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# **Contributing to Economic Development in Sub-Saharan Africa Through Value-Added Agriculture**

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# **Contributing to Economic and Social Development in Sub-Saharan Africa through Value-Added Agriculture**

## *Abstract*

Primary commodity production and exports are the primary drivers of growth in SSA. Thus, value-added agriculture and the resulting market linkages to other sectors are limited. These limitations constrain the ability of SSA to lift its population out of poverty. To evaluate the contributors to growth, we apply the augmented Solow growth model using a system GMM approach. The two findings of this analysis are value-added agriculture contributes substantially to GDP in SSA and the total effect of the agricultural sector exceeds that of the non-agricultural sector, suggesting the need for developing countries in SSA to promote market linkages for economic transformation.

## **Introduction**

Primary commodity production and exports are the most important drivers of growth in Sub-Saharan Africa (SSA). This dependence on commodities and export of agricultural raw goods makes it difficult for the region to lift its population out of poverty. Thus, SSA continuously lags behind most regions in economic growth (Figure 1) and remains a region where poverty persists. Recent estimates in 2014 indicate that nearly 50% (414 millions) of the SSA population are living in extreme poverty\*. This number, which is more than twice the number reported three decades ago (205 million), makes the poverty targets unachievable for the SSA region. Fundamentally, this slow performance, related to limited value-added agriculture and market linkages to other sectors,

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\* The World Bank defines “extreme poverty” as a standard of living of less than US \$1.25 (PPP) a day (PPP stands for Purchasing Power Parities).

reveals weaknesses in the industrial sector in most SSA economies (Economic Report on Africa, 2013). The agricultural sector improvement through value-added agriculture and market linkages development can be favorable to promote economic growth, improve human development, and therefore, reduce poverty (Diao et al., 2006; Christiaensen and Demery, 2007; Christiansen et al., 2011, Dethier and Effenberger, 2012). In most SSA countries, the agricultural sector accounts for approximately 32% of GDP (World Bank, 2013), with limited value-added (Figure 2) and market linkages to the other sectors

(Economic Report on Africa, 2013). Figure 3, showing value added in different sectors of the economy, displays the low level of value-added agriculture compared to others sectors among SSA countries. The potential for SSA countries to promote value added will not only help diversify agricultural products, but also help creating job opportunities for its poor population and accelerating economic and social development. Given that countries that participate in high value-added products tend to benefit more from agricultural and overall economic growth (Datt and Ravallion, 1996) and have been successful in reducing poverty (World Bank, 2008), it is important for African economies to promote value-added from agricultural products. For instance, except for Brazil and Pakistan, most countries with high growth rates in agriculture value-added per capita (China, Malaysia, Vietnam, and India) have been successful in reducing poverty (World Bank, 2008). Some countries on the African continent, such as Botswana, Gabon, Mauritius and South Africa have been successful in promoting growth through agro-food processing and mostly natural resource exploitation. Only a few papers emphasize the need for SSA farmers, as well African nations, to be involved in the production for sale of high value-added products (Irz et al., 2001 and

Economic Report on Africa, 2013). The present paper identifies value-added agriculture as a key strategy to promote economic and social development in SSA.

The recent strong economic growth in Africa has not translated into socioeconomic development needed to improve social conditions and alleviate poverty. This result supports the fact that raw commodity production is the main driver of African economic growth, which does not generate job opportunities for poor populations. Compared to emerging economies in Asia and Latin America, most countries in SSA (Cameroon, Cote d'Ivoire, Ghana, Kenya, Nigeria, and Zambia) depend heavily on primary commodity production and exports. This dependence limits the ability of countries to generate higher incomes from value-added agriculture. For instance, only between a fifth and a quarter of cocoa production in Cote d'Ivoire and Ghana is semi-processed before export (Economic Report on Africa, 2013).

In this context, the present paper examines the contribution of value-added agriculture to overall economic and social development in SSA. To illustrate further the importance of the value-added agriculture in low-income SSA countries, this study highlights the importance of developing market linkages in target countries. This research is relevant because of the implications for development assistance for African governments, NGOs, and the World Bank, the largest donor to African agriculture. Thus, the hypotheses are (1) an increase in value-added agriculture raises GDP, and (2) market linkages influence the effect of value-added agriculture on growth in SSA. Hence, the current paper provides analysis that determines the importance of value-added agriculture on economic and social growth in Sub-Saharan Africa.

The paper proceeds as follows: the first section provides the theoretical approach of the paper. The second section reviews relevant literature providing a theoretical basis of empirical evidence on

the relationship between agriculture value-added and economic growth and social development. The third section describes the methodology used to address the research question, followed by the description of data; and the final sections report the results, the conclusion and policy implications of the findings.

## **Literature Review**

The principal aim of this paper is to assess the effects of value-added agriculture and market linkages on economic growth in SSA. Traditional agriculture, along with primary commodity exports, has been the main driver of African economic growth. The region still has low economic performance with a weak industrial sector. Therefore, industrializing African agriculture through increased participation in growing world markets for high-value product, may not only yield employment and income benefits to poor people, but also help lower exposure to commodity price fluctuations. While per capita GDP in SSA is increasing significantly, SSA remains the poorest region in the world (World Bank, 2016). Several studies, using cross-country analysis of the effect of agricultural and non-agricultural sectors, support the argument that improving the agricultural sector can be favorable to promote economic growth, improve human development, and therefore, reduce poverty (Diao et al., 2006; Christiaensen and Demery, 2007; Christiansen et al., 2011). For example, Garner (2006) explores the growth experiences of Sub-Saharan African countries and argues that the reasons for the poor performance of Africa have been inconsistent economic policies and other factors such as low investment rates and institutions. Bresciani and Valdes (2007) suggest three channels that link agricultural productivity to poverty reduction: labor market, farm income, and food prices. The authors question whether limited resource farms producing mainly household consumption goods can influence economic growth. With the persistent debate

that poverty reduction is not effective if it only depends on one sector's growth, but also on the other sectors' performance, Christiansen and Demery (2007) report that growth from the agricultural sector is more poverty-reducing than growth from other sectors. Similarly, Irz et al. (2001) use a cross-country estimation model to investigate the impact of agricultural growth on poverty alleviation. The authors link value-added agriculture to economic growth and poverty reduction. Their study shows strong linkages between agricultural productivity and poverty alleviation. The empirical approach tests the argument that changes in agricultural growth affect not only the farm economy, but also the rural and national economies. Thirtle et al. (2003) use a similar model and show that investment in agricultural R&D raises value-added agriculture sufficiently to give satisfactory rates of return within the agricultural sector, and that increase in agricultural productivity has a substantial effect on poverty reduction.

Hence, in this paper, we evaluate the effects of agricultural productivity from value-added agriculture, together with market linkages to other sectors on economic growth. Several recent papers investigating factors fundamental to economic growth have used the augmented Solow model (Hoeffler, 2002; NKurunziza and Bates, 2004; Ding and Knight, 2009; Ndambiri et al., 2012).

Regarding the debate on whether the augmented Solow model can account for the growth experiences of certain regions, more specifically SSA, Hoeffler (2002) finds that Africa's poor performance can fully be accounted using the augmented Solow model. Indeed, when allowing for unobserved country-specific effects and controlling for the endogeneity of regressors, the augmented Solow model can explain SSA's growth experience. Correspondingly, Ding and Knight

(2009) report that China's economic growth experience is perfectly in line with the augmented Solow model, precisely when allowing for international variations in technology.

Notwithstanding the wide literature review on economic growth and poverty alleviation, none of them focuses on the poorest countries in SSA, where agriculture is essential for growth. In addition, very few cross-country analyses explore the contribution of value-added agriculture on economic and social growth. Hence, in this paper, we attempt to fill this gap by emphasizing value-added from agriculture in low and lower-middle income countries in SSA using the augmented Solow model. The emphasis of this paper is to determine the importance of value-added agriculture and market linkages to other sectors on economic growth.

Growing value-added sectors requires adequate investments in skills and technology, and remains a key challenge in the sector of agriculture for low-income countries in SSA. Previous research on the topic (Thirtle et al., 2003; Christiansen and Demery, 2007), typically focuses on the importance of the sector to economic growth throughout the developing world. Very little research considers value-added agriculture for low and lower middle-income SSA countries. The specific focus on these countries is important because traditional, limited resource farmers and the output of these farmers are an important source of foreign income for these countries. Therefore, the present paper attempts to assess the contribution of value-added from SSA's agricultural sector to its economic growth. In addition, none of the empirical work connects value-added agriculture to other sectors in the economy. Thus, this paper offers a new dimension of this work to previous studies by investigating the impact of value-added agriculture on other sectors of the economy.



## Theoretical Concept

The study hinges on previous studies conducted by Bloom et al. (2004), Thirtle et al. (2003) and Mangeloja (2005) where economic growth is composed of two sources: growth from the level of inputs versus growth from total factor productivity (TFP). The generalized form of the model used in the present paper has on the left hand side the output of gross domestic product (GDP) and on the right hand side the TFP (technological progress), and the physical capital. This model follows initially the basic Solow growth model (Solow, 1956), which is appropriate to the research question in the sense that it captures the effects of agricultural inputs on growth. The basic model starts as the neoclassical Cobb-Douglas production function:

$$(1) \quad Y = F(A, K, L)$$

Based on the research interest in this paper,  $Y$  represents gross domestic product (GDP);  $A$  is the technology level, proxied by a time trend (Solow, 1957);  $K$  is the capital stock; and  $L$  is the labor input.

According to the Solow model, it is more appropriate to use output per worker instead of output per capita since not every person in a country contributes to output growth (Solow, 1957). Hence, in order to get all variables of the model expressed in per worker terms, we divide each side of the previous equation by labor ( $L$ ). Thus, equation (1) is as follow:

$$(2) \quad \frac{Y}{L} = F\left(\frac{A}{L}, \frac{K}{L}, \frac{L}{L}\right)$$

Then, the model in equation (2) becomes:

$$(3) \quad y = f(a, k)$$

where  $y$  represents the total production in an economy that is the gross domestic product (GDP) per worker;  $a$  is the technology level which is proxied by a time trend (Solow, 1957); and  $k$  is the physical capital per worker.

An augmented version of the model in equation (3) gives the following form:

$$(4) \quad y = a k^{\alpha} h^{\beta} (va)^{(1-\alpha-\beta)}$$

Value-added agriculture per worker ( $va$ ) is incorporated in the model based on the assumption that this variable contributes to growth. In the augmented version of the Solow model, investment in human capital ( $h$ ) is an important explanatory variable of growth.

However, instead of proxying investment in human capital using school enrollment like Barro and Lee (1993, 2001), we use an index of human capital per person from the Penn world table 9. This index is calculated based on years of schooling (Barro/Lee, 2012) and returns to education (Psacharopoulos, 1994). Literate farmers are assumed able to assimilate new methods or technologies and make use in the production process in order to increase agricultural and overall growth.

The empirical growth model, augmented with the human capital index and the contribution of value-added agriculture, in logarithmic form is as follows:

$$(5) \quad \ln y = \ln a + \alpha \ln k + \beta \ln h + \gamma \ln va + \ln \varepsilon_1$$

with  $\gamma = 1 - \alpha - \beta$ .

$h$  is the human capital per worker; and  $va$ , the contribution of value-added agriculture (table 1).

Other potential variables that are important factors to economic growth (Fan et al., 2000; Thirtle et al., 2003; Bloom et al., 2004; Christiaensen and Demery, 2007) include population growth rate

(*pop*), government expenditure (*goe*), trade openness (*open*), foreign direct investment (*inv*), and the share of value-added in non-agricultural sectors (*nonag*). The model that we estimate is,

$$(6) \quad \ln y = \ln a + \alpha \ln k + \beta \ln h + \gamma \ln va + \delta \ln pop + \theta \ln goe \\ + \rho \ln open + \sigma \ln inv + \tau \ln nonag + \ln \varepsilon_1$$

All variables are in logarithm form.

As stated earlier, another dimension of this work is forged in investigating the impact of value added agriculture on other sectors of the economy. Hence, to estimate the linkages between agricultural and non-agricultural sectors, we add to equation (6) an interaction term ( $\ln va * \ln nonag$ ). Thus, the revised model is as follow:

$$(7) \quad \ln y = \ln a + \alpha \ln k + \beta \ln h + \gamma \ln va + \delta \ln pop + \theta \ln goe + \rho \ln open \\ + \sigma \ln inv + \tau \ln nonag + \omega (\ln va * \ln nonag) + \ln \varepsilon_2$$

Depending on the importance of the contribution of value-added agriculture to growth, this paper provides a clear picture of the market linkages between value-added agriculture and the other sectors of the economy.

## Methods

The current paper estimates two equations to determine the importance of value-added agriculture on economic growth in Sub-Saharan Africa. First, a production function model by Solow (1956) of economic growth is estimated to determine the impact of value-added agriculture on economic development. Second, the production function is re-estimated to assess the influence value-added agriculture and non-agricultural market linkages. Therefore, the empirical models are expressed as follows:

*Model 1: Growth model*

$$(8) \quad \ln y_{i,t} = \ln a_{i,t} + \alpha \ln k_{i,t} + \beta \ln h_{i,t} + \gamma \ln va_{i,t} + \delta \ln pop_{i,t} + \theta \ln goe_{i,t} \\ + \rho \ln open_{i,t} + \sigma \ln inv_{i,t} + \tau \ln nonag_{i,t} + \varepsilon_{1,i,t}$$

The second model, derived from the previous model, explains the market linkage model. Thus, the model is expressed as follows:

*Model 2: Market linkages model*

$$(9) \quad \ln y_{it} = \ln a_{i,t} + \alpha \ln k_{i,t} + \beta \ln h_{i,t} + \gamma \ln va_{i,t} + \delta \ln pop_{i,t} + \theta \ln goe_{i,t} \\ + \rho \ln open_{i,t} + \sigma \ln inv_{i,t} + \tau \ln nonag_{i,t} + \omega(\ln va_{i,t} * \ln nonag_{i,t}) \\ + \varepsilon_{2,i,t}$$

$i$  and  $t$  represent each country and each year from 2000 to 2014, respectively.  $\varepsilon_{1it}$ ,  $\varepsilon_{2it}$  and  $\varepsilon_{3it}$  are errors terms for model 1, 2 and 3 respectively.

Since this paper uses panel data, which controls for unobserved heterogeneity issue, it is important to determine if there exist some country-specific effects, and therefore, decide whether ordinary least squares (OLS) estimation is appropriate or not. The result also helps determine if the fixed effects (FE) or random effects (RE) model is more efficient in our estimation. This is done using the Breusch and Pagan Lagrange multiplier test. A high p-value indicates that OLS estimation is valid, and therefore, there is no need for the FE or the RE model. Otherwise, it is necessary to implement the Hausman test which indicates whether the FE or the RE model is more efficient. The FE model assumes that there exist time-invariant characteristics that are unique to each country and are not correlated with the error term. If chosen over the RE model, the FE model will reveal the existence of country-specific factors (geographical location, cultures, weak governances, political and social stability, climates and others) and their impact on value-added

agriculture and economic growth among SSA countries. The FE model estimation will therefore remove the effect of those time-invariant country characteristics and give the net effect of the right hand side variable. However, if the RE model is chosen the effect of these time-invariant country characteristics will be included in the estimation.

In addition to the above tests, other basic assumptions such as homoscedasticity and autocorrelation assumptions of the models are also tested to decide the appropriate models' specification in this paper.

#### *Preliminary results and choice of the appropriate model*

Appendix 1 presents the preliminary results from statistical tests, enabling the selection of the estimation methods. The Breusch and Pagan Lagrange multiplier test yields a chi-squared value of 1122.85 and a significant p-value=0.000, rejecting the null hypothesis that there are no country-specific effects; therefore, OLS estimation is not appropriate. Hence, it is necessary to perform the Hausman test for RE. Results give a chi-squared value = 52.46 with a significant p-value (0.0000) indicating that the null hypothesis is rejected at 5%. Thus, the FE model is consistent. This result implies that there exist country-specific factors that may have some influence on GDP.

Furthermore, the statistical tests for autocorrelation by Woodridge (2002) and homoscedasticity are performed. The Woodridge test for autocorrelation in panel data yields an F-value = 1925.69 and p-value = 0.0000 which rejects the null that there is no first-order autocorrelation. The results for the homoscedasticity assumption using the modified Wald test for groupwise heteroscedasticity in the FE regression model shows a statistical significant p-value = 0.000 (chi-squared=21318.85). The null hypothesis that the variance among countries is constant, is therefore rejected at 5%. This

indicates the presence of heteroscedasticity which is addressed through the use of robust standard errors. Also, the test for over-identifying restriction is statistically significant indicating that the model is valid. Furthermore, in order to see whether or not the interaction term is valid in our second model (Market linkages variable), we test the joint hypotheses that the interaction term between value added from agriculture and value added from the non-agricultural sector is statistically significant. Result from the joint test gives a low p-value ( $p < 0.05$ ) rejecting the null hypothesis that our interaction variable is zero. Hence, this indicates that the interaction term is valid in our second model, and we can conclude therefore that this variable has a significant impact on GDP per worker.

Based on previous test results and since OLS estimates are not appropriate, the generalized method moments (GMM) estimation technique seems more appropriate.

GMM allows for unobserved heterogeneity, heteroscedasticity and autocorrelation. Therefore, we use the GMM estimation by Hansen (1982) to estimate our empirical growth model. Christiansen et al. (2011), Doytch and Uctum (2011) and Bloom and Canning (2005) used the same econometric technique of growth effects and have demonstrated that GMM estimation is more reliable when dealing with the issues stated above. Estimation of panel data using GMM is based on the exogeneity assumption. One problem encountered in the estimation of the growth panel model is violation of the exogeneity assumption. To address this issue, we could use instrumental variables (IV); however, in the presence of the heteroscedasticity problem, IV is inefficient. Therefore, GMM estimation is a more efficient econometric technique in this paper.

### *Statistical models*

Our empirical growth models based on preliminary results are expressed in the following form:

*Model 1: Growth model*

$$(10) \ln y_{i,t} = \ln a_{i,t} + \alpha \ln k_{i,t} + \beta \ln h_{i,t} + \gamma \ln va_{i,t} + \delta \ln pop_{i,t} + \theta \ln goe_{i,t} \\ + \rho \ln open_{i,t} + \sigma \ln inv_{i,t} + \tau \ln nonag_{i,t} + \eta_{1,i} + \mu_{1,i,t}$$

*Model 2: Market linkages model*

$$(11) \ln y_{i,t} = \ln a_{i,t} + \alpha \ln k_{i,t} + \beta \ln h_{i,t} + \gamma \ln va_{i,t} + \delta \ln pop_{i,t} + \theta \ln goe_{i,t} \\ + \rho \ln open_{i,t} + \sigma \ln inv_{i,t} + \tau \ln nonag_{i,t} + \omega(\ln v_{i,t} * \ln nonag_{i,t}) + \eta_{2,i} \\ + \mu_{2,i,t}$$

where  $\eta_{j,i}$  and  $\mu_{j,i,t}$  are respectively the unknown intercepts for each country and the error terms for model 1 and model 2.

Using panel data, one or more of the regressors in the growth equations may be correlated with the error term,  $\mu_{j,i,t}$ . Hence, to address the problem of endogeneity, we use the dynamic panel data model estimation, which uses all lagged values as instrumental variables and relies on first-differencing transformation to eliminate the country-specific effects. Previous work demonstrates that the first-differenced GMM method can perform poorly<sup>2</sup> (Bond et al., 2001). Due to potential weakness in the estimator, we use the system GMM<sup>3</sup> estimator as an extension of the first-differenced GMM estimator (Arrelano and Bover, 1995 and Blundell and Bond, 1998). The system GMM model is expressed as a system of equations (one per time period) and designed for

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<sup>2</sup> Lagged level variables constitute weak instruments for subsequent first-differences variables in first-differenced GMM estimation; hence, the first-difference GMM estimation by Arrelano and Bond (1991) may lead to bias and inconsistent estimates. See Bond et al. (2001) for further details.

<sup>3</sup> The system GMM used in this paper is relevant for the following reasons: first, system GMM estimators by Arrelano and Bover (1995) and Blundell and Bond (1998) produces consistent and efficient estimators (Bond et al., 2001). Second, the system GMM (as well as first-differenced GMM) estimation method addresses endogeneity issues and eliminate all unobserved country-specific effects. Third, the system GMM estimation is consistent when using panel data with a large number of entities over a small number of time periods.

situations with independent variables that are not strictly exogenous, fixed effects, heteroscedasticity, autocorrelation within individuals, and dependent variable that depends on its own past realization. Thus, this estimator will produce more efficient and consistent estimates. Following Blundell and Bond (1998), Hoeffler (2002) and, Nkurunziza and Bates (2004), the system GMM is the preferred model in the present study. Therefore, equations (12) and (13) can be generalized in the following panel data model:

$$(12) \quad \Delta \ln y_{i,t} = \varphi \Delta \ln y_{i,t-1} + \phi \Delta \ln X_{i,t} + \Delta \mu_{i,t}$$

for  $i=1, \dots, N$  and  $t=1, \dots, T$ , where  $\Delta \ln y_{i,t}$  is the log difference in real GDP per worker such that  $\Delta \ln y_{i,t} = (\ln y_{i,t} - \ln y_{i,t-1})$ ,  $\ln y_{i,t-1}$  is the logarithm of real GDP per worker at the beginning of each period, and  $X_{i,t}$  is a vector of other characteristics such that in:

model 1,

$$(a) \quad \Delta \ln X_{i,t} = \Delta \ln a_{i,t} + \alpha \Delta \ln k_{i,t} + \beta \Delta \ln h_{i,t} + \gamma \Delta \ln va_{i,t} + \delta \Delta \ln pop_{i,t} \\ + \theta \Delta \ln goe_{i,t} + \rho \Delta \ln open_{i,t} + \sigma \Delta \ln inv_{i,t} + \tau \Delta \ln nonag_{i,t}$$

and model 2,

$$(b) \quad \Delta \ln X_{i,t} = \Delta \ln a_{i,t} + \alpha \Delta \ln k_{i,t} + \beta \Delta \ln h_{i,t} + \gamma \Delta \ln va_{i,t} + \delta \Delta \ln pop_{i,t} + \theta \Delta \ln goe_{i,t} \\ + \rho \Delta \ln open_{i,t} + \sigma \Delta \ln inv_{i,t} + \tau \Delta \ln nonag_{i,t} + \omega \Delta (\ln va_{i,t} * \ln nonag_{i,t})$$

As mentioned earlier, the growth models may encounter some unobserved heterogeneity and endogeneity problem. Thus, it is important to note that the system GMM used in this paper is relevant for the following reasons: first, system GMM estimation techniques by Arrelano and Bover (1995) and Blundell and Bond (1998) produce consistent and efficient estimators (Bond et al., 2001). Second, the system GMM (as well as first-differenced GMM) estimation method addresses endogeneity issues and eliminates all unobserved country-specific effects. Third, the



system GMM estimation is consistent when using panel data with a large number of entities,  $N$ , over a small number of time periods,  $T$ .

Rewriting our empirical models, we get:

*Model 1: Growth model*

$$(13) \quad \Delta \ln y_{i,t} = \Delta \ln a_{i,t} + \varphi \Delta \ln y_{i,t-1} + \alpha \Delta \ln k_{i,t} + \beta \Delta \ln h_{i,t} + \gamma \Delta \ln va_{i,t} + \delta \Delta \ln pop_{i,t} \\ + \theta \Delta \ln goe_{i,t} + \rho \Delta \ln open_{i,t} + \sigma \Delta \ln inv_{i,t} + \tau \Delta \ln nonag_{i,t} + \Delta \mu_{1,i,t}$$

*Model 2: Market linkages model*

$$(14) \quad \Delta \ln y_{i,t} = \Delta \ln a_{i,t} + \varphi \Delta \ln y_{i,t-1} + \alpha \Delta \ln k_{i,t} + \beta \Delta \ln h_{i,t} + \gamma \Delta \ln va_{i,t} + \delta \Delta \ln pop_{i,t} \\ + \theta \Delta \ln goe_{i,t} + \rho \Delta \ln open_{i,t} + \sigma \Delta \ln inv_{i,t} + \tau \Delta \ln nonag_{i,t} \\ + \omega \Delta (\ln v_{i,t} * \ln nonag_{i,t}) + \Delta \mu_{2,i,t}$$

More details about the above variables are given in the following section.

## **Data and sources**

Data are obtained from the Penn World table 9.0, World Development Indicators (WDI, 2014). Using country level dataset, data are from 2000 to 2014 for low and lower-middle income SSA countries, based on the World Bank classification list of economies (appendix 2). This classification table divides all economies among income groups according to the 2014 gross national income (GNI) per capita. Countries with a GNI per capita less than \$1,045 are classified as low-income countries. The lower-middle income group represents all economies with income per capita between \$1,046 and \$4,125 (WDI, 2014). Most countries in the Sub-Saharan region are

in the latter category (WDI, 2014), except for Angola, Botswana, Equatorial Guinea, Gabon, Mauritius, Namibia, Seychelles and South Africa. Figure 4 shows the level of income for all countries in the SSA region. Countries with a GNI per capita greater than \$4,125 are deleted. The countries with a GNI per capita greater than U.S \$4,125 have experienced economic progress resulting from sectoral improvements from tourism, diamond mining (Botswana, South Africa) and, most importantly, petroleum producing or exporting activities (Gabon). Because of data unavailability, we exclude Chad, Ghana, Sao Tome and Principe, Somalia and South Sudan. As a result, only data for 35 countries remain from the original 48 SSA countries to estimate the model (Appendix 2). Data are not available for all countries and for all periods; thus, making the panel unbalanced but usable<sup>4</sup> for our estimation, since we corrected for missing observations using the mean. Table 2 presents the summary statistics of all variables.

*Gross domestic product* (GDP) measures the efficiency of population producing goods and services. GDP is the dependent variable in our growth models.

*Value-added agriculture* refers generally to increasing the economic value of a primary agricultural commodity through manufacturing processes; it measures the output of the agricultural sector of an economy less the value of intermediate inputs (World Bank, 2014). We expect to find a positive impact on growth. A significant coefficient indicates that value-added agriculture contributes substantially to economic growth.

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<sup>4</sup> a. There are two key assumptions underlying the consistency of the FE estimators on unbalanced panel; namely, the strict exogeneity assumption and the rank condition. See Wooldridge (2002) for further details.

b. Also, the STATA command `xtabond`, used for our dynamic panel regression in this paper, handles data that have missing observations in the middle of panels.

*Labor* measures the total labor force, involving economically active people (World Bank, 2014). That is all persons engaged in an economic activity, whether farm or non-farm activity, paid or unpaid workers.

*Capital stock* is a measure of the physical assets used in the production; it includes all the production components such as land development, livestock, machinery and equipment and others. This variable is important to growth in the sense that high investment in physical capital may yield to higher returns, thus improving economic growth.

*Human capital* is an index measuring the level of human capital per person based on years of schooling and returns to education (Penn World Table 9). Proxying human capital investment using school enrolment rates like (Barro, 1993) is problematic. Reasons are it conflates the level and accumulation effects of human capital and may leads to misinterpretations of the role of the labor force growth (Gemmell, 1996). Thus, we include the human capital index in our regressions, to avoid these problems. Similar to capital stock, a higher investment in human capital leads to higher returns and increase GDP.

*Technology* measures the technological rate of progress over time. In the absence of reliable data on technological change, time trend (year) is used as a proxy variable to explain technological progress. Agricultural technological change is an important measure for growth (de Janvry et al., 2000; Besharat and Amirahmadi, 2011) since it can contribute to agricultural growth and GDP through adoption of new agricultural technologies by poor farmers. Famers who adopt new technology may increase their welfare, thus promoting their social condition.

*Population growth* measures the annual rate of growth of the total population in a country. Based on the literature review, the coefficient is expected to be negative as the rapid population growth

in SSA countries constitutes a challenge in SSA countries (Ramsey, 2005). Further, population in Africa is growing at a faster rate than that of the output per worker.

*Government expenditure*, also classed as government final consumption expenditures, measures all current government expenditures on purchases for goods and services in an economy. Government expenditure is an important factor in the economic development of SSA countries (Thirtle et al., 2003); however, in the absence of foreign aid, and dependence on their own capital, these African countries cannot face the economic growth challenge with such slow growth in agricultural development and contribution to GDP. Hence, we expect to find a negative impact on both economic and social growth.

*Foreign direct investment* measures the net inflows of investment from foreign investors among SSA economies. As elaborated earlier, FDI is a dominant factor in most SSA countries as these countries depend significantly on foreign aid, to overcome the world food crisis and reducing poverty and hunger (Fan and Rosegrant, 2008). Thus, a positive coefficient in FDI shows foreign investment contributes to overall economic growth in SSA.

*Trade openness* is an indicator measuring a country's openness to international trade, relative to domestic transactions. Hence, the higher the indicator in a country is, the larger the influence of trade on domestic activities, and therefore the stronger that country's economy.

*Value-added, non-agriculture* is a measure of the share of value-added in other sectors (manufacturing, industry, and service) than agriculture, which are all important determinants of African economies. A significant positive coefficient of value-added from the non-agricultural sector demonstrates strong linkages between value-added from the other sectors of the economy and GDP (Irz et al, 2001).

## **Results and Discussion**

### *Economic Growth*

From the growth models (i.e. models 1 and 2), we observe similarities in the significance and signs concerning the main variables of interest in table 3. As expected, value-added agriculture constitutes an important determinant of economic growth among SSA countries. For instance, results in model 1 show a positive and highly significant coefficient indicating that a 10% increase in value-added agriculture raises GDP per worker by 0.76%. This result is consistent with findings in countries with similar constraints such as countries in Latin American (Thirtle et al., 2003; Christiansen and Demery, 2007), and in Asia (World Development Report, 2008). Although the findings confirm our expectations, this provides evidence that more attention should be given to value-added agriculture since most countries in the SSA region show remarkably low levels of value-added agriculture (ERA, 2013). For instance, Cote d'Ivoire, which is the biggest producer of cocoa, as well as Ghana, exports their primary products in a semi-processed form. Similarly, the coefficient for value-added from the non-agriculture sector has the expected (positive) sign indicating the significant contribution of this sector to output per worker. Specifically, GDP increases by 0.63% following a 10% rise in value-added from non-agricultural sectors. This result is not surprising given that the non-agricultural sector is generally known to be an important contributor to the growth of national economies.

In agreement with the literature, physical capital and human capital are important factors of economic growth among SSA countries; as expected, results show that the coefficients for physical capital and human capital are positive and statistically significant, suggesting that GDP per worker

increases by 0.82% and 1.88% respectively with a 10% increase in each factor. However, total factor productivity (technological progress) is not statistically significant in both growth models. This can be explained by the fact that most countries in the region have limited adoption of new agricultural technologies. In addition, irrigation problems and inadequate use of fertilizer are sources of low crops yields in Africa, particularly in many West African countries (Lipton, 2012). As expected, the first lagged value of the GDP per worker is positive and statistically significant; thus, from the model 1, GDP per worker would go up by 7.40% with an increase of 10% in GDP per worker in the previous year. Government expenditure also contributes positively to output per worker. That is, if government expenditure goes up by 10%, GDP would also raise by 0.33%. Similarly, trade openness has a positive effect on output per worker, showing that GDP per worker increases by 0.32% following a 10% increase in openness. Most SSA countries are net importers of goods on the international market. The trade deficit status is detrimental to economic growth in the sense that low export levels and unfavorable trade terms prevent African countries from enjoying trade benefits. For example, Dollar and Kraay (2000) show that countries with high levels of trade openness tend to grow rapidly and generate higher GDP per capita. Moreover, population growth rate has a positive impact on economic growth in the model 1 while in the second model there is no significant effect. The insignificance of the result for population growth in model 2 is particularly surprising; first, one would expect high population growth rate in Africa would tend to influence economic growth; second, population in Africa is growing at a faster rate than that of the output per worker, and this rapid growth constitutes a challenge in SSA countries (Ramsey, 2005). Furthermore, FDI is insignificant in both model 1 and model 2 as shown in table 3.

### *Market linkages*

The statistical significance of the interaction term in Model 2 (Table 3) is an indication of the existence of market linkages in national economies. Estimation results show that both agriculture and non-agriculture sectors contribute significantly to economic growth in SSA countries. For example, using the typical output of the non-agricultural sector per year, findings show that the total effect<sup>5</sup> of the agricultural sector on economic growth is 1.52% for every 10% increase in agriculture. Hence, this finding confirms that value added contributes significantly to growth among SSA countries. Similarly, GDP goes up by 0.43% following a 10% increase in the non-agricultural sector given the mean annual agricultural output for SSA countries. Thus, the positive effect implies that the higher the share of value added in the secondary (manufacturing) and tertiary (services), the greater (more positive) is the effect of value-added agriculture. In the same way, the higher the effect of value-added agriculture, the higher the effect of value-added non-agriculture on GDP is. As expected, the total effect of agriculture exceeds that of the non-agricultural sector. The results show the importance of the contribution of value-added agriculture in growth, providing a clear picture of the marketing linkages between value-added agriculture and the other sectors of the economy.

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<sup>5</sup> Since the market linkage model contains an interaction term between two continuous variables (*value-added agriculture and value-added non-agriculture*), I use the following method to determine the total effect of each variable on GDP and the other sectors: [*coefficient of estimated parameter + (coefficient of interaction term \* mean of estimated parameter)*]. Hence, the total effect of value-added agriculture is  $0.1925 + (-0.065 \times 6.14) = 0.1527$ ; likewise, the total effect of variable value-added non-agriculture is  $0.1770 + (-0.0065 \times 20.53) = 0.0435$ .

Overall, the findings highlight the importance of value-added agriculture and other factors on economic development in low and lower-middle-income SSA countries. This is clear evidence that agriculture should not be neglected given its contribution to socioeconomic.

## **Conclusion**

The contribution of value-added agriculture to economic and social development in Sub-Saharan African (SSA) countries was the main purpose of this paper. We have applied the Solow growth model using the GMM approach generally used in empirical growth models. Generally, the results support previous studies in that value-added agriculture positively affects GDP. Results also demonstrate that government spending is an important determinant of the nature of economic growth. Although, number of factors are significant in increasing GDP, value-added agriculture is a weak contributor of economic growth in SSA countries. Hence, improvement in value-added in the agricultural sector would drive economic growth thereby reducing poverty and promoting social conditions among SSA countries. Nevertheless, further research should be directed at policies to increase value-added agriculture in Africa. This implies that effective poverty reduction strategies should focus on fostering higher rates of value-added in the agricultural sector and improving market-linkage with other sectors. Thus, governments must invest in agricultural R&D and infrastructure (e.g. constructing rural roads).

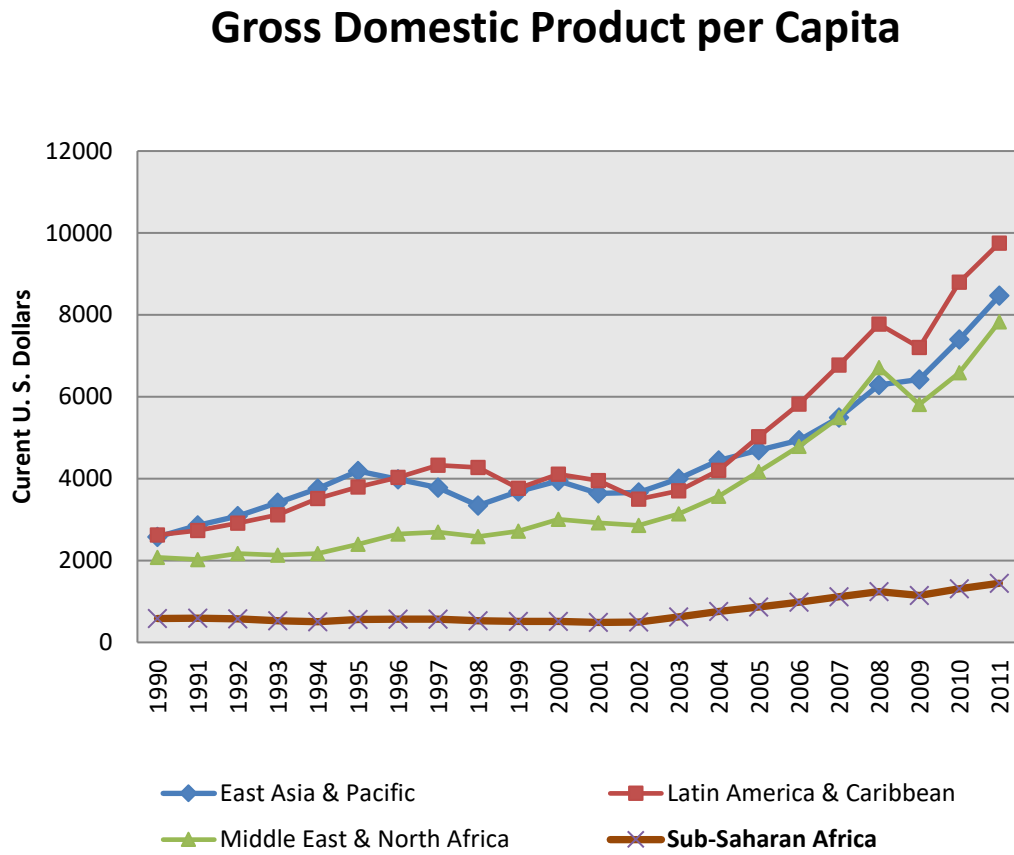
The results of this study are important in the sense that emphasizing value-added agriculture can be an effective strategy to improve growth, and promote market linkages to other sectors of the economy in SSA countries. Moreover, the findings of this paper have significant development



policy implications for African governments, NGOs, and important donor agencies such as the World Bank.

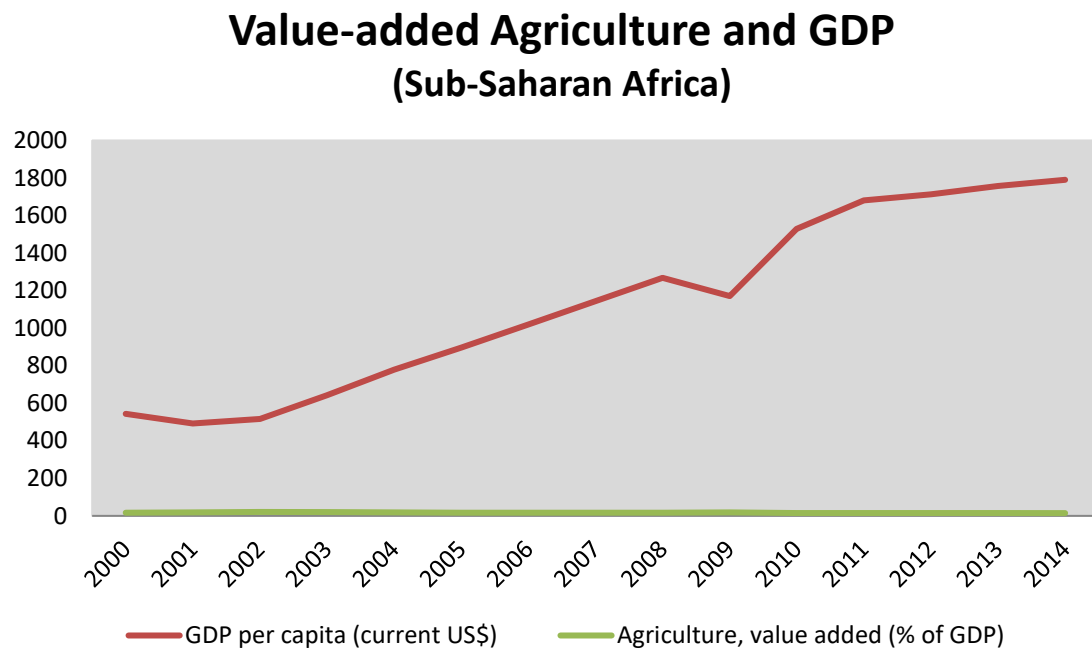
Overall, the study has shown the link between value-added in agricultural sector, market linkages to other sector and economic growth.

**Figure 1. Gross domestic product per capita per regions**



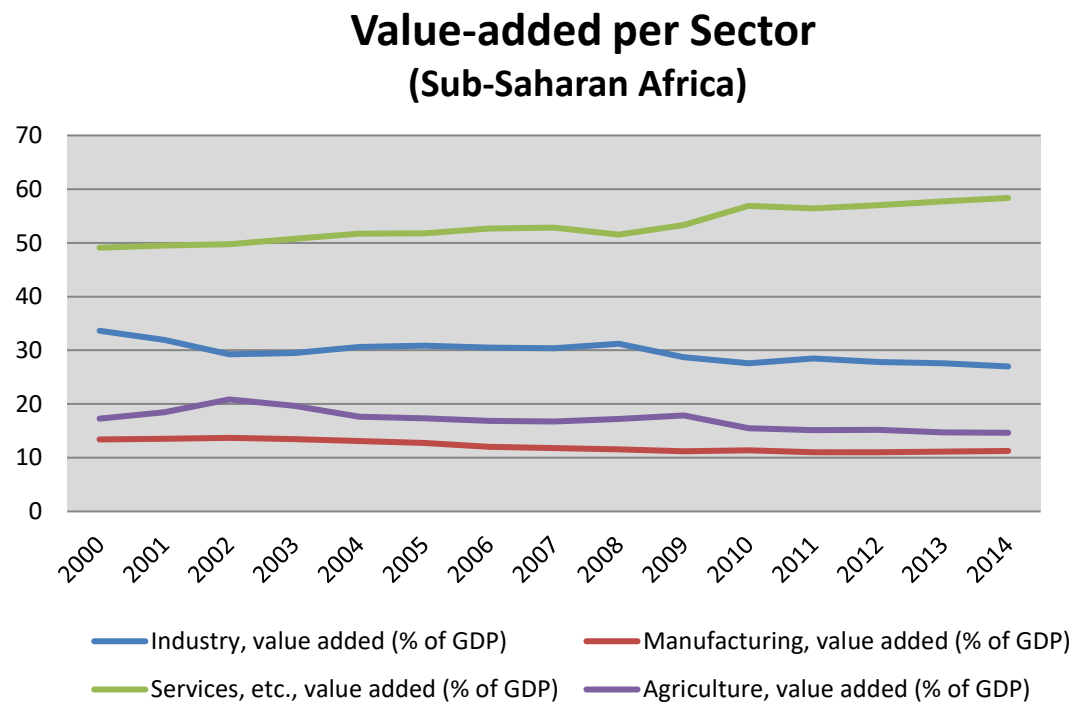
Source: World Bank, World Development Indicators database 2014

**Figure 2. Value-added agriculture and gross domestic product per capita in Sub-Saharan Africa**



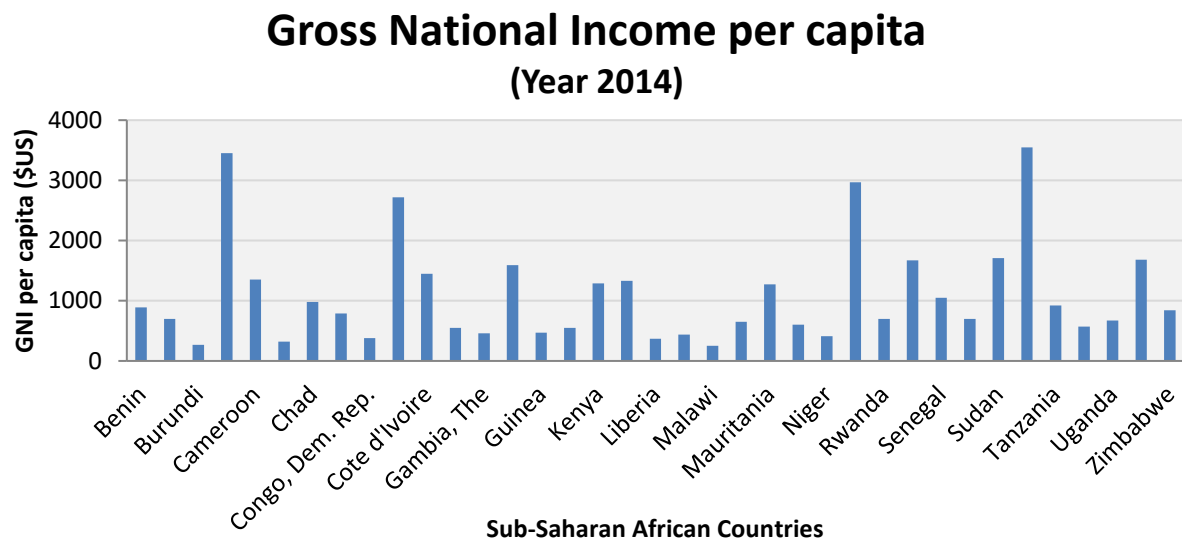
Source: World Bank, World Development Indicators database 2014

**Figure 3. Value-added per sectors in Sub-Saharan Africa**



Source: World Bank, World Development Indicators database 2014

**Figure 4. Gross national income per capita in low and lower-middle income Sub-Saharan African Countries**



Source: World Bank\_ World Development Indicators database 2014

Table 1. Descriptions of variables

| Variables                                     | Description  |
|---|--|
| GDP ( <i>y</i> )                              | Gross Domestic Product (constant 2005 US\$, in millions)   |
| Government expenditure ( <i>goe</i> )         | Government final consumption Expenditures (constant 2005 US\$)   |
| Human capital ( <i>h</i> )                    | Human capital index, proxied with investment in human capital per person based on years of schooling and return to education |
| FDI ( <i>inv</i> )                            | Foreign direct investment, net inflows (BoP, current US\$)   |
| Labor ( <i>l</i> )                            | Total economically active population in agriculture  |
| Lagged GDP ( <i>lgdp</i> )                    | Lagged value of gross domestic product (constant 2005 US\$)  |
| Openness ( <i>open</i> )                      | Trade Openness indicator (US \$ at current prices, in millions)  |
| Physical capital ( <i>k</i> )                 | Gross Capital Stock (constant 2005 prices)   |
| Population ( <i>pop</i> )                     | Population growth rates (annual %)   |
| Technology ( <i>a</i> )                       | Technological change, proxied with time trend (year)   |
| Value-added, agriculture ( <i>va</i> )        | Share of value-added in agriculture (constant 2005 US\$)   |
| Value-added, non-agriculture ( <i>nonag</i> ) | Value added in non-agriculture such as Industry, Services... (constant 2005 US\$)  |

Table 2. Summary statistics (N=525 Observations)

| Variables                    | Mean     | Std dev. | Min.      | Max.     |
|------------------------------|----------|----------|-----------|----------|
| GDP                          | 5.12e+12 | 1.05e+13 | 3.95e+08  | 6.80e+13 |
| Government expenditure       | 1.54e+09 | 3.09e+09 | 3.60e+07  | 2.38e+10 |
| Human capital index          | 1.6066   | 0.3156   | 1.0694    | 2.5503   |
| FDI                          | 4.98e+08 | 1.11e+09 | -4.21e+08 | 8.84e+09 |
| Labor                        | 7702555  | 1.02e+07 | 158091    | 5.58e+07 |
| Openness                     | 4109.86  | 11536.22 | 38.527    | 99755.75 |
| Physical capital             | 101359   | 211022.9 | 2054.008  | 1875939  |
| Population Growth            | 2.6035   | 0.7199   | 0.5276    | 5.5981   |
| Technology                   | 8        | 4.3243   | 1         | 15       |
| Value-added, agriculture     | 2.88e+09 | 7.37e+09 | 2.15e+07  | 5.87e+10 |
| Value-added, non-agriculture | 7.62e+09 | 1.55e+10 | 0         | 1.31e+11 |

Sources: Penn World table 9.0; WDI 2014, unless otherwise stated.

Table 3. Estimation Results

| Explanatory variables        | Expected Sign | Growth model (GDP)    |                        |
|------------------------------|---------------|-----------------------|------------------------|
|                              |               | Model 1               | Model 2                |
| Technology                   | +             | 0.0048<br>(0.0107)    | 0.0108<br>(0.0101)     |
| Physical capital             | +             | 0.0816***<br>(0.0296) | 0.0752**<br>(0.0295)   |
| Human capital                | +             | 0.1885***<br>(0.0615) | 0.2478***<br>(0.0711)  |
| Value-added, agriculture     | +             | 0.0761***<br>(0.0267) | 0.1926***<br>(0.0443)  |
| Lag(GDP)                     | +             | 0.7404***<br>(0.0476) | 0.8372***<br>(0.0444)  |
| Government expenditures      | -             | 0.0329***<br>(0.0109) | 0.0104<br>(0.0124)     |
| Foreign investment           | -             | -0.0029<br>(0.0024)   | -0.0016<br>(0.0025)    |
| Openness                     | +             | 0.0321***<br>(0.0112) | 0.0273**<br>(0.0109)   |
| Population growth            | -             | 0.0275*<br>(0.0165)   | 0.0213<br>(0.0161)     |
| Value-added, non-agriculture | +             | 0.0631***<br>(0.0169) | 0.1770***<br>(0.0445)  |
| Ag*non-ag, value added       | +             |                       | -0.0065***<br>(0.0023) |
| Constant                     |               | 3.5966***<br>(0.9727) | 1.1712<br>(1.0267)     |
| Wald Chi2                    |               | 3,209.05              | 3,141.12               |
| R-squared                    |               | -                     | -                      |
| Number of Observations       |               | 276                   | 276                    |

Notes: \_1\_: Asterisks indicate level of significance: \*\*\*=1%, \*\*=5%, \*=10%.

\_2\_: Robust standard errors are in parenthesis.

\_3\_: All variables are in logarithm form.

\_4\_: In model 1 and model 2, both dependent and independent variables are in first differences.



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## Appendix 1. Statistical Analysis Results for the Growth Model

|   | Value |
|---|-------|
| <u>Breusch and Pagan Lagrange multiplier test</u> |       |

|   |              |
|---|--------------|
| Chi-square  | 1,122.85***  |
| <u>Hausman (FE-RE)</u>  |              |
| Chi-square  | 52.46***     |
| <u>Heteroskedasticity (Modified Wald test for groupwise heteroskedasticity)</u> |              |
| Chi-square  | 21,318.85*** |
| <u>Autocorrelation (Arrelano-Bond test)</u>                                     |              |
| F-test (Woodridge test)   | 1,925.69***  |
| Overidentifying restrictions (Sargan test)                                      |              |
| Chi-square  | 274.34***    |
| Joint-test (for interaction term in market linkage model)                       |              |
| Chi-square  | 7.99**       |

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Note: Asterisks indicate level of significance: \*\*\*=1%, \*\*=5%, \*=10%.

## Appendix 2. World Bank classification of economies and their gross national income per capita (GNIp)

| <i>Economy</i> | <i>Income group</i> | <i>GNIp</i> | <i>Economy</i> | <i>Income group</i> | <i>GNIp</i> |
|----------------|---------------------|-------------|----------------|---------------------|-------------|
| Angola         | Upper middle income |             | Madagascar     | Low income          | 440         |
| Benin          | Low income          | 890         | Malawi         | Low income          | 250         |
| Botswana       | Upper middle income | 7240        | Mali           | Low income          | 650         |

|                      |                     |       |                       |                     |       |
|----------------------|---------------------|-------|-----------------------|---------------------|-------|
| Burkina Faso         | Low income          | 700   | Mauritania            | Lower middle income | 1270  |
| Burundi              | Low income          | 270   | Mauritius             | Upper middle income | 9630  |
| Cabo Verde           | Lower middle income | 3450  | Mozambique            | Low income          | 600   |
| Cameroon             | Lower middle income | 1350  | Namibia               | Upper middle income | 5630  |
| Central African Rep. | Low income          | 320   | Niger                 | Low income          | 410   |
| Chad                 | Low income          | 980   | Nigeria               | Lower middle income | 2970  |
| Comoros              | Low income          | 790   | Rwanda                | Low income          | 700   |
| Congo, Dem. Rep.     | Low income          | 380   | São Tomé and Príncipe | Lower middle income | 1670  |
| Congo, Rep.          | Lower middle income | 2720  | Senegal               | Lower middle income | 1050  |
| Côte d'Ivoire        | Lower middle income | 1450  | Seychelles            | High income:        | 14120 |
| Equatorial Guinea    | High income:        | 10210 | Sierra Leone          | Low income          | 700   |
| Eritrea              | Low income          |       | Somalia               | Low income          |       |
| Ethiopia             | Low income          | 550   | South Africa          | Upper middle income | 6800  |
| Gabon                | Upper middle income | 9720  | South Sudan           | Low income          |       |
| Gambia, The          | Low income          | 460   | Sudan                 | Lower middle income | 1710  |
| Ghana                | Lower middle income | 1590  | Swaziland             | Lower middle income | 3550  |
| Guinea               | Low income          | 470   | Tanzania              | Low income          | 920   |
| Guinea-Bissau        | Low income          | 550   | Togo                  | Low income          | 570   |
| Kenya                | Lower middle income | 1290  | Uganda                | Low income          | 670   |
| Lesotho              | Lower middle income | 1330  | Zambia                | Lower middle income | 1680  |
| Liberia              | Low income          | 370   | Zimbabwe              | Low income          | 840   |

Source: World Bank, World Development Indicators database 2014. Available at <https://datahelpdesk.worldbank.org/knowledgebase/articles/378834-how-does-the-world-bank-classify-countries>