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Determinants Of Agricultural Productivity Growth In Economic Community Of West African States (Ecowas): 1971 – 2009

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***Abstract:** The economic growth of the Economic Community of West African States (ECOWAS) has fallen short of 7% growth rate which is required to achieve the Millennium Development Goals (MDGs) due to the declining nature of agricultural productivity growth in ECOWAS. This study employed panel data in analyzing the Determinants of Agricultural Productivity Growth in ECOWAS (1971-2009) in the context of diverse institutional arrangements using a Standard Full Cumulative Method, which is one of the Extended Data Envelopment Analysis (DEA) Window Approach. The panel data employed in the study consists of information on agricultural production and means of production obtained from FAO AGROSTAT on thirteen selected ECOWAS member states. The panel data span over a period of 39 years (1971 -2009).*

In its broad objective, the study investigated the determinants of agricultural productivity growth in ECOWAS. Specifically, the study was carried out to: decompose total factor productivity of the ECOWAS agricultural sector into its major components; and analyze the factors influencing Total Factor Productivity (TFP) growth in ECOWAS agriculture.

A decomposition of Total Factor Productivity (TFP) measures revealed that the observed increase in the TFP in ECOWAS agriculture is due to the efficiency change rather than technological change and as such technological change is the main constrained of achieving higher level of TFP during the reference period. The study further examined the effect of such institutional indicators as political stability, domestic armed conflict, rural infrastructure, control of corruption as well as human development indicators as education, life expectancy at birth and malaria control on agricultural productivity growth in ECOWAS. Life expectancy at birth, rural infrastructure and control of domestic armed conflict had positive significant influence on the TFP of ECOWAS agriculture, while other variables like corruption and malaria had negative significant influence on the TFP of ECOWAS agriculture respectively.

The study concluded that the capacity of agriculture to fuel the economic growth among the member states of ECOWAS is still grossly under-utilized due to very low investment in rural infrastructural growth, high prevalence of malaria, political instability, widespread corruption and domestic armed conflicts or incessant civil war.

***Keywords:** Data Envelopment Analysis, Standard Full Cumulative Approach, Efficiency, Productivity, ECOWAS*

I. INTRODUCTION

The productivity of ECOWAS agriculture has been hampered by the outcomes of past poor agricultural and economic policies in member states, civil and social unrest, burgeoning population, resource mismanagement and failure to build capital and strengthen local industries in certain member states like Guinea, Guinea Bissau, Sierra Leone, Liberia, Mali and Nigeria (ECA, 2002). Internal conflicts with its spillover effect have severely disrupted all the efforts aimed at engendering and sustaining the social and economic development of ECOWAS in the last two decades (Ayee, 2002; Atuobi, 2007). At the present level of resources (technical, technological, financial, etc.) in the sub-region have not allow ECOWAS member states to experience true economic liberalization (UNECA, 2012; Ogbonna et. al., 2013).

The ECOWAS internal conflicts engineered by widespread of corruption have allowed the weapons trafficked across the sub-region are eventually used by rebel groups and criminals for fighting civil wars, as in the case of Liberia, Sierra Leone and Cote D‟Ivoire, among others, or used for armed robbery (Addo, 2005; Atuobi, 2007).

The economic growth of the ECOWAS region is still far below the minimum 7% required to attain the Millennium Development Goals, a problem that can be traced to the crawling nature of the per capita agricultural GDP in the sub-region. Thus, for future sustainable agricultural growth in the ECOWAS region, a greater emphasis will have to be on agricultural productivity growth of its member state, because suitable land areas for new cultivation are declining in nutrient and vigor, especially with the prevalence of environmental issues and climate change (IFPRI, 2010; World Bank, 2011).

CONCEPT OF EFFICIENCY AND PRODUCTIVITY

Productivity growth is defined as output growth indexes divided by an input growth index, driven by movements in the technology frontier (technical progress) as well as by movements around the frontier (returns to scale) (see e.g. Tinbergen, 1942; Solow 1957, and Jorgenson and Griliches, 1967). Over the last few decades, a lot of attention has been drawn to the issue of productivity growth, as it is perceived to be the major determinant for developing the agricultural sector of all economies (developed, developing and underdeveloped), at a rate that they will all be able to meet their local demands for food and raw materials in order to cater for their population. If a country fails to achieve agricultural productivity growth, it may suffer setbacks in the areas of having comparative advantage in the export markets, foreign exchange balance as well as of the internal terms of trade against industry, and these setbacks will also hinder its industrial production capacity (Hayami and Ruttan, 1970; Coelli and Rao, 2003). Efficiency is a term often widely used interchangeably with productivity in economics literatures. It is refers to how well a system or unit of production performs in the use of resources to produce outputs given available technology relative to a standard (frontier) production. Productivity on the other hand is definable in terms of individual resources or a combination of them (Fried, 2008). Ideally, efficiency is inherently unobservable while its estimation is often derived indirectly after taking into account relevant phenomenon, usually relationship between outputs, inputs, their prices and the behavioral objectives of the production units of interests (Nguyen and Coelli, 2009).

The idea of measuring the efficiency of a production unit dates back to the works of Koopmas (1951). Farrell (1957) extended the work of Koopmas by decomposing the efficiency of a production unit into technical, allocative and economic efficiencies. Farrell described technical efficiency as a measure of how much inputs can be reduced given the level of outputs (input-oriented efficiency) or how much outputs can be increased given the level of in-puts (output-oriented efficiency). Allocative efficiency is a measure of how much costs can be reduced if the combination of inputs was optimal according to prices (input-oriented efficiency) or how much revenue can increase if the combination of outputs was optimal according to prices (output-oriented efficiency). Economic efficiency is the product of technical and allocative efficiencies (Farrell, 1957).

Farrell (1957) pioneered the works on measurement of production efficiency and from then till date, a great volume of studies have been done with respect to measuring frontier production functions and productive efficiency and as well as on their comparison (Shephard, 1970; Fare et. al.,1994; and Coelli and Rao, 2001) Many of these works have been done either by using the non-parametric programming approach, which is popularly known as data envelopment analysis (Charnes et. al.,1978); or its counterpart, a parametric stochastic frontier approach (Aigner et. al., 1977).

Total factor productivity (TFP) growth measures the change in total outputs net of the change in total input use. TFP growth is driven by four distinct components namely efficiency change, technical change (or technology change), scale efficiency and allocative efficiency change in inputs and outputs. Efficiency change (EC) determine how much the distance of an individual firm to the efficient frontier has changed while technical change (TC) determine the movement of the efficient frontier itself due to technology change over time. The scale efficiency (SE) reflects change in efficiency frontier associated with input growth. While addressing efficiency and productivity in the developing agriculture, Brümmer et. al., (2006) identified efficiency change (i.e., EC) as a major component of total factor productivity growth that needs to be explored for policy making.

The study is undertaken to provide answers to the following research questions: (i.) To what extent has the growth in agricultural output in ECOWAS member states being catered for by the growth in various physical inputs, and components of TFP? (ii.) What are the determinants of productivity growth in ECOWAS agriculture?

The broad objective of the study is to investigate the determinants of agricultural productivity growth in ECOWAS. To achieve the above objective, the specific objectives are to: decompose total factor productivity of the ECOWAS agricultural sector into its major components; and analyze the factors influencing TFP growth in ECOWAS agriculture.

The hypotheses of the study include: (i.) There is no significant growth in the productivity of agriculture among ECOWAS member states; (ii.) There is no significant relationship between the determinants of agricultural productivity growth and the TFP of agriculture among ECOWAS member states.

II. MATERIALS AND METHODS

Fare et. al.,(1994) used Data Envelopment Analysis (DEA) methods to estimate and decompose the Malmquist productivity index. TheDEA method is a non-parametric approach in which the envelopment of decision-making units (DMU) can be estimated through linear programming methods to identify the "best practice" for each DMU. The efficient units are located on the frontier and the inefficient ones are enveloped by it. Four linear programs (LPs) must be solved for each DMU in this study (Country) to obtain the distances defined in equation (iii) and they are:

✓ $$\left[d_o^t(x_t, y_t)\right]^{-1} = Max_{\phi,\lambda}\ \phi,$$
s.t $$-\phi y_{it} + Y, \lambda \geq 0$$
$$x_{i,t} - X, \lambda \geq 0$$
$$\lambda \geq 0$$

✓ $$\left[d_o^{t+1}(x_{t+1}, y_{t+1})\right]^{-1} = Max_{\phi,\lambda}\ \phi,$$
s.t $$-\phi y_{i,t+1} + Y_{t+1}\lambda \geq 0$$
$$x_{i,t+1} - X_{t+1}\lambda \geq 0$$
$$\lambda \geq 0$$

✓ $$\left[d_o^t(x_{t+1}, y_{t+1})\right]^{-1} = Max_{\phi,\lambda}\ \phi,$$
s.t $$-\phi y_{i,t+1} + Y_t\lambda \geq 0$$
$$x_{i,t+1} - X, \lambda \geq 0$$
$$\lambda \geq 0$$

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s.t $$-\phi y_{i,t} + Y_{t+1}\lambda \geq 0$$
$$x_{i,t} - X_{t+1}\lambda \geq 0$$
$$\lambda \geq 0$$

Where λ is a N X 1 vector of a constant and ϕ is a scalar with $\phi \geq 1$. Over time best practice are natural and to include frontier shifts, that is, technical change, the Malmquist productivity index is a well-established measure (Ajao, 2008).

EXTENDED MALMQUIST DEA METHODS

Fare et.al. (1994) attested that the Malmquist DEA method may produce unstable TFP indices because the sparse data will not be able to construct approximately "smoothed-surface" frontiers in each period. In order to overcome this problem, the two extended DEA methods, the Three Year Window (TYW) method and the Full Cumulative (FC) method were developed. The Three Year Window (TYW) method and the Full Cumulative (FC) method seek to include extra observations from previous years to construct a more robust reference frontier in each year. The TYW method uses data from the current year plus the two preceding years, while the FC method uses data from the current year and all previous years (that are in the panel data set) (Nghiem, 1999; Nghiem and Coelli, 2000).

THE FULL CUMULATIVE (FC) DEA METHOD

The Full Cumulative method is similar to that of the window DEA method. The first sub-panel contains periods {1, 2, …, S}. One more time period is then also added to the second sub- panel, but in contrast to the window DEA method, the first time period is not discarded. Therefore, the second sub- panel contains periods {1, 2,…., S+1}; the third sub-panel contains periods {1, 2, …, S+2} and so on until the last sub- panel, which is actually the entire panel, contains periods {1, 2, …, T} (Nghiem, 1999; Nghiem and Coelli, 2000).Otherwise, the LPs are identical to those in equations (8) to (11) (Nghiem, 1999; Nghiem and Coelli, 2000).These methods are clearly quite computationally intensive. There are two publicly available computer programs that can be used to readily calculate the standard Malmquist DEA TFP index. These are DEAP, written by Coelli (1996) and OnFront written by EMQ (1997) (Nghiem, 1999; Nghiem and Coelli, 2000).

MALMQUIST PRODUCTIVITY INDEX

The Malmquist productivity index, as proposed by Caves et. al.,(1982), allows one to describe multi-input, multi-output production without involving explicit price data and behavioral assumptions. It is a non-parametric methodology that uses data envelopment analysis (DEA) methods to construct a piece-wise linear production frontier for each country and year in the sample (Ajao, 2008; Coelli et. al.,2005).

The Malmquist Productivity Index identifies TFP growth with respect to two time periods through a quantitative ratio of distance functions (Malmquist, 1953). Distance functions can be classified into input distance functions and output distance functions. Input distance functions look for a minimal proportional contraction of an input vector, given an output vector, while output distance functions look for maximal proportional expansion of an output vector, given an input vector. By using distance functions, the Malmquist Productivity Index can measure TFP growth without cost data, only with quantity data from multi-input and multi-output representations of technology (Coelli et. al.,2005).

Ajao (2008) reported that the output based Malmquist productivity index as a measure of productivity growth was introduced by Cave et. al.,(1982). They specify the Malmquist productivity index as the geometric mean of these two indices:

$$M_o(x_t, y_t, x_{t+1}, y_{t+1}) = \left[\frac{d_o^t(x_{t+1}, y_{t+1})}{d_o^t(x_t, y_t)} * \frac{d^{t+1}(x_{T+1}, y_{t+1})}{d_o^{t+1}(x_t, y_t)}\right] \text{.............(1.)}$$

Where $d_o^t(x_t, y_t)$ is the output distance for year t, which is defined as the ratio of observed output to the maximum output, y producible with given technology and input vectors, *x* (Shephard, 1970). The superscript is the value of the output distance evaluated at input-output of year *t+1* using technology of year *t*. Equation (1) can be decomposed into the following two components namely efficiency change index which measures the output-oriented shift in technology between two periods and the technical change between period *t+1* and *t*. If the technical change is greater (or less) than one, then technological progress (or regress) exists. Here, EFFCH and TECHCH represented efficiency change and technological change respectively. Symbolically,

$$EFFCH = \frac{d_o^{t+1}(x_{t+1}, y_{t+1})}{d_o^t(x_t, y_t)} \text{.....................(2.)}$$

and

$$TECHCH = \left[\frac{d_o^t(x_{t+1}, y_{t+1})}{d_o^{t+1}(x_{t+1}, y_{t+1})}\ X\ \frac{d_o^t(x_t, y_t)}{d_o^{t+1}(x_t, y_t)}\right]^{\frac{1}{2}} \text{............(3.)}$$

There exist several methods of estimating the distance functions which makes up the Malmquist TFP index. The most popular and widely adopted in recent time has been the DEA like linear programming (LP) methods suggested by Fare et. al., (1994) and its parametric equivalent – stochastic frontier method were adopted in this study.

PANEL DATA AND PANEL UNIT ROOT TESTS

Panel (or longitudinal) data are cross-sectional and time-series. A panel data set contains *n* entities or subjects (e.g., firms and states), each of which includes *T* observations measured at 1 through *t* time period. Thus, the total number of observations is *nT*. Ideally, panel data are measured at regular time intervals (e.g., year, quarter, and month). Otherwise, panel data should be analyzed with caution. The use of panel data sets for economic research has several major advantages over conventional cross-sectional or time-series data sets (Park, 2009).

DATA, DATA SOURCE AND MEASUREMENT OF VARIABLES

Panel data on output and conventional agricultural inputs (land, labor, fertilizer, and machinery) for the 13 ECOWAS countries for the period 1971–2009 were accessed from the FAOSTAT database (FAO, 2011).The data collected from FAOSTAT include: (a.) Per Capita Value of Agricultural Production (1971-2009) (i.e. Value of agricultural production divided by the total population). (b.) Input data (1971-2009) which are: (i.) Agricultural land which include total arable land area, permanent cropland and pasture measured in '000 ha. (ii.) Fertilizer consumption measured in metric tonnes. (iii.) Agricultural machines which are number of tractors – wheel and crawler – used in agriculture as a measure of the use of modern technological tools. (iv.) Labour measured in thousands and covers the economically active population involved in agriculture.

- ✓ Education score (scored from 0-100 where 100 = Best) was computed from education provision and quality; ratio of pupils to teachers in primary school; primary school completion; progression to secondary school and tertiary enrolment. Education is a proxy for quality of labor (Center of International Development, Harvard University).
- ✓ Life expectancy at birth is measured in years. This is a broad indicator of the health of the population, which has been shown in earlier study to be a significant predictor of future economic growth (World Bank Indicators).
- ✓ Political Stability reflects perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism. The estimate of governance ranges from approximately -2.5 (weak) to 2.5 (strong) governance performance (Governance Matter II).
- ✓ Domestic Armed Conflict reflects the state of national security. The score of governance ranges 0-100 where 100 = Best(International Peace Research Institute, Oslo).
- ✓ Malaria control is a proxy for quality of health services (Center of International Development, Harvard University).
- ✓ Corruption: reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests. The estimate of governance ranges from approximately -2.5 (weak) to 2.5 (strong) governance performance (Governance Matter II).
- ✓ Infrastructure score (scored from 0-100 where 100 = Best) was computed from access to electricity, road and rail networks, telephone network and others.(Center of International Development, Harvard University).

The first stage of this study is the construction of Malmquist TFP and its components using Full Cumulative Malmquist Index (Extended DEA Malmquist Index) from panel data on output and conventional agricultural inputs (Per Capita Value of Agricultural Production, Agricultural land Area, Tractorization and Labour).

The second stage of this study centers on investigating the relationship between the TFP of ECOWAS agriculture and such institutional and governance indicators like Education, Life expectancy at birth, Political Stability, Domestic Armed Conflict, Malaria control, Control of Corruption, Infrastructure score. The panel regression analyses were used to explain the relationship between the TFP of ECOWAS agriculture and such institutional and governance indicators include: Fixed effects panel regression using least square dummy model was employed in order capture the country effects.

III. RESULTS AND DISCUSSION

PANEL UNIT ROOT TEST

In order to avoid spurious regression and analysis in this study, panel unit roots tests were carried out to first examine whether the variables are stationary. If variables are non-stationary, ordinary panel techniques of estimation by least squares will be inconsistent and standard inference of the coefficient will also be impossible. In this study, four unit root tests for panel data are applied to assess stationarity. The tests are Levin Lin and Chu t-stat, IPS, ADF Fisher chi square, and Phillip Perron Fisher chi square. All the tests include individual constants and individual trends. Levin Lin and Chu (LLC) assume a common root unit root process while Phillip Perron (PP), IPS and Augmented Dickey Fuller (ADF) allow for individual unit root process so that the autoregressive coefficient can vary across units (Levin et. al., 1993, 2002). The tests are provided by the econometric software package E-view 5. Table 2 below presents the results of panel unit root test. Through the estimation, it was found that all variables are I(1) except for Rural Population (X_4) which is I(2). Under the level data sets, LLC, IPS, ADF-fisher and PP-fisher test are almost non-stationary series for all the variables (Agricultural land area, fertilizer consumption, tractorization, rural population and per capita value of agricultural production). Under the difference form, all variables reject the unit root null hypothesis (i.e. Agricultural land area, fertilizer consumption, tractorization and per capita value of agricultural production are stationary at I(1) while rural population is at I(2)). The results reported in Table 2 shows that at 1^{st} differencing ((i.e. X_1, X_2, X_3, and Y) and 2^{nd} differencing (i.e. X_4) respectively, all variables are stationary using LLC, IPS, ADF-fisher and PP-fisher test.

The data for the second

Variables	PP Fisher	LLC	ADF Fisher	I.P.S	Decision
X_1	190.70 (0.00)	-9.89 (0.00)	129.30 (0.00)	-	Stationary at I(1) (No intercept and trend).
X_1	184.20 (0.00)	-10.21 (0.00)	151.24 (0.00)	-11.19 (0.00)	Stationary at I(1) (With intercept).
X_2	670.26 (0.00)	-15.96 (0.00)	281.61 (0.00)	-	Stationary at I(1) (No intercept and trend).
X_2	237.16 (0.00)	-10.13 (0.00)	138.23 (0.00)	-8.74 (0.00)	Stationary at I(1) (With intercept)
X_3	206.39 (0.00)	-10.95 (0.00)	158.35 (0.00)	-	Stationary at I(1) (No intercept and trend).
X_3	151.05 (0.00)	-12.31 (0.00)	130.37 (0.00)	-8.75 (0.00)	Stationary at I(1) (With intercept).
X_4	76.31 (0.00)	-8.19 (0.00)	107.68 (0.00)	-	Stationary at I(2) (No intercept and trend).
X_4	38.20 (0.00)	-2.05 (0.00)	69.14 (0.00)	-5.42 (0.00)	Stationary at I(2) (With intercept)
Y	824.03 (0.00)	-18.86 (0.00)	374.31 (0.00)	-	Stationary at I(1) (No intercept and trend)
Y	281.97 (0.00)	-14.05 (0.00)	201.41 (0.00)	-14.84 (0.00)	Stationary at I(1) (With intercept)

Source: Data Analysis, 2014

Table 1: Panel Unit Root Test Results

Methodology	Period	Effch (mean)	Techch (mean)	Tfpch (mean)
Standard DEA Full Cumulative Method	Pre-ECOWAS: 1971 – 1978	1.0000	1.0103	1.0103
	ECOWAS: 1979 – 2009	1.0000	1.0158	1.016
	ENTIRE: 1971 – 2009	1.0009	1.0890	1.0797

Source: Data Analysis, 2014

Table 2: Productivity Growth in ECOWAS Agriculture Using Standard DEA Full Cumulative Method: 1971 -2009

DECOMPOSITION OF TFP IN ECOWAS AGRICULTURE: 1971 – 2009

In the first stage of the analysis of this study, Standard DEA Full Cumulative Methodology was employed in the decomposition of TFP in ECOWAS agriculture within the period of 39 years covering 1971 - 2009.

EXPLAINING THE DECOMPOSITION OF TFP OF ECOWAS AGRICULTURE: 1971 -2009

Summarily as shown in Table 4, the results of the TFP indices obtained from Standard DEA Full Cumulative Methodology show positive TFP growth for the reference period (1971 - 2009) periods respectively. The results of TFP decomposition based on Standard DEA Full Cumulative (FC) Method as shown in Table 4 show a better performance of agriculture in ECOWAS between 1971 and 2009. Here, a simple average of TFP measures at the country level for a sample of 13 ECOWAS countries shows a positive annual productivity growth of 7.97 percent per annum (i.e. the TFP index value for the period was 1.0797) as a result of a 0.09 percent increase in the efficiency change and a 7.97 percent increase in the technological progress (TECHCH) over the period considered. For the reference period (1971-2009), there is an excellent performance and a very encouraging productivity growth in ECOWAS agriculture due largely to the impact of the technological changes.

The pre-ECOWAS period (1971-1978) was characterized by better performance and productivity growth (1.03 percent per annum), due largely to a 1.03 percent increase in the technological change (TECHCH). The ECOWAS period (1979-2009) was also characterized by a better performance and productivity growth (1.60 percent per annum), and it was due largely to a 1.60 percent increase in the technological progress (TECHCH). The ECOWAS period (1979 - 2009) had an outstandingly significant improvement over the pre-ECOWAS period (1971-1978) largely due to the impact of the technological changes and on the overall there is an excellent performance and a very encouraging productivity growth in ECOWAS agriculture over the entire period (1971-2009).

The major finding from the above discussion on the decomposition of ECOWAS's agricultural TFP growth into efficiency and technical change shows that the improvements in its agricultural TFP growth in the reference period are due to ECOWAS agricultural sector catching up to the technology frontier as shown in Table 4 and Figure 2. Thus, based on previous literature on agricultural TFP growth in the sub-Saharan Africa and ECOWAS alike, the above behaviour and the various upturns and downturns (fluctuations) in TFP of ECOWAS agriculture (due to the variations in the technological progress) which may be due to the following: the number of people producing and how well they are producing in those countries; prevalence of low per capita production of food and cash crops; weak human assets; a high degree of economic vulnerability; unstable climatic conditions in the sub-region like recurrent droughts and a general trend towards desertification; high cost of production factors; institutional weaknesses; ecological and land tenure constraints; weak use of innovative technologies; increasing trend towards urbanization, consumption of imported food grains and demand for diversified foodstuffs; decrease in export earnings, low capital formation, food insecurity and poor rural development; recurrent drought and adverse terms of trade movements (Repello et. al., 1996; Colander,2001; Boutong and Downswell,2002; ECA, 2002; Fulginiti et. al., 2004; Fuglie, 2010; Nin-Pratt and Yu, 2008; Seka, 2009).

Country	Effch	Techch	Tfpch
Benin	0.9999	1.0189	1.0193
Burkina Faso	0.9999	1.0043	1.0043
Cote D'Ivoire	1	1.0214	1.0214
Gambia	1	1.0657	1.0657
Ghana	0.9999	1.0352	1.0352
Guinea	1	1.038	1.038
Liberia	0.9999	1.0635	1.0653
Mali	1.0001	1.0513	1.0525
Niger	1	1.035	1.0358
Nigeria	0.9999	1.0231	1.0231
Senegal	0.9999	1.0045	1.0045
Sierra Leone	0.9999	1.003	1.003
Togo	0.9998	0.992	0.9921

Source: Data Analysis, 2014

Table 3: Agricultural TFP Growth and Performance of ECOWAS Member States (1971 – 2009)

Full Cumulative Approach/Variable	Coefficient	Std. Err.	Z	P>|z|
Constant	0.488	0.214	2.28	0.023
Life expectancy at birth	0.011	0.005	2.16**	0.031
Malaria	-0.004	0.0014	-3.23*	0.001
Infrastructure	0.003	0.0013	2.20*	0.028
Corruption	-0.082	0.040	-2.05**	0.040
Domestic Armed Conflict Control	0.001	0.0004	1.77***	0.076
Political Stability	0.0001	0.021	0.00	0.997
Burkina Faso	-1.786	0.169	-7.78*	0.000
Cote D'Ivoire	-1.959	0.244	-3.71*	0.000
Gambia	0.550	0.166	0.93	0.693
Ghana	-1.753	0.198	-5.36*	0.000
Guinea	-1.714	0.237	-3.63*	0.000
Liberia	-3.646	0.794	-5.46*	0.000
Mali	-2.664	0.380	-3.47*	0.000
Niger	-3.645	0.470	-5.35*	0.000
Nigeria	-0.049	0.383	-0.51	0.882
Senegal	-1.207	0.185	-4.46*	0.000
Sierra Leone	-0.674	0.606	-2.25*	0.000
Togo	-0.776	0.508	-6.50*	0.000
Adjusted R-square = 0.6599 F(18, 111) = 147.36 Prob > chi2 = 0.0000				

Source: Data Analysis, 2014

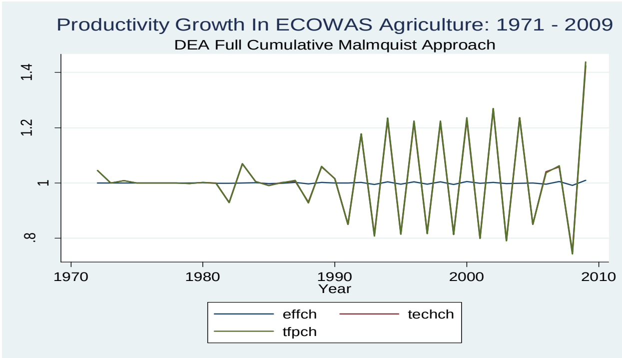
Table 4: Analysis of the Determinants of Productivity Growth of ECOWAS Agriculture Using Panel Regression (Fixed Effects Using Least Square Dummy Variable Model) Approach: 1971 -2009

AGRICULTURAL TFP GROWTH AND PERFORMANCE OF ECOWAS MEMBER STATES: 1971 – 2009.

In ECOWAS member states like Benin, Burkina Faso, Cote D'Ivoire, Gambia, Ghana, Guinea, Liberia and Senegal, there were indications of a positive agricultural TFP growth during the reference period (1971 - 2009) due majorly to the technological progress in such member states as shown in Table 5. Member states like Mali, Niger and Nigeria experienced a negative agricultural TFP growth during the pre-ECOWAS, a positive agricultural TFP growth in ECOWAS with resultant positive agricultural TFP growth in the entire period due majorly to the technological progress in such member states. Other member states like Sierra Leone and Togo which experienced a negative agricultural TFP over the entire period (1971-2009) as a result of a negative agricultural TFP over a prolong ECOWAS period (1979 - 2009) as shown in Table 5.

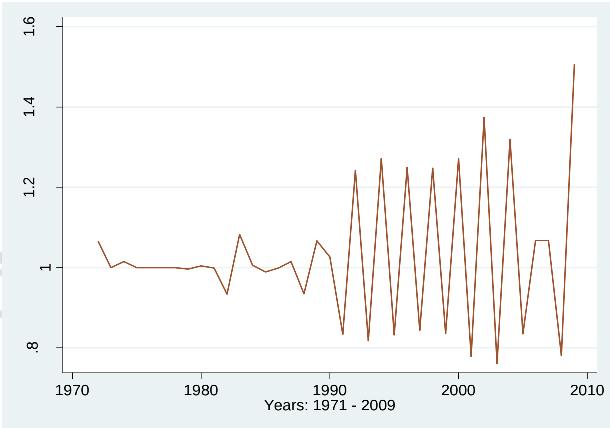
THE GRAPHICAL REPRESENTATIONS OF THE AGRICULTURAL TOTAL FACTOR PRODUCTIVITY GROWTH AND PERFORMANCE OF ECOWAS MEMBER STATES

The graphical representations of the agricultural total factor productivity growth and performance of ECOWAS member states revealed the obviously consistent upturns and downturns in the movement of agricultural TFP growth within the reference period (1971 - 2009) as presented in Figures 1 and 2. The growth of agricultural TFP in these member states has on the average not been too impressive due to very serious national socio-economic and socio-political situations. The growth of agricultural TFP in ECOWAS member states has been very much discouraging considering their capacities to soar instead of dwindling and terribly declining.



Source: Data Analysis, 2014

Figure 1: Graph of Productivity Growth in ECOWAS Agriculture: 1971 -2009



Source: Data Analysis, 2014

Figure 2: Graph of Total Factor Productivity Growth in ECOWAS Agriculture: 1971-2009

ANALYSIS OF THE DETERMINANTS OF PRODUCTIVITY GROWTH OF ECOWAS AGRICULTURE: 1971 -2009

The second stage of this study is centered on the analysis of the determinants of productivity growth of ECOWAS agriculture. Generally, in literature, several factors have been identified as being very important sources of agricultural productivity change especially in the sub-Saharan Africa (Lipton, 1988; Nkamleu et.al., 2003; Ajao, 2012, Kaufman et. al., 2002; Fulginiti et.al., 2004; Lusigi and Thirtle, 1997; Nin-Pratt and Yu, 2008; Fuglie, 2010) and these include: research and development, extension education, infrastructure and government programmes but certain institutional quality variables like political stability and control of corruption among others have been ignored in many of these works. However, this study has decided to examine the effects of life expectancy at birth, education, infrastructure, political stability, domestic armed conflict, corruption and malaria on agricultural productivity growth in ECOWAS in order to further elucidate on the work of Ajao (2012). Unlike Ajao (2012) where the OLS Regression Analysis was used to analyze the determinants of agricultural productivity growth in sub-Saharan Africa, this present study employed panel regression analysis based on panel data for the analysis. Due to insufficiency of data with respect to Kaufmann governance indices, a 10 year panel data per each of the 13 selected ECOWAS countries (which spanned 2000 – 2009) were regressed against a 10 year TFP indices per each of the ECOWAS countries, thereby making a panel of 130 observations. This was done due to the subjectivity of the Kaufmann governance indices in order to be able to use them in the analysis. From the fixed effects panel regression (least square dummy variable model) results of the analysis of the determinants of agricultural productivity growth in ECOWAS (1971 - 2009), an R-squared of 0.6599, shows that 65.99 percent of the explained variations in the agricultural TFP growth of ECOWAS was due to the overall effects of all the explanatory (exogenous) variables specified in the model.

On the basis of a-priori expectations, variables like life expectancy at birth, infrastructure and domestic armed conflict control are expected to have positive (direct) relationship with the TFP growth of agriculture, while the others like corruption and malaria are expected to have negative (inverse) relationship with the TFP growth of agriculture in any economy or region. Here, all the variables included in the model are significant at 1%, 5% and 10% levels of significance respectively. Malaria was significant (at 1%), life expectancy at birth (at 5%), infrastructure (at 5%), corruption (at 5%) and control of domestic armed conflict (at 10%). While life expectancy at birth, infrastructure and control of domestic armed conflict performed well in terms of a-priori expectations (i.e. directly or positively significant relationship) with TFP of ECOWAS agriculture, Corruption and Malaria also performed well in terms of a-priori expectations (i.e. inversely or negatively significant relationship) with TFP of ECOWAS agriculture.

For life expectancy at birth which is positively and significantly related to the TFP of ECOWAS agriculture which is significant at 5%, this result is congruent with the finding of Ajao (2012) and the reason for the positive relationship may be due to the advancement in the delivery of public health services as well as health programmes on the eradication of diseases in sub-Saharan African (of which ECOWAS dominates) and this in turn impact positively on the productivity of the farming households in the ECOWAS region.

The positively significant relationship of domestic armed conflict with TFP at 10%, is better explained in the light of the excellent results from the joint efforts of the ECOWAS and ECOMOG from various peace-keeping and conflict resolution programmes in many of the war-torn and conflict-ridden member states like Liberia, Sierra Leone, Guinea, Guinea-Bissau, Cote d'Ivoire, Ghana, and recently Mali among others. Khobe (2000), reported that the resurgence of regionalism in sub-Saharan Africa especially West Africa, has been more in the area of security than economics.

The positively significant relationship of infrastructure with the TFP growth of ECOWAS which is significant at 10% shows that there is an improvement in the levels of investments in rural infrastructure among the various ECOWAS member states as a way to encourage rural infrastructural growth and development in the region. This finding is also congruent with one of the resolutions of the 8th Africa Farm Management Association (AFMA) Africa (inclusive of the ECOWAS region) that the various West African governments therefore need to invest more on infrastructure development and strengthen institutions through Private Public Partnerships (PPPs)in order to reduce the incidences of dilapidated road network, poor coverage by Information and Communication technologies, and poorly developed markets which are common characteristic features across Africa.

The inversely (negatively) significant relationship of malaria control with the TFP growth of ECOWAS which is significant at 10% is congruent with the finding of Ajao (2012) and it shows that malaria prevalence is still very high and as such is responsible for over 50 percent of the child mortality which invariably affect the quality of available family labour.

The inversely (negatively) significant relationship of control of corruption with the TFP growth of ECOWAS which is significant at 5% is congruent with the findings of Atuobi (2007), Transparency International (2009), and Ajao (2012) that there is a very high corruption profile among various stakeholders overseeing the running of the government projects in various ECOWAS member state and this widespread of corruption has reduced growth in many sectors of the economy of all ECOWAS member states (including agricultural sector) as it has discouraged productive utilization of capital and has encouraged misallocation of resources.

The fixed effects panel regression with least square dummy variable (LSDV) made it possible to capture the country effects of the various determinants of agricultural TFP growth in ECOWAS in various member states. The results revealed negative country effects on such countries Burkina Faso, Cote D'Ivoire, Ghana, Guinea, Liberia, Mali, Niger, Senegal, Sierra Leone, and Togo which were significant at 1 percent level of significance. Only Nigeria had a negative country that was not significant negative at all the known levels of significance being the only country with a positive current account balance because of its large exports of crude oil and gas which commanded high world prices (ECOWAS Statistical Bulletin, 2011). The negative country effects of the determinants of agricultural TFP growth may be as a result of political crises linked to wars and to the democratization process; the steady degradation of the soil and climate; difficulties accessing factors of production; increasing poverty and lack of control over stocks of foodstuffs; irregular rainfall in the region; and lack of control over water resources, an indispensable factor for agriculture may be responsible for the negatively significant country effects stated above (UNECA, 2012; Ogbonna et. al., 2013).

IV. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This study employed panel data in analyzing the Determinants of Agricultural Productivity Growth in ECOWAS (1971- 2009) in the context of diverse institutional arrangements.

In its broad objective, the study investigated the determinants of agricultural productivity growth in ECOWAS. Specifically, the study was carried out to: describe the structure of the ECOWAS agriculture; estimate the effect of the different production factors that influence agricultural output in ECOWAS member states; decompose total factor productivity of the ECOWAS agricultural sector into its major components; and analyze the factors influencing TFP growth in ECOWAS agriculture.

All the four panel unit root tests employed to assess stationarity which Levin Lin and Chu t-stat, IPS, ADF Fisher chi square, and Phillip Perron Fisher chi square, and all the variables included in the study (Per Capita Value of Agricultural Production, Agricultural Land Area, Fertilizer Consumptions and Tractorization) are I(1) except for Rural Population (X_4) which is I(2). The Im-Pesaran-Shin (IPS) test was adopted being an extension of Levin Lin and Chu (LLC) t-stat.

The TFP indices of ECOWAS agriculture as derived from Standard DEA Full Cumulative Method present a 7.97 percent growth per annum and this was due largely to a 7.97 percent increase in the technological progress) over the entire period (1971 – 2009). Thus, the improvement in the agricultural TFP growth in ECOWAS over the entire period was largely due to its agricultural sector catching up to the technology frontier.

From the results of the fixed effects panel regression with least square dummy variable (LSDV) on the determinants of agricultural TFP growth In ECOWAS, 65.99 percent of the explained variation in TFP of ECOWAS agriculture is due to the overall effects of all the explanatory (exogenous) variables specified in the model. The factors that significantly influence the productivity growth of ECOWAS agriculture are: malaria (negatively significant at 1%), life expectancy at birth (positively significant at 5%), infrastructure (positively significant at 5%), corruption (negatively significant at 5%) and control of domestic armed conflict (positively significant at 10%).

The following conclusions have been drawn based on the major findings of this study: the capacity of agriculture to fuel the economic growth of ECOWAS is still grossly under-utilized despite the conduciveness of the environment, climatic factors as well as available human resources; tractorization and rural population will always enhance the per capita value of agricultural production in ECOWAS; The better performance of agriculture in ECOWAS (7.97 percent per annum which was due largely to a 7.97 percent increase in the technological progress) over the entire period (1971 – 2009) and such improvement in the agricultural TFP growth in ECOWAS over the entire period was largely due to its agricultural sector catching up to the technology frontier; the advancement in the delivery of public health services as well as health programmes on the eradication of diseases in sub-Saharan African (of which ECOWAS dominates) which positively affect the life expectancy at birth is bound to enhance positively on the productivity of the farming households in the ECOWAS region; the domestic armed conflict is being curtailed by the excellently effective joint efforts of the ECOWAS and ECOMOG from various peace-keeping and conflict resolution programmes in many of the war-torn and conflict-ridden member states like Liberia, Sierra Leone, Guinea, Guinea-Bissau, Cote d'Ivoire, Ghana, and recently Mali among others and such have helped to enhance the per capita value of agricultural production in ECOWAS; a high corruption profile among the member states of ECOWAS has led to the inefficiency in the government in the various ECOWAS member states, hence imparting negatively on the per capita value of agricultural production in ECOWAS (Ajao, 2012; Atuobi, 2007); the high prevalence of Malaria which is responsible for over 50 percent of the child mortality is invariably affecting the quality of available family labour and the per capita value of agricultural production in ECOWAS (Ajao, 2012).

From this study, the following are recommended:

- ✓ ECOWAS member states need to implement and execute the content of the ECOWAS agricultural policy (ECOWAP) so as to allow for ease of use of available technologies and production inputs more efficiently to produce more from its available input base, develop their capacity for export market and thereby raising the per capita agricultural GDP that has simply crawled up over the years in the sub-region.
- ✓ For ECOWAS agriculture to grow into an enviable status, policies that will nurture and sustain the benefits of good governance in the areas of rural infrastructure, political stability, corruption control, enhanced life expectancy at birth should be implemented and executed by the various governments in ECOWAS member states.
- ✓ Investment in rural infrastructure in ECOWAS member states through government –private sector funding programme should be encouraged in order to promote rural infrastructural growth and development in the sub-region thereby discouraging the high incidences of rural-urban migration which pose danger of inadequate family labour for agricultural activities in the rural farming communities of ECOWAS.
- ✓ The issue of high corruption profile among the member states of ECOWAS, being one of the factors contributing to the inefficiency in the government in the various ECOWAS member states should be properly addressed through well implemented policy strategy with correct sanctions enforced.

The prevalence of malaria should also be further addressed through adequate funding of the integrated roll-back malaria programme that has been in operation in the various member states of ECOWAS in order to minimize the negative effect of malaria on the per capita agricultural production in the sub-region.

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