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THE EFFECTS OF AGRICULTURAL
GROWTH ON AGRICULTURAL IMPORTS
IN DEVELOPING COUNTRIES

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THE EFFECTS OF AGRICULTURAL GROWTH ON AGRICULTURAL IMPORTS IN DEVELOPING COUNTRIES

International phenomena are having increased influence on U.S. agriculture [Schuh]. One dimension of this increased interdependence is the rapid increase in the value of U.S. agricultural exports and imports, 349 and 209 percent respectively, since 1970 [Kellogg]. The value of U.S. agricultural exports has increased at a rate over twice as fast as total farm gross cash income since 1970 (349 versus 155 percent) [USDA, Economic Indicators]. Not only have exports increased in importance, but their destination has changed. The percent of U.S. agricultural exports going to developing countries has increased from 34.6 in 1974-76 to 41.3 in 1983-85 (Table 1).

Another dimension of this interdependence is agricultural development assistance which has received varying emphases during the past three decades in the U.S. development assistance program. In 1975, Congress passed Title XII of the Foreign Assistance Act which provided a congressional mandate for the involvement of U.S. land-grant and other similar universities in U.S. foreign aid programs [York]. One area of emphasis in Title XII is agricultural development and most land-grant universities have been involved in projects designed to increase agricultural production in developing countries.

Recently, the U.S. farm sector has faced a number of conditions that have adversely affected farmers' net income and net worth positions. The 29 percent decline in value of agricultural exports since 1981 has contributed to the severity of these problems (Table 1). Some believe that increased agricultural production in developing countries has been substantially responsible for the decline in U.S. agricultural exports [Avery].

Table 1. U.S. Agricultural Exports to Both Developing and Developed Countries and Total Exports for Fiscal Years 1974-85.

(1)	(2)	(3)	(4)	(5)
Year	To Developing ¹ Countries	To Developed ² Countries	Total	Percent to Developing Countries
		(Billion U.S. Dollars)		(%)
1974	7.61	13.95	21.56	35.3
1975	8.27	13.55	21.82	37.9
1976	6.93	15.81	22.74	30.5
1977	8.46	15.51	23.97	35.3
1978	9.24	18.05	27.29	33.9
1979	11.04	20.94	31.98	34.5
1980	15.67	24.81	40.48	38.7
1981	18.24	25.54	43.78	41.7
1982	15.30	23.80	39.10	39.1
1983	14.45	20.32	34.77	41.6
1984	15.59	22.44	38.03	41.0
1985	12.92	18.27	31.19	41.4

¹All Latin American countries, all countries in Asia, except Israel and Japan, and all countries in Africa, except South Africa.

²All countries other than developing countries.

Source: ERS, USDA. U.S. Foreign Agricultural Trade Statistical Report, various issues.

ERS, USDA. Foreign Agriculture Trade Statistics of the U.S., FY 1985 Supplement.

In this situation of increased international interdependence, declining export sales and other farm problems, and increased visibility of land-grant university involvement in agricultural assistance to developing countries, U.S. agricultural leaders have become concerned about the relationship between increasing agricultural production in developing countries and those countries' agricultural imports.

The purpose of this inquiry is to provide a preliminary examination of the relationship between imports of agricultural products into developing countries and changes in domestic agricultural production in these countries. The specific question is: What have been the effects of increased per capita production in developing countries on agricultural imports into these countries?

To investigate this question, time series and cross sectional data are analyzed from 65 developing countries for the 1970-1982 period. After briefly reviewing the literature and discussing the conceptual model developed to explain agricultural imports of developing countries, the data and method of analysis are presented. Then, the results of generalized least squares (GLS) estimation of the conceptual model are provided. Finally, implications of the findings and conclusions are given.

Literature Review

The literature on trade and economic growth is extensive and has, in general, focused on the aggregate relationship between trade and growth in the developing world. Recently, several studies have appeared that examine the relationship between developing countries agricultural growth and their agricultural imports. More specifically, it has been suggested that economic development guided by comparative advantage may complement, rather than compete

with U.S. agriculture exports [Abbott; Lee and Shane]. Abbott asserts that net U.S. agricultural exports may increase as developing countries specialize in specific exports because competitors for one commodity are also likely to import others (p. 17). Lee and Shane note that exports to developing countries have grown most rapidly among those pursuing export lead development following their comparative advantage. Brazil, Malaysia, and the United States are cited as examples of countries that have become major importers of food and feed grains while becoming significant agricultural exporters [Lee and Shane; Kellogg].

Bachman and Paulino showed that the 16 developing countries with the most rapid growth rates in staple food production between 1961 and 1976 also more than doubled their net staple foods imports during this period. Kellogg reported that the group of 18 developing countries with the highest growth rates in their own per capita food production between 1970 and 1982 also increased total agricultural, corn, soybean and soybean product imports at rates of 34, 97 and 257 percent faster than a group of 13 developing countries with slow growth rates in per capita food production. Kodl, in an analysis of 77 developing countries, found no statistically significant negative correlation between indices of per capita agricultural production in these countries and imports of U.S. agricultural products. In five country groups, there were statistically significant positive associations between these variables [Kodl].

In contrast, Avery argues that the expansion in agricultural production in developing countries displaces imports and produces export competition. His arguments are based on research institution reports of higher potential yields in particular crops, increased acreages being brought into production, and technological advances that might be adopted by farmers. Many examples of

large yield increases appear to be taken from data on crop specific experiments at research stations. What will happen to these crop yields on farmers' fields is highly uncertain. To have a widespread impact, new technologies require effective agricultural policies, input delivery and output marketing systems. In addition, Avery's analysis is incomplete regarding whether total agricultural versus specific commodity imports into developing countries will decline. Increased production of one commodity may come at the expense of another crop. Also, other important factors influencing demand for agricultural imports, including income growth, foreign exchange availability, and diet diversification, were omitted from the analysis.

Conceptual Model

The objective of this research is to investigate the effects of agricultural growth in developing countries on agricultural exports to these countries. To investigate this relationship, it is hypothesized that the per capita value of commercial agricultural imports (PAM) into developing countries is related to per capita income (PCI), per capita concessionary sales (PCS), and per capita agricultural production (PAG).

Changes in per capita commercial agricultural imports are expected to be positively related to changes in per capita incomes. Not only do developing countries have relatively high income elasticities for food and other agricultural products, but as incomes grow and urbanization occurs, diets are diversified and additional services embodied in food and agricultural products are demanded. These forces tend to increase the demand for imported agricultural products.

The expected sign of the coefficient of PCS on PAM is uncertain. In some cases, concessionary sales or aid reflect short-run food deficits and inability

to finance commercial imports suggesting a negative sign may result. However, the U.S. concessionary sales program requires that these sales not offset U.S. commercial imports. In addition, a major objective of the program is to increase markets for U.S. commercial exports. Concessionary sales are often used to generate or save income or foreign exchange which may be used to purchase commercial agricultural exports. Given these arguments, a positive relationship is expected between PCS and PAM.

The effect of PAG on PAM is a priori not clear. Domestic shortfalls in agricultural production can lead to increased agricultural imports. Further, more rapid increases in domestic production than in domestic demand for a specific commodity could result in the substitution of local production for imports. These effects would indicate a negative relationship between PAG and PAM.

In contrast, increased production of specific commodities may require that land and other resources be transferred from production of other commodities. Imports of these commodities may increase to compensate for this change in the output mix. In addition, increased agricultural production may be exported and the foreign exchange earned might be used to import other agricultural products [Lee and Shane; Kellogg]. Also, increased agricultural production can result in the importation of agricultural products to be used as inputs. These possible effects indicate that the relationship between PAG and PAM might not be negative.

While distinct effects for agricultural production and income on agricultural imports are posited, it may be difficult to separate the effects of these variables. Increased agricultural production in developing countries is generally considered to be an important determinant of per capita income in these countries [Mellor]. While this linkage between agricultural production

and broad-based income increases is not completely direct and proportional, developing countries with increasing agricultural production will more likely experience income growth.¹

In this analysis, the value of total per capita commercial agricultural imports of developing countries is investigated rather than per capita agricultural imports from the U.S. What is of concern is the influence of agricultural production in developing countries on agricultural imports in general. Whether the U.S. can compete effectively for these developing country markets is an important question, but is not the focus of this study.

Data and Method of Analysis

To examine these relationships, cross sectional and time series data for 65 developing countries between 1970 and 1982 were used. Specifically, the annual value of total agricultural import data by country, taken from FAO Trade Yearbooks, was divided by the annual population of the country, taken from various issues of the World Bank Atlas, to construct PAM. These data are measured in U.S. dollars per capita. The gross national product per capita data in U.S. dollars were also taken from the World Bank Atlas. The PCS variable was constructed by dividing the annual value of U.S. concessional agricultural sales to each country, taken from the USDA Foreign Agricultural Trade Statistics Reports, by the annual population. PCS is measured in U.S. dollars per capita. The PAG variable is the index of per capita agricultural production (1969-71 base) taken from FAO Production Yearbooks.

A GLS time series, cross-section procedure which permits for the correction of potential autocorrelation and heteroscedasticity frequently encountered in pooled data sets is used. Specifically, the model assumes: 1) the coefficients are the same for each individual country; 2) the disturbance

vector for any given country follows a first-order autoregressive process; 3) the variance of the disturbance can differ for each country; and 4) the disturbances for different countries are contemporaneously correlated [Kmenta, pp. 512-514].

Prior to estimation, several steps were taken to minimize the effects associated in dealing with countries of various sizes and differences in agricultural and political structures. First, the countries were subdivided into similar groups, based on whether agricultural production per capita was growing or declining during the sample period, and income groups, according to World Bank classifications. Table 2 provides information on these classifications. Second, individual observations on variables for each country were subtracted from their mean values. This procedure assumes that the characteristics of that country have remained constant through the analysis period and tends to reduce the effect of the different domestic and trade policies associated with each country [Mundlak].

Findings

GLS results for each classification, as well as for the entire data, are presented in Table 2. The PCI variable is dominant among all variables regardless of the classification scheme. A one percent increase in PCI has a much larger affect on per capita agricultural imports than a one percent change in any other variable. PCI is significant and positively related to PAM in all formulations.² The income elasticities seem reasonable and are higher for the low income countries. These results strongly suggest that increases in PCI not only increase the demand for agricultural products, but also increase the demand for imported commercial agricultural products and embodied services. These increases in demand for agricultural imports are probably related to

Table 2. GLS Estimates of Factors Influencing Per Capita Agricultural Imports in 65 Developing Countries from 1970-82.

	Intercept	PCS	PCI	PAG	N
All	-.241 (.031) ^a	1.821 (.009) ^b [.072]	.031 (.00006) [.734]	-.0004 (.0003) [-.00002]	845
Ag Growth ^c	.104 (.064)	-.037 (.090) [-.0009]	.020 (.0004) [.663]	.136 (.003) [.006]	377
Ag ^c Decline	-.398 (.038)	1.97 (.029) [.0968]	.058 (.0004) [.982]	-.028 (.004) [-.0012]	468
Upper Middle ^d Income	-.075 (.184)	-.417 (.258) [-.0078]	.022 (.0004) [.670]	.125 (.027) [.003]	130
Lower Middle ^d Income	.34 (.20)	1.83 (.125) [.079]	.042 (.0007) [.8977]	.011 (.012) [.004]	416
Low ^d Income	-.301 (.016)	1.64 (.057) [.109]	.046 (.0003) [.974]	-.113 (.003) [-.0123]	299

^aThe numbers in parentheses are standard errors.

^bThe numbers in brackets are elasticities.

^cCountries in the ag growth and ag decline categories had positive and negative trends respectively in per capita agricultural production from 1970 through 1982.

^dUpper middle income countries had per capita incomes in 1982 between \$1,680 and \$2,650. Lower middle income countries had per capita incomes between \$440 and \$1,610. Low income countries were defined as those countries with per capita incomes less than \$390 (World Bank, 1984).

diversification of diet and increasing demands for services and processed foods.

PCS is positively related to PAM except for the categories of ag growth and upper middle income developing countries. This positive sign may be expected because of the legal requirement that this kind of aid not replace commercial exports. No significant relationship was found between PCS and PAM for ag growth countries. These results indicate that concessionary agricultural sales are more likely to stimulate demand for commercial agricultural imports in countries facing declining, rather than increasing, domestic per capita agricultural production. In countries where agricultural production is decreasing, the difference between domestic demand and supply of food will likely be increasing. Therefore, the foreign exchange and income earned (or saved) from concessionary sales in these countries is more likely to be spent on importing agricultural products to fill this food demand/supply gap than will be the case in countries where per capita agricultural production is increasing.

There is a difference in the relationship between PCS and PAM among the three income classifications. The estimated coefficients for the impact of PCS on PAM are positive and highly significant for the low and lower middle income countries. For the upper middle income developing country class, the coefficient is negative and marginally significant. This suggests that resources released from concessionary sales in lower income countries are more likely to be used to increase agricultural imports than is the case in higher income developing countries.

The estimated coefficients for the relationship between agricultural imports and agricultural production differ in sign and statistical importance depending on country category. However, regardless of the relationship, the elasticities associated with the separate effects of PAG are small in magnitude and in relation to the elasticities of PCI and PCS.³

For all developing countries, the estimated coefficient of PAG is not significant. With regards to the two per capita agricultural production classes, the results suggest an asymmetric relationship between agricultural production and imports. A positive and significant relationship between PAM and PAG resulted for the 29 developing countries experiencing agricultural growth. In these countries, rapid growth in domestic agricultural production was accompanied by high and increasing per capita agricultural imports during the 1970's and early 1980's. A negative and significant coefficient for PAG was estimated for the 36 ag decline countries. In this instance, it appears that countries experiencing declining per capita agricultural production increased imports of agricultural products to compensate for possible growing imbalances between domestic production and demand.

Regarding income classifications, the PAG coefficients are positive and significant for the upper middle income countries. This positive relationship is probably a reflection of greater agricultural specialization and, hence, more agricultural imports and exports. Increases in PAG in these countries may also lead to a change in the composition of agricultural imports toward higher valued agricultural inputs and more specialized agricultural goods and services. The relationship between PAM and PAG is negative and significant for the low income group. While it appears that increased domestic production may have substituted for imports, care must be taken with this interpretation. A high proportion (14 out of 23) of the countries in this income group is also classified in the ag decline category. Therefore, this estimated effect is likely due to a situation of declining production leading to increased imports rather than a substitution of domestic production for imports.

Conclusions

Several conclusions are apparent from this study on the relationship between agricultural production and agricultural imports in developing countries. Per capita agricultural imports in developing countries are positively and substantially related to per capita income. In most cases, per capita concessionary sales contribute to higher imports of agricultural products on a per capita basis. The separate effect of per capita agricultural production on per capita agricultural imports appears to be slight, particularly in comparison to income effects, and difficult to disentangle from other effects. Positive relationships between agricultural production and agricultural growth resulted for the two higher income groups and the agricultural growth country group. This likely resulted from greater specialization and trade in agricultural products, a changing composition of agricultural imports toward high valued items, and the interaction of agricultural production and income. Negative coefficients between PAG and PAM were encountered in classifications which were primarily associated with declining agricultural production. This suggests that these countries might have been increasing agricultural imports to offset declining domestic agricultural supplies. No significant evidence from this analysis was obtained that indicated increasing per capita agricultural production caused a decline in imports of agricultural goods and services of developing countries.

This research effort is a straightforward and broad analysis of a complicated and important question. The statistical results are suggestive and not definite findings. In addition, this study focused on the effects of agricultural production on total agricultural imports. Therefore, for specific commodities and countries, the effects of increasing agricultural production on agricultural imports of these commodities may be quite different. Further work

is needed to better conceptualize the important linkages between agricultural imports and agricultural production in developing countries and to incorporate dynamic effects. Quantitative analysis of the size and direction of these linkages is also necessary. More detailed data sets are required to ascertain the relevant variables that account for agricultural imports of developing countries. For example, time series and inter-country comparable data on foreign exchange availability are needed so that this variable can be considered in future analyses. Additional attention should be given to acceptable ways to deflate monetary value variables over time and among countries. More country case studies focusing on this agricultural import/agricultural production relationship are necessary so that effects of economic and trade policies can be better understood. In addition, alternative country classifications to those used in this study may assist in developing better understandings of these important relationships in various parts of the world. Lastly, more analysis is needed on the effects of agricultural production changes on imports of sub-classes of agricultural imports and various specific commodities.

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FOOTNOTES

1. This expected relationship was confirmed in the data of the 65 developing countries used in this study where the coefficient of correlation between PAG and PCI was positive and significantly different from zero.
2. The large coefficient values relative to their standard errors for income and concessionary sales in several relationships appear to be a function of the larger number of observations associated with certain classifications.
3. While the correlation coefficient between PAG and PCI was positive and significant, the condition indices generated from OLS regressions were small and generally no higher than 20. This suggests that multicollinearity was not a severe problem.

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