Research Paper Commerce

The impact of exchange rate fluctuations on the agricultural export with reference to Sub Saharan African Countries.

Dr.Pentela Fareed Mastan

ABSTRACT

The abandonment of the fixed exchange rate systems created exchange rate movements a major hurdle among traders, policy makers and researchers. This study focuses on the impact of exchange rate fluctuations on the agricultural exports of Sub Saharan African countries. 29 sample SSA countries were selected for the period 1996-2008. Estimation is made using random effects model, difference generalized methods of moments (GMM) and systems GMM. Fluctuations of the official exchange rate of SSA countries was generated using GARCH (1,1) and ARCH models. The Standard gravity model augmented by variables which affect trade between SSA and major trading countries is estimated. Exchange rate fluctuations had significantly negative impact on agricultural exports of the SSA countries across the different estimation techniques. Trade policies which are designed to increase exports might create uncertainty in exchange rate and ultimately end up reducing exports. In conclusion, SSA countries should have a stable exchange rate policy.

KEYWORDS Gravity model, System GMM, ARCH, GARCH, Exchange rate fluctuations,

Introduction

Exchange rate liberalization was a major component of the economic reform programs of Africa in 1980s. The structural adjustment program led to the adoption of the flexible exchange rate regime. This resulted in huge surge in exchange rate ranging from 0.04% in 1973 to a staggering 150% in 2006 averaging 95% for the 1973-2006 periods. The export growth for Africa after the introduction of those changes plummeted from an annual average of 13.35%in

1970-79 to 4.26% in 1990-2006 (Omojimite et al 2010). One can perceive a link between the raise in exchange rate fluctuation and the decline on the growth in exports. The high degree of fluctuation and uncertainty of exchange rate movements since the beginning of the generalized floating in 1973 have led policy makers. and researchers to investigate the nature and extent of the impact of such movements on the volume of trade. However other reasons attributed to exchange rate fluctuation include increase in cross border flows witnessed by the increase in capital flows, the advancement in technology and currency speculation (IBID).

General objective:

Response of Sub Saharan African agricultural exports to the exchange rate fluctuations.

Specific objectives

To assess the impact of exchange rate fluctuation on the agricultural exports of

Sub Saharan African countries.

To estimate the magnitude of the impact of exchange rate volatility on the amount of agricultural export of Sub Saharan African countries.

Methods and Meterials: Data source

Secondary data is used for this study. The data type will be arranged in a panel set up for 29 Sub-Saharan African countries expanding for the period, 1996-2008. The data sets are obtained from the United Nation Commodity Trade Statistics (UNCOMTRADE) web site, the World Bank (WB) World Development Indicator (WDI) and International Financial Statistics (IFS) and countries web sites. The gravity model is used to investigate how the sub region's agricultural exports responds to the variabilities in exchange rate. Following Willenbloke et al. (2008), the empirical model is specified as follows

X= f (Y, Y, POP, POP_PARTNER, Dist., RFTA, VOL, CB, elc_cons, ,Sec_Schl, road_net)*,

Where X stands for Agricultural exports of Sub Saharan African countries;

Y is the total income of an exporting Sub Saharan African country.

*Y** represents the economic mass of trading partners which import the agricultural exports of SSA countries (five major trading countries trading)

Dist. is an abbreviation for distance between(capital cities and trading partners) sub Saharan African countries and the major trading partners. The distance data including a set of different distance and common dummy variables used in gravity equations to identify particular links between countries such as colonial past, common languages and common borders(CB), membership to a particular Regional free trade area (RFTA) etc. POP and POP_PARTNER refer to the total number of people living in the SSA and partner countries respectively.

Official exchange rate is used to estimate fluctuations of the respective countries' exchange rate by using ARCH (1, 1) and GARCH (1, 1) model. The standard gravity model is augmented by infrastructure indicator captured by the length of road network, road_net, a sub Saharan African country is covered and the power generating capacity of the nation proxied by the electric consumption figures (elc_cons). To control for the impact of education of a standard gravity equation, the paper tries to use the rate of school enrollment proxied by high school enrollment rate (*Sec_Schl)*.

Descriptive Analysis, Summary Statistics and Graphical Inspection

Graphical inspections provide the picture on how the variables of interest behave over time. Selected major variables are discussed using chart plots. When the of the SSA coutries fluctuations official exchange rate is drawn against the time period 1996 to 2008, most countries exhibit similar pattern. Except for few outliers like Nigeria, whose volatilities depict a very sharp rising and deep falling pattern. Most of the countries have fluctuation in logarithmic figures which oscillates between -0.5 to +1.5. This has to do with the fixed and managed floating exchange rate regime of SSA countries that anchors their currencies against a basket of major internation-

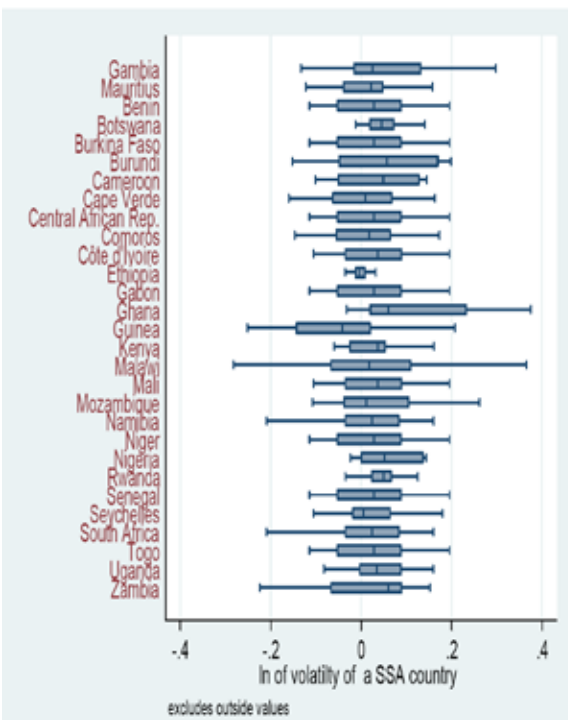
al currencies. Market forces of demand and supply play little role and therefore they tend to show similar pattern. Possibly, the Nigeria exception could be explained by the rapidly changing world price of petroleum for which Nigeria is the largest exporter of petroleum in the sub region.

The box plot of the logarithm of the fluctuation of the SSA countries plotted below depict a trend that is following a similar pattern for almost all countries between the upper and lower bounds.

Except Gambia, Ghana and Malawi which showed more dispersion of tail values of the fluctuation there is no much deviations within the countries of the sub region.

One exception that is vivid from the box plot is Rwanda, Botswana and Ethiopia. Those countries have fluctuation in logarithm which oscillates around zero. From the nature of the agricultural exports of Ethiopia being dependent on few agricultural products and the strict control over the exchange rate market, watching a less fluctuation exchange does not sound much of a surprise.

Figure-1FluctuationsinSSACountries



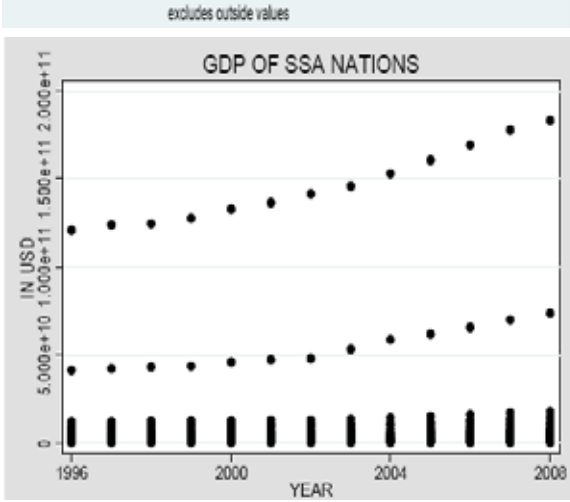


Figure-2GDPofSSACountires

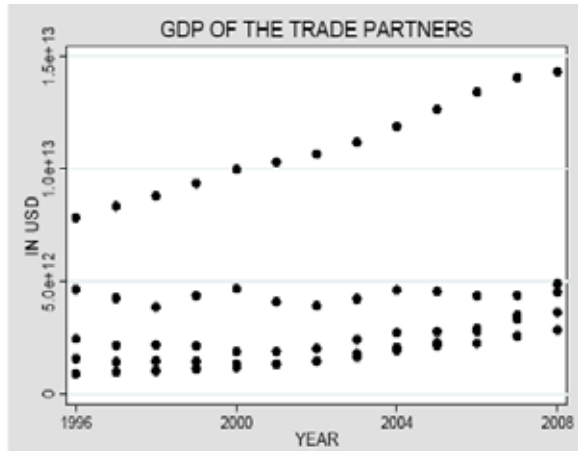


Figure-3GDPofpartnercountries

The summary statistics provides important information about the main variables of the model we are going to estimate. In the table below we report the summary statistics of the major variables of the model. Among the variables bilateral agricultural export has the highest variability with coefficient of variability of 5.35 and mean of 265 million.

All the variables are positively skewed except the distance between the capital cities of a country and its major trading partner. Bilateral agricultural export has more of its observation around its mean value, that is why it has the highest value of Kurtosis.

The JB test for normality is due Jarque and Bera (1980, 1981 and 1987). In statistics, the test is a goodness-of-fit measure of departure from normality. It is based on the sample kurtosis and Skewness.Jarque and Bera (1980, 1987) used the Lagrange Multiplier procedure to derive efficient joint tests for residual normality, homoscedasticity and serial independence.

$$LM = N\left[\frac{b_1}{6} + \frac{(b_2 - 3)^2}{24}\right]$$

Where, b1 and b2 are measures of sample skewness and kurtosis coefficient respectively, N is sample size. Jarque and Bera (1987) showed that the LM as asymptotically distributed as $\chi 2$ and a test based on the above equation is locally powerful.

The null is a joint hypothesis of both the skewness and excess kurtosis to be zero.

$H_0 : b_1 = 0$ and $b_2 = 3$

And the alternative hypothesis is

$H_1 : H_0$ is not true

The null hypothesis is rejected if the calculated statistic is greater than the appropriate

significance point of $X2$.

Estimation Frame work: Diagnostics and Estimation Procedure

Panel data enables one to study the dynamics of adjustment (see also Baltagi, 2005). More importantly panel data models provide more variation within the unit of analysis and/or between different size and characteristics of the cross sectional unit of analysis

Testing for fixed effects:
Since the analysis for this study focuses on a specific set of Sub Saharan African countries and their major trading partners and employs data with a relatively long time dimension, the fixed-effect estimator is considered as the most appropriate method. Hsiao (1999) notes that if the time dimension (T) of the panel is sufficiently larger than the cross-sectional dimension (N), then the fixed effects coefficients are consistent and asymptotically efficient.

Hausman and Taylor (1981) noted that an important benefit from pooling time-series and cross-section data is the ability to control for individual-specific effects, possibly unobservable, which may be correlated with the other included variables in the specification of an economic relation.

Following the cross-section panel over time, we can test this assumption. Moreover, the fact that the within, between, and GLS estimators are affected by the failure of this assumption suggests that we may base a test of it on functions of these statistics (Hausman and Taylor, 1981:1382)

Table – 1: Fixed vs Random effects model

Variables	Fixed	Random
lngdp	1.623***	1.018***
	-6.8	-10.75
lnpop	-0.026	-0.082*
	(-0.78)	(-2.56)
lnroad_net	-0.154***	-0.140***
	(-5.33)	(-4.73)
lnelec_cons	0.200**	0.250***
	-2.75	-4.16
lnsec_schl~l	0.262	0.473***
	-1.93	-5.87 o.
lndistcap	0	-0.523*
	(.)	(-2.29)
lnpop_part~r	1.53	0.109
	-1.1	-1.45
lngdp_part~r	0.235*	0.329***
	-2.05	-5.15 o.
comcol	0	0
	(.)	(.)
volatility	-0.001***	-0.001**
	(-3.69)	(-3.03)
Constant	-54.690*	-12.786***
	(-2.28)	(-5.11)
	R-squared	0.671
Number	295	295

The above is the estimated fixed effect model and random effect models. All the variables have the expected signs. The only variable with unexpected sign is the road network which captures the impact of infrastructure on growth of agricultural exports. Except the population of SSA countries and their trading partner's population all variables are significant at 5% level of

significance. The distance and common language variables are dropped since they are fixed across the observations.

In order to compare the fixed effect model against the random effect model, the econometric model is utilized by using the random effects estimation technique. Almost all the variables showed similar results with that of the fixed effects model. The interesting aspect is that the fixed variables in the previous model are now random with significant results.

Test:Ho:differenceincoefficientsnotsystematic
chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 9.12
Prob>chi2 = 0.2444

Since the tabulated value at 1% 7 d.f is 15.09. Since 9.12<15.09 and also the p-value is >0.01. We fail to reject the null hypothesis and hence stick to random effects Test for Heteroskedasticity

Breush and Pagan (1979) noted that in some applications of the general linear model, the usual assumption of homoscedastic disturbances and fixed coefficients may be questioned. The authors further argued that when these requirements are not met, the loss in efficiency in using OLS may be substantial and more importantly, the biases in the estimated standard errors may lead to invalid inferences (Breush and Pagan, 1979:1287). Heteroskedasticity does not affect the consistency of estimators, and it is only a minor nuisance for inference (Wooldridge, 2003:125).

For the random effects model heteroskedasticity is not a problem. However in order to correct the hetroskedastic nature of the model (if any), the data is clustered and bootstrapped. Comparing the standard errors of the bootstrapped model to the previous random effect model, we witness a significant reduction in the standard errors of our major variables.

Testing For Serial Correlations
When explanatory variables are not strictly exogenous, so that one or more explanatory variables are correlated to the error terms, neither t-terms from our equation nor the overall significance of the model are valid. We formally test for presence of the first order autocorrelation.

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
F(1, 59) = 97.662
Prob> F = 0.0000

The p-value is 0.000 which is less than 0.01. This makes us to reject the null hypothesis that says there is no first-order autocorrelation. We can conclude that there is no first order serial autocorrelation

Hausman Test forEndogenecity
By endogeneity we mean the correlation of the right-hand side regressors and the disturbances. This may be due to the omission of relevant variables, measurement error, sample selectivity, self-selection or other reasons. Endogeneity causes inconsistency of the usual OLS estimates and requires instrumental variable (IV) methods like two-stage least squares (2SLS) to obtain consistent parameter estimates (Baum, 2006).

Two reasons which make us to doubt the results from the fixed-effect estimation. The first is the potential problem of endogeneity. A sub Saharan country from our sample may take a policy measure aimed at increasing the amount of export through devaluing its currency. This creates an endogeneity problem (Willenbockel, 2008). Secondly, the inclusion of country-pair fixed-effect dummy variables could control for the potential endogeneity if the relative size of trade partners remains the same over the period considered (Dell'Ariccia, 1999).

The standard solution to a problem of correlation between the regressor and unobserved effects is to estimate by IV using appropriate set of instruments. A crucial prerequisite for IV estimation is that all instruments must satisfy two conditions:

(i) they must be correlated with the endogenous variables (instrument relevance); and (ii) they must be uncorrelated with the error term (instrument exogeneity).

Since GDP is highly correlated with exports and no correlation with the error term and distance is highly correlated to exports, but not correlated to error term. The instruments used are GDP and distance. Hence, distance fully satisfies instrument relevance and instrument exogeneity.

Endogeneity is formally tested using the endogeneity test of endogenous regressor. This is referred as Hausman test for endogeneity (see Hausman, 1978). The test statistic under Hausman (1978) is:

CHI^2 **(Q)=*(b-B)'[V_b-V_B) ^(-1)] (b-B)***

Where b = consistent under
H_0 and
H_1 ; obtained from IV regression

B = inconsistent under H_1 , efficient under H_0 ; obtained from OLS regression

Under Hausman test for endogeneity our model the null and alternative hypotheses are:

H_0 **:** difference in coefficients is not systematic
H_1 : there is a systematic difference in coefficients

After running the Hausman test we find the following results Test: Ho: difference in coefficients not systematic

chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= -1095.40

Here in all cases the calculated values are less than the tabulated value and in addition their p- value is greater than 0.01. Therefore, in all cases we can rule out the existence of endogeneity.

According to Arellano-Bond (1991), problem of endogeneity induced in the model by the predetermined variables could be handled by transforming the data taking the first difference of the lagged variable as instruments. By doing so, one can remove the impact of all fixed effect errors in the model. On the way the problem of endogeneity created by all lagged variables (predetermined values) will be taken care of. The second option is to instrument all the predetermined variables, as to Bond and Blundell (1998), with variables that are expected to be uncorrelated with all fixed effects. This method is referred as system generalized method of moments. At first, system GMM assumes that all the exogenous variables that are included in the model as possible explanatory variables are assumed to instrument themselves, whereas for all endogenous variables and predetermined values are instrumented with differences of the lagged values.

Roodman (2006) argues that, for random walk-like variables, past changes may indeed be more predictive of current levels than past levels are of current changes, as a result instruments generated from past changes that are utilized in system GMM. It provides system GMM instruments to be better representations for all endogenous variables, predetermined values as well. Representing lagged values, i.e. predetermined values, with best instrument gives estimates for these variables to capture all past time shocks to these variables. Therefore, system GMM is best estimator for simultaneous equation models which is endowed with an inherent problem of endogeneity of variables and the inclusion of lagged values as possible explanatory variables of a given model.

Hence the study used Arellano-Bond type of estimation to account for the effect of lagged values of the dependent variable and the endogeneity problem so created. The final results of the regression shall be discussed below.

Table – 2: Arellano bond estimation of difference and system GMM

Dependent variable lnagri_export	Abond Difference GMM	Abond System GMM
Independent variables	**Coef./P>t**	**Coef./P>t**
L1.lnagri_expo	0.9218	0.9618
	(0.0000)	(0.0000)
volatility	-0.0002	-0.0003
	(0.7710)	(0.0060)
lngdp	0.1040	0.0559
	(0.6700)	(0.0750)
lnpop	-0.0869	-0.0561
	(0.5680)	(0.0140)
lnroad_net	0.0129	-0.0074
	(0.8760)	(0.6770)
lnelec_cons	0.0564	0.0584
	(0.7180)	(0.0610)
lnsec_schl_enrol	-0.1175	-0.0885
	(0.5840)	(0.0240)
lndistcap	-0.2653	-0.1816
	(0.8420)	(0.1410)
lnpop_partner	-0.6020	0.0692
	(0.5270)	(0.2780)
lngdp_partner	0.4793	
	(0.3640)	
ABondtestAR(1) first diff z	-0.9	-1.97
Pr > z	(0.371)	(0.049)
ABondtestAR(2) first diff z	2.33	-1.97
Pr > z	(0.02)	(0.049)
Sargan test of overid chi2(43)	376.91	376.91
Prob> chi2	(0.000)	(0.000)
Hansen test of overid chi2(43)	63.24	74.99
Prob> chi2	(0.014)	(0.002)
Hansen test excluding group chi2(24)	51.81	63
Prob> chi2	(0.000)	(0.000)

All the variables in table 2 for A bond difference GMM estimations have coefficients and p- value which are insignificant and with wrong signs. The model crushes and fails since the estimates are insignificant and contrary to the expected signs.

Since estimates from the first differencing of the lagged dependent variable cannot explain the model, we resort to estimate the model using system GMM. The model is estimated using two step system GMM method. The result is given on the right side oftheTable.

Discussion on the Regression Result

According to Hayashi (2000), under the assumption of conditional homoscedasticity, Hansen's J statistic is consistent in the presence of heteroskedasticity and (for HAC-consistent estimation) autocorrelation, where a p-value result that is greater than 0.1 is typically considered passing. As shown in the Table 2, the instruments pass this test. For all the models under consideration, the Hansen J statistics is greater than 0.4. Hence it is safe to interpret the above table

The regression of the final system GMM estimates coefficient estimates that are consistent with the theory and previous studies. Exchange rate fluctuation has a negative influence on growth of the agricultural exports of SSA countries even though the magnitude is very minimal. A 1000% increase in fluctuation imparts a 0.2% reduction in the export of the agricultural goods to their major trade partners. This contrasts to the finding of Olayungbo et al (2011) who estimated systems GMM from 40 SSA African countries using 10 years data. They found out that a 10% increase in exchange rate fluctuation led to 0.2% raise in the export of primary commodities. The estimation was made across three different

categories of products namely aggregate, primary and manufactured goods where all categories of goods showed positive responses to exchange rate volatilities.

GDP is positively related with the agricultural exports and is significant at 10%. The increase in the population is the same as increase in local consumption therefore the result which is significant at 5% is negatively related to the agricultural exports. The distance between a sub Saharan country and its trading partner is a structural variable in the gravity equation. In our equation in the estimate demonstrated above has a theoretically consistent negative sign. However, it is insignificant.

From the standard gravity equation, all variables are significant except population of the partner nations and have the right sign. In addition to the gravity variables, there were control variables which further are included in the estimation. The consumption of electricity which shows infrastructure availability is significant and positively correlated with the agricultural exports of the SSA. Education captured by secondary school enrollment is negatively correlated with agricultural exports and marginally significant. Probably education might reduce the labour force from the agricultural sector and hence the negative correlation.

Conclusions

The result on the impact of exchange rate fluctuations on agriculture exports found to be negative and significant. This will reduce their activities; switch sources of supply and demand change prices in order to maximize their exposure to effect of exchange rate risk. This , in turn can alter the distribution of output across many sectors in the concerned coutries.

A second and major policy implication is that, if the problem of exchange rate fluctuation is not solved, trade adjustment program which are under implementation in these countries may lose their appeal to the policy makers of SSA countries ending in a serious balance of payments crisis.

Thirdly, since the data used is of shorter years(thirteen years data were used) and most SSA countries are still in the fixed to managed fixed policy regimes, the history of exchange rate fluctuation is still very short in SSA countries compared to developed countries. Therefore, its impact on the macro variables in these countries might not yet be substantial.

Recommendation

The adverse effect of exchange rate fluctuation on exports calls for policy actions to tackle rising exchange rate volatility. Especially monetary policy instruments should be used to curtail these shortcomings. The monetary authorities should adopt a mechanism that will lead to the stability of the exchange rate. Erratic changes in the exchange rate have a long-term negative effect on production of agricultural exports.

The design and implementation of trade and exchange-rate policies in SSA countries should benefit from knowledge of both the existence and the degree of foreign exchange-rate fluctuation. It is clear that policy actions aimed at stabilizing the export market are likely to generate results that are, at best, uncertain, if policy makers ignore the stability, as well as the level, of exchange rate. On the other hand, given the high rate of inflation, an exchange-rate policy by itself would not eliminate all exchange-rate volatility; therefore, policy makers should also pay attention to fiscal policy.

Further studies are warranted with primary data substantiated with secondary data and qualitative study.

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