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DETERMINANTS OF COFFEE PRODUCTION IN THE KENYAN ECONOMY

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Abstract

Purpose: To establish determinants of coffee production in the Kenyan economy

Methodology: The study adopted descriptive survey research. The target population consisted of ***Results:*** Results from the first model indicate that there exists a negative relationship between coffee output with credit advanced to farmers. Findings also did show there also exists a positive relationship between coffee output with coffee price, hectarage planted and price of input (fertilizer). Results further indicate that there is a significant negative relationship between the depreciation of the exchange rate and the coffee output.

Unique contribution to theory, practice and policy: The study recommended that the Kenya government may put in place measures and policies aimed at improving coffee production in Kenya, ie, financial institutions may be encouraged to lend loans to coffee farmers at no low interest rates. The study recommended that the government should introduce subsides aimed at reducing cost of inputs hence encouraging farmers to increase areas under coffee production as well as providing incentives to the farmers to encourage them engage in coffee farming. The sturdy also recommended that government may also set up factories or encourage investors, both local and foreign to set up factories that will process coffee to the final product within the country.

Keywords: *output, policies, exchange rate, policy recommendations, long run and short run factors, production.*

1.0 INTRODUCTION

Agriculture is the mainstay of the Kenyan economy. The agricultural sector is the largest contributor of foreign exchange through export earnings from tea, horticulture and coffee. The agricultural sector represents 23.8 % of the GDP and 65% of the total exports (Kenya vision 2030). In Kenya 20% of the land is medium to high potential which supports the bulk of arable agriculture. Arable agriculture is mainly rain fed and of the irrigation potential of 530,000 hectares, only 150,000 hectares are currently exploited. The other 80% of the land is arid and semi arid (ASAL) and rangelands and this supports 20% of human and 60% of livestock population. Agriculture also

provides employment and livelihood to a large proportion of the population. The sector provides 18% of total formal employment in the country and indirect employment to over 70% in the Kenyan economy (Kenya vision 2030). Agriculture provides an avenue for gender balance in terms of income since it is a major source of employment to the women who will engage in farming for both subsistence and commercial purposes in the rural setting since the majority of women are not engaged in formal employment. Evidence shows that agricultural sector growth is highly effective in reducing poverty. It is important to note that every 1% increase in per capita agricultural output lead to a 1.61% increase in the incomes of the poorest 20% of the population (Gallup 1997). On average every 1% increase in agriculture productivity reduces the number of people living on less than US $1 a day by 0.83 % (Thirtle 2001). Agriculture therefore plays a significant role in reducing the poverty levels in the economies of developing countries, Kenya included. The impact of agriculture goes beyond impacting directly on the farmer. It also results to food security and growth of other sectors in the economy e.g. manufacturing by providing raw materials to the other sectors and providing a ready market to these sectors too. Increase in agricultural productivity has allowed poor countries to make the initial step on the ladder leading to prosperity. This is the case for labour intensive, small scale agriculture with its strong links to growth in other areas. No poor country has ever successfully reduced poverty through agriculture alone but almost none has achieved it without first increasing agricultural productivity. To maximize the impact on poverty, agricultural development strategies should aim to realize the links between increasing agricultural productivity and growth in the wider economy. Agricultural contribution to poverty reduction is sometimes thought to be small because its relative economic importance usually falls when low income countries successfully develop, but this view is misleading. Countries that have increased productivity in agriculture have successfully reduced poverty. In Asia, the green revolution played a major role in reducing poverty. An example is China and India adopted improved high yielding varieties of rice and wheat to achieve and sustain food security eliminating the risk of starvation and reducing poverty levels in these countries (IFPRI 2002).

1.1 Problem Statement

The production of coffee in Kenya has been on the decline. Previously the coffee sub-sector recorded high levels of production e.g. production has declined from highs of 114,376 tonnes in the crop year 1989/90 to 59,991 tonnes in 2008/09. It is important to note from Table 3 that the production of coffee has been at low levels causing the earnings from coffee to be on the decline as compared to tea. We also observe that as much as price is an important factor in determining production, there are other factors e.g. cost of production, hectarage under coffee, rainfall, credit advanced to coffee farmers, price of inputs and other non measurable factors e.g. duration of payment to the coffee farmers that will determine the level of coffee production. This is because despite the price of coffee being higher than that of tea, production of tea has been higher than that of coffee in the recent years of our study. The coffee board of Kenya affirms that the number of coffee small scale farmers has reduced from around 700,000 in the year 2000 to 650,000 farmers as at 2009. This has resulted to a decline in the hectarage under coffee plantation. Thus from our study, we shall seek to determine if this could be one of the factors that have led to the decline in coffee production and come up with policy recommendations on how to encourage farmers to continue with coffee farming. One continuing concern in Kenya coffee sub- sector is that farmers

are producing less high-quality coffee and thus unable to meet the continuing demand for world coffee standards. A number of factors may be contributing to this. Prices paid to farmers are not providing sufficient incentives to them to focus on quality. Farmers continue to produce much more ordinary quality coffee. Due to lack of motivation in coffee farming, farmers have opted to engage in the production of more profitable crops and activities e.g. engage in horticultural farming or engaging in real estate and thus reducing the area under coffee thus reducing the coffee produced in the country. As the global demand of coffee is expected to rise, coffee growing countries in East Africa, Kenya included are performing poorly in production. Annual world coffee consumption interpreted as the demand, is growing at 2.4%, and is projected to reach 170 million bags in the next 10 years, which is much higher than an estimated production of 140 million bags, according to the International Coffee Organization, 2010. This analysis is a clear indicator that measures can be put in place to salvage coffee production in Kenya and should this happen, the farmers engaging in the production of the crop stand to reap profits. Therefore this study aims at assessing the factors behind the coffee production decline in terms of earning and output towards the growth of the economy in Kenya. It is due to the above problems that have been facing the coffee sub-sector that we seek to engage our study on the ways in which coffee production can be revived. Kenya is known for her high quality beans thus the demand for her coffee has always been high but the farmers have no motivation to engage in high quality coffee production and also engaging in coffee farming. The study will also provide some literature on the way forward in the coffee sub-sector and by increasing the coffee production and export.

. 1.2Research Objective

The main objective of the study is to explain the decline in production of coffee in the Kenyan economy. The study will also be guided by the following specific objectives;

i. Determine the factors that affect coffee production both in output and hectarage in Kenya.
ii. Establish the long run and short run factors affecting coffee production in Kenya and their relationship to coffee output.
iii. To come up with policy recommendations to improve the coffee sub-sector in Kenya.

2.0 LITERATURE REVIEW

2.1Empirical Review

The International coffee market was subjected to continuous control from 1962 to July 1989 through four International Coffee Agreements (ICA). When the agreements were in force, the coffee market was regulated through systems of export controls (quotas), which were triggered when prices fell to significant low levels. According to Gilbert and Brunett (1998), and Gilbert, (1996), the main benefit of the coffee agreements was to raise the average level of producer prices relative to the levels which would have prevailed without the agreements. Gilbert &Brunett (1998) estimate that the agreements may have indeed raised producer prices by as much as 50-60%. In Kenya it has been shown that the farmers also benefited through 30% higher prices when the ICA was in place (Karanja, 2006).The success of the first four International Coffee Agreements (signed in 1962, 1968, 1976 and 1983) was to maintain relatively high and stable prices and significantly

strengthening the economies of coffee producing countries while enhancing development of international trade and co-operation (ICO, 1997). However, due to lack of consensus between and among consumer and producer countries the 'Economic Clauses' of the 4th agreement were suspended on 4th July 1989. Gilbert (1998) refers to this date as the coffee 'Independence day' in that coffee trade regulation through ICA was no longer to be the case. The prevailing economic thought advocating for increasingly globalised and free trade also means that commodity agreement such as ICA is a thing of the past. Consequently, the current ICA that entered into force on 1st October 1994 did not have any price regulation mechanism.Going by the International Coffee Organisation (ICO) statistics, the coffee crisis is caused by imbalances between supply (production) and demand (consumption). The production of coffee has been increasing at a rate of 3.6% annually while the demand has been increasing by 1.5%. The increase in coffee production has been attributed to production increases in Brazil and Vietnam. Vietnam increased production by 1,400% between 1990 and 2000 while Brazil increased its production by 31%. By the year 2000, Brazil was expected to harvest one of its highest productions (44.7 million bags) in 15 years. The over-supply scenario being witnessed in the coffee market is reminiscent to the "fallacy of composition" which indicates that commodity producer countries as a group can hardly expect to boost their export revenues just by increasing their individual production. Total coffee production in 2001/02 was estimated at around 113 million bags, and when combined with world stocks of 40 million bags it totaled to 153 million bags. This level of production was expected to increase to 119.6 million bags in 2002/03 after taking into account the record crop production from Brazil. However, according to ICO projections, there was a decrease in production in the year 2003/04. This was mainly attributed to the adjustments made in most producer countries in terms of production costs and farm maintenance due to the prevailing low coffee prices. The high production levels in Brazil also led to lower production in 2003/04 in most coffee producing countries. The decrease in production had limited impact on prices given the levels of stocks in both producer and consumer nations. Coffee prices have not only declined but have also become very unstable and unpredictable. The historical evolution of coffee prices indicates the cyclical and instability phenomena that characterize the world coffee markets. The trends in Colombian Milds Arabica at the New York futures market, which are used as reference prices for Kenyan coffee, show three main periods of rising prices, which alternate with periods of falling prices. The first two periods of rising prices (1981 to 1986 and 1994 to 1995) were mainly as a result of supply problems in Brazil arising from adverse weather conditions. A third period of rising prices was also witnessed in 1997 and like the rest of earlier periods was also attributed to supply problems in Brazil (ICO, 1997). The same trends are replicated for robustas. Since 1998, the prices have been on a downward trend and are currently at the lowest levels in 100 years (Nyoro 2002). It can also be observed from 1980 up to beginning of 1990, the arabica coffee prices have remained above 100 US cents/lb. It was only in two periods in the last twenty years (1990 to 1993 and 2000 to 2009) when these prices were below 100 US cents/lb. The long-run yearly average for arabica coffee has been 130 US cents/lb. during the last thirty years. This should form the long-term price expectation for Kenyan farmers. The arabica coffee enjoys a high price at the world market. This is due to the fact that the arabica is of better quality than the robusta. The difference in price have averaged between US cents 20/lb to US cents 60/lb and have tended to increase in the recent past.

These high prices for the arabica indicate that the world market still recognizes and rewards high quality coffee. For Kenyan farmers this means that quality coffee production can pay, the only issue remains on cost of producing that coffee and also the amount of money received by farmers as payment for their coffee. Due to the overvaluation of the Kenya shilling in 1992, exporters had a heavy indirect tax. Ephanto (1993) estimated the overvaluation of the Kenya shilling in 1992 resulted in coffee farmers and other agricultural exporters carrying an implicit tax burden of 29%. The flotation of the exchange rate and subsequent depreciation has removed this implicit tax burden. The retention of foreign exchange by coffee farmers has also allowed them to access cheaper foreign currency dominated credit from local banks. Nevertheless, the fluctuations in the exchange rate have exposed farmers to price volatility.

2.2 Empirical Literature Review

Various empirical studies focusing on the determinants of coffee production in Kenya have been conducted. Absew and Belay (2004) use a Cobb-Douglass production function and they observed that the factors that determine agricultural output are within the country and can be corrected from within. What a country produces in form of agricultural produce will be a factor of how well the resources are managed within the country including all the factors that can be controlled by humans. They illustrated this using capital, land and labour as the explanatory variables and they observed that for a country to increase the quantity of output produced then, there has to be proper management of the factors of production i.e. land, capital and labour. If the right combination of capital and labour is subjected to the right proportion of land, then we shall have the returns on agriculture rise and quantities of coffee supplied to world market increase. The authors also argue that health services need to be provided to farmers so is extension services so as to raise the quality of farming. The uncontrollable factors by human beings are the weather and the producers will only plan on their farming so as to maximize on the agriculture outputs in this case coffee.Maitha (1974) did an econometric analysis study on coffee in the Kenyan economy and noted that the coffee farmers; both large scale and small scale farmers behave rationally, and will engage more in production in the current period if there was an incentive of high prices in the previous period. He argues that the price effect is significant for any level of production. Were et al (2002) noted that there are other non price factors e.g. Cost of inputs, labour costs, access to credit etc that play a vital role in production and export supply response. While analyzing Kenya`s export performance, they use the potential supply approach and utilization rate approach. according to their study, real exchange rate, real foreign income (income of major trading partners) and total investment are the factors that influence Kenya`s export. Even though the coffee sub sector has been performing poorly, the authors argue that with a price incentive to the farmers, there will be an increase in the coffee production as well as a rise in the earnings. The positive response to a price incentive (depreciation of real exchange rate) could be taken as an indication that while maintaining a stable exchange rate is important, strategies that maintain a highly overvalued exchange rate could be a disincentive to export. Thus it is important to have strategic domestic policies to help the sectors that might not be able to cope with the wave of globalization, coffee being one of the sub sectors. The study also found out that high production and transaction costs coupled with declining prices have adversely reduced profitability leading to severe decline in coffee production and in some cases abandonment of what was once a leading export crop.

Nyangito (2001) did a study on policy and legal framework for the coffee subsector and the impact of liberalization in Kenya. He looked at the role of the various coffee institutions e.g. coffee factories, coffee co-operative societies, millers and the C.B.K and the impact of policies adopted in the coffee sub sector. He observed that market liberalization has led to the high prices of inputs and that diseases have also contributed to the decline in coffee productivity e.g. the coffee berry disease. Macroeconomic reforms which include removing restrictions on the exchange rates, foreign exchange retention and remittances, have allowed exporters to keep most earnings in foreign exchange. Most small scale farmers are paid through their cooperative societies and therefore do not receive payment in foreign exchange directly, they do not benefit from this liberalisation. The author found out that small holders complain about the prices they receive because of the high deductions from the cooperative societies. Payout to farmers is determined by charges for services rendered, such as processing, storage, bulking, transportation and overhead costs, but these expenses are exaggerated. Progressive decline in the producer price of coffee has had a negative effect in the production of coffee argues Gahiro (2000). In his study on the impact of production and market structures, to coffee he observed that the producer price is fixed by the government at least to a level of the previous year. For uninformed people, it is always increasing but in real terms it decreases due to the various economic factors e.g. local currency devaluation and inflation. Thus the price of the previous period will have an effect on the price of the current period since it is used as a bench mark to set the current price which will thus influence the level of production. The success of price incentives depends on the absence of intermediaries who affect the devaluation's pass-through to producers (Boccara & Nsengiyumva, 1995). The authors did a desk study literature review which sought to determine the impact of international market prices and regulations on agricultural production. They observed that the coffee sub-sector is also vulnerable to the vagaries of the international market just like all other agricultural commodities. Coffee has adversely been affected by the rapid and persistent fall in the international prices of coffee, especially since the collapse of the International Coffee Agreement in 1989. The other difficulty in the coffee industry is that it has been stuck on the primary level production. Draconian regulations have prevented brand development where income is high. Nelson and Kodhek (2007) on their study on distortions to agricultural incentives in Kenya consider how various crops e.g. coffee, tea, maize have responded to changes in price, exchange rate, price of inputs, taxation levels. Using an econometric analysis, they acknowledge that Coffee production has declined significantly and yet other sub sectors like the tea sector has continued to perform well over time. The decline in coffee production is due both to declining world market prices for the commodity and to low growth in output in the last 20 years. Frustration on the part of farmers has led to widespread uprooting or neglect of coffee trees in favour of other profitable crops like horticulture and tea. Other farmers, especially those close to the capital city of Nairobi, e.g. Ruiru, Kiambu have subdivided their former coffee plantations into smaller plots, which they sell or lease to real estate developers, thereby earning more income than what would have been earned by engaging in coffee production. With time we have had an increase in the commercial millers in Kenya. The coffee milling monopoly held by Kenya Planters Co-operative Union was dismantled in 1993 when four more commercial millers were licensed. This move has increased the installed coffee milling capacity in the country from around 140,000 metric tonnes to around 230,000 metric tonnes

(Karanja, 1998). This increase in installed milling capacity against a backdrop of declining production has resulted in an over-capacity of about 60% in 2000. This low capacity utilization is expensive to maintain and is a major constraint to securing lower milling charges which was the original objective of liberalizing milling.

3.0 RESEARCH METHODOLOGY

The study used Nerlovian model. The following diagnostic tests were run on the model so as to come up with conclusions; OLS estimation, Stationarity test, cointegration test, Normality test. The study used secondary data covering the period 1970-2009.The average prices paid to the producer were obtained from the statistical abstracts and economic surveys.

4.0 RESULTS AND DISCUSSIONS 4.1 General Information on Respondents

4.1 Descriptive Statistics

Table 1: Descriptive Statistics

	TONNES	HECTARES	FERTILIZER	EXCHANGERATE	CREDIT	COFFEEVALUE	COFFEEPRICE
Mean	77742.82	138603.2	1322.689	35.86769	12014.79	6184696.	8236.812
Median	78144.00	155666.0	969.3400	21.60000	6020.000	4419920.	4312.000
Maximum	126486.0	170000.0	6161.000	78.60000	34521.00	16856034	25718.00
Minimum	41470.00	83700.00	72.14000	6.900000	286.8200	390600.0	636.4600
Std. Dev.	21271.46	34464.80	1383.018	28.49803	12243.63	4711062.	7218.692
Skewness	0.180038	-0.733309	1.522623	0.390948	0.671461	0.673449	0.850801
Kurtosis	2.373728	1.768589	5.143036	1.416448	1.868274	2.397977	2.581635
JarqueBera	0.848042	5.959426	22.53245	5.068372	5.011893	3.536918	4.989529
Probability	0.654410	0.050807	0.000013	0.079326	0.081598	0.170596	0.082516
Observations	39	39	39	39	39	39	39

It is clear from the descriptive statistics that all variables are normally distributed as indicated by test results using skewness and kurtosis. This is evidenced by the fact that the skewness coefficients

range from -2 to +2. The Jarque-Bera statistic further indicates that all the variables are normally distributed.

4.2 Unit Root Tests

Prior to testing for a causal relationship and cointegration between the time series, the first step is to check the stationarity of the variables used in the model. The aim is to verify whether the series have a stationary trend, and, if non-stationary, to establish orders of integration. The study uses both Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests to test for stationarity. The test results of the unit roots are presented in Table 2a and 2b and 2c below.

Table 2a: Tests for stationarity: Level

Variable name	ADF test	PP test	1% Level	5% Level	10% Level	Comment
LNTONNES	-0.565 (0.575)	-0.565	-2.626	-1.950	-1.620	Non
LNHECTARES	2.692(0.010)	2.692(0.010)	-2.626	-1.950	-1.620	Non
LNFERTILIZER	2.126(0.040)	2.126(0.040)	-2.626	-1.950	-1.620	Non
LNCREDIT	5.328(0.000)	5.328(0.000)	-2.626	-1.950	-1.620	Non
LNCOFFEEVALUE	-0.161(0.872)	-	-2.626	-1.950	-1.620	Non
LNCOFFEEPRICE	-0.185(0.853)	-	-2.626	-1.950	-1.620	Non
LNEXCHANGERAT	0.879 (0.3846)	0.879(0.3846	-2.626	-1.950	-1.620	Non
LAGHECTARES3	2.749(0.009)	2.749(0.009)	-2.626	-1.950	-1.620	Non
LAGCOFFEEVALU	-0.305(0.761)	-	-2.626	-1.950	-1.620	Non
LAGCOFFEEPRICE	-0.039(0.968)	-	-2.626	-1.950	-1.620	Non
LAGTONNES3	-0.604(0.549)	-	-2.626	-1.950	-1.620	Non

Table 2b: Tests for stationarity: First Difference

Variable name	ADF test	PP test	1% Level	5% Level	10% Level	Comment
LNTONNES	-6.696 (0.000)	-6.696 (0.000)	-2.626	-1.950	-1.620	Stationary
LNHECTARES	-2.828(0.007)	-2.828(0.007)	-2.626	-1.950	-1.620	Stationary
LNFERTILIZER	-6.123(0.000)	-6.123(0.000)	-2.626	-1.950	-1.620	Stationary
LNCREDIT	-2.257(0.030)	-2.257(0.030)	-2.626	-1.950	-1.620	Non Stationary
LNCOFFEEVALUE	-5.360(0.000)	-5.360(0.000)	-2.626	-1.950	-1.620	Stationary
LNCOFFEEPRICE	-5.124(0.000)	-5.124(0.000)	-2.626	-1.950	-1.620	Stationary
LNEXCHANGERATE	-7.460(0.3846)	-7.460 (0.3846)	-2.626	-1.950	-1.620	Stationary
LAGHECTARES3	-2.746(0.009)	-2.746(0.009)	-2.626	-1.950	-1.620	Stationary
LAGCOFFEEVALUE3	-5.143(0.000)	-5.143(0.000)	-2.626	-1.950	-1.620	Stationary
LAGCOFFEEPRICE3	-4.876(0.000)	-4.876(0.000)	-2.626	-1.950	-1.620	Stationary
LAGTONNES3	-6.526(0.000)	-6.526(0.000)	-2.626	-1.950	-1.620	Stationary

Source: Computation from Eviews software

Table 2c: Tests for stationarity: Second Difference

Variable name	ADF test	PP test	1% Level	5% Level	10% Level	Comment
LNCREDIT	-6.805 (0.000)	-6.805 (0.000)	-2.630	-1.950	-1.620	Stationary

Study results in table 2a and 2b clearly indicate that all the series except LNCREDIT are non stationary at levels but on first differencing the series become stationary. Table 2c shows that LNCREDIT becomes stationary on second differencing. Therefore the first step for testing the necessary condition that the series are stationary is thus satisfied once LNCREDIT becomes stationary on second differencing.

4.3. Co-Integration tests

After ascertaining the stationarity properties of the series, cointegration analysis has been done. The first step is to generate the residuals from the long run equation of the non-stationary variables. Then stationarity of the residual was tested using ADF. Results are presented in table 3 below.

Table 3: ADF test for residuals

ADF Test Statistic	**-5.592684**	**1% Critical Value***	**-2.6261**
		5% Critical Value	-1.9501
		10% Critical Value	-1.6205

*MacKinnon critical values for rejection of hypothesis of a unit root.

It is clear from the Engle Granger test of cointegration in Table 3 that the residuals were stationary at levels which imply that the non stationary variables have a long run relationship. The study also conducted Johansen test as an alternative test for cointegration. Johansen test results presented in table 4 compared the log likelihood ratios with the t statistics at 5% critical values.

Table 4: Cointegration test results

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.947605	203.0079	94.15	103.18	None **
0.659605	99.79494	68.52	76.07	At most 1 **
0.614612	62.07725	47.21	54.46	At most 2 **
0.426546	28.70454	29.68	35.65	At most 3
0.195835	9.241837	15.41	20.04	At most 4
0.045055	1.613556	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level

L.R. test indicates 3 cointegrating equation(s) at 5% significance level

From the results, the null hypothesis of non-cointegration is rejected whereas the null hypothesis of at most three co integrating equations cannot be rejected. This implies that in the long run, all the variables (tonnes, hectares, fertilizer, credit, coffee value and coffee price) converge to equilibrium.

4.4 Regression Results

Regression was also conducted so as to test various study hypotheses. Results are presented in the table 4a and 4b below. The first part of the Nerlovian Model (Output Model) yielded the following results.

Table 4a: Regression Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	45457.92	13000.83	3.496539	0.0016
LAGCOFFEEVALUE3	-0.000210	0.001777	-0.118160	0.9068
LAGCOFFEEPRICE3	1.012856	1.054432	0.960570	0.0413
LAGTONNES3	0.271629	0.230755	-1.177130	0.2494
LNCOFFEEVALUE	0.001764	0.000858	2.056806	0.0495
LNCREDIT	-3.993237	1.060227	-3.766398	0.0008
LNFERTILIZER	8.154897	8.463137	0.963579	0.0438
LNHECTARES	0.535284	0.136365	3.925376	0.0005
LNEXCHANGE RATE	-0.339950	0.109244	-3.11182	0.0036
DUMMY	-1765.183	3800.877	0.464415	0.6461

R-squared	0.805938	Mean dependent variable	80009.69
Adjusted R-squared	0.748438	S.D. dependent variable	20467.44
S.E. of regression	10265.63	Akaike info criterion	21.52331
Sum squared residual	2.85E+09	Schwarz criterion	21.91919
Log likelihood	-378.4196	F-statistic	14.01637
Durbin-Watson stat	1.961254	Prob(F-statistic)	0.000000

Therefore;

LnQ_t=45457.92+1.0128LAGCOFFEEPRICE3+0.271LAGTONNES3+0.535 LNHECTARES+8.154LNFERTILIZER-3.993LNCREDIT-0.339LNEXCHANGE RATE+1765.183 DUMMY

The study results indicate that the overall goodness of fit of the model is satisfactory as reflected by R-squared of 0.8059. This indicates that 80.59% of the variations in coffee production are

explained by the variables included in the model. In an attempt to answer the first objective of the study which seeks to determine the factors that affect coffee production in output in Kenya, table 4a presents results of regression which guide on whether to accept or reject the respective hypothesis for each of the study variables. It is clear that there is a positive relationship between price and output as reflected by a coefficient of 1.0128. This relationship is statistically significant (shown by a p value of 0.04) and therefore we reject the null hypothesis that there is no relationship between the relative prices and output (coffee tonnage).The results indicate that coffee output has a positive and statistically significant relationship with hectarage planted (indicated by a coefficient of 0.5352 and p value of 0.0005). This follows that the study rejects its second null hypothesis that there is no relationship between Hectarage planted and output. Therefore, an increase in hectarage leads to an increase in coffee output (Tonage). There is a negative but statistically insignificant relationship between coffee output and rainfall (dummy) as indicated by a coefficient of -1765.183 and a p value of 0.64. This implies that the study rejects the null hypothesis that there is no relationship between rainfall received and coffee production and accepts the alternative. The finding further implies that an increase in rainfall beyond the level of 2500mm and a drop in rainfall below1000mm leads to a drop in coffee output (Tonage).From the results that there exist a positive and statistically significant relationship between coffee out and price of input (fertilizer) as shown by a coefficient value of 8.154 and a p value of 0.04. Hence the study will reject the null hypothesis that there is no relationship between the price of input (fertilizer) and coffee output. The relationship between coffee output and credit advanced is negative (coefficient of -3.993) but statistically significant (p value of 0.0008). This means that the study also rejects the null hypothesis that there is no relationship between the credit advanced to farmers and output. These findings imply that the increase in credit as demonstrated by the graphical illustration in figure 1 was accompanied by a drop in coffee output (tonnage). This finding is out of line with study expectation but is in line with reality since financial deepening in Kenya has increased since independence. However, coffee production has not done well due to various reasons mentioned in studies such as Nelson and Kodhek (2007). In addition, there is a possibility that farmers may be diverting financial resources meant for coffee production to other areas such as dairy farming and short term commercial agricultural ventures.

Results further indicate that there is a significant negative relationship between the depreciation of the exchange rate and the coffee output. This is evidenced by a coefficient of -0.339950 (p value of 0.0036). The finding implies that the devaluation of the Kenyan shilling towards other currencies has really not helped to encourage coffee production. It can further be implied that for the depreciation of the exchange rate to have an effect on coffee production, perhaps non price incentives such as institutional and physical infrastructure such as roads need to be put into consideration first. The second part of the Nerlovian Model (Hectarage Model) yielded the following long term results;

Table 4b: Regression Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3443.188	8923.580	0.385853	0.7023
LAGHECTARES3	0.925736	0.055984	16.53564	0.0000
LAGCOFFEEVALUE3	0.000971	0.000929	-1.045547	0.3041
LAGCOFFEEPRICE3	0.653055	0.697804	0.935871	0.3568
LAGTONNES3	0.169468	0.105931	1.599796	0.0012
DUMMY	-1902.479	2748.937	-0.692078	0.4942
R-squared	0.957127	Mean dependent variable		140976.2
Adjusted R-squared	0.949982	S.D. dependent variable		33102.73
S.E. of regression	7403.326	Akaike info criterion		20.80826
Sum squared residual	1.64E+09	Schwarz criterion		21.07218
Log likelihood	-368.5486	F-statistic		133.9497
Durbin-Watson stat	0.486564	Prob(F-statistic)		0.000000

Results in table 4b imply that;

LnX_t=3443.188+0.653LAGCOFFEEPRICE3+0.925LAGHECTARES3+0.169 LAGTONNES3 – 1902.479 Dummy

The Hectarage model also demonstrated an overall goodness of fit of 0.9571 which was satisfactory. This implies that 95.71% of movements in hectarage can be explained by movement in the independent variables. From the study results it is clear that the relationship between the hectarage planted and coffee output is positive and statistically significant as indicated by a coefficient of 0.169 and a p value of 0.001. Therefore the null hypothesis that there is no relationship between hectarage planted and coffee output is rejected. There exist a positive and statistically insignificant relationship between hectarage and coffee value as shown by a coefficient value of 0.0009 and a p value of 0.304. This follows that we accept the null hypothesis that there is no relationship between the yield of the previous period and the hectarage planted in the current period. Results also reveal that there is a positive and statistically insignificant relationship between hectarage and coffee prices as indicated by a coefficient value of 0.653 and a p value of 0.356. Therefore the null hypothesis that there is no relationship between hectarage planted and prices is accepted. Finally, there is a negative and statistically insignificant (shown by a coefficient of – 1902.479 and a p value of 0.494) relationship between hectarage planted and rainfall (dummy).

Hence the null hypothesis that there is no relationship between hectarage planted and rainfall fails to be rejected.

4.5 Error Correction Model

Since the variables are co integrated, then an error-correction model can be specified to link the short-run and the long-run relationships. Residuals from the co integrating regression are used to generate an error correction term (lagged residuals) which is then inserted into the short-run model. The estimates of the error-correction model are presented in Table 5 below**.**

Table 5: Error Correction Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-826.4066	3435.492	-0.240550	0.8119
DHECTARES	0.344654	0.411895	0.836751	0.4110
DFERTILIZER	-4.714845	3.894198	-1.210736	0.2378
DDCREDIT	0.048566	0.766976	0.063322	0.9500
DCOFFEEVALUE3	-0.000496	0.001643	-0.301925	0.7653
DCOFFEEVALUE	0.006017	0.001153	5.216816	0.0000
DCOFFEEPRICE3	0.256644	0.945059	0.271564	0.7883
DCOFFEEPRICE	-3.569798	0.729139	-4.895910	0.0001
DHECTARES3	-0.039375	0.408828	-0.096312	0.9241
DTONNES3	0.004315	0.212400	0.020317	0.9840
DEXCHANGERATE	-0.005496	0.002643	-0.281925	0.7773
LAGRESID	-0.065368	0.225308	-0.290128	0.7742
R-squared	0.745919	Mean dependent variable		-967.0571
Adjusted R-squared	0.640051	S.D. dependent variable		16279.13
S.E. of regression	9766.779	Akaike info criterion		21.46264
Sum squared residual	2.29E+09	Schwarz criterion		21.95146
Log likelihood	-364.5962	F-statistic		7.045796
Durbin-Watson stat	2.098871	Prob(F-statistic)		0.000045

The results indicate R-squared of 0.7459. This implies that 74.59% of variations in the coffee production are explained by the explanatory variables in the model. Consequently, 25.41 % of the variations are unexplained. The only variable that was found to have a positive and significant

relationship to the coffee production in the short run was coffee value (coefficient of 0.006 and p value of 0.000). The error correction term (Lag res) measures the speed of adjustment to the long run equilibrium in the dynamic model. The error term is negative (-0.065) and statistically insignificant at the 5% level .This result implies that there is a gradual adjustment (convergence) to the long run equilibrium. The coefficient of -0.065 indicates that 6 % of the disequilibria in coffee production achieved in one period are corrected in the subsequent period.

5.0 DISCUSSION CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the Results

This study attempted to explain the decline in production of coffee in the Kenyan economy and particularly to determine the factors that affect coffee production both in output and hectarage in Kenya. Other objectives of the study were to explain the long run and short run factors that determine coffee production as well provide policy recommendations. The study first sought to check the stationarity of the variables used in the model. It was found that all the series except LNCREDIT are non stationary at levels but on first differencing the series become stationary. Results showed that LNCREDIT becomes stationary on second differencing. Engle Granger test of cointegration indicated that the residuals were stationary at levels. Johansen test further indicated that the null hypothesis of no-cointegration was rejected at 5%. The study adopts two Nerlovian Model with the first model having coffee output as the dependent variable and coffee prices, coffee export value, hectarage planted, credit advanced to farmers and rainfall received (dummy) as the independent variables. The second Nerlovian model uses hectarage planted as the dependent variable and coffee output, coffee prices, coffee value and rainfall received (dummy) as the independent variables . Significant long run factors of coffee production identified in the model included credit access, coffee price, hectarage planted and price of input (fertilizer). Results from the first model indicate that there exists a negative relationship between coffee output with credit advanced to farmers. This finding is out of line with study expectation but is in line with reality since financial deepening in Kenya has increased since independence. However, coffee production has not done well due to various reasons mentioned in studies such as Nelson and Kodhek (2007). In addition, there is a possibility that farmers may be diverting financial resources meant for coffee production to other areas such as dairy farming and short term commercial agricultural ventures. There also exists a positive relationship between coffee output with coffee price, hectarage planted and price of input (fertilizer). The second model estimations reveal a positive relationship between the hectarage planted and coffee output, coffee value and coffee prices. However, there is a negative relationship between hectarage planted and rainfall (dummy). This implies that coffee production is at its best when the average rainfall is between 1000mm and 2500 mm.Results further indicate that there is a significant negative relationship between the depreciation of the exchange rate and the coffee output. The finding implies that the devaluation of the Kenyan shilling towards other currencies has really not helped to encourage coffee production. It can further be implied that for the depreciation of the exchange rate to have an effect on coffee production, perhaps non price incentives such as institutional and physical infrastructure such as roads need to be put into consideration first.Short run factors were identified in the error correction model. Error-correction model estimation showed that in short run the only variable that had a positive and statistically

significant relationship with coffee production was coffee value. The results also indicated a negative errorcorrection term of negative 0.065. This meant that 6 % of the disequilibria in coffee production achieved in one period are corrected in the subsequent period.

5.2. Conclusion and Policy Recommendations

The Study concludes that there exist relationships between coffee output with coffee price, hectarage planted, price of input (fertilizer), rainfall (dummy) and with credit advanced to farmers. However, the coffee output related negatively to rainfall (dummy) and therefore an increase in rainfall beyond the level of 2500mm and a drop in rainfall below1000mm lead to a drop in coffee output (Tonage). The relationship between coffee out and credit advanced is also negative which may be as result of farmers diverting financial resources meant for coffee production to other areas such as dairy farming and short term commercial agricultural ventures. From the second part of the Nerlovian Model (Hectarage Model) the study further concludes that there is a relationship between the hectarage planted and coffee output, coffee value, coffee prices and rainfall(dummy).Overall, it is clear that coffee price, hectarage planted, price of input (fertilizer), rainfall (dummy) and credit advanced to farmers are other factors that determine the coffee production both in output and hectarage in Kenya other than the price. These factors may therefore explain the reason why the prices of coffee were higher than that of tea but the production of coffee was lower than that of tea.Since factors such as hectarage planted, price of input (fertilizer), rainfall (dummy) and credit advanced to farmers are other important factors determining coffee production in Kenya, then the government may put in place measures that incorporate these factors in deriving policies aimed at improving coffee production in Kenya. For instance financial institutions may be encouraged to lend loans to coffee farmers at no low interest rates. These way farmers may be motivated to practice coffee farming focusing on high quality coffee that is globally competitive. Instead of farmers opting to engage in the production of more profitable crops and activities, credit availability would encourage farmers to engage more in coffee production.It is important to note that most coffee farmers have been uprooting their coffee so as to engage in other more profitable activities e.g. horticulture and real estate. The government should introduce subsides aimed at reducing cost of inputs hence encouraging farmers to increase areas under coffee production as well as providing incentives to the farmers to encourage them engage in coffee farming, some of this incentives may include bonuses paid more frequently.

The government may also set up factories or encourage investors, both local and foreign to set up factories that will process coffee to the final product within the country. This will mean that instead of exporting coffee in a raw state, the coffee will be exported after processing and in so doing there will be value added to the product and thus the earnings from coffee export will increase.

5.3. Study Limitations

The study adopted the Nerlovian model which does not combine both expectational and adjustment lag variables thus it is difficult to specify a separate coefficient for each. The other shortcoming is that it is cumbersome to estimate a scenario where the expectational variables and equations to be estimated are many. The unavailability of data restricted us from having more observations for

analysis. The mean annual rainfall used was for the main coffee producing areas in Kenya to represent the annual rainfall for the country for the period covered.

5.4. Areas for further study

Whereas this study focuses on the determinants of coffee production in the Kenyan economy, other topics that might require investigations include; impact of coffee production on total factor productivity, the impact of research and development on coffee sub-sector.

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