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Is Agricultural Production Spillover the Rationale Behind NEPAD CAADP Framework?

Spatial Econometric Approach

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Introduction

In adopting the Comprehensive Africa Agriculture Development Programme (CAADP), African governments have set a collective goal for their countries of achieving a 6 percent agricultural growth rate as a key strategy toward halving the poverty rate from its 1990 level, which is also a Millennium Development Goal. They have also opted for a partnership framework to mobilize the required funding to achieve the above growth rate, including the allocation by national governments of a budget share of at least 10 percent to the agricultural sector. Finally, CAADP also reflects an option for evidence and outcome based planning and implementation in support of an inclusive sectoral review and dialogue process in line with the broader NEPAD peer review and accountability principles.

The adoption of a common agenda should improve the efficiency of policy outcomes whenever independent policies generate spillovers (Etro, 2001). This arises because of the ability of a common agenda to reduce the scope of free-riding behavior among member countries. The present study seeks to determine whether there is evidence of spillover that might validate the adoption of the CAADP agenda among Sub-Saharan African countries.

We also look at the impact of production spillover on spatio-temporal dynamics of agricultural production among sub-Saharan African countries.

Analytical Framework

Following Alesina et al. (2001), if all *N* countries decide on a common policy agenda such as CAADP, the utility function of the representative individual in member country *i* is: $U_i = y - g_i + \alpha_i H(g_i + \rho \sum_{j=1, j\neq i}^{N} g_j)$ where y is income; ρ represents the spillover effects from other countries' government spending g_i on the "home" country; α>0 captures how much the representative individual of country *i* values public consumption relative to private consumption.

If every country acts independently, taking as given the spending of all the other countries, the maximizing first order conditions with respect to g_i is given by: $\alpha_i H_{g_i}(g_i + \rho \sum_{j\neq i} g_j) = 1$. In the case of collective action, where each country endogenizes other countries' expenditures decisions, the optimality condi-tions for each country are: $\alpha_i H_g(g_i + \rho \sum_{j\neq i} g_j) = 1 - \rho \sum_{j\neq i} \alpha_j H_g(g_j + \rho \sum_{k\neq j} g_k)$ which is an efficient Nash equilibrium because countries' behaviors account for the effect of their decisions on other countries. As pointed out by Alesina et al. (2001), this first best policy requires that the union dictate a different policy for each country and that the policy preferences of every country are known and verifiable. CAADP has provisions that meet these conditions: i) CAADP is built around common goals in terms of agricultural growth, poverty reduction, and agricultural investment but actual design of agricultural strategies is left to individual countries; ii) the CAADP peer-review mechanisms allow for regular verification of countries' policy preferences.

Empirical Model

Given geographical proximity between countries, each country's agricultural production can be expressed as a Cobb-Douglas: $y_i = A_i \exp(u_i) \prod_{r=1}^{p} s_r^{\beta_r}$ where A_i represents country *i*'s total factor productivity; u=ρWu+ε, is an autoregressive (AR) spatial error term; ε is an error term with mean zero and constant variance; ρ represents substantive agricultural spatial spillover; β represents elasticity of production with respect to input ; *W* is the spatial weight matrix that describes geographical proximity among countries.

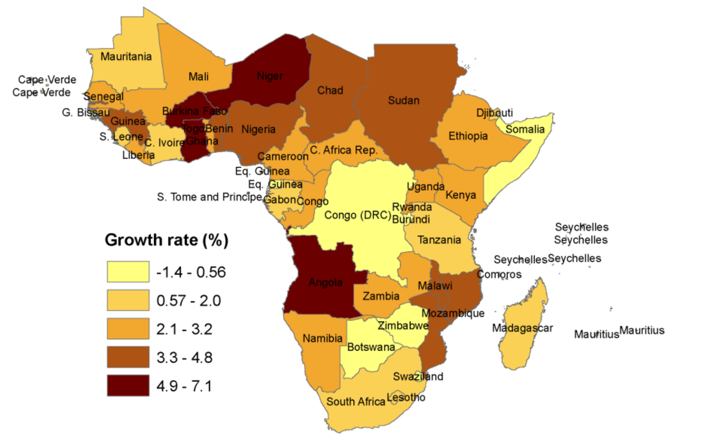
In log form, the regression model takes the following form: $y_{it} = \rho \sum_{j=1}^{N} w_{ij} y_{jt} + x_{it}\beta + \sum_{j=1}^{N} w x_{ijt}\theta + \mu_i + \varepsilon_{it}$ which is estimated using procedure developed by Elhorst (2009).

Data

Panel data were collected on 48 countries in Sub-Saharan Africa from 1961 to 2006. Traditional inputs are from theFAOSTAT website and Fuglies (2008). Data include agricultural output, fertilizers, livestock, tractors, labor and land quality. The summary statistics are presented in Table 1 with mean, standard error, and minimum and maximum values of the variables (output, traditional inputs, land quality, and inefficiency changing variables).

Agricultural Gross Production (constant 1999-2001, USD $1000, smoothed by using Hodrick-Prescott filter with λ=6.25) is used as agricultural production (Fuglie, 2008).

Map 1: Agricultural production growth rates (1991-2006)



Fertilizer is quantity of fertilizer plant nutrient consumed (tons of N P_2O_5 plus K_2O). Agricultural land is measured as the sum of pasture land and permanent crops in thousand hectares (not quality adjusted). Agri-cultural labor is measured as the number of persons (male and female) economically active in thousands. The livestock variable is the number of Cattle Equivalent- Aggregate using Hayami-Ruttan weights (Fuglie, 2008). The farm machinery is the number of agri-cultural tractors in use.

Table 1: Descriptive statistics

Variable	Obs.	Mean	SE	Minimum	Maximum
Production	2162	1254.9	2072.0	5.9	12251.7
Land	2162	20.2	25.6	0.0	113.1
Fertilizer	2162	34.0	107.4	0.0	720.3
Labor	2162	3.0	3.9	0.0	18.7
Machine	2162	5.5	19.7	0.0	134.9
Livestock	2162	5282.3	8597.1	7.3	43568.5

Estimation Results

Production elasticities (see Table 2) with respect to countries own inputs are positive and significant: 0.689 (land), 0.034 (fertilizer), 0.379 (labor), and 0.430 (livestock). The results suggest that, on average, a one percent increase (decrease) in agriculture production in neighboring countries increases (decreases) agriculture production in the home country by 0.039 percent. Over time, after a sharp decline in 1971-1980, the neighbors' effect rose to 0.179 in 1991-2006 which corresponds to the period in which the NEPAD's CAADP agenda was adopted by African leaders.

Both spatial and non-spatial specifications support the hypothesis that countries lagging in terms of per capita agricultural growth are catching up with the leading countries. The potential for convergence is much higher when spatial spillover is accounted for.

No country had to blame its neighbors for negative growth spillovers. On the contrary, on average, each country received 2.5 percent growth rate as a result of spillover from neighbors. Even countries with negative actual agricultural growth rate such as Equatorial Guinea (-0.5 percent), Swaziland (-0.6 percent), DRC (-1.4 percent) and Burundi (-0.2 percent), benefited from positive spillover growth rates of 1.8 percent, 2.5 percent, 2.5 percent and 3.1 percent, respectively. Ethiopia (4.4 percent), Uganda (4.4 percent), Nigeria (4.4 percent), Comoros (3.7 percent), and Zambia (3.5 percent) are the top beneficiaries.

Table 2: Estimation results (1961-2006)

	Coefficient	SE
Neighbors' outputs elasticities		
Spatial lag	0.039[a]	0.021
Own inputs elasticities		
Land	0.689[a]	0.024
Fertilizer	0.034[a]	0.003
Labor	0.379[a]	0.020
Machine	0.004	0.006
Livestock	0.430[a]	0.014
Neighbors' inputs elasticities		
Land	-0.003	0.008
Fertilizer	-0.001	0.004
Labor	0.000	0.008
Machine	-0.007	0.005
Livestock	0.012	0.009
#Obs.	2162	
LM robust test	15.5	p-value=0.00

Map 2: Neighbor's growth effect (1991-2006)

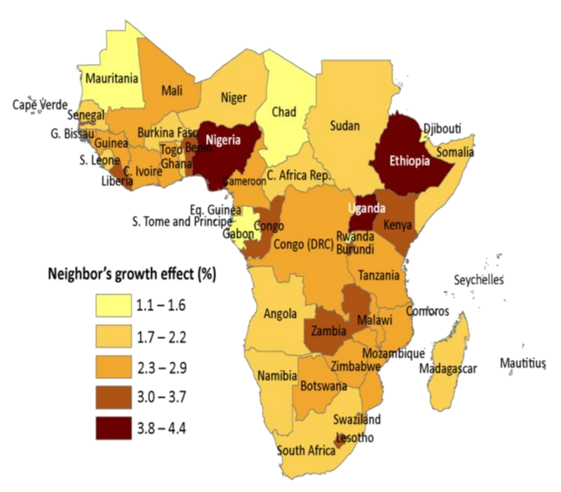


Figure 1: Beta-convergence estimates

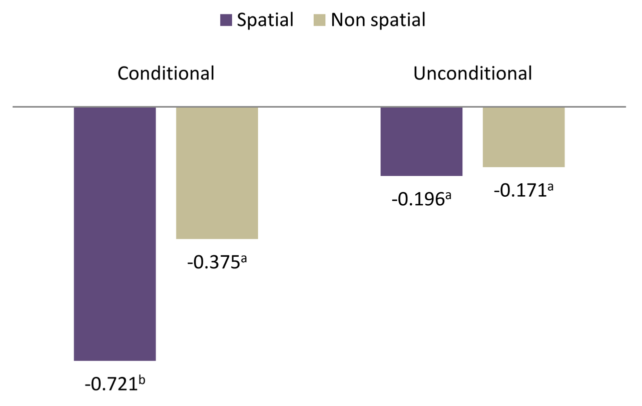
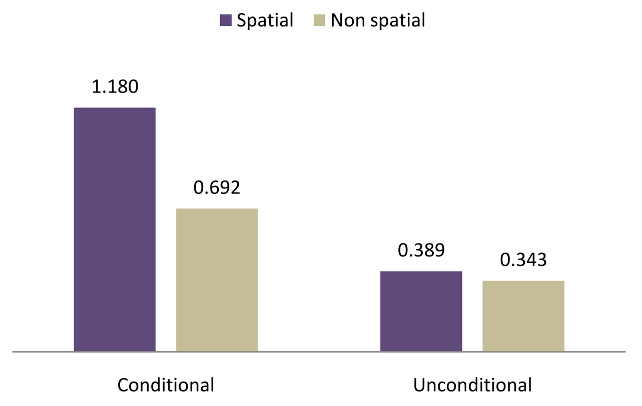


Figure 2: Speed of convergence



Conclusions

Using a Spatial Durbin Model for panel data, the present study examined the extent and magnitude of agricultural production spillover that might validate the adoption of CAADP agenda among Sub-Saharan African countries. Overall, our results suggest the presence of positive and significant agricultural production spillover with a one percent change on average for agricultural production of neighboring countries inducing an increase in one's own country's agricultural production by 0.039 percent over the 1961-2006 period. No evidence of *beggar-thy-neighbor* or negative spillover policies was found. On average, each country received 2.5 percent growth as a result of spillover. Finally, our results suggest that convergence dynamics is much stronger whenever spillover is accounted for, which provides a rationale for a common agenda such as CAADP.

Our results have clear implications for policies that require coordinated interventions by donors and countries. First, bringing in countries to pursue a common agricultural policy agenda will require coordinated actions in the provision of a public good, such as international agricultural research. Second, monitoring such coordinated actions will require an institutional setting (such as the NEPAD and the RECs) for sustained consistency. Finally, the adoption of a common agricultural policy is one way of making foreign aid work better. Donors can fund a common agricultural agenda continent-wide that can move the equilibrium toward the first best solution whenever independent policies generate spillovers. Such coordination will help in guiding strategies and investments to achieve sustainable growth, poverty reduction, and food and nutrition security.

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