The Impact of Agricultural Structural Transformation on Economic Growth in Africa

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Abstract
This study examines the influence of agricultural structural transformation on economic growth in 36 African countries over a period from 1990 to 2018. The Feasible Generalized Least Squares estimation technique is used to control for spatial dependence across African countries and error autocorrelation. The results revealed that the reallocation of agricultural labor positively contributes to economic growth in Africa. In contrast, agricultural value-added and agricultural employment negatively affect economic growth in Africa. As a policy implication, African countries must strengthen agricultural structural transformation for their economic development in line with the African Union vision.

Keywords: Agricultural structural transformation; economic growth; reallocation; Feasible Generalized Least Squares; Africa.

JEL Classification Codes: O1, O11, O4, O47

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1. Introduction

The economic literature shows that the structural transformation is an engine of economic development (Gniniguè and Tchalim, 2021; Mühlen and Escobar, 2020; De Vries et *al.*, 2015; Bustos et *al.*, 2016). So, no nation can develop sustainably without the structural transformation of its economy (Kuznet, 1979). Indeed, development theories teach that the process of economic development has generally been accompanied by a structural transformation (Bustos et *al.*, 2016; Kuznets, 1979). The latter is not only a necessary condition for development but also one of its sufficient conditions and has always accompanied the process of modern economic growth (Mühlen and Escobar, 2020; De Vries et *al.*, 2015). Flows of labor and other resources from low-productivity activities to high-productivity activities grow the economy even if there is no productivity growth in the sectors (McMillan et *al.*, 2014). According to Wonyra (2019), the reallocation of resources from low-productivity sectors such as traditional agriculture or informal services to high-productivity sectors such as industry provides a structural change bonus.

According to Erumban et *al*. (2019), structural change contributed to aggregate labor productivity growth in 'India between 1980 and 2011. For Sub-Saharan African countries, Amadou and Aronda (2020) showed that the contribution of labor reallocation to economic growth was 0.85% from 1991 to 2012. The structural transformation may then be needed to sustain the pace of growth to achieve significant poverty reduction. Furthermore, based on World Bank data (2020), real GDP per capita is estimated at US$3508 from 1990 to 2018 for all African countries. The average contributions of value-added to GDP and the share of agricultural employment are estimated at 24.64% and 52.17% respectively, from 1990 to 2018. Over the same period, the average reallocation of labor from the agricultural sector is -0.05% and suggests that labor has moved out of the agricultural sector into the industrial and service sectors.

These statistics show a weak structural transformation performance in Africa as agriculture, which employs more than half of the labor force, contributing only about 25% of GDP on average. According to Mamba et al. (2020) and Gniniguè and Tchalim (2021), this weakness in the structural transformation can be explained by the non-existence or low synergy between the different sectors of the economy, as the agricultural sector does not provide intermediate goods for the production of the industrial sector. Because of the above, the fundamental question is what is the effect of agricultural structural transformation on economic growth in Africa? The general objective is therefore to examine the effect of agricultural structural transformation on economic growth in Africa. Specifically, it is to: i) examine the effect of agricultural labor reallocation on economic growth in Africa; ii) examine the effect of agricultural value-added on the structural transformation in Africa, and iii) analyze the effect of agricultural sector employment on economic growth in Africa.

The contribution of this paper to the economic literature is that despite the work on the effects of structural transformation, those that focus on the effects of structural transformation on economic growth in Africa are rare or largely ignored to our knowledge. The most recent work focuses on analyzing the share of structural transformation across sectors in economic growth (Amadou and Aronda, 2020; De Vries et *al.*, 2015; McMillan et *al.*, 2014). Bashir et al., (2019) attempted to examine the causality between agriculture, industry, and economic growth in Indonesia. Moreover, Bashir et al, (2019) considered only sectoral value-added shares without considering the crucial role of the labor reallocation effect. This paper fills this gap, by considering the agricultural value-

added and employment shares as well as agricultural labor reallocation. Furthermore, through Agenda 2063, African countries have committed to transforming all their production structures to achieve sustainable economic development. This research will then inform African governments that have embarked on economic integration dynamic through the African continental free trade area, in the continent's march toward structural transformation and sustainable economic development.

The rest of the article is organized as follows. Section 2 presents a brief literature review of agricultural structural transformation and economic growth. Section 3 presents the methodology and data. Section 4 analyzes and discusses the results. Finally, the conclusion summarizes the article.

2. Brief literature review

In a neoclassical model, the accumulation of human capital, physical capital, and technology are the main drivers of productivity growth (Aghion and Howitt, 1992; Mankiw et al., 1992; Barro, 1990; Lucas, 1988; Romer, 1986). This literature seems to ignore the role of structural transformation, defined according to Herrendorf et al, (2013), as a process marked by a decrease in the weight of the agricultural sector, an inverted U-shaped evolution of the weight of industry, and a gradual increase in the weight of services in the economy. In this context, omitting the importance of intra-sectoral heterogeneity in productivity may not provide the true picture of productivity (Brondino, 2019).

Changes in sectoral composition and economic specialization, stimulate technological innovation and create new products (Silva and Teixeira, 2011; Saviotti and Pyka, 2012) and in turn contribute to economic development. According to Bustos et al. (2020), high agricultural productivity can attract labor to the agricultural sector and weaken the development of the industrial sector. Thus, according to Pugno (2006), a shift in the share of employment to services increases the rate of economic growth, while according to Baumol (1967), this type of shift decreases the rate of economic growth. Kaldor (1957) argues that the growth rate of real GDP per capita is almost constant despite the presence of structural changes.

The various theories that have attempted to explain the importance of the agricultural sector in economic growth can be divided into two main trends. The first trend is marked by the work of Lewis (1956) and Rosenstein Rodan (1943), who believes that industry is the engine of economic growth, unlike the agricultural sector. According to them, the industrial sector is the largest provider of employment and is gradually absorbing workers from agriculture. However, the second trend argues that agriculture is a panacea for economic growth (Myrdal, 1957) and that increasing agricultural production improves the welfare of the population (Mellor, 1995; Mundlak, 2001). It stimulates domestic demand for industrial production and thus promotes the expansion of the domestic industrial sector. This industrial expansion due to agricultural development can lead to structural transformation and improve modern economic growth.

Empirically, Bashir et al. (2019) examined the causality between agriculture, industry, and economic growth in Indonesia. The results revealed that the agricultural sector contributes to economic growth in the Indonesian economy. According to Oyakhilomen and Zibah (2014), agricultural production significantly and positively influences economic growth in Nigeria. Butos et al.(2016) studied the effect of the adaptation of new agricultural technology on the structural

transformation. They show that the technical change in the agricultural sector led to industrial growth and hence improved overall productivity. Brondino (2019) studied the productivity growth and structural change in China from 1995 to 2009. He obtains evidence of a reduction in the employment share of primary and light manufacturing activities and an increase in the employment of heavy manufacturing and tertiary activities in China. Over the same period, the Chinese economy has experienced a strong process of technological progress and productivity growth in every sector.

For Sertoglu et al (2017), the agricultural sector contributes positively to GDP eventually in Nigeria. Busse et al (2018) analyze the role of structural transformation in economic growth in 41 sub-Saharan African countries. The results revealed that structural transformation contributed significantly to economic growth in these countries. As for the effects of industrialization on economic growth, Wonyra (2018) studies the effect of the manufacturing sector on economic growth in sub-Saharan Africa from 1990 to 2015. The results reveal that the manufacturing sector has a positive impact on economic growth in sub-Saharan African countries. Opoku and Yan (2019) use data over a period from 1980 to 2014 and 37 African countries to examine the effect of industrialization on economic growth. The results mounted that industrialization is an important driver of economic growth in Africa.

According to Zhao and Tang (2018), industrialization positively affects economic growth in China between 1995 and 2008. From 1992 to 2012, McCausland and Theodossiou (2012) find that industrialization positively affects growth in a sample of 11 countries. Chen et Xing (2019) conduct an empirical examination of the impact of industrial policies on economic growth in China. They confirm the hypothesis that industrial policy has positive effects on economic growth. Considering the above, the role of agricultural structural transformation in the economic growth of African countries is rarely taken into account in the economic literature while such data are crucial to contribute to the achievement of the 2063 agenda of the African Union. This research fills this gap.

3. Methodology and data

To examine the effect of agricultural structural transformation on economic growth in African countries, our basic model is the Romer-Mankiw-Weil (1992) model, which is as follows:

$$Y_{it} = A_{it} K_{it}^{\alpha} H_{it}^{\beta} (L_{it})^{1-\alpha-\beta} \quad (1)$$

Y: output (GDP), K: physical capital stock, H: human capital stock, L: labor, A: factor reflecting the technological level and the efficiency of the economy, $\alpha + \beta < 1$. The reduced form of the model (output per head) is :

$$\frac{Y_{it}}{L_{it}} = y_{it} = A_{it} \left(\frac{K_{it}}{L_{it}}\right)^{\alpha} \left(\frac{H_{it}}{L_{it}}\right)^{\beta} \left(\frac{L_{it}}{L_{it}}\right)^{1-\alpha-\beta} \quad (2)$$

Equation (1) becomes:

$$y_{it} = A_{it} k_{it}^{\alpha} h_{it}^{\beta} \quad (3)$$

where $y_{it}=\frac{Y_{it}}{L_{it}}$, $k_{it}=\frac{K_{it}}{L_{it}}$ et $h_{it}=\frac{H_{it}}{L_{it}}$

Linearizing equation (3), we obtain:

$$lny_{it} = lnA_{it} + \alpha lnk_{it} + \beta lnh_{it} \quad (4)$$

Moreover, endogenous growth models predict that technical progress is explained by certain factors. Thus, equation (4) can be extended by introducing an agricultural structural transformation as a determinant of economic growth. Additionally, certain variables such as credit to the private sector, investment, human capital and trade openness can be introduced into the growth model. Investment is measured by gross fixed capital formation as a percentage of GDP (GFCF). Solow (1956) shows that investment positively contributes to growth. Human capital stock (HC) is measured by the gross secondary school enrollment rate. It stimulates economic growth (Mamba, 2021, Mankiw et al., 1992; Romer, 1986) as for a large human capital stock into large productive capacities through externalities and contributes to economic growth. Trade openness is measured by the sum of imports and exports relative to GDP (TRADE). It can have a positive effect on growth (Mamba, 2021). Indeed, with the international division of labor, each country specializes in those activities in which it has a comparative advantage. The development of the financial system, measured by the ratio of credit to GDP granted to the private sector (CRED), can positively affect economic growth insofar as financial development promotes investment. The structural transformation is an engine of economic development (Amadou and Aronda, 2020; De Vries et al., 2015; Mcmillan et al., 2014). The migration of factors of production from less productive sectors to more productive sectors increases the economy.The empirical model is :

$$Ln(GDP)_{it} = \phi_0 + \phi_1 AST_{it} + \phi_2 GFCF_{it} + \phi_3 Ln(HC)_{it} + \phi_4 Ln(CRED)_{it} + \phi_5 Ln(TRADE)_{it} + \vartheta_{it} \quad (5)$$

With AST_{it} the agricultural structural transformation, the ϕ_i coefficients to be estimated and ϑ_{it} the error term. Agricultural structural transformation is measured by three variables: agricultural value added to GDP, agricultural sector employment (Herrendorf, 2013), and the agricultural sector labor reallocation term (Gniniguè and Tchalim, 2021; Mcmillan, 2014. De Vries et al, 2015). Agricultural value-added is the net output that is calculated by adding up all the output of the

agricultural sector, deducted from all intermediate consumption of said sector reported. Agricultural employment is the share of employment in this sector in total employment. To examine the effect of labor reallocation (REA) on economic growth in Africa, an indicator from the aggregate productivity decomposition presented by De Vries et *al.* (2015) is constructed. It is presented as follows:

$$REA_i = \sum_1^n (S_i^1 - S_i^0) P_i^0 \qquad (6)$$

REA_i is the reallocation of labor from sector i (agricultural sector), P_i^0 is the productivity of sector i at date 0, S_i^1 is the employment of sector i in the employed population at date 1, S_i^0 is the employment of sector i in the employed population at date 0, and n is the number of sectors. The data mobilized for this article cover 36 African countries from 1990 to 2018 and come from World Development Indicators (WDI, 2020). Figure 1 presents the scatterplot between GDP per capita and agricultural labor reallocation in Africa on a two-dimensional plane.

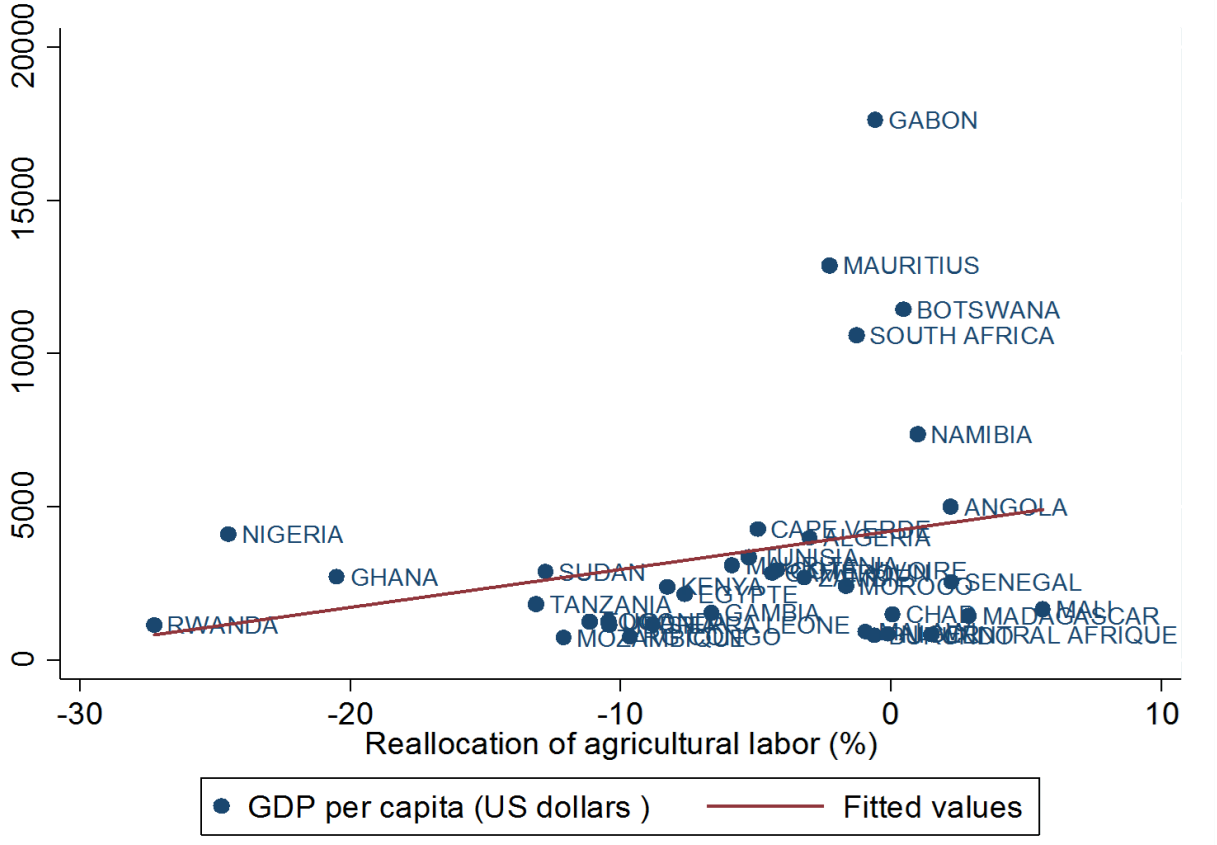

Figure 1: Scatterplot of GDP per capita and agricultural labor reallocation in Africa

The x-axis represents labor reallocation and the y-axis represents real GDP per capita. The observation of this figure shows that there is a positive relationship between GDP per capita and agricultural labor reallocation in Africa. An increase in the reallocation of agricultural labor to other sectors would contribute to an increase in real GDP per capita in Africa. In countries such as Ghana, Nigeria, and Rwanda, labor has moved out of the agricultural sector, while in countries such as Gabon, Mauritius, and Botswana it has not. Table 1 presents the descriptive statistics for the variables included in the model. The average annual real GDP per capita for all African countries is estimated at $3508 from 1990 to 2018 with very high volatility measured by its standard deviation. The average reallocation of agricultural labor is estimated at -0.05% and shows that the agricultural sector is the least productive in Africa and that labor has left this sector for other sectors.

Table 1: Descriptive statistics

Variables	Unit	Obs.	Mean	Std.Dev.
GDP per capita	US dollars	998	3508.801	3941.44
Agricultural reallocation term	%	971	-0.05	37.140
Agricultural value-added	%GDP	979	24.647	14.698
Agricultural employment	%Total employment	1008	52.176	25.869
Gross fixed capital formation	%GDP	942	21.500	9.045
Human capital	% of the population enrolled in secondary school	620	41.029	25.679
Private sector credits	%GDP	967	22.601	25.976
trade openness	%GDP	979	66.425	29.478

The multicollinearity test revealed that the mean VIF and all VIF statistics associated with each variable are less than 5 (Table 2), all explanatory variables can be included in the model to be estimated (Mamba et *al.*, 2020). Wooldridge's (2002) error autocorrelation test showed that the first-order errors are time-dependent at the 5% threshold (Table 2). Table 3 presents the Maddala and Wu (1999) stationarity tests due to the non-cylindrical panel data. These tests revealed that all variables in the model are stationary in level (Table 3).

Table 2: Correlation, multicollinearity, and autocorrelation tests

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) GDP	1.000					
(2) REA	-0.634***	1.000				
(3) GFCF	0.253***	-0.371***	1.000			
(4) HC	0.623***	-0.719***	0.146***	1.000		
(5) TRADE	0.353***	-0.276***	0.376***	0.349***	1.000	
(6) CRED	0.467***	-0.512***	0.089***	0.710***	0.213***	1.000
VIF		1.71	1.39	1.91	1.59	1.77
Mean VIF=1.67						
Wooldridge's error autocorrelation test: Prob > F = 0.000						

**** p<0.01, ** p<0.05, * p<0.1*

Table 3: Maddala and Wu stationarity test

Variables			Test in level
	Chi2	P-value	Decision
GDP per capita	142.9507***	0.000	I(0)
Agricultural reallocation term	763.497***	0.000	I(0)
Gross fixed capital formation	285.254***	0.000	I(0)
Human capital	186.117***	0.000	I(0)
Private sector credits	185.383***	0.000	I(0)
trade openness	262.696***	0.008	I(0)

Note: I represents the order of integration of the variables

Since the individual dimension is greater than the time dimension of panel data in this paper, Pesaran's (2004) cross-sectional dependence test is appropriate. This showed the existence of a correlation between the different countries in Africa (Table 4). Pesaran's cross-sectional dependence test showed the existence of spatial dependence among African countries and Wooldridge's (2002) autocorrelation test revealed that the first-order errors are time-dependent, ordinary least squares, and fixed or random effects estimation techniques cannot be used. The appropriate estimation technique is then Feasible Generalized Least Squares since it solves this problem of spatial dependence and autocorrelation of errors.

Table 4: Pesaran's (2004) cross-sectional dependence test (CD-test)

Variables	CD-test	p-value	corr	abs(core)
GDP per capita	61.90***	0.000	0.468	0.668
Agricultural reallocation term	129.71***	0.000	0.960	0.960
Gross fixed capital formation	14.26***	0.000	0.105	0.373
Human capital	37.21***	0.000	0.280	0.633
Private sector credits	56.11***	0.000	0.434	0.560
trade openness	20.57***	0.000	0.157	0.345

3. Results and discussions

In Table 5, column 2 considers the reallocation of agricultural labor, and the next two columns deal with agricultural value-added and agricultural employment, respectively. This decomposition allows us to examine the effect of the three measures of agricultural structural transformation on economic growth in Africa. In contrast to the reallocation of agricultural labor, agricultural value-added and agricultural employment negatively affect economic growth in Africa at the 1% threshold. Other factors such as investment, human capital, private sector credit, and trade openness positively and significantly affect economic growth in African countries regardless of the measure of structural transformation used. Only credit to the private sector has a positive effect but is not statistically different from zero when the agricultural value-added is used.

The effect of different measures of structural transformation on economic growth in Africa is consistent with the theoretical literature on the structural transformation. This result is similar to those of Bashir et al. (2019) for Indonesia and Erumban et al. (2019) for India. To recall, theoretically, structural transformation results in a reallocation of labor from the agricultural sector to the industrial and service sectors in the process of economic development. Additionally, there is a decline in the share of agricultural production in total production and a decline in agricultural employment in total employment. In this context, any increase in the reallocation of agricultural labor to other sectors will improve the rate of economic growth in Africa.

Table 5: Effect of agricultural structural transformation on economic growth in Africa.

Variables	ln(GDP)	ln(GDP)	ln(GDP)
Agricultural reallocation term	0.001***		
	(0.000)		
ln(Agricultural value-added)		-0.706***	
		(0.018)	
ln(Agricultural employment)			-0.291***
			(0.020)
Gross fixed capital formation	0.006***	0.004***	0.012***
	(0.002)	(0.001)	(0.002)
ln(Human capital)	0.647***	0.226***	0.453***
	(0.024)	(0.026)	(0.027)
ln(Trade opness)	0.227***	0.137***	0.210***
	(0.045)	(0.038)	(0.045)
ln(Private sector credits)	0.050***	0.004	0.036*
	(0.019)	(0.018)	(0.020)
Constant	4.240***	8.340***	5.973***
	(0.163)	(0.169)	(0.202)
Wald chi2	1554.22***	8036.46***	2204.36***
Prob > chi2	0.000	0.000	0.000
Number of countries	36	36	36

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Indeed, since the productivity of the agricultural sector is lower than that of other sectors, agricultural labor moves to the high productivity sectors where it will be more productive and contribute significantly to economic growth. Similarly, any increase in the share of agricultural value-added and the share of agricultural employment should be reflected in a decrease in the rate of economic growth in Africa. As the share of agricultural labor and value-added increases, the shares of employment and value-added in the industry and service sector decline. While the industrial sector is the most productive sector relative to the agricultural sector. Under these conditions, for economic growth to be sustained and sustainable, the share of agricultural value-added and employment must decline in favor of the industrial sector over time.

4. Conclusion

Development theories teach that the process of economic development has generally been accompanied by structural transformation. However, despite agendas put in place, African countries have difficulty escaping poverty. This study examines the influence of agricultural

structural transformation on economic growth in 36 African countries over a period from 1990 to 2018. The Feasible Generalized Least Squares estimation technique is used to control for the problem of spatial dependence between different developing countries and error autocorrelation. The results revealed that the reallocation of agricultural labor positively contributes to economic growth in Africa. In contrast, agricultural value-added and agricultural employment negatively affect economic growth in Africa. Other factors such as investment, human capital, private sector credit, and trade openness positively and significantly affect economic growth in African countries. As a policy implication, African countries should strengthen the structural transformation of their economies for economic development in line with the vision of the African Union's Agenda 2063.

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