

Analysis of Structural Breaks in Inflation, Exchange Rate, Interest Rate and Horticultural Exports in Kenya

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Abstract

The main objective of this study was to identify the major structural breaks associated with horticultural exports in Kenya using time series variables. To achieve this objective of the study, monthly secondary data was sourced from Central Bank of Kenya. The sample period was 2005 to 2018. The variables that were used are exchange rate, interest rate, inflation and horticultural exports. Structural breaks were tested by application of Clemente-Montanes-Reyes with both Additive and Innovative outlier unit root test to allow for multiple breaks. Results indicated that some of the variables had significant structural breaks while some recorded some insignificant structural breaks. The structural breaks were also variable specific and were associated with key changes in both policy and international economic episodes. This shows that Kenya's horticultural exports are affected by both domestic and international events and there is need by policy makers to factor in the effects of structural breaks in designing export policies.

Keywords: Kenya; Unit root; Structural breaks

Introduction

Agriculture industry is the most important sub-sector in the Kenyan economy given its contribution to employment, foreign exchange earnings, food, and its linkages with other sectors of the economy, Salami et al., [1]. It has been argued that after industrial revolution and the phasing out of political-economic conflicts industrial and investment sectors were regarded as the most important drivers and determinant of economic growth and development but this is not the case given its high versatility agriculture is still the most decisive and major contributor sector in national developments [2]. In Kenya, agriculture was one of the first sectors to be fully devolved to county governments in Kenya underscoring the importance of county governments in ensuring food security in the country.

The sector is still the most significant in economic development and a major component of gross domestic product of the developing countries. In 1980s, Kenyan real GDP annual average growth rate was 4.56% and dropped to annual average of about 2.07 % during liberalization era with agriculture accounting for about 16%. In the 2000s the real GDP annual growth rate rose to 3.43% and this was attributed to increased exports of agricultural products with horticulture contributing to a larger percentage [3,4]. However, there has been a decrease in agricultural productivity attributable to changes in financial sector, latest being 2007 and 2009 financial crisis. This has also been aggravated by vagaries of drought that negatively affected agricultural production hence reducing GDP growth rate. This decrease was further accelerated by the post-election violence that rocked the country in 2007/2008. These factors have interlocked together to negatively affect agricultural production and restraint the rate of GDP growth in Kenya. GDP from Agriculture in Kenya decreased to 207970 Million KES in the third quarter of 2017 from 267619 Million KES in the second quarter of 2017. GDP from Agriculture in Kenya averaged 205042.23 Million KES from 2009 until 2017, reaching an all-time high of 286308 Million KES in the first quarter of 2017 and a record low of 142195 Million KES in the fourth quarter of 2009. Consumer prices in Kenya increased by 4.5 percent year-on-year in December of 2017, easing from a 4.7 percent rise in the previous month. It was the lowest inflation rate since May 2013, as prices grew slower for food, housing, and utilities. Inflation Rate in Kenya averaged 10.09 percent from 2005

until 2017, reaching an all-time high of 31.50 percent in May of 2008 and a record low of 3.18 percent in October of 2010 [5].

Overall Export Performance of Horticultural Subsector in Kenya

In the recent past horticulture has received a lot of concern from international NGOs, government due to rapid and growing of export sector to the European countries [6]. In 2011 USA, allowed Kenya to export fresh French bean and this showed that there is room for expansion of export market for agricultural product outside its traditional markets in Europe. Overall exports to the European market started to increase in the 1970's with the Netherlands being the largest importer, taking a 71 per cent share by volume, with most distributed through the auction system. Next is the United Kingdom on 20 per cent, followed by Germany on 6 percent, France, Switzerland, Belgium and Italy. Other importing countries include Saudi Arabia and South Africa [5,7].

Exports are crucial in the process of growth and the expansion of the exports is an important part of economic growth process. Export promotion has been commercial policy issue that has attracted a lot of devotion both at national and international levels [8]. Kenya government is focusing on export promotion of their products mainly due to the shrinking local markets. The export sector of a given country is very crucial, as it is a source of growth, which can be attributed to the foreign exchange earnings. This is evident in the Kenyan horticultural sub-sector, which has been significant over the last decade in generation of the foreign exchange and in employment creation. Above all, horticultural export sub-sector in a number of African countries is considered a major significant factor to economic development [9].

Kenya's ability to provide high quality products on a year-round

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basis, backed by daily airfreight arrivals to key destinations and several interceptions due to MRLs exceed in Europe causes Kenya's horticultural exports increase, while the decrease was associated with unfavourable weather conditions in Kenya that resulted in low yield and consequently low export volumes, inability of farmers in accessing quality seeds for some vegetables, lack of value addition technologies and high post-harvest losses.

Statement of the Problem

Kenya's economy is highly dependent on exports of agricultural products. However, the stability of their markets is not guaranteed as it is highly unstable in terms of exchange rate fluctuation, inflation, price and declining global income in the recent past over the past decade [10] as a consequence, the consumption of many high priced agricultural items typically fresh fruit and vegetables has been static or declining and that market demand is stagnating, while the supply of flowers is abundant [11].

i. To determine the structural breaks associated with horticultural exports in Kenya.

Study Hypotheses

The following hypothesis was tested:

Ho1: There exist no structural breaks associated with horticultural exports in Kenya.

Aggregate Supply Response Theory

Kenya like any other third world countries has stagnated and the recent emphases on market-oriented strategies have re-introduced interests in the role of agricultural sector. The impact of structural reforms among many of low-income countries especially in agricultural sector is highly dependent on agricultural aggregate supply response how the magnitude of these parameters is still unclear. Aggregate supply theories on agricultural exports have taken different dimensions. Several studies in the world have used different approaches in estimating the effects of some variables on agricultural exports in a country or different countries Wani [12]. The approaches adopted have been motivated by increased land sizes and improved technologies in horticultural production that have adopted by various players in the sector.

Seasonality in production continues to characterize price horticultural products at different levels of production and consumption. One of the approaches used to assess supply response is the Nerlovian approach. Nerlove [13] modelled aggregate supply response of a commodity to incorporate price dynamics and partial adjustment both in the short run and in the long run.

$$Q_t^d = \beta_1 + \beta_2 P_t^e + \beta_3 Z_t + \mu_t \tag{1.1}$$

Where;

Q_t^d : The quantity of desired output

β_s : Parameter estimates

P_t^e : The expected prices

Z_t : Set of exogenous variables that affects horticultural production

μ_t : The unobserved random effects that affect output and its expected value is zero with zero variance

Since the total supply of the horticultural supplies could be

constrained by several other factors, then output could differ then Nerlove model is adjusted so as;

$$Q_t - Q_{t-1} = \delta(Q_t^d - Q_{t-1}) + \gamma_t \tag{1.2}$$

$$Q_t = Q_{t-1} + (Q_t^d - Q_{t-1}) + \gamma_t \tag{1.3}$$

Where;

Q_t = total output at period t, Q_{t-1} is the total output at period t-1 and δ is the partial adjustment parameter and its values ranges between 0 and 1. It is described a partial adjustment since the level of output cannot be obtained by the farmers due to constraints in policies. When Nerlovian model is used to model time series data it may produce spurious R2 to overcome this problem vector error correction model is usually applied.

Research Design

Research design refers to the plan of action that links the philosophical assumptions to specific methods. A research design is a basic arrangement of conditions and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure. The study utilized time series research design.

Data Types and Sources

The researcher utilized monthly time series data covering the period 2005-2017. This period was selected because of availability of data for all the variables under study. Exchange rates (in percentage) were obtained from International Monetary Fund, Horticultural exports (Kshs in millions) and inflation rates (in percentage) were extracted from Central Bank of Kenya.

From Table 1, there were 156 observations. Inflation rate recorded a mean of 8.2692 and a standard deviation of 3.7388 implying a high variation in the rates of inflation. Exchange rate posted a minimum of 85.8410 and a maximum of 102.8410. Interest rates registered a mean of 15.2272 percent and a maximum of 20.3400 percent. On the other hand, horticultural exports had a mean of Ksh 5415.37 (Million), a maximum of Ksh 9493.3000 (Millions) and a minimum of Ksh 1977.27 (Millions).

Unit Root Tests

Some of macro-economic variables are sometimes not stationary in nature and the impact of shock on the variable may result into its elimination from the series. If there is stationarity among variables, then the mean and the variance are a function of time. If time is taken to be infinite, then the variable also assumes infinity and moves away from equilibrium path. As a time series property, unit root test was performed. The order of integration of each of the time series variables was determined using and Augmented Dicker Fuller tests.

Unit Root Tests with Structural Breaks

A structural break occurs as a result of abrupt policy change in economic entity that can be reflected by legislation, institutional, or technical changes [14]. It can be a change in an economic policy or large

Variables	Mean	Std. Dev	Min	Max
Inflation	8.2692	3.7388	4.5263	1.8500
Exchange rate	102.0723	10.7734	85.8410	107.8410
Interest rates	15.2272	2.0618	12.1200	20.3400
Horticultural exports	5415.37	1753.52	1977.27	9493.3000

Table 1: Descriptive statistics.

macroeconomic episodes such as oil crises of 1970s. This can cause a variable to become non-stationary and have a permanent pattern on economic series [7]. Structural break tests help to determine when and whether there is a significant change in data. A structural break test produces unbiased results and identifies the point in time when the break occurred. Test for structural breaks is normally done by Zivot-Andrews test [15], Clemente-Montanes-Reyes [16].

Zivot and Andrews test with one structural breaks

The critical values for Zivot and Andrews tests are 1%: -5.34 5%: -4.80 10%: -4.58 [15]. The cumulative effects of various policy measures by the government on the Kenyan economy especially on the horticultural subsector was tested whether it has brought any significant structural break and in this regard ZA test was applied to show the significance of these breaks in the horticultural subsector. Zivot and Andrews [15] noted that there is high likelihood of rejecting the unit root hypothesis when conventional methods of testing the presence of unit root such as Philip Perron and ADF are used without considering structural breaks. Philip-Perron and Dicker-Fuller methods assumed the structural break as exogenous factors. Zivot and Andrews proposed a method of endogenizing the break at the intercept in analysing times series unit root tests. In the recent past [15], Lee and Strazicich [17] suggested a minimum Lagrange Multiplier structural unit root test

with two structural breaks. Results of Zivot-Andrews test are presented in Table 2 [15].

The results for Zivot Andrews unit root tests allowing for one structural break in the intercept is presented in Table 2 [15]. It indicated one significant structural break for inflation in 2014 which is explained by the spill over effects of multiparty elections of 2013 which saw a lot of money being pumped into economy in the run up elections. Exchange rate recorded a significant structural break in the year 2007. This is attributable to post poll chaos that led to depreciation of Kenya shilling against major world currencies. Interest rates attested a significant structural break in 2011 at 5% level of significance and this is explained by Kenya economic recovery despite the rise in world’s oil prices, which worsened Kenya’s terms of trade, reduced the rate of economic growth and fuelled inflation. Kenya’s liberalized economy became more open and its balance of payments improved, with rising exports and higher foreign reserves. Horticultural exports reported a significant structural break in 2012, this was linked to a strong demand for flowers, canned fruits and vegetables in the USA, and this helped grow Kenya’s exports to the USA owing to a new range of products allowed to enter the key market under the ordinary trade and the preferential African Growth Opportunity Act (AGOA). Zivot Andrews with one Structural break is shown on the graphs below in Figure 1 [15].

Variables	t-statistics	Critical values			Lag(s)	Break Dates
		1%	5%	10%		
INF	-4.1080**	-5.34	-4.80	-4.80	3	2014
EXR	-3.9190**	-5.34	-4.80	-4.80	1	2007
INT	-4.4660*	-5.34	-4.80	-4.80	3	2011
HOE	-11.4750*	-5.34	-4.80	-4.80	0	2012

**Variables that are statistically significant at 5% level of significant
*Variables that are significant at 1%.

Table 2: Results of Zivot Andrews unit root tests with one structural break in the intercept.

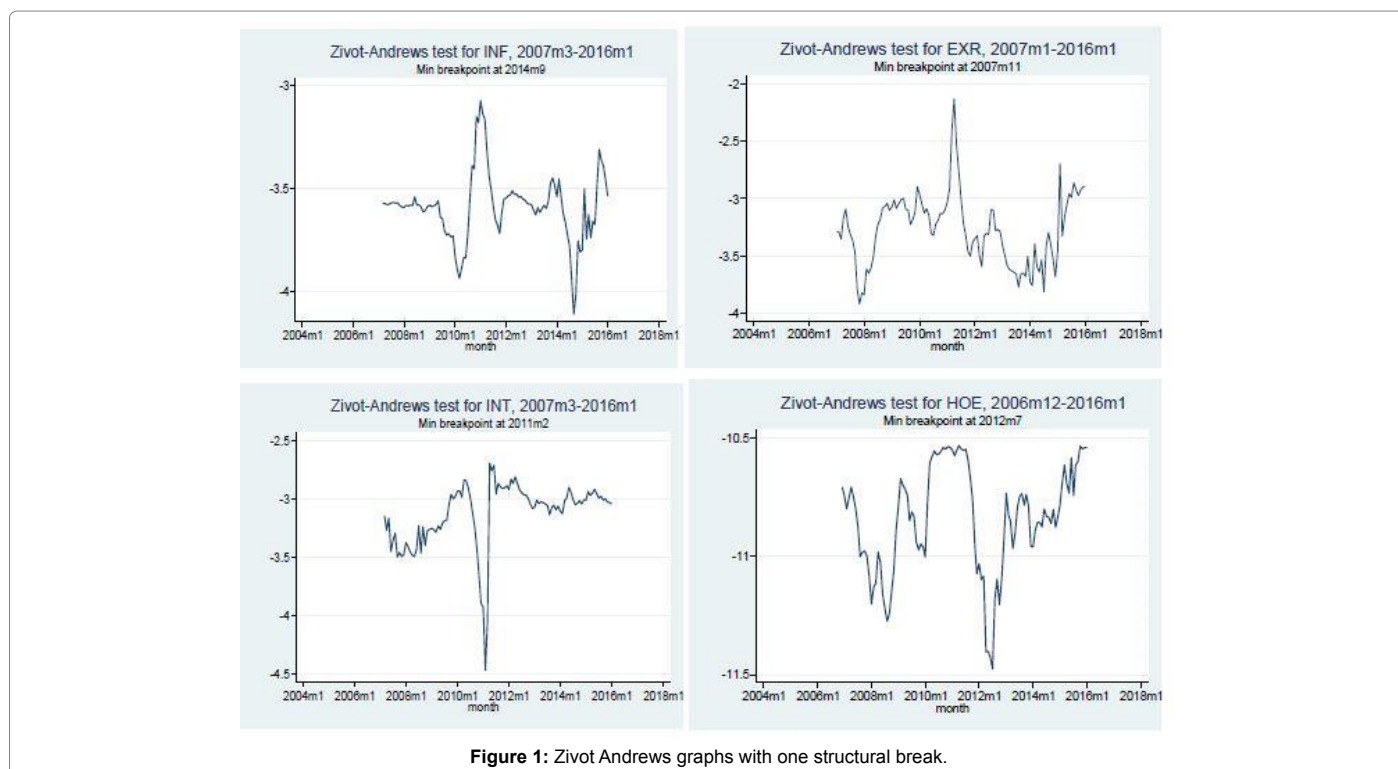


Figure 1: Zivot Andrews graphs with one structural break.

Clemente-Montañés-Reyes unit-root test with single mean shift, AO model with two structural breaks

The next step of data analysis was to test for unit root with two structural breaks and results are presented in Table 3. Zivot-Andrews test for unit root takes into account only one structural break in time series data while there might be more than one structural break in the system. It was therefore necessary to perform Clemente-Montañés-Reyes [16] tests to test the presence of two structural breaks in each of the univariate time series.

Clemente-Montanes-Reye tests indicated that there are two structural breaks for inflation [17]. The first and second breaks occurred in 2013 and 2015 respectively with (p-value 0.000<0.05) and was associated with spill over effects of tightened monetary in 2013 to curb the rising food prices occasioned by unfavourable weather conditions in Kenya [18] and this effect caused inflation rate to be sustained above single digit.

Exchange rates recorded two significant breaks in 2012 and 2015 (p-value 0.000<0.05). The first break in 2013 was associated with the uncertainties that emanated from general election of 2013 and the possibilities of changes in regime shift. The other significant break was in 2015 and this was associated with pressures from balance of

payment that weakened and sustained volatility of exchange rate in Kenya. Interest rate registered one significant structural breaks in 2009 (p-value 0.000<0.05). This structural break was occasioned by the anticipation of commercial bank to adjust lending interest rate upwards that stood at 12.76% [19].

Horticultural export indicated two significant two structural breaks in 2009 and 2015 (p-value 0.000<0.05) as shown in the graphs below. The first structural break in 2009 is explained by slowed economic growth of 1.7% in 2008 and 2.60% in 2009. Economic performance was adversely affected by three factors as follows: the global economic turndown depressed export markets, rainfall was erratic, which impacted the agriculture and energy sectors, and the post 2008 election violence which caused a reduction in horticultural exports 2015 structural break is attributed to unstable Kenyan exchange rate (Figure 2).

Conclusion

This study analysed the structural breaks within the horticultural exports in Kenya. The results of vector error correction model showed that that horticultural exports, horticultural exports, interest rates, exchange rates and inflation had significantly influenced horticultural exports in Kenya.

Variable	Breaks	Coef	T-Stat	P-Value	Break
INF	D1	6.8717	6.1860	0.0000	2013
	D2	-7.6569	-6.1310	0.0000	2015
EXR	D1	-10.5337	-8.9340	0.0000	2012
	D2	-11.7082	-8.2320	0.0000	2015
INT	D1	2.9763	8.4790	0.0000	2009
	D2	-5.1180	-1.5118	0.1233	2002
HOE	D1	10.96226	4.0880	0.0000	2009
	D2	12.5047	3.5900	0.0000	2015

Table 3: Clemente-Montañés-Reyes unit-root test with two structural breaks.

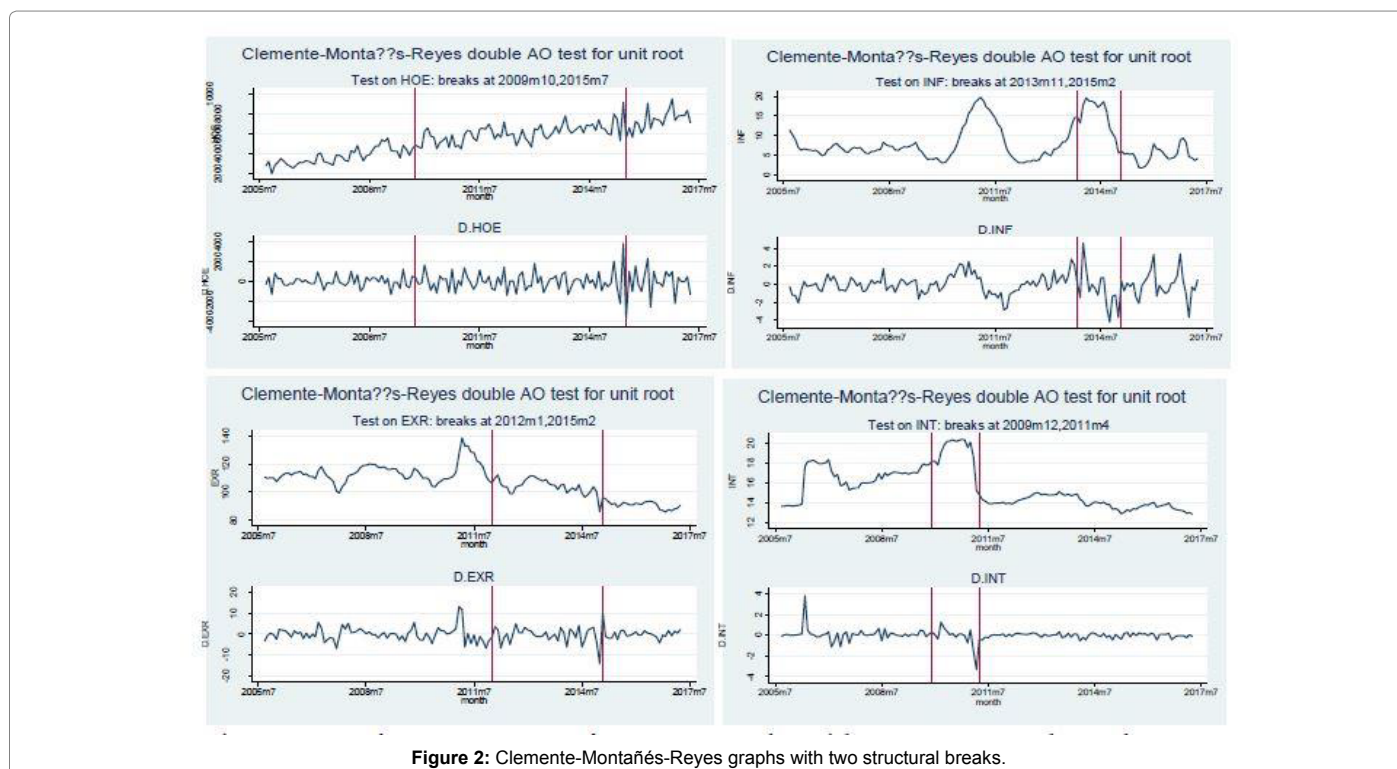


Figure 2: Clemente-Montañés-Reyes graphs with two structural breaks.

Recommendation

This indicates that Kenya's horticultural export was affected by both domestic and international economic events. Policy makers should take into account structural breaks or changes in designing policies concerning horticultural exports.

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