Is Agricultural Production Spillover the Rationale Behind NEPAD CAADP Framework?  
Spatial Econometric Approach  
John Ulimwengu and Prabuddha Sanyal  

Introduction

In adopting the Comprehensive Africa Agriculture Development Programme (CAADP) into its NEPAD Agenda, Africa adopted a collective goal for their countries of achieving 6 percent agricultural growth rate as a key strategy toward fulfilling the poverty reduction agenda. CAADP is the implementation arm of NEPAD Agenda. They have also opted for a partnership framework to mobilize the required funding to ensure the above goal, 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 sectorial 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 policy makers generate spillover (Bro, 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 spillover effects as spatial interactions and to 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.

Empirical Model

Given geographical proximity between countries, each country’s agricultural production can be expressed as a Cobb-Douglas production function of the form:

\[ Y_k = A_k L_k^\alpha_k S_k^\beta_k, \]

where \( A \) represents country \( k \) total factor productivity, \( u_k \) is an autoregressive (AR) spatial error term which is stochastic and constant in variance; \( \beta \) represents substantive agricultural spatial spillover; \( \beta \) represents elasticity of production with respect to input \( i \) to the spatial weight matrix that describes geographical proximity among countries.

In log form, the regression model takes the following form:

\[ \ln Y_k = \ln A_k + \alpha_k \ln L_k + \beta_k \ln S_k + \sum_{i=1}^{n} w_{ki} \ln Y_i + \epsilon_k, \]

where \( \sum_{i=1}^{n} w_{ki} \) is a matrix of weights estimated using the Moran method. This model is estimated using the econometric software developed by Elhorst (2009).

Data

Panel data were collected on 48 countries in Sub-Saharan Africa from 1991 to 2006. The following data inputs are from the FAOSTAT database and Figures (2008). Data include agricultural output, fertilizers, livestock, tractors and land quality. The summary statistics for Table 1 with mean, standard error, and minimum and maximum values of the variables (output, total inputs, land quality, and inefficiency changing variables).

Table 1: Descriptive statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Error</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural output</td>
<td>43568.5</td>
<td>8476.0</td>
<td>18.7</td>
<td>91.7</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>20.1</td>
<td>3.6</td>
<td>0.3</td>
<td>11.6</td>
</tr>
<tr>
<td>Land</td>
<td>329.1</td>
<td>58.9</td>
<td>8.8</td>
<td>1105.8</td>
</tr>
<tr>
<td>Livestock</td>
<td>2057.1</td>
<td>465.1</td>
<td>0.3</td>
<td>5280.5</td>
</tr>
<tr>
<td>Machine</td>
<td>4.3</td>
<td>1.8</td>
<td>0.3</td>
<td>12.5</td>
</tr>
<tr>
<td>Female</td>
<td>75.2</td>
<td>20.1</td>
<td>0.3</td>
<td>179.8</td>
</tr>
<tr>
<td>Male</td>
<td>172.6</td>
<td>36.6</td>
<td>0.3</td>
<td>450.1</td>
</tr>
<tr>
<td>Machine</td>
<td>4.3</td>
<td>1.8</td>
<td>0.3</td>
<td>12.5</td>
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</table>

Agricultural Gross Production (1999-2001, US$1000) smoothed by using Hodrick-Prescott filter with \( \lambda=25 \) is used as agricultural production (Fuglie, 2008).

Fertilizer is typically mineral plant nutrient consumed (tons of N, P, K, plus K2O). Agricultural land is measured as the sum of pasture land and permanent crops in thousand hectares (net quality adjusted). Agricultural labor is measured as the number of persons (male and female) economically active in the livestock sector. The livestock variable is the number of cattle equivalent—Aggregate using Hayami-Ruttan weights (Fuglie, 2008). The farm machinery is the number of agricultural tractors in use.

Analytical Framework

Following Alesina et al. (2001), if N countries decide on a common policy agenda such as CAADP, the utility function of the representative individual in member country \( i \) is:

\[ u_i = g_i + \rho_i (\sum_{j=1}^{N} w_{ij} Y_j - \sum_{j=1}^{N} w_{ij} Y_i), \]

where \( g_i \) is income; \( \rho_i \) is the utility weight of all other countries’ government spending \( g \) in the “home” country; and \( \rho_i \) 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 \( g \) is given by:

\[ d u_i / d g_i = \rho_i \sum_{j=1}^{N} w_{ij} Y_j - \rho_i \sum_{j=1}^{N} w_{ij} Y_i = 0, \]

in the case of collective action, where each country endogenizes other countries’ expenditures decisions, the optimality conditions for each country are:

\[ d u_i / d g_i = \rho_i \sum_{j=1}^{N} w_{ij} Y_j - \rho_i \sum_{j=1}^{N} w_{ij} Y_i = 0, \]

which is an efficient Nash equilibrium because countries’ behaviors account for the effect of their decisions on others. As pointed by Oates and Byers (1977), 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, which are poverty reduction, and agricultural investment but actual design of agricultural strategies is left to individual countries; (ii) CAADP provides mechanisms for regular verification of countries’ policy preferences.

Estimation Results

Production elasticities (see Table 2) with respect to counties own inputs are positive and significant (68.1, 0.012, 0.010, 0.010, 0.010, and 0.010 respectively). This results suggest that, on average, a one percent increase in agricultural production in neighboring countries increases the FAO output in the home country by 0.01 percent. Over time, after a sharp decline in 1971-1986, the countries’ effect rose to 0.19 percent in 1995-2006, which corresponds to the period in which the NEPAD’s CAADP agenda was adopted by African countries.

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 spillover growth. On the contrary, on average, each country received 2.5 percent growth rate as a result of spillover from neighbors. Yet, countries with negative actual agricultural growth rate received both negative spillover (Guinea, Sudan, Senegal, and Burundi (-0.2 percent), benefited from positive spillover growth rates of 1.8 percent, 5.4 percent and 3.1 percent, respectively. Ethiopia (0.4 percent), Nigeria (4.4 percent), Comoros (3.7 percent), and Zambia (3.5 percent) are the top beneficiaries.

Conclusions

Using a Spatial Durbin Model for panel data, the present study examined the extent and magnitude of agricultural production spillovers 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 0.01 percent over the 1991-2006 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, bring 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 RCI) 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 equation toward the first best solution, avoiding policies that undermine others. This will help guide strategies and investments to achieve sustainable growth, poverty reduction, and food and nutrition security.

LITERATURE CITED


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

Map 2: Spatial spillover effects (1991-2006)}