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SUPPLY RESPONSE OF TEA EXPORT TO LEVELS OF RAINFALL IN KENYA

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Abstract

Tea export in Kenya has witnessed an ever ascending trend in metric tonnes but also depicted a volatile cyclic character. This study looked into the causes of these fluctuating volumes and how the tea export supply responds to rainfall. Time series data for years 1980 through 2015 was used. The autoregressive distributed lag (ARDL) approach to cointegration employed here gives consistent estimates of supply response in the presence of regressor endogeneity and also permits the estimation of distinct estimates of both long-run and short-run elasticities when exogenous variables are not integrated of the same order. The results from the study revealed the significance of rainfall in sustaining tea export supply in Kenya.

Keywords : Long-run, Short-run, Tea Export Supply, Tea Export Supply Response

I. Introduction

In the world, the second mainly accepted non-alcoholic beverage after water is tea and it is enjoyed by both the rich and poor in a similar way (Werkhoven, 1974). Tea drinking originated in China in the 6th century B.C and it was adopted by bordering states in South East Asia, for instance Japan. Tea history in Kenya started from as early as 1903 when a European settler, Mr. G. W Cain initiated the earliest tea shrub in Limuru region of Central Kenya. Commercial production of tea in Kenya began in the 1920s (Republic of Kenya (RoK), 2012). The tea industry got bigger after the 2ndWorld War, although development was restricted to money-making lands up to 1957 and subsequently the adoption of Swynnertton plan 1954 helped a lot (Kenya Tea Development Agency (KTDA), 2012). The Swynnertton plan aimed at deepening growth of agricultural sector in Kenya (Lamb and Muller, 1982).

Tea is produced best in tropical red loam mixed with volcanic soils found in the higher altitudes of Kenya usually between 1500m and 2700 m above sea level. The soils are required to be well drained within two meters depth and a PH range between 4.5 and 6.5. The crop thrives with rainfall ranging from 1200 to 2500 mm annually, preferably with long and sunny intervals (Owuor, 2011). The tea in Kenya is mainly grown in area as sited in and about the highland areas on both sides of the Great Rift Valley; and on both sides of the Equator in altitudes between 1500 meters and 2700 meters above the sea level.

The Kenyan tea contributes to about 22 per cent of the export share worldwide. In 2016, Kenya was among the top producers of black tea in the world while UK, Egypt and Pakistan were the principal purchasers (Tea Board of Kenya (TBK), 2012). Even if Kenya does not lead in producing tea in the world, it is majorly the most significant country in exporting tea (International Tea Committee (ITC), 2010).

A major problem of tea export in Kenya is rainfall. Drought is a key climatic change aspect that is affecting tea industry in Kenya; tea farmers in Nyeri indicated that low rainfall, extreme cold or heat and frost were some of the climatic changes they were experiencing (Maina *et.al,* 2015). During the drought periods production of tea decreases by very vast margins which causes a lot of sadness particularly to small holder farmers. A good example is

the years 1997 and 2000 droughts which enforced output to fall by approximately 15 percent. There was reduction in supply especially in the first half of 2015 where production dropped by 6 percent However, from the start of year 2016, production had gone down by 30% (KTDA 2016).

Statement of the Problem

Tea has remained to be one of the major primary exports in Kenya. Tea production in Kenya has repeatedly indicated a rising movement for years. A sustainable tea export particularly in countries which are in developing stage, for example, Kenya can help farmers to rise out of poor quality life and convert their farming activities to profitable business operations. It can also reduce the impact of poverty on the environment and kindle economies locally. However, the volume of tea exported from Kenya over the years display a fluctuating, repeated character (Fig. 1).

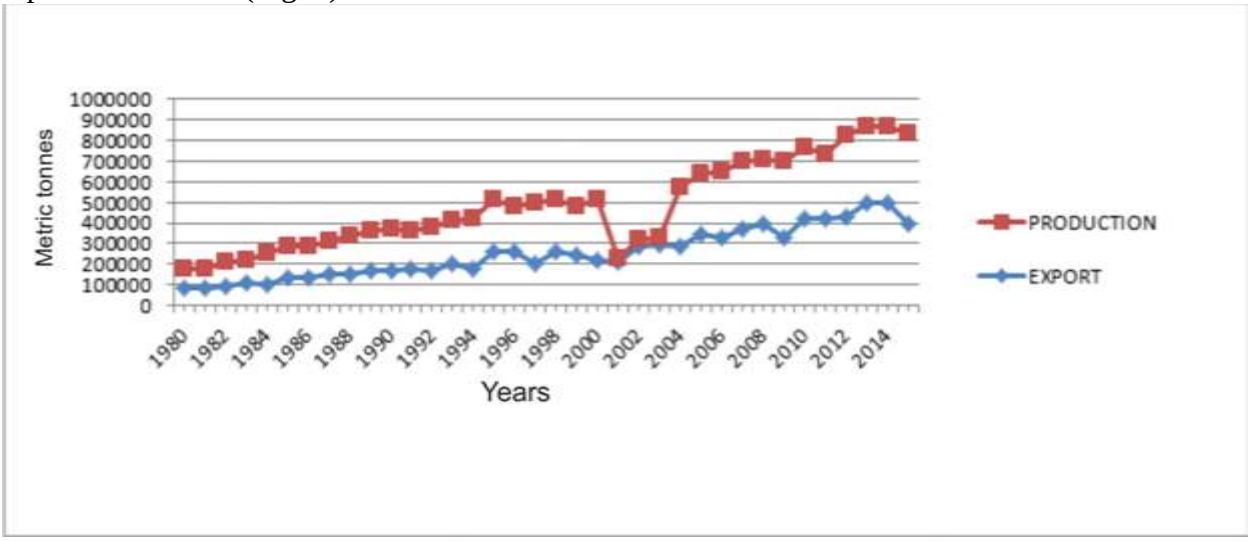

Figure 1: Tea production and export in Kenya from year 1980-2015
Source: Tea Board of Kenya (2016)

The tea export has faced problems of variations of weather/climate change impact which result to lower quantities of tea being produced for exports, price and exchange rate fluctuations, and, dependency on few main markets for export, decrease in world tea prices which results in a decrease in what tea export earns internationally among others. All these factors mainly in Kenya have affected export earnings which is a component of the GDP in the countries producing tea. Various studies on the determinants of tea export in Kenya have been done; (Kagira (1994); Were, et al., 2002; Nzioki, (2005); Miano, 2009; Jeptoo, 2010) some of these studies did not include climatic conditions: rainfall which is an important factor in the tea export. The studies provided mixed findings because of the methodology used and the sample sizes.The study fills the gap of incorporating rainfall as a dummy variable and not linearly as in case of Miano (2009); and which was not included in the study of Jeptoo (2010); Jeptoo's study had 14 observations only which is an undersized sample size and finally the researcher employed a different methodology from what Miano (2009) and Jeptoo (2010) used. The rationale of this research was to look into rainfall and tea export fluctuations and give a thoughtful knowledge of the tea export supply as well as determine the magnitude of the supply responses in tea export supply.

II. Research Objective

To investigate the supply response of tea export to levels of rainfall in Kenya.

III. Research Question

What is the elasticity of rainfall levels on tea export in Kenya?

IV. Literature Review

Theoretical Framework

This study analyzed tea exports supply based on Goldstein and Khan (1985), and Islam and Subramanian (1989) theory. According to Goldstein and Khan (1985), country's export supply relies on four variables: the level of domestic price within the country in relation to the price of exports in market q, output in country calculated via its deviation from trend, extra factors including weather conditions, which influence the nation's exports; and a time trend (t) that give explanation about issues that influence the production of export of a country over time. As shown in equation (1).

$$XVS_{pq} = \beta_0 (PD_p)^{\beta 1} QT_p^{\beta 2} Z_p^{\beta 3} T^{\beta 4} e^{ut} \quad (1)$$

Where: QTp = GDPp/GDPTp

XVSpq– this is the supply of export from country p to country q and it relies on four variables: the level of domestic price in country p-(PDp) in relation to the price of exports in market q - (PXpq); produce in a nation p is calculated by its deviation from trend (QTp); additional factors (Zp), for instance weather conditions, which have an effect on the nation's exports; plus a time trend (T)

GDPp is an index of a nation p's home production. GDPTp is an index of nation p's probable home production. Apart from prices all the other variables are measured in U.S. dollars. In equation (1), it is expected that exporters will raise their supply given that the price of exports in home currency goes up comparatively to a proxy for domestic costs. Therefore, coefficients β l and β2 are anticipated to be positive while, β3 and β4 are anticipated to be indeterminate. The reason being that export supply is greatly influenced by authorized price-incentive policies, tax, trade strategies and by the lengthy growth times essential for some crops prior to increased output can take place, these effects are captured by dummy variables where possible (Goldstein and Khan, 1985). Changes in real export to the supply of export implicitly occur in a period of one year.

Nevertheless, some crops call for a longer gestation periods prior to increased output can take place, furthermore for exporting groups containing a bigger share of these crops in their exports, the coefficients will be inclined downward (Islam and Subramanian (1989).

Imperfect Substitute Theory

Islam and Subramanian (1989) and Goldstein and Khan (1985) recommended that the fundamental hypothesis of the imperfect substitute form is that both imports and exports aren't perfect substitute for domestic goods. This is because; if domestic and foreign goods were perfect substitutes, some countries would be exporters others importers. This model discriminates both short-term and long-term fluctuations and in this case long-term variations are grasped by a trend term (Islam and Subramanian, 1989). The short-term variations in supply are transmitted from the domestic production of the exporting group (measured by deviations from trend) to their own exports.

Goldstein and Khan (1985) revealed that the benefit of having both the supply side and the demand side of the imperfect substitute model would clearly show the association between quantities and prices simultaneously. Nonetheless, most of the time-series works on import and export equations are concentrated on the supply side only by assumption. The popular

practice is the assumption that the supply-price elasticities for imports and exports are infinite. Thus, the Goldstein and Khan (1985) and Islam and Subramanian (1989) theories are interconnected and one theory builds on another. This imperfect substitute model was adapted in this study.

Empirical Literature

Rudaheranwa, *et.al* (2003) in their study used Nerlove (1958) model and the secondary data of crop production, acreage, domestic consumption, rainfall and export prices among others to analyze the supply response of crops in Uganda. They found that the supply response to changes in price is very inelastic for all the crops under consideration. When prices increased by 100%, the supply of coffee and tea increased by only 33%. There was also insignificant response to exchange rate. The current study also analyzed the supply response of tea to price incentives and non-price incentives using ARDL.

Kanwar (2004) used regression analysis on a panel data pooled using a random effects model concerning the Indian agriculture. The study covered the years 1967-68 to1999-00. Seven main yearly cash crops cultivated across sixteen most important states were considered. The study presented approximation of yield, area, and output elasticities considering price and non-price variables. The investigation indicated that the supply response of Indian farming was biased to the accessibility of input; weather and particularly irrigation, probably fertilizer and prices. Rainfall was found to be the sole mainly significant feature influential on area response. It was the second most vital feature influencing produce response and shows the largest elasticities of output. This study also looked into the supply response of tea commodity, tea producer price index and non-price incentives.

Miano (2009) used the Nerlovian Model on the determinants of tea export supply in Kenya. The exchange rate was found to influence the quantity produced and the quantity exported. A positive relationship suggests that tea producers may be reactive to price incentives through exchange rates and total tea exports. The price of inputs was found to be very important in the enhancement of the Kenyan tea industry especially the export sector. The current study also looked into the response of tea export to exchange rate but using ARDL. The study fills the gap of incorporating rainfall as a dummy variable and not linearly as in case of Miano (2009).

V. Research Methodology

Empirical Model Specification

This study employed co-integration and error-correction modeling to examine the causal association between tea export and producer price index of tea, exchange rates, tea domestic product, rainfall and GDP by use of yearly data from 1980 to 2015. The study employed, a bounds testing technique to co-integration, in an autoregressive distributive lag (ARDL) framework, brought forth by Pesaran along with others (Pesaran and Pesaran,1997; Pesaran and Shin,1999; Pesaran *et.al*.,2001), due to its advantages as discussed: it calculates approximately the short- and long-run elements of the model concurrently, getting rid of problems connected with variables not there and autocorrelation; it is also useful when the sample size of data is undersized (Pesaran *et. al.,* 2001), thus carrying out bounds testing was appropriate for the research; the standard F-statistics employed in the bounds test has a non-standard distribution under the null hypothesis of no-co-integration association among the inspected variables, regardless of whether the fundamental variables are I (0), I(1) or fractionally integrated.

Another advantage according to Harris and Sollis (2003) is that this technique in general offers unbiased estimates of the long-run model and a legitimate t-statistic yet a number of the regressors may be endogenous. Pesaran and Pesaran (1997) have revealed that the endogenity bias might correct itself when dynamics are included. The co-integration relationship can be estimated using a simple Ordinary Least Square (OLS) method after the orders of the lags in the ARDL model have been fittingly chosen. Finally, the parameters in both short run and long-run of the model can be projected all together.

The tea export supply function estimated in this study is a modification of equation (1) since some factors were dropped and others adopted due to unavailability of data, where price and non-price variables take the following general form:

$x_t^s = PPI_t^{\alpha 1} TDP_t^{\alpha 2} GDP_t^{\alpha 3} ER_t^{\alpha 4} DR_t^{\propto 5}$ .....(2)

Where:

x_t^s = Volume of tea export supply, PPI= producer price index, TDP= tea domestic product, GDP = Gross Domestic Product, ER = exchange rate, DR= dummy variable for rainfall. Below is a linear function form:

$x_t^s = A+\alpha_1 \log PPI_t+\alpha_2 \log TDP_t+\alpha_3 \log GDP_t+\alpha_4 \log ER_t+\propto_5 DR_t$ .....(3)

The constant term is interpreted as the level of output that would be produced regardless of the level of price as well as additional variables built-in in the model are equal to zero. A Dummy variable or Indicator variable does not have logarithm because it is a non-natural variable formed to signify a feature in the midst of two or more different stages or groups and the numbers assigned to it do not have intrinsic meaning of their own.

The study selected orders of the ARDL model through the use of Schwarz Bayesian Criterion (SBC). If the lag length is excessively diminutive, the model could be rnisspecified and if it is excessively big, degrees of freedom would be thrown away, (Enders 1995). The orders of the lags in the ARDL model are selected using either Akaike information criteria or the Schwartz-Bayesian information criteria. For annual data, Pesaran and Shin (1999) suggested utmost two lags

Data Type and Sources

This research study sourced secondary data from institutions that store reliable data that is used by researchers' including economists. These institutions include among others; Kenya National Bureau of Statistics (KNBS), the Tea Board of Kenya (TBK), and World Bank database. In addition the KNBS publications such as the Economic Survey and Statistical Abstract, for the years covered by the study, were used to dig out data essential for the study.

VI. Research Findings and Discussion

Supply Response of Tea Export to Various Incentives

The study found the response of tea export supply by having the OLS equation estimated. A regression analysis was involved between the differenced value of volume of tea export supply against the values of annual average rainfall dummy variable. An error correction model (ECM), co integration analysis provides a technique of attaining in parts approximations of both the short-run and long-run elasticities.

The response of tea export to levels of rainfall dummy variable was positive and statistically significant at 1 per cent level. For a unit change in yearly average rainfall, the model

predicted that volume of tea export supply responded positively by 198.5 percentage points increase when rainfall is at optimal level. This means that rainfall is a major factor that affects tea export supply in Kenya. The results also concur with findings by Maina *et.al*, (2015) where tea farmers in Nyeri indicated that low rainfall, affect productivity of tea and reduces yield significantly. Production plunges vast resulting to lots of sadness particularly by peasant farmers during the times of drought.

Other studies on the climate changes, shows that a small increase is actually expected in mean annual rainfall, by approximately 2 per cent by 2025 and 11per cent by 2075 (Bore, 2015). However, this increase will be outweighed by increases in temperature, the associated increases in evapo-transpiration, and changes in rainfall distribution; so that on average there will be more periods and areas experiencing water deficit (Bore, 2015; Cracknell, 2015).Yield of tea shrubs is decreased by drought because little amount of soil moisture lessen photosynthesis process as well as existence of plants and their development (Cheserek *et al.,* 2015). The shallow roots of clonally tea shrubs are mainly vulnerable to erosion effects and drought; furthermore they show severe stress throughout dry spells (Ahmed, *et al.,* 2014).

Although leaf 'quality' can be retained during a drought (Ahmed, *et al*., 2014); currently droughts incur average annual yield losses of between 12-20%, depending on the clonal stock and the length of the drought (Bore, 2015).The impact of change in climate on production of tea was carried out in Kenya during a workshop that was held in the year 2013. Presently in Eastern Africa, tea is produced in rainy highlands, although rainfall patterns have proved more and more unpredictable as compared to the precedent decade. Modern tea-producing regions have got an occurrence of a customary 3-month dry spell season amid December and March, which is capable of creating losses that ranges between 14 and 30 per cent in output (FAO 2015).

VII. Conclusion of the Study

The study concluded that rainfall is a key factor in determining the supply response of tea export in Kenya. Too much rainfall delays the harvesting of tea hence reducing the produce while too little rainfall lowers the yield. Low production results into lower tea exports.

VIII. Recommendations of the Study

To cope with uncertain rainfall distribution, water conservation and management options are also promoted, including the introduction of cost-effective drip irrigation to improve soil water content and yields. The government through the ministry of agriculture can help the farmers to monitor weather patterns in order to maintain the quantity produced which translates into tea export in Kenya. Irrigation is particularly instrumental in raising tea domestic product which translates into high quantities of tea exports resulting into high tea export supply response in Kenya.

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