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AID-TO-PRODUCTION, CONSUMPTION, AND AGRICULTURAL GROWTH IN DEVELOPING COUNTRIES

Francis Yao Srofenyoh
Central University, Agribusiness Management Department, Dansoman, Ghana,
ORCID: 0000-0002-6669-6181

Kofi Aaron Aboa-Offei Agyei-Henaku
Central University, Agribusiness Management Department, Dansoman, Ghana,
ORCID: 0000-0003-1922-7582

Charlotte Badu-Prah
Central University, Agribusiness Management Department, Dansoman, Ghana,
ORCID: 0000-0001-6144-2142

Akua Agyeiwaa-Afrane
Central University, Agribusiness Management Department, Dansoman, Ghana,
ORCID: 0000-0001-6348-9737

Ferguson Korbla Gidiglo
Central University, Agribusiness Management Department, Dansoman, Ghana,

Justice Gameli Djokoto
Central University, Agribusiness Management Department, P.O. Box DS 2310,
Dansoman, Ghana, Email:dgameli2002@gmail.com,
ORCID: 0000-0002-2159-2944

Abstract

The paper assessed the effect of economic policy on the effects of aid to agricultural production and consumption on agricultural growth in developing countries. We used data from a panel of 117 countries from 1996 to 2020 fitted to a GMM estimator. We found that both aid-to-production and aid-for-consumption discourage agricultural growth. Economic policy independently enhances agricultural growth. Foreign direct investment promotes agricultural growth. In the presence of economic policy, whilst aid-to-production did not discourage agricultural growth, it worsened the effect of aid-to-consumption on agricultural growth. Among other recommendations, developing countries should seek less foreign aid-to-production and more FDI into agricultural production as both the former and the latter would increase agricultural growth. Governments in developing countries must enhance trade and macroeconomic policies and promote FDI as this would increase agricultural growth.
Keywords: *Agricultural aid, aid effectiveness, developing countries, food aid, growth*.
JEL Codes: *O11,13; Q14*

1. Introduction

Developing agriculture is one of the most influential instruments to end acute destitution, boost shared wealth, and feed a projected 9.7 billion people by 2050 (World Bank, 2023a). Growth in the agricultural sector is two to four times more effective in raising incomes among the poorest compared to other sectors. Agriculture's share of gross domestic product (GDP) is more than 25% of GDP. As a result, the sector can help alleviate deprivation, raise wealth, and enhance food security for 80% of the world's poor who derive their livelihoods from farming (World Bank, 2023a). In 1996, growth in developing countries' agriculture was 4.8%. In 2000, it reduced to 3.7%. By 2019, growth declined further to 3.3% (FAOSTAT, 2023a). Given the importance of the sector, a significant amount of foreign aid-to-production has been channelled to the sector. Foreign aid-to-production represents overseas development assistance to agriculture, other agriculture, forestry and fishing, general environmental protection, and rural development (FAOSTAT, 2023b). From US$2,157m, in 1996, the level rose to US$4,600m in 2000. By 2019, the level was US$7,917m (FAOSTAT, 2023c). In response to natural disasters, drought, and climate change, developing countries have received foreign aid for consumption. This is overseas development assistance that covers food security, food safety, and food and nutrition assistance (FAOSTAT, 2023b). In 1996, aid-for-consumption was US$236m. By 2000, this rose to US$236m. It recorded US$ 9,788m in 2019 (FAOSTAT, 2023c).

By its purpose, aid-to-production is expected to enhance agricultural GDP. Alabi (2014), Shimada (2022) and Waya et al. (2020) reported a positive effect of agricultural foreign aid on agriculture in sub-Sahara Africa, Africa, and Nigeria, respectively. However, Ighodaro and Nwaogwugwu (2013) reported a neutral effect for Nigeria earlier. In the case of aid-for-consumption, whereas Barrett et al. (1996) reported a neutral effect for developing countries, Shimada (2022) reported negative effects for sub-Saharan Africa and Africa, respectively. To explain the ineffectiveness of aid on economic growth in total economy studies, Burnside and Dollar (2000), Ozekhome (2019) and Sharma and Bhattarai (2013) show that aid is effective in the presence of a good policy environment. Therefore, what is the effect of foreign agricultural aid on agricultural production in developing countries? Does the economic policy environment impact the foreign aid-growth relationship in developing countries' agriculture?

Some literature exists on foreign agricultural aid effects on agricultural growth (Alabi, 2014; Aljonaid et al., 2022; Ighodaro & Nwaogwugwu, 2013; Kaya, Kaya, & Gunter, 2012; Shaibu & Shaibu, 2022; Waya, 2020). However, some gaps exist in the literature. First, agricultural growth was measured as output, input utilisation and total factor productivity (Alabi, 2014; Ighodaro & Nwaogwugwu, 2013; Kaya, Kaya, & Gunter, 2012; Shaibu & Shaibu, 2022; Waya, 2020). Since agricultural growth is the change in the real agricultural GDP over time, the estimated relationships do not adequately reflect the rate of change of the dependent variable due to aid. Second, the studies did not account for agricultural aid (aid-to-production) and food aid (aid-for-consumption) jointly. Third, Aljonaid et al. (2022) appropriately measured agricultural growth as growth in real agricultural GDP, but they studied only aid-to-production. Shimada (2022) accounted for both aid-to-production (agricultural aid) and aid-for-consumption (food aid) within the same model, however, Shimada (2022), Aljonaid et al. (2022) and the rest, did not explore the role of economic policy on foreign aid and agricultural growth effects. Therefore, we depart from existing studies and make two contributions to the agricultural foreign aid effects on agricultural growth literature. Firstly, we define agricultural growth as the annual growth rate of the real agricultural GDP. Secondly, we assessed the role of the economic policy environment on the effects of aid-to-production and aid-for-consumption on agricultural growth. We used data from a panel of 117 countries from 1996 to 2020 fitted to a GMM estimator. We found that both aid-to-production and aid-for-consumption discourage agricultural growth. Economic policy independently enhances agricultural growth. Foreign direct investment (FDI) in agriculture promotes agricultural growth. In the presence of economic policy, whilst aid-to-production did not discourage agricultural growth, it worsened the effect of aid-to-consumption on agricultural growth. The decline in agricultural growth resulting from aid-for-consumption occurred at an increasing rate. Among other recommendations, developing countries should seek less foreign aid-to-production and more FDI into agricultural production as both the former and the latter would increase agricultural growth. Governments in developing countries must enhance trade and macroeconomic policies and promote FDI as this would increase agricultural growth.

In what follows, we summarise the theoretical literature on aid effectiveness and provide both the general and agriculture-specific responses of aid to economic growth and agricultural outcomes, respectively. In section 3, we outline the initial model, state the policy model and incorporate policy into the initial model before estimation. In line with the theoretical position of possible non-linearity of aid and development outcomes, we explore this in our model. We present the results in section 4 and show several instances of the robustness of the same. Consequently, we explain the results and position the same considering the literature. Finally, in section 5, we present our conclusions and provide policy recommendations.

2. Literature Review

2.1 Theoretical Review

Two sets of economic growth theories explain aid effectiveness; the Harrod-Domar model (Harrod, 1939; Domar, 1946), and the gap models (Chenery and Strout, 1966; McKinnon, 1964). According to Harrod (1939) and Domar (1946), national saving drives economic growth through capital accumulation therefore, developing countries should save. The savings will be channelled into investments for growth. Following the understanding of a stable linear relationship between growth and investment in physical capital, the Harrod-Domar model envisages a positive aid-growth relationship. The gap theory, however, identifies two gaps, savings and investments on one hand and foreign exchange on the other. Developing countries are unable to mobilise the needed savings for investment. Also, they lack adequate foreign exchange to finance international trade (Chenery & Strout, 1966; McKinnon, 1964). Following the Harod-Domar model and the gap theory, aid should fill the gaps and provide resources for growth in developing countries (McKinnon, 1964; Yiew & Lau, 2018).

Easterly (1999, 2003) criticised the first two positions noting that growth is less related to physical capital investment than often assumed by the Harrod-Domar and the two-gap approach. And several reasons can cause a non-positive relationship. Aid goes into consumption (Boone, 1994). Aid is fungible and hence can be used for an unintended purpose for which the desired growth would not occur (Rajan & Subramanian 2008). The dependency created by aid could undermine institutional quality, weaken accountability, and encourage rent-seeking and corruption, among others (Knack, 2001; Svensson, 2000). Hansen and Tarp (2001a) identified as third, the endogeneity and possible non-linear relationship between aid and economic growth strand (Veiderpass & Andersson, 2011). However, we consider this as a group of empirical conclusions that find contrary evidence to the first two theories. The methodologies of the existing studies suggest the existence of endogeneity and a possible non-linear relationship between aid and growth (Veiderpass & Andersson, 2011). Others recognised the role of economic policy and governance environment within which aid-growth relationship occurs (Adedokun, 2017; Burnside and Dollar, 2000; Stiernstedt, 2010). Consequently, the interaction of good economic policy and good governance should provide a positive aid-growth relationship (Burnside & Dollar, 2000; Rodrik, 2000). Easterly, Levine and Roodman, (2004) and Jensen and Paldam (2006) note that much of the available data as possible show that good policies do not necessarily guarantee a positive aid-growth nexus.

2.2 Empirical Review

In one of the earliest studies on aid and growth, Burnside and Dollar (2000), found that aid had a positive impact on growth in developing countries with good fiscal, monetary, and trade policies. In the presence of poor policies, aid has no positive effect on growth. As noted earlier, although some other studies examined aid, and growth (Adedokun, 2017; Akramov, 2012; Mwakalila, 2019; Stiernstedt, 2010), only Adedokun (2017) and Stiernstedt (2010) measured growth as the annual growth rate of real GDP (per capita). Thus, these are reviewed as they relate more to our dependent variable, the growth rate of real agricultural GDP, than those without the growth measure. Following the high aid and low ranking in the wealth of Sub-Saharan Africa (SSA) countries, Adedokun (2017) revisited the aid effectiveness debate quantitatively by investigating the relationship between foreign aid, and economic growth in SSA using data from 1996 to 2012. Employing the system generalised methods of moments technique, Adedokun (2017) found that foreign aid had an insignificant negative relationship with economic growth in aggregate SSA. Adedokun (2017) however, found heterogeneity in the aid-growth relationship across regions and resource endowments.

Stiernstedt (2010) replicated Burnside and Dollar (2000) and examined the relationship between aid effectiveness and economic growth in developing countries. Using OLS and 2SLS estimators, it was found that aid had a negative but statistically insignificant effect on economic growth. As earlier research has predicted, the author finds that aid alone has no significant positive effects on growth.

Aljonaid et al. (2022) investigated the heterogeneous effects of sectoral aid inflows on their corresponding growth sectors using data from 37 Sub-Saharan African and MENA-recipient developing nations from 1996 to 2017. Using the seemingly unrelated regression framework and the GMM approach robustness check, they found systematic impacts associated with sectoral aid. Aid had a strong positive impact on agricultural growth, helping boost overall growth, whereas aid allocated to the service and industrial growth sectors tends to minimise the net benefits of total aid on growth due to financial and institutional reasons.

In the specific case of agricultural aid, Alabi (2014), Shimada (2022) and Waya (2020) reported a positive relationship between agricultural aid and agricultural output in sub-Saharan Africa, Africa, and Ethiopia respectively. Ighodaro and Nwaogwugwu (2013) however, found a neutral relationship for Nigeria. It must be noted Alabi (2014), Ighodaro and Nwaogwugwu (2013) and Waya (2020) used agricultural GDP as the response variable whilst Shimada (2022) used the agricultural output index. In respect of the effects of food aid, Barrett et al. (1996), and Mabuza, Taeb and Endo (2008) respectively found a neutral response of cereal production and maize production to food aid and maize as aid. Whilst Shimada (2022) found that the agricultural output index responded to cereal food aid, the response was negative for Africa.

Regarding the control variables, initial GDP had a negative relationship with growth albeit statistically insignificant (Stiernstedt, 2010) and significant according to Adedokun (2017). Domestic investment and trade openness were positively related to growth whilst population growth and inflation, although positive, did not significantly influence growth. Whilst Kaya, Kaya, and Gunter (2012) found a negative effect of trade openness on growth, Waya (2020) reported neutral, positive, negative, and neutral effects respectively for inflation, exchange rate, FDI, and population.

It is apparent from the empirical review that the relationship of agricultural aid and food aid with growth and the moderation effect of policy has not been investigated for agriculture, a sector that is the world's largest employer and with international goals to double income for smallholders (World Bank, 2022). Further, agriculture is important to developing countries, that receive so much agricultural aid (McArthur and Sachs, 2019; Shaibu & Shaibu, 2022; Waya, 2020). The study fills these gaps.

3. Data and Methods

3.1 Models and data

Following the objectives of the study and existing literature,

$$GROWTH = f(PROD\_AID, CON\_AID, FDI, DINV, INFRA, INFLA, TO, POPG) \quad (1)$$

GROWTH is agricultural growth measured as the annual growth rate of real agricultural GDP. *PROD_AID* and *CON_AID* are respectively, aid to production and aid for consumption. Aid to production comprises aid to agriculture, forestry and fishing, other agriculture, forestry and fishing, general environmental protection, and rural development. According to FAOSTAT (2023a), other agriculture, forestry and fishing provide additional aid information that accrues in fact to agriculture but is included in aid flows assigned to other sectors. The accrual to agriculture is deduced from the text and the description of projects. *PROD_AID* and *CON_AID* are measured as the value in current US dollars divided by the agriculture value added (GDP) in current US dollars. The data for aid and GDP were obtained from FAOSTAT (2023a,b). The annual growth rate of GDP in 2015 prices (*GROWTH*) is obtained from FAOSTAT (2023a).

For the control variables, *FDI* is measured as FDI inflow into agriculture, forestry and fishing divided by agricultural GDP. FDI provides resources to agricultural production, hence influencing *GROWTH* (Waya, 2020). *DINV* is the gross fixed capital formation for agriculture as a ratio to agricultural GDP. We proxy infrastructure (*INFRA*) as the sum of mobile and fixed phone line subscriptions per 100 people. This includes roads and other non-agricultural capital that form the backbone of an economy. Inflation (*INFLA*) is the annual growth rate of the consumer price index. Inflation is known to determine agricultural growth (Waya, 2020). Trade openness, *TO*, is the sum of agricultural imports and exports as a ratio of agricultural GDP. Developing countries are large exporters of primary agricultural commodities and importers of agricultural resources. Moreover, trade is a constituent of the national income equation. Thus, changes in trade would influence agricultural growth (Kaya et al., 2012). Annual population growth of both males and females is the measure for *POPG*. Growth in POPG provides the human resources for production and market for food as an agricultural product. Thus, population changes must have some effect on growth (Waya, 2020). *FDI* and *DINV* were obtained from FAOSTAT (2023). *INFRA*, *INFLA* and *POPG* were obtained from the World Bank (2023b). Data on agricultural exports and imports were drawn from FAOSTAT (2023).

Based on the panel data, we specify equation 2 as

$$GROWTH_{it} = \alpha_0 + \alpha_1 PROD\_AID_{it} + \alpha_2 CON\_AID_{it} + \alpha_3 CON\_AID_{it}^2 + \alpha_4 FDI_{it} + \alpha_5 DINV_{it} + \alpha_6 INFRA_{it} + \alpha_7 INFLA_{it} + \alpha_8 TO_{it} + \alpha_9 POPG_{it} + \omega_{it} \quad (2)$$

Where *i* and *t* are the country and time dimensions of the data respectively. ω_{it} are the idiosyncratic errors. The α_k are parameters to be estimated. The two square terms arose from Figures 1 and 2.

Following Burnside and Dollar (2000), we estimated equation 3,

$$GROWTH_{it} = \beta_0 + \beta_1 FDI_{it} + \beta_2 DINV_{it} + \beta_3 INFRA_{it} + \beta_4 INFLA_{it} + \beta_5 TO_{it} + \beta_6 POPG_{it} + \varphi_{it} \quad (3)$$

And generated the *POLICY* variable as,

$$POLICY = \beta_0 + \beta_1 + \beta_2 + \beta_3 + \beta_6 + \beta_4 * INFLA_{it} + \beta_5 * TO_{it} \tag{4}$$

Consequently, equations 6 and 7 were estimated.

$$GROWTH_{it} = \gamma_0 + \gamma_1 PROD\_AID_{it} + \gamma_2 CON\_AID_{it} + \gamma_3 CON\_AID_{it}^2 + \gamma_4 POLICY + \gamma_5 FDI_{it} + \gamma_6 DINV_{it} + \gamma_7 INFRA_{it} + \alpha_8 POPG_{it} + \tau_{it} \tag{5}$$

$$GROWTH_{it} = \delta_0 + \delta_1 PROD\_AID_{it} + \delta_2 POL\_PROD_{it} + \delta_3 CON\_AID_{it} + \delta_4 POL\_CON_{it} + \delta_5 CON\_AID_{it}^2 + \delta_6 POL\_CON_{it}^2 + \delta_7 FDI_{it} + \delta_8 DINV_{it} + \delta_9 INFRA_{it} + \delta_{10} POPG_{it} + \sigma_{it} \tag{6}$$

φ_{it}, τ_{it} and σ_{it} are idiosyncratic error terms whilst *i* and *t* are as defined previously. *POL_PROD* is *POLICY * PROD_AID*. Whilst *POL_CON* is the interaction of *POLICY* and *CON_AID*, POL_CON^2 is the interaction of *POLICY* and CON_AID^2.

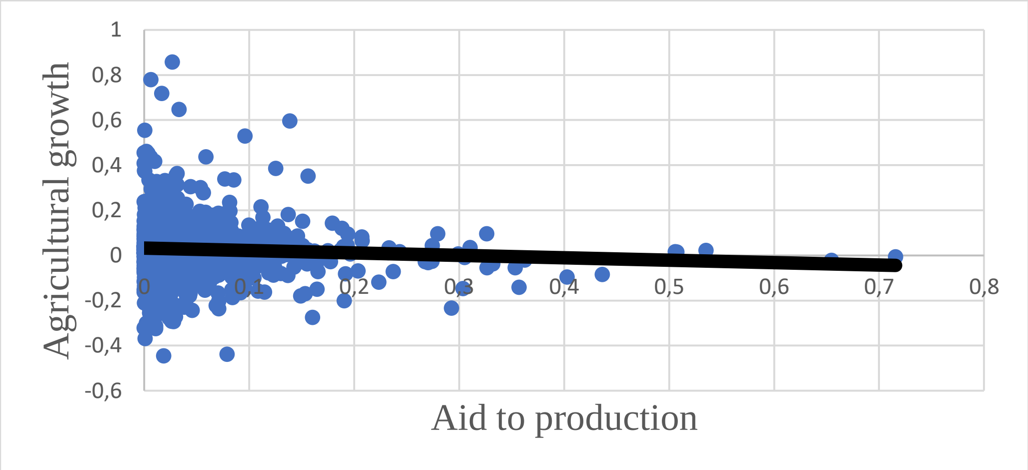

Figure 1. Scatter Plot and Trend Line of Agricultural Growth and Aid for the Production

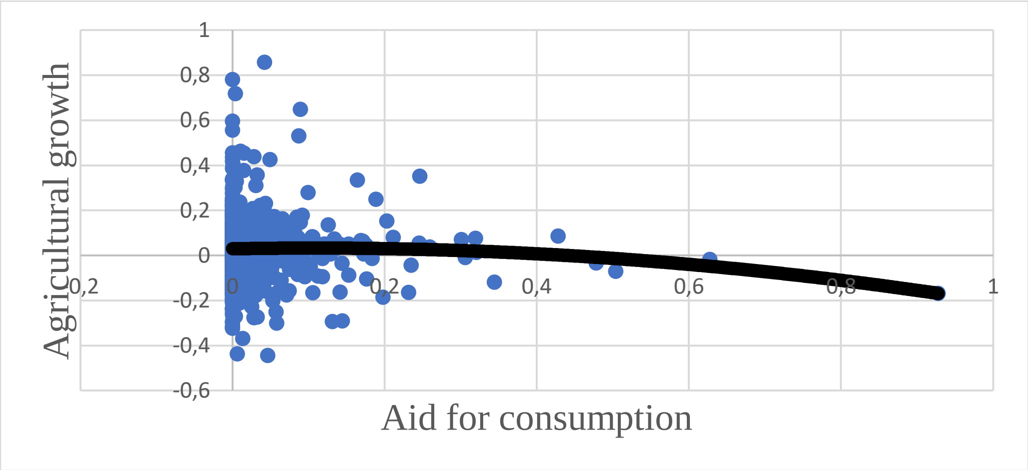

Figure 2. Scatter Plot and Trend Line of Agricultural Growth and Aid for Consumption

In response to our research objectives, we compute some effects; the independent effects of aid to production and aid for consumption on growth on the one hand and the interaction effects of policy on aid to production and aid for consumption, on the other hand (Table 1). Since the aid for consumption is non-linearly related to growth (Figure 2), we also compute the acceleration of aid for consumption on growth or the second speed of aid for consumption on growth (Table 1).

Table 1. Computation of the Effects of Types of Agricultural Aid on Agricultural Growth

	Equation 3	Equation 4	Equation 7
	No interaction with the policy		Interaction with policy
Aid to production	α_1	γ_1	δ_2
Aid for consumption	$\alpha_2 + \alpha_3 * \overline{CON\_AID}$	$\gamma_2 + \gamma_3 * \overline{CON\_AID}$	$\delta_4 + \delta_6 * \overline{POL\_CON}$
Acceleration of consumption aid	α_3	γ_3	δ_5

We employed panel data from 1996 to 2020, drawn from 117 countries listed in the Appendix.

3.2 Estimation procedure

The specification of equations 3 – 7 shows that aid predicts agricultural growth. However, Hoellerbauer and Smith (2018) noted that economic growth determines aid. FDI predicts growth (Narteh-Yoe, Djokoto & Pomeyie, 2022). But the GDP and GDP growth determine FDI (Djokoto, 2012; Kubik and Husmann, 2019; Tho, 2022). This introduces simultaneity bias. Also, infrastructure is proxied with fixed and mobile telephone subscriptions. Although it has been used in the literature (Atitianti & Dai, 2021; Djokoto, 2021; Djokoto et al., 2022a,b), it may not adequately capture infrastructure in the economy. This could create measurement errors. From the foregoing, there is a likelihood of endogeneity in our model specification. We address this in the estimation by using the general method of moments (GMM) (Hansen, 1982). The GMM uses the orthogonality conditions that permit efficient estimations in the presence of heteroskedasticity (Baum, Schaffer, & Stillman, 2003). It also enables the predictor variables to be considered as potentially endogenous or exogenous (Piper, 2014). We prefer the system GMM estimator (Arellano & Bover 1995) to the difference GMM estimator (Arellano & Bond, 1991) based on reasons provided by Roodman (2009). First, the system GMM allows for more instruments and can greatly enhance efficiency. Second, system GMM magnifies gaps in unbalanced panels less than that of the difference GMM. Thirdly, system GMM does not exclude the fixed effects dissimilar to the difference GMM. Further, the system GMM does not require distributional assumptions such as normality and can permit unknown forms of heteroscedasticity (Baum et al., 2003; Greene, 2002; Piper, 2014; Verbeek, 2000).

4. Results and Discussions

4.1 Profiling the Data

The mean agricultural growth is three (3) per cent, which coincides with the growth rates of Egypt in 2013 and Indonesia in 2010. The lower extreme is a decline of 44.5% (Central African Republic in 2013) and the highest of 85.73% recorded by Palestine in 2014. The mean of PROD_AID is about twice the mean of CON_AID. Since the mean of CON_AID is less

Table 2. Descriptive Statistics

Variable	Observation	Mean	Standard deviation	Minimum	Maximum
GROWTH	2,645	0.0300	0.0858	-0.4449	0.8573
PROD_AID	2,635	0.0284	0.0477	0	0.7158
CON_AID	2,635	0.0130	0.0394	-0.0001	0.9276
CON_AID^2	2,645	0.0017	0.0207	0	0.8604
POLICY	2,645	0.7610	0.0040	0.6909	0.8105
POL_PROD	2,635	0.0215	0.0361	0	0.5408
POL_CON	2,635	0.0098	0.0289	-0.0001	0.6628
POL_CON^2	2,645	0.0013	0.0148	0	0.6148
FDI	2,645	0.2378	0.4258	0	1
DINV	2,644	0.0944	0.0531	0.0019	0.4318
INFRA	2,645	6.1718	5.2171	0	23.6958
INFLA	2,645	0.0944	0.8341	-0.1811	41.4511
TO	2,645	1.1468	2.4273	0	45.1502
POPG	2,645	0.0188	0.0125	-0.0514	0.1809

Table 3. Estimations without the Role of Policy

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	*GROWTH*	*GROWTH*	*GROWTH*	*GROWTH*	*GROWTH*	*GROWTH*	*GROWTH*	*GROWTH*
L. GROWTH	-0.0577*** (0.0141)	-0.0572*** (0.0141)	-0.0589*** (0.0141)	-0.0595*** (0.0149)	-0.0580*** (0.0140)	-0.0661*** (0.0141)	-0.0581*** (0.0141)	-0.0640** (0.0152)
PROD_AID	-0.1672*** (0.0160)	-0.1680*** (0.0163)	-0.1703*** (0.0159)	-0.1727*** (0.0161)	-0.1693*** (0.0162)	-0.1796*** (0.0158)	-0.1697*** (0.0155)	-0.1824*** (0.0165)
CON_AID	-0.1324 (0.0849)	-0.1311 (0.0893)	-0.1211 (0.0823)	-0.0950 (0.0954)	-0.1270 (0.0842)	-0.1885** (0.0815)	-0.1371 (0.0828)	-0.1660** (0.0747)
CON_AID^2	0.1059 (0.0731)	0.1054 (0.0722)	0.0972 (0.0710)	0.0769 (0.0835)	0.1008 (0.0728)	0.2859*** (0.0774)	0.1104* (0.0713)	0.2702*** (0.0673)
FDI		0.0057 (0.0037)						0.0051 (0.0039)
DINV			-0.0681 (0.0677)					0.0844 (0.0591)
INFRA				-0.0005 (0.0007)				-0.0003 (0.0006)
INFLA					-0.0138** (0.0069)			-0.0092 (0.0068)
TO						-0.0150*** (0.0027)		-0.0155*** (0.0025)
POPG							0.2584 (0.2502)	0.3256 (0.2434)
CONSTANT	0.0367*** (0.0016)	0.0352*** (0.0018)	0.0429*** (0.0066)	0.0394*** (0.0052)	0.0379*** (0.0015)	0.0513*** (0.0032)	0.0318*** (0.0052)	0.0387*** (0.0094)
Model diagnostics								
Observations	2,518	2,518	2,517	2,518	2,518	2,518	2,518	2,517
Countries	117	117	117	117	117	117	117	117
Wald	115.10***	115.34***	120.77***	123.92***	122.35***	174.93***	125.76***	211.83***
RESET test	1.30	1.28	1.42	0.03	0.27	0.89	0.05	0.27
Instruments	50	51	51	51	51	51	51	56
Prob. AR(2))	0.6492	0.6638	0.6499	0.6339	0.6482	0.5184	0.6436	0.5260
Prob. Sargan	0.7649	0.7496	0.7569	0.7143	0.7522	0.3968	0.7657	0.3768

Notes. 1) Robust standard errors in parenthesis. 2) *p<0.10, **p<0.05, ***p<0.01

than 1, the square of it is further less than 1, (less than the mean of *CON_AID*). The square of the standard deviations of *PROD_AID*, *CON_AID* and CON_AID^2 gives the variance. These are less than the respective means. Hence, the *PROD_AID*, *CON_AID* and CON_AID^2 are under-dispersed around the mean. The means of *POL_PROD*, *POL_CON* and POL_CON^2 are less than *PROD_AID*, *CON_AID* and CON_AID^2 respectively because they have been weighted by *POLICY* with a mean less than 1. The standard deviations and the maximum values are correspondingly lower.

4.2 Results

The system GMM estimation of equation 3 is presented in Table 3. The coefficients of *PROD_AID* are consistent across models 1 – 8. These are negatives in line with the slope of the line in Figure 1. The coefficients of *CON_AID* and CON_AID^2 are also consistent across models 1 – 8. The estimates of the control variables in models 1 – 5 are also like those of the respective counterparts in model 6. Thus, not only are the estimates of *PROD_AID*, *CON_AID* and CON_AID^2 robust to the control variables, but the estimates of the control variables also show robustness.

Table 4. System GMM Estimation of the Independent Role of Policy

	(9)	(10)	(11)	(12)	(13)	(14)
VARIABLES	*GROWTH*	*GROWTH*	*GROWTH*	*GROWTH*	*GROWTH*	*GROWTH*
L. GROWTH	-0.0660** (0.0140)	-0.0655*** (0.0140)	-0.0639*** (0.0141)	-0.0649*** (0.0150)	-0.0674*** (0.0140)	-0.0628*** (0.0152)
PROD_AID	-0.1791*** (0.0158)	-0.1798*** (0.0160)	-0.1775*** (0.0168)	-0.1840*** (0.0160)	-0.1790*** (0.0157)	-0.1820*** (0.0166)
CON_AID	-0.1834** (0.0820)	-0.1865** (0.0810)	-0.1625** (0.0781)	-0.1703** (0.0816)	-0.1917** (0.0895)	-0.1606** (0.0749)
CON_AID^2	0.2781*** (0.0782)	0.2763*** (0.0774)	0.2535*** (0.0753)	0.2683*** (0.0743)	0.2792*** (0.0760)	0.2604*** (0.0684)
POLICY	8.8036*** (1.7271)	8.8659*** (1.7211)	8.8610*** (1.7180)	9.3972*** (1.5459)	8.7850*** (1.6947)	9.4090*** (1.5643)
FDI		0.0056 (0.0040)				0.0052 (0.0039)
DINV			0.0566 (0.0656)			0.0786 (0.0607)
INFRA				-0.0004 (0.0006)		-0.0004 (0.0006)
POPG					0.3468 (0.2498)	0.3714* (0.2367)
CONSTANT	-6.6948*** (1.3204)	-6.7436*** (1.3157)	-6.7439*** (1.3135)	-7.1461*** (1.1825)	-6.6866*** (1.2938)	-7.1714*** (1.1948)
Model diagnostics						
Observations	2,518	2,518	2,517	2,518	2,518	2,517
Countries	117	117	117	117	117	117
Wald	172.37***	175.85***	173.59***	195.39***	186.03***	216.59***
RESET test	0.70	0.71	0.74	0.46	0.15	0.27
Instruments	51	52	52	52	52	55
Prob. (AR(2))	0.5182	0.5302	0.5303	0.5269	0.5012	0.5351
Prob. Sargan test	0.4089	0.4097	0.4036	0.3820	0.4194	0.3941

Notes. 1) Robust standard errors in parenthesis. 2) *p<0.10, **p<0.05, ***p<0.01

We constructed *POLICY* using *INFLA* and *TO,* equations 4 and 5. Thus, in Table 4, *POLICY* replaces *INFLA* and *TO*. The coefficients of *PROD_AID*, *CON_AID*, and *CON_AID*^{2} are similar in magnitude and sign as well as the size of the standard errors across models 15 – 20. Also, the magnitude and sign of the coefficients of *POLICY* are consistent across models 9 – 14. The estimates of the control variables in models 15 – 19 are also consistent with the corresponding estimates in model 14. These point to the robustness of the estimates of the key variables as well as those of the control variables.

Table 5. System GMM Estimations of the Interaction of Policy with Aid to Production and Aid for Consumption

	(15)	(16)	(17)	(18)	(19)	(20)
VARIABLES	*GROWTH*	*GROWTH*	*GROWTH*	*GROWTH*	*GROWTH*	*GROWTH*
L.GROWTH	-0.0568*** (0.0141)	-0.0562*** (0.0142)	-0.0600*** (0.0143)	-0.0601*** (0.0149)	-0.0581*** (0.0142)	-0.0624*** (0.0151)
PROD_AID	1.9402 (2.2252)	1.6873 (2.2461)	2.3294 (2.3028)	2.1381 (2.2706)	2.6066 (2.2834)	2.6605 (2.3645)
CON_AID	12.4712*** (2.3122)	12.4042*** (2.3239)	13.5486*** (2.2444)	14.1112*** (2.2600)	12.6469*** (2.2981)	14.7818*** (2.2014)
CON_AID^2	-19.0491*** (4.4395)	-18.9836*** (4.4444)	-20.6286*** (4.3257)	-21.3073*** (4.4068)	-19.1523*** (4.5178)	-21.9825*** (4.3999)
POL_PROD	-2.7765 (2.9428)	-2.4454 (2.9569)	-3.2903 (3.0329)	-3.0425 (2.9872)	-3.6563 (3.0054)	-3.7325 (3.1100)
POL_CON	-16.7715*** (3.0840)	-16.6831*** (3.0986)	-18.1730*** (3.0032)	-18.8807*** (3.0211)	-17.0008*** (3.0693)	-19.7508*** (2.9527)
POL_CON^2	25.9610*** (6.0901)	25.8755*** (6.0954)	28.0695*** (5.9428)	28.9473*** (6.0581)	26.0916*** (6.2039)	29.8309*** (6.0594)
FDI		0.0063* (0.0036)				0.0064* (0.0035)
DINV			-0.1049* (0.0631)			-0.0503 (0.0562)
INFRA				-0.0006 (0.0007)		-0.0006 (0.0007)
POPG					0.3192 (0.2491)	0.2913 (0.2355)
CONSTANT	0.0385*** (0.0017)	0.0368*** (0.0019)	0.0482*** (0.0064)	0.0419*** (0.0052)	0.0325*** (0.0051)	0.0391*** (0.0095)
Observations	2,518	2,518	2,517	2,518	2,518	2,517
Countries	117	117	117	117	117	117
Wald	151.39***	155.22***	180.40***	180.55***	164.77***	231.75***
RESET test	0.12	0.12	0.13	0.12	0.18	0.16
Instruments	53	54	54	54	54	57
Prob. (AR(2))	0.6706	0.6863	0.6582	0.6408	0.6532	0.6328
Prob. Sargan test	0.7548	0.7403	0.7589	0.6923	0.7635	0.7008

Notes. 1) Robust standard errors in parenthesis. 2) *p<0.10, **p<0.05, ***p<0.01

In Table 5, we report the estimates of the interaction of *POLICY* with our key variables. Although the coefficients of *PROD_AID*, *CON_AID*, and *CON_AID*^{2} are higher than their counterparts in Table 4. Nevertheless, these are consistent across models 15 – 20 in Table 5. The coefficients of the interaction terms are also consistent across models 15 – 20. A close look at the estimates of the control variables shows consistency between those in models 15 – 19 and those in 20. Thus, the estimates in Table 5 show robustness to control variables and among the control variables.

Table 6. The Effects of Aid on Growth with and Without Policy

	(8)	(14)	(20)
VARIABLES	*GROWTH*	*GROWTH*	*GROWTH*
L.GROWTH	-0.0640*** (0.0152)	-0.0628*** (0.0152)	-0.0624*** (0.0151)
PROD_AID	-0.1824*** (0.0165)	-0.1820*** (0.0166)	2.6605 (2.3645)
CON_AID	-0.1660** (0.0747)	-0.1606** (0.0749)	14.7818*** (2.2014)
CON_AID^2	0.2702*** (0.0673)	0.2604*** (0.0684)	-21.9825*** (4.3999)
POL_PROD			-3.7325 (3.1100)
POL_CON			-19.7508*** (2.9527)
POL_CON^2			29.8309*** (6.0594)
POLICY		9.4090*** (1.5643)	
FDI	0.0051 (0.0039)	0.0052 (0.0039)	0.0065* (0.0036)
DINV	0.0844 (0.0591)	0.0786 (0.0607)	-0.0793 (0.0590)
INFRA	-0.0003 (0.0006)	-0.0004 (0.0006)	-0.0004 (0.0006)
INFLA	-0.0092 (0.0068)		
TO	-0.0155*** (0.0025)		
POPG	0.3656 (0.2334)	0.3714 (0.2367)	0.3221 (0.2499)
CONSTANT	0.0387*** (0.0094)	-7.1399*** (1.1899)	0.0442*** (0.0097)
Model diagnostics			
Observations	2,517	2,517	2,517
Countries	117	117	117
Wald	211.83***	216.59***	231.75***
RESET test	0.27	0.29	0.16
Instruments	56	55	57
Prob. of AR(2)	0.5260	0.5351	0.6238
Prob. of Sargan test	0.3768	0.3941	0.7008

Notes. 1) Robust standard errors in parenthesis. 2) *p<0.10, **p<0.05, ***p<0.01

Models 8, 14 and 20 are re-assembled in Table 6. As in Tables 4 and 5, the probability of the second-order serial correlation test exceeds 10%. This suggests there is no second-order serial correlation of the error terms of the system GMM models. Also, the probability of the Sargan test statistics is above 10%. Thus, the null hypothesis that the overidentifying restrictions are valid cannot be rejected. The RESET test is used here as a test of misspecification. The null hypothesis is that the model is not mis-specified. Hence, the probability of the RESET test above 10% in models 1 – 20 in Table 4, 5 and 6 suggest equation 3, 6 and 7 are appropriately specified. The number of cross-sections (countries) is 117. This covers the number of instruments in the GMM estimates by more than two (2) times. This shows there certainly cannot be instrument proliferation thereby causing inconsistent estimates. The large cross-section exceeding the number of instruments is certainly a comfortable situation. The Wald is also statistically significant. These imply the variables jointly explain the variation in agricultural growth. Thus, models, 8, 14 and 20 are appropriate for discussion.

The coefficient of *L.GROWTH* is similar in magnitude, sign, and statistical significance across all three models (Table 6). This suggests that the endogeneity has been catered for. Also, the negative sign suggests the previous year's agricultural growth is higher than the current year's agricultural growth. This is suggestive of a declining trend. This can be seen from Figures 1 and 2 in which, as aid increases, agricultural growth declines. The estimates of *PROD_AID*, *CON_AID* and CON_AID^2 are similar between models 8 and 14, but dissimilar between models 8 and 14 on the one hand and models 20, on the other hand. The coefficients of the interaction variables with *POLICY* are high. This can be traced to the size of *POLICY*. The mean is 0.7610. This is more than 20 times the *PROD*_AID's mean of 0.0284, the highest among *PROD_AID*, *CON_AID* and CON_AID^2 (Table 1). This explains the large estimates in model 20 (Table 6).

4.3 Discussion of the Control Variables

FDI in agriculture promotes agricultural growth. This is not surprising as FDI augments domestic capital enhances technology transfer and creates employment. Capital and technology would contribute to increasing productive capacity. Employment in agriculture would increase the income of households which can be spent on agricultural products. Our finding is inconsistent with that of Waya (2020) for Nigeria. The influence of other developing countries' data may have caused the differences between our findings and those of Waya (2020).

The statistically insignificant coefficient of *DINV* implies agricultural domestic investment has no discernible effect on agricultural growth. This is different from that of Adedokun (2017) for the total economy of sub-Saharan Africa. As domestic investment is capital accumulation, we expected a positive and statistically significant coefficient. However, this was not the case.

The coefficient of *INFRA* is also statistically insignificant. Thus, infrastructure has no discernible effect on agricultural growth. Population growth (*POPG*) also has a neutral effect on agricultural growth. This is consistent with the findings of Adedekun (2017) and Waya (2020).

4.4 Discussion of the Independent Effects of Aid-To-Production and Aid-for-Consumption and Their Interaction with Policy

The coefficient of POLICY is positive and statistically significantly different from zero (Model 14 in Table 6). It must be noted that the effect of *POLICY* has the highest coefficient in model 14. This points to the strength of the POLICY effect. Economically, this suggests that effective economic policy, the combination of both sectoral and macroeconomic policy, would enhance agriculture more than any variable. The independent effect of policy on economic growth was noted by Burnside and Dollar (2000).

The effect sizes computed from models 8 and 14 are similar. These suggest that the effect sizes are robust to the inclusion of *POLICY* (Table 7). That is, the presence of *INFLA* and *TO* independently in model 8 did not change the effects when these were dropped and replaced with *POLICY* constructed from *INFLA* and *TO*. This is a demonstration of the robustness of the computed effects on the variable inclusion. Although the introduction of the interaction terms caused large changes in the effect sizes, the signs of the effects computed from model 20 conform to those of models 8 and 14. There is thus consistency in sign. This means that the effect of inclusion of *POLICY* serves to enhance the effect of aid-to-production and aid-for-consumption and agricultural growth relationship.

The independent effect of aid-to-production on agricultural growth is negative. Thus, an increase in aid-to-production is associated with a decrease in agricultural growth and vice versa. This conforms to the relationship in Figure 1. Therefore, the computed effect is borne out of the data employed. Although this is like some studies on the total economy for developing countries and other aid recipients, evidence from agriculture without the use of the annual growth of real agricultural GDP shows the contrary, a positive relationship (Alabi, 2014; Aljonaid et al., 2022; Shimada, 2022; Waya, 2020). Ighodaro and Nwaogwugwu (2013) however, reported a neutral effect. Two reasons explain our findings. First, the coverage of aid is not uniform for every country every year. Also, these resources may not be reaching the target or may be ineffectively applied. This is not uncommon in developing countries. Secondly, from the sign of *L.GROWTH*, other factors may be responsible for the decline in agricultural growth. Considering these, our findings can be explained. Ear (2007) indicated that aid dependence can also reduce the need for FDI. Therefore, the reduction in aid would stimulate FDI. Interestingly, whilst the aid-growth relationship is negative, the FDI-growth nexus is positive.

When interacting with *POLICY*, the effect is statistically insignificant (Table 7). This is a departure from the significant negative sign found earlier. This is instructive. This must be the cause of *POLICY*. Whilst trade independently reduced agricultural growth (Table 6), the combination of trade with inflation rendered the statistically significant negative coefficient into a statistically insignificant one. Our finding appears to follow the views of Hansen and Tarp (2001b) that good economic policies themselves promote growth, but aid is ineffective in the presence of good economic policies.

Table 7. Effects of Types of Foreign Agricultural Aid on Agricultural Growth

	(8)	(14)	(20)
	No interaction with the policy		Interaction with policy
Aid-to-production	-0.1820 (0.0165) [122.23]***	-0.1820 (0.0166) [120.48]***	-2.8402 (2.3667) [1.44]
Aid-for-consumption	-0.1625 (0.0739) [4.83]**	-0.1572 (0.0740) [4.60]**	-14.7375 (2.1924) [45.19]***
Acceleration of consumption aid	0.2712 (0.0673) [16.11]**	0.2604 (0.0684) [14.49]***	29.8309 (6.0594) [24.24]***

Notes: 1) Robust standard errors in parenthesis. 2) Chi-square test statistics in square brackets. 3. *p<0.10, **p<0.05, ***p<0.01.

The Chi-square statistics of 4.83 and 4.60 at 1 degree of freedom have an alpha level of less than 0.05. This suggests that the effect of aid-for-consumption on agricultural growth is significantly different from zero. It is negative. This means that aid-for-consumption reduces agricultural growth. The substitution effect is due to some reasons. First, food aid is like the outputs of the agricultural sector of the recipient countries. This replaces the output that could have been produced from the domestic agricultural sector (Bronkhorst, 2011). Second, aid is often offered for free. This tends to make domestically produced agricultural products less competitive. In some cases, the populace in recipient countries acquires the taste of the food aid and consequently prefers the aid product to the domestically produced ones (Bronkhorst 2011; Demeke et al., 2004). Third, Demeke et al. (2004) have reported that farmers who received aid for consumption took longer to prepare for farm production in the domestic country than when there was no aid for consumption. Fourth, some aid donors use the aid as bait to supply that which the domestic economy could have produced (Weisbrot et al., 2010). The situation is worsened because aid donors provide subsidies to their farmers and sometimes at levels that farmers in recipient countries cannot afford. The worsening situation is illustrated by the acceleration of the decline in Figure 2 and the positive values of effect size and statistically significant chi-square statistics of acceleration of consumption aid in Table 7. Although the values are positive, these mean that the decline of agricultural growth due to consumption aid is decreasing at an increasing rate. It will be observed that *POLICY* worsens the magnitude of the negative sign. Increased trade, such as more imports than exports would harm agricultural growth.

5. Conclusions and recommendations

Although much ink has been spilt on the aid effectiveness debate, the facet of the contemporaneous effect of aid-to-production and its interaction with policy has not been studied. We filled this gap using data from a panel of 117 countries from 1996 to 2020 fitted to a GMM estimator. Aid-to-production discouraged agricultural growth. Aid-for-consumption also discouraged agricultural growth. Policy independently enhanced agricultural growth. FDI in agriculture promotes agricultural growth. In the presence of policy, whilst aid-to-production did not discourage agricultural growth, it worsened the effect of aid-to-consumption on agricultural growth. The decline in agricultural growth resulting from aid-for-consumption occurred at an increasing rate.

Developing countries should seek less foreign aid for production and more FDI for agricultural production as the latter would increase agricultural growth than the former would. It would also enhance the balance of payments in developing countries. Governments in developing countries must enhance trade and macroeconomic policies as this would increase agricultural growth. In the presence of these policies, the discouraging effect of aid-to-consumption can be reversed. Recalling that the existing level of policy produced the result under discussion, a significantly enhanced macroeconomic policy environment would increase agricultural growth. Following the negative effect and acceleration of the decline in agricultural growth arising from aid-for-consumption, aid-for-consumption must be restricted to times of emergency as humanitarian aid. This reduction would increase agricultural growth at an increasing rate initially and later at a decreasing rate. To reduce emergency aid in developing countries, governments must build food stocks to be used in times of emergency. Not only will this reduce the level of aid-to-consumption receipts, but humanitarian agencies could also purchase from the food stocks to assist people in developing countries.

Although the statistical significance of the lag of agricultural growth is statistically significant showing that endogeneity is accounted for, the statistical significance of the constant suggests the introduction of other relevant variables could produce statistically significant coefficients. Thus, further studies could explore other agricultural growth determinants. We focused on developing country aid recipients. Others such as transition economies could be studied.

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Appendix. List of Developing Countries in The Data

Afghanistan	Egypt	Malawi	Saint Vincent and the Grenadines
Algeria	El Salvador	Malaysia	Sao Tome and Principe
Angola	Equatorial Guinea	Maldives	Saudi Arabia
Antigua and Barbuda	Eswatini	Mali	Sénégal
Bangladesh	Ethiopia	Mauritania	Seychelles
Barbados	Fiji	Mauritius	Sierra Leone
Benin	Gabon	Mexico	Solomon Islands
Bhutan	Gambia	Micronesia	South Africa
Bolivia	Ghana	Mongolia	Sri Lanka
Botswana	Grenada	Morocco	Suriname
Brazil	Guatemala	Mozambique	Syrian Arab Republic
Burkina Faso	Guinea	Myanmar	Thailand
Burundi	Guinea-Bissau	Namibia	Timor-Leste
Cabo Verde	Guyana	Nauru	Togo
Cambodia	Haiti	Nepal	Tonga
Cameroon	Honduras	Nicaragua	Trinidad and Tobago
Central African Republic	India	Niger	Tunisia
Chad	Indonesia	Nigeria	Türkiye
Chile	Iran	Oman	Uganda
China, mainland	Iraq	Pakistan	United Republic of Tanzania
Colombia	Jamaica	Palestine	Uruguay
Comoros	Jordan	Panama	Vanuatu
Congo	Kenya	Papua New Guinea	Venezuela
Costa Rica	Kiribati	Paraguay	Viet Nam
Côte d'Ivoire	Lao PDR	Peru	Yemen
DR Congo	Lebanon	Philippines	Zambia
Djibouti	Lesotho	Republic of Korea	Zimbabwe
Dominica	Liberia	Rwanda	
Dominican Republic	Libya	Saint Kitts and Nevis	
Ecuador	Madagascar	Saint Lucia	