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Full Length Research Paper

Effects of Exchange Rate Volatility on French Beans Exports in Kenya

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In Kenya, exports of French beans are one of the leading foreign exchange earners. Nevertheless, the economic impacts of exchange rate volatility on French beans exports in Kenya are unclear. This paper evaluates the magnitude and direction of the effects of exchange rate volatility on French beans exports from Kenya to its major trading partners in the European Union using monthly data from January 1990 to December 2011. The generalized autoregressive conditional heteroscedasticity model was employed to measure exchange rate volatility. The analytical framework used encompasses estimation of an export demand model, cointegration and specification of an error correction model. The results reveal a negative and significant short and long run effect of exchange rate volatility on French beans exports. Specifically, the empirical results show that a unit increase in exchange rate volatility in Kenya leads to more than proportionate decrease in French beans exports to the European Union. The paper recommends firms to hedge their currency exposures in the short run and implementation of economic policies aimed at stabilizing the exchange rate in the long run to improve Kenya's export performance.

Keywords: exchange rate volatility, exports, cointegration, error correction model, time series, GARCH model

INTRODUCTION

The French beans sub-sector contributes significantly to the growth of the Kenyan economy since it generates foreign exchange earnings and creates employment opportunities. The crop is the second largest vegetable export in Kenya after the Asian vegetables and supports more than 1 million people with 34 percent of the produce destined mainly for the European Union export market (Horticultural Crops Development Authority, 2011). French beans exports contribute to over 60 percent of all exported vegetables and approximately 21 percent by value of the horticultural export earnings (HCDA, 2011).

The term variability refers to the extent to which an economic variable, such as a price or an exchange rate, moves up and down over time in relation to its mean (Harwood *et al*., 1999). Volatility represents the directionless variability of an economic variable as represented by the dispersion of that variable within a given time horizon (Prakash, 2011). In mainstream economic theory volatility connotes two principal concepts: variability and uncertainty (Prakash, 2011). Where variability represents the overall movement and uncertainty refers to unpredictable movement. An exchange rate is the price of a foreign currency unit in terms of the domestic currency units. The measurement is therefore Local Currency Unit (LCU) divided by foreign currency (Sadoulet and de Janvry, 1995).

There are fixed and floating exchange rate systems. Fixed exchange rates are meant to be fixed for a specified period of time. On the other hand, floating exchange rates move up and down from year to year, week to week, and minute by minute (Clark *et al*., 2004). Under a fixed exchange rate regime, the rise and fall of the exchange rate are referred to as exchange rate devaluation and exchange rate revaluation (Sadoulet and de Janvry, 1995). There are a wide variety of factors that influence the exchange rate, such as interest rates, inflation, and the state of politics and the economy in each country (Pugel, 2007).

Exchange rate volatility refers to the extent to which prices of currencies tend to fluctuate over time (Cote, 1994). The measure captures the uncertainty due to unpredictable fluctuations in the exchange rates. Thus a volatile exchange rate is characterized by or prone to sudden change and is therefore unpredictable. 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 (Cote, 1994). Volatility in exchange rates cannot be ignored in the exchange markets as both importers and exporters

of goods and services are affected by exchange rate risk (Cote, 1994). A floating exchange rate may or may not be volatile depending on how much it changes over time. Since floating exchange rates are free to change, they are generally expected to be more volatile (Clark *et al*., 2004). Conversely, given that fixed exchange rates are not supposed to change as per definition, they have no volatility. Nevertheless, fixed exchange rates are frequently devalued or revalued, implying that they can change over time and may also be volatile.

Exchange rate volatility is mainly a concern for firms that are linked to international markets and therefore exposed to currency risk (Raddatz, 2008). Thus exchange rate volatility is an important factor in explaining the worldwide trade pattern. The exchange rate volatility creates risk in macroeconomic policy formulation, investment decisions and international trade flows (Musonda, 2008). High exchange rate volatility sends conflicting signals to investors as it creates vagueness about their profits. Exchange rate volatility is important as it creates gains or losses to farmers and exporters. This unexpected losses cause exchange rate risk thus discouraging production and this affects volumes of trade leading to adverse effects on economic growth. Further, exchange rate volatility affects international price competitiveness of exports leading to resource reallocations, which has a bearing on economic efficiency (Pugel, 2007). Unless they cover themselves in the forward market, traders with commitments to pay or receive foreign currency in the future bear exchange rate risk. So do holders of assets and liabilities denominated in foreign currency (Pugel, 2007). Exchange rate volatility leads to change in export earnings and is therefore detrimental to growth of exports (Kiptui, 2008). The exchange rate predictability is of interest to investors, exporters, importers, retailers and consumers. These agents ultimately decide their actions based on the value of domestic currency and also on their volatility.

However, the issue of exchange rate volatility impacts on international trade has been controversial (Musonda, 2008). Although several studies have focused on the effect of exchange rate volatility on international trade, neither theoretical nor empirical analyses have been successful in producing a consensus on the direction and magnitude of that effect. Theoretically, there are two contrasting schools of thought to explain the effect of exchange rate volatility on exports; the traditional and risk-portfolio. The traditional school of thought argues that higher volatility increases risk and therefore depresses trade flows. This school of thought is based on theoretical studies by Clark (1973), Baron (1976), and Hooper and Kohlhagen (1978). Conversely, the risk-portfolio school maintains that higher risk presents greater opportunity for profit and increases trade. This school of thought is based on theoretical studies by Broll and Eckwert (1999), Dellas and Zilberfarb (1993) and De Grauwe (1988).

The available body of empirical literature provides conflicting evidence on the effect of exchange rate volatility on international trade (Musonda, 2008). One argument is that higher exchange rate volatility will reduce exports by creating uncertainty about future profit from export trade. According to this view, traders are risk-averse and high exchange rate volatility induces them to reduce the volume of exports. This is supported in studies by Hooper and Kohlhagen (1978), Coes (1981), Akhtar and Hilton (1984), Kenen and Rodrick (1986), Thursby and Thursby (1987), Cushman (1988), Peree and Steinherr (1988), Koray and Lastrapes (1989), Chowdhury (1993), Arize (1995) and Adjaye (1998).

The contrasting argument is that the volume of exports raises with an increase in exchange rate volatility. Studies in support of this view include Giovannini (1988), Asseery and Peel (1991), Franke (1991), Sercu and Vanhulle (1992) plus Kroner and Lastrapes (1993). Moreover, De Grauwe (1988) argues that if exporters are sufficiently risk averse, an increase in exchange rate volatility results in an increase in expected marginal utility of export revenue which serves as an incentive for exporters to increase their exports in order to maximize their revenues. In addition, few studies have found that exchange rate volatility does not have a significant effect on trade (Klein, 1990; Gagnon, 1993; McKenzie, 1998 and Aristotelous, 2001).

Most of the previous studies have focused on the effects of volatility on aggregate trade flows, ignoring potentially different effects that may be observed at a more disaggregated level of analysis. Bini-Smaghi (1991) suggests that there may be different export demands and price elasticities across sectors and this may be a reason why aggregate studies have found little evidence of the effects of exchange rate volatility on trade. The disaggregated focus is appealing because exchange rate volatility may affect export commodities differently, so that aggregate effects may cloud the effects in individual products, or perhaps cancel out different effects across sectors which would otherwise provide information as to how individual products are affected by exchange rate volatility. Thus the volatility of the exchange rate may be more sensitive when disaggregated data is used and have a different impact across commodities (Bini-Smaghi, 1991).

Available literature shows mixed results on the effects of exchange rate volatility on exports plus paucity of such studies in developing countries. The available studies in Africa include Vergil (2002) for Turkey, and Bah and Amusa (2003) and Takaendesa *et al*., (2005) for South Africa. The review of literature finds weakness in the previous studies carried out in developing countries by use of aggregated data instead of disaggregated data which gives better results (Bini-Smaghi, 1991). Exchange rate volatility is a crucial element that needs to be considered for small countries like Kenya that depend

extensively on trade. An understanding of the effects of exchange rate volatility on French beans exports from Kenya is of interest to researchers, farmers, exporters and policy makers. Indeed, producers and exporters of French beans in Kenya are not only concerned with the magnitude of the price they receive but also about how stable these prices are as it affects their earnings of a consistent income. Kenya's main exports of tea, horticulture and coffee have been vulnerable to exchange rate volatility, but exchange rate risk hedging facilities in Kenya are virtually nonexistent (Kiptui, 2008). As a result, exporters bear the consequences of unexpected changes in the exchange rates. Despite the critical importance that French beans play in Kenya's economic development and concerns raised by exporters and policy makers, the relationship between exchange rate volatility and French beans export growth in Kenya remains unclear.

There have been limited studies in Kenya on the effects of exchange rate volatility on aggregate horticultural exports done by Were *et al*., (2002), Minot and Ngigi (2004), Kiptui (2008), Gertz (2008), and Maana *et al*., (2010). However, these studies gave conflicting evidence on the effect of exchange rate volatility on exports as Were *et al*., (2002) and Kiptui (2008) show negative effects while Minot and Ngigi (2004), Gertz (2008) and Maana *et al*., (2010) indicate positive or no effects. Additionally, these studies used aggregated horticultural data and did not evaluate the effects of exchange rate volatility on French beans exports in Kenya. Thus there is a gap in literature on the lack of empirical evidence on the effects of exchange rate volatility on French beans exports in Kenya. The purpose of this paper is therefore to evaluate the impact of exchange rate volatility on Kenya's French beans exports to its major trading partners in the European Union market. The specific objective of this study is to assess the magnitude and direction of the effect of exchange rate volatility on the volumes of French beans exports in Kenya. The findings of this study will assist policy makers in Kenya and other developing countries to design appropriate exchange rate and trade policies to boost their exports.

Theoretical framework

In economic theory, there are two theoretical schools of thought to explain the effect of exchange rate volatility on exports; the traditional and risk-portfolio. The traditional school of thought based on theoretical studies by Clark (1973), Baron (1976), and Hooper and Kohlhagen (1978) posits that higher volatility increases risk and therefore depresses trade flows. On the other hand, the risk-portfolio school based on theoretical studies by Broll and Eckwert (1999), Dellas and Zilberfarb (1993) and De Grauwe (1988) maintains that higher risk presents greater opportunity for profit and should increases trade. The traditional school of thought postulates that the volatility of exchange rates results to exchange rate risk which affects the volume of exports and hence international trade. The exporters are either risk averse, risk neutral or risk loving and thus react differently to volatility in exchange rates. If agents are risk neutral, exchange rate volatility does not affect the exporters' decision. When agents are risk averse an increase in exchange rate volatility induces them to reduce the volume of exports by reallocating production towards domestic markets.

The risk-portfolio claims that the traditional school is unrealistic. The main objection against the traditional school by the risk-portfolio school of thought is that it does not properly model how firms manage risk. The theory postulates that the result of an increase in the exchange rate volatility depends on the convexity of the utility function, which in turn depends on the level of risk aversion. For the highly risk averse, a rise in exchange rate volatility leads to an increase in the utility of export revenue and encourages exporters to export more to avoid the risk of a decline in their revenues. This is referred to as the income effect of exchange rate volatility. The less risk averse agents consider an increase in exchange rate variability as greater risk. Thus increased exchange rate volatility makes these players to reduce exports and switch resources to other sub-sectors. This is referred to as the substitution effect of exchange rate volatility. Thus exports increase with increase in exchange rate volatility; the greater the income effect while exports decline if the substitution effect outweighs the income effect. Thus higher income effects over substitution effects can lead to positive relationship between trade and exchange rate volatility.

Empirical model

This study developed an export demand model based on Goldstein and Khan (1978) and applied by Chowdhury (1993) and Arize *et al*., (2000). The model suggests a long-run relationship between exports, foreign economic activity, relative prices and exchange rate volatility. According to Chowdhury (1993) and Arize *et al*., (2000) the export demand model can be written as:

$$\ln X_t = \alpha + \beta_1 . \ln Y_t + \beta_2 . \ln P_t + \beta_3 . \ln V_t + \beta_4 L_t + \beta_5 . \ln Q_t + \varepsilon_t \quad (1)$$

Where *ln* stands for the natural logarithm of the relevant variable, t is the time dimension, X_t is export volume of French beans to 25 European Union (EU) countries (Tonnes), Y_t is foreign incomes proxied by the industrial production index of EU countries (US$), P_t is Kenya's French beans export price to the EU relative to world non-fuel commodity prices (US$), V_t is an exchange rate volatility which is a measure of risk given by the GARCH method, L_t is a dummy variable to represent exchange rate liberalization with a value of 1 representing the

liberalization period (1994-2011) and 0 to stand for the period before exchange rate liberalization (1990-1993) and ε_t is the error term which represents all the unknown and unmeasured variables that affect French beans exports in Kenya. Q_t represents the total volume of monthly supply of French beans to the EU market by other countries except Kenya (Tonnes).

The loglinear form is adopted, since it is found to be the most suitable functional form for the export demand functions in many empirical studies and has the additional advantage of reducing heteroskedasticity (Maddala, 1992). The theory of demand suggests that quantity of trade rather than value is the appropriate dependent variable (Learner and Stern, 1970). The application of the industrial production index as a proxy variable for the economic condition of the importing country is used due to the lack of monthly data for income or GDP. The variables X, Y, P, V and Q are in logarithm form so that the estimated parameters are interpreted as elasticities. If the coefficient of a variable is less than one, it implies that the export demand is inelastic. Hence an increase in the variable leads to less than proportionate change in demand of French beans exports in Kenya to the EU market.

In this model, a statistically significant and negative coefficient for β_3 indicates the existence of a negative relationship between exchange rate volatility and French beans exports from Kenya to the EU market. However, the coefficient of the exchange rate volatility β_3 is indeterminate. According to the traditional school of thought based on theoretical studies by Clark (1973), Baron (1976), and Hooper and Kohlhagen (1978), a higher volatility increases risk and therefore depresses trade flows. The risk-portfolio school based on theoretical studies by Broll and Eckwert (1999), Dellas and Zilberfarb (1993) and De Grauwe (1988) contends that higher risk presents greater opportunity for profit and should increases trade.

The impact of exchange rate volatility on French beans exports in Kenya is expected to be negative as is the case within the African context where forward exchange markets are non-existent (Omojimite and Akpokodje, 2010). Nonetheless, it has been argued that if traders predict the exchange rate movements better than the average foreign exchange rate participant then they would gain from their better knowledge and thus be able to counteract the adverse effects of exchange rate uncertainty (De Grauwe, 1988). Consequently, there is the possibility that exchange rate volatility can increase rather than decrease exports. As a result of this, the coefficient of exchange rate volatility is determined empirically rather than through theory.

Data

This study used secondary time series monthly data from various sources for a period of 21 years from January, 1990 to December, 2011. The prices of French beans exports in US$ were obtained from the Monthly Trade Reports of the customs department of the Kenya Revenue Authority (KRA). On the other hand, the volume of French beans exports in Kenya were obtained from the Ministry of Agriculture (MoA), Horticultural Crops Development Authority (HCDA) and the United Nations Food and Agriculture Organization Statistical Database (FAOSTAT). The volumes of French beans supply in the markets of 25 EU countries were obtained from the European Statistical Database (EUROSTAT).

The nominal exchange rates were obtained from the Ministry of Finance and the Central Bank of Kenya (CBK). The foreign exchange rate used in this study is the Kenyan shilling (Kshs) against the US$. This exchange rate was chosen because the US$ is the leading currency in the foreign exchange market trade and most of the official reserves and foreign currency transactions in Kenya are held in this currency. Nominal exchange rates were used because despite the debate on the distinction between real and nominal exchange rates; empirical results suggest that this distinction does not impact significantly on the results achieved (Enders, 2010). The exchange rate volatility was evaluated using the GARCH model and incorporated as an independent variable. The export volumes of French beans from Kenya to the EU market are given in tonnes while export prices are in US$. Other sources of the secondary data were the International Financial Statistics (IFS) of the International Monetary Fund (IMF), where world non-fuel commodity prices which together with export prices of French beans in Kenya were used to derive relative prices (which are export prices divided by world non-fuel commodity prices). The foreign incomes were proxied by the industrial production index of EU countries and were obtained from the IFS of the IMF.

The secondary data were collected by the researcher and the assistants through making visits to relevant organizations. The study made use of Stata computer software package to analyze the data. The unit root tests were used to test the data series for stationarity or the order of integration in order to avoid spurious regression results while Johansen's maximum likelihood cointegration analysis was carried out and a cointegrating long run relationship of the export demand model developed. Finally, an error correction model was developed and estimated to determine the short-run effects of the explanatory variables of exports of French beans in Kenya to the EU market.

The Consumer Price Index (CPI) statistics for the period under consideration were obtained from the Kenya National Bureau of Statistics (KNBS) and EUROSTAT. The real values of monthly French beans export volumes, export prices and exchange rates were obtained by deflating the nominal values using the monthly CPI from the KNBS. At the same time, the real values of foreign incomes and supply volumes were obtained by deflating the nominal values using the

Table 1. Unit Root (ADF and PP) Tests Results

Series	Level Series		First Differences			I (d)
	ADF	PP	Lags	ADF	PP	
Dependent Variable						
Export Volumes (T)	-2.88	-2.88	1	-5.57[c]	-4.30[c]	I (1)
Independent Variables						
Exchange Rates (Kshs/US$)	-2.89	-2.88	1	-6.88[c]	-6.94[c]	I (1)
Foreign Incomes (US$)	-2.90	-2.82	1	-6.26[c]	-7.40[c]	I (1)
Relative Prices (US$)	-2.90	-3.00	1	-6.47[c]	-6.91[c]	I (1)
Supply Volumes (T)	-2.89	-2.88	1	-6.93[c]	-6.85[c]	I (1)
5% Critical Values	-3.50	-3.50		-3.50	-3.50	

Note: [c] Denotes rejection of the null hypothesis of a unit root at 5 percent level of significance (MacKinnon, 1991).
Source: Author's Computations

monthly CPI from EUROSTAT. The base year of analysis was 2002, such that September 2002 =100.

RESULTS AND DISCUSSION

Unit root test results

There is need to check for the stationarity of the data series before estimating the relationships between French beans exports and its explanatory variables. The testing of the stationarity of economic time series is of great importance since standard econometric methodologies assume stationarity in the time series while they are, in fact, non-stationary (Engle and Granger, 1987). Consequently, the usual statistical tests are likely to be inappropriate and the inferences drawn are likely to be erroneous and misleading. Several tests for unit roots have been proposed in the literature. The commonly used ones are the Augmented Dickey-Fuller (ADF) (1979) and Phillips-Perron (PP) (1988) unit root tests. The ADF procedure is a parametric test that is most commonly used, but requires homoscedastic and uncorrelated errors in the underlying structure (Gujarati, 2005). The PP is a non-parametric test and generalizes the ADF procedure, allowing for less restrictive assumptions for the time series in question. The PP is a more powerful test for unit roots than the Augmented Dickey-Fuller (1979) test in small samples and follows a first order autoregression. In large samples the results of the PP and ADF test statistic are similar in most empirical evaluations.

The null hypothesis in the unit root test is that the time series under consideration has a unit root, that is it is nonstationary while the alternative hypothesis is that the time series is stationary (Green, 2004). This study makes use of both the Augmented Dickey-Fuller (ADF) (1979) and Phillips-Perron (PP) (1988) unit root tests in order to corroborate the robustness of the test results and ensure that the inferences regarding stationarity are unlikely influenced by the choice of the testing procedure used. The tests were applied to each variable over the period of 1990-2011 at the variables level and at their first difference. The test results were compared against the MacKinnon (1991) critical values for the rejection of the null hypothesis of no unit root. The results of the unit root tests as presented in Table 1.

The null hypothesis of nonstationaity or unit root is accepted if the absolute values of the computed ADF and PP statistics exceed the absolute critical values at 5 percent level of significance. The ADF and PP test critical values at 5 percent level of significance are given as -3.5 (Enders, 2010) at the level and first difference series (Table 1). As can be seen from Table 1 the computed test statistic for the French beans export volumes was -2.88 in the ADF and PP level series. In the first difference of the export volumes series the ADF and PP statistics were calculated as -5.57 and -4.30 respectively. The absolute values of the computed test statistic for the export volumes level series are less than the critical absolute values at 5 percent level of significance in both the ADF and PP test. However, the absolute values of the computed test statistics for the export volumes first difference series are greater than the critical absolute values at 5 percent level of significance in both the ADF and PP tests (Table 1).

The results show the presence of a unit root or that the export volumes series are non stationary in their

Table 2. Optimal Lag Length Selection

Dependent variable: Monthly export volumes of French beans to the EU
Independent variables: Foreign incomes, relative prices, exchange rates and supply volumes

Lag	Log L	FPE	AIC	SCIC	HQIC
0	-599.8353	6.155779	4.655231	4.791428	4.709972
1	-602.1732	6.10956	4.647705*	4.769946*	4.696831*
2	-597.844	6.219219	4.666472	4.8157	4.725859
3	-592.4404	6.12103	4.649542	4.813881	4.715608

Notes: * indicates the lag length selected by the criterion
FPE: Final Prediction Error
AIC: Akaike Information Criterion
SCIC: Schwarz Information Criterion
HQIC: Hennan-Quinn Information Criterion
Source: Author's Computations

level series. However, the first difference series are stationary, hence we conclude that the export volumes series is integrated of order one, that is; they are **I (1)**. Similarly, comparisons of the computed and critical values of the ADF and PP test statistics for the exchange rates, foreign incomes, relative prices and supply volumes shows that all variables are integrated of order one; **I (1)** in levels and of order zero; **I (0)** in first differences, meaning that they are nonstationary in levels and stationary in first differences (Table 1). From the results of the unit root tests, the conclusion is that the data series used in the export demand model in this study are **I (1)** in the level series and the first differences series are **I (0)**. A key implication of these findings is the existence of a long run relationship between the dependent and independent variables. This means that in the long run, the dependent variable; French beans export volumes can be well predicted using the specified independent variables.

The nonstationarity of the level series of export volumes, exchange rates, foreign incomes, relative prices and supply volumes imply that the means and variances of these variables vary over time. In addition, regressions carried out on nonstationary variables often gives spurious results implying that the estimates are invalid and have no economic implications; hence the need to formally test for unit roots to determine the right choice of model to apply (Enders, 2010). This indicates that the variables are **I (1)** and specifying the export demand function of the variables in the level of the series will be inappropriate and may lead to problems of spurious regression. The econometric results of the model in the level of series will not be ideal for policy making and such results cannot be used for prediction in the long-run. Hence given that the level series are **I (1)** and the first difference are **I (0)**, the Johansen-Juselius (1990) cointegration test therefore becomes appropriate for assessing the existence of long-run relationships among the variables.

Cointegration analysis

Cointegration analysis refers to the process of getting equilibrium or long-run relationships among non-stationary variables. The idea is that although the variables are non-stationary, linear combination of them may be stationary, given that all variables are integrated of the same order (Enders, 2010). The vector that links the variables in the long-run relationship is called the cointegrating vector. The cointegration analysis is useful because it shows whether the time series variables can jointly be used in the long run and avoids spurious regressions results. If long-run elasticities are present, then it is rational to evaluate how short-run behavior responds to long-run elasticities (Enders, 2010). Various tests for the presence of cointegration among **I (1)** variables have been proposed beginning with Engle and Granger (1987). The procedure used in this study was a multivariate procedure based on maximum likelihood methods introduced by Johansen (1988, 1991) and expanded upon by Johansen and Juselius (1990).

Having tested the stationarity of each time series, the next step was to apply the co-integration procedure as developed by Johansen and Juselius (1990) in order to test the presence of long-run equilibrium relationships among the variables in the export demand model. Before proceeding to the results of the cointegration test, the optimal lag length for the vector autoregressive (VAR) model specification was determined using the Akaike Information Criterion (AIC), Schwarz Information Criterion (SCIC) and the Hennan-Quinn Information Criterion (HQIC). Table 2 shows the results of the lag length for the different information criteria used. The results explicitly show that the optimal lag length for the VAR model is 1. This arises from the fact that all the information criteria adopted chose 1 as its optimal lag length since it gave the minimum value for each of the evaluated information criterion in AIC, SCIC and HQIC. On the basis of the optimal lag length chosen by the lag selection criteria, the results of the maximum eigenvalue and the trace statistic were obtained from the Johansen and Juselius (1990) method to ascertain the number of cointegrating relationships. Except for the exchange rate volatility and liberalization variables the other variables were converted into their logarithmic forms in order to remove heteroscedasticity problem from the VAR model. This implies that the parameter estimates generated from the VAR model are interpreted as elasticities. The

Table 3. Johansen Multivariate Cointegration Test Results

	λ-max Statistics					Trace Statistics				
H_0	r = 0	r ≤ 1	r ≤ 2	r ≤ 3	r ≤ 4	r = 0	r ≤ 1	r ≤ 2	r ≤ 3	r ≤ 4
H_a	r = 1	r = 2	r = 3	r = 4	r = 5	r = 1	r = 2	r = 3	r = 4	r = 5
	63.47	31.95	22.06	9.25	2.79	34.82	22.48	16.13	9.66	2.35
5% Critical values	59.46	39.89	24.31	12.53	3.84	30.04	23.80	17.89	11.44	3.84

Note: The critical values are from Osterwald-Lenum (1992).

Source: Author's Computations

model was normalized on the export volumes variable X_t, in order to obtain the long run parameter estimates as reported in Table 3.

The appropriate cointegrating vector is indicated by the first column under the largest eigenvalue and trace statistics. Hence, starting with the null hypothesis of no co-integration (r≤1) among the variables; the maximum eigenvalue and trace test statistics both reject the null hypothesis of more than one cointegrating vector at the 5 percent significance level (Table 3). Therefore we conclude that on the basis of the eigenvalue and the trace test statistics, there is one cointegrating vector for the VAR model. In particular, this suggests that there is a unique long run equilibrium relationship amongst the variables.

Estimation of the Export Demand Model

The results of the Johansen Multivariate Cointegration test indicate the presence of a long run cointegrating relationship between the variables. The estimation of the French beans export demand model results is the following cointegrating long-run relationship:

$$X_t = \underset{(3.27)}{12.87} + \underset{(2.14)}{4.96}Y_t - \underset{(0.15)}{0.45}P_t - \underset{(0.89)}{2.30}V_t + \underset{(0.21)}{0.53}L_t - \underset{(0.34)}{0.86}Q_t \quad (2)$$

Note: The values in parenthesis are standard errors and all the estimated elasticities are significant at 5 percent level of significance.

Where X_t is export volumes of French beans to the 25 EU countries (Tonnes), Y_t is foreign incomes proxied by the industrial production index of EU countries (US$), P_t is Kenya's French beans export prices to the EU relative to world non-fuel commodity prices (US$), V_t is the exchange rate volatility given by the GARCH method, and L_t is a dummy variable to represent exchange rate liberalization with a value of 1 representing the liberalization period (1994-2011) and 0 to stand for the period before exchange rate liberalization (1990-1993) and Q_t represents the total volumes of monthly supply of French beans to the EU market less the total volume of Kenyan French beans exports to the EU market (Tonnes).The coefficient of the exchange rate volatility variable (V_t) has negative long run effects on French beans exports with elasticity of 2.30 (Equation 2). Thus the responsiveness of French beans export demand in the EU market to exchange rate volatility is elastic. This implies that an increase in the shilling exchange rate volatility leads to a more than proportionate decrease in demand for French beans exports from Kenya in the EU market. As the results indicate, a unit increase in exchange rate volatility in Kenya leads to a two-fold decrease in French beans exports to the EU. This is in concurrence with the expectation in African countries where a negative sign is predicted due to the absence of forward exchange markets.

Thus, increased exchange rate volatility increases uncertainty about future exchange rate behavior. This implies that French beans exporters in Kenya are therefore risk averse and with an increase in exchange rate volatility exporters reduce their exports in order to reduce their risk exposure. These results are explained by the fact that Kenya's French beans exports compete with the local market, as there is a substantial amount that is consumed domestically. Hence in conditions of high exchange rate volatility which causes uncertainties regarding exporters' profits, their option is to reduce production or sell to the domestic market. According to the risk aversion theory, this is due to lack of well developed hedging facilities and institutions in Kenya's foreign exchange markets (Doroodian, 1999). Therefore, exporters prefer to sell in domestic markets rather than foreign markets, negatively affecting exports. The implication is that economic policies aimed at stabilizing the exchange rate will increase the volume of French beans exports in Kenya.

Error correction model

Having concluded on the inherent long run relationships, we proceed to evaluate the short run dynamics of the export demand function. As the Engle-Granger Representation Theorem (1987) suggests, the existence of the cointegrating relationship among a set of variables that are not stationary in levels, implies there will be a short run error correction relationship associated with them. The relationship represents an adjustment

Table 4. Regression Results for Vector Error Correction Model (1990-2011)

Variable	Coefficient	Standard error	ρ value
Constant	2.04**	0.57	0.035
$\Delta \ln X_{t-1}$	-0.23**	0.11	0.026
$\Delta \ln Y_t$	4.86**	2.33	0.019
$\Delta \ln P_t$	-0.38**	0.12	0.027
ΔV_t	-1.73**	0.75	0.044
$\Delta \ln Q_t$	-0.71**	0.19	0.021
L_t	0.42**	0.18	0.020
ECM_{t-1}	-0.77**	0.29	0.015
Summary statistics			
$R^2 = 0.74$			
Durbin-Watson = 2.49			
Serial Correlation, F = 1.15 (0.46)			
Heteroscedasticity, F-statistic = 4.97 (0.01)			
Normality, Jarque-Bera = 0.54 (0.91)			

Note: ** denotes significance at 5 percent level.

Source: Author's Computations

process by which the deviated actual export is expected to adjust back to its long-run equilibrium path (Engle and Granger, 1987). Engle and Granger (1987) provided a principal feature of the cointegrated variables in that their time paths are influenced by the deviation from the long run relationship, given that cointegration implies error correction representation. Thus the cointegrated system in this study can be represented by an Error Correction Model (ECM), which represents the short-run relationship described as:

$$\Delta E\,X_t = C + \gamma E\,C_{t-1} + \sum_{i=0}^{n} \beta_{1i} \Delta E\,X_{t-i-1} + \sum_{i=0}^{n} \beta_{2i} \Delta Y_{t-i} + \sum_{i=0}^{n} \beta_{3i} \Delta P_{t-i} + \sum_{i=0}^{n} \beta_{4i} \Delta V_{t-i} + \varepsilon t \quad (3)$$

The first difference of export is a function of lagged exports value, current and lagged values of the independent variables, and the lagged value of the long run disturbance term $E\,C_{t-1}$. The parameter γ describes the short run adjustment and indicates the speed of adjustment towards the long run equilibrium state so that a high coefficient implies rapid adjustment and a low coefficient slow adjustment (Engle and Granger, 1987). Table 4 provides the regression results for the error correction model.

In Table 4.14, ln represents natural logarithm, the symbol Δ is the first difference operator, X_{t-1} is the French beans exports volume, Y_t is foreign incomes, P_t is relative prices, V_t is exchange rate volatility, Q_t is French beans supply in the EU market, L_t is exchange rate liberalization dummy and ECM_{t-1} is the error correction term. The lag length for each variable and the sequence in which the variables were entered in the VECM was selected using Akaike (1969) Information Criterion. The coefficient of multiple determination, (R^2) is high at 0.74 (Table 4). The high value of R^2 indicates that the model fits the data well and 74 percent of the variance in the volumes of French beans exports are predicted by the independent variables. This shows a strong explanatory power of 74 percent of the independent variables in affecting change in volume of Kenyan exports of French beans to the EU market. The F-statistics of 4.97 with a statistical significance at 1 percent shows that the variation in the long-run French beans export volumes is attributable to changes in the independent variables (Table 4). The presence of autocorrelation test was carried out using the Durbin Watson statistics and found to be within the normal bound at 2.49 (Table 4). The model fulfilled all diagnostic tests of no serial correlation, homoscedasticity, and normality of residuals as indicated by the summary statistics (Table 4). The results show that Kenya's French beans export demand can effectively be explained using the specified independent variables.

The coefficients on the lagged values of $\Delta \ln Y_t$, $\Delta \ln P_t$, ΔV_t and ΔQ_t are short run parameters measuring the short run immediate impact of independent variables on ΔX_t. The coefficients on the lagged values of $\Delta \ln P_t$, ΔV_t and ΔQ_t have negative signs (Table 4). This means that a unit change in any of these variables will impact negatively on the level of export demand. The short run coefficients follow the same pattern as the long run coefficients but the magnitudes of the short run coefficients are smaller than the long run coefficients.

The economic implication of this is that the independent variables have smaller effects on the volumes of French beans exports in the short run compared with the long run. With the dynamic specification of the model, the short-run dynamics are influenced by the deviation from the long run relationship as captured by ECM_{t-1} term. The regressor ECM_{t-1} corresponds to the one month lagged error correction term which is indicative of the measure of the average speed at which export volume adjusts to a change in equilibrium conditions or the average time lag for adjustment of exports to changes in the explanatory variables.

The coefficient on error correction term ECM_{t-1} is negative as theoretically predicted and is statistically significant at the 5 percent level (Table 4). The significant error correction term implies that Kenya's French beans exports demand model adjusts to changes in the specified independent variables. This further confirms the existence of a stable equilibrium long run relationship among the variables in the model (Banerjee *et al.,* 1993). The result justifies the use of ECM specification and further confirms that the variables are indeed cointegrated. The magnitude of the error correction term reveals the change in French beans exports per period that is attributable to the disequilibrium between the actual and equilibrium levels. The coefficient of the ECM_{t-1} shows the proportion of the disequilibrium that is corrected each month.

The economic importance of this finding is that the French beans exports speed of adjustment to correct long run disequilibrium between itself and its determinants is high, and 77 percent of the disequilibrium is eliminated in one month. This implies that 77 percent of the disequilibria of the previous month`s shock adjust back to equilibrium in the current month. These estimates of ECM suggest that in the absence of further shocks, the gap to revert back to equilibrium would be closed within a period of 1.3 months. These results indicate that the adjustment of French beans export volumes to any change in the independent variables of the export demand model does not take a long time to return to equilibrium because market forces in the export market restore equilibrium rapidly.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The specific objective of this study was to evaluate the effect of exchange rate volatility on French beans exports from Kenya to the European Union market using monthly data from January, 1990 to December, 2011. The values of exchange rate volatility of the Kenya shilling against the US$ were computed using the Generalized Autoregressive Conditional Heteroscedasticity model. The study applied the Augmented Dickey-Fuller (1990) and Phillips-Perron (1988) methods to test for the long run stability of the variables used in the empirical analysis. In order to detect whether the variables moved along the same path or not, cointegration analysis using Johansen and Juselius (1990) method was used. The cointegrating long run relationship of the export demand model was developed using the monthly data. To detect the speed of adjustment to equilibrium in case of sudden shock, the Vector Error Correction Model was used. This relationship represents an adjustment process by which the deviated actual export is expected to adjust back to its long run equilibrium path.

The results of cointegration analysis using the Vector Autoregressive model indicated the presence of a long run equilibrium relationship between French beans exports, foreign incomes, relative prices, exchange rate volatility, liberalization and supply volumes. The exchange rate volatility variable has negative long run effects on French beans exports with elasticity of 2.30. Therefore, the responsiveness of French beans export demand in the EU market to exchange rate volatility is negative and elastic. This implies that an increase in the shilling exchange rate volatility leads to a more than proportionate decrease in demand for French beans exports from Kenya in the EU market. As the results indicate, a unit increase in exchange rate volatility in Kenya leads to a two-fold decrease in French beans exports to the European Union. This is consistent with the expectation in African countries where a negative sign is predicted due to the absence of forward exchange markets.

The short-run dynamics of the French beans export demand model were estimated using a Vector Error Correction Model and the coefficient on error correction term was found to be -0.77 and was statistically significant thus confirming the existence of a stable equilibrium long run relationship among the variables. The negative sign of this coefficient indicates that the direction of correction is towards the long-run equilibrium while the size indicates the speed of adjustment towards the long-run equilibrium. The economic importance of this finding is that the French beans exports adjust to correct long run disequilibrium between itself and its determinants rapidly, and 77 percent of the disequilibrium is eliminated in one month. This implies that 77 percent of the disequilibria of the previous month`s shock adjusting back to equilibrium in the current month. The conclusion is that the adjustment of French beans export volumes to any change in the independent variables of the export demand model takes a short period to return to equilibrium because market forces in the export market restore equilibrium quickly.

The results of this study indicate that exchange rate volatility is one of the variables that influence performance of French beans exports from Kenya to the

European Union market with a negative and elastic short run and long run relationship. There is interdependence between exchange rate stability, macroeconomic stability, institutional reforms and export

performance and hence policy makers need to consider the existence, degree and likely effects of exchange rate volatility while designing, developing and implementing trade policies. The government needs to make key commitments to maintain the stability and competitiveness of the exchange rate as part of its export promotion and diversification strategy and apply appropriate policy management tools to this task. As such trade policy should be geared towards overall macroeconomic stability supported by a competitive exchange rate as well as structural reforms that contribute to increased productivity and the enhancement of international competitiveness. Therefore firms need to increase efficiency, diversify their range of products and aggressively search for niche markets to boost competitiveness. French beans export promotion strategies like subsidies and tax concessions need to be promoted.

There is need for a stabilization policy aimed at mitigating high exchange rate volatility to promote exports in Kenya. The government needs to seek ways of reducing volatility of the Shilling exchange rate. In managing exchange rate risk, the government and the Central Bank of Kenya need foresight, better forecasting and a willingness to undertake calculated risk to avoid economic losses arising out of exchange rate volatility. To avoid exchange rate risk in the short term, firms will require hedging of their currency exposures. Hedging will involve taking of a position, by obtaining a cash flow, an asset or a contract; including a forward contract that will rise in value and offset a fall in the value of an existing contract. In the long run, economic policies aimed at stabilizing the exchange rate are likely to increase the volumes of French beans exports from Kenya. In order to cushion exporters from high exchange rate volatility, the government needs to set up French beans export stabilization funds and develop forward markets in the French beans exports sub-sector.

Additionally, there is need for more diversification of the export products and markets while at the same time improving on quality. In particular, export diversification strategies need to put emphasis on promoting non-traditional, higher-productivity and technology-intensive exports. On the other hand, with the rising economic integration, Kenya needs to balance its trade with developed and developing countries and increase its market share for French beans in the East African Community and Common Market for East and Southern Africa because both have a huge and growing market potential. Thus bilateral, multilateral and regional trade agreements need to be intensified for markets in both developed and developing nations. At the regional level, the East African Community needs to have a regional currency pegged to a major world currency to shield export operators from exchange rate volatility and stabilize their revenues.

To limit over-reliance on exporting as a major channel for French beans produce in Kenya, the alternative is to produce for consumption in the domestic market. However, given Kenya's comparatively small size and domestic consumers taste and preference for French beans; there is limited scope for local producers to divert production away from exporting. In order to address this constraint the government and key stakeholders in the industry needs to be proactive in increasing utilization of French beans locally through research and extension promotion activities.

A decrease in trade volume as a result of exchange rate volatility is not the net cost to the Kenyan economy, thus the effect of exchange rate volatility on whole trade is therefore an area for future research. This will improve our understanding on how exchange rate volatility impacts on overall Kenyan national welfare. There is need to analyze not only the effect of exchange rate volatility on exports but the effect on Kenyan imports. Future research could extend the exchange rate volatility analysis to other specific agricultural primary commodity exports in Kenya and other countries. Further research could also evaluate whether the sources of exchange rate volatility determine its effects on exports. In addition, the theoretical relationship between exchange rate volatility on trade is still not yet resolved; thus further research on this issue is required.

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