 US Dollars) and annual population sizes. Total GDPs of country trade-pairs i and j (in logarithm) is thus calculated as;

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

[9] The augmented gravity trade model, an extension of the traditional gravity model of Tinbergen (1962) and Poyhonen (1963) allows us to test the explanatory significance of other variables that are deemed to affect bilateral trade.

[10] Eichengreen and Irwin (1996) as well as Baak (2004) used the US GDP deflator to calculate real exports from nominal exports values.

Where GDP_{it} represents the GDP of country i at time t, and GDP_{jt} represents the GDP of country j at time t.

The total population (in logarithm) for county trade-pairs, i and j is calculated as;

$$LogPOP_{ijt} = Log(POP_{it} \times POP_{jt}) \qquad (5)$$

Where POP_{it} represents the population of country i at time t and POP_{jt} represents the population of country j at time t.

Distance

In this research, distances ($Dist_{ij}$) between major goods and cargo ports (sea) serving countries trade pairs (in kilometres) are used (See Table 1 in Appendix). In the case of the distance between one of the developing countries under consideration and EU-12[11] however, an average of all the distances between the particular development country and each member country of the EU-12 is used.

Exchange Rate Volatility

Previous studies suggest that volatility (which is thought to reflect market uncertainty) is usually captured by variances in a data. The problem faced by practitioners and researchers is using the technique that best capture volatility in a particular series. For each developing country and her bilateral trade partner, three different estimation techniques are used to generate volatility series over the estimation period. The three techniques used to generate exchange rate volatility were;

I. ***Autoregressive Conditional Heteroscedastic (ARCH) Technique*****e**

[11] The EU-12 (EU-15 without Denmark, Sweden and UK) includes member states of the European Union before expansion in 2004. The United Kingdom is treated differently because the British pound still remains her national currency. The EU-12 member states are Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain.

One stylised fact of foreign exchange market is that it is characterised by time-varying volatility (See Engle, Ito, and Lin 1990). The literature on modelling the time-varying nature of volatility in the exchange rate market is however dominated by the ARCH family of models, introduced by Engle (1982). In the ARCH modelling technique, conditional variance of the current error term (or current volatility) is modelled as a function of variances of previous error terms. In an ARCH(q) specification, conditional variance is modelled mathematically as $\sigma_{x_t}^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \varepsilon_{t-2}^2 + ... + \alpha_q \varepsilon_{t-q}^2$. For non-negative conditional variance, $\alpha_0 > 0$ and $\alpha_k \geq 0$ for *k=1, 2, 3…, q*; ε_{t-k} represents error terms from the exchange rate forecasting model of the experimenter choice.

Bollerslev (1986) developed the GARCH (Generalized ARCH) models to cater for the slow decaying nature of ARCH models. Also the GARCH models are less likely to breach the non-negative constraints required for the ARCH models. Nelson (1991) developed the EGARCH (Exponential GARCH) whilst Zakoian (1994) and also, Glosten, Jaganathan and Runkle (1993) independently developed the TARCH (Threshold ARCH) models to cater for asymmetric effects in financial time series[12] .

Robust measures of volatility are estimated by first testing the time series properties for all the monthly exchange rate percentage change series (x_t)[13] under consideration. Finding them stationary and highly autocorrelated, I then experimented with different ARMA specifications based on the general model,

[12] See Bera and Higgins (1993) and Bollerslev (2009) for a thorough overview of the ARCH estimation technique and exhaustive list of ARCH family members

[13] Percentage changes are calculated as the first difference of logarithm of each of the exchange rate series under consideration.

$$\alpha(L)\alpha_S(L)\left[(1-L^m)x_t-\mu_t\right]=\beta(L)\beta_S(L)\varepsilon_t \qquad (6)$$

Where α, α_s, β and β_s are well-behaved polynomials of adequate orders in the lag operator L, subscript s denotes the seasonal component that can be factorised and together with $m = 12$ captures any dynamics due to the months' effects, μ_t is a deterministic component which captures any mean-shifting across months using seasonal dummies and ε_t is an independently distributed random disturbance term. From these experiments, statistically robust and parsimonious empirical representations of the generating process for x_t are selected (See Table 1 in Appendix).

The empirical representations obtained based on Equation 6 for each monthly exchange rate series are conditional on the assumption that ε_t is homoscedastic. The homoscedasticity assumption (using the ARCH-LM test) and was strongly rejected in all cases. Using residuals from the estimated time series model for each exchange rate series, statistically robust and parsimonious ARCH family of models that adequately describes the conditional variances in the monthly exchange rate series under consideration are estimated (See Table 1 in Appendix). Annual forecasts from our obtained ARCH family of models are estimated by taking the average over twelve months.

II. *Exponentially Weighted Moving Averages (EWMA) Technique*

Although this technique does not possess sophisticated mechanism like the ARCH family of models in its ability to capture some of the empirical regularities found in exchange rate markets, previous researches suggest that the EWMA can produce comparably good or better volatility forecasts (Lopez 2001 as well as Nelly and Weller, 2001). The technique attaches more importance to recent volatility innovations. A geometric random walk model of the form in Equation 7 below is first estimated.

$$x_t = a + \varepsilon_t,\ \varepsilon_t \sim iid \tag{7}$$

Where a is the drift component. Residuals from the estimated geometric random walk models[14] of our monthly exchange rates series are then used to estimate volatility using an EWMA technique with RiskMetrics™ smoothing factors[15] $\lambda = 0.97$. The monthly forecasts from our obtained EWMA models are then annualised by taking the average over twelve months.

III. ***Average Annualized Monthly Variances (AMV)***

Similar to Dell' Ariccia (1999), annual variances to proxy annual volatilities for our exchange rate series under consideration are estimated as,

$$\sigma^2_{x_t} = \frac{1}{12}\sum_{i=1}^{12}(x_t - \bar{x}_t)^2 \tag{8}$$

Common Language

Many studies (for instance, Frankel and Rose, 2002) show significant evidence of the influence of a common language on international trade. This could stem from the fact

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[14] In order to derive the recursive form of the EWMA model for volatility forecasts as suggested by the JP Morgan RiskMetrics group, it is assumed that infinite amount of data is available and also sample mean is zero. Hence, the use of residuals from the geometric random walk model in our volatility forecasts. The conditional variance of percentage changes is accordingly expressed $\sigma^2_{x_t} = \lambda\sigma^2_{x_t} + (1-\lambda)x^2_{t-1}$, $0 < \lambda < 1$

[15] JP Morgan group analysed a very large number of financial time series and observed that on the average, the RiskMetrics smoothing factor $\lambda = 0.97$ produces optimal forecasts for most monthly financial time series(see J.P Morgan *RiskMetrics™ Technical Document Part II: Statistics of Financial Market Returns*, Fourth Edition. New York: 1996).

that language (and other similar intangible factors including culture and ways in executing business) influences international trade relationships. Also, most sub-Saharan countries sharing a common language with some European countries tend to have previous colonial relationships; improved trade terms are now evident in the post colonial era. In this study, a dummy variable ($D1_{ij}$) is used to capture the influence of common language on the flow of trade in our gravity models. For each country under consideration and their respective bilateral trade partners, common language is given a score of one; otherwise a score of zero is given (see Table 1 in appendix).

In general, the coefficients of explanatory variables are a priori signed on the basis of the underlying economic theory. *Ceteris Paribus,* bilateral trade is expected to be higher the higher are incomes of trade partners. Population may take either signage in a gravity model (see Martinez-Zarzosa and Nowak-Lehman, 2002). Population may possess a negative sign if trade partners trade less when they become larger or a positive sign if they export more as they become larger. *Ceteris Paribus,* bilateral trade is expected to be higher between trade partners having a homogenous culture (share border, common language, colonial relationship, etc) and also bilateral trade is expected to be higher the closer the trading partners are, and as already explained in Section 1, bilateral trade is expected to be higher, the less volatile is the bilateral exchange rate between the trade partners.

2.3 Data and Estimation Technique

The data used in this study range from 1980 to 2005. Data on nominal bilateral trade were obtained from the Direction of Trade Statistics (DOTS) of the International Monetary Fund (IMF). The US GDP deflator, nominal GDP, population sizes and nominal exchange rates were obtained from the US Department of Agriculture website.

The distances between Ghana, Mozambique and Tanzania and each of their respective trading partners were obtained from the world ports distances website.

For the three Sub-Saharan developing countries under consideration, there are serious deficiencies in the availability of historical bilateral exchange rate and trade data between country trade pairs. In this study, bilateral country /US dollar[16] currency exchange rate data are used to generate volatility proxies for our period of study. The assumption made here is that a volatile domestic country /US dollar currency exchange rate have the potential to negatively affect trade.

The bilateral trade partners' considered for Ghana in this study are China, EU-12, India, Japan, Nigeria, the US and the UK. Mozambique trade partners considered were EU-12, India, the UK and the US. Finally for Tanzania, China, India, Japan, the US and the UK were considered. The trade partners were selected based on their share in each of the three countries trade volume as well as data availability.

The fixed effect pooled cross sectional estimation technique applied to the gravity models is of the type:

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

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 $\beta_{1_{ijt}}, \beta_{2_{ijt}}, \beta_{3_{ijt}}, \beta_{4_{ijt}}, and\ \beta_{5_{ijt}}$ were allowed to remain common to all years and all country-trade pairs throughout the estimation process; the intercept α_t varies each year

[16] The preferred currency for cross border foreign exchange transactions in most developing countries is the US dollar.

to control specific annual world events that generally impacted on bilateral trade for the period under consideration and the intercept $\beta_{0_{ij}}$ accounts for the specific factors that determined trade flow for Ghana, Mozambique and Tanzania and their respective trade partner across time (accounting for heterogeneity including 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 model is 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 contributions to bilateral trade were then analysed.

In all, 3 bilateral gravity trade equations are estimated[17] for each of the three Sub-Saharan developing economies under consideration and their respective trade partners.

3. Analyses of Findings

Tables 2 (see Appendix) shows findings on estimated gravity trade relationships for Ghana, Mozambique, Tanzania and their trade partners. The estimated intercepts that

[17] As three different volatility measures were experimented with for each of the time series cross-sectional estimation technique applied.

capture the impact of heterogeneous trade relationships including multilateral trade resistances ($\beta_{0_{ij}}$) are shown in Tables 4 (see Appendix) and the intercepts that cater for the time related events (α_t) are respectively shown in Table 5 (see Appendix). In sub-section 3.1 that follows, the paper s presents a comparative analysis on findings.

3.1 Comparative Analyses on Findings

For all estimated gravity models, the estimated coefficient which is of major interest to this study is $\beta_{4_{ijt}}$. This estimated coefficient is not statistically significant for Ghana, Mozambique, Tanzania and their respective trade partners considered. This is contrary to expectations; Arize, Osang, and Slottje (2000) argued that a negative relationship between bilateral trade and exchange rate volatility is expected by suggesting that higher volatility leads to higher expenditure for risk-averse traders, and in effect lowers the urge for international trade. Normally, exchange rate is settled on the time of the trade contract but payment is not made until after delivery takes place; in between the time the exchange rate is agreed and goods delivery, there is a possibility of exchange rate varying with time, which may affect earnings from international trade.

So what could have contributed to our observation? A number of arguments have been proposed to support such empirical observation. One of such explanations argues that that exchange rate volatility may not necessarily affect trade if hedging opportunities exists (Baron 1976). Opponents to this explanation however argues that exchange rate risk is not generally hedged in most developing economies since forward markets are usually not available to many of the traders. 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). Since exchange rate risk hedging tools are not very developed in Sub-Saharan countries like Ghana, Mozambique and Tanzania, the paper attributed the empirical findings on the following reasons-

1. These countries have less advanced technological and manufacturing capabilities. Thus the composition of their imports varies from basics and necessities to sophisticated manufactures and intermediate capital goods. Consequently, the need to import both finished products for domestic consumption as well as intermediate, technological and capital inputs for production dominated trade decisions.

2. In the spirit of De Grauwe (1988), we can argue that periods of exchange rate volatility did not significantly deter trade decisions. Adequately risk-averse traders knowing that such group of countries have the need to import (due to the explanation given above), relatively increase their exports in the presence of earning uncertainty. As argued by DeGrauwe (1998), these exporters' actions are as a result of how their marginal utility of revenue increases in the presence of periods of exchange rate uncertainty. This relative increase in exports during periods of earnings uncertainties may result in a more than proportional increase in the earnings from international trade and thus, compensate for the effects that exchange rate volatility brings.

Similar to most sub-Saharan developing economies, Ghana, Mozambique and Tanzania rely mainly on primary commodities exports to finance their imports and foreign exchange needs. But it is not unusual for such countries to experience sustained periods where export earnings are not able to meet import costs[18]. Thus exchange rate volatility may not necessarily depress trade significantly based on the reasons offered above but the long-run consequences should not be underestimated. Krugman (1989) argues that exchange rate volatility is expected to worsen if the expenditure switching effects that follows a nominal depreciation is not adequate to balance trade deficits. Osei-Assibey (2014) further explained that an undesired shock to exchange rate market (even if it is minimal) could further worsen terms of trade, thus making persistence in trade deficits a commonplace for such countries: Figure 1 in appendix show sustained deficits in external balance for the three countries for the period under consideration.

Persistent trade deficit problem is symptomatic of a nations' economic health and it is also widely believed to cause or worsen external debt. Esquivel and Larrain (2002) explained that for developing countries who are net debtors, a volatile domestic currency may affect the real cost of debt servicing. Available data for the period considered show that exports are insufficient in servicing external debts for all three countries [19]. Rosenberg (2003) explained that a sustained external debt burden in the long-run negatively affects domestic interest rates or the domestic currency's value. Since, in the long run, foreign investors would demand a higher risk premium to hold increasing claims on the debtor country's assets. The higher risk premium could either take the form of interest rates spread (both domestic and foreign) or a weaker domestic

[18] Relative to their manufactured imports, primary commodities have low elasticities, thus manufactures demand usually outstrips primary commodities exports. In addition, primary commodities exports are vulnerable to shocks from natural disasters and world demand conditions.

[19] Also, it is amply documented that developing economies use loans and favourable trade financing to finance trade deficits (See works by Movavcsik 1989, Radelet 2006 and Opoku-Afari 2007). Historical graphical representations of external debt as percentages of exports for the three countries are presented in Figure 2 of appendix.

currency[20], or both. Edward (2003) further provides evidence on the relationship between unsustainable trade deficits and currency problems.

For all three developing countries and their trade partners' considered we observe bilateral trade to increase with increasing income of trade-pairs: This observation is consistent with underlying economic theory and expectations. The paper observed diverse empirical findings on the relationship between country-pair population sizes and bilateral trade. Whereas country-pair population plays a significant and positive role on Ghana bilateral relationships it is observed that country-pair population sizes does not generally play a significant role on Tanzania bilateral trade relationship. In the case of Mozambique, we cannot justify using the explanation given by Martinez-Zarzosa and Nowak-Lehman (2002) in explaining a negative relationship between population size and bilateral trade. Although Mozambique is endowed with natural resources, the country does not have the means to become self sustainable as population increases: Among the three developing countries considered, Mozambique has comparably experienced sustained periods of civil strife[21] particularly in the period under consideration. It is therefore plausible that this civil strife could have impacted on their international trade relationships.

Distance and common language appear not to significantly impact on bilateral trade in all estimated fixed effects models (apart from Ghana when EWMA technique is used to generate volatility proxies). This empirical observation does not

[20] Figure 3 (in Appendix) illustrates year-on-year currency depreciations for the countries. Ghana, Mozambique and Tanzania respectively experienced average depreciations of 48%, 23% and 47% with highs of 307% for Ghana, 96% for Mozambique and 619% for Tanzania.

[21] For empirical evidence on how conflicts impacts trade, see studies by Awukuse and Gempesaw II (2005) as well as Martin, Mayer, and Thoenig (2008)

mean we should pre-suppose that these variables do not affect bilateral trade relationship; in fact, diverse findings on the relationships between distance and common language are observed for the three countries if we do not control for heterogeneity and events effects[22]. However several studies including Cheng and Wall (2005) argued against the reliability of estimates from standard cross sectional methods as they yield biased results since they do not cater for heterogeneity and other effects. Thus we can argue that the inclusion of the fixed and time effects components captured the effects of distance, common languages and other omitted observable and unobservable variables that might have contributed to trade relationships.

4. Conclusion

Exchange rate volatility is widely believed to potentially affect trade especially if a volatile currency induces uncertainty in import costs and export earnings. The empirical evidence from the extant literature however offers no consensus on this relationship. The diverse empirical findings on the trade-exchange rate volatility nexus have stimulated new debates and proposals. One of such proposals in the literature however appear to suggest that empirical findings are sensitive to a number of factors including the classification that a country falls (i.e. develop vs. developing); with the negative impact of exchange rate volatility on bilateral trade comparably more pronounced in studies involving developing economies: To examine if this hold for every developing country in all instances, the paper studied twenty-five year data between 1980 and 2005 for Ghana and compared results with Mozambique and

[22] It is observed that distance is significant in adversely affecting bilateral trade relationships for Ghana and Tanzania but not for the case of Mozambique. Also, estimated coefficients of common language are significant and negatively signed (irrespective of the volatility proxy used) for Ghana and its trade partners, significant and positively signed for Mozambique and its trade partners and not significant but positive for Tanzania and its trade partners (See Table 3 in appendix).

Tanzania. It is observed that the effect of exchange rate volatility on bilateral trade is not statistically significant for all three countries.

The empirical findings could be attributed to two main reasons: Firstly, as developing economies, the need to import finished products for local consumption as well as intermediate and capital goods for exports production dominated trade decisions. Secondly, adequately risk-averse traders knowing that such group of countries have the need to import may have increased their exports in periods of higher currency uncertainty to compensate for the negative effects that exchange rate volatility could potentially bring to their expected earnings. The empirical evidence presents challenges to policymakers in these countries especially if the two main reasons given above reinforce each other: This should result in increasing volume of trade even in the presence of higher currency volatility.

One of such challenges to governments and policymakers is the sustainability of external debt. These countries usually rely on loans, aid and trade-financing agreements to finance their imports as exports earnings are usually not enough to finance imports cost. A volatile domestic currency may not affect trade in the short-run but would definitely affect the real cost of debt servicing. It is therefore not surprising that these countries have experienced high and persistent external debts for decades: In fact, Ghana, Mozambique and Tanzania reached the completion point on Highly Indebted Poor Countries (HIPC) initiative in 2004, 1998 and 2001 respectively. Even after benefiting from the HIPC scheme, Ghana, Mozambique and to some extent Tanzania still have large stocks of debts to manage. Sun (2004) argues that most of the countries that got relief under the HIPC initiative still have structural weakness in their economies that can make them slip back into debt trap again. Currency management problems are also one of such many challenges that may result; because of the low income elastic nature of their exports a depreciation may not necessarily balance trade deficits making these countries to experience persistent trade deficits. Exchange rate volatility is expected to worsen if the expenditure switching effects that follows a nominal depreciation is not adequate to balance trade deficits. Thus, the persistent currency management problems that have become a bane and a commonplace for these three countries can be attributed to the vicious cycle of persistent trade deficits, currency depreciation and exchange volatility that ensues.

The useful policy lessons from the empirical findings may be obvious and debated widely but are more relevant than ever. In 2015, these countries are still facing external debt, deficits and currency problems even after enjoying a decade of stable and favourable commodity prices between 2000 and 2010. This is because the structures of their economies have largely remained the same. Thus it is advocated that their dependence on commodities exports should not be abandoned but should be complemented with long-term and well planned investments into some manufactures and services.

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Appendix

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

	Sub-Saharan Developing Country								
	Ghana			**Mozambique**			**Tanzania**		
	Volatility Model	$Dist_{ij}$	$D1_{ij}$	Volatility Model	$Dist_{ij}$	$D1_{ij}$	Volatility Model	$Dist_{ij}$	$D1_{ij}$
China	MA(1)-EGARCH(1,1)	19,038	0	NA	NA	NA	MA(1)-EGARCH(1,1)	10,984	**0**
EU-12	AR(1)-GARCH(1,1)	7,213	0	AR(1)-GARCH(1,1)	10,958	0	AR(1)-GARCH(1,1)	10,216	**0**
India	AR(1)-EGARCH(1,1)	13,296	1	AR(1)-EGARCH(1,1)	5,159	0	AR(1)-EGARCH(1,1)	4,630	**1**
Japan	MA(1)-EGARCH(1,1)	20,266	0	MA(1)-EGARCH(1,1)	NA	NA	MA(1)-EGARCH(1,1)	12,694	**0**
Nigeria	AR(1)-ARCH(1)	420	1	NA	NA	NA	NA	NA	**NA**
UK	AR(1)-ARCH(1)	7,252	1	AR(1)-ARCH(1)	12,556	0	AR(1)-ARCH(1)	11,845	**1**
US	ARMA(1,1)-ARCH(1)	8,622	1	ARMA(3,3)-EGARCH(1,1)	18,319	0	AR(1)-ARCH(1)	18,374	**1**

Table 2: Fixed Effects Gravity Estimation

	Estimated Coefficients								
	Ghana			Mozambique			Tanzania		
	ARCH	EWMA	AMV	ARCH	EWMA	AMV	ARCH	EWMA	AMV
Intercept	-520.842***	-528.286***	-535.635***	-588.747***	-595.326***	-530.780***	-249.750***	-247.506***	-268.344***
	(-5.989)	(-5.907)	(-6.339)	(-4.301)	(-4.352)	(-3.206)	(-2.897)	(-2.929)	(-3.574)
$LogGDP_{ijt}$	3.476**	3.296**	3.525***	23.854***	23.558***	25.364***	2.515***	2.446***	1.999***
	(2.595)	(2.450)	(2.733)	(6.740)	(6.490)	(6.439)	(4.518)	(4.412)	(3.357)
$LogPOP_{ijt}$	10.804***	11.196***	11.107***	-16.074**	-15.473**	-19.835**	4.232	4.330	5.538**
	(4.794)	(4.798)	(4.904)	(-2.456)	(-2.299)	(-2.238)	(1.549)	(1.631)	(2.258)
$LogDIST_{ijt}$	-0.536	-0.593**	-0.578*	0.608	0.603	0.627	-0.239	-0.242	-0.261
	(-1.526)	(-2.101)	(-1.678)	(0.239)	(0.243)	(0.217)	(-0.685)	(-0.481)	(-0.413)
$\log VOL_{ijt}$	0.212	-0.087	-0.112	0.127	0.133	0.042	-0.362	-0.034	0.017
	(1.206)	(-0.481)	(-0.752)	(0.366)	(0.513)	(0.644)	(-1.574)	(-0.169)	(1.396)
$D1_{ij}$	6.970	7.801	7.567	-21.319	-29.195	-30.997	3.711	3.762	4.142
	(0.525)	(0.766)	(0.723)	(-1.248)	(-1.263)	(-1.156)	(1.418)	(0.621)	(0.547)
R-Square	**0.846**	**0.844**	**0.849**	**0.872**	**0.871**	**0.872**	**0.829**	**0.820**	**0.845**
Observations	**26**	**26**	**26**	**25**	**25**	**25**	**26**	**26**	**26**

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

Table 3: Gravity Model Estimated by Standard Cross Sectional Method

	Estimated Coefficients								
	Ghana			Mozambique			Tanzania		
	ARCH	**EWMA**	**AMV**	**ARCH**	**EWMA**	**AMV**	**ARCH**	**EWMA**	**AMV**
Intercept	32.066*** (3.023)	31.083*** (2.904)	24.119** (2.210)	4.603 (0.234)	0.734 (0.044)	-18.465 (-1.486)	48.549*** (6.130)	54.048*** (7.088)	-66.980*** (9.156)
$LogGDP_{ijt}$	0.702*** (9.182)	0.699*** (9.241)	0.782*** (9.729)	0.877** (1.977)	0.801* (1.956)	0.653* (1.691)	1.267*** (9.653)	1.161*** (8.766)	1.083*** (7.549)
$LogPOP_{ijt}$	-0.617** (-2.345)	-0.590** (-2.206)	-0.510* (-1.938)	-0.136 (-0.304)	-0.041 (-0.103)	0.312 (0.861)	-1.303*** (-11.327)	-1.230*** (-10.526)	-1.309*** (-11.318)
$LogDIST_{ijt}$	-0.798*** (-2.882)	-0.752*** (-2.911)	-0.699*** (-2.967)	-0.715 (-0.373)	-0.343 (-0.206)	0.848 (0.664)	-3.908*** (-8.889)	-3.863 (-7.878***)	-4.206*** (9.683)
$\log VOL_{ijt}$	-0.185 (-1.141)	-0.147 (-0.795)	-0.061*** (-2.879)	0.475 (1.190)	0.367 (1.241)	-0.061 (-0.945)	-0.816*** (-3.459)	-0.413 (-2.082**)	0.009 (0.674)
$D1_{ij}$	-2.919*** (-6.161)	-3.008*** (-6.396)	-2.862*** (-6.135)	3.480*** (5.149)	3.513*** (5.242)	3.452*** (4.990)	0.371 (1.497)	0.341 (1.355)	0.409* (1.664)
R-Square	**0.474**	**0.474**	**0.498**	**0.656**	**0.656**	**0.654**	**0.671**	**0.653**	**0.672**
Observations	**26**	**26**	**26**	**25**	**25**	**25**	**26**	**26**	**26**

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

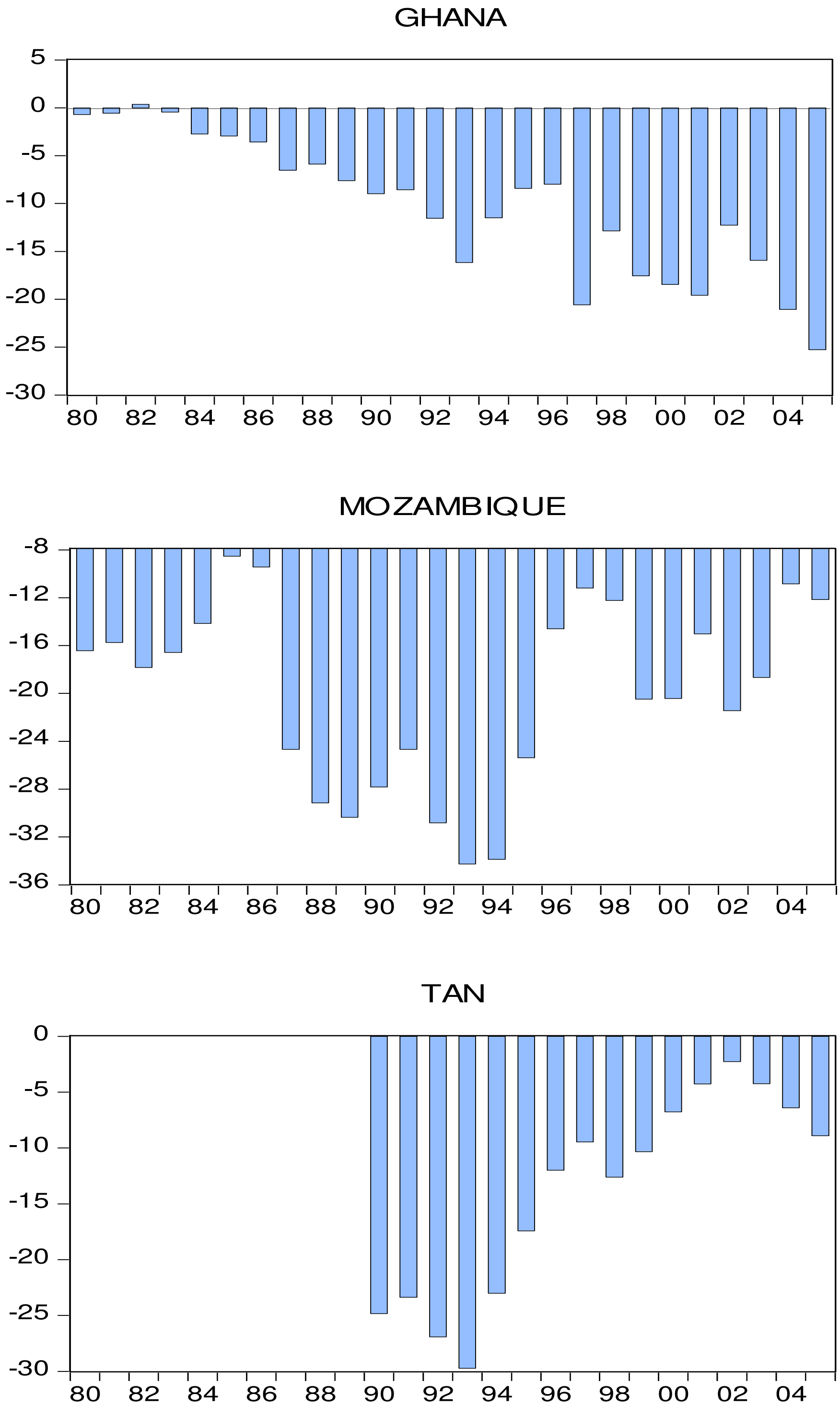
Table 4: Fixed Effects Cross-Sectional Intercepts

Trade-Partner	Sub-Saharan Country								
	Ghana			Mozambique			Tanzania		
	ARCH	EWMA	AMV	ARCH	EWMA	AMV	ARCH	EWMA	AMV
China	2.654	0.706	2.175	NA	NA	NA	-0.668	-6.767	-8.771
EU-12	-5.368	-5.116	-5.738	-23.859	-23.586	-25.165	NA	NA	NA
India	-15.671	-16.610	-16.333	63.241	61.946	70.676	-0.643	-0.657	-2.707
Japan	-7.217	-6.949	-7.338	NA	NA	NA	2.134	2.172	3.549
Nigeria	18.299	19.003	19.317	NA	NA	NA	NA	NA	NA
UK	15.720	16.291	15.911	-10.312	-9.619	-14.824	9.098	9.252	11.182
US	-8.417	-7.325	-7.994	-29.070	-28.741	-30.687	-3.922	-4.001	-3.252

Table 5: Time Specifics Intercepts for the Three Sub-Saharan Developing Countries and their Bilateral Trade Partners

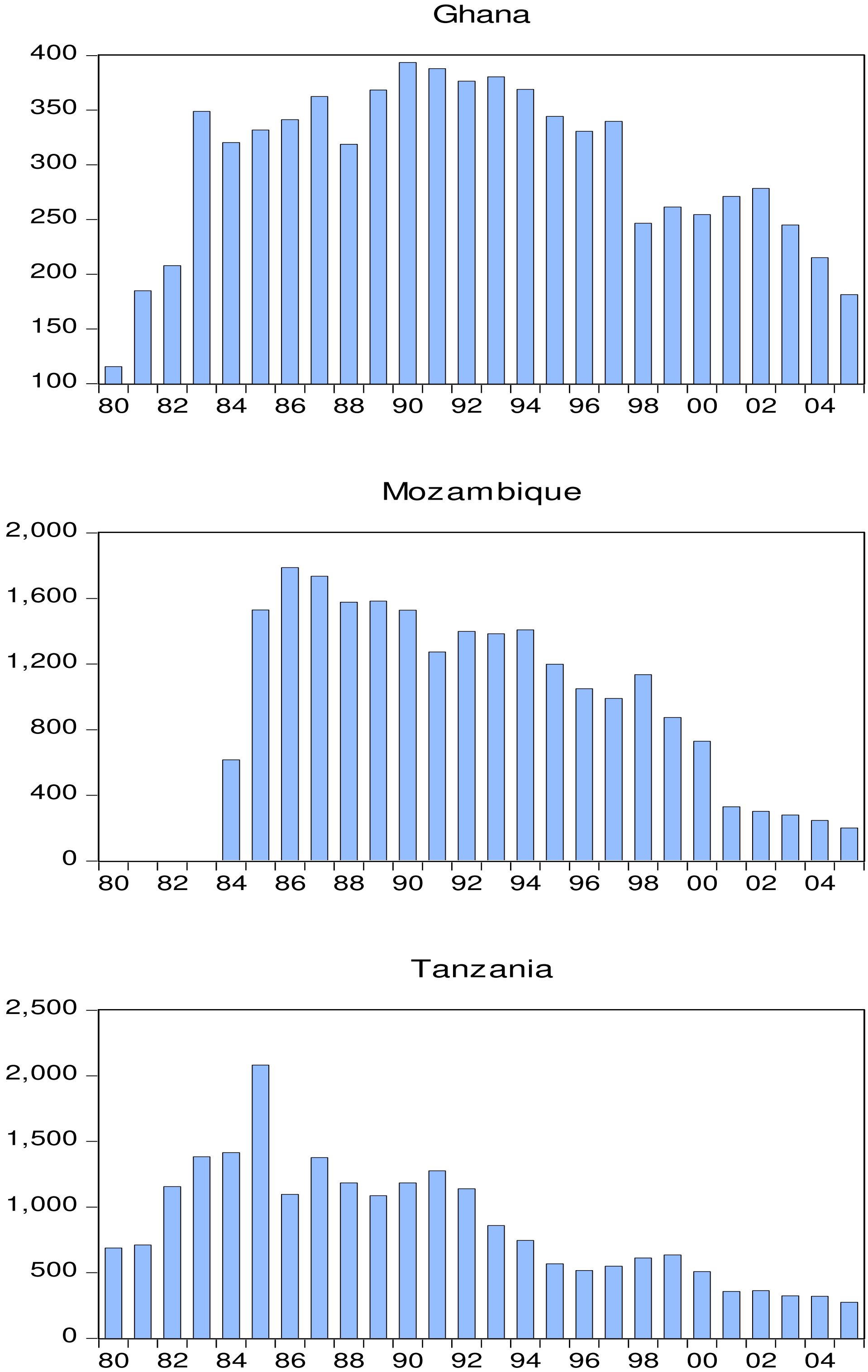
Year	Ghana			Mozambique			Tanzania		
	ARCH	EWMA	AMV	ARCH	EWMA	AMV	ARCH	EWMA	AMV
1980-- α_t	8.4289	8.771	8.459	-	-	-	5.481	5.700	5.222
1981-- α_t	7.615	7.827	7.852	15.446	15.346	15.939	4.964	5.167	4.884
1982-- α_t	7.202	7.338	7.397	17.421	17.286	18.128	4.481	4.535	4.225
1983-- α_t	4.379	4.508	4.564	20.261	20.094	21.234	2.244	2.259	1.953
1984-- α_t	3.746	3.887	3.935	20.089	19.927	21.109	2.940	2.895	2.537
1985-- α_t	3.794	3.931	3.968	18.934	18.827	19.953	1.894	1.875	1.516
1986-- α_t	2.915	3.215	3.215	18.083	17.926	19.147	1.488	1.410	1.016
1987-- α_t	2.682	2.900	2.768	13.923	13.783	14.664	0.874	0.918	0.745
1988-- α_t	1.154	1.342	1.231	11.434	11.346	11.807	0.149	0.218	0.043
1989-- α_t	0.792	0.988	0.957	9.517	9.442	9.803	0.161	0.232	-0.185
1990-- α_t	0.966	1.061	1.017	9.312	9.234	9.621	-0.499	-0.458	-0.867
1991-- α_t	-1.840	-1.694	-1.739	8.444	8.356	8.713	0.001	0.063	-0.387
1992-- α_t	-0.882	-0.667	-0.717	9.751	9.606	10.212	0.194	0.202	-0.252
1993-- α_t	-0.150	-0.037	-0.088	8.125	7.982	8.567	-0.233	-0.227	-0.717
1994-- α_t	-0.382	-0.357	-0.562	7.144	6.969	7.821	-0.198	0.006	-0.481
1995-- α_t	-0.924	-0.966	-1.061	5.791	5.615	6.521	-0.395	-0.061	-0.592
1996-- α_t	-1.517	-1.510	-1.622	4.718	4.550	5.477	-0.630	-0.452	-0.954
1997-- α_t	-2.225	-2.174	-2.267	1.271	1.152	1.976	-1.372	-1.276	-1.764
1998-- α_t	-2.764	-2.698	-2.822	-1.873	-1.953	-1.309	-1.616	-1.536	-2.021
1999-- α_t	-3.605	-3.340	-3.487	-4.361	-4.401	-3.817	-1.631	-1.577	-2.067
2000-- α_t	-4.323	-4.242	-4.393	-5.527	-5.587	-5.072	-2.464	-2.383	-2.850
2001-- α_t	-4.756	-4.703	-4.874	-8.292	-8.338	-7.9053	-2.730	-2.645	-3.108
2002-- α_t	-5.215	-5.195	-5.320	-9.448	-9.476	-9.0745	-3.059	-2.960	-2.964
2003-- α_t	-5.459	-5.431	-5.564	-11.330	-11.323	-10.988	-2.690	-2.596	-3.491
2004-- α_t	-5.563	-5.549	-5.698	-13.846	-13.809	-13.624	-2.705	-2.612	-3.590
2005-- α_t	-6.136	-6.141	-6.298	-15.450	-15.444	-15.283	-2.813	-2.698	-3.123

Figure 1: External Balances on Goods and Services (as a Percentage of GDP)



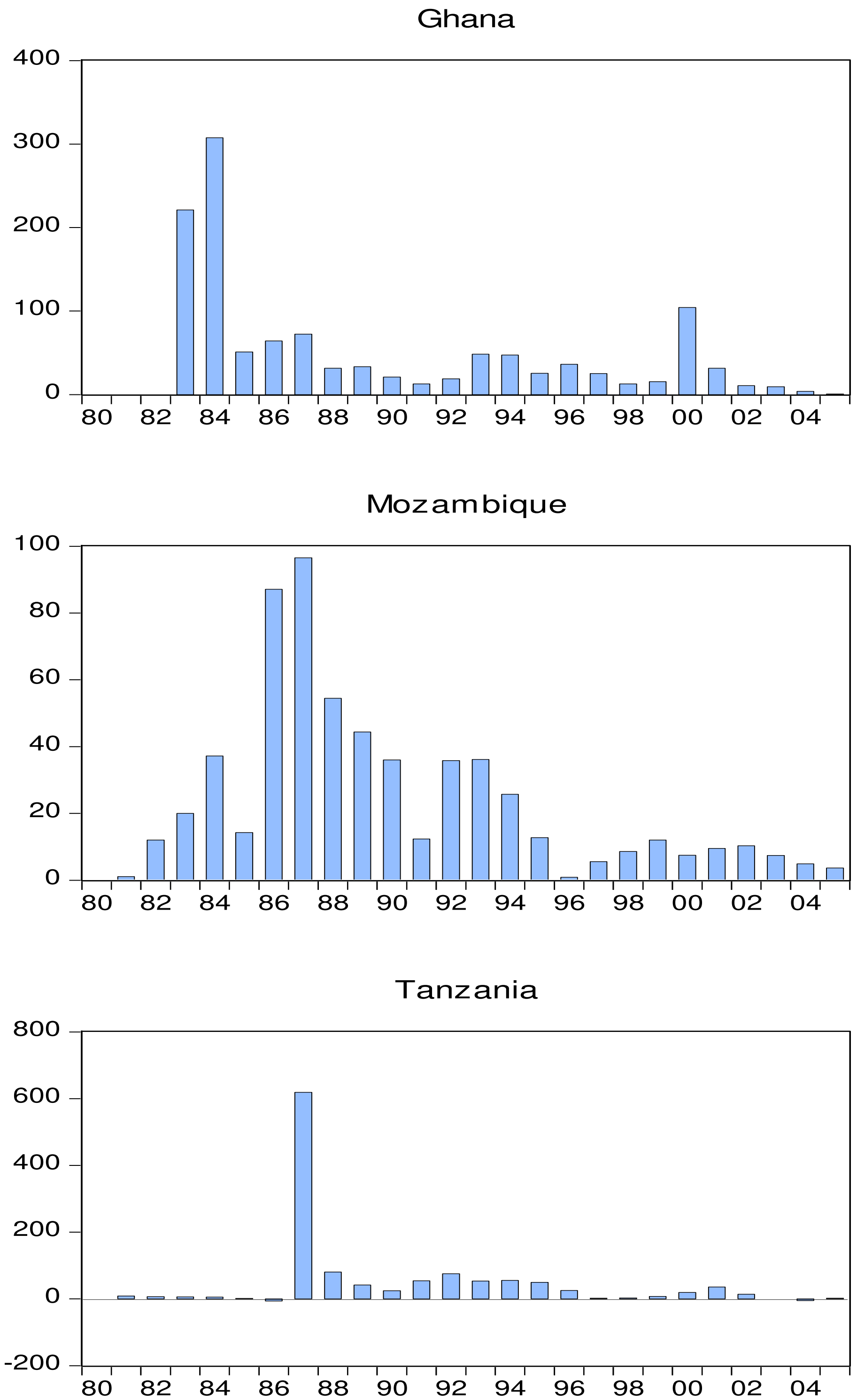
Source: World Bank Indicators

Figure 2: External Debt Stock (as a Percentage of Exports)



Source: World Bank Indicators

Figure 3: Year-on-Year Currency Depreciation



Source: Calculated from World Bank Indicators