Impacts of official development assistance on agricultural growth, savings and agricultural imports

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Abstract

   This paper explores the links between development assistance, agricultural output growth and imports in 56 developing economies over the period 1974–1990. The empirical model treats agricultural growth and imports, savings and aid as endogenous. The analysis also accounts for differences in macroeconomic policies. The results show that aid had a positive impact on agricultural growth. A robust relationship exits between aid and agricultural imports consistent with the argument that aid helps industrialized countries through market expansion and strengthened trade ties.

1. Introduction

   Opposition to the use of foreign aid funds to promote agricultural development in less developed countries (LDCs) is widespread among farm organizations in industrialized countries. These groups argue that development assistance leads to productivity increases and greater agricultural output in developing countries, thereby reducing industrialized countries' farm exports (Houck,

1986; Pardey, Roseboom and Anderson, 1991, p. 70). For instance the U.S. Congress responded to the various farm lobbies' pressures by adopting an amendment that prohibits the use of development assistance funds for support of research or of measures to increase production of commodities currently exported by the United States (Thompson, 1992).
   In reaction to farmers opposition, many economists argue that agricultural assistance to developing countries should be encouraged because it is of benefit to both industrialized countries' farmers and LDC producers and consumers. Foreign aid to agriculture leads to increases in agricultural productivity, resulting in income increases in LDCs. These rising incomes then lead to increased demand for imports, including agricultural products from industrialized

countries. Several studies have tested the last link in the above chain of reasoning: income growth leads to larger food imports (Bachman and Paulino, 1979; Mackie, 1993; Lee and Shane, 1985; Kellogg, Kodl and Garcia, 1987; Houck, 1986; Kellogg, 1987; Christiansen, 1987; Vocke, 1987; de Janvry and Sadoulet, 1988). Most of these authors find the reasoning to be empirically supported. The first part of the argument, however, that foreign aid leads to agricultural income growth has received little scrutiny (Norton, Ortiz and Pardey, 1992).

The purpose of this article is to explore the relationship of official development assistance (ODA) to the growth of agricultural output and the creation of foreign agricultural markets through increased imports by recipient countries. An understanding of this relationship is important in assessing the validity of the argument that foreign aid, and more particularly, agricultural assistance, is of benefit to both parties. The major methodological contribution of the paper is the use of a simultaneous equation model where agricultural growth rates, agricultural imports, savings and development assistance are treated as endogenous variables.

In the next sections, the relevant literature is reviewed and our model is described. Following these sections, the results of the statistical estimation are reported and discussed. The implications of our results for industrialized countries' agricultural exports conclude the paper.

2. Literature background

While there is strong evidence that income growth in LDCs results in increases in industrialized countries' agricultural exports, there is some controversy concerning the effects of aid on growth. In the 1960s, Chenery and Strout (1966), among others, suggested that foreign capital could be introduced as a supplement to domestic savings, thereby contributing to economic growth. Since then many economists have tested this theoretical proposition with widely divergent results. Two conflicting positions have emerged from this research. The first finds that aid does not promote development, and in some cases can even

slow the rate of growth in LDCs. The main argument is that foreign aid is used as a substitute for domestic savings, and that a large fraction of foreign capital is used to increase consumption rather than investment (Gyimah-Brempong, 1992; Griffin, 1970; Griffin and Enos, 1970; Landau, 1971; Mosley, 1980; Rahman, 1968; Stoneman, 1975; Weisskopf, 1972). The opposite side of the aid debate sees foreign aid as an important contributor to economic development. The main defenders of this traditional aid theory (including Dacy, 1975; Rana and Dowling, 1988; Gulati, 1978; Dowling and Hiemenz, 1983; Gupta and Islam, 1983; Levy, 1987, 1988; Papanek, 1972, 1973) have all found positive relationships between aid and growth. Most of these authors have concluded that the impact of foreign capital on domestic savings could not be 'unambiguously' stated. Complex demographic, economic, social and political conditions across countries have an important effect on the relationship between foreign aid and economic growth, and may be the source of variability among the results.

These studies (except for Gupta and Islam, 1983; Mosley, 1980; Rana and Dowling, 1988) have used ordinary least squares to estimate income growth and have treated savings and aid as exogenous. This may lead to simultaneous equation bias and the estimates may be inconsistent if aid and savings are actually endogenously determined. In addition, most of these researchers have analyzed the effect of foreign assistance on overall economic growth. In contrast, we focus on the impact of foreign assistance on the agricultural sector.

3. Model

A substantial body of literature suggests that a simultaneous equations approach is the most appropriate means of estimating the effect of foreign aid on growth rates and savings rates (Rana and Dowling, 1988; Gupta and Islam, 1983; Mosley, 1980; Mead Over, 1975). Two main arguments are presented to support this view. First, savings both influence growth and are influenced by growth, and hence they are simultaneously determined. Second, single-equation models tend

to exaggerate the positive effect of aid on growth and aid's negative effect on the savings rate. Accordingly, a simultaneous equation model will be estimated in which both savings and growth are specified as endogenous variables.

Furthermore, it has been argued that countries with declining savings and growth rates are the ones that attract larger amounts of foreign assistance. The amount of foreign aid a country receives is at least partially determined by and endogenous to its economic performance (Michalopoulos and Sukhatme, 1989). Therefore, this study considers aid as simultaneously determined with agricultural growth and savings rates. In addition, aid creates trade ties between donors and recipients (Ruttan, 1989), increasing import capacity and creating foreign markets. This suggests that agricultural imports and aid should also be considered as jointly dependent. To test the effect of aid on growth, a simultaneous equation model is estimated in which the growth of agricultural output, savings rates, imports and aid are all treated as endogenous variables. Measuring the specific effect of agricultural assistance on agricultural savings and agricultural growth would have been ideal. However, data on agricultural

assistance and farm savings were not available for each country. This is a recurring problem in this literature (Norton, Ortiz and Pardey, 1992; Pardey, Roseboom and Anderson, 1991).

The simultaneous equation system is:

$$\text{GRA} = f\left(\sum_{j=-1}^{6} \beta_j \text{ ODA}_{t-j}, \text{ SAV, FPI, AGTR, TOT,} \right.$$

$$\text{OVER, DEF, ARES, INF, REG1,}$$

$$\left. \text{REG2, REG3, SZ} \right) \quad (1)$$

$$\text{SAV} = g(\text{ODA, GRA, GRNA, FPI, AGTR, NAGTR,}$$

$$\text{PCY, DR, TAXR}) \quad (2)$$

$$\text{ODA} = h(\text{GRA, GRNA, SAV, AGIMP, NAGIMP,}$$

$$\text{PCY}) \quad (3)$$

and

$$\text{AGIMP} = j(\text{ODA, GRA, PCY, FEL, INF}) \quad (4)$$

An explanation of the symbols is listed below.

Following Norton, Ortiz and Pardey (1992) the agricultural growth equation (Eq. 1) is estimated using a quadratic distributed lag of ODA to estimate the effect of current and past aid on agricultural growth. The ODA polynomial lag structure

List of symbols

GRA	Average annual growth rate of agricultural output
GRNA	Annual growth rate of aggregate (nonagricultural) output
ODA$_{t-j}$	Official development assistance (grants and loans made on concessional financial terms) at time $t-j$ in percent of GDP
β_j	Coefficients of the quadratic lag structure with $\beta_1 = \beta_6 = 0$
SAV	Gross domestic savings in percent of GDP
FPI	Foreign private investment in percent of GDP
AGTR	Net agricultural exports (agricultural(exports − imports)) in percent of GDP
NAGTR	Net nonagricultural exports (nonagricultural(exports − imports)) in percent of GDP
TOT	Terms of trade (ratio of index of export unit value over index of import unit value)
OVER	Overvaluation of exchange rate (black market rate − official rate) in percent of official rate
DEF	Budget deficit (government revenues minus expenditures) in percent of GDP
ARES	National agricultural research expenditures in percent of GDP
INF	Rate of inflation (growth of the Consumer Price Index) in percent of GDP
REG1, REG2, REG3	Dummy variables for Africa, Latin America, and West Asia/North Africa, respectively
SZ	Dummy variable for population size greater than ten million
PCY	Per capita income
DR	Dependency rate (percentage of population below 15 years of age)
TAXR	Tax revenues in percent of GDP
AGIMP	Agricultural imports in percent of GDP
NAGIMP	Nonagricultural imports in percent of GDP
FEL	Foreign exchange holdings in percent of GDP

assumes constrained end points such that the effect of ODA starts with current aid and disappears at the sixth lag. The β_j's are found by solving a system of equations of the form:

$$\beta_i = \alpha_0 + \alpha_1 i + \alpha_2 i^2 \quad \text{for } i = -1, 0, \ldots, 6$$
$$\text{and} \quad \text{with} \quad \beta_6 = 0 = \beta_{-1}$$

Only α_2 is directly estimated. Other lag structures were considered but the results were not conclusive.

Most empirical studies have shown a positive contribution of exports to growth (Cohen, 1868; Vovoidas, 1973; Ram, 1968; Massell et al., 1972). Net farm exports bring additional revenues that can be used for investment. The production of exportables also makes use of unemployed resources, increases specialization to capture the benefits of comparative advantage, expands production possibilities through access to knowledge and technology, offers greater economies of scale due to an enlargement of the market size, and enables the country to import goods which are more productive than domestic resources (Ram, 1968; Rana and Dowling, 1988). Official development assistance, foreign private investment and gross domestic savings targeted to the agricultural sector are all considered as important forms of agricultural investment and are therefore treated as determinants of growth (Papanek, 1973). Unfortunately, data on the agricultural sector were not generally available and therefore total measures were used as proxies. This problem was also encountered by other authors (Norton, Ortiz and Pardey, 1992; Pardey, Roseboom and Anderson, 1991).

National expenditures on agricultural research are included as an explanatory variable because of the observation that returns to agricultural research are generally very high in comparison with other investments available to society (Ruttan, 1987). This expenditure variable covers personnel's salaries and operating capital expenditures. The use of foreign aid to support agricultural research is one of the specific targets of the farm organizations favoring restrictions on development assistance. These groups see agricultural research as a source of competition rather than as a determinant of economic growth. Inclusion of this variable in the growth equation allows a test of the impact of agricultural research on farm growth.

To account for differences in economic policy and performance, Eq. (1) also includes the exchange rate overvaluation, inflation rates, and government deficit variables. Overvaluation is used by many developing countries as a means of subsidizing imports, and taxing exports. We use black market premia published by Pick to measure overvaluation. Overvaluation is the difference between black market and official exchange rates expressed in percent of the official rate. Many developing countries also experienced high levels of inflation during the late 1970s and early 1980s. By dramatically increasing the money supply, governments can generate revenues at the expense of a depreciating currency and ever-rising inflation rates. In addition, government deficits have been running high in many LDCS in the last decade creating a heavy burden on the overall developmental process. Including these variables in the growth equation helps to correct for the impact of policies on agricultural productivity. To capture the effect of the international environment on LDCs' economies, we use a terms of trade variable. Declining terms of trade mean that the purchasing power of agricultural exports is falling and this may have an unfavorable impact on agricultural performance. The regional dummy variables are included to account for regional differences in the growth experience. Finally, the dummy variable for country size allows us to distinguish small countries from large ones and to control for potential scale effects on growth.

The savings rate function (Eq. 2) is based on Mikesell and Zinser (1973). Macroeconomic theory suggests that the level of savings is positively related to per capita income (Landau, 1971). Moreover, richer countries tend to save more out of their income than poorer countries, thereby suggesting a positive relationship between the rate of savings and per capita income. Growth of agricultural and nonagricultural output implies positive income growth for developing countries. Consequently, an increase in the output growth rate increases transitory income with positive in-

fluences on the savings rate (Gupta and Islam, 1983). Current official development assistance and foreign private investment are also consid-

ered here as important sources of gross domestic savings. The effect of these two variables on savings has created the strongest controversy in

Table 1
Results of two-stage least squares estimation of agricultural growth, savings, ODA and agricultural imports for 55 LDCs, 1975–1990, 1975–1982 and 1983–1990

Explanatory variables	Agricultural growth			Savings		
	75–90	75–82	83–90	75–90	75–82	83–90
SAV	0.21	0.27	0.13			
	(2.51)	(2.29)	(1.11)			
GRNA				0.08	0.19	0.09
				(1.17)	(2.71)	(1.29)
GRA				0.14	0.14	0.23
				(2.71)	(2.31)	(2.67)
ODA				−0.72	−0.82	−0.611
				(10.26)	(8.70)	(5.71)
$\sum \beta_j \, \text{ODA}_{t-j}$	0.006	0.007	0.005			
	(2.71)	(2.26)	(1.51)			
FPI	−0.41	−0.56	−0.04	0.90	0.99	0.56
	(1.96)	(2.10)	(0.11)	(5.43)	(5.18)	(1.60)
AGTR	0.11	0.11	0.14	0.26	0.14	0.38
	(1.76)	(1.19)	(1.42)	(6.16)	(2.22)	(6.10)
NAGTR				0.27	0.22	0.33
				(10.74)	(6.29)	(8.39)
OVER	−0.0001	−0.002	−0.001			
	(0.028)	(0.42)	(0.28)			
INF	0.0001	−0.012	0.0002			
	(0.08)	(0.67)	(0.26)			
DEF	−0.01	0.01	−0.09			
	(0.12)	(0.10)	(0.80)			
TOT	0.007	0.02	−0.01			
	(0.31)	(0.52)	(0.34)			
ARES	−0.88	0.86	−3.91			
	(0.28)	(0.19)	(0.93)			
PCY				0.003	0.002	0.003
				(4.26)	(2.56)	(3.77)
DR				−0.09	−0.03	−0.23
				(1.26)	(0.25)	(−2.15)
TAXR				0.28	0.19	0.41
				(5.76)	(2.70)	(5.67)
Africa	−1.89	−1.66	−1.61			
	(1.60)	(0.94)	(1.00)			
Latin America	0.55	−0.01	−1.08			
	(0.44)	(0.00)	(0.59)			
Mediterranean region region	0.04	0.17	−0.05			
	(0.03)	(0.09)	(0.03)			
SZ	0.27	0.52	0.34			
	(0.32)	(0.37)	(0.28)			
CONSTANT	−2.57	−4.71	−0.47	17.91	16.84	21.65
	(0.75)	(0.95)	(0.10)	(5.24)	(3.16)	(4.37)
Number of observations	714	422	292	714	422	292

Values in parentheses are absolute values of t-statistics.

Table 1 (continued)

Explanatory variables	Agricultural imports			ODA		
	75–90	75–82	83–90	75–90	75–82	83–90
ODA				0.41	0.38	0.45
				(17.77)	(14.05)	(11.19)
GRNA	0.10	0.09	0.08			
	(2.64)	(2.51)	(2.06)			
GRA	0.03	0.05	0.03	−0.04	−0.05	−0.06
	(0.98)	(1.62)	(0.55)	(2.32)	(2.41)	(1.86)
SAV	−0.25	−0.30	−0.22			
	(8.11)	(8.26)	(4.75)			
AGIMP	0.99	1.24	0.44			
	(9.24)	(10.31)	(2.67)			
NAGIMP	−0.001	−0.07	0.13			
	(0.34)	(3.49)	(3.99)			
PCY	−0.002	−0.001	−0.004	0.001	0.001	0.002
	(6.74)	(3.32)	(6.96)	(5.74)	(4.42)	(5.15)
FEL				0.14	0.15	0.04
				(9.08)	(8.91)	(1.26)
INF				−0.0004	−0.02	−0.0003
				(1.73)	(4.94)	(1.35)
CONSTANT	6.73	6.37	7.34	0.70	1.45	0.22
	(10.21)	(8.09)	(7.69)	(3.06)	(5.30)	(0.58)
Number of observations	714	422	242	714	422	292

Values in parentheses are absolute values of t-statistics.

the foreign aid literature, as mentioned above. Their inclusion in the savings equation will help to determine whether foreign assistance leads to higher current consumption or higher savings rates.

Several studies have used exports as a determinant of savings (see Mikesell and Zinser, 1973). In developing countries, net farm exports are an important source of income and serve to generate tax revenues and relieve foreign exchange bottlenecks (Papanek, 1972, 1973; Rana and Dowling, 1988). We disaggregate exports into agricultural and other exports to allow for the potential role of farm exports. Taxes are a common variable regarded by development economists as an important measure of the ability of the developing countries to mobilize savings and to grow (Dowling and Hiemenz, 1983; Mosley, 1980; Mikesell and Zinser, 1973). The dependency rate variable has been used by Gupta and Islam (1983) among others. The argument is that the larger the percentage of dependents in the population, the

smaller the potential to save, since additional people have to be provided for with given resources.

The ODA equation (Eq. 3) includes the agricultural and nonagricultural output growth and savings rates variables to measure their influence on the amounts of aid received. The level of per capita income also has an important bearing on the size of ODA disbursements, since poorer countries appear to receive larger amounts of aid. Agricultural and other imports are included in the ODA equation to test whether foreign assistance is actually used to fill a trade gap created by large import volumes especially for agricultural products.

Finally, agricultural imports (Eq. 4) are specified as a function of foreign assistance to test the hypothesis that aid creates commercial ties between donor and recipient countries. Agricultural income growth as measured by output growth rates and per capita income are also expected to have a positive impact on food imports. Logically,

higher income levels mean a higher level of absorption. Foreign exchange availability determines the ability of a country to purchase foreign commodities. A larger pool of foreign exchange expands the country's ability to trade. Equally important is the level of inflation. High inflation rates decrease the value of the domestic currency relative to foreign currencies, thereby lowering the purchasing power of the inflating country.

4. Data and empirical results

The sample used for this study covers 56 developing countries for the period 1975–1990. The sample was selected on the basis of data availability. The countries can be grouped into four regions: Asia, Latin America, Africa and the West Asia/North Africa region, and are listed below. All the data were measured in constant dollars, with 1980 as the base year. In addition, since we are analyzing a cross-country sample, error terms for larger countries are expected to have greater variance than those associated with smaller countries. This heteroscedasticity problem was corrected by dividing the original data by GDP so that most variables are expressed as a percentage of GDP (except for per capita income, the dependency rate, the growth rate variables, the terms of

List of countries by region

AFRICA	LATIN AMERICA
Cameroon	Argentina
Central	Bolivia
African Republic	Brazil
Congo	Colombia
Ghana	Costa Rica
Ivory Coast	Dominican Republic
Kenya	Ecuador
Liberia	El Salvador
Malawi	Guatemala
Mauritania	Haiti
Nigeria	Honduras
Rwanda	Jamaica
Senegal	Mexico
Sierra Leone	Nicaragua
Tanzania	Panama
Zaire	Paraguay
Zambia	Peru
Zimbabwe	Uruguay

ASIA	WEST ASIA/NORTH AFRICA
Bangladesh	Algeria
Burma	Egypt
China	Jordan
India	Morocco
Indonesia	Portugal
Korea (South)	Syria
Malaysia	Tunisia
Pakistan	Turkey
Philippines	Yemen
Singapore	Arabic Republic
Sri Lanka	
Thailand	

List of data sources

GRA, GRNA	World Tables (World Bank, 1993)
ODA	Geographical distribution of financial flows to developing economies official development assistance (OECD, various issues)
SAV	World Tables (World Bank, 1993)
FPI	International Financial Statistics (IMF, various issues)
AGTR, AGIMP	Trade Yearbook (FAO, various issues)
NAGTR, NAGIMP	Direction of Trade Statistics (IMF, various issues)
TOT	World Tables (World Bank, 1993)
OVER	Pick's World Currency Yearbook (International Currency Analysis, Inc., Brooklyn, NY, various issues) International Financial Statistics (IMF, various issues)
DEF, INF	International Financial Statistics (IMF, various issues)
ARES	ISNAR Agricultural Search Indicator Series by Pardey, Roseboom and Anderson (International Service for National Agricultural Research, The Hague, The Netherlands, 1991)
SZ	World Tables (World Bank, 1993)
PCY	U.N. Yearbook of National Account Statistics
DR	World Development Report (World Bank)
TAXR	Government Finance Statistics Yearbook (IMF, various issues)
FEL	International Financial Statistics (IMF, various issues)

trade, the overvaluation measure, and inflation). The data sources are listed below.

The series of nonagricultural aggregate output growth was obtained by removing the agricultural contribution to total output from the latter (in levels), then to compute the rate of change of that new variable. This series showed implausible values inconsistent with income level data. Therefore, we alternatively use aggregate output growth as a proxy for nonagricultural output growth. The latter proxy improves the results although not substantially. We report results obtained with the latter proxy.

To measure the link between aid and agricultural productivity, the simultaneous equation system specified earlier was estimated with two-stage least squares. The results are presented in Table 1. The equations were estimated over three time frames: 1975–1990, 1975–1982 (pre-debt crisis and mid-period), and 1983–1990. Results over the longer time period are reported first. The distributed lag of ODA, savings, and agricultural net trade contributed to agricultural growth in LDC's. The link between net exports and growth is consistent with studies by Massell et al. (1972), Cohen (1968) and Ram (1968). The foreign investment variable is negatively related to agricultural growth. Typically foreign investment targets industrial sectors favoring the latter over agriculture. In some alternative specifications (not reported) we investigated the regional effects of ODA on agricultural growth. Interaction terms (ODA and Regional dummy variables) were used. None of these regional effects appeared significant. The remaining variables in the agricultural growth equation were not significantly different

Table 2
Elasticities of agricultural growth, savings and agricultural importswith respect to ODA, 1975–1990, 1975–1982 and 1983–1990

	GRA (75–90)	GRA (75–82)	GRA (83–90)
$\sum \beta_j \, \mathrm{ODA}_{t-j}$	0.755	0.699	0.755
	SAV (75–90)	SAV (75–82)	SAV (83–90)
ODA	−0.241	−0.248	−0.225
	AGIMP (75–90)	AGIMP (75–82)	AGIMP (83–90)
ODA	0.495	0.393	0.633

from zero. The policy performance and environmental circumstances measures did not help explain agricultural growth. It is possible that some of the proxies used were not adequately developed. The agricultural research variable was surprisingly insignificant in light of Ruttan's (1987, 1989) finding. Two lines of reasoning may explain the insignificant coefficient. First, the dollar amount included in agricultural research does not include contributions to international research centers (less than 5% of total expenditure) and thus slightly underestimates total research efforts. Second, a lag between research expenditures and agricultural growth is likely and was not accounted for in this regression.

The results from the savings equation were more conclusive. Official development assistance was negatively and significantly related to savings. This seems to support what many of the aid critics have argued, that foreign aid reduces domestic savings. However, this outcome does not offset the positive impact of aid on agricultural growth. Agricultural growth rate, both agricultural and other net exports, foreign private investment, and per capita income were all positively significant, a finding consistent with Papanek (1972, 1973) and Cohen (1968). Tax revenues were also significantly positively related to savings. Larger tax revenues increase the pool of domestic savings if the government relies on taxes to finance its budget. Finally, we could not find a significant positive link between saving rates and aggregate nonagricultural growth with either of the two proxies of that variable. This result may be due to the strong positive association of savings with other variables (export and agricultural growth measures) which are highly correlated with aggregate (nonagricultural) growth.

In Eq. (3) describing ODA, most parameters were significant at the 5% level except for the growth rate of agriculture. As expected, savings was inversely related to aid flows, indicating that aid flows more into countries where savings rates are low, or that poorer countries receive more assistance. Furthermore, aid was negatively related to per capita income, which constitutes further evidence that poor countries with limited savings receive more foreign aid. The strong posi-

tive relationship between agricultural imports and development assistance is also noteworthy. This result provides evidence that aid helps to fill foreign exchange needs associated with large food import volumes in developing countries. However, we could not find a significantly positive link between other imports and aid.

In our last equation (Eq. 4), agricultural imports, official development assistance was positively related to imports. Several reasons can be offered for this relationship. First, much foreign aid is tied, so that higher levels of foreign aid automatically generate larger import flows. Second, the low-income countries that are the main recipients of aid may also be highly dependent on imports. Third, countries like Egypt which receive foreign aid on a political basis are also likely to be commercial customers of the donor countries. These results are consistent with Ruttan's (1987, 1989) argument that foreign aid strengthens commercial ties between the donor and recipient and run counter to the argument raised by farm interest groups, that foreign aid to developing coun-

tries decreases potential industrialized countries' export markets. According to the present analysis, foreign aid contributes in expanding agricultural markets for industrialized countries' exporters. Agricultural income growth in LDCs did not lead to increased levels of farm imports during the period 1975–1990, a result that may be related to the generally depressed conditions of the world economy during the early 1980s as well as certain protectionist policies applied to LDCs' imports by industrialized countries. Inflation rates and foreign exchange reserves showed a negative impact on agricultural imports. On the other hand, per capita income and foreign exchange holdings have a statistically significant positive effect on farm imports.

When the same four-equation model was estimated for the periods 1975–82 and 1983–90, the coefficient estimates did not vary substantially across sub-samples but there was a tendency for statistical significance in the most recent period to be lower. The ODA and nonagricultural imports are positively associated during the 1983–90 pe-

Table 3
Data summary

Variable	Definition	Units	Observations	Mean	SD
GRA	agricultural growth rate	% change	871	2.16	9.06
GRNA	nonagricultural growth rate	% change	890	3.07	18.78
SAV	savings	% of GDP	879	15.85	11.23
ODA	official development assistance	% of GDP	890	5.28	6.74
AGIMP	agricultural imports	% of GDP	890	4.37	3.95
NAGIMP	nonagricultural imports	% of GDP	847	23.16	21.99
$\sum \beta_j \text{ODA}_{t-j}$	distributed lagged ODA	% of GDP [a]	890	262.96	318.85
FPI	foreign investment	% of GDP	888	0.84	1.90
AGTR	net agricultural exports	% of GDP	890	2.50	7.67
NAGTR	net nonagricultural exports	% of GDP	847	−8.42	13.28
TOT	terms of trade	unitless	879	95.39	18.20
OVER [b]	overvaluation exchange rate	% off. rate	866	90.15	379.60
DEF	budget deficit	% of GDP	799	−5.36	5.38
ARES	agricultural research expenditure	% of GDP	890	0.20	0.18
INF [b]	inflation	% change	884	93.09	701.84
SZ	size dummy variable	1, 0	891	0.47	0.50
PCY [c]	per capita income	$/person	890	899.10	879.56
DR	dependency rate	% population	891	45.60	4.71
TAXR	total tax revenues	% of GDP	801	15.91	5.87
FEL	foreign exchange holdings	% of GDP	874	7.31	14.23

[a] The structure is $\beta_0 = 6 = \beta_{-5}$, $\beta_{-1} = \beta_{-4} = 10$, $\beta_{-2} = \beta_{-3} = 12$.
[b] OVER and INF a priori high mean values are due to high inflation countries such especially in the Latin America.
[c] In 1980 constant $.

riod in contrast to the earlier period. On the other hand, inflation had a major negative impact on imports during the late 1970s.

To illustrate the implications of the results, elasticities of growth, savings and imports relative to aid were calculated at the sample means. These elasticities are reported in Table 2. The results indicate that a 1% increase in aid flows was associated with a 0.755% proportional increase in agricultural growth rate. This positive relationship was somewhat weaker during the 1975–82 period. The elasticity estimates relating savings to aid show that a 1% increase in ODA led to a 0.241% decline in saving rates. The estimated elasticities of agricultural imports with respect to ODA ranged from 0.393% to 0.633%. De data summary is listed in Table 3.

5. Conclusions

The primary purpose of this study was to empirically test the link between foreign aid, agricultural income growth and trade in the developing countries during the period 1975–1990. To explore these relationships, a simultaneous equation system was specified with agricultural output growth, savings, aid and agricultural imports specified as four endogenous interdependent variables. According to the results presented in Table 1, official development assistance had a significant impact on agricultural income growth in LDCs during the 1975–1990 period. This finding provides the missing link in the argument that foreign aid leads to larger food imports and supports the hypothesis that development assistance promotes agricultural growth. It was also found that aid is more likely to be directed to countries with low savings rates such as countries in sub-Saharan Africa.

In addition, the negative relationship between aid and per capita income may be evidence that the poorest countries receive relatively greater amounts of aid. Finally, agricultural imports and aid were positively related, leading us to believe that aid fills a trade gap and promotes trade ties between donor and recipient countries.

On the basis of these results, we can conclude that, in general, current and past foreign aid had a positive influence on agricultural growth in the developing countries during the 1975–1990 period. The argument that foreign aid leads to increases in agricultural imports of LDCs by contributing to agricultural income growth has been completed and validated for this particular period of time.

We also established a significant direct positive relationship between aid and agricultural imports, consistent with a possible strengthening of trade ties between donors and recipients. These findings suggest that foreign aid is in the interests of industrialized countries and Third World farmers, and should not be opposed on the false ground of its negative impact on exports of industrialized countries. Even in the absence of growth or development of the agricultural sector, aid promotes the development and the stability of foreign markets. Development assistance creates important commercial ties between donors and recipients, especially when aid-assisted investments require further technological assistance or replacement of basic equipment. All these factors create a favorable environment for expanding industrialized countries' agricultural exports to the Third World. These countries have been important markets for their own agricultural output but they are mature economies with little prospect for expansion. LDCs, on the other hand, are growing import markets, if allowed to develop. It is therefore in the interest of industrialized countries to promote a favorable policy environment which encourages mutual trade expansion. Our study provides essential information to dispel the seeming antagonism between assistance and agricultural export expansion. This information could shed light on the current debate between opponents and promoters of assistance.

Measuring the effect of foreign aid on agricultural growth is a complex and difficult task. Our results are far from definitive, and suffer from the usual limitations of cross-country analysis. Another shortcoming in this type of aggregate study is that there are conceptual difficulties in identifying and measuring the true determinants of agricultural income growth. Various other so-

cial, economic, and demographic variables that are not easily quantified may have an important influence on the effectiveness of aid in promoting growth. For example, wars, natural disasters, droughts and political turmoil can severely hinder growth. Concurrently, a society's propensity to save, its initial endowment of natural resources, its macroeconomic policies and institutions, and its government structure, organization, and efficiency all have an important bearing on how capital inflows can be absorbed and used in the development process. Individual country-studies could provide an alternative measure of the impact of foreign aid on agricultural growth, savings and imports (Lele, 1992; Lele and Goldsmith, 1989). These studies should include more detailed demographic, social, political, and policy variables which influence capital utilization, agricultural growth and trade in LDCs, and should decompose the effects of foreign assistance by type (technical assistance, project loans, aid grants, food aid) (Islam, 1992). Although conclusions from case studies cannot always be generalized to identify common factors that affect growth, the two approaches do complement each other.

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