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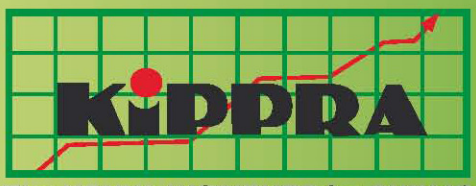

The KENYA INSTITUTE for PUBLIC
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Supply Response of Kenya's Primary Exports to Price and Non-Price Factors: The Case of Coffee and Tea

Priscilla Wanjiku Mugo

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YOUNG PROFESSIONALS (YPs) TRAINING
PROGRAMME

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Trade and Foreign Policy Division

Kenya Institute for Public Policy
Research and Analysis

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Abstract

This paper sought to empirically estimate the export supply response of coffee and tea in Kenya. The export supply models for both coffee and tea exports were developed and estimated using the Nerlovian technique. The paper used annual data for the period 1980 to 2014 while E-Views was used in fitting and testing of the models. The model estimates suggest that the supply of coffee exports is significantly influenced by its price, production, agricultural Gross Domestic Product (GDP) and real estate growth in the short-run, while in the long-run, only production is significant. The results also indicated that coffee exports in the previous year were important predictors of coffee exports. However, real exchange rate and openness index were not important predictors. On the other hand, estimates of the tea model revealed that own price, agricultural GDP, production and lagged tea exports were statistically significant determinants of export supply in the short-run, while in the long-run, production and agricultural GDP were statistically significant predictors. The overall conclusion is that long-run elasticities are larger when compared with the short-run ones, since agricultural policies take time to affect the agricultural sector due to time lags in production. There is need to establish stabilization measures to keep farmers producing enough quantities for large scale exports. In addition, improved productivity in tea and coffee is key in improving the quantity and quality of coffee and tea exported.

Abbreviations and Acronyms

ADF	Augmented Dickey-Fuller
AGOA	African Growth Opportunity Act
CBK	Central Bank of Kenya
CBS	Central Bureau of Statistics
COMESA	Common Market for East and Southern Africa
EATTA	East African Tea Trade Association
EAC	East Africa Cooperation
ECM	Error Correction Model
EGCS	Export Guarantee and Credit Scheme
EPC	Export Promotion Council
EPZ	Export Processing Zone
EU-ACP	European Union – Africa-Pacific Caribbean
IEA	Institute of Economic Affairs
GDP	Gross Domestic Product
GoK	Government of Kenya
KTDA	Kenya Tea Development Agency
MTP	Medium Term Plan
MUB	Manufacturing Under Bond
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Squares
TOT	Terms of Trade
UNIDO	United Nations Industrial Development Organization
UNCTAD	United Nations Conference on Trade and Development
WDI	World Development Indicators
WTO	World Trade Organization

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1. Introduction

1.1 Background Information

The export performance of any country highly determines the prospects for economic growth. There is a close relationship between economic growth and exports, in that if exports grow faster than imports, economic growth will be enhanced and foreign exchange earnings will increase over time (Sajjad and Mahmood, 2014). Exports stimulate economic growth in many ways, including employment creation, enhanced competitiveness, and promotion of overall economic development.

However, according to the Organization for Economic Cooperation and Development - OECD (2012), developing countries are challenged in harnessing this power mainly due to domestic supply-side constraints to their productive capacity. Economists have argued that emphasis on demand factors in determining the export performance of developing countries is largely misplaced, and that instead, Love (1982) remarks that supply factors play a more dominant role. He further claims that the capacity to supply exports for small open economies is important, just like demand for its export is, and therefore supply of exports should be an area of focus. Additionally, Lepetit and Barek (2011) argue that increasing the capacity to supply exports will increase exports, and this will consequently increase earnings to finance development activities.

Agricultural commodity exports are the most important source of exports for most countries in Africa, except in a few mineral resource-rich African countries. Amoro and Shen (2013) further stress that most African countries export unprocessed agricultural commodities. In Sub-Saharan Africa, agriculture accounts for about 40 per cent of Gross Domestic Product (GDP) and contributes 15 per cent to its exports. Moreover, about 75 per cent of Sub-Saharan population engages in agriculture, making the agricultural export sector the single-most important sector in this region. Further, the sector has contributed to poverty reduction and provides raw materials to agro-manufacturing industries (World Bank, 2008). However, Dramé–Yayé et al. (2011) point that support to this sector has over time declined, and African countries have been unable to expand the capacity to supply exports (Ng and Yeats, 2005; United Nations Industrial Development Organization - UNIDO, 2006; Marco, 2008; and United Nations Conference on Trade and Development - UNCTAD, 2008). According to Kandiero and Randa (2004), failure to expand the capacity for exports supply inhibits trade opportunities. Furthermore, Mayer and fajarnes (2005) argue that there should be deliberate efforts towards exports expansion for economic growth. Towards

this, Marco (2004), has shown that for a given level of international markets access, countries with higher export supply export more and grow faster.

Kenya's export structure is similar to most African countries', as it is largely dominated by agricultural primary commodities. Its major export commodities include tea, coffee and horticulture.

1.2 Overview of Kenya's Export Policies

The key objective of the Kenya National Trade Policy is to promote and expand Kenya's export of goods and services. Expanding Kenya's primary exports is one of the means of increasing incomes and foreign exchange earnings, stimulating industrial expansion, and raising incomes. With trade liberalization, the role of trade and particularly exports cannot be over-emphasized, especially for a developing country such as Kenya. Kenya Vision 2030 envisages industrialization and middle income status for Kenya, and realizing this goal requires Kenya to expand its current level of exports.

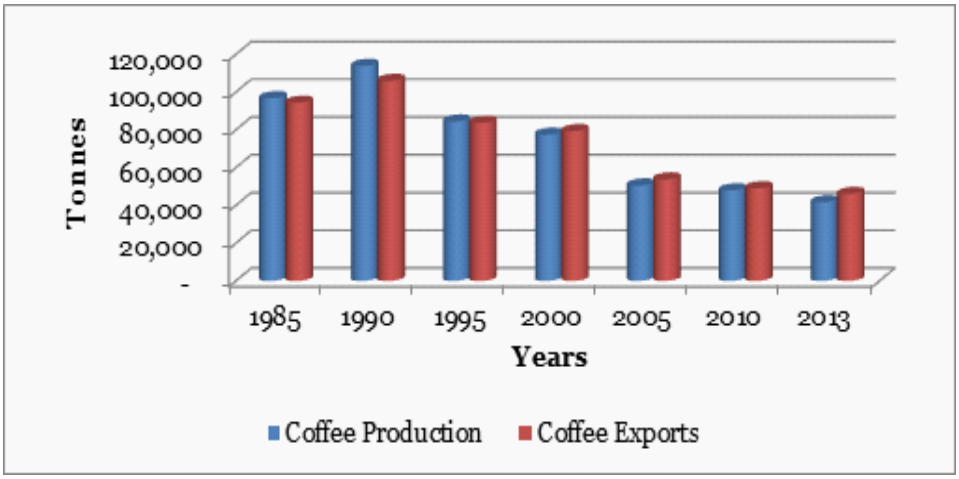
During the first decade after independence, Kenya was under the import substitution strategy. This export policy was meant to substitute externally-produced basic goods and services with locally produced ones. According to Were et al (2002), this resulted in significant growth in the manufacturing sector. This is because the strategy was highly capital-intensive and had high import requirements that threatened Kenya's balance of trade position. From the early 1980s, there was a policy shift from the inward looking import substitution to a more outward looking export promotion policy. The government liberalized the economy, and the first development strategy referred to as *Sessional Paper No. 1 of 1986 on Economic Management for Renewed Growth* was developed (Were et al., 2002). Through this development strategy, the government committed to liberalize the economy and improve the then deteriorating performance of exports. Within this framework, a number of reforms were introduced, including the export compensation scheme, the Manufacturing Under Bond (MUB) reforms, and the establishment of Export Processing Zones (EPZs). Other incentives to promote exports were also introduced, including the Export Guarantee and Credit Scheme and the establishment of the Export Promotion Council, among others. However, these incentives were biased towards labour-intensive manufactured exports than agricultural commodity exports. Recently, Kenya has made attempts to open its trade further through regional economic integration, but this strategy, like other previous policies, favours Kenya's manufactured exports than agricultural exports. Further, markets for Kenya's agricultural exports are constrained to

traditional European countries, and in their primary form without any value addition (Government of Kenya, 2014).

1.3 Overview of Kenya's Coffee and Tea Export Performance

Kenya's leading exports are agricultural. They include tea, coffee and horticulture and they contribute approximately 50 per cent of total exports (Government of Kenya, 2014). The importance of exports to the economy of Kenya, therefore, cannot be over-emphasized. At independence, coffee was the leading export commodity. However, coffee production and exports have shown a continuous decline (Figure 1.1). Within the same period, other countries such as Brazil and Vietnam increased their coffee exports and have established their dominance. Between 2001 and 2013, for instance, Kenya's coffee exports declined by about 33 per cent from 62,000 tonnes to about 41,700 tonnes in 2013. Bagal et al. (2013) attributes this decline to low coffee export prices that have discouraged production. Moreover, Kenya exports its coffee to Germany, Belgium and Sweden. This has remained the same over time, further putting pressure on the exported quantity.

Figure 1.1: Kenya's coffee production and export, 1985-2013

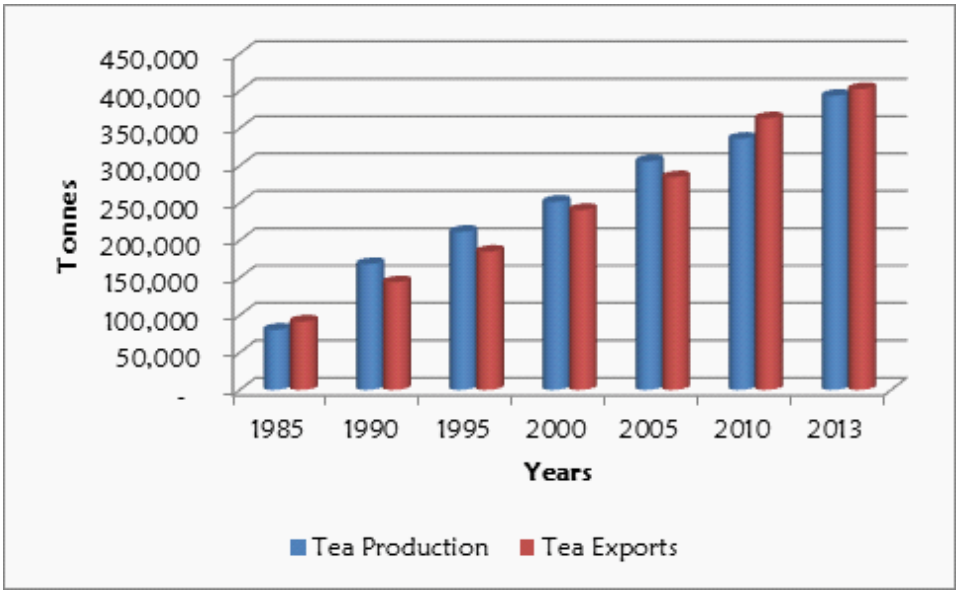


Source: Authors' construct from KNBS (Various), Economic Survey

On the other hand, tea exports have improved over time, and are currently the second highest foreign exchange earner after horticulture. About 95 per cent of Kenya's total tea production is exported, and the market share is estimated at about 27 per cent of the world's tea trade. Tea production in Kenya has increased consistently and currently stands at an all-time high of slightly over

445,000 tonnes (Figure 1.2). The major tea markets include Pakistan, Egypt, United Kingdom and Sudan. Other major world tea producers include Sri Lanka, China and India. However, Kenya still needs to increase its production, hence its exports, in order to increase earnings. Nyangweso and Odhiambo (2004) reiterate that a favourable export supply-side environment can be achieved by ensuring a favourable production environment, and providing adequate market information, research and extension services and infrastructure.

Figure 1.2: Kenya's tea production and export, 1985-2013



Source: Authors' construct from KNBS (Various), Economic Survey

Given the importance of coffee and tea commodities to Kenya's economy, there is need to identify the extent to which price and non-price factors affect the export supply of these commodities. Maugu et al., (2013) point that the Government of Kenya acknowledges that increasing the supply of exports would contribute significantly to economic growth and farmers' welfare. The ever increasing imports as compared with exports has led to the worsening balance of trade position and declining export earnings for Kenya.

1.4 Constraints to Export Supply of Tea and Coffee in Kenya

The factors that constrain export supply of tea and coffee in Kenyan can be categorized as either price or non-price factors. These factors are production-related, regulatory-related, international market challenges, as well as international market forces. Export supply constraints of tea include reliance on

old tea gardens, which are past productive age, low quality and undifferentiated tea (Kagira et al., 2012), high inputs and operational costs, poor information access especially by the smallholder farmers, and inadequate training leading to poor farm management practices (Mwaura and Muku, 2007). Further, tea farmers lack effective representation at the Kenya Tea Development Agency (KTDA) and the East African Tea Trade Association - EATTA) (Kagira et al., 2012). This leaves tea farmers disfranchised and it affects production. Other non-price constraints to export supply of tea are administrative challenges at the KTDA - and its poor operation and coordination, coupled with inconsistent leaf collection methods leading to significant wastage and losses (Kagira et al., 2012). Lastly, fluctuation of tea prices highly impacts on incomes, and this forms a major problem affecting tea production and therefore exports of tea in Kenya (Nyaga and Doppler, 2009). Export supply constraints of coffee include the decline in production volumes. Monroy et al. (2013) notes that coffee marketing channels have negatively affected farmers' incomes in form of high transaction costs. Such costs are attributed to coffee cooperative societies' inefficiencies that leave very low returns after sales. This is the major reason for the decline in coffee production, and worse abandonment of the crop.

1.5 Statement of the Problem

Kenya's Medium Term Plan envisions the country becoming a regional and international competitor in agricultural exports by raising both quality and quantity. In addition, the Exports Promotion Council targets an annual volume growth of 10 per cent in exports in order to hasten Kenya's economic growth (http://epckenya.org/index.php?option=com_content&task=view&id=544&Itemid=253). Therefore, Kenya has implemented various export growth strategies, and trade liberalization has not only expanded markets through various bilateral and multilateral framework agreements, but has also reduced trade barriers under the World Trade Organization (WTO), all meant to positively impact Kenya's exports. However, the value and scope of exports has not been increasing in tandem.

The repressed growth of Kenya's exports due to failure to expand production is a key concern to policy makers. The reduced exports consequently have led to increased imbalance, since exports are not growing in tandem with imports, making the economy vulnerable to external shocks. Currently, Kenya's main exports do not earn enough to pay for its imports, leading to increased external financing and a widening current account deficit, at 9.1 per cent and 8.4 per cent of GDP in 2011 and 2012, respectively (World Bank, 2013). In view of this, expanding export supplies of coffee and tea would contribute significantly to

improved export performance. Furthermore, it is easier to increase agricultural exports in the short-run relative to manufactured exports, since they are less capital and technology intensive.

1.6 Research Questions

(i) To what extent do price and non-price factors affect export supply of tea in Kenya?

(ii) To what extent do price and non-price factors affect export supply of coffee in Kenya?

(iii) What policy proposals can be made to increase supply of tea and coffee exports in Kenya?

1.7 Objectives

The overall objective of the study is to estimate the export supply response of Kenya's primary export commodities (tea and coffee). The specific objectives are to:

(i) Estimate the effects of price and non-price factors on the export supply of coffee in Kenya.

(ii) Estimate the effects of price and non-price factors on the export supply of tea in Kenya.

(iii) Make policy proposals meant to increase the supply of tea and coffee exports in Kenya.

1.8 Relevance of the Study

The Kenyan economy is highly dependent on agricultural exports, whose poor performance negatively affects economic performance. This has led to calls for diversification of Kenya's exports. There is need to increase Kenya's exports in order to increase Kenya's foreign exchange earnings and enhance overall export performance. The overall success of an exports strategy would depend on factors that increase export growth and trigger farmers' responsiveness to changes in price and non-price factors. Therefore, a better understanding is needed of the key factors affecting agricultural commodity export performance. The knowledge of how export supply responds to price and non-price factors will help policy makers formulate appropriate policies on how to increase export supplies that would in turn generate adequate foreign exchange to finance development projects. The study will also add to the existing literature on export supply response.

2. Literature Review

2.1 Theoretical Literature Review

Most studies use time series data to model supply response for either aggregate or individual crops. There are three main theories in modelling supply response by farmers. These include the supply function approach (profit maximization approach) developed by Griliches (1959, 1960), rational expectations approach by Muth (1961) and the Nerlovian approach developed by Nerlove (1958).

The supply function approach estimates output supply response based on aggregate of input demand and a Cobb-Douglas production function with a vector of *n* inputs differentiated with respect to the producer price. Assuming that the farmer's intention is to maximize profits, the output elasticity with respect to input is estimated by the value share of input *i* in total revenues. Total supply elasticity is then obtained by aggregating input demand price elasticities in accordance with their factor shares in total revenues. Short-run and long-run elasticities are then estimated by introducing lags in the input demand functions. If output is assumed to reach equilibrium if all inputs are in equilibrium, then short-run aggregate supply response to prices is given by the weighted aggregate short-run input demand elasticities, while the long-run supply response is obtained from the weighted aggregate long-run input demand elasticities. However, this method has several limitations. First, it requires comprehensive input price data, which is not usually available in developing countries, making its application more ideal for developed countries. Secondly, it assumes that increased use of purchased inputs would increase total supply. However, this does not account for inputs not purchased by farmers such as family labour. Thirdly, this approach presupposes that the inputs supplied to the agricultural sector are perfectly elastic and meet the farmer's demand at going prices. However, this is not applicable for most developing countries, since they import most farm inputs, which could be constrained by shortages in foreign exchange.

The rational expectation approach developed by Muth (1961) is based on the optimizing behaviour of economic agents and it depends on future events, a major limitation for this methodology. This is because such events are rare, non-accurate and unrealistic. This limitation makes the Nerlovian approach more ideal, since data on prices and quantities are easily available. The Nerlovian approach, developed by Nerlove (1958), examines farmers' output reaction based on price expectations, and captures the dynamics of agriculture production. Further, it enables estimation of short and long-run elasticities, and the model is flexible in introducing non-price production shift variables. According to Nerlove, the desired output can be expressed as a function of the expected price and other

exogenous shifters. It also focuses on the speed and the level of adjustment of actual acreage and yield towards the desired acreage.

This study focuses on the output supply function, and therefore, the Nerlovian approach will be used.

2.2 Empirical Literature Review

Empirical works on the export supply responses of agricultural commodities have taken different approaches. Various models have been used to explain the behaviour of exogenous and endogenous variables, as well as agricultural export growth in an economy or in a group of countries.

Maugu et al.,(2013) investigated the determinants of agricultural crop exports (pyrethrum, tea, horticulture and coffee) supply for Kenya using annual time series data for the period 1963-2012. Using the profit maximization approach, the results showed that real exchange rate was a significant determinant of pyrethrum, tea, and horticulture exports but not of coffee export. GDP, a proxy for productive capacity, was found to be significant in determining exports for coffee and tea aggregate. El-Nino rainfall, as captured by a dummy, was significant for coffee exports, while trade liberalization, also captured by a dummy, was only significant in determining pyrethrum exports.

Mofya et al., (2012) examined the supply response of coffee to various incentives (coffee prices, prices of competitive crops, real exchange rate) and economic reforms in Zambia using the Engle and Granger cointegration model. They found that there exists a long-run relationship between coffee supply and all the explanatory variables. Specifically, changes in the real exchange rate had the most significant effect on coffee supply, whereby the depreciation of the Zambian Kwacha led to increased supply of coffee. Additionally, economic reforms had a positive and statistically significant impact on coffee production (supply). However, the price of competing crop with coffee had no significant impact on coffee supply.

Mesike et al., (2010) analyzed the supply response of rubber farmers to prices and other factors in Nigeria using co-integration and Value at Risk (VAR) technique on time series data from 1970 to 2008. The results were that producer's prices and structural break (deregulation) significantly affected rubber supply, even though response to price of rubber were low at an elasticity of 0.373 in the short-run and 0.204 in the long-run. The significance of the producer's price implied that increasing producer prices to the world price level would trigger a positive response to increasing output. In addition, the significance of structural breaks meant that abolishing the cocoa marketing boards (deregulation) had a positive

effect to rubber output, since it favoured farmers by increasing cocoa output. The study further suggested that policy efforts to promote sustainable marketing and high value quality products for exports were important considerations in understanding farmers' responses to incentive changes.

Okon and Sunday (2014) investigated supply response of seven agricultural export commodities from Nigeria: cocoa, benniseed, rubber, palm-oil, ground nut, cotton seed, and soybeans between 1970 and 2010, using the econometric Error Correction Model. They found that response of export supply to changes in relative price was positive and fairly significant for all the crops, except cocoa and soybeans. Both output growth and credit to the agricultural sector had positive and significant effects on the export supply of all the commodities, while change in road network positively and significantly affected export supply of three commodities. The exchange rate was significant for four commodities and positive in all the products. Rainfall was positive and significant to perennial crops only (cocoa, rubber and palm-oil). Short-run export supply responses ranged between 0.01 - 0.77 and were smaller than the long-run responses of between 0.22 - 28.09. The results pointed significant sensitivity of the commodities under consideration to output growth, credit to agricultural sector, and improved road network, such that price incentives alone are not sufficient to generate the desired level of export, and therefore attempts to increase the export supply of these commodities should be more on their productivity. Moreover, the exchange rate appreciation may not hurt exports much, if at all, and policies that would stimulate increased production of exports should have significant considerations on climatic conditions.

While examining the aggregate export and food crop supply response in Tanzania, McKay et al. (n.d.) analysis suggested that total production would respond if constraints are relaxed and incentives improved. The study observes that farmers are highly responsive. For instance, liberalization of agricultural markets (increasing the effective prices paid to farmers), was effective in increasing production. The study further suggests that other complementary interventions – improving the infrastructure and marketing, enhanced access to inputs and finance, improved production technology, etc – are most likely to make producers more responsive in expanding total agricultural output.

Tchereni and Tchereni (2013) used the following explanatory variables in analyzing the supply response of maize to price and non-price incentives in Malawi:

- Hectarage
- Producer price of maize
- Producer price of tobacco

- Producer price of rice
- Rainfall
- Fertilizer
- Transport

This explained 81.27 per cent of the variation in maize hectarage in the period 1970-2005. Further, rainfall was found to be significant at 5 per cent due to the fact that weather is a key factor affecting agricultural production, while fertilizer was significant at 10 per cent, emphasizing the fact that more fertilizer translates into increased hectarage.

Gbetnkom and Khan (2002) used Ordinary Least Squares (OLS) estimation procedure while analyzing the determinants of three agricultural exports (cocoa, coffee and banana) in Cameroon between 1972 and 1996. The results were that the export supply response of all the three crops to relative price changes was positive and significant. Similarly, changes in the road network positively affected the export supply of all the three commodities. Similar results were obtained for the credit variable, while rainfall though positive, was insignificant for bananas. The results point out that price incentives are not sufficient to induce the preferred export supply of agricultural commodities, and that the positive and significant effects of credit, improved road networks and specific policy changes implemented, leads to the conclusion that efforts to increase the supply of agricultural export in Cameroon should centre on these variables. In another analysis discussing factors that affect Cameroon's exports of coffee, cocoa and cotton using co-integration and error-correction procedures, Tambi (1999) found that GDP, lagged quantities of cocoa and coffee and export/domestic price ratio explain changes in exports of cocoa.

Boubacar (2001) analyzed the agricultural supply response for export crops to world price and exchange rate in Niger. Using a profit function approach, the results obtained showed that the supply response elasticities were positive and significant for almost all export crops. For peanut and cotton, their price elasticities of supply were relatively higher at 1.50 and 0.80, respectively, compared to those of onion and cowpea at 0.30 and 0.04, respectively. The elasticities were lower for onion and cowpeas due to the limiting factors that constrain production - lack of irrigated land. The impact multipliers indicated that a depreciation of nominal exchange rate led to an increase in supply and exports for all export crops in the study. Exchange rate elasticity of peanut exports and supply was higher compared to the other crops, since a more tradable commodity is more responsive to macro-policies that affect the real exchange rate.

Ghafoor et al., (2013) analyzed the factors impacting on mangoes exports from Pakistan using the co-integration approach and ECM for the period 1970-2005. Mango exports was regressed against the index mango exports relative prices, real agricultural GDP, length of all-weather roads, quantity of mango production, and dummy variable of WTO agreement to determine the impact international standardization would have on mango exports in Pakistan. The results obtained show that the relative price index variable (it shows the relative profitability of selling mangoes in export markets) was significant both in the short and long-run, at one and five per cent level of confidence, respectively. It also had a positive sign implying that a rise in relative price in the export market increases mango exports from Pakistan. Equally, mango production (both in the short and long-run) was significant and positive; as expected, an increase in production increases the level of exports from Pakistan. Real agricultural GDP (indicator for the pace of relative economic growth and market size) was also significant, implying that an expansion in real agricultural GDP increases mango exports. The impact of infrastructure development was assessed using the length of all-weather roads as a proxy. The variable was found to be insignificant in the short-run, but significant at a 10 per cent level of confidence in the long-run. However, the direction of the variable was consistent (positive), implying that increasing the length of roads would increase mango exports. However, the impact of international standardization was insignificant in the long-run.

A model of export supply response of the Australian citrus industry was developed and estimated using co-integration and ECM techniques for the period 1983-1993 (Gunawardana et al., 1995). The estimates suggested that the supply of citrus exports is inelastic with respect to relative price even in the long-run. The results also show that domestic production capacity was significant and had a positive impact on export supply.

Haleem et al., (2005) examined factors that cause changes in the volume of citrus exports from Pakistan, using time series data from 1975-2004. The variables considered included domestic prices, export prices, GDP and foreign exchange rates, while employing co-integration and ECM techniques. The results show that the Gross Domestic Product, domestic and export prices, level of production, and foreign exchange rates were the most critical factors affecting volume of citrus exports. The estimated results revealed the importance of price and non-price factors in explaining the citrus export supply function. For price factors, the export price (international price) played a very critical role in citrus export, with an export price elasticity of 1.48 while domestic price elasticity was -0.98. Overall results suggested that external factors (the exchange rate and export price) played

a more leading role than internal factors in explaining variations in citrus exports from Pakistan.

Boansi et al., (2014) studied the determinants of fresh pineapple exports in Ghana using the Ordinary Least Squares (OLS) estimator. They found that 97.52 per cent of variations in the volume of pineapple exports were explained by the variables used in the model. Specifically, the export price and the real effective exchange rate were insignificant to the volume of pineapple exports. However, all other variables were observed to be in conformity with the prior expectation. Particularly, the index of openness to trade (proxied by Terms of Trade –TOT- was significant at the 10 per cent confidence interval, and yielded positive effects to both value and volume of exports. Therefore, a major conclusion was that openness to trade increases opportunities for countries to export more.

2.3 Overview of Literature

The reviewed empirical work for Kenya used the profit function approach, while this paper uses the Nerlovian approach, which is flexible in adding other non-price production factors. Secondly, this paper analyses export supply for tea and coffee for the period 1980 to 2014. In addition, the paper will update the existing literature work in supply response studies.

3. Methodology

3.1 Analytical Framework

Nerlovian model is built to examine the output reaction based on farmers' price expectations formation (Nerlove, 1958). It uses time series data for the commodity/ies being studied to capture agricultural production dynamics. This approach enables the determination of both short and long-run elasticities. It is also flexible, such that non-price production shifting variables can be introduced in the model. Supply response models can be formulated in terms of area, yield or output response.

Following this, the desired output in period *t* is a function of expected price and a number of exogenous factors.

$$y_t^* = \alpha_0 + \alpha_1 p_t^e + \alpha_2 z_t + \mu_t \qquad (1)$$

Where y_t^* is desired output in period *t*; p_t^e is the expected price; z_t is a set of other exogenous factors and μ_t accounts for unobserved random factors affecting production.

Since full adjustment to the desired level of output may not be possible in the short-run, actual adjustment will only be a fraction of the desired, and equation (2) then becomes the partial adjustment model. Therefore, actual change in level of output in period *t* depends on the gap between the desired level and last period's actual output. Then δ determines the speed of adjustment, where $0<\delta<1$. If $\delta=0$, there will be no adjustment and if $\delta=1$, it means that output will adjust fully to the long-run target at equilibrium. The functional model can then be stated as:

$$y_t - y_{t-1} = \delta(y_t^* - y_{t-1}) + \mu_t \qquad (2)$$

Where y_t is the actual output; δ is the partial adjustment coefficient and μ_t is the random term.

Similarly, the price farmers expect cannot be observed. Therefore, price expectations are formed based on actual and past prices and other observable variables. Farmers' price expectations are a fraction, λ, of the difference between the expected and the actual price in the last period.

$$p_t^e - p_{t-1}^e = \lambda(p_{t-1} - p_{t-1}^e) + v_t \qquad (3)$$

Re-arranging Equation (3) becomes:

$$p_t^e = \lambda p_{t-1} + (1-\lambda) p_{t-1}^e + v_t \text{ , } o<\lambda<1 \qquad (4)$$

Where p_t^e is the expected price; p^e_{t-1} is the prevailing price for production decision making; λ is the adaptive expectations coefficient and v_t is the random term.

Since the expected output and price are not observable, we substitute Equation (1) and Equation (4) into Equation (2), and rearranging it gives the reduced form as:

$$y_t = \alpha_0 \delta + \alpha_1 \delta p_{t-1} + \alpha_2 \delta z + (1-\delta) y_{t-1} \qquad (5)$$

Equation (5) implies that output supplied can be expressed as a function of its own lagged value and price with a short-run elasticity of $a_1\delta$. This means that the supply function can be derived from the partial adjustment perspective, that is the actual change in output in one period is a fraction δ (such that $o<\delta<1$) of the change required to achieve the desired output (y_t^*). Simplifying the equation further gives the following equation:

$$y_t = \beta_0 + \beta_1 p_{t-1} + \beta_2 y_{t-1} + \beta_3 z_t + \mu_t \qquad (6)$$

Where: $\beta_0 = \alpha_0 \delta$; $\beta_1 = \alpha_1 \delta$; $\beta_2 = 1-\delta$; $\beta_3 = \alpha_2 \delta$

Thus, the Nerlovian model to be used for estimation is a distributed lag model with lagged dependent variable in the model. The short-run supply response of each independent variable is estimated directly by its coefficients while the long-run responses are obtained by dividing short-run elasticities by the adjustment coefficient.

3.2 Empirical Model Specification

Equation (1) is modified to include non-price factors (Gbetnkom and Khan, 2002). Accordingly, two (2) long-run models for this study will be specified to capture the relationship between export supply of each of the select two (2) agricultural export commodities and their prices and non-price factors between 1980 and 2014.

The export supply function of coffee is specified implicitly as follows:

$$Lxc_t = \beta_0 + \beta_1 Lpx_{t-1} + \beta_2 Lxc_{t-1} + \beta_3 rer + \beta_4 Lq + \beta_5 Lagdp + \beta_6 Lpc_t + \beta_7 oi + \mu \qquad (7)$$

Where:

xc_t=export supply of coffee measured in tons

px_{t-1}= coffee export price in the previous period

xc_{t-1}=coffee exports in the previous period

rer_t=real exchange rate

q_t=coffee produced (output)

$agdp_t$=agricultural GDP

pc_t=price of the competing crop/sector

oi_t=openness index

μ=error term

L is the log form, since variables in question are in logarithms. β_o is autonomous export of coffee while *β1, β2…….β7* are short-run elasticities.

The export supply model for tea is specified as follows:

$$Lxt_t = \beta_0 + \beta_1 Lpx_{t-1} + \beta_2 Lxt_{t-1} + \beta_3 rer + \beta_4 Lq + \beta_5 Lagdp + \beta_6 Lpc_t + \beta_7 oi + \mu \qquad (8)$$

All variables are as defined above.

3.3 Measurement of Variables and Priori Expectations

Table 3.1 presents the dependent and independent variables, their description, priori expectation as well as their source of data.

3.4 Econometric Estimation Technique

In this sub-section, time series characteristics of the variables to be modelled will be examined to test for stationary and co-integration of variables in the two (2) equations under consideration. Unit root tests will investigate whether the data is stationary in order to avoid getting spurious results. The co-integration analysis will test whether the explanatory variables are co-integrated. Error Correction Model (ECM) is used to estimate the long-run relationship among the variables.

Table 3.1: Variables and their descriptions

	Variable	Unit of measure	Source	Description	Expected sign
	Export supply	Tonnes	Economic surveys	This is the dependent variable	
	Independent variables				
Price factors	1. Exports Price (px)	Kenya shillings	Economic surveys	This is the price at which export commodities (coffee and tea) are sold in the international market, whereas a high price encourages more exports and vice versa.	+
	2. Real exchange rate (RER)	This is a measure of competitiveness	Economic surveys	This is a financial incentive, whereby, a depreciation of the Kenyan shilling would be an incentive to export and vice versa. It is calculated as follows; Where NER is nominal exchange rate, PD is domestic/producer price, and PF is export price (foreign)	+/-
	3. Price/ contribution of a competing sector/crop		Economic survey	This indicates the relative profitability of the competing crop/sector. In the tea model, it will be proxied by price of maize, while in the coffee model, it will be proxied by contribution of the real estate sector to Kenya's GDP.	
Non-price factors	4. Production (Q)	Tonnes	Economic surveys	It is a key supply side determinant of exports, and a good harvest increases the probability of exporting more.	+
	5. Agricultural GDP	Kenya shillings	Economic survey	This indicates the pace of relative agricultural economic growth and also shows the size of the agriculture market in Kenya. A higher agricultural GDP represents good performance of the sector.	+
	6. Openness Index	Index	Data on all variables from the economic survey.	This measures how open the Kenyan economy is.	+

Source: Author's compilation (2015)

4. Results

4.1 Summary Statistics of the Data

The summary statistics for all the variables used in this study for the period 1980-2014 are presented in Table 4.1. The log of quantities of coffee and tea exported had a mean of 4.85 tonnes and 5.32 tonnes, respectively, and corresponding standard deviations of 0.15 and 0.23. The gap between the minimum and maximum values of both crops implies an increase in the export volumes of both commodities during the period of study. The export prices of both commodities showed similar upward trend during the sample period.

Table 4.1: Summary statistics of data

Variable	Mean	Minimum	Maximum	Std. Deviation
Coffee				
Log of exports	4.85	4.60	5.10	0.15
Log of production	4.85	4.60	5.10	0.17
Log of price of exports	2.05	1.40	2.74	0.39
Real exchange rate	1.58	0.87	1.95	0.33
Log of agricultural GDP	5.11	4.14	6.17	0.60
Log of real estate	4.57	3.43	5.62	0.63
Openness Index	0.62	0.48	0.76	0.10
Tea				
Log of exports	5.32	4.87	5.66	0.23
Log of production	5.32	4.49	5.65	0.29
Log of price of exports	1.9	1.19	2.43	0.38
Real exchange rate	49.84	7.77	86.77	27.41
Log of price of maize	2.86	1.98	3.53	0.49

Source: Author's computation (2015)

4.2 Time Series Properties and Diagnostic Tests

4.2.1 Skewness and kurtosis test

Summary statistics of variables used in this empirical study for coffee and tea are represented in tables 4.2 and 4.3, respectively. The values of the skewness and kurtosis were between 0 and 1 for all the variables in both models, which indicates that all the variables used in this study are normally distributed. The

Jarque Bella statistic tests whether the variables are normally distributed. All the probability values are greater than 0.05, indicating a normal distribution, and this strengthens the analysis.

Table 4.2: Skewness/Kurtosis tests for coffee model

Variable	Skewness	Kurtosis	JB	Prob
Log of exports	0.123	0.754	2.35	0.31
Log of production	0.103	0.615	2.85	0.24
Real exchange rate	0.721	0.017	4.44	0.11
Log of price of exports	0.106	0.814	2.11	0.34
Log of agricultural GDP	0.035	0.181	2.07	0.36
Log of real estate	0.155	0.014	1.55	0.45
Openness Index	0.450	0.648	3.16	0.14

Source: Author's computation

Table 4.3: Skewness/Kurtosis tests for tea model

Variable	Skewness	Kurtosis	JB	Prob
Log of exports	0. 427	0.251	2.04	0.36
Log of production	0.068	0.428	2.51	0.27
Real exchange rate	0.243	0.142	3.98	0.13
Log of price of exports	0.433	0.875	2.94	0.23
Log of agricultural GDP	0.035	0.181	2.07	0.36
Log of price of maize	0.425	0.806	3.13	0.21
Openness Index	0.450	0.648	3.16	0.14

Source: Author's Ccomputation

4.2.2 Unit root tests

It is well established that most time series data tend to exhibit a deterministic or stochastic time trend, making them non-stationary. Such prevalence of substantial co-movements among most economic time series data, therefore, undermine any policy recommendation that could be inferred from such a model. Therefore, time series properties of all variables used in this empirical estimation are tested for unit root using the Augmented Dick-Fuller test (ADF). The results of ADF indicate that all variables in the study are stationary after first differencing at 5 per cent level (Table 4.4).

Table 4.4: Unit root test results

Augmented Dick-Fuller Test				
	Coffee		Tea	
Variable	**Level**	**I(1)**	**Level**	**I(1)**
Log of exports	-0.187(0.930)	-4.931(0.001)	-2.995(0.046)	-13.399(0.00)
Log of production	-0.571(0.864)	-5.635(0.000)	-6.410(0.000)	-11.758(0.000)
Real exchange rate	-2.327(0.170)	-5.877(0.000)	-0.963(0.755)	-8.490(0.000)
Log of price of exports	-1.030(0.731)	-6.589(0.000)	-1.615(0.464)	-6.003(0.000)
Log of agricultural GDP	0.149(0.965)	-5.320(0.000)	0.149(0.965)	-5.320(0.000)
Openness Index	-1.177(0.673)	-5.893(0.000)	-1.177(0.673)	-5.893(0.000)
Log of real estate	-0.695(0.835)	-8.802(0.000)	-	-
Log of price of maize	-	-	-1.611(0.466)	-9.852(0.000)

Source: Author's computations; Probabilities are represented in parenthesis

This therefore means that variables to be modelled are I(1), since specifying the functions at level will be inappropriate and will lead to problems of spurious regression, making the econometric results not ideal for policy making.

4.2.3 Co-integration test

The Johansen co-integration test was used to test whether variables are co-integrated in the long-run. Using the trace statistic, coffee model showed existence of 2 co-integration equations, while tea model had 3 co-integrated equations (Table 4.5).

Table 4.5: Co-integration test results

Commodity	Trace statistic	0.05 critical value	Hypothesized No. of CE(s)
Coffee	104.051	95.75	At most 1*
Tea	69.933	69.82	At most 2*

Source: Author's computations (2015)

A conclusion from the above, therefore, is that there exists a unique long-run relationship among the explanatory variables in the two commodity export models.

4.3 Estimation Results

Since log linear forms of equations were estimated, the coefficients of the estimates are elasticities. The results of the analysis are presented in Table 4.6 and 4.7 for coffee and tea, respectively.

Table 4.6: Coffee regression results

Variable	Short-run	Long-run
Constant	0.052** (0.035)	1.224* (0.064)
Lagged price of exports	0.250* (0.06)	0.119 (0.207)
Lagged exports	0.477** (0.032)	-
Log of agricultural GDP	0.517* (0.061)	0.119 (0.207)
Log of production (Q)	0.774*** (0.000)	1.084*** (0.000)
Log of real estate	-0.480 (0.037)**	-0.144 (0.245)
Openness Index	0.078 (0.659)	0.033 (0.767)
Real exchange rate	0.284 (0.182)	0.016 (0.824)
ECT	-0.480** (0.032)	-
R^2 Durbin Watson F- Statistics Prob (F-statistic)	0.72 2.8 6.56 0.0003	0.72 2.8 6.56 0.0003

*Source: Author's computations. Levels of significance: ***1%, ** 5% and *10%, and p-values are given in brackets.*

4.3.1 Coffee model results

In the short-run, all the estimated coefficients are statistically significant, except the openness index and the real exchange rate, while in the long-run the only significant variable is production. The results further indicate that 72 per cent of variations in the coffee model are explained by the independent variables. Moreover, the significant coefficient for the error correction term gives evidence of

a co-integrating relationship between export supply and the explanatory variables and, therefore, the estimated ECM can be used to forecast future volumes of coffee exports. In addition, it signifies that any disequilibrium is corrected annually at a speed of 48 per cent.

A positive and significant relationship was found between lagged price of coffee and export supply of coffee at 5 per cent. Increasing coffee prices, therefore, influences export supply in that farmers increase production as price increases. A one per cent increase in coffee prices leads to a 0.25 per cent increase in export supply for the next period. This is consistent with the cobweb phenomenon, which stipulates that an increase in current period price of an agricultural commodity leads to its increased production in the following period. Moreover, the coefficient for the export price suggests that the supply of coffee exports is inelastic in the short-run, indicating that short-run supply adjustment to changes in prices is not instantaneous. This result is consistent with perennial crops and, thus, its output cannot be varied instantly towards a change in its prices.

The estimated coefficient for real estate as a competing sector to coffee indicates a negative and significant relationship. This result indicates that if the real estate expands, the supply of coffee reduces, due to reduced acreage of coffee plantations. Moreover, low returns from the coffee sector are likely to shift resources away to a more profitable one. As such, a one per cent increase in the returns from real estate would reduce coffee export supply by 0.48 per cent.

The coefficient of production was positive and significant as expected, both in the short and the long-run. This direction of relationship is consistent, since increasing coffee production would enhance the level of exports. The elasticity coefficient for this variable in the short-run indicates that a one per cent increase in coffee production brought 0.774 per cent in the short-run, whereas in the long-run, this elasticity coefficient increased to 1.084 per cent.

Agricultural GDP is also positive, significant and fairy elastic. By expanding it with one per cent, coffee export supply will respond positively by 0.517 per cent.

4.3.2 Tea model results

From the results, agricultural GDP, production, price of exports and lagged exports variables are statistically significant both in the short and the long-run. Further, the results indicate that 74 per cent of variations in the tea model are explained by the independent variables. Moreover, the significant coefficient for the error correction term gives evidence of a co-integrating relationship between export supply and the explanatory variables and, therefore, the estimated ECM

can be used to forecast future volumes of tea exports. In addition, it signifies that 0.1 per cent of any disequilibrium will be corrected in one year.

Table 4.7: Tea regression results

Variable	Short-run	Long-run
Constant	0.073*** (0.0011)	2.500*** (0.000)
Log of export price	0.269** (0.023)	0.282** (0.028)
Lagged exports	-0.410*** (0.007)	-
Log of agricultural GDP	0.265* (0.069)	0.332*** (0.000)
Log of production (Q)	0.220*** (0.007)	0.298*** (0.000)
Log of price of maize	-0.063 (0.526)	-0.193* (0.074)
Openness Index	0.164 (0.127)	-0.006 (0.951)
Real exchange rate	0.001 (0.478)	0.001 (0.508)
ECM	-0.001*** (0.011)	-
R^2 Durbin Watson F- Statistics Prob (F-statistic)	0.74 2.7 8.56 0.0000	0.96 1.9 170.57 0.000

*Source: Author's computations. Levels of significance: ***1%, ** 5% and *10%, and p-values are given in brackets*

The export price of tea variable was positive and significant at five per cent and, therefore, increasing tea prices would influence tea export supply. A one per cent increase in tea prices leads to a 0.269 per cent increase in the short-run, and this increases to 0.282 per cent in the long-run. This is consistent with the supply theory, which stipulates that an increase in price of a commodity leads to its increased supply. The coefficient of agricultural GDP was significant and its direction was consistent, which indicates that an expansion of the agricultural GDP would increase tea exports. This could be due to increased economic growth, and thus presents opportunities with increased share of agricultural GDP in Kenya. Its elasticity coefficient in the short-run showed that a one per cent increase in agricultural GDP brought 0.265 per cent increase in tea exports, and this elasticity coefficient increased up to 0.332 in the long-run. The larger long-run elasticity

coefficient is logical, since policies that promote agricultural commodities exports take time to take their effects, making tea exports more responsive to agricultural GDP in the long-run than in the short-run.

The effect of tea production was significant both in the short-run and in the long-run, and the direction was also consistent with the expectation. This indicates that an increase in tea production enhances the supply of exports. Its elasticity coefficient in the short-run explained that a 1 per cent increase in tea production brought 0.22 per cent increase in tea exports, whereas in the long-run, this elasticity coefficient increased to about 0.3 per cent. These findings conform to findings by Ndubuto et al. (2010), Boansi et al. (2014) and Tchereni and Tchereni (2013).The effect of the competing sector was significant and negative in the long-run. An increase in price of maize by one per cent will lead to a reduction in tea exports by 0.193 per cent. This indicates, therefore, that better prospects in the competing crop would reduce tea export supply, since farmers would find it more profitable to engage in.

The higher long-run elasticity coefficient is quite consistent, since tea cannot respond to increased exports since production may not be increased in the short-run due to time lag involved in the production process. However, in the long-run, yields and acreage can be increased, thereby enhancing tea exports.

5. Conclusions and Policy Recommendations

5.1 Conclusions

The main objective of this study was to examine the factors that determine the export supply of coffee and tea in Kenya. Based on the Nerlovian analytical framework and using time series techniques, empirical evidence indicates that exports price, lagged coffee exports, agricultural GDP, production and real estate as the coffee competing sector have significant effects on the Kenya's coffee export supply in the short-run. In the long-run, production was the only significant variable. On the other hand, tea export supply responds significantly to export price, lagged exports, agricultural GDP and production both in the short and long-run. These results show that Kenya's export supply of both commodities not only responds to prices but also to other non-price factors.

Further empirical evidence indicates that elasticities are larger in the long-run as compared with the short-run. This is expected since agricultural policies take time to affect the agricultural sector due to time lags in production. These results are consistent with findings in Nigeria (Kwanashie et al., 1998) and Uganda (Nichodemus and Banga, 2003). Additionally, farmers' positive response to price increases leads to the conclusion that a farmer would find it necessary to increase the area under plantation or at least enhance production levels for better returns on their investment.

5.2 Policy Recommendations

In light of the above findings, the overall conclusion is that output is highly responsive to production, agricultural GDP and price. Therefore, improving the current level of exports should be matched by increasing the current capacity. In such, Kenya would increase its revenues by exporting in large scale. For this reason, as the country tries to expand the market for its exports, policy focus should mainly be on expanding her exports by:

1. Improving the productivity potential of both tea and coffee. Towards this, farmers should be educated and supported in planting new tea and coffee trees to increase the quantity and quality of tea and coffee.
2. Increasing investment in this sector. Investing in agriculture and sectors linked to agriculture will enlarge the agriculture-related processing sectors such as tea and coffee processing due to abundant supply of raw materials from the primary agricultural sector. This will not only ensure increased

production, but also variety of processed products for higher incomes. Moreover, marketing channels (Kenya Tea Development Authority and Coffee Board of Kenya) should identify and collaborate with appropriate organizations that would add value to tea and coffee, and thus grant an efficient association for delivering value.

3. Consider stabilization measures to even out producers' incomes. Export prices for both commodities were positive, meaning that a higher price is always an incentive to producers. Given that international prices for both tea and coffee are always fluctuating, the government should ensure that farmers are compensated when prices are low to keep production high for higher export earnings. Towards this, the government should operationalize the proposed tea stabilization fund.

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