Feed the Future Innovation Lab for Food Security Policy

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Agriculture, Land Access and Economic Growth in Africa: An Instrumental Variable Approach

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Introduction

In Africa, the agricultural sector is critical to achieving global poverty reduction targets. The sector remains the single most important productive sector in this region, in terms of its share of Gross Domestic Product, employment creation and source of food livelihood for the majority of the populace (World Bank, 2014). This suggests that the growth and development of nations in this region depend largely, on the improvement of the productivity, profitability, and sustainability of farming. Ewetan et al. (2017), share similar views. They stressed the significant role agriculture plays in reforming both the social and economic framework of a nation's economy. This could be because the sector presents multiple pathways through which the economic growth of a nation can be enhanced. According to Gollin et al. (2014), agriculture has both direct and indirect impacts on the economies of nations. For instance, agriculture has a direct effect by raising the real incomes of poor farm (and non-farm) households. Indirectly, agriculture can increase outputs which induce job creation in upstream and downstream non-farm sectors as a response to higher domestic demand (Gollin et al., 2014).

However, despite the potential role of the agricultural sector as an engine of growth, agricultural productivity on the African continent is still very low. As a result of the sector's poor performance, it is yet to provide the required boost for the attainment of the desired economic growth (Hasan and Quibria, 2004). Inequality in resource distribution (particularly land) has been heralded as a plausible explanation for agriculture being less effective in driving economic growth (de Janvry and Sadoulet, 2010). This may be linked to the reality that farmers (especially poor and vulnerable ones) are increasingly faced with the challenge of accessing land. This challenge of agricultural land access becomes critical when we consider that agricultural activities on the continent are largely based on smallholder farms averaging two hectares or less (Wiggins, 2009).

Key Findings

1. Since the year 2014, Africa has been experiencing declining economic growth.

2. The size of agricultural land area remains almost unchanged in the last decade when compared to the steady rate of agricultural land expansion over the last century.

3. In terms of the gross value of production, Africa recorded the highest production in the year 2013 after which the value declined by about 30% in the year 2016.

4. The study found a statistically significant influence of the agricultural sector in enhancing economic growth in Africa.

5. The study succeeded in providing empirical evidence that the growth in agricultural output which had positive impact on economic growth was due to the expansion of the land area used for agriculture.

6. Domestic credit provided by financial sector and inflation rate play significant role in explaining Africa's

Equitable access to agricultural land is important for improved agricultural productivity. Maletta (2014), reports a positive relationship between access to farmland and growth in agricultural output. He argues that the expansion of the land area used for agriculture is one of the ways to grow agricultural output. Moreover, Abbey et al., (2006), point out that for the agricultural sector to be a leading sector in the overall strategy for the economic growth of the vast majority of African countries there must be a deliberate attempt by governments to improve land distribution for agricultural development. Therefore, the extent to which nations would gain from agricultural productivity depends on agricultural land distribution and equitable access for cultivation. Developing an efficient

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land reform that improves land access for agriculture is likely to lead to a sustained economic development.

This study is organized around the performance of the agricultural sector, land access and economic growth in Africa. There is a growing body of research highlighting the relationship between agricultural output and economic growth. For example, Alexander (2013) carried out an econometric analysis of this relationship in Zimbabwe. Sertoglu et al., (2017) analyzed the relationship in Nigeria. However, in these studies the problem of the explanatory variables (agricultural output, in this case) being correlated with the error term remains inadequately addressed and doing so precludes making policy recommendations. In this paper, we employ the instrumental variable technique to address this problem or methodological shortcomings.

Methodology and Model Estimation

The study uses data from databases of the World Development Indicators (WDI) and the Food and Agriculture Organisation Statistics (FAOSTAT). The time series data covers the period of 1996 to 2015 from which a panel was compiled for twenty-six (26) African countries. The explanatory variables in the study model include; Gross Domestic Product (GDP) (in million US dollars), agricultural output (value of agricultural production in US dollars), land available for agriculture (in 1000 hectares), total population (in persons), inflation, GDP deflator (in annual %), domestic credit provided by financial sector (% of GDP) and exchange rate (in US dollars annual average). A number of countries were omitted due to missing data for some of the key variables of interest that have a strong influence on economic growth (Agwu 2015; Hossain and Mitra, 2013; Ndambiri, 2012). These variables include the external debt (in US dollars at current prices); gross physical capital formation (percentage of nominal GDP); domestic investment (in US dollars at current prices); general government final consumption expenditure (in US dollars at current prices).

According to Obansa and Maduekwe, (2013), there exists a bidirectional causality between agricultural output and economic growth, implying that these two variables affect each other. In other words, a change in agricultural output would result in either negative or positive changes in economic growth and vice versa. In some countries, there is persistently a negative response of GDP growth to shock in agriculture whereas in others an increase in GDP led to improved agricultural output (Obansa and Maduekwe, 2013). Consequently, a test of simultaneity between agricultural output and economic growth was conducted using the Hausman (1978) test which compares the estimates of the same model from an ordinary least squares (OLS) and an instrumental variable (IV) (IV is used when an explanatory variable of interest is correlated with the error term) estimation method. We strongly reject the null hypothesis that OLS estimates are consistent. This means that there is a correlation between the unobserved individual effects in the error term and agricultural output which would cause a bias and inconsistent ordinary least squares (OLS) estimates (Wooldridge, 2010). To adjust for a potentially endogenous response of agricultural output, equation (1) is estimated by two-stage least squares (2SLS) where the agricultural output is instrumented by the land available for agriculture (see Box 1). The validity of our instrument is also tested by checking that agricultural output and land available for agriculture are correlated.

Results and Discussion

Both descriptive and inferential statistics were employed for data analysis. The descriptive statistics' results are presented in Table 1 (see Appendix below). The table shows that across the 26 African countries included in the study, the mean gross domestic product between the years 1996 to 2015 is USD 34.9 billion. The minimum and maximum values are USD 340 million and USD 568,499 million, respectively. In addition, the mean value of the agricultural output is USD 5,866 million, with a minimum and maximum values ranging between USD 28 million and USD 101,752 million.

Trend analysis of GDP growth, agricultural land area and the value of agricultural output in the Africa

Figure 1, 2 and 3 show the trends of GDP growth, agricultural land area and the value of agricultural output in the African continent from the year 1986 to 2016. First, Figure 1 shows that Africa's economic growth remained almost unchanged over a period of 14 years- from 1986 to 2000, when compared to the growth experienced over previous decades. In 2002, the region saw its economy improve, reaching its peak in 2008 at USD 1,772,272.427 million after which it dropped by about 7 %. However, in subsequent years, the economy bounced back and rose steadily until 2014. Thereafter, the continent is still struggling to maintain positive economic growth. From the graphs, it is evident that the continent has been experiencing declining economic growth since 2014.

Figure 2 shows that the size of the agricultural land area remains almost unchanged in the last decade when compared to the steady rate of agricultural land expansion over the last century. From the graph, it is clear that there was a decline in the size of agricultural land area in 2009 by about 3 % which has since then been slowly expanding.

Box 1: Technical notes on Econometric Analysis

This study focuses on the economic growth in country i, in year t ($GDP_{i,t}$), using data from the World Development Indicators (WDI) and FAOSTAT databases. Land available for agriculture ($AL_{i,t}$) is used as an instrumental variable for agricultural output ($AO_{i,t}$).

The first stage (equation 1) is the regression of agricultural output (AO) on the instrumental variable (agricultural land area) including other exogenous variables. Second stage (equation 2) is regression of GDP on the predicted value of AO from equation 1 and the other exogenous variables to correct for the problem of endogeneity. The country fixed effects (αi) is also included to capture time-invariant unobservable country-characteristics that may be related to GDP and AO. The empirical specification therefore for the two-stage least square (2SLS) regression analysis, is given as:

First stage ➔ $$AO_{i,t} = \gamma_i + \delta_t + \pi_1 AL_{i,t} + \pi_2 P_{i,t} + \pi_3 I_{i,t} + \pi_4 C_{i,t} + \pi_5 E_{i,t} + \eta_{i,t} \quad (1)$$

Second stage ➔ $$GDP_{i,t} = \alpha_i + \lambda_t + \beta_1 \widehat{AO}_{i,t} + \beta_2 P_{i,t} + \beta_3 I_{i,t} + \beta_4 C_{i,t} + \beta_5 E_{i,t} + \mu_{i,t} \quad (2)$$

Where;

$GDP_{i,t}$ = Natural logarithm of Gross Domestic Product (US$) that varies for country i in time t.

$AO_{i,t}$ = Agricultural output (gross production value US$) that varies for country i in time t.

$AL_{i,t}$ = Land available for agriculture (hectares) that varies for country i in time t.

$P_{i,t}$ = Natural logarithm of population, total that varies for country i in time t.

$I_{i,t}$ = Inflation, GDP deflator (annual %) that varies for country i in time t.

$C_{i,t}$ = Domestic credit provided by financial sector (% of GDP) that varies for country i in time t.

$E_{i,t}$ = Exchange rate is the (US$ annual average) that varies for country i in time t.

β, π = are the estimated coefficients

$\eta_{i,t}$, $u_{i,t}$ = Error terms for equations (1) and (2)

λ_t , δ_t = Time effects for equations (1) and (2)

γ_i , α_i = (i = 1….n) is the unknown intercept for each country. It is the country specific constant capturing unobserved country-specific effects. It allows for the presence of any number of unspecified country-specific, time-invariant variables that influence the GDP levels and which may also affect other explanatory variables such as Agricultural output.

An important issue in the instrumental variable estimation approach is whether the instrument is uncorrelated with the second stage error term. Certainly, land available for agriculture is an exogenous variable that is not affected by changes in the economic growth. The main advantage of the instrumental variable estimation approach is that it adjusts for reverse causality bias that arises in the least squares estimation of equation (2). Whether the instrumental variable estimate will also adjust for omitted variables bias depends crucially on whether the instrument fulfil the exclusion restriction; that is, whether land available for agriculture only affects economic growth systematically through its effect on agricultural output.

Two Diagnostic tests (F-test and Wu-Hausman) were implemented and stated as follows:
In the first stage, the F-test is implemented to test the null hypothesis that the instrument is weak. If the F statistics is greater than 10, the null hypothesis is rejected. An F-Test of 55.37, indicates that our IV is strongly correlated with the endogenous variable (AO). Also, the Wu-Hausman test is implemented to test if the instrumental variable is as consistent as OLS. A rejection means OLS is not consistent, suggesting the presence of endogeneity. We reject the null hypothesis, thus the instrumental variable estimation is preferred.

Figure 3 shows that African countries experienced unsteady growth in their agricultural output, especially from 1990s' up until 2000. Thereafter, except for the decline in 2008, the continent has been enjoying a steady growth in agricultural production. Additionally, the region recorded its highest production in 2013 after which there was a sharp decline of about 30 % in 2016.

Impact of agricultural output on economic growth in Africa

We use an instrumental variable estimation model to estimate the effect of agricultural output on economic growth. The estimation results confirm the significant and positive relationship between agricultural output and gross domestic product. This calls for well thought out investments in the agricultural sector by public and private sector stakeholders working to promote economic growth in Africa. Moreover, at the 1 % significance level, domestic credit has a positive impact while inflation rate has a negative impact on economic growth. This means that the availability of domestic credit positively affects economic growth in Africa. On the other hand, increase in prices negatively affects economic growth.

Policy Implication

- Many African countries are seen as not having realized their agricultural potential. This is because Agriculture in many African countries is characterized by mostly small-scale farming. Even in relatively land abundant countries, the majority of the farmers operate on less than two (2) hectares of land, chiefly as a result of poor land governance and tenure system (Deininger, Hilhorst and Songwe, 2014). Consequently, there is a need for land reforms targeting the review of the provisions guiding existing land policies. Such reform may improve land tenure systems by making it more farmer-friendly.
- The study finds a positive impact of domestic credit on economic growth in the region. Thus, suggesting that the development of the financial markets is crucial for achieving economic growth in the region. It is, therefore recommended that the financial system in the African countries be developed. Policy makers should focus attention on long-run policies such as the development of modern banking sector, efficient financial market, and infrastructures. These would, however, increase domestic credit which is instrumental to foster economic growth.
- Moreover, addressing other institutional and structural problems in the countries' economy would be a necessary precondition to derive maximum gains from financial intermediation.
- The development and implementation of effective agricultural policies and programmes targeted at achieving sustainable economic growth in the region are desirable.
- Based on the study findings, there is an urgent need for effective monitoring of inflation rate to allow for acceleration of economic growth. Policy makers in these countries should strive to keep inflation rate at a possible minimum rate. This study also recommends that to foster economic growth, all factors which would lead to the rise in general price levels such as energy crisis, exchange rates volatility, increase in money supply, poor agricultural production etc. should be addressed with the appropriate policies.

Conclusion

The study provides rigorous evidence on the impact of the agricultural sector on economic growth in Africa. We found dual causality between agricultural output and economic growth, with the former being endogenous. This was corrected for using an instrumental variable approach. The study finds that an increase in the value of agricultural output increases the economic growth in Africa.

References

Abbey, L., Baer, W. & Filizzola, M. (2006). Growth, efficiency and equity: the impact of agribusiness and land reform in Brazil. *Latin American Business Review*, 7 (2), 93-115.

Agwu, C. (2015). Factors that Contribute to Economic Growth in Nigeria. *International Journal of Management and Commerce Innovations,* 2 (2), 487-495.

Alexander, M. (2013). An econometric analysis of the relationship between agricultural production and economic growth in Zimbabwe. *Russian Journal of Agricultural and Socio-Economic Sciences*, *23*(11).

De Janvry, A., & Sadoulet, E. (2009). Agricultural growth and poverty reduction: Additional evidence. *The World Bank Research Observer*, *25*(1), 1-20.

Deininger, K., Hilhorst, T., & Songwe, V. (2014). Identifying and addressing land governance constraints to support intensification and land

market operation: Evidence from 10 African countries. *Food policy*, *48*, 76-87.

Ewetan, O., Fakile, A., Urhie, E. S., & Odunatan, E. (2017). Agricultural Output and Economic Growth in Nigeria. *Journal of African Research in Business & Technology*, (516093).

Food and agricultural organisation statistical database (FAOSTAT). Retrieved on 12/08/2018 from www.fao.org/statistics/en.

Gollin, D., Lagakos, D., & Waugh, M. E. (2014). Agricultural productivity differences across countries. *American Economic Review*, *104*(5), 165-70.

Hasan, R., & Quibria, M. G. (2004). Industry matters for poverty: a critique of agricultural fundamentalism. *Kyklos*, *57*(2), 253-264.

Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica: Journal of the econometric society*, 46, 1251-1271.

Hossain, M. S., & Mitra, R. (2013). The determinants of economic growth in Africa: a dynamic causality and panel cointegration analysis. *Economic Analysis and Policy*, *43*(2), 217.

Maletta, H. (2014). Land and farm production: Availability, use, and productivity of agricultural land in the world.

Ndambiri, H. K., Ritho, C., Nganga, S. I., Kubowon, P. C., Mairura, F. C., Nyangweso, P. M. & Cherotwo, F. H. (2012). Determinants of economic growth in Sub-Saharan Africa: A panel data approach. *International Journal of Economics and Management Sciences*, 2 (2), 18-24.

Obansa, S. A. J., & Maduekwe, I. M. (2013). Agriculture financing and economic growth in Nigeria. *European Scientific Journal, ESJ*, *9*(1).

Sertoglu, K., Ugural, S., & Bekun, F. V. (2017). The Contribution of Agricultural Sector on Economic Growth of Nigeria. *International Journal of Economics and Financial Issues*, *7*(1), 547-552.

Wiggins, S. (2009): Can the Smallholder Model Deliver Poverty Reduction and Food Security For A Rapidly Growing Population in Africa? FAO Expert Meeting on How to feed the World in 2050, 24-26 June 2009. FAO, Rome.

Wooldridge, J. M. (2010). Econometrics analysis of cross section and panel data. MIT press.

World Bank, (2014). World Development Indicators 2014. Washington, DC.

World development indicators (WDI). Retrieved on the 13/08/2018 from https://data.worldbank.org/products/wdi

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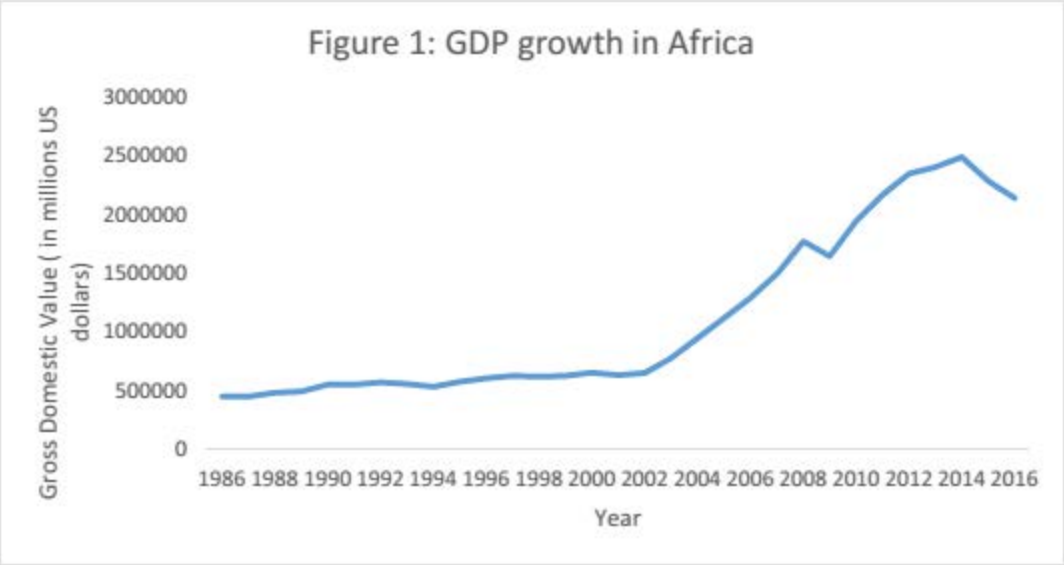

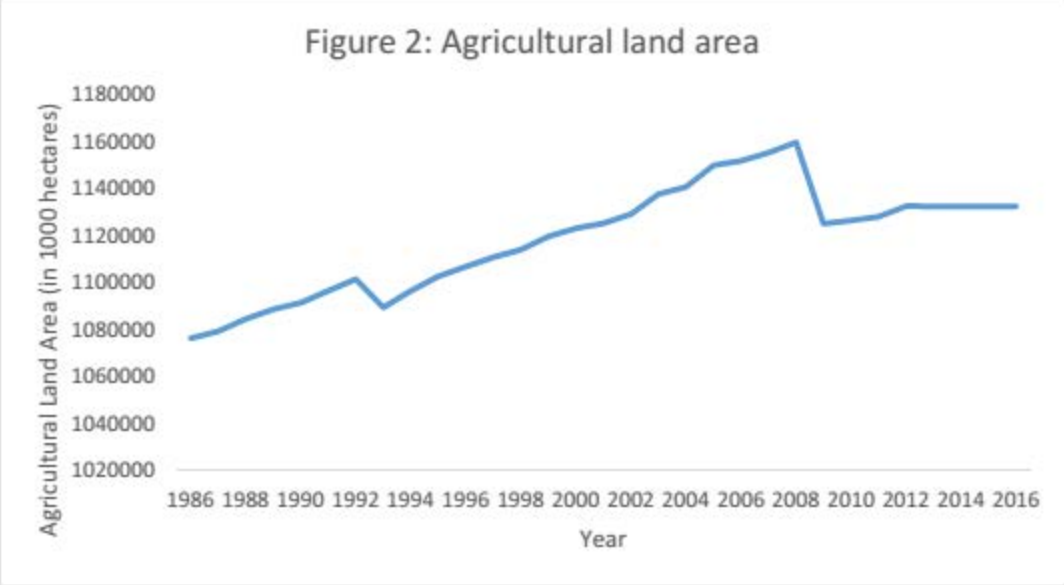

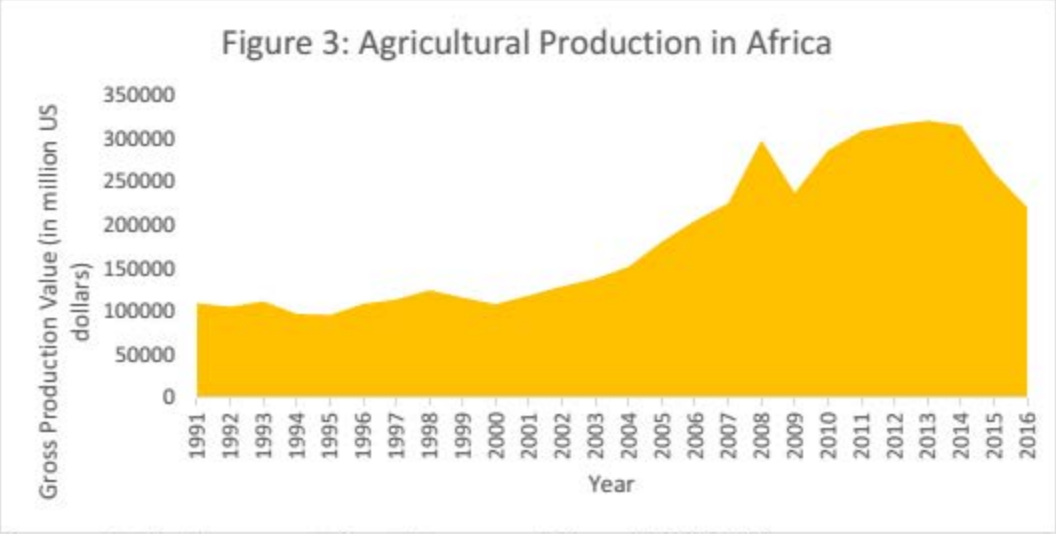

Source: Author's computation, data sourced from FAOSTAT

APPENDIX:

Table A1: Descriptive Statistics Result

Statistic	Observations	Mean	St. Dev.	Min	Max
Credit	520	37.624	42.260	-79.092	192.660
Inflation	520	6.298	12.389	-31.566	112.694
Population	520	21,992,994	30,085,191	398,773	181,744
GDP	520	34,928.700	77,774.490	340.198	568,498.800
Agric. output	520	5,866.489	11,032.500	26.048	101,751.500
Exchange rate	520	449.169	923.135	0.164	7,485.517
Land available	520	23,992.820	23,587.690	70	98,125

Source: Author's computation, data sourced from WDI and FAOSTAT

Table A2: Result showing Instrumental Variable Estimation

Coefficients	Estimates	Standard Error	P value
Intercept	7.139e+00	1.549e+00	5.11e-06***
Exchange rate	-9.360e-07	6.724e-05	0.98890
Credit	6.579e-03	1.319e-03	8.29e-07***
Inflation	-1.281e-02	4.509e-03	0.00467**
Population	6.841e-02	1.026e-01	0.50524
Agricultural output	1.386e-04	2.000e-05	1.28e-11***
Diagnostic tests			
	Statistic	**p-value**	
Weak instruments	55.37	1.06e-12***	
Wu-Hausman	36.18	3.43e-09***	
R squared = 0.3335	**Wald test: 56.61**	**P-value: 2.2e-16**	

*, **, and *** denote significance at the 0.10, 0.05 and 0.01 level, respectively

Source: Author's computation, data sourced from WDI and FAOSTAT

About the Author

Chukwudi Charles Olumba is a PhD candidate at Ebonyi State University, Abakaliki, Ebonyi State, Nigeria and will study at MSU under the Project Scholars program for 2 semesters.

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