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Drivers of Horticultural Exports in Kenya

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Abstract

This study examines major drivers behind horticultural exports in Kenya for the period 2005-2017. Using co-integration model, the study finds out horticultural exports, interest rate, exchange rate, and inflation rate are co-integrated in long-run. These co-integrated series converge to their long-run equilibrium at a speed of 8.53% on each period at 1% statistically significance level. More specifically, the study explores that the interest rate has negative influence on horticultural exports of Kenya, while inflation and exchange rates have positive impact. Thus, the study recommends that the government in Kenya should reduce interest rates using their monetary policies and stabilize macroeconomic environment in order to increase horticultural exports such as targeted exchange rate through application of foreign reserves adjustments.

Keywords: *Horticultural Exports; Co-integration; Error Correction Model.*
JEL Classification: *C10, E10, E31, F00.*

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1. Introduction

This paper aims to examine impacts of inflation, exchange, and interest rates on horticultural exports in Kenya. The agriculture is one of the crucial sectors in Kenya's economy as it provides employment, source of food, foreign exchange earner and provides linkages to other sectors of the economy (Salami et al., 2011). Agriculture has an important role in growth and development in any economy of the developing countries and it is known to be the driving force behind the industrialization of many nations (Szirmai, 2012). Kenya's GDP growth rate was at 5.7 percent in 2014 and 5.3 percent in 2017 and the major contributor was agriculture and fishing (Kenya National Bureau of Statistics, 2014). With the promulgation of the new constitution in 2010, agriculture was devolved to county government (Mwenda, 2010). During this period, the stability of the Kenya's currency was relatively stable as compared with its major trading currencies (Asongu, Folarin & Biekpe, 2020). Inflation rate rose by a small margin but remained within the stipulated CBK lending rate. Agriculture contributed approximately 34.5 percent of the total gross domestic product (GDP) in 2000s coming second after tourism sector.

1.2. Horticultural Subsector in Kenya

Historically, manufacturing sector has been recognized as the engine of economic growth and change. However, in the recent past, owing to the rising number of services and development of agro-industries including horticulture, innovation has made horticulture industry share similar characteristics with manufacturing. According to Hallward and Nayyar (2017) because they are tradable, high added value per employee and can easily absorb large number of moderately qualified workers. The production and exports of horticultural crops dates to colonial period when Kenya was required to contribute towards running of East Africa budget. However, after independence the industry grew and flourished as the Kenya's exports to Europe increased and this led to opening of Kenya's export markets. In terms of household income generation, foreign exchange earnings and food security at household and national, horticulture has continued to play an important role.

In Kenya, horticultural subsector accounts for approximately 33 percent (US$300 Million) of agricultural gross domestic product and 38 percent of the total national export earnings thus making it one of Kenya's main contributors of foreign exchange (Bijaoui, 2017). The production of horticultural products in Kenya is approximately 3 million metric tons per year, which makes Kenya one of the major world exporters of horticultural products according to Kenya Horticulture Council. Approximately 4.5 people million work directly in production, processing, and marketing activities. Another 3.5 million are engaged indirectly through trade and other related activities (Boulanger et al., 2018).

1.3. Exports Performance of Horticultural Sub-sector in Kenya

According to Muendo, Tschirley & Weber (2004), horticulture production in Kenya has received a lot of attention from international NGOs and Governments given its rapid and growing of export sector in major importing countries such as those in the Europe and the United States of America. In USA for instance, Kenya's horticultural exports such as French beans were allowed into their markets, which is a clear indication that there is room for horticultural exports outside its traditional markets of Europe. Kenya's exports to European markets increased in the 1970s with Netherlands as the largest importer with a 71 percent share by volume. Kenya's exports to the United Kingdom are about 20 percent and Germany at 6 percent. France, Switzerland, Belgium, Saudi Arabia Italy and South Africa are the other important importers of Kenya's horticultural exports (World Bank Group, 2013).

Kenya's government has focused on promoting horticultural exports due to its reduction markets in both international and its local market. Studies such as those of Mania and Rieber (2019) show that exports of a country are important as it provides a country a base for expansion of growth which is brought about by increased foreign exchange earnings. In Kenya, it is evident that horticultural exports generate employment and attracts foreign exchange earnings and further, a major factor in economic development (Barrett, 2008). The cause of Kenya's increase in exporting quality horticultural exports has been facilitated by increased airfreight arrivals to it major destinations with several interceptions due to MRLs exceedance in countries from Europe. On the other hand, decrease in horticultural exports has been highly associated with unpredictable weather patterns which resulted in low yields, lack of value addition of technologies, increased post-harvest losses and the inability of horticultural farmers to access the right quality of planting materials.

Horticultural exports have exhibited an increasing trend over the last two decades though not stable as evidenced by small and continuous fluctuations. This sustained increase is attributed to various policy interventions to increase horticultural exports by the government effort to stabilize macroeconomic variables such as exchange rate and the increased interest rate from wide range of stakeholders. On the other hand, the deviations have been partly due to unfavourable macroeconomic environment such as variability in exchange rate. Horticultural exports rose steadily over the years, except in 2000 which was largely as a result of ban on some of horticultural exports products from Kenya because they did not meet requirements of GLOBAL GAP as a consequence of excess of MRLs. In 2013, horticultural exports recorded a sharp decline, this was attributed to the fluctuations in Kenya's currency instability in terms of prices fluctuation, dynamic, and versatile operational environment that include bureaucracy in decision making, regional trading challenges, unfavourable global trade (Nayioma, 2016). This was partially attributed to uncertainties of 2013 general elections by the investors in agricultural sector.

2. Research Methodology

The study utilizes longitudinal research design, which is time series in nature, and it involves the measurement of a single variable at a regular interval of time. Prior to core analysis, the paper examines stationarity of the variables. In order to fulfil requirements of the OLS methodology, all variables should be stationary to avoid spurious results (Mesikeet al., 2010). If not, they should be converted into stationary series using various techniques. Thus, it is important to carry out unit root tests (Habte, 2017). It also ensures validity of the test statistics such as t,F statistics.

Unit Root Tests

This paper employs the Augmented Dickey Fuller (ADF) and Philips Perron (PP) tests in order to check stationarity of the variables.

The ADF teststatistic is based on the t-statistic of the coefficient φ from OLS estimation as per Dickey & Fuller (1979). It does not have an asymptotic standard normal distribution, but it has a non-standard limiting distribution. ADF test estimates equation Eq.1 on time series model to accommodate serial autocorrelation, auto covariance and covariance (Pfaff, 2008).

$$\Delta Y_t = \beta_1 + \beta_{2t} + \delta Y_{t-1} + \sum_{\mathrm{i}=1}^{p} \propto_i \Delta Y_{t-1} + \varepsilon_t \qquad (Eq.1)$$

where ΔY_t represents first difference of each variable; β_1 is an intercept; β_{2t} stands for a time trend; δ represents the co-efficient of the lagged variable; the *"p"* is the optimum lag length; and ε is a resudal of the model. ADF hypothesizes

H_0 (δ=0) against alternative (δ<0), and rejection of the null confirms stationarity of Y.

On the other hand, the Phillips and Perron (1988) proposed two alternative statistics; Phillips and Perron's test statistics can be viewed as Dickey–Fuller statistics that have been made robust to serial correlation by using Wang & Wu, (2012) heteroskedasticity and autocorrelation-consistent covariance matrix estimator.To consider the problem of serial correlation, the Augmented Dickey–Fuller test's regression includes lags of the first differences of ΔY_t. The Phillips–Perron test involves fitting $I(1)$, and the output is used to calculate the test statistics. Phillips – Perron builds on Dickey–Fuller unit root test and it involves fitting the equation Eq.1;

$$\Delta Y_t = \delta Y_{t-1} + \sum_{j=1}^{p-1} \propto_j \Delta Y_{t-j} + \vartheta_t \qquad (Eq.2)$$

Vector Error Correction Model

If the variables exhibits cointegration, it implies that there exists a long term relationship among variables (Sohail & Hussain, 2009) it is appropriate to apply the VECM model for analysis to explain the characteristics of the cointegrated series as noted by Greene (2008).

$$\Delta HOE = \sum_{i=0}^{p} \beta_1 \Delta INF_{t-1} + \sum_{i=0}^{p} \delta_1 \Delta EXR_{t-1} + \sum_{i=0}^{p} \delta_1 \Delta INT_{t-1} + \varepsilon_{t-1} \qquad (Eq.3)$$

Where, ECT is error correction term,

HOE denotes value of Horticultural exports (in Million Kshs)

INF is inflation (in percentage)

EXR is exchange rates (in percentage)

INT is interest rates (in percentage)

For the model to have long-term relationship, the ECM (ε_{t-1}) must have negative and significant coefficient.

3. Diagnostic Tests

Lagrange Multiplier Test for Serial Autocorrelation

Before performing inference and post estimation analysis on the VARM and VECM, the LM test is applied to test if autocorrelation exist among the residuals. The LM test hypothesizes that there is no correlation at a specific lag order of i. for $i = 1, 2, \cdots, p$. The model form to test this hypothesis was as follows;

$$\Delta Y_t = \alpha \hat{E}_t + \sum_{i=1}^{p-1} \Phi_i^* \Delta Y_{t-i} + \varepsilon_t \qquad (Eq.3)$$

$\hat{E}_t = \hat{\beta} Y_t$ which is $r \times 1$ vector of the estimated cointegration relations (Lutkepohl, 2005).

Jarque-Bera Test for Normality

Before performing inference from the estimated VECM model, Jarque-Bera test is applied to test whether the sampled data have skewness and kurtosis that follows normal distribution. Jarque-Bera test for normality has a joint hypothesis and hypothesizes that disturbances are normally distributed. Jarque – Bera test is based on the following statistical model.

$$JB = \frac{T}{6}\left[T^{-1}\sum_{t=1}^{T}\left(\hat{\varepsilon}_t^p\right)^3\right]^2 + \frac{T}{24}\left[T^{-1}\sum_{t=1}^{T}\left(\hat{\varepsilon}_t^p\right)^4 - 3\right]^2 \qquad (Eq.4)$$

The test statistic was used to test a pair of hypotheses

$$H_0 : E\left(\varepsilon_t^p\right)^3 = 0 \text{ and } E\left(\varepsilon_t^p\right)^4 = 3 \text{ versus } H_1 : E\left(\varepsilon_t^p\right)^3 \neq 0 \text{ or } E\left(\varepsilon_t^p\right)^4 \neq 3 \qquad (Eq.5)$$

Test for Multicollinearity

Variance inflation factor (VIF) is applied to check presence of multicollinearity in the estimated VECM model. VIF measures how variance has been increased the estimates of the slope. High VIFs reflects an increase in the variances of estimated regression coefficients due to collinearity among predictor variables over variances obtained when predictors are orthogonal (Murray *et al.,* 2012). Models with multicollinearity have lower precision and have problems in forecasting (Midi, Sarkar & Rana, 2010). In computing VIF, the equation Eq.6 is estimated.

$$VIF_k = {}^{1}/_{1 - R_K^2} \qquad (Eq.6)$$

VIF_k is the variance inflation factor of each of the independent variables in the model and R_K^2 is the coefficient of multiple determination of the variable k.

Model Stability

Before making statistical inference on estimated VECM, the stability conditions of the estimates were computed. For VECM model to be stable, it is required that that all characteristics of the companion matrix lies inside the unit circle.

$$A = \begin{pmatrix} A_1 & A_2 & \cdots & A_{p-1} & A_p \\ I & 0 & \cdots 0 & & 0 \\ 0 & I & \cdots & 0 & 0 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & \cdots & I & 0 \end{pmatrix} \qquad (Eq.7)$$

If the model is stable, its modulus of each of the eigen values of the matrix A in equation Eq.6 must lie inside the unit circle and strictly is less than one (Lutkepohl, 2005) and (King, Plosser, Stock & Watson, 1987).

4. Data Analysis & Results

4.1. Descriptive Statistics

Table I presents the descriptive statistics of INF, EXR, INT and HOE. From the results, INF had mean 8.2692 percent, standard deviation of 3.7388 which is not close to its mean. A standard which is away from its mean implies that INF is more spread.EXR reported a monthly average of 84.0192 percent and a standard deviation of 10.7734 percent implying that there is much variability which is a sign of volatility in EXR. This high variabilty in EXR is indicator that Kenya’s currency is unstable as compared to those of their major trading partners such as the US$ and Euro. INT had a monthly average of 15.2272 percent and a standard deviation of 2.0618 percent. It indicates that its standard deviation is not clustered around its mean and this indicates that INT highly varies from one period to another.

Table 1. Descriptive Statistics

Variable	Code	Obs	Mean	Std. Dev.	Min	Max
Inflation Rate	INF	156	8.27	3.74	1.85	19.72
Exchange Rate	EXR	156	84.02	10.77	62.03	105.29
Interest Rate	INT	156	15.23	2.06	12.12	20.34
Horticultural Exports	HOE	156	5415.37	1753.52	1977.27	9493.30

Horticultural exports (HOE) reported a monthly average of Kshs 5415.37 million. Its standard deviation is 1753.52 indicates that there is much variability in horticultural exports in Kenya. This implies underlying seasonal variations in value of horticultural exports in Kenya occasioned by natural calamities such as Icelandic volcanic eruption in 2009 and low rainfall which resulted in low export volumes. HOE also registered a minimum of Kshs 1977.27 million and maximum of Ksh 9493.3 million.

4.2. Unit Root Tests

We examine stationarity of the variable using two differen unit root tests such as Augmented Dickey Fuller (ADF) and Phillips Perron (PP) tests.

Table 2. Results of ADF Test for Unit Root

Variable	ADF	p-values	Critical values			Conclusion
			1%	5%	10%	
INF	-6.503	0.8169	-3.572	2.925	-2.598	*Unit root*
EXR	-9.570	0.4388	-3.572	-2.925	-2.598	*Unit root*
INT	-3.733	0.6386	-3.572	-2.925	-2.598	*Unit root*
HOE	-3.733	0.9938	-3.572	-2.925	-2.598	*Unit root*
First Difference						
INF	-14.285	0.0000	-3.573	-2.926	-2.598	*I(1)*
EXR	-10.132	0.0000	-3.573	-2.926	-2.598	*I(1)*
INT	-8.559	0.0000	-3.573	-2.926	-2.598	*I(1)*
HOE	-6.454	0.0000	-3.573	-2.926	-2.598	*I(1)*

Table 3. Results of PP Test for Unit Root

Variable	PP	Prob	Critical values			Conclusion
			1%	5%	10%	
INF	-64.476	0.0944	-19.008	-13.348	-10.736	*Unit root*
EXR	-6.518	0.1918	-3.572	-2.925	-2.598	*Unit root*
INT	-3.683	0.4196	-3.572	-2.925	-2.598	*Unit root*
HOE	-7.168	0.7500	-3.572	-2.925	-2.598	*Unit root*
First Difference						
INF	-20.213	0.0000	-3.573	-2.926	-2.598	*I(1)*
EXR	-11.457	0.0000	-3.573	-2.926	-2.598	*I(1)*
INT	-9.095	0.0000	-3.573	-2.926	-2.598	*I(1)*
HOE	-6.454	0.0000	-3.573	-2.926	-2.598	*I(1)*

ADF and PP tests are applied to determine if INF, EXR, INT and HOE have unit root problem. Their results are presented in table 2 and 3 respectively. According to these results, we can confirm that all variables are non-stationary at their levels, but can be successfully converted into stationary series using first differentiation methodology. Thus, the results show that all variables are integrated of order one, I(1).

As all series are I(1), we can conduct co-integration analysis in order to examine their long-run interactions between themselves. To do this, we need first to find out optimal lag length for each variable using Lag Length Selection analysis. The table 4 shows results of this analysis. All the criteria FPE, AIC, SBIC and HQIC, predicted the optimum number of lags at the first period. Wooldridge (2013) recommends the use of one lag in the case of time series data to estimate VECM Model. Cheung et al. (2019) proposes lag selection order remains the discretion of the researcher to choose the optimum lag order to use. The optimum lag length are indicated by "*" in the output lag length selection results. It means that these selected lags are the lowest values of each criteria, thus they will give a better model estimates with lower serial correlation and will reduce degrees of freedom.

Table 4. Results of Lag Length Selection

Lag	LL	LR	DF	P	FPE	AIC	HQIC	SBIC
0	-2005.15				0.000	26.61	26.64	26.69
1	-1961.01	88.28	16	0.000	0.000*	26.24*	26.24*	26.64*
2	-1948.08	25.87	16	0.056	0.000	26.28	26.57	26.99

3	-1933.47	29.22	16	0.022	0.000	26.30	26.72	27.34
4	-1918.61	29.71	16	0.020	0.000	26.31	26.87	27.67

Note: *indicates the Optimum Lag lengths of the various criteria

4.3. Vector Error Correction Model

We employ this model in order to examine long-run changes in horticultural exports in relation with explanatory variables such as inflation, exchange, and interest rates. Moreover, it shows the speed of adjustment of the system to correct its previous period disequilibruim. In other words, speed of the model to reach its long-run equilibruim. The results of VECM analysis are present in table 5 below.

Table 5. Summary Estimates of the Vector Error Correction Model

Equation	**Parms**	**RMSE**	**R-Sq**	**Chi^2**
HOE	6	8.8511	0.7403	128.2536
	Coef	**std error**	**z**	**p>|z|**
ECT(-1)	-0.0853	0.0245	-3.4816	0.0010
INF	0.3599	0.0721	4.9917	0.0000
EXR	0.2059	0.0682	3.02	0.0300
INT	-0.0241	0.0118	-2.04	0.0207

The VECM model estimate significant long-run relationship between explanatory variables that accounts 74.03% of variations in horticultural exports. As per (Lutkepohl, 2005) coefficients represent the short run elasticity in the model. The model also finds negative and statistically significant error correction term (ECT), which shows the model works perfectly according to Engle & Yoo (1987) theorem. It confirms that 8.53% speed of convergence towards its long-run equilibrium. In other words, 8.53% of the disequilibria are adjusted from lagged period of error shocks and it will take approximately 11.72 months (obtained by taking the reciprocal of the ECT term) for the deviations from the short-run to come back to its long-run equilibrium path.

The ECM term also reveals that long-term relationship between horticultural exports (HOE), inflation (INF), exchange rate (EXR) and interest rate (INT) in Kenya. And their past values plays role in determination of HOE's present value in the short run (Maddala & Lahiri, 1992). Looking at coefficient magnitudes, the inflation has the highest effect on horticultural exports as it recorded the highest positive value of the coefficient. The findings from the study indicated that inflation and horticultural exports have a positive and significant relationship in long-run. Similar results were observed by Rono and Rotich et.al. (2018) who identified that changes in inflation rate and export volumes affects export earnings positively in many flower firms in developing nations. Likewise, Gylfason (2001) also found positive long-run relationship between inflation rates and exports. On contrary, Meme (2015) and Oliver (2014) argued that an increase in inflation rate will cause decrease in horticultural exports in Kenya. This is because increasing inflation translates to an increase in cost of borrowing as a result of increased cost of production that reduces horticultural exports.

The results show that exchange rates have a positive significant coefficient at 5% level which is consistent with economic theory. This implies that increasing exchange rate by 1% causes horticultural exports to increase by 0.20% in long-run. These findings are in line with results of Meme (2015), Shane et al. (2008), Chege et al. (2014) and Mesike (2010). Devaluation of the local currency against those of their major trading partners makes horticultural exports more competitive therefore increase in demand. Pierola and Freund (2012) also document that low exchange rate volatility causes exports to increase. Likewise, Bhattarai and Armah (2005) have observed similar findings in Ghana. On the other hand, Serenis (2011) and Wang and Barret (2007) found contrary results after observing that exchange rates negatively influence exports.

In case of interest rates, the results document negative and significant impact from long-run interest rates to the horticultural exports. It implies that a one percent increase in the levels of interest rates causes a drop in horticultural exports by approximately 0.24% in long-run. This negative relationship sheds light on the fact that horticulture industry is a capital-intensive venture in comparison to other agricultural subsectors in terms of technology acquisition, inputs, materials required to set greenhouses structures, irrigation systems agrochemicals required. Therefore, increased interest rates by commercial banks is likely to reduce disposable incomes of investors because they will be forced to pay more money in terms of increased rates and this consequently leads to decrease in aggregate supply of horticultural exports (Meme, 2015). This finding is parallel with Adofu et al. (2010), Kaabia and Gill (2000), Keror et al. (2018), and Mabeta (2015).

4.4. Diagnostic of the Model

Below we also present diagnostic tests of our model for robustness.

Table 5. Lagrange Multiplier Test for Serial Correlation

Lag order	Chi^2	Prob> Chi^2
1	77.0429	0.1269
2	79.6318	0.1955

***H_0:** no autocorrelation at a specified lag order*

***H_1:** presence of autocorrelation at a specified lag order*

The LM test is employed in order to check if the residuals of the VECM model has autocorrelation problem. Table 5 shows that the residuals of the VECM model are not serially correlated with lags of one and two. Thus, the analysis fails to reject the null hypothesis.

Table 6. Jarque-Bera Test for Normality

Equation	Chi^2	DF	Prob > Chi^2
INF	2.92	2	0.3423
EXR	3.46	2	0.1887
INT	1.57	2	0.4670
HOE	1.56	2	0.5400
ALL	7.84	8	0.3560

We have also employed Jarque-Bera test for normality in order to check whether sampled series are normally distributed or not. Table 5 reports output of this analysis where it shows that all the Jarque-Bera statistics fails to reject the null hypothesis which is *"sampled data is not significantly different from normal"*. Thus, the analysis confirms that all sample data have normal distribution.

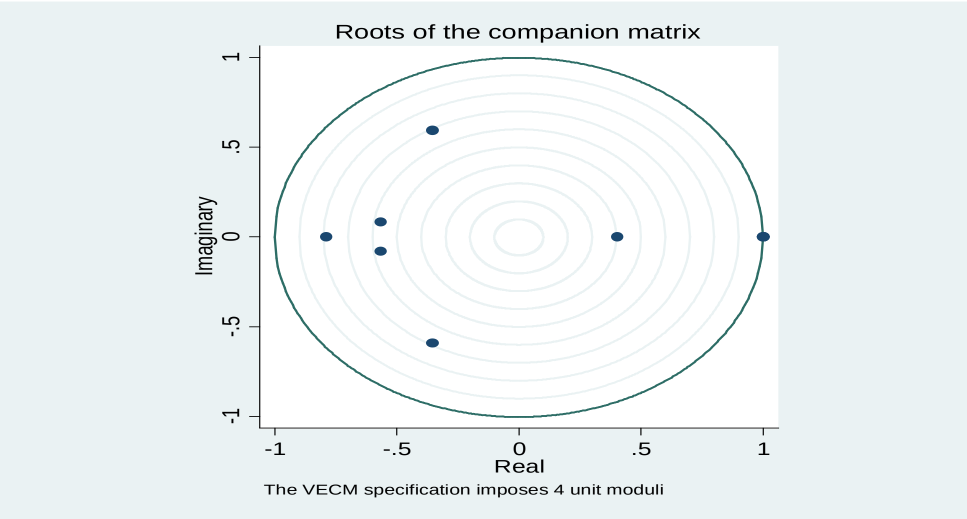
Moreover, we also examine whether the model comprises any multicollinearity problem or not. The multicolinearity refers to the case in which two or more explanatory variables in the regression model are highly correlated, and make it difficult to isolate their individual effects on the dependent variable. Using Variance Inflation Factor (VIF) test, we estimate VIF value for each of the independent variables in the model. The mean of variance inflation factor is calculates as 1.18 which is threshold below ten. Thus, the analysis confirms absence of multicollinearity in the model.

Table 7. Variance Inflation Factor

Variable	VIF	1/VIF
INF	1.27	0.7853
EXR	1.23	0.8122
INT	1.04	0.9613
Mean VIF	**1.18**	

Lastly, we observe Eigen values on a complex plane in order to check stability of the VECM model. Below figure 1 shows graphical illustration of the roots of companion matrix plotted on a unit circle. The figure clearly reveals that none of the Eigen values appear closer to the unit circle and none of them lie outside the unit circle boundaries. This suggests that the model is stable and properly defined.

Figure 1. Unit Circle – Roots of Companion Matrix



6. Conclusion

The study examines effects of inflation rate, exchange rate and interest rate on value of horticultural exports in Kenya for the period 2005-2017. It documents several results using VECM analysis.

First, inflation rates, exchange rate, interest rates, and horticultural exports are co-integrated in long-run and inflation, exchange, and interest rates have significant long-run impact on horticultural exports as they account 74.03% of its variation.

Second, the VECM model finds negative and statistically significant error correction term (ECT) as -0.0853. It confirms that 8.53% speed of convergence towards its long-run equilibrium and indicates that adjustment of error shock will take approximately 11.72 months to correct itself.

Third, the study finds positive impacts from inflation and exchange rates, while negative impact from interest rates to horticultural exports. In other words, 1% increase in inflation rates, exchange rates, or interest rates will lead to 0.35% increase, 0.20% increase, or -0.02% decrease in long-run horticultural exports respectively.

Fourth, the negative long-run relationship of interest rates and horticultural exports sheds a light on the fact that horticulture industry is a capital-intensive venture in comparison to other agricultural subsectors and when commercial bank and other lending institutions increases interest rate, it increases cost of borrowing which discourages businesses owners from borrowing to finance their horticultural production. This will eventually lower aggregate supply and thereby leading to low horticultural exports.

7. Policy Implications

The study recommends to the government that there is need to formulate both long and short-term economic policies that stimulate investment opportunities in horticultural sector. This can be done through encouraging both local and foreign investors to invest in agricultural subsectors such as horticulture production by creating conducive environment for investment. The government through Central Bank of Kenya needs to stabilize macroeconomic environment that is essential in formulating trade policies to increase horticultural exports by finding out an appropriate exchange rates and finding appropriate strategies to control inflation rate. This can be done by CBK through application of monetary policy instruments such as regulation of foreign reserves and money supply. From the findings of the study, it is recommended, that there is need for commercial banks to further reduce interest rate. This can also be achieved through radical changes in the borrowing structure and application of monetary policies such as credit control.

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