Does Exchange Rate Volatility Harm Exports?
Empirical Evidence from Kenya's Tea and Horticulture Exports

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ABSTRACT

The study investigates the impact of real exchange rate volatility on Kenya's exports of horticulture and tea in an export demand framework which also includes relative prices which is a measure of competitiveness and foreign incomes capturing foreign economic activity. The study applies cointegration techniques and error correction modelling to Kenyan monthly data over the post-liberalization period, from 1997:01 to 2007:9.

The results indicate the existence of long-run relationships and show that real exchange rate volatility has negative effects both in the short-run and the long-run. In the long-run or cointegrating equations, the foreign income elasticities turn out to be around unity, that is, 1.19 for horticulture and 1.03 for tea while the relative price elasticities are -1.28 for horticulture and -0.53 for tea. The results demonstrate the important role played by exchange rate volatility as it is shown to have adverse effects on horticulture and tea in the long-run with elasticities of -0.02 for tea and -0.33 for horticulture. Results from the long-run estimations are corroborated by the short-run dynamics derived from the error correction models, showing that exchange rate volatility has significant negative effects in the short-run and that the foreign income and relative price variables remain highly significant. Therefore, there is need to pay greater attention to exchange rate volatility by effectively monitoring movements in the exchange rate. It is also clear from these results that export growth has benefited a lot from the recent expansion in global economic activity and the consequent upward pressure on world commodity prices, thus implying that the recent export boom is to some extent driven by external factors that fall outside the sphere of influence of local policy makers.

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1.0 INTRODUCTION

A large number of recent studies focus on effects of exchange rate volatility. For instance, Arize, Osang and Slottje (2004) investigate the impact of real exchange rate volatility on the export flows of eight Latin American countries over the quarterly period 1973-1997. The results show that increases in the volatility of the real effective exchange rate exert a significant negative effect upon export demand in both the short-run and long-run. The long-run elasticities range from a low of 0.10 in the Dominican Republic to a high of 0.69 in Venezuela, implying that exchange rate volatility exerts a significant adverse long-run effect on export volume.

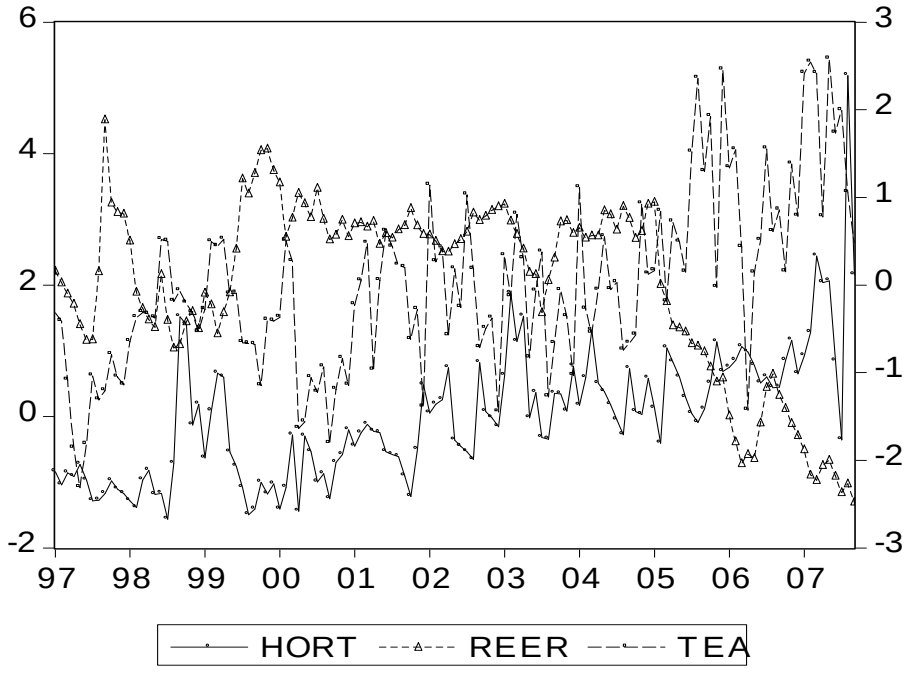
Cameron, Kihangire and Potts (2005) investigated the effects of exchange rate variability on Uganda's tropical freshwater fish exports. The empirical evidence suggests that Uganda's exports of fish were negatively and significantly correlated with exchange rate volatility. Similarly, Vergil (2005) investigates the impact of real exchange rate volatility on the export flows of Turkey to the United States and its three major trading partners in the European Union for the period 1990:1-2000: 12. The exchange rate volatility measure is negative for all countries and is significant at 1% level for France and Germany and at 10% for the U.S. The results obtained provide evidence that the real exchange rate volatility has a significant long-run effect on real exports. Frey (2005) also finds significantly negative coefficients for the exchange rate uncertainty measure in the case of Canada, the United Kingdom and the United States. In the case of Canadian pork and live swine exports, Fabiosa (2002) finds that the volatility of the exchange rate has a negative impact.

Turning to the movements of the Kenya shilling exchange rate, it can be argued that the Kenya shilling exchange rate has gone through various cycles. The shilling depreciated by 78.2% in January 1995 to October 2000 followed by a period of relative stability (October 2000 to November 2004). Recently however, the shilling has experienced a strong appreciation.

The large swings in the shilling exchange rate are also associated with varying degrees of volatility. Volatility was highest during the period just after liberalization, that is, January 1995 to October 2000 and lowest in the period from October 2000 to November 2004. Since then, however, the shilling experienced prolonged appreciation in nominal and real terms up to the end of 2007. The fluctuation in the exchange rate has attracted public attention especially from exporters who have argued that the strengthening shilling is eroding their competitiveness.

In addition to the developments in the shilling exchange rate, there has been a significant change in export earnings. Export earnings have been on an upward trend since 2002 and more so in 2005-2007 when the Kenya shilling appreciated steeply (figure 1, drawn using normalized data).

Figure 1: Movements in the Kenya Shilling Real Exchange Rate (REER, Horticulture (HORT) and Tea (TEA) Exports



In short, owing to external developments and large capital inflows in Kenya, the shilling exchange rate experienced, in the recent past, prolonged appreciation in nominal and real terms. Yet export earnings have continued to rise in volume and value terms, making it difficult to conjecture the impact of exchange rate movements on export growth. Does it mean for example that exchange rate movements have had little impact on exports? Should the authorities ignore exchange rate volatility, which has been shown to impact negatively on export growth elsewhere? Despite the concerns raised by exporters and policy makers alike, very little analysis is available to guide policy decisions, particularly on the relationship between exchange rate movements and export growth in Kenya.

The rest of the paper is organized as follows. Section 2 discusses the methodology applied together with a description of data and data sources. Section 3 presents the results, including unit root tests, cointegration and error correction model results. Section 4 concludes the study.

2.0 MODEL SPECIFICATION

The approach followed in this study is in line with the traditional framework for analyzing the demand for commodity exports as set out by Goldstein and Khan (1978) and applied by, among others, Chowdhury (1993), Arize (1995) and Arize, Osang, and Slottje (2000).

The export demand framework postulates a long-run relationship between exports, foreign economic activity, relative prices and exchange rate volatility and can be written as follows.

$$lnX_t = \alpha + \beta_1.lnY_t + \beta_2.lnP_t + \beta_3.V_t + \varepsilon_t \quad \text{.....1}$$

Where, X_t is export volume or real exports, Y_t is foreign incomes proxied by the industrial production index of industrial countries, P_t is export prices relative to world non-fuel primary commodity prices and ε_t is a disturbance term. V_t is a

measure of risk or uncertainty given by the 12-month moving average of the standard deviation of absolute changes in the real effective exchange rate. Several studies use such a time varying measure of exchange rate variability to account for periods of high and low exchange rate volatility (see, Chowdhury, 1993; Lastrapes and Koray, 1989; Kenen and Rodrik, 1986 and Arize et al, 2000) and define volatility as follows.

$$V_t = \left[(1/m) \sum_{i=1}^{m} (\log R_{t+i-1} - \log R_{t+i-2})^2 \right]^{1/2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

Where V_t is exchange rate volatility, m (=12 in this case) is the order of the moving average, and R_t is exchange rates.

It is expected that higher foreign incomes would create more demand for the country's exports. On the other hand, a decline in relative prices reflects increased competitiveness and hence higher demand for exports. The expected coefficient signs are therefore positive for foreign incomes and negative for relative prices. The sign on the exchange rate volatility coefficient is however indeterminate. Theoretically, exchange rate volatility is a source of risk and uncertainty which tend to impact negatively on risk averse traders or exporters, thus reducing exports. On the other hand, it has been argued that if traders anticipate the exchange rate movements better than the average foreign exchange market participant then they would gain from their better knowledge and thus be able to offset the adverse effects of exchange rate uncertainty. There is thus a possibility that exchange rate uncertainty could increase rather than decrease exports. Therefore, the sign on β_3 is determined empirically rather than by theory.

Equation 1 is considered the long-run or equilibrium relationship based on the assumption that desired (unobserved) exports equal actual (observed) exports in the long-run. In this paper, the Johansen multivariate approach introduced by Johansen (1988) is applied in order to establish the existence of a long-run or equilibrium relationship and the maximum eigenvalue statistic is used to test for the existence of cointegration.

Upon confirmation of existence of cointegration among the variables, an error correction model is estimated to capture the short-run dynamics and is as follows.

$$\Delta \ln X = \alpha_0 + \alpha_1 ECM + \sum \beta_i \Delta \ln X_{t-i} + \sum \gamma_i \Delta \ln Y_{t-i} + \sum \tau_i \Delta \ln P_{t-i} + \sum \phi_i \Delta V_{t-i} + \varepsilon_t$$

…………………………………………………………………………………….. 3

Where ECM is the error correction term or the residual from equation 1 and X, Y, P, V and ε_t are as defined above.

2.1 DATA SOURCES

The data used in this study is obtained from different sources. Export volumes and prices of tea and horticulture and the real effective exchange rate are obtained from the Central Bank of Kenya database. Export volumes are given in tons while export prices are in US dollars. The real effective exchange rate is computed through a weighting process, weights being dependent on the importance of the export destination country.

The other source of data is the International Financial Statistics (IFS) of the IMF. From this source we obtain the world non-fuel commodity prices which together with export prices are used to derive relative prices (being export prices divided by world non-fuel commodity prices) for both commodities. This source also provides us with the industrial production index of industrial countries.

3.0 EMPIRICAL RESULTS

3.1 COINTEGRATION RESULTS

Before testing for the existence of cointegration among the variables of interest in the study, unit root tests were carried out using Dickey-Fuller tests. As shown in

table 1 below, the tests suggest that real exports, foreign real incomes, relative prices, and exchange rate volatility are integrated of order 1 or nonstationary for that matter. This provides the impetus to proceed and perform cointegration tests using the maximum eigenvalue likelihood ratio test statistic. Monthly data spanning the period from 1997:1 to 2007:9 was used.

Table 1: Time Series properties of the Variables: Unit Root Tests

Augmented Dickey-Fuller Tests	Series					
	X_t		Y_t	P_t		V_t
	Horticulture	Tea		Horticulture	Tea	
Level	-0.88	-2.51	-1.27	-1.64	-2.71	-2.63
First Difference	-7.43	-7.99	-12.05	-7.99	-5.03	-4.77

Notes: Mackinnon critical values at 5% level of significance is -2.88 and -3.48 at 1% level

Given that we have four variables, there can be three cointegrating vectors and so we test the null hypothesis that $r = 0$, $r \leq 1$, $r \leq 2$, and $r \leq 3$. The results, reported in tables 2 and 3 indicate one cointegrating equation for horticulture and similarly, one for tea.

Table2: Multivariate Cointegration Test Results for the Horticulture Equation

Null	Eigenvalue Statistic	Likelihood ratio statistic	5% critical value
$r = 0$	0.213	43.94*	39.89
$r \leq 1$	0.054	14.53	24.31
$r \leq 2$	0.045	7.70	12.53
$r \leq 3$	0.016	1.98	3.84

Notes: * = significant at the 5% level

Table 3: Multivariate Cointegration Test Results for the Tea Equation

Null	Eigenvalue Statistic	Likelihood ratio statistic	5% critical value
r = 0	0.194	44.18*	39.89
r ≤ 1	0.073	17.71	24.31
r ≤ 2	0.060	8.31	12.53
r ≤ 3	0.006	0.71	3.84

Notes: * = significant at the 5% level

Normalizing the cointegrating vector with respect to horticulture and tea real exports respectively results in the following cointegrating relationships.

$lnX_t = 1.19*lnY_t – 1.28*lnP_t – 0.33*V_t$ ……2
(Long-run demand function for horticulture)

$lnX_t = 1.03*lnY_t – 0.53*lnP_t – 0.02*V_t$ ……..….3
(Long-run demand function for tea)

The results suggest that the exchange rate risk variable has negative long-run effects on real exports of tea and horticulture with elasticities of -0.02 and 0.33 respectively. The responsiveness to exchange rate risk is therefore higher for horticulture.

Long-run foreign income elasticities are around unity for both tea and horticulture; 1.03 for tea and 1.19 for horticulture, implying that export responsiveness to income is comparable in both cases.

The relative price elasticities however, differ markedly; elastic for horticulture (1.28) and inelastic for tea (0.53). The responsiveness to price changes is therefore higher for horticulture.

3.2 ERROR-CORRECTION MODELS

The finding that there is one cointegrating vector for each export category implies that it is possible to formulate and estimate error correction models to capture the short-run and long-run dynamics of real exports of tea and horticulture. Error correction models were therefore estimated and results reported in table 4. The estimation period for the error correction model for the horticulture equation is 1997:10 to 2007:6 while for tea the period covered is 2002:01 to 2007: 09. For each export category, the analysis began with 5 lags of the regressors which were then reduced sequentially by eliminating the insignificant lags based on the Akaike AIC criteria to achieve a more parsimonious model.

Table 4: Regression Results - Error Correction Models

	Export Demand Equations	
Variable	Horticulture Equation (1997:10-2007:06)	Tea Equation (2002:01-2007:09)
C	0.007(0.447)	-0.0418(-1.776)
$\Delta \ln X_{t-1}$	-0.122 (-1.509)	-0.189 (-1.937)
$\Delta \ln P_t$	-0.922 (8.935)	-0.921 (-1.546)
$\Delta \ln Y_t$	1.354 (3.913)	
$\Delta \ln Y_{t-1}$	0.829 (2.396)	
$\Delta \ln Y_{t-5}$		1.366 (3.286)
ΔV_t	-0.169 (-2.753)	
ΔV_{t-5}		-0.178 (-2.323)
Dum1(*sept-oct2001=1, zero otherwise*)	-0.447 (-1.939)	
Dum 2 (*Nov-Dec 2002=1,*	-0.163 (-2.733)	

zero otherwise)

ECM	-0.163 (-2.733)	-0.62 (-4.71)
	Summary Statistics R^2= 0.65, R^2_{adj}=0.63 DW = 2.00 Serial Correlation, F=1.04 (0.36) Normality, Jarque-Bera =0.64 (0.72) Heteroskedasticity, F=3.27(0.00)	*Summary Statistics* R^2= 0.56, R^2_{adj}=0.53 DW = 2.09 Serial Correlation, F=1.13 (0.33) Normality, Jarque-Bera =0.4 4 (0.80) Heteroskedasticity, F=3.86(0.00)

The estimated models pass the diagnostic tests such as normality, serial correlation, and stability tests (Ramsey Reset test, cusum and Cusum of squares). The residual series passed normality Jarque-Bera test. Serial correlation was ruled out in both models with the Breusch-Godfrey LM test. Stability was ascertained using cusum, cusum of squares and Ramsey Reset tests. Since there was evidence of heterokedasticity in the residual series, this was corrected to achieve heteroskedasticity consistent error terms and covariance. The adjusted R^2 is high in both cases; 0.63 for horticulture and 0.53 for tea.

The long-run equilibrium relationships are once again confirmed by the significant negative coefficient of the error correction term (which is the residual from the cointegrating equation). The error correction term is significant at 1% for both tea and horticulture. The coefficient of the error correction term is -0.16 for horticulture and -0.62 for tea implying faster adjustment towards equilibrium for the latter. These results imply that 16% and 62% of adjustment toward equilibrium (or elimination of disequilibrium) occurs in one period for horticulture and tea, respectively.

Of particular interest in this study is the exchange rate risk variable which is found to be highly significant for both export categories and the elasticities turn out to be

comparable; 0.17 for horticulture and 0.18 for tea. For horticulture, the relative price and foreign incomes are highly significant while in the case of tea, the income variable is highly significant, with the relative price variable being relatively less significant.

In brief, the results from the error correction models suggest that whereas the exchange rate risk variable has significant negative short-run and long-run effects on exports, the foreign income variable exerts significant positive short-run and long run effects.

4.0 CONLUSIONS

This study was motivated by concerns among policy makers and exporters over the recent fluctuations in the Kenya shilling exchange rate. The study covers the post-liberalization period (1997:1-2007:09) and examines the short and long-run effects of exchange rate volatility on Kenya's major export commodities, namely tea and horticulture using cointegration and error correction modelling approaches.

The results show that exchange rate volatility has significant negative short and long-run effects on Kenya's real exports of tea and horticulture. The elasticity with respect to the exchange rate risk variable is found to be -0.02 for tea and -0.33 for horticulture implying higher sensitivity of horticultural exports to exchange rate volatility. It is also shown that the price and income elasticities for horticulture are -1.28 and 1.19 respectively while for tea, the price and income elasticities are -0.53 and 1.03.

The results emphasize the need to monitor exchange rate volatility and to adopt appropriate monetary and fiscal policies to ensure stability in exchange rates. Although exporters and policy makers alike have often been preoccupied with the recent steep exchange rate appreciation, focus needs to shift to exchange rate volatility and support towards reforms that enable exporters to hedge against exchange rate risk such as developing forward and futures markets which basically

represent long-term solutions. In the short-run however, the pursuit of appropriate fiscal and monetary policies to counter volatile short-term capital inflows would help reduce effects of such inflows on exchange rates.

Finally, the finding that foreign incomes and relative prices have significant effects on real exports implies that export growth could be driven by factors which are beyond the control of local policy makers. This implies that external developments are important in influencing export performance. Though capital inflows are driven by both push and pull factors, recent inflows to Kenya are considered to be growth-related thus suggesting a role for pull factors. This is however an area for further research especially the need to determine whether the source of exchange rate movements determines its impact on exports.

REFERENCES

Arize, A.C. (1995); "The Effects of Exchange Rate Volatility on U.S. Exports: An Empirical Investigation", *Southern Economic Journal*, Vol. 62, No. 1, pp. 34-43.

Arize, A.C; T. Osang and D.J. Slottje (2000); "Exchange-Rate Volatility and Foreign Trade: Evidence from Thirteen LDC's", *Journal of Business & Economic Statistics*, Vol. 18, No. 1, pp.10-17

Arize, A.C.; T. Osang and D.J. Slottje (2004); "Exchange Rate Volatility in Latin America and its Impact on Foreign Trade", College of Business and Technology, Texas A&M University, Texas.

Batten, S.D. and M.T. Belongia (1984); "The Recent Decline in Agricultural Exports: Is the Exchange Rate the Culprit?", Federal Reserve Bank of ST. LOUIS, October.

Behar, A. and L. Edwards (2005); "Estimating Elasticities of Demand and Supply For South African Manufactured Exports Using a Vector Error Correction Model", School of Economics, University of Cape Town.

Cameron, S.; D. Kihangire and D. Potts (2005); "Has Exchange Rate Volatility Reduced Ugandan Coffee Export Earnings?" Bradford Centre for International Development (BCID), University of Bradford, Bradford, BD7-1DP, U.K.

Chowdhury, A.R (1993); "Does Exchange Rate Volatility Depress Trade Flows? Evidence from Error Correction Models", *The Review of Economics and Statistics*, Vol. 75, No. 4, pp. 700-706.

IMF (2004); *Exchange Rate Volatility and Trade Flows- Some New Evidence*, International Monetary Fund, Washington, USA, May.

Fabiosa, J.F. (2002); "Assessing the Impact of the Exchange Rate and Its Volatility on Canadian Pork and Live Swine Exports to the United States and Japan", Working paper 02-WP 305, Center for Agricultural and Rural Development, Iowa State University, Iowa, June.

Frey, R. (2005); "Exchange Rate Volatility and International Trade- Some GARCH Estimations Stress the Importance of Trade Diversification", International Economics, Rockstock University, Germany

Goldstein, M. and M.S. Khan (1978); "The Supply and Deamnd for Exports: a Simultaneous Approach" *Review of Economics and Statistics*, pp. 275-86.

Gouws, A.R. (2005) "A South African Export Model", University of Pretoria.

Johansen, Soren (1988); "Statistical Analysis of Cointegrating Vectors", Journal of economic Dynamics and Control, pp. 231-54.

Kenen, P. and D. Rodrik (1986); “Measuring and Analyzing the Effects of Shrot-term Volatiltiy in Real Exchange Rates”, *The Review of Economics and Statistics*, 52, pp. 169-210.

Lastrapes, W.D.,and F. Koray (1990); “Exchange Rate Volatility and U.S. Multilateral Trade Flows”, *Journal of Macroeconomics*, 12, pp. 341-362

Vergil, H. (2002) “Exchange Rate Volatility in Turkey and its Effect on Trade Flows”, *Journal of Economic and Social Research* 4(1), 83-89.

Warr, P.G. and F.J. Wollmer (2005) “The International Demand for Thailand’s Rice Exports”, Australian National University