Agricultural Economics, 2 (1988) 159-166
Elsevier Science Publishers B.V., Amsterdam — Printed in The Netherlands

Link between Agricultural Assistance and International Trade

James P. Houck

Department of Agricultural and Applied Economics, University of Minnesota, 231 Classroom Office Building, 1994 Buford Avenue, St. Paul, MN 55108 (U.S.A.)

(Accepted 15 January 1988)

Abstract

Houck, J.P., 1988. Link between agricultural assistance and international trade. *Agric. Econ.*, 2: 159-166.

This paper investigates a central part of the argument that agricultural assistance by the United States to developing nations leads to diminished export markets for U.S. farmers. A sizeable cross section of low-income and lower-middle-income nations is used to provide statistical analyses of: (1) the link between agricultural productivity and economic performance, and (2) the link between economic performance and agricultural imports. The results show that a reasonably strong case can be made for the idea that advances in agricultural productivity are associated with long-run increases in imports of cereals and other agricultural products by less wealthy nations. The connection comes via the positive income effect of general economic development. For these countries, investments in agricultural development through successful assistance are not detrimental to U.S. farm export interests in the long run. They are generally beneficial.

For middle-income nations, the case is less clear and more controversial. However, nothing in the cross-section data used suggests that farm productivity improvements in these nations is systematically threatening to U.S. agricultural trade in the long run.

Introduction

One of the consequences of the stagnation and decline of U.S. agricultural exports in the 1980's is a strong belief among farm organizations, commodity groups, and their political allies that virtually any form of assistance to farmers in less-developed nations is unwise and unfair. Their view is that foreign agricultural development is another serious threat to the dismal U.S. farm export

The computations and statistical analyses reported here were conducted by Hugh Maginnis, research assistant at the University of Minnesota.

This is Scientific Journal Series Paper 15487, Minnesota Agricultural Experiment Station.

0169-5150/88/$03.50

markets. The argument is that we teach foreigners how to grow commodities that we are good at producing ourselves. Then they do it and replace U.S. exports, leaving American farmers holding the bag. Aid opponents are critical of agricultural assistance dispensed by government agencies like USAID, by Land Grant schools like the University of Minnesota, and by international organizations like The World Bank.

The objective of this paper is to examine and, perhaps, throw some light on the matter. At the outset, we need to recognize that the chain of reasoning that leads from one end of this argument to the other is quite complex and not at all straight-forward. Let us look at it briefly. First, we have to assume that dollars appropriated in the United States for agricultural assistance actually find their way into existing or new projects for technical assistance or education. Then it must be true that these projects actually boost farm production in the favored countries beyond that which otherwise would have occurred. Next, we must be prepared to show that this augmented farm production somehow replaces imports of agricultural goods from or expands exports to the world market. Finally, we are required to assert that these changes work their way through the complex channels of world commerce to the detriment of U.S. agricultural interests.

Considering today's rapidly changing and uncertain international environment, no one could reasonably test all the links in this chain. The part that we will focus on here is a central proposition in this argument; namely, that agricultural development in the less-developed world leads to diminished trade. For simplicity, we assume that at least some agricultural assistance is, in fact, successful and increases farm productivity in the affected countries. What more can be said? The answer to this question relies on some relatively simple statistical analysis conducted recently with information drawn from a sizeable cross section of developing nations. Using cross-section data allows us to draw long-run inferences that may be masked in time-series data.

Although there is a growing body of professional work in this area of concern, relatively few broad, multi-country statistical studies are available. Most of the emerging articles and papers are national or regional case studies or discursive and qualitative arguments (Timmer, 1985; Abbott, 1986; Schuh, 1986; National Planning Association, 1987; Paarlberg, 1987; Ruttan, 1987; Schuh et al., 1987; Vocke, 1987). The econometric and quantitative analyses by Bachman and Paulino in 1979 and more recent work by Kellog et al. (1986), Christiansen (1987) and De Janvry and Sadoulet (1987) are generally consistent with the results of this paper.

Framework

Here is how this particular investigation unfolded. First, we adopted the premise that if agricultural development is successful, whether assisted by out-

siders or not, then the long-run economic value of farm workers in the affected nation must increase. So, for our sample of countries (discussed below) we collected 1983 and 1984 data on 'value added per worker in agriculture'. This particular measure is the total annual value of agricultural output in each nation less the value of purchased inputs used in production, all divided by the number of agricultural workers. This variable summarizes the economic performance (or productivity) of agricuture in each sample country.

Second, we related this agricultural value-added measure for each sample nation to its 1983 and 1984 per-capita gross domestic product (GDP). The idea here is that since virtually all of these countries depend heavily on agriculture for employment and output, the long-run link between economic performance in agriculture and economic performance in total is likely to be significant.

Third, we linked per-capita GDP data to 1983 and 1984 national imports of food and related products. In one version, we used per-capita imports, and in another we used the per-capita value of *all* food imports, including grains. This linkage enabled us to examine how the overall economic performance of the sample nations affects their agricultural importing behavior.

Basic data

To examine the agricultural productivity versus trade questions, we assembled data for a rather large group of the world's poorer nations. The countries included in the analysis were drawn from two categories of the World Bank's listing of national economies by stage of economic development: (1) "low income economies", and (2) "lower middle-income economies". Cross-section data from 1983 and 1984 for countries in these two categories were assembled from recent World Bank reports (1985, 1986).

The countries falling into these two categories and reported by the World Bank have populations in excess of 1 million persons and jointly represented 65% of the world's 1984 population. In 1983, they ranged in annual per-capita gross national product (GNP) from Ethiopia's $120 to Colombia's $1430. In 1984, Ethiopia was still on the bottom at $110 per person with Syria listed as the highest at $1620. Although the number of countries reported in these two categories totaled 72 in 1983 and 76 in 1984, the availability of suitable data limited our sample to a maximum of 44 countries in 1983 and 48 countries in 1984. Next, the following variables for 1983 and 1984 were assembled for each low and lower-middle-income country from basic data reported in the World Bank's *Development Reports*, 1985 and 1986 issues:

GDP, *per-capita gross domestic product.* This variable is similar to gross national product (GNP) as a measure of national economic activity but somewhat more suitable for international comparisons.

VAW, *value added per worker in agriculture.* This is the total value of national agricultural output less the value of purchased inputs all divided by the number of agricultural workers. This variable indicates the economic performance or efficiency of agriculture in each sample country.

TABLE 1

Cross section regression estimates: agricultural productivity per worker (VAW*) and manufacturing productivity per worker (VWM*) versus per-capita income (GDP*) in less-developed countries, 1983 and 1984.

Year and dependent variable	Constant term	Coefficient on: VAW*	VMW*	r^2	Number of Observations
1983					
(1) GDP*	-0.74	+ 1.15		0.61	44
	(-0.88)	(8.03)			
(2) GDP*	-0.87	+ 0.90	+0.26	0.70	42
	(-1.13)	(6.26)	(3.91)		
1984					
(3) GDP*	-0.61	+ 1.12		0.71	48
	(-0.99)	(10.62)			
(4) GDP*	-1.05	+ 1.02	+ 0.15	0.74	47
	(-1.66)	(9.48)	(2.58)		

Note: Values in parentheses are *t*-ratios; all variables measured in natural logarithms.

TABLE 2

Cross section regression estimates associating per-capita income (GDP*) with per-capita imports of cereals (CIC*) or with per-capita imports of all food (FIC*) by less-developed countries, 1983 and 1984

Year and dependent variable	Constant term	Coefficient on GDP*	r^2	Number of Observations
1983				
(5) CIC*	-3.77	+ 1.15	0.33	44
	(-2.52)	(4.58)		
(6) FIC*	-4.06	+ 1.11	0.46	37
	(-3.32)	(5.51)		
1984				
(7) CIC*	-3.33	+ 1.07	0.30	48
	(-2.14)	(4.11)		
(8) FIC*	-4.00	+ 1.08	0.45	34
	(-3.05)	(5.07)		

Note: Values in parentheses are *t*-ratios; all variables measured in natural logarithms.

VMW, *value added per worker in manufacturing*. This was calculated for the manufacturing sectors in the various sample countries and is comparable to VAW. The variable indicates productive efficiency in manufacturing.

CIC, *per-capita cereal imports*, including wheat, rice, rye, and coarse grains.

FIC, *food imports per capita*. This includes food and feed products in SITC sections 0, 1 and 4 plus live animals, beverages, tobacco, nuts, fats, oils, and oilseeds. This variable is a very broad measure of food and agricultural products in international trade.

In all analyses reported here, the variables were converted to natural logarithms so that proportional relationships could be highlighted. This conversion is indicated by an asterisk (*) attached to the symbols in Tables 1 and 2.

Agricultural development and economic performance

The sample nations displayed a relatively close, positive association between agricultural productivity, as measured by value added per worker, and per-capita GDP in both 1983 and 1984.

The ordinary least squares estimates in Table 1 reflect the linkage between agricultural productivity and GDP for the two cross sections of country data, 44 countries in 1983 and 48 countries in 1984. Equations (1) and (3) illustrate the simplest formulations. The coefficients of determination (r^2) are relatively high for cross-section studies of this kind, 0.61 and 0.71. Notice that the estimated regression coefficients on VAW* in equations (1) and (3) are highly significant and quite close to +1.0, suggesting a nearly equi-proportional relation between agricultural productivity and overall economic activity.

Equations (2) and (4) provide a somewhat more sophisticated look at the same phenomenon. Here, differences in GDP* are related to the simultaneous influences of productivity in both agriculture (VAW*) and manufacturing (VMW*). (Lack of manufacturing data precluded the inclusion of two nations in 1983 and one in 1984.) The addition of manufacturing data naturally added to explanatory power of each equation and did so with statistically significant coefficient estimates. Moreover, the basic result of a nearly equi-proportional net relation between VAW and GDP was strengthened by the more elaborate analysis of equations (2) and (4).

Of course, there are many other factors beyond VAW and VMW that influence GDP, even among low-income nations, and the objective of this study was not to construct a macro-economic model suitable for a cross section of 40 to 50 nations. However, the dominance of agriculture in these nations makes these simple estimated relations rather compelling yet not at all surprising. However, nothing in this work implies that expenditures for assistance projects will

necessarily lead to improved productivity in agriculture much less to overall economic growth. But *if* projects are successful, then farm productivity will surely rise. If agricultural productivity rises, then broader economic benefits ensue.

Economic performance and agricultural trade

Having established an important, positive link between agricultural productivity and GDP, let us now consider the connection between national GDP and agricultural import behavior. Many factors influence trade activity, but no one seriously doubts that income is one important element. Without attempting to devise an elaborate economic model of trade determination, we postulated a simple relation between GDP per capita and agricutural imports, assuming that other influences in our sample of nations do not systematically, over-ride and obscure this fundamental linkage.

The ordinary least squares estimates in Table 2 illustrate how GDP* and agricultural imports were related in our sample for 1983 and 1984. Equations (5) and (7) show how per-capita cereal imports and GDP were associated with each other in the 2 years across the sample. The estimates indicate that 30–33% of the proportional variation in cereal imports across the countries is directly and significantly associated with differences in per-capita GDP. The coefficients on GDP* are close to +1.0 again suggesting an equi-proportional relation.

Estimated relations between GDP* and a broader measure of food imports (FIC*) were very similar to those for cereals only–equations (6) and (7). In fact, the r^2 values are somewhat higher. The smaller samples used in equations (6) and (7) arise because data on FIC* were not available for some of the nations in the original group. Together, the estimates in Table 2 suggest that a significant, positive statistical relation exists between overall economic activity in poorer nations and imports of agricultural products. This relation is present no matter whether the imports are measured in terms of cereals or a much broader category of agricultural and food commodities.

Middle-income countries

Substantial controversy surrounds almost any U.S. assistance, agricultural or otherwise, to nations in the middle-income group–those with annual per-capita GNP's between Chile's $1700 and Singapore's $7300. The reasons for controversy are diverse. Several nations in this group are mired in international debt problems; several are major international competitors with the United States for grain, oilseed, and other farm product markets around the globe; and several are enmeshed in sensitive political and military dealings with the United States.

Not surprisingly, the simple approach that succeeded with the lower-income

group was less revealing with this middle group. However, some general impressions can be gained. First, there is, for the middle-income nations, a positive net relation between value added per agricultural worker and GDP. This positive connection also emerges even after netting out the effects of manufacturing productivity upon GDP. The actual regression calculations border on statistical significance across a 22-country sample, but they not compelling, hence, not reported.

Similarly, the link between GDP per capita and food imports was not at all clear for middle-income nations. The regressions indicate a generally positive connection, but the results could not be said to show a significant relationship. Recall that this whole inquiry involved data from many countries observed at particular moments in time. The lack of clear results for this middle group does not imply that significant, systematic relations are absent within individual nations over time.

In any case, the evidence concerning the middle-income group as a whole does *not* point to any negative relation between agricultural productivity and imports of food and related products. There is nothing in these data to support such a view.

In addition, no clear relationship emerged between value added in agriculture and farm *exports* from this group. Hence, the view that agricultural assistance leads directly to increased competitive supplies on world markets is not borne out in these cross-country comparisons.

Productivity versus production

An important feature not to be overlooked in this work is that agricultural *productivity* not agricultural output was specified as the key factor associated with general economic development. This is a crucial distinction. It is likely, but not necessary, that farm output expands as productivity advances. However, we expect farm output to expand less rapidly than productivity per worker since the movement of resources, including people, out of agriculture is a widespread phenomenon of economic development.

Summary and conclusion

This simple analysis is surely not going to be the last word on these matters. But the lessons are reasonably clear, at least for the low-income nations on this planet. A strong case can be made for the idea that advances in agricultural productivity are associated with long run increases in imports of cereals and other agricultural products. The connection comes via the positive income effect of general economic development. For these countries, investments in agricultural development through successful technical assistance and education

are not detrimental to U.S. farm export interests in the long run. They are generally beneficial.

For the middle-income nations, the case is not so clear and probably more controversial. What can be said is that nothing in these aggregate data leads one to conclude that improvements in farm productivity among middle-income nations is generally or systematically threatening to U.S. farm exports across a broad international spectrum.

Naturally, specific episodes of trade displacement in some products by some countries can be identified and perhaps associated with agricultural assistance of one kind or another. However, wider evidence shows that the burden of proof clearly rests with those who insist that agricultural assistance for poor nations is usually a bad thing for American farmers. On the contrary, it is mostly a good thing.

References

Abbott, P.C., 1986. Agricultural production in the Third Word: Implications for U.S. trade and policy. Unpublished paper prepared for the Agricultural Trade Project, American Enterprise Institute, Washington, DC, 44 pp.

Bachman, K.L. and Paulino, L.A., 1979. Rapid food production growth in selected developing countries. Res. Rep. 11, International Food Policy Research Institute, Washington, DC, 98 pp.

Christiansen, R.E., 1987. The impact of economic development on agricultural trade patterns. ERS Staff Rep. AGES861118, International Economics Division, Economic Research Service, U.S. Department of Agriculture, Washington, DC, 72 pp.

De Janvry, A. and Sadoulet, E., 1987. The conditions for harmony between Third World agricultural development and U.S. farm exports. Am. J. Agric. Econ., 68: 1340-1346.

Kellog, E., Kodl, R. and Garcia, P., 1986. The effects of agricultural growth on agricultural imports in developing countries. Am. J. Agric. Econ., 68: 1347-1352.

Paarlberg, R.L., 1987. U.S. agriculture and the developing world: partners or competitors. In: R.B. Purcell and E. Morrison (Editors), US Agriculture and Third World Development: The Critical Linkage. Curry Foundation, Lynne-Rienner, Boulder, CO, pp. 221-242.

Ruttan, V.W., 1987. Why foreign economic assistance? Econ. Dev. Cent. Bull. 87-2, University of Minnesota, St. Paul, MN, 29 pp.

Schuh, G.E., 1986. The United States and the developing countries: an economic perspective. National Planning Association, Washington, DC, 139 pp.

Schuh, G.E., Kellog, E.D. and Paarlberg, R.L., 1987. Assistance to developing country agriculture and U.S. agricultural exports: Three perspectives on the current debate. Occasional paper, Consortium for International Cooperation in Higher Education, Washington, DC, 28 pp.

Timmer, C.P., 1985. Agricultural development, income growth, and grain imports: the implications for American agriculture (unpublished).

National Planning Association, 1987. U.S. agriculture and third world economic development: Critical interdependency. Washington, DC, 103 pp.

Vocke, G., 1987. Economic growth, agricultural trade, and development assistance. Agric. Inf. Bull. 509, Economic Research Service, U.S. Department of Agriculture, Washington, DC, 6 pp..

World Bank, 1985. World Development Report, 1985. Oxford University Press, New York, 243 pp.

World Bank, 1986. World Development Report, 1986. Oxford University Press, New York, 256 pp.