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The Impact of Foreign Assistance on Agricultural Growth

by

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Abstract

Foreign development assistance (aid) takes many forms: financial, technical, food. The rationale for aid rests on humanitarian, political, and economic grounds. The effectiveness of aid to agriculture is empirically assessed using a production function approach with cross-sectional-time-series data for 98 countries. Results indicate that aid to agriculture has had a positive and significant impact in Asia and Sub-Saharan Africa, but little effect in the Middle East and Latin America. Debt problems may be influencing the effectiveness of aid in Latin America. Aid effects did not differ across countries by income level or by importance of the agricultural sector.

The Impact of Foreign Assistance on Agricultural Growth

Foreign development assistance (aid) to agriculture in developing countries has taken many forms and the nature and magnitude of its effects, intended and unintended, has generated considerable debate. However, few studies have attempted to assess empirically the magnitude of agricultural productivity effects attributable to foreign development assistance. This paper briefly reviews the nature of and rationale for aid to agriculture and presents the results of a multi-country analysis of the effects of development assistance on agricultural growth. The relative effectiveness of aid by region and for countries at different stages of growth also are considered.

Nature of Foreign Assistance to Agriculture

Foreign development assistance takes many forms: financial, technical, and food. This aid may be transferred through projects or programs and may represent grants or concessional loans. If official flows from one country to another are aimed at economic development or welfare improvements, and have at least a 25% grant element, they are called official development assistance (ODA). Aid through non-official flows is also provided by non-governmental organizations (NGO's).

Foreign assistance to agriculture is a portion of total ODA and includes such diverse components as agricultural research and extension, irrigation projects, rural roads, agricultural education and training, flood control projects, health improvement programs, integrated rural development projects, and agricultural policy assistance. It is difficult, and for our purposes not entirely appropriate, to separate agricultural from non-agricultural aid.

Foreign exchange and budgeting support directed at a country as a whole can indirectly benefit agriculture, as can the policy dialogue and changes which may accompany that support. Food aid may be directed at meeting short term crises or be funneled through food-for-work programs which improve rural infrastructure. Support to primary and secondary education benefits all sectors of the economy.

Rationale For Foreign Assistance to Agriculture

The rationale for foreign aid in general as well as for aid to agriculture rests on humanitarian (moral or ethical), political (strategic self-interest), and economic self-interest grounds (Krueger, Ruttan). Ruttan notes that the humanitarian argument is often treated as obvious by foreign assistance sponsors. However, he points out that several variants of the argument have been made based on compensation for past injustices, uneven distribution of global natural resources, and a moral obligation to help the least advantaged members of society, with the premise that the emergence of international economic and political interdependencies has extended the moral basis for distributive justice from the national to the international spheres. Foreign assistance to agriculture can benefit one of the largest and poorest sectors in most developing countries.

The political self-interest rationale is based on the notion that aid will strengthen the political commitment of the recipient to the donor(s). A quick glance at the distribution of U.S. foreign assistance by country makes it clear that strategic political considerations have been a major motivation for aid, regardless of whether the intended results have been achieved.[1]

The economic self-interest rationale for foreign assistance to agriculture has received considerable attention in recent years due to increased concerns

by farm groups that aid may be generating foreign competition. Studies by de Janvry and Sadoulet; Houck; Kellogg, Kodl, and Garcia; Lee and Shane; Vocke and Christiansen, have examined the empirical evidence supporting the idea that agricultural growth in developing countries increases incomes which stimulates their agricultural imports and, by extension, donor (U.S.) exports. Economic self-interest arguments have tended to focus on either the effects of aid on donor exports or employment. These studies begin with the implicit assumption that foreign assistance has indeed stimulated agricultural growth in developing countries. However, as Ruttan notes, the economic self-interest as well as humanitarian and political self-interest rationales for aid lose their credibility if the aid transfers do not achieve their desired results. Therefore it becomes imperative to measure empirically the effectiveness of foreign assistance aimed at agriculture.

Measuring the Effectiveness of Aid to Agriculture

The effectiveness of foreign assistance can be measured at the microeconomic, sectoral, or national levels. At the microeconomic level, benefit cost analyses have been completed for many foreign assistance projects affecting agriculture; particularly irrigation, flood control, road, and agricultural research projects. Although many of these analyses have shown high rates of return on investment, for a variety of reasons it is not sufficient to conclude that the returns of aid to agriculture in the aggregate have been high. Benefit cost analyses of projects often do not consider effects on behavior elsewhere in the economy or fail to account for positive or negative externalities (Michalopoulous and Sukhatme). Thus it is desirable to consider the wider sectoral or economy-wide effects of aid.

At the sectoral or national levels, foreign assistance theoretically can augment domestic savings or capital stocks which can be used to stimulate growth. Several studies have attempted to assess the impact of development assistance at the national level as it affects savings, capital formation, or growth. Michalopoulous and Sukhatme briefly summarize these studies and note the inconclusive nature of their results. Peterson (1989) recently estimated a rate of return on development assistance based on the contribution of aid to aggregate economic growth using cross-sectional data for 73 countries. He found a 47% rate of return for low income countries, but obtained non-significant impacts for middle-income and for centrally-planned economies.

Few studies have attempted to evaluate the effects of aid at the level of the agricultural sector. Rai used cross-sectional over time data for 58 countries to evaluate the effects of foreign assistance to agriculture, but that study suffered from data quality and heteroscedasticity problems. The current study examines the effects of aid on agricultural growth using a newly-constructed data set for 98 less developed countries from 1970-1985.

Methods and Variables

An aggregate agricultural production function was estimated with official development assistance (ODA) included as a variable in the analysis. Agricultural output (Y) was defined as the real value of agricultural gross domestic product in U.S. dollars and the inputs were livestock (X_1), labor (X_2), machinery (X_3), a land quality index (X_4), schooling (X_5), higher education (X_6) and ODA (X_7). To reduce problems with heteroscedasticity due to large differences in country size, all outputs and inputs were measured on a per hectare basis. The

output and input variables included annual data from 1975-1985 with the foreign aid variable lagged back 6 years to 1970.

The output variable measured in nominal local currency units was first deflated to 1980 currency units using country specific implicit GDP deflators and then converted to an "international" dollar using 1980 purchasing power parity indices obtained from Summers and Heston. Livestock were measured in cattle equivalents, labor was the economically active population in agriculture, and machinery was proxied by tractor horsepower. The land quality index was a revised and extended version of the Table 1 data reported in Peterson (1987). Schooling included the number of pupils enrolled in primary and secondary levels while higher education included the number of pupils in the third level (post-high school) of schooling. Foreign aid, deflated by the U.S. GDP Implicit Price deflator, was included as a quadratic distributed lag of a 3-year moving average of ODA receipts. The complete data set with sources is available from the authors.

Average per hectare values of all variables are summarized by regions in Table 1. The largest agricultural output per hectare is found in the Asia and Pacific regions, while per hectare aid flows are highest in the Middle East (West Asia and North Africa).

A log-linear form was used in the estimation,

$$Y = \alpha_0 \prod_{i=1}^{7} X_i^{\alpha_i}. \qquad (1)$$

The model was estimated with ordinary least squares and the marginal product of foreign assistance to agriculture was calculated as:

Table 1. Average per Hectare Values of Agricultural Output and Input Variables, 1970-1985.

	AGGDP (1980 PPPs[a])	Foreign Aid (1980 US Dollars)	Labor (agr. pop.)	Schooling (pupils)	Higher Education (pupils)	Livestock (cattle equiv.)	Tractor HP	LQ Index
SS Africa	162.951	11.889	0.282	0.116	0.001	0.403	0.010	105
Asia and Pacific	548.894	6.723	0.554	0.342	0.014	0.652	0.038	154
West Asia and North Africa	403.255	27.102	0.173	0.223	0.009	0.396	0.144	53
Latin America and Caribbean	205.194	2.985	0.071	0.133	0.007	0.527	0.062	107
All Developing Countries	332.157	10.497	0.259	0.209	0.008	0.531	0.051	98

[a] See text for discussion of units

$$\frac{\partial Y}{\partial \bar{X}_7} = \beta_7 \frac{\bar{Y}}{\bar{X}_7}$$

where $\bar{Y}$ and $\bar{X}_7$ are the geometric means of output and ODA and β_7 was calculated from the coefficient on the distributed lag of ODA.

Additional models also were estimated incorporating regional, income level, debt burden, and other dummy variables. The purpose was to evaluate regional differences in the effects of ODA on agriculture conditioned on other factors which may influence aid effectiveness.

Results

The results of the initial estimation and the estimations incorporating regional dummy variables are presented in Table 2. All the non-aid variables were significant at least at the 5% level and had the appropriate signs. Foreign aid was significant in some regressions but not others. In model 1, which included all 98 countries in the aid variable, the coefficient on foreign aid was positive but non-significant at the 5% level. However, in model 2 where an intercept dummy variable and a slope dummy variable on foreign aid were included for the Middle East countries, the foreign aid variable was highly significant for the remaining countries.

In model 3, both the Middle East and Latin America were dummied out and the coefficient on foreign aid for the remaining countries became larger and more significant than in model 2. In model 4, all countries except Asia were dummied out and the foreign aid coefficient became larger and still more significant. In model 5, all countries except Sub-Saharan Africa were dummied out and the aid coefficient, although smaller and less significant than for Asia, was still

Table 2. Agricultural Production Function with Foreign Aid Variables for 98 Less Developed Countries

Explanatory Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Constant	-1.421 (-9.60)[a]	-3.325 (-20.05)	-3.704 (-20.95)	-3.270 (-12.34)	-2.462 (-13.27)	-0.819 (-4.24)	-1.250 (-6.02)
Labor	.463 (26.06)	.366 (21.85)	.442 (23.95)	.518 (29.05)	.518 (29.05)	.518 (29.05)	.518 (29.05)
Schooling	.070 (6.28)	.081 (8.06)	.081 (7.85)	.069 (7.21)	.069 (7.21)	.069 (7.21)	.069 (7.21)
Higher Education	.073 (11.20)	.052 (8.64)	.040 (6.58)	.020 (3.48)	.020 (3.48)	.020 (3.48)	.019 (3.48)
Land Quality	.375 (9.76)	.901 (20.06)	.855 (19.25)	.673 (15.75)	.673 (15.75)	.673 (15.75)	.673 (15.75)
Livestock	.275 (17.69)	.336 (23.39)	.297 (20.24)	.213 (14.60)	.213 (14.62)	.213 (14.62)	.213 (14.62)
Tractor H.P.	.177 (22.52)	.104 (12.68)	.089 (10.79)	.087 (11.38)	.087 (11.38)	.087 (11.38)	.087 (11.38)
Foreign Aid	.005[b] (0.68)	.027[b] (3.51)	.051[b] (5.50)	.127[b] (8.25)	.030[b] (3.05)	-.010[b] (-0.87)	-.011[b] (-1.03)
S.S. Africa Intercept Dummy				.808 (3.18)		-1.640 (-8.40)	-1.212 (-6.34)
S.S. Africa Slope Dummy on Aid				-0.97[b] (-5.60)		0.39[b] (7.43)	.041[b] (7.27)
Mid-East Intercept Dummy		1.859 (9.69)	2.200 (11.01)	2.450 (9.10)	1.642 (8.40)		.430 (2.00)
Mid-East Slope Dummy on Aid		-.077[b] (-5.52)	-.091[b] (-6.33)	-.137[b] (-9.10)	-.039[b] (-2.77)		.013[b] (0.09)
Asia Intercept Dummy					-8.080 (-3.17)	-2.450 (-9.10)	-2.020 (-7.25)
Asia Slope Dummy on Aid					.097[b] (5.60)	.137[b] (7.43)	.138[b] (7.27)
Lat. America Intercept Dummy			1.154 (5.77)	2.020 (7.25)	1.212 (6.34)	-4.300 (-2.00)	
Lat. America Slope Dummy on Aid			-.062[b] (-4.40)	-.138[b] (-7.27)	.041[b] (-3.03)	-.00002[b] (0.09)	
R^2	.905	.924	.927	.938	.938	.938	.938

[a] Figures in parentheses are t-ratios

[b] Calculated based on coefficient on the distributed lag variable

significant at the 5% level. However, when all countries except the Middle East were dummied out (model 6), foreign aid was non-significant, and likewise when all countries except Latin America were dummied out (model 7).

The conclusion that can be drawn is that foreign aid significantly enhanced agricultural productivity in Asia and Sub-Saharan Africa, particularly Asia, from 1975- 1985. Impacts on agriculture in the Middle East and Latin America were non-significant.[2] The agricultural marginal value product (MVP) of foreign aid in Asia was $10.38 per dollar of aid. The aid MVP in Sub-Saharan Africa was $.40, and for the world as a whole except for the Middle East, $.85. While, except for Asia, these MVP's may at first appear to be a small return on the dollar, remember that the measure of Official Development Assistance used as the foreign aid variable in the analysis was directed at non-agricultural as well as agricultural development. The agricultural impact is therefore an underestimate of the total impact.[3]

The results of the analysis are time period specific and clearly vary by region. Effects of foreign aid in Latin America may have been masked by the effects of the debt crisis in several countries. A high proportion of the aid to the Middle-East may have been directed at non-agricultural programs. It appears that aid has had a positive impact in the most populous region of the world (Asia) and the poorest region (Sub-Saharan Africa). This evidence should encourage recipients and donors alike that aid has had at least some of its intended economic effects.

Because debt problems may be masking the effects of foreign aid in certain countries, a second set of models was estimated in which countries were grouped by relative external debt levels per agricultural worker based on data in the World Development Report, 1988 (Table 3). Intercept and slope dummies on foreign

Table 3. Agricultural Production Functions for Countries With Different Levels of External Debt per Agricultural Worker

Explanatory Variable	Model 8[a]	Model 9	Model 10
Constant	-0.897 (-4.06)[b]	-.713 (-2.95)	-.643 (-2.63)
Labor	0.366 (16.52)	.534 (21.24)	.507 (19.80)
Schooling	0.321 (12.10)	.175 (6.42)	.220 (8.07)
Higher Education	0.075 (8.47)	.075 (9.02)	.072 (8.49)
Land Quality	0.143 (2.96)	.220 (4.91)	.184 (4.05)
Livestock	0.264 (14.52)	.285 (16.34)	.281 (15.89)
Tractor H.P.	0.078 (6.49)	.051 (4.51)	.054 (4.68)
Foreign Aid	-0.003[c] (-0.34)	-.037[c] (-3.06)	-.043[c] (-3.49)
Intercept Debt Dummy 1 (< $2000 U.S.)		-1.49 (-6.90)	
Slope Debt Dummy 1 (< $2000 U.S.)		0.62[c] (3.85)	
Intercept Debt Dummy 2 ($2000-10000 U.S.)		-1.01 (-4.42)	
Slope Debt Dummy 2 ($2000-10000 U.S.)		.060[c] (3.57)	
Intercept Debt Dummy 3 (< $1000 U.S.)			-.998 (-3.90)
Slope Debt Dummy 3 (<$1000 U.S.)			0.29[c] (1.59)

(Table 3 continued)

Explanatory Variable	Model 8[a]	Model 9	Model 10
Intercept Dummy 4 ($1000-10000 U.S.)			-1.150 (-5.38)
Slope Debt Dummy 4 ($1000-10000 U.S.)			.068[c] (4.26)
$\bar{R}^2$	.911	.924	.922

[a] Because statistics for foreign debt were not available for all 98 countries, model 1 from Table 2 was reestimated for a reduced set of 76 countries for which data are available. The pattern and nature of aid effectiveness for the 76 countries was not significantly different (at the 5% level of significance) from aid effectiveness for the 98 countries.

[b] Figures in parentheses are t-ratios.

[c] Calculated based on coefficient on the distributed lag variable.

aid were included in models 9 and 10. It appears that high levels of external debt (greater than $10,000 per agricultural worker) actually led to a negative effect of foreign aid on agricultural output. This effect may be due to the severe reductions in domestic government support to agriculture necessitated by the need to pay off debts.

Another model was estimated to examine if foreign assistance was more effective for countries at low (less than $460 per capita), compared with high (greater that $1800 per capita), or at intermediate ($461-$1800 per capita) compared with high income levels. No significant differences were found (at the 5% level of significance). This result seems to indicate that stage of development is not a major determinant of aid effectiveness.

Finally, in an attempt to explore the importance of the relative size of the agricultural sector on aid effectiveness, another set of models was estimated in which countries were grouped by the relative size of their agricultural sectors in the whole economy. Intercept and foreign aid slope dummy variables were included for countries with less than 10% of their GDP in agriculture, 10-30% in agriculture, and greater than 30% in agriculture. No significant differences were found (at the 5% level of significance) for these countries.

Implications and Conclusions

Foreign assistance to agriculture takes many forms and is intended to accomplish a variety of economic, political, and humanitarian objectives. Donors and recipients alike have a vested interest in the economic effectiveness of agricultural aid. The results of this study indicate that such aid, since 1970, has improved agricultural productivity in Asia and to a lesser extent in Sub-

Saharan Africa. Aid, in the aggregate, does not appear to have increased agricultural productivity in the Middle East or Latin America.

The results of this study also indicate that aid has been less effective in countries with high levels of external debt. Additional analysis is needed to explain why foreign assistance seems to be most effective in countries with an intermediate level of external debt. Perhaps when the debt was incurred, it resulted in investment in the agricultural sector which complemented the foreign aid. Additional results suggest that aid effectiveness did not vary by income level of the country or by the relative importance of the agricultural sector.

This study identified significant differences in aid effectiveness by region, but only scratched the surface in accounting for why these differences occurred. Additional analysis of aid effectiveness within regions would be a useful and needed step in attempts to quantify the effects of foreign assistance to agriculture.

ENDNOTES

1. For example, in recent years more than one-fourth of all U.S. development assistance has gone to Israel and Egypt. And, small countries such as El Salvador and Costa Rica receive more U.S. development assistance than a large country like India.

2. A separate model also was estimated in which Israel and Egypt were dummied out based on the hypothesis that those countries may be outliers because the large amount of ODA received for political reasons. However, the magnitude and significance of the coefficient on the ODA variable was not appreciably affected and therefore these countries were left in the data set. Likewise, Singapore, Hong Kong, and Surinam was dummied out in another regression based on the hypothesis that those countries may be outliers because of their small agricultural bases. However, the results were not appreciably different and they too were left in the data set.

3. The effects of ODA on agricultural output also might have been underestimated if donors targeted slow growth countries for special attention, perhaps for humanitarian reasons. To test for this possible selection bias, the cumulative level of ODA over the study period, 1975-85, was regressed on the compound growth rate of Ag GDP for the pre-sample period, 1965-75, while controlling for size as proxied by the land in agriculture variable. However, no significant effect of agricultural growth rates on ODA was found.

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