AGRICULTURE AND COMMODITY EXPORT AND ITS PRODUCTIVITY AND PRODUCTION IN SUB-SAHARAN AFRICA: EVIDENCE FROM TIME SERIES DATA OF FOUR COUNTRIES

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Abstract. We analyze the evolution of output and exports of Agriculture and Commodity in four countries of Sub-Saharan Africa: Cote d´Ivoire, Ethiopia, Kenya and Uganda, for the period 1961-2019. The increase of Exports of Coffee and other goods, have had a positive impact on economic development.This study aimed to examine the long and short-run relationship using the Johansen co-integration test and a vector error correction model, as well as the causation direction by using Granger causality test, between commodity export and commodity productivity and production. With the exception of Ethiopian oilseeds, the results of the vector error correction model demonstrated that cocoa, coffee, and tea exports were significantly and positively linked with cocoa and tea productivity and production growth in all nations. Except for Ethiopian oilseeds, the coefficients of error correction model revealed that there was significant long-run causation from five independent variables to cocoa, coffee, and tea productivity and production in all of the study countries. The results indicated that the causal relationship between commodity export and agricultural growth has heterogeneous patterns across crop commodities and African countries. The findings of this study's heterogeneity could imply that in casual relationship between commodity export and commodity production, contexts of the study, spatial dimensions and agricultural policies affect direction of causality.

Keywords: Agricultural export, Agricultural growth, Cocoa, Coffee, Tea, Sub-Saharan Africa

JEL Codes:

1. Introduction

Previous studies have investigated the linkages between export and economic growth in advanced and emerging economies (e.g., Araujo and Soares, 2011, Josling and Hebebrand, 2011). The relationship between exports and economic growth has been studied in Africa (Abdulai and Jaquet, 2002; Njikam, 2003; Bbaale and Mutenyo, 2011; Menson, 2012; Noula et al., 2013; Yifru, 2015; Ee, 2016; Ouma et al., 2016; Furuoka, 2018, Siaw et al., 2018). A substantial correlation between two variables does not imply that they are causally related. Empirical results showed that causal links between export and growth differed among countries and sectors. The direction of causality may differ significantly across countries because of infrastructure, high population growth, spatial dimensions, and economic policies. As a result, recognizing the causal links may be critical when deciding on economic or agricultural policy, as well as identifying and investing in a significant industry.

The sample countries such as Côte d'Ivoire, Ethiopia, Kenya, and Uganda are selected purposely, but with consideration for their largest commodities production and the largest exporters of selected commodities in Africa.

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These selected commodities in these countries are the main sources of livelihood for many farmers and foreign currency earnings. They are mainly produced for export purposes in Côte d'Ivoire, Ethiopia, Kenya and Uganda (Salami et al., 2010).
Most economies in these countries highly depend on agricultural commodity exports. The choices of Côte d'Ivoire, Ethiopia, and Kenya in this study are motivated by the fact that these countries are the major coffee producing and exporting countriesof Africa. Although these sample countries account for about 75% of Africa's coffee production together, they represent different production and export ranks in the region. Coffee production is the important source of rural household livelihood, employment and foreign exchange in Côte d'Ivoire, Ethiopia, Kenya, and Uganda. They play a central role in generating large employment and income opportunities for producers in these countries (FOA, 2016). Uganda and Kenya are also the largest tea producing and exporting countries in Africa. The Côte d'Ivoire is the largest producer and exporter of cocoa in Africa. Cocoa is the main source of export earnings for this country. Also, cocoa is the major source of employment, foreign exchange, and producers' income in Côte d'Ivoire (UNCTAD, 2016). Oilseeds are defined as a group of the commodity which includes soybeans, linseed, sunflower seeds, cotton seeds, sesame seeds, rapeseed, mustard seeds, safflower seeds, and ground-nuts fresh. Oilseeds are the second an aggregation of the Ethiopian export commodities next to coffee. Oilseeds are the second-largest export foreign exchange earner for Ethiopia next to coffee. Ethiopia is a third sesame seed exporter in the world next to India and Sudan. It is the fifth linseed producer and the sixth sesame seed producer in the world. Sesame seed and linseed account for about 33% and 13% of the Ethiopian oilseed production (Wijnands et al., 2009).

As far as my knowledge is concerned, there are no studies that investigated causal relationships between commodity export and its production in selected counties using both annual aggregated and disaggregated time-series data covering the periods 1961–2019. Accordingly, this study investigated the relationship, causal relationship between the commodity' production, and its export in these countries. Do export, policy, spatial dimension and data types matter the direction of causation? The paper is organized as follows: Sections 2 & 3 present the theoretical arguments and the research methodology, respectively. Section 4 discusses the findings. Finally section 5 presents conclusions and implications for policy.

2. Literature review

It is well established the relationship between export and economic growth. There is a strong relationship between export and economic growth through promoting the diffusion of technical knowledge in the long run, and through learning by doing. Scholars argue that outward export policies are one of the key determinants of economic growth (Awokuse, 2003; Schweicker et al., 2006). The significant economic growth has been achieved by promoting export-led growth policies in some Asian countries, such as South Korea, Taiwan, Japan, and Hong Kong. This implies that the success of the East Asian countries in the 1970s is a result of utilization export led growth strategy (James et al., 1989). In general, empirical results provide divergent results concerning strength and sign of coefficient or connection of two variables. Some empirical studies found both positive and negative relationships between export and economic growth, whereas others found either positive or negative relationship between the two variables.

Noula et al. (2013), for example, revealed both a positive and negative relationship between economic growth and export. In Sub-Saharan Africa, there is a significant and positive (Menson, 2012; Ehinomen and Daniel, 2012) or significant and negative (Shah et al., 2015; Yifru 2015) association between economic growth and export. According to current research, the strength and sign of correlations between export and economic growth are dependent on the analysis period and economic policies. The differences in empirical results could be attributed to the methods of analysis used, which claim that the relationship between export and economic growth is constant and symmetric through time.

The direction of causality is uncertain whether export boosts economic growth, or vice versa. Both perspectives have empirical and theoretical support. In some countries, export is important for achieving agricultural growth. Elsewhere, agricultural growth derives exports**.**

Since the 1960s, debate remains over whether export-led-growth or growth-led-export is important to achieve overall economic development. For instance, the works of Siaw et al. (2018) found bidirectional causality between cocoa export and economic growth in Ghana. They also found unidirectional causality running from banana export to economic growth and also independence between pineapple export and economic growth in Ghana.

In general, the significant heterogeneous relationship and causal relationship between economic growth and export has also been observed across commodities in Ghana. Furuoka (2018) empirically approved that there has been bidirectional relationship between export and economic growth in Zimbabwe; a unidirectional causality running from export to economic growth in sub-Saharan countries like Benin, Burkina Faso, Mozambique and Senegal; and no interdependence between export and economic growth in African countries like Botswana, Cameroon, Congo, Gabon, Kenya, Lesotho, Mali, South Africa and Sudan. Ouma et al. (2016) found bidirectional causality in Kenya, a unidirectional causality running from agricultural export to economic growth in Rwanda, and independence between agricultural export and economic growth in Burundi, Tanzania and Uganda. The study of Ee (2016) has supported export led growth policies to improve economic growth in Africa. The results of these studies implied that the direction of causality varied across countries and commodities.

The causality analysis has risen in popularity as it is imperative for policymakers to have information whether there is a unidirectional or bidirectional effect or independent relationship between exports and growth. Most of these studies have used panel data and aggregated time-series data to investigate the causal relationship between export and economic growth for Africausing small sample observations. The recent study, such as Furuoka (2018) has used innovative methods of analyses including a comparative analysis of three causality tests and a rolling causality test procedure to find that causal relationships are weak, unstable and not constant across countries. Moreover, only little direction of causality analyses has been carried out between commodity export and commodity output so far in Africa.

Both theoretical and empirical literature reviews conclude that the direction of causality between export and economic growth is conditioned upon the country, period, policies and so forth. This study examines whether conclusions hold true for selected Sub Saharan countries. This study fills the research gap by analyzing the direction of causality between commodity export and commodity production growth for each of four selected countries simultaneously, to determine whether the development process is export or agricultural growth in each context. The findings could allow making pragmatic policy suggestions for developing export, and accelerating agricultural productivity and production of each country.

3. Methodology

3.1. Source of data

The source of the time-series data for agricultural exports, outputs, yield, exchange rate, and agricultural growth was the FOASTAT databases covering the periods 1961-2019. The data on commodity export; output and yield, and area harvested, and exchange rate were taken from the FOASTAT databases covering the periods 1961-2019. The periods 1961-2019 were chosen on the basis of data availability on these variables. The data were converted into natural logarithms for the purpose of statistical analysis, and reduction of estimation flaws to some degree. The value of commodity and agricultural outputs has been measured in monetary terms by multiplying physical outputs by farm gate price.

The value of gross outputs were measured in constant terms and expressed in US dollars. Average prices from a certain year or years, referred to as the base period (i.e., 2004-2006), and were used to calculate the value of production in constant terms. Constant price series, often called as volume measurements, can be used to show how product quantities or productivities have changed.

The time-series data on the aggregation of agricultural exports, commodity outputs, agricultural outputs and oilseed outputs were used in constant 2004-2006 (Unit is 1000 US dollars

) rather than volumes.

Commodity ouputs and exports refer primary crop products and crop exports that include coffee, cocoa, oilseeds and tea produced to domestic consumption and exported to other countries in the selected countries. The study aggregated agricultural outputs by adding up values of agricultural products into monetary value. It was aggregated agricultural exports by adding up the export values of agricultural products. All yields per hectare are calculated using full area and production figures for specific countries. The yields were expressed in kilograms per hectare of harvested land, includes coffee, tea, and cocoa. All variables were expressed in natural logarithms except for the exchange rate in the models

3.2. Evolution for the period 1961 2019.

Table 1 present's real value of Gross Domestic Product per capita (PH), in Dollars at 2017 international prices, and Population (million) in year 2019, as well as the rates of annual growth of real GDP, Population and PH for the period 1990-2019.

Table 1. GDP per capita, Population and rates of growth for 1990-2019

Country	PH 1990	PH 2019	Pop 1990	Pop 2019	Rate of GDP	Rate of Pop	Rate of PH
Côte d´Ivoire	4272	5212	11.9	25.7	3.34	2.65	0.69
Ethiopia	767	2221	47.9	112.1	6.60	2.93	3.67
Kenya	3569	4453	23.7	52.6	3.51	2.74	0.77
Uganda	914	2183	17.4	44.3	6.23	3.23	3.00
World	9676	16894	5280	7762	3.21	1.29	1.92

Source: Elaborated from World Bank Statistics. PH=real GDP per capita in Dollars at 2017 international prices. Pop=Population (millions), Rates calculated as exponential Rates of annual growth for the period 1990-2019 of real Gross Domestic Produc (GDP), Population (Pop) and real GDP per capita (PH).

The four countries have experienced rates of growth of real GDP higher than World average. They have experienced rates of population growth much higher than World average. The difference between both rates is the rate of growth of real GDP per capita (PH). If the rate of population growth were equal to World average, the rates of growth of PH would have been higher (2.05% in Côte d´Ivoire, 5.31% in Ethiopia, 2.22% in Kenya and 4.94% in Uganda. Accordingly to Guisan and Exposito (2021) and other studies, it is expected an effect of the increase of education on the moderation of average rates of population growth and and increase of investment and real production per capita.

Table 1.2 shows the production by sector and per inhabitant in these countries in year 2017. We may notice a value of Agriculture close to World average in Côte d´Ivoire and higher in Kenya, while in Ethiopia the value is close to African average of 37 countries, and the value of Uganda lower than African average. In Industry the four countries have very low levels, no only in comparison with World average but also with African average. The highest value, of this group of 4 countries, corresponds to Côte d´Ivoire. In Services the values are also much lower than World average and lower than African average, being Côte d´Ivoire the country of this group with the highest value.

Table 1.2. Real Production per inhabitant (QH) in year 2017, Dollars at 2011 prices and Purchasing Parities: Agricultura, Industry, Services and total GDP per capita (PH)

Country	QHA Agri	QHI Industry	QHS Services	PH Total
Cote d´Ivoire	769	880	1915	3565
Ethiopia	583	407	735	1724
Kenya	1031	499	1431	2961
Uganda	435	360	974	1768
Africa 37	592	1211	2411	4214
World	766	4771	12149	17686

Note: Elaborated by Guisan and Expositon (2021), from WB (2021) WDI statistics.

Table 1.3. shows the evolution of output and exports of Coffee, Agriculture and Commodity for the years 1961, 2000 and 2019.

Agriculture Exports have experienced a great increase for the period 2000-2019, with the following average rates of annual growth: 7.45% in Côte d´Ivoire, 8.89% in Ethiopia, 5.91% in Kenya and 9.06% in Uganda.

There countries were among the highest producers of Coffee in year 2020: Ethiopia, with 384 million Kg in the 5th world position, after Brazil, Vietnam, Colombia and Indonesia, Uganda, with 288 million Kg, in the 8th position, Côte d´Ivoire, with 108 million Kg, in the 14th position and Kenya, with approximately 50 million Kg, in the 16th position.

Coffee Exports in year 2019, million Dollars: Cote d´Ivoire: 227 (2.89% of Agriculture Exports), Ethiopia: 759 (38.70% of Agriculture Exports), Kenya 182 (88.78%of Agriculture Exports) and Uganda 530 (36.93% of Agriculture Exports).

Table 1.3. Output and Exports of Coffee, Agriculture and Commodity (constant 2004-2006 (Unit is million US dollars)

Items	Côted¨Ivoire	1961	2000	2019
CQ	Coffee Output	139..098	284.944	507.631
CE	CoffeeExport	82.310	13.754	227.400
AO	Agriculture Output	1303.656	5598.789	21854.317
CCO	Commodity Output	114.244	1883.140	2930.013
CCE	Commodity Exports	321.691	1016.970	4627.280
	Ethiopia	1961	2000	2019
CQ	Coffee Output	12.324	280.354	588.259
CE	CoffeeExport	37.558	255.314	759.423
AGE	AgricultureExports	60.693	331.526	1519.384
AO	Agriculture Output	4513.360	8489.172	22495.589
CCO	Commodity Output	24.817	36.660	104.644
CCE	CommodityExports	1.400	6.448	18.464
CQ	Kenya	1961	2000	2019
CE	Coffee Output	115.168	412.718	182.383
AGE	CoffeeExport	31.595	154.807	205.044
AO	AgricultureExports	80.130	1011.035	3107.426
CCO	Agriculture Output	3129.012	8674.177	16735.932
CCE	Commodity Output	32.131	600.600	1166.321
CQ	Coffee Output	12.000	455.924	1113.518
	Uganda	1961	2000	2019
CQ	Coffee Output	39.140	299.816	530.961
CE	CoffeeExport	196.638	125.316	438.544
AGE	AgricultureExports	107.026	256.661	1435.572
AO	Agriculture Output	3217.591	8243.422	8234.263
CCO	Commodity Output	0.291	5.812	51.503
CCE	CommodityExports	0.575	1.206	77.548

Where CQ, AO and CCO represent outputs of coffee, agricultural and commodity, respectively. CE, AGE and CCE represent exports of coffee, agricultural output and commodity, respectively. This study considers coffee and cocoa commodity from Côte d'Ivoire, coffee and oilseeds from Ethiopia, coffee and tea from Kenya, and coffee and cocoa from Uganda.

3.3. Data analyses methods

To check stationary properties of the series, the study uses both linear ADF and the Zivot and Andrews (ZA) unit root tests. The study runs unit root tests for each time series data separately to check non-stationarity at the level of each variable by using augmented Dickey-Fuller (ADF) test (Dickey and Fuller,1979) which ignores the possible break in the time series data. Also, this study also applies unit root test of Zivot and Andrews which consider structural break in the time series data. This approach endogenize the break years in the unit root test (Zivot and Andrews, 1992; Lee and Strazicich 2003). This unit root test is used which considers the structural break in the data that avoid misleading conclusions. The results of conventional ADF test and ZA unit root test in Table 2 indicate that all variables are non-stationarity at levels. Thus, the results permit us to conduct multivariate Johansen tests. The Johansen test statistics is a process for testing long-run co-integration relations of many I(1)time series data (Johansen, 1995*)*. This test allows more than one co-integrating relationship so it is largely valid than the Engle-Granger test (Davidson, 2000*)*. The Johansen process is a maximum likelihood method that identifies the number of co-integrating vectors in a non-stationarity time series data. Johansen's Maximum Likelihood ratio tests can either be trace test and/or maximum eigen value test, presented in equations (1) and (2), respectively. Their inferences may be a little bit different (Johansen, 1991*)*.The trace statistics tests the null hypothesis of r co-integrating relations against the alternative hypothesis of n co-integrating relations. On the other hand, the maximum eigen value statistics tests the null hypothesis of r co-integrating relations against the alternative hypothesis of r +1 co-integrating relations.

$$J_{trace} = -T * \sum_{i=r+1}^{n} ln(1-\hat{\lambda}_i) \tag{1}$$

$$J_{max} = -T * ln(1-\hat{\lambda}_i) \tag{2}$$

Where T is the sample size and $\hat{\lambda}_i$ is the i^{th}biggest canonical correlation.

A vector error correction model (VECM) requires pretests of trace test and/or maximum eigen value test. The result of Eigen value statistics shows that there are long run co-integrating vectors. Thus, the VECM can be adopted a maximum likelihood procedure that includes short-run dynamics with long-run equilibrium among variables (Kim, 1998).

The VECM approach has two advantages over other methods. First, the model can assess both short and long-run relationships between variables at a time. Next, the estimating framework can overcome the potential model misspecification (Enders, 1995), and the model does not require a prior assumption of endogeneity and normalisation of variables (Maysami and Koh, 2000). VECM is a restricted VAR where the dependent variable is a function of lagged magnitudes of endogenous and exogenous variables, and the error correction term. A long-run relationship is established in equations 3& 4, then equations of VECM for output growth and yield that can be formulated as under:

$$\Delta \log Q_t = \theta_0 + \sum_{i-1}^{n-1} \varphi_{1i}\, \Delta \log y_{t-i} + \sum_{i-1}^{n-1} \varphi_{2i}\, \Delta \log E + \sum_{i-1}^{n-1} \varphi_{3i}\, \Delta \log Q_{t-1} + \theta\, ECTQ_{t-1} + \varepsilon_t \tag{3}$$

$$\Delta \log Y_t = \chi_0 + \sum_{i-1}^{n-1} \beta_{1i} \Delta \log y_{t-i} + \sum_{i-1}^{n-1} \beta_{2i} \Delta \log E + \sum_{i-1}^{n-1} \beta_{3i} \Delta \log Q_{t-1} + \chi ECTY_{t-1} + \varepsilon_t \tag{4}$$

Where $\log Q_t$ is the natural logarithm (log) of output in period t; $\log Q_{t-1}$ is the value of lagged output in period t, Y_{t-1} is the values of lagged yield in period t and E_t is a vector of exogenous factors, such as area harvested, exported agricultural commodities and world price of exchange rate influencing output and yield (i.e. shift factors) at time t. The sign Δ denotes the difference operator. θ and χ are the coefficients of error correction terms for output and yield respectively which are obtained as residual from the long-run relationship in equations 3&4. Thus, the difference between the actual level of output and its predicted value captures the long-run effect of agricultural growth. The equation 3 is a function of the current and lagged values of equation 4, current and lagged values of exogenous variables.

Granger (1969) has developed the Granger causality test. Granger causality analysis is a powerful tool to identify causal interaction between two time-series data. Granger causality is established when a variable E causes a variable Q, if past and present values of E support to predict Q. The existence of co-integration and error correction representation implies the existence of causality in at least one direction (Granger, 1988). However, co-integration itself is not enough to figure out the direction of causation between agricultural export and agricultural growth. Thus, the Granger causality test is necessary to check the existence of directional causality. To test whether agricultural export does Granger causes agricultural output or not, this paper applies the Granger causality test developed by Granger (1969). This Granger causality test consists of two variables, agricultural export and agricultural output is written as:

$$\Delta E_j = \alpha_1 + \sum_{j=1}^{k} \beta_j \Delta AE_{t-j} + \sum_{i=1}^{k} \beta_i \Delta A\, Q_{t-i} + u_{1t} \tag{5}$$

$$\Delta Q_i = \alpha_2 + \sum_{i=1}^{k} \beta i \Delta Q_{t-i} + \sum_{j=1}^{k} \beta j \Delta E_{t-j} + u_{2t} \tag{6}$$

Where E and Q are output export and commodity output, respectively, Δ is the difference operator, k denotes optimal lag length, u_{it} are the error terms in the equations 5 & 6. Both null hypotheses and alternative hypotheses are deduced from the theoretical framework and empirical review of the literature.

Granger causality is running from agricultural growth to agricultural export, but not vice versa. Thus, H0: $\beta i \neq 0$ and HA: $\beta j=0$. If H0: $\beta i=0$, implies rejection of null hypothesis in favor of the alternative hypothesis. Granger-causality is running from agricultural export to agricultural growth but not vice versa. In this case, agricultural export increases the prediction of the agricultural output growth, but not vice versa. Thus, H0: $\beta i = 0$ and HA: $\beta j \neq 0$. Rejection of the second hypothesis means that the causality runs from agricultural output to agricultural output export. If all hypotheses are rejected, there is bi-directional causality between agricultural export and agricultural output. Granger causality is running from agricultural growth to agricultural export and vice versa. Thus,H0: βi ≠0 and HA: βj≠0. In the case, there is independency between commodity export and its productivity growth. The null hypothesis to be tested is that agricultural export does not Granger cause agricultural output; and the alternative hypothesis is that commodity output does not Granger cause agricultural output export. If none of the hypothesis is rejected, it means that agricultural output export does not Granger cause agricultural output and vice versa.

4. Results and Discussions

4.1. Results of unit root tests and Johansen Co-integration tests

The Augmented Dickey-Fuller (ADF) and Zivot and Andrews (ZA) unit root tests results indicate that the variables are non-stationary at level. They are stationary in the first difference in all cases. The findings confirm that all variables are non-stationary at level. Both unit root test results allow conducting Johansen co-integration test in the next step to examine the presence of long-run relationships among time series data. Results of Johansen co-integration tests show that there are the long-run equilibrium relationships between variables.

4.2. Results of the vector error correction model

Results of Johansen co-integration tests give us information only about the long-run equilibrium relationship between variables, but do not provide us any information about the short-run dynamics. The VECM addresses the weakness of the Johansen co-integration model without losing long-run information on the level variables. Thus, this study uses the VECM to measure the speed of adjustment towards long-run equilibrium. The findings indicate that the coffee export has a significant and positive effect on coffee productivity and production growth in all countries, apart from Ethiopia (oilseeds). Coefficients of error terms show that there is significant long-run causality running from five independent variables to coffee output in all the study countries (Table 2).

Table 2. The results of vector error correction model for coffee

Variable	Output	Yield	Output	Yield	Output	Yield	Output	Yield
	Coeff	Coeff	Coeff	Coeff	Coeff	Coeff	Coeff	Coeff
Constant	5.36	7.12**	-0.17	0.62	-2590	0.62	-4.12*	-0.68
	(3.42)	(3.28)	(0.62)	(0.68)	(5503.33)	(0.68)	(2.28)	(0.92)
LagCQ	0.76	-0.05	0.48**	0.39	303.56	76.88	-0.53	0.68
	(0.98)	(0.16)	(0.23)	(0.11)	(387.12)	(229)	(0.86)	(0.73)
LagCY	-0.15	-0.27	-0.12	-0.47	-303.81	-76.61	-0.97	-0.52
	(0.20)	(0.19)	(0.15)	(0.11)	(387)	(229)	(1.61)	(0.55)
CAH	-1.67	-1.61	0.48**	-0.16	304	-76.61	-0.67	-1.48
	(1.27)	(1.20)	(0.23)	(0.18)	(387)	(229)	(0.97)	(1.73)
CE	0.76***	0.33**	0.35***	0.05*	0.51***	0.35***	0.29***	0.30***
	(0.13)	(0.12)	(0.09)	(0.03)	(0.07)	(0.09)	(0.08)	(0.09)
EXR	0.11	0.26**	0.54	-0.04	-0.07***	-0.05**	0.06	-0.48
	(0.13)	(0.13)	(0.37)	(0.05)	(0.02)	(0.02)	(0.09)	(0.37)
ECT	-0.36	-0.6***	-0.51**	-0.06	0.23	0.45	-0.53**	-0.71
	(0.21)	(0.02)	(0.19)	(0.20)	(0.34)	(0.73)	(0.12)	(0.59)

Notes: All variables are expressed in logarithmic terms; the standard errors are in parentheses. The dependent variables are the logarithms of the coffee yield and output. The last row reports adjustment coefficient (error correction term coefficient (ECT)) from an error correction model. CE represents coffee export. *Source*: Author's calculations based on the FAOSTAT database, 2019.

The findings indicate that the cocoa and tea exports a significantly and positively correlated with cocoa and tea productivity and production growth in all countries, apart from Ethiopia (oilseeds). Coefficients of error terms show that there is significant long-run causality running from five independent variables cocoa and tea productivity and production in all the study countries except for oilseeds of Ethiopia (Table 3).

Table 3. Results of vector error correction model for the cocoa, oilseeds and tea in the four countries

	Côte d'Ivoire		Ethiopia		Kenya		Uganda	
Variable	CCQ	CCY	OSQ	OSY	TQ	TY	TQ	TY
	Coef	Coef	Coef	Coef	Coef	Coeff	Coef	Coef
Constant	6.79***	2.42	-3.79***	12.34	15.77***	-6.63	9.23***	-0.02
	(1.69)	(1.69)	(0.34)	(46.56)	(5.56)	(5.54)	(0.84)	(0.82)
Lag Q	0.02	0.02	0.03	-0.01	-0.26	-0.26	0.08	0.08
	(0.18)	(0.18)	(0.11)	(0.10)	(0.64)	(0.63)	(0.08)	(0.08)
Lag Y	-0.49	-0.49	-3.46	-0.47	-0.22	-0.22	-0.26	-0.25
	(0.21)	(0.21)	(1.31)	(0.17)	(0.66)	(0.66)	(0.18)	(0.18)
AH	0.72	-0.28	0.11***	-0.09	1.59***	0.59	0.95***	-0.05
	(0.18)	(0.18)	(0.01)	(0.10)	(0.58)	(0.58)	(0.10)	(0.10)
E	0.93***	0.11**	0.03	0.06	0.14**	0.14**	0.05*	0.05*
	(0.03)	(0.04)	(0.09)	(0.10)	(0.06)	(0.06)	(0.03)	(0.03)
EXR	0.01	0.16	5.21**	0.55*	-0.01	-0.01	0.07**	0.07**
	(0.12)	(0.32)	(2.16)	(0.31)	(0.09)	(0.06)	(0.03)	(0.03)
ECT	-0.87***	-0.13	-0.99***	-0.06	-1.78***	0.78	-1.18***	-0.18*
	(0.18)	(0.14)	(0.13)	(0.12)	(0.57)	(0.58)	(0.09)	(0.09)

Notes: *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively. Figures in parentheses are standard errors. The dependent variables are the logarithms of the cocoa, oilseeds, and tea yields and outputs. E represents commodity export cocoa (Côte d'Ivoire), oilseeds (Ethiopia), and tea (Kenya and Uganda).
Source: Author's calculations based on the FAOSTAT database, 2019.

The empirical results indicate that causal relationship between export and economic growth has heterogeneous patterns across crop commodity and African countries. For instance, the works of Siaw et al. (2018) found bidirectional causality between cocoa export and economic growth in Ghana. They also found unidirectional causality running from banana export to economic growth and also independence between pineapple export and economic growth in Ghana.

Furuoka (2018) empirically approved that there has been bidirectional effect between export and economic growth in Zimbabwe; a unidirectional causality from export to economic growth in sub-Saharan countries like Benin, Burkina Faso, Mozambique and Senegal; and no interdependence between export and economic growth in African countries like Botswana, Cameroon, Congo, Gabon, Kenya, Lesotho, Mali, South Africa and Sudan. Ouma et al. (2016) found bidirectional causality in Kenya, a unidirectional causality in Rwanda, and independence between agricultural export and economic growth in Burundi, Tanzania and Uganda. The results indicate that there are no causal relationships between coffee export and coffee output growth in all study countries except for Ethiopia (Table 4) that are in line with Siaw (2018) finding in Ghana, and Furuoka (2018) findings in Botswana, Cameroon, Congo, Gabon, Kenya, Lesotho, Mali, South Africa and Sudan and Ouma et al. (2016) results in Burundi, Tanzania and Uganda. For Ethiopia, there is unidirectional causality running from coffee production to coffee export that support works of Al-Yousif (1999).

Table 4. Results of Granger causality tests

Variable	Côte	Ethiopia	Kenya	Uganda
	F-statistics	F-	F-	F-
Coffee export led coffee output	1.23	1.11	0.95	0.38
	(0.35)	(0.34)	(0.39)	(0.68)
Coffee output led coffee export	1.88	4.45***	0.69	2.11
	(0.16)	(0.01)	(0.51)	(0.13)
Agricultural export led agricultural growth	0.28	1.17	2.46*	1.72
	(0.76)	(0.32)	(0.09)	(0.19)
Agricultural growth led agricultural export	3.34**	6.02***	12.56***	1.56
	(0.04)	(0.00)	(0.00)	(0.22)
Commodity export led commodity output growth	11.25***	0.07	3.77**	8.19***
	(0.00)	(0.93)	(0.05)	(0.00)
Commodity output growth led commodity export	7.65***	5.76***	2.54	1.24
	(0.00)	(0.00)	(0.10)	(0.27)

Notes: The lag length is selected based on the Akiake Information Criteria and F-test considering a maximum lag of five. The values of probability are in parentheses. Commodity includes cocoa for Côte d'Ivoire, tea for Kenya and Uganda, and oilseeds for Ethiopia. *Source:* Author's estimations from the FAOSTAT databases, 2019.

Results also found the existence of bidirectional causality between the commodity exports and commodity output growth for Côte d'Ivoire. This is line with results of Siaw (2018) in Ghana, and Furuoka (2018) findings in Zimbabwe and Ouma et al. (2016) results in Kenya. Significant unidirectional causality running from cocoa and tea exports to their production is found for countries like Kenya and Uganda, respectively. The study of Ee (2016) supports this finding of this study that confirms export led growth policies as important tool to improve commodity production and productivity growth in Africa.

A significant unidirectional causality running from agricultural growth to agricultural export is found in Côte d'Ivoire and Ethiopia. No casual relationship between agricultural growth and agricultural export is found in Uganda. This result supports the findings of Siaw (2018) in Ghana, and findings of Furuoka (2018) in Botswana, Cameroon, Congo, Gabon, Kenya, Lesotho, Mali, South Africa and Sudan and works of Ouma et al. (2016) in Burundi, Tanzania and Uganda.

5. Conclusions and Policy Implications

The paper applies these key techniques to key export commodities, namely, coffee (Cotéd'Ivore, Ethiopia, Kenya and Uganda), cocoa (Cotéd'Ivore), tea (Kenya and Uganda) and oilseeds (Ethiopia). The study examines the significance of the impact of coffee exports on coffee productivity and production growth in the short run. This study contributes to the ongoing debate by studying the impact of commodity exports on commodity productivity by using both aggregated and disaggregated data.

The findings of this study disclose three patterns in the direction of causality between commodity export and commodity production. First, there is no independence between coffee export and coffee production on the basis of disaggregated data in all countries. The policy implications of the findings of this study imply country's context, period, policies and so forth determine the causal relationships.

There is a bidirectional relationship between cocoa export and cocoa production for disaggregated data in Cotéd'Ivore. Therefore, governments might adopt agricultural policies to increase agricultural productivity and production, which in turn increase agricultural exports in Cotéd'Ivore. They might use export oriented policies to increase agricultural productivity as well as agricultural export, and thereby accelerating economic growth. Second, the study reveals unidirectional causality running from agricultural growth to agricultural export for aggregated data in Côte d'Ivoire, Ethiopia and Kenya.

In such a context, agricultural policies should focus on promoting agricultural growth other than promoting export-led growth strategies, which in turn increase agricultural export.Unidirectional causality running from tea and cocoa export to tea and cocoa production is found on the basis of disaggregated data for Kenya and Uganda, respectively.

They might use export oriented policies to increase agricultural productivity as well as agricultural export, and thereby accelerating economic growth. In summary, the study concludes the findings and draws different implications for the ongoing debate on the role of agricultural exports in agricultural growth in four Sub-Saharan African countries. Direction of causality in economic policy related may change with political reforms and changes to agricultural policies. Regarding the causal relationship between commodity export and commodity production, the findings of this study suggest that policy implication will differ across contexts of the study, spatial dimensions and economic policies.

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Annex: ADF and AZ unit root tests and Johansen cointegration test.

Annex:

Table A 1.Augmented Dickey-Fuller (ADF) and Zivot and Andrews (AZ) unit root tests for following variables with constant

Variable	Côte d'Ivoire		Ethiopia		Kenya		Uganda	
	ADF	ZA	ADF	ZA	ADF	ZA	ADF	ZA
CAH	1.86	3.32	-0.98	-2.19	0.69	1.38	-0.48	-1.75
	(0.12)	(0.23)	(0.52)	(0.15)	(0.65)	(0.18)	(0.45)	(0.12)
CQ	1.66	5.19	-0.89	-1.21	0.79	1.13	0.92	2.00
	(0.12)	(0.19)	(0.42)	(0.13)	(0.22)	(0.21)	(0.31)	(0.23)
CY	0.290	3.12	1.60	-2.30	0.23	1.21	0.22	1.01
	(0.92)	(0.23)	(0.12)	(0.11)	(0.97)	(0.11)	(0.93)	(0.12)
CE	-0.92	-3.32	-1.24	-2.35	-0.47	-1.31	-0.45	-1.54
	(0.52)	(0.37)	(0.22)	(0.13)	(0.52)	(0.23)	(0.52)	(0.11)
EXR	-0.72	-2.46	-2.25	-4.12	-0.69	-2.51	-1.20	-1.52
	(0.67)	(0.15)	(0.11)	(0.09)	(0.19)	(0.23)	(0.12)	(0.09)
CCAH, OSAH, TAH	1.87	-2.75	-0.98	-1.53	0.69	1.98	-0.57	-1.42
	(0.12)	(0.11)	(0.52)	(0.13)	(0.65)	(0.09)	(0.45)	(0.10)
CCQ, OSQ, TQ,	1.66	5.01	-0.89	-4.66	0.79	2.82	0.92	2.86
	(0.12)	(0.09)	(0.42)	(0.14)	(0.22)	(0.14)	(0.31)	(0.12)
CCY, TY, OSY	0.290	2.16	1.60	5.22	0.23	1.53	0.22	1.95
	(0.92)	(0.55)	(0.12)	(0.09)	(0.97)	(0.10)	(0.93)	(0.21)
CCE, OSE, TE	-0.92	2.97	-1.24	4.02	-0.47	-1.39	-0.45	-1.93
	(0.52)	(0.14)	(0.22)	(0.16)	(0.82)	(0.25)	(0.78)	(0.45)
AGE	0.32	1.31	-0.25	3.52	-0.94	-2.33	-0.56	-1.57
	(0.25)	(0.43)	(0.75)	(0.21)	(0.37)	(0.10)	(0.45)	(0.16)

Notes: $P < 0.1$, $P < 0.05$, and $P < 0.001$ indicate significant at the 10%, 5% and 1% significance levels, respectively. Values of probability or P-values- are represented in parentheses. Where CAH, CCAH, and TAC are area harvested for coffee, cocoa, and tea, respectively. CQ, CCQ, TQ, OSQ, and AO represent outputs of coffee, cocoa, tea, oilseeds, and agricultural output, respectively. CE, CCE, TE, OSE, and AGE represent exports of coffee, cocoa, tea, oilseeds, and agricultural product export, respectively. Variables CY, CCY and TY denote yield of coffee, cocoa, and tea, respectively. This study considers coffee and cocoa commodity from Côte d'Ivoire, coffee and oilseeds from Ethiopia, coffee and tea from Kenya, and coffee and cocoa from Uganda. EC stands for exchange rate.

Table A 2. Results of Johansen co-integration tests

		CÔTED'IVOIRE	ETHIOPIA	KENYA	UGANDA
Variable	Ranks	Trace test	Trace test	Trace test	Trace test
CAH, CY, CQ, CE, EXR	0	66.76***	112.98***	87.34***	78.12***
		[0.00]	[0.00]	[0.00]	[0.00]
	1	53.49***	61.26**	53.49***	48.96***
		[0.00]	[0.00]	[0.00]	[0.00]
	2	37.92***	33.56**	38.92***	26.18***
		[0.00]	[0.00]	[0.00]	[0.00]
	3	13.54***	16.65**	23.76**	14.29***
		[0.00]	[0.03]	[0.00]	[0.00]
	4	8.76**	8.10**	11.09**	8.91***
		[0.04]	[0.05]	[0.04]	[0.03]
CCAH, TAH, CCY, TY, CCQ, TQ, CCE, TE, OSQ, OSY, OSE, and EXR	0	87.60***	116.17***	99.62***	79.99***
		[0.00]	[0.00]	[0.00]	[0.00]
	1	48.06***	74.`10***	64.76**	41.12**
		[0.00]	[0.00]	[0.02]	[0.04]
	2	31.92***	41.86**	44.92**	22.18***
		[0.00]	[0.01]	[0.04]	[0.00]
	3	16.08**	18.16*	13.76*	7.57*
		[0.02]	[0.05]	[0.07]	[0.09]
	4	8.10**	6.43**	2.76*	2.69*
		[0.04]	[0.03]	[0.09]	[0.10]
AQ, AGE, EXR	0	31.92***	26.78**	41.92***	22.18**
		[0.00]	[0.01]	[0.00]	[0.02]
	1	13.76**	9.23*	23.76**	11.59*
		[0.02]	[0.05]	[0.02]	[0.07]
	2	3.46**	3.73*	13.76*	3.19*
		[0.04]	[0.06]	[0.06]	[0.08]

Notes: Rank denotes the number of the co-integrating vectors. The Akaike information criterion (AIC) is used to choose the lag-length. *, **, and *** indicate significance levels at the 10%, 5% and 1%, respectively. Values of probability are represented in parentheses.