Working Paper Series

Working Paper No. 430

THE CONDITIONS FOR COMPATIBILITY BETWEEN AID AND TRADE IN AGRICULTURE

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DEPARTMENT OF AGRICULTURAL AND RESOURCE ECONOMICS

BERKELEY

CALIFORNIA AGRICULTURAL EXPERIMENT STATION

University of California

DIVISION OF AGRICULTURE AND NATURAL RESOURCES
UNIVERSITY OF CALIFORNIA

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January 1987

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The Conditions for Compatibility Between Aid and Trade in Agriculture

I. Economic Growth and Agricultural Imports

Similar to the pressures of organized labor on the legislature to increase industrial protectionism in the United States, there currently exists a strong opposition by farm lobbies to aid programs that spread modern agricultural technologies to least-developed countries (LDCs) in ways that compete with U. S. farm exports. The presumption is that there is a conflict between aid and trade. Political support for this view has been increased by the recent demise of U. S. agricultural exports and the disastrous consequences this has had on farm incomes.

This short-run view does not take into account the fact that technological change in LDC agriculture can create strong economywide growth and income effects with the potential of increasing the level of agricultural imports in future years. Countries such as Korea, Malaysia, Taiwan, and Thailand have shown how successful agricultural development sustained broad-based industrial growth which, subsequently, increased the demand for imports of coarse grains and feedstuffs. Stimulating the demand for U. S. farm exports via technological change in LDC agriculture is, however, not free of difficulties. Successful agricultural development in India and China has transformed these countries into exporters instead. This has been due to failure in the linkages between agriculture and the rest of the economy to propagate agricultural growth as well as lack of employment creation. There are, in all cases, substantial time lags involved between successful technological changes in agriculture and eventual increased import demand. Farm lobbies, with high private discount rates in measuring gains from trade, may oppose aid while the rest of society, with lower social discount rates for gains from agricultural trade or with an interest in total trade effects, may support aid programs.

Several trade analysts, such as Lee and Shane[1] and Paarlberg,[2] have recently argued that there exists a strong communality of interest between the U. S. farm sector and the developing world since the economic performance of the latter, and that of its agriculture in particular, is an important source of export demand for the former. Mellor[3] has shown how the strong income effects on food/feed demand created by successful economic growth in the newly industrialized countries (NICs) tends to outstrip the growth potential of agriculture and create a rapid increase in demand for imports. No attention has been paid, however, to the time lags involved and to the fact that different social groups apply different discount rates to the assessment of the benefits of aid to LDC agriculture. This paper agrees with the general position that there can exist harmony between LDCs and U. S. agricultural interests, but it also attempts to quantify the conditions under which it is likely to exist. It identifies, in particular, a number of key structural characteristics and policy variables which can enhance the likelihood of harmony. Their manipulation should be at the heart of enhancing the consistency of U. S. aid programs and trade interests.

During the last 20 years, there has been a significant relocation of the origin of import demand for food and feed grains away from the more-developed countries (MDCs) and toward the centrally planned economies (CPEs), the oil-exporting and NICs, and the LDCs. As table 1 shows, between 1961-1963 and 1981-1983, 63 percent of the growth in net imports of food grains originated in the developing countries (DCs), of which 41 percent was in the low-income

TABLE 1

Percent Distribution of Growth in Net Imports Between Geographical Areas, 1961-1963 to 1981-1983

Group	Total agri-cultural trade	Growth in imports of			
		Food grains[a]	Coarse grains[b]	Oilseeds[c]	Grains and oilseeds[d]
	percent				
Industrial market	24.60	3.34	23.00	43.60	19.15
Planned economies	23.49	33.68	28.19	16.83	33.63
Developing countries	51.91	62.99	48.81	39.56	47.21
Middle income	23.62	19.24	35.22	18.82	25.91
Low income	20.36	41.17	9.60	20.45	18.46
Oil exporters	7.93	2.58	3.99	0.29	2.84

[a]Includes wheat, wheat flour, and rice.

[b]Includes maize, barley, sorghum, and millet.

[c]Includes soybeans and groundnuts.

[d]Includes everything in footnotes a, b, and c.

Source: Shane, M. "Government Intervention, Financial Constraints, and the World Food Situation." U. S. Department of Agriculture, Economic Research Service, May, 1986 (mimeographed).

countries. For feed grains, 49 percent of the growth in net imports originated in the DCs, of which 35 percent was in the NICs. With unabated agricultural protectionism and saturation of demand in the MDCs, the future growth of food grain imports in those countries is likely to decline and that of feed grains to expand only modestly. Their share in U. S. agricultural exports has declined from 63 percent in 1961-1977 to 51 percent in 1982-1984, and it is expected to continue to decline in the future.[4] The CPEs are at income levels where the transition in consumption from direct food grains to animal products will sharply accelerate the demand for feed grain imports. The share of these countries in U. S. agricultural exports increased from 1.9 percent in 1965-1967 to 13.2 percent in 1984-85, but this share remains relatively modest and heavily loaded with political uncertainties.

It is the NICs and LDCs that have become the most significant sources of growth in import demand, increasing their share of U. S. exports from 35.1 percent in 1965-1967 to 40.4 percent in 1984-85. This is particularly true for food grains in the LDCs and feed grains in the NICs. Whether this growing demand will be sustained in the future depends crucially upon successful income growth and export performance in these countries.

Rapid growth in agricultural imports has resulted from different development strategies. The most evident are those with a strong component of industrial exports (Singapore, Hong Kong, etc.), of oil and primary-product exports (Venezuela, Saudi Arabia, etc.), and of cash crop exports (Ivory Coast). Another development path is explored in this paper, namely one that is based on a strong growth performance in food production based on successful diffusion of technological change promoted, in particular, by foreign-aid programs.

The possibility of compatibility between aid and trade is explored in two steps. In the first, econometric analysis is used to show that most countries with successful agricultural growth have also been able to sustain rapid industrial growth and rapid growth of per capita income. The result in many situations has been to increase the demand for cereal imports, particulary feed grains in the NICs. This econometric model makes it possible to identify the levels of trade dependency and the composition of domestic agricultural growth that result in positive elasticities of import demand relative to agricultural growth. In the second step a three-sector, open-economy, general-equilibrium dynamic model is developed for archetype economies at different levels of Gross National Product (GNP) per capita to explore under what conditions and with what time lags technological change in cereal production (the Green Revolution) may create income effects that are sufficiently strong to increase the demand for food or feed grain imports. This model allows the identification of the structural conditions and parameter values that create this effect. It provides policy guidelines to design international aid programs complementary to technological change in food production that will allow the protection of grain export markets for the United States and other exporters. The paper concludes with recommendations as to how to maximize compatibility between foreign assistance programs and U. S. farm export interests.

II. Impact of Agricultural Growth on Import Demand: Econometric Analysis

A. Agriculture as a Source of Industrial Growth

Although many countries have attempted to industrialize by taxing their agricultures, it is increasingly evident that this strategy has rarely resulted in sustained industrial growth as opposed to one that is based on strong agricultural growth. The growth of agriculture can be expected to stimulate industrial growth through a variety of mechanisms that include (1) the release of agricultural labor for industrial employment, which is relevant if there is labor scarcity;[5] (2) the lowering of food prices and, hence, of nominal wages[6] and of the price of raw materials for industry; (3) the freeing of foreign exchange by import substitution or the generation of foreign exchange through agricultural exports; (4) the generation of intermediate and final demand for industrial products;[7] and (5) the transfer of agricultural savings and rents for investment in the rest of the economy.

This relationship between agricultural growth and industrial growth is confirmed by analyzing the determinants of manufacturing growth cross-nationally using estimated annual growth rates for 60 DCs between 1970 and 1980.[8] Countries are also split into two groups with gross national product per capita (GNPPC) below and above $600 in 1965. The estimated equations are

$$\dot{I} = \alpha_0 + \alpha_1 \dot{A} + \alpha_2 \dot{X} + \alpha_3 \dot{P},$$

where

$\dot{I}$ = growth rate of manufacturing

$\dot{A}$ = growth rate of agriculture

$\dot{X}$ = growth rate of total exports

$\dot{P}$ = inflation rate.

The results are as follows:[9]

All countries n = 60	$\dot{I} = \underset{(3.81)}{2.93} + \underset{(3.76)}{0.82\dot{A}} + \underset{(4.51)}{0.41\dot{X}} - \underset{(-3.10)}{0.05\dot{P}}, \; R^2 = .64$
GNPPC < \$600 n = 37	$\dot{I} = \underset{(1.61)}{2.91} + \underset{(2.69)}{0.94\dot{A}} + \underset{(1.95)}{0.34\dot{X}} - \underset{(-.78)}{0.08\dot{P}}, \; R^2 = .60$
GNPPC > \$600 n = 23	$\dot{I} = \underset{(3.08)}{4.19} + \underset{(1.71)}{0.56\dot{A}} + \underset{(4.25)}{0.43\dot{X}} - \underset{(-3.85)}{0.06\dot{P}}, \; R^2 = .66.$

They show that the growth of agriculture is a significant determinant of manufacturing growth and this particularly in the poorer countries where the share of agriculture in gross domestic product (GDP) is larger. Export growth and the ability to control inflationary pressures are also important determinants of successful industrialization.

While it is clear that, over the long run agricultural growth is itself supported by industrial growth, we establish the short-run direction of causality running from agricultural to industrial growth by using time series data between 1960 and 1981 for 42 countries for which complete information is available in The World Bank Tape of Economic Indicators. The estimated equation in table 2 is between the logarithm of manufacturing output as the dependent variable and the logarithms of agricultural and mining outputs lagged one year as the predetermined variables. The results show that 76 percent of the countries have significantly positive elasticities of manufacturing output with respect to lagged agricultural production. Among these, the average value of this elasticity is 1.38.

B. Patterns of Agricultural Growth and Imports

Table 3 shows the classification of the 60 DCs for which information is available between 1970 and 1980 according to two criteria: the rate of per capita

TABLE 2

Elasticity of Manufacturing Output With Respect to Lagged Agricultural Output for 42 Countries, 1960-1981[a/]

Elasticity[b/]	Number of countries	Average value of elasticity
Not significantly different from zero[c/]	10	0.25
0-1	7	0.78
1-2	23	1.39
2+	2	3.29

a/ These are the 42 countries for which complete time series data for 1960-1981 are available in The World Bank Tape of Economic Indicators.

b/ Estimated in regression: log (manufacturing output) = a + b log (agricultural output lagged one year) + c log (mining output lagged one year) using the Cochrane-Orcutt procedure to correct for autocorrelation when needed.

c/ Student's $t \leq 1.70$.

TABLE 3

Country Classification by Agricultural and Income Growth, 1970-1980

1970-1980	Growth of gross domestic product per capita < 2 percent			Growth of gross domestic product per capita > 2 percent		
	Indicator[a]	All other countries[b]	India	Indicator[a]	All other countries[c]	Uruguay
Growth of agricultural output per capita ≤ 0	$P\dot{o}p$	2.7	2.1	$P\dot{o}p$	3.0	0.3
	$\dot{I}$	2.0	4.5	$\dot{I}$	8.3	5.2
	$\dot{X}$	-0.7	3.7	$\dot{X}$	5.6	4.8
	$\dot{P}$	14.9	8.5	$\dot{P}$	14.7	62.3
	$\dot{U}$	5.5	3.3	$\dot{U}$	4.7	0.6
	$W\dot{M}$	4.6	-29.2	$W\dot{M}$	17.3	29.0
	$Co\dot{M}$	22.9	0.0	$Co\dot{M}$	27.9	75.7
	$Ce\dot{M}$	5.2	-24.5	$Ce\dot{M}$	19.5	35.1
	Aid	36.8	35.7	Aid	1.6	0.0

1970-1980	Growth of gross domestic product per capita < 2 percent			Growth of gross domestic product per capita > 2 percent		
	Indicator[a]	High-income countries[d]	Low-income countries[e]	Indicator[a]	High-income countries[f]	Low-income countries[g]
Growth of agricultural output per capita > 0	$P\dot{o}p$	2.2	2.7	$P\dot{o}p$	2.5	2.4
	$\dot{I}$	1.7	1.5	$\dot{I}$	9.2	4.7
	$\dot{X}$	4.5	1.7	$\dot{X}$	6.4	2.3
	$\dot{P}$	109.5	9.8	$\dot{P}$	14.2	13.2
	U	2.9	4.8	$\dot{U}$	4.4	4.9
	$W\dot{M}$	5.0	3.0	$W\dot{M}$	8.1	3.3
	$Co\dot{M}$	28.1	31.7	$Co\dot{M}$	31.2	-19.3
	$Ce\dot{M}$	9.0	4.4	$Ce\dot{M}$	9.7	0.5
	Aid	5.2	21.4	Aid	12.1	29.1

[a]Annual growth rate of population ($P\dot{o}p$), of manufacturing ($\dot{I}$), of total exports ($\dot{X}$), of prices ($\dot{P}$), of urbanization ($\dot{U}$), of imports of wheat ($W\dot{M}$), of imports of corn ($Co\dot{M}$), of imports of cereal ($Ce\dot{M}$), and share of aid in total imports of cereal (Aid).

[b]Chad, Angola, Mozambique, Uganda, Ghana, Zaire, Zambia, Madagascar, Sierra Leone, Mauritania, Niger, Ethiopia, Congo, Togo, Sudan, Ivory Coast, Burkina Faso, Bangladesh, India, and Pakistan.

[c]Mexico, Algeria, Nigeria, Ecuador, Morocco, and Uruguay.

[d]Argentina, Chile, and Venezuela.

[e]Central African Republic, Somalia, Liberia, and Senegal.

[f]Korea, Brazil, Indonesia, Malaysia, Philippines, Thailand, Egypt, Tunisia, Kenya, Cameroon, Syria, Guatemala, Dominican Republic, Colombia, and Paraguay.

[g]Bolivia, Malawi, Mali, Burma, and Sri Lanka.

agricultural growth (countries with negative and positive growth rates) and the rate of growth in the gross domestic product per capita (GDPPC) (countries below and above 2 percent). Most countries fall on the first diagonal of the table indicating that there indeed exists a strong correlation between agricultural and economic growth. The four clusters of countries which this creates correspond to sharply contrasted economic performances with resulting differential demands for cereal imports.

Countries with negative agricultural growth per capita and low per capita income growth are basically the African countries and the populous Asian countries. We place India apart from the others because of her successful drive to achieve food self-sufficiency and reduce food imports sharply. The other countries all display high rates of urbanization, a poor industrial performance, and failing exports. Cereal imports have grown at an average annual rate of 5.2 percent, more than a third of it obtained through international aid.[10]

Cases with high rates of agricultural growth and low income growth are few and relatively uninteresting since, like Chile, they usually correspond to instances of political failure stifling economic growth.

Countries with poor agricultural performance but high rates of income growth are, with the exception of Uruguay, exporters of oil and gas (Mexico, Nigeria, Algeria, and Ecuador) or phosphates (Morocco). They have high rates of industrial and export growth. Cereal imports are booming, both for food grains (17.3 percent) because of failures of their own agriculture and for feed grains (27.9 percent) because of strong income and urbanization effects. These countries thus provide rapidly expanding markets for food and feed exports but are numerically few and unstable owing to fluctuations in international commodity markets.

The most interesting group, from our standpoint, is composed of countries with strong agricultural and income performances. The high-income countries in that group display the highest rates of industrial and export growth. Although the performance of agriculture is strong, cereal imports are growing rapidly (9.7 percent annually), particularly those of feed for animal consumption (31.2 percent). This group of countries includes principally the NICs and a few countries with strong agriculture and primary-export bases.

C. Determinants of Import Demand

To establish the impact of agricultural growth on import demand, an economic model based on observed growth rates between 1970 and 1980 for 60 LDCs is constructed as follows:

$$\dot{I} = \alpha_0 + \alpha_1 \dot{A} + \alpha_2 \dot{X} + \alpha_3 \dot{P} \qquad \text{growth rate of manufacturing}$$

$$\dot{Y} = \beta_0 + \beta_1 \dot{A} + \beta_2 \dot{I} \qquad \text{income equation}$$

$$\dot{C}_i = \delta_{0i} + \delta_{1i} \dot{Y} + \delta_{2i} \dot{U} + \delta_{3i} \dot{Pop} \qquad \text{consumption function}$$

$$\dot{M}_i = \frac{C_i}{M_i} \dot{C}_i - \frac{Q_i}{M_i} \varepsilon_i \dot{A} \qquad \text{import equation for product i,}$$

where

$$\varepsilon_i = \frac{\dot{Q}_i}{\dot{A}} \qquad \text{agricultural growth structure equation.}$$

From this, we derive the elasticity of import demand for product i with respect to agricultural growth:

$$\frac{\partial \dot{M}_i}{\partial \dot{A}} = \varepsilon_i + \frac{\Theta_i - \varepsilon_i}{D_i},$$

where

$\Theta_i = \delta_{1i}(\beta_1 + \alpha_1 \beta_2) = \frac{\partial \dot{C}_i}{\partial \dot{A}}$ elasticity of consumption with respect to agricultural output

$D_i = \frac{M_i}{C_i}$ dependency ratio for product i

and

$\dot{Y}$ = growth rate of GDP

$\dot{C}_i$ = growth rate of consumption of agricultural product i

$\dot{U}$ = growth rate of urbanization

$P\dot{o}p$ = growth rate of population

$\dot{Q}_i$ = growth rate of output of agricultural product i

$\dot{M}_i$ = growth rate of net imports of agricultural product i.

The growth rates of I, A, X, P, Y, C_i, U, Pop, and Q_i are estimated by loglinear regression over the period 1970-1980.

Table 4 shows the estimated parameters of the model for all 60 countries as well as for the LDCs (GDPPC less than $600 in 1965) and NICs (GDPPC above $600). The elasticities of manufacturing output with respect to agricultural output and of consumption with respect to income are highly significant. The derived elasticity of consumption with respect to output is high for wheat in the LDCs and for corn (feed) in the NICs.

TABLE 4

Parameters, 1970-1980

Gross domestic product per capita	Number of countries	α_1	β_1	β_2	δ_{1i}			Θ_i			ε_i		
					Cereals	Wheat	Corn	Cereals	Wheat	Corn	Cereals	Wheat	Corn
1965 U. S. dollars													
<600	37	.94[a]	.56[a]	.31	.26[a]	1.01[a]	.27	.22	.86	.23	1.20	1.43	1.39
>600	23	.56[a]	.50[a]	.46	.35[a]	.36	1.34[a]	.26	.27	1.01	1.62	-.35	1.24
All	60	.82[a]	.53[a]	.37	.33[a]	.80[a]	.93[a]	.28	.67	.78	1.33	.79	.78

[a]Significant at the 95 percent confidence level.

Whether the resulting elasticity of import demand with respect to agriculture is positive or negative depends on Θ_i but also on the level of dependency ($D_i = M_i/C_i$) and on the structure of agricultural growth (ε_i), namely the growth rate of product i relative to that of agriculture in general. Table 5 shows the frontier of compatibility of interest between agricultural growth (LDC interests) and growth of import demand (U. S. interests). Compatibility exists for cereals in 27 percent of the countries, for wheat in 90 percent, and for corn in 48 percent. In the case of wheat, compatibility is dominated by the African countries which are, in general, not producers of wheat themselves. In the case of corn, it is dominated by the NICs due to strong income effects and shifting consumption patterns toward meat products.

The most interesting cases are the countries that had positive growth of agricultural output per capita and high growth of per capita GNP in table 3, nonnegative growth rates of product i relative to the growth rate of agriculture (ε_i) in table 5, and positive elasticities of import demand with respect to agricultural growth. They include Korea (cereals and corn), Brazil (wheat and corn), Malaysia (cereals and corn), Egypt (wheat), Tunisia (cereals and corn), Kenya (wheat), Guatemala (wheat), Colombia (corn), and Paraguay (wheat). These success stories combine strong agricultural growth, strong economic growth, and growing agricultural imports in specific cereals in spite of the fact that the output of these cereals has grown at a rate at least equal to the overall growth rate of agriculture.

III. Impact of Technological Change on Cereal Imports: Simulation Models

A. General-Equilibrium Open-Economy Archetype Models

To explore further the location of the harmony frontier between agricultural growth in DCs and demand for food- or feed-grain imports, the temporal

TABLE 5

Elasticities of Import Demand with Respect to Agricultural Growth, All Countries[a/]

D_i \ ε_i	≤ -2.0	-1.5	-1.0	-.5	0	.5	1.0	1.5	≥2.0
Cereals, θ_i = .28									
.1	Chad 20.80	16.30	Uganda 11.80	7.30	2.80	Kenya -1.70	Indonesia -6.20	India -10.70	Nigeria -15.20
.25	7.12	Morocco 5.62	4.12	2.62	Korea 1.12	Brazil -.38	Colombia -1.88	Pakistan -3.38	Ivory Coast -4.88
.50	2.56	Egypt 2.06	1.56	Algeria 1.06	Malaysia .56	Tunisia .06	Senegal -.44	-.94	Venezuela -1.44
.75	1.04	.87	.71	.54	.37	.21	0.04	-.13	Mauritania -.29
.90	.53	.48	.42	.37	.31	.26	.20	.14	Jamaica .09
1.00	.28	.28	.28	.28	.28	.28	.28	.28	.28
Wheat, θ_i = .67									
.1	Ethiopia 24.70	20.20	15.70	11.20	6.70	2.20	-2.30	-6.80	India -11.30
.25	8.68	7.18	5.68	4.18	2.68	Kenya 1.18	Syria -.32	Mexico -1.82	Burma -3.32
.50	3.34	Morocco 2.84	Chile 2.34	Algeria 1.84	1.34	Paraguay .84	Brazil .34	-.16	Sudan -.66
.75	Ecuador 1.56	1.39	1.23	Bolivia 1.06	.89	.73	Guatemala .56	.39	Egypt .23
.90	Korea .97	Niger .91	Colombia .86	.80	.74	Angola .69	.63	Zambia .58	Nigeria .52
1.00	.67	.67	.67	.67	Sahel .67	.67	.67	.67	.67
Corn, θ_i = .78									
.1	Chad 25.80	21.80	Ecuador 16.80	Morocco 12.30	Colombia 7.80	Brazil 3.30	Indonesia -1.20	El Salvador -5.70	Ivory Coast -10.20
.25	Niger 9.12	7.62	6.12	4.62	3.12	Mexico 1.62	.12	Panama -1.38	Egypt -2.88
.50	3.56	3.06	2.56	Dominican Republic 2.06	1.56	Venezuela 1.06	.56	.06	Syria -.44
.75	1.71	1.54	1.37	1.21	1.04	.87	.71	.54	.37
.90	1.09	1.03	.98	.92	.87	Malaysia .81	.76	.70	Korea .64
1.00	.78	.78	.78	.78	Tunisia .78	.78	.78	.78	.78

a/ θ_i = elasticity of consumption of product i with respect to agricultural output, ε_i = growth rate of product i relative to growth rate of agriculture, and D_i = dependency ratio for product i (imports over consumption).

dimension must be added and the role of specific technological and structural parameters must be identified. To do this, a dynamic three-sector model is constructed for several archetype developing economies at different levels of GNP per capita, and the impact of a land-saving technological change in agriculture on the demand for food- and feed-grain imports is simulated. The three sectors are tradable agriculture (A) which imports, a labor-intensive nontradables sector (NT), and tradable industry (T) which exports. The equations of the model are given in table 6, and the parameter values for three archetype economies are given in table 7. The model incorporates a number of features taken from Lele and Mellor. Both that model and the model in this paper trace out the growth effects of technological change in food grains, but the causal logics are markedly different. In the former, the causal linkage is through lower food prices and lower nominal wages in a two-sector closed economy; in the latter, it is through (1) foreign exchange savings and higher import of capital goods for the industrial tradables sector and (2) income effects and increased demand for the nontradables sector.

The agricultural sector produces with two inputs, land and labor, with land being in fixed quantity. The labor-intensive NT sector produces with capital and labor. There is surplus labor, and employment in these two sectors is determined by equating marginal productivity with fixed real wages. Unemployment or underemployment in the economy is equally located in these two sectors, and the income earned by employed workers is shared by the two populations. Per capita income is thus a direct function of the rate of employment.

Inputs in the T sector are labor and an aggregate capital stock made of imperfectly substitutable domestic and imported capital goods. Imported

TABLE 6

Model Equations

For i, j = A, T, NT (agricultural and nonagricultural tradables and nontradables sectors)
For g, k = Fo, Fe, T, NT (food, feed, nonagricultural tradables and nontradables goods)

Static Relations (time argument omitted)

Production:	$X_i = f(L_i, t_{Ki}K_i, \lambda_i, \sigma_i)$ with f = CD or CES	(1)
Capital aggregation:	$K_T = CES(KM, KD, \lambda_K, \sigma_K)$	(2)
Capital productivity in tradable sector:	$t_{KT} = t_0 K_T^{\varepsilon}$	(3)
Labor demand:	$\partial X_i/\partial L_i = w_i/p_i$	(4)
Wages:	$w_r = \bar{w}_r^* P_r$ for r = A, NT	(5)
	$w_T = P_T y_A/P_A + \delta$	(6)
Income:	$y_i = w_i L_i/Pop_i$ for workers of sector i (per capita)	(7)
	$YK_i = p_i X_i - w_i L_i$ for capitalists of sector i	(8)
Population distribution:	$Pop_T = L_T$	(9)
	$Pop_i = (Pop - Pop_T)\, L_i/(L_A + L_{NT})$ for i = A, NT	(10)
Consumption:	$CW_{ig} = Pop_i\, LES(y_i, p_k, \alpha_{ik}, \eta_{ik}, \phi_i)$ by workers of sector i	(11)
	$CK_{ig} = LES\,(YK_i, p_k, \alpha K_{ik}, \eta K_{ik}, \phi K_i)$ by capitalists of sector i	(12)
Agricultural imports:	$M_A = \sum_i (CW_{iFo} + CW_{iFe} + CK_{iFo} + CK_{iFe}) - X_A$	(13)
Capital goods imports:	$M_{KM} = e\, X_T - M_A$	(14)
Numeraire:	$p_T = 1$	(15)
Agricultural prices:	$p_{Fo} = p_{Fe} = p_A = \bar{p}_A$	(16)
Consumer price indices:	$P_i = (\sum_k CW_{ik} p_k)/(\sum_k CW_{ik})$	(17)
Market equilibrium for NT sector:	$X_{NT} = \sum_i (CW_{i,NT} + CK_{i,NT})$	(18)

Dynamic Relations (t = time argument)

Imported capital accumulation:	$KM(t+1) = KM(t) + M_{KM}(t)$	(19)
Land productivity:	$t_{KA}(t+1) = t_{KA}(t)\, [1 + z(t)]$	(20)

List of Symbols

CD, CES	Cobb-Douglas and Constant Elasticity of Substitution production functions
LES	Linear Expenditure System

Parameters Derived From Initial-Year Values

λ_i	Labor share parameters in production function
λ_K	Foreign capital share parameter in capital aggregation derived from $\partial K_T/\partial KM = \pi\, \partial K_t/\partial KD$ in initial year
e	Share of tradable production exported to cover agricultural goods imports derived from $M_{KM} = 0$ in initial year
δ	Difference between tradable sector workers' wage and agricultural income per capita
t_0	Parameter of capital productivity derived from $t_{KT} = 1$ in initial year

(Continued on next page.)

TABLE 6--continued.

Parameters Defined in Table 7

σ_i, σ_K	Elasticities of substitution in production function and capital aggregation
π	Relative productivity in imported capital compared to domestic capital
α_{ik}, η_{ik}	Income shares and elasticities for consumption of good k by workers of sector i
αK_{ik}, ηK_{ik}	Income shares and elasticities for consumption of good k by capitalists of sector i
ϕ_i, ϕK_i	Frisch parameter for workers and capitalists of sector i
ε	Elasticity of capital productivity with respect to the stock of capital in tradables sector

Exogenous Variables

KD	Domestic capital in tradables sector
K_{NT}	Capital in nontradables sector
$k_{K,NT}$	Capital productivity in nontradables sector (= 1)
$\bar{w}_A^*$, $\bar{w}_{NT}^*$	Real wage in agricultural and nontradables sector
$\bar{p}_A$	Exogenous agricultural price (=1)
$\bar{M}_A$	Exogenous agricultural imports equal to initial year value
Pop	Total population
z	Annual growth rate of land productivity

Endogenous Variables

X_i	Production in sector i
L_i	Employment in sector i
K_A, K_T, K_{NT}	Land in agricultural sector, capital in tradables and nontradables sectors
KM	Imported capital in tradables sector
w_i	Nominal wage in sector i
y_i	Per capita income of workers of sector i
Pop_i	Population in sector i
YK_i	Capitalists' income in sector i
p_g, p_i	Prices of good g and sector i
P_i	Consumer price index for workers of sector i
CW_{ig}	Consumption of good g by workers of sector i
CK_{ig}	Consumption of good g by capitalists of sector i
M_A, M_{KM}	Imports of agricultural and capital goods
t_{KA}	Land productivity
t_{KT}	Capital productivity in tradables sector

TABLE 7

Parameters for Archetype Economies

			Countries		
			Very low income	Low income	Middle income
Total production			1,000	1,000	1,000
Production	A[a]	X_A	410	330	250
	T	X_T	170	300	350
	NT	X_{NT}	420	370	400
Total Population		Pop	1,087	689	352.9
Employment	A	L_A	300	176	80
	T	L_T	60	80	70
	NT	L_{NT}	350	230	150
Wages	A, NT	W_A W_{NT}	0.85	1.125	1.6
	T	W_T	1.0	1.50	2.0
Domestic capital	A	K_A	800	660	750
	T	KD	360	900	1,050
	NT	K_{NT}	820	550	800
Imported capital	T	KM	150	300	350
Elasticity of substitution between KD and KM		σ_K	0.4	0.4	0.4
Relative productivity of KM		π[b]	3.0	3.0	3.0
Elasticity of capital productivity in T		ε	0.1	0.2	0.3
Elasticity of substitution between capital and labor:	A	σ_A	0.1	0.1	0.1
	T, NT[c]	$\sigma_T \sigma_{NT}$	1.0	1.0	1.0

Consumption parameters	Share α	Elasticity η	Share α	Elasticity η	Share α	Elasticity η
A and NT workers						
Food	0.51	0.9	0.42	0.7	0.33	0.5
Feed	0.03	2.0	0.07	2.0	0.11	1.8
T	0.09	1.4	0.18	1.3	0.21	1.2
NT	0.37	1.0	0.33	1.0	0.35	1.2
Frisch parameter ϕ	-7.0		-5.0		-4.0	
T workers						
Food	0.32	0.7	0.26	0.5	0.22	0.4
Feed	0.06	1.8	0.10	1.5	0.12	1.4
T	0.22	1.3	0.27	1.2	0.28	1.1
NT	0.40	1.0	0.37	1.1	0.38	1.2
Frisch parameter ϕ	-5.0		-4.0		-3.0	
Capitalists	αK	ηK	αK	ηK	αK	ηK
Food	0.21	0.4	0.12	0	0.08	0
Feed	0.10	1.5	0.12	1.1	0.14	1.0
T	0.20	1.1	0.34	1.1	0.34	0.8
NT	0.49	1.1	0.41	1.2	0.44	1.3
Frisch parameter ϕK	-4.0		-1.6		-1.3	

[a]A = agricultural, T = tradables nonagricultural, and NT = nontradables nonagricultural sectors.

[b]π = 4 in experiments with high productivity of imported capital.

[c]σ_T = 4.0 for elastic supply in NT and σ_{NT} = 0.4 for labor bias in T.

capital goods are more productive than domestic capital goods, and the productivity of the stock of capital increases with its size.[11] Workers are employed at a real wage rate which differs from real per capita income in agriculture by an additive constant.

Consumption behavior is specified for each of the four social classes (workers of the three sectors and capitalists) by a linear expenditure system where parameters are based on income shares, income elasticities, and Frisch parameters. Total grain demand is made up of direct food grain consumption and derived demand for feed grains. Net imports of grains, calculated from the difference between domestic production and demand, require that a certain proportion of industrial production be exported to generate the needed foreign exchange. Supply and demand are equalized through international trade in the tradables sectors and through price flexibility in the nontradables sector.

The foreign exchange saved in each period after satisfying the demand for food and feed imports is used to import capital goods that increase the stock of capital in the T sector and production in the next period. This use of foreign exchange savings is based on the assumption that, of the two gaps (foreign exchange and domestic savings) which potentially constrain economic growth, the former is the effective one.

Empirical values in the model typify three economies at different levels of economic development: very low, low, and medium income. The low-income economy corresponds to the higher half of the World Bank low-income group with a GNP per capita of $250 to $400 in 1983 which includes India, China, Sri Lanka, Pakistan, Kenya, and the Sudan. The very low-income group corresponds to the lower half of the World Bank low-income group with a GNP per capita of between $120 and $250. It includes countries such as

Bangladesh, Nepal, Burma, Ethiopia, and Tanzania. Finally, the middle-income countries have a GNP per capita of between $500 and $1,000 and include Indonesia, the Philippines, Thailand, Egypt, Morocco, and El Salvador. The structural characteristics and parameter values for each of these three archetype economies are given in table 7. They are derived as much as possible from average observed values for these three groups of countries. The consumption structure is derived from Indian data with a higher share of the food budget given to meat than is observed in India, based on empirical evidence from other countries.[12]

B. Simulation of Time Paths

Table 8 gives indicators of growth, income level, and income distribution, the structure of consumption, and the structure of imports associated with the base run and a number of alternative experiments.

Technological change is represented by a 15 percent increase in land productivity. Since the reference path is a steady state with growth of neither population nor capital, this change should be understood as an increase in per capita production. Technological change can occur either as a one-time event in period one or as a continuous flow over a 10-year period. If it is spread over 10 years, a 15 percent increase corresponds to an average annual growth rate of 1.4 percent, which is a median value for the countries with positive per capita agricultural growth during the 1970s. Indeed, among the 60 countries studied (table 3), 32 experienced a negative growth rate of per capita agricultural production, 9 had a growth rate of between 0 percent and 1 percent per year, 10 had a growth rate of between 1 percent and 2 percent per year, and 9 had a growth rate of more than 2 percent per year.

TABLE 8.

Impact Over 25 Years of a 15 Percent Increase in Land Productivity[a/]

Experiments	Growth							Poverty				Consumption					Agricultural imports			
	GNP	Production			Employment		Price	Workers' real income per capita						Share of food in agricultural consumption increase	Elasticity of agricultural consumption with respect to			Present value of net increase[d/]		
		A	T	NT	T	NT	NT	A,NT	T	All	Equity[b/]	Food	Feed		Agricultural Production	GNP	t_m[c/]	δ = 2	δ = 15	δ*[e/]
	percent[f/]											percent[f/]					years	percent		
Low-income country																				
1. Base run	15.9	14.5	19.5	14.2	5.6	21.0	9.1	18.9	9.4	17.5	1.41	10.5	25.8	53.6	1.00	.91	12.3	34	-184	2.4
2. Elastic supply in NT	16.8	14.9	18.4	17.1	6.1	24.7	2.4	21.4	10.7	19.8	1.45	11.3	25.0	56.2	1.00	.89	11.4	62	-170	2.8
3. High productivity of imported capital in T	16.4	14.5	20.6	14.7	6.3	21.6	9.3	19.4	9.7	18.0	1.41	10.7	26.7	53.4	1.03	.91	9.8	154	-158	3.9
4. Labor bias in T	15.7	14.5	19.4	13.9	13.5	20.4	8.8	19.8	9.9	19.2	1.45	11.1	25.5	55.2	1.02	.94	9.2	177	-132	4.4
5. = 2 + 3 + 4	16.7	14.9	18.6	16.8	13.3	24.2	2.3	22.3	11.1	21.4	1.50	11.8	24.9	57.5	1.03	.91	7.2	250	-102	6.0
6. Peasant agriculture	16.2	14.4	19.7	14.9	2.3	22.0	9.5	15.7	13.1	15.8	2.41	10.1	28.9	55.1	.99	.88	11.2	153	-94	4.5
7. Diffusion over 10 years	15.4	14.5	18.3	13.8	4.9	20.3	8.8	18.4	9.2	17.0	1.41	10.2	25.0	53.7	.98	.91	17.6	0	-95	2.0
Very low-income country	14.3	14.4	18.1	12.8	4.8	18.5	8.3	16.8	9.0	16.8	1.65	13.2	24.0	78.1	1.02	1.02	6.8	240	-110	5.8
Middle-income country	14.1	14.5	16.4	12.0	-.7	20.7	17.2	18.2	11.8	16.4	1.08	7.3	24.0	31.6	.96	.99	11.4	108	-103	3.9

a/ A = agricultural, T = tradables nonagricultural, and NT = nontradables nonagricultural sectors.

b/ Defined as the ratio of workers' to capitalists' real income. Initial value is 1.36 with a capitalist agriculture and 2.43 with a peasant agriculture, 1.58 in very low income country, and 1.03 in middle income country.

c/ Time at which agricultural imports are equal to initial value.

d/ Computed over 50 years, in percent of agricultural imports in base year.

e/ Discount rate for which the present value of net increase is zero.

f/ Cumulated growth rates.

In experiments 1 to 6, technological change is represented by a one-time change in land productivity in the first year. This generates employment in agriculture, a reduction in total unemployment, and thus an increase in per capita income. The increased demand for nontradables induces a price increase and a production response of magnitudes which depend on the elasticity of substitution between capital and labor. This further reduces unemployment and increases the workers' per capita income. With a low elasticity of substitution between land and labor in agriculture, the wage increase induced by rising prices leaves production and employment in that sector virtually unchanged but it dampens the employment effect in the other two sectors. The cost of labor in the T sector, which has to keep in line with rural per capita real income, increases and induces a loss of employment and a reduction in nonagricultural tradables production in the first year.

Agricultural imports decrease dramatically in the first year for two reasons. One is the increase in agricultural production. The other is the shift of unemployed T sector workers back to the lower income groups which partially cancels the demand effect created by the higher level of employment in the other two sectors. The result is that only 44 percent of the incremental agricultural output is consumed while 46 percent replaces imports. Consumption increases with both higher income within classes and a shift of agricultural workers to higher paid jobs in the T sector. Feed consumption increases with income more than food consumption and, after 25 years, accounts for almost half of incremental consumption when it represents only 25 percent of total cereal consumption in the base year. The foreign exchange saved from lower cereal imports is used to import capital goods which, in the following years, enhance T sector production, reduce unemployment, and raise the per capita income of workers in all sectors.

This growth process is somewhat slowed down by two mechanisms: The rate of employment growth is reduced by an increasing labor cost brought about by the reduction of unemployment and rising nontradable prices, and import savings are reduced by increasing consumption induced by increasing incomes. However, foreign exchange availability has been increased by T sector growth and exports. The result is that the initial momentum given by the release of foreign exchange from decreased food imports is sustained even after the agricultural balance of trade has again reached its initial value.

This base-run path is represented in figure 1. It illustrates the importance of the time scale in appraising the impact of technological change in agriculture on agricultural imports.

The frontier of harmony between DC agricultural development and U. S. agricultural export interests is characterized by two scalars, t_M and δ^*; t_M is the time at which cereal imports return to their initial level before agricultural technological change took place. In the base run, imports are back at their initial level after 12.3 years and, from then on, continue to increase. Present values of the stream of changes in imports calculated with alternative discount rates best appraise the overall impact of agricultural development on food imports. This calculation shows that, for low discount rates (δ = 2 percent) which value the long-term growth effect on imports over the short-term replacement of imports by domestic production, there indeed exists a communality of interest between DC agricultural development and U. S. agricultural export. But, for high discount rates (δ = 15 percent), on the contrary, rising imports occur too slowly and too late to compensate for the losses incurred in the first years. The discount rate, δ^*, at which present value of imports calculated over 50 years is equal to 0 is, in this case,

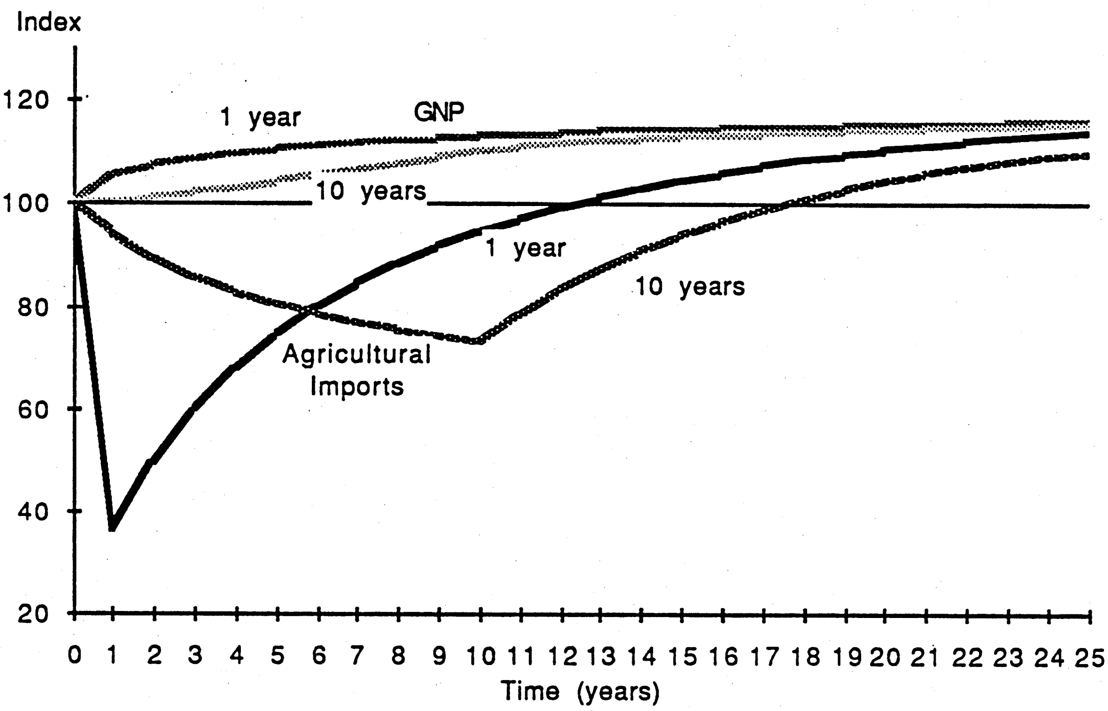

Figure 1 - Growth in GNP and Agricultural Imports
with Different Rates of Diffusion of Technological Change

2.4 percent. This illustrates the conflicts between developmental agencies (e.g., USAID) which perceive through low discount rates the harmony of interest between agricultural development and U. S. trade and farm lobbies whose discount rate is too high to value the positive impact of international agricultural development on their exports markets. Key parameters to the growth process and the location of the frontier, t_M and δ^*, are the supply elasticity of the NT sector, the productivity of imported capital goods, the share of labor in value added in the T sector, the structure of landownership, and the size of the agricultural sector in the economy. We explore the implications of each of these in the following experiments.

The crucial role of the supply elasticity of the NT sector is often invoked, both as a major growth linkage[13] and a source of effective demand for agricultural products[3]. At one extreme, if the fixed amount of capital is fully utilized and cannot be substituted for by increased employment or if there is a very tight labor market, a Dutch disease phenomenon of rapidly rising prices will result. If, on the contrary, there is labor surplus and capital and labor are highly substitutable in production, production will increase rapidly under the pull of demand.

Comparison of experiment 2 with the base run shows the positive growth effect of an elastic supply in the NT sector, although the linkage with the rest of the economy and the impact of such a strategy on food consumption is certainly much lower than often expected. First, a high supply response in the NT sector has two counteracting effects on the cost of labor: a lower price increase but a higher per capita agricultural income due to decreased unemployment, which together result in very little overall impact on employment in the T sector; and second, while workers' increasing income per capita boosts their food demand, the capitalists' income and feed consumption increase much less than in the base run due to rising labor costs in all sectors and a much lower increase of quasi rent in the NT sector. This fairly progressive growth strategy thus does not affect the overall agricultural imports flows very much relative to the base run.

An alternative employment strategy, implemented this time in the T sector, is simulated in experiment 4 by decreasing the elasticity of substitution between K and L from 1 to 0.4. This results in an increasing share of labor from 40 percent in year 1 to 43 percent in year 25. Overall growth is slightly reduced but equality increases. The shift of income distribution toward workers, however, does not affect substantially capitalist income compared to an employment strategy in the NT sector. Food consumption increases rapidly, accounting for more than 55 percent of the total increase in cereal consumption while feed consumption does not decrease substantially. This equitable growth path accelerates the growth of imports: t_M is brought forward to only 9.2 years and the critial discount rate, δ^*, is raised to 4.4 percent.

In experiment 3, the productivity of imported capital goods is increased. An industrialization process that makes a more efficient use of the foreign exchange released by import substitution in agriculture accelerates income growth, increases consumption and the shift to meat consumption, and brings forward the harmony frontier.

Another aspect of the role of income distribution in these growth strategies is illustrated by simulating the impact of technological change in agriculture when it is organized on a family farm basis. In this case, there is no landlord class and all agricultural income (rather than 60 percent) goes to the labor force. Paarlberg[2] and others have, indeed, argued that a "broad based" pattern of agricultural development is more likely to harmonize agricultural development in the Third World and U. S. export interests because it enhances cereal consumption. The simulation in experiment 6 indeed shows that with a peasant agriculture the initial consumption increase captures a higher share of additional production. The resulting growth pattern induced by technological change is quite different. Peasants immediately benefit from increased productivity as their income and overall equity increase. The long-run impact, however, is dominated by a somewhat perverse effect: A capital bias is induced by rising labor costs, and feed consumption by high income groups rises sharply. While growth started at a lower pace, the growth rate is higher than in the base run after 25 years. It follows that the present value of imports is higher than with a capitalist agriculture for all discount rates and positive for discount rates up to 4.5 percent.

The issue of the length of time over which the diffusion process takes place is analyzed in experiment 7 and is illustrated by figure 1. For a given 15 percent increase in land productivity, the impact on the economy is greater if this technological change is implemented rapidly. At one extreme, when it is completely done in the first year, maximum foreign exchange is freed and nonagricultural growth is induced, which itself adds to the momentum for further growth. But, as agricultural imports increase, the growth process slows down. At the other extreme, a continuous growth in land productivity of 1.4 percent per year over 10 years induces a lower initial rate of economic growth. Twenty-five years after the initial impulse given to the economy by technological change, production in the different sectors and GNP are approximately at the same level (under both diffusion processes). However, rapid growth in the first few years, induced by a one-time technological change, is preferable as it gives a higher present value of total agricultural imports. If technological change is implemented gradually over 10 years, agricultural imports never fall by more than 30 percent, but they recover their initial value only after 18 years. Thus, with a low social discount rate, rapid growth generates a higher present value of rising imports (34 percent for the base run versus a 0 present value for gradual diffusion with δ = 2 percent) while, with a high private discount rate, the loss of agricultural imports is lower when diffusion time is longer (present values of agricultural imports decrease are -184 and -95 percent respectively, with δ = 15 percent). This reveals a new dimension to the conflict of interest between DC growth and U. S. agricultural exports. A progressive diffusion of technology, while generating somewhat less growth in the first few years, may be more acceptable to U. S. farm interests.

The impact of technological change in agriculture is different in countries at different levels of per capita income. This is seen in table 8 by contrasting the base runs in the very low-, low-, and middle-income countries for a one-time technological change. A key factor explaining these differences is the size of the agricultural sector. In a very low-income country where agriculture accounts for 41 percent of GNP, a 15 percent increase in agricultural production has a larger growth effect than in a middle-income country where agriculture is only 25 percent of GNP. This is reinforced by the fact that the capital-output ratio is also lower in the very low-income country, so the same amount of foreign exchange has a stronger growth effect. The increase in capital productivity is, however, higher at a higher level of development. The net effect is that it is the low-income countries which benefit the most from technological change in agriculture (a growth in GNP of 15.9 percent), followed by the very low-income countries (14.3 percent).

It is also in the low-income countries that the aggregate elasticity of consumption for food and feed grains with respect to income is the lowest (0.91). This is because, in the very low-income countries, a large segment of the population essentially relies on food grains for direct consumption with a high-income elasticity (close to one). In the middle-income countries, the share of meat in consumption has increased. Since it has an income elasticity greater than one, the aggregate elasticity for cereals is high again (.99).

Combination of the rate of economic growth and the income elasticity of cereal consumption determines the import needs and the time (t_M) at which imports are back to their original level. With fairly high growth and income elasticity of consumption, the very low-income countries are the first to absorb completely the increased production (6.8 years), followed by the middle-income (11.4) and the low-income countries (12.3).

The present value of imports increase gives the same ranking. With the very poor economy, the long-term positive impact of agricultural development on imports dominates the short-term reduction for discount rates up to 5.8 percent compared to 3.8 percent in middle-income countries and 2.4 percent only for low-income countries.

C. Differential Interests and Compensation Schemes

The loss that agricultural exporters will incur as a consequence of agricultural development in DCs can be compensated by income transfers if the strategy generates net social gains in the exporting country. Indeed, as agricultural imports decrease, imports of industrial investment goods replace them; and total imports exceed their initial value, except for the first year (figure 2).

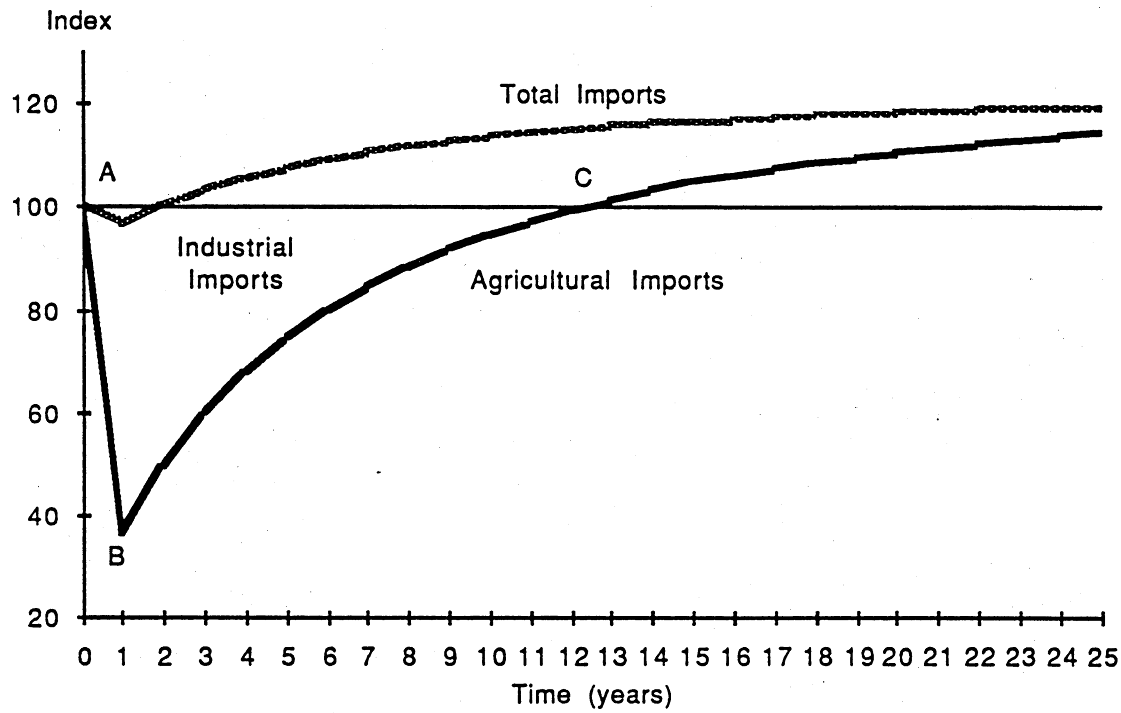

Figure 2 - Imports Induced by a 15 Percent Increase in Land Productivity

This opens the possibility of a compensation of agricultural exporters by industrial exporters. If this compensation was computed on a year-to-year basis, ensuring that at any time agricultural exporters do not lose from the base year, its value between year 0 and t_M would be represented by the area ABC, declining rapidly from 100 percent of industrial exports in the first two years to 50 percent in year 8. From time $t_M = 12.3$ on, both agricultural and industrial exporters benefit from growth in the developing country and no compensation is needed.

A compensation scheme that ensures the agricultural exporters of no over-all loss should, however, be computed on the basis of the present value of imports increase. For a private discount rate of 125 percent for both exporters, compensation should cover the over-all loss (i.e., 184 percent of base year agricultural imports which represents 80 percent of the present value of the increase in industrial imports). This share of industrial benefits that should be surrendered to compensate agriculture increases with the discount rate from no compensation at $\delta^* = 2.4$ percent to 66 percent at a discount rate of 10 percent and 80 percent at a discount rate of 15 percent.

Full compensation only becomes impossible for discount rates over 40 percent because they give such high weights to the first two years. It is only in that unlikely situation that the harmony between NDC and DC agricultural interests after compensation cannot be achieved.

IV. Conclusion

Rapid income growth in DCs has been identified as the most important potential source of increased demand for U. S. agricultural exports. While this is obvious for situations where the leading sectors of economic growth are export oriented (primary products, cash crops, or industry), claims have also been made that it could be achieved by a strong growth performance in food production induced, in particular, by diffusion of land-saving technological change. If this is the case, international assistance to food production in the DCs would be compatible with the promotion of U. S. exports of food and feed grains. We call the "frontier of harmony" the limiting conditions under which this compatibility of interests exists. The purpose of this paper was to explore the location of this frontier and the policy instruments that can enlarge the area where harmony prevails.

We approached this problem through both intercountry econometric analysis and simulation analysis in archetype general-equilibrium models. The first gives the long-run structural determinants of the location of the frontier while the second gives the time dimension and the role of specific technological and distributional parameters.

The main conclusion is that harmony of interests can indeed be achieved but that it is not automatic and requires explicit policy interventions. The principal potential source of conflict comes from the fact that lobbies of agricultural exporters tend to have high discount rates which make their valuation of the present value of the change in agricultural imports induced by technological change in the DCs negative. This results in a clash between aid and trade in the MDCs with the observed opposition of farm lobbies to aid programs directed at the technology of food crops in the DCs. There are, basically, three types of policy interventions that can be used to achieve harmony:

(1) The import demand effect of technological change can be increased by a number of complementary policies that affect the structure of the economies of the DCs. One approach consists of strengthening the linkages between agriculture and the rest of the economy in ways that also stimulate greater equity. This includes increasing the elasticity of substitution between capital and labor in the nontradables sector, enhancing the productivity of imported capital goods into the industrial sector, and increasing the share of labor in industry. Another approach is to establish, through land reform, an agrarian structure of owner-operated family farms. It is in the very low-income countries that aid to agriculture will have the largest potential payoffs on future import demand.

(2) A rapid diffusion of technological change enhances harmony by creating earlier foreign exchange, nonagricultural growth, and income gains. Programs of technological assistance to Third World agriculture should, therefore, attempt to concentrate their impact over a short period of time.

(3) Since aid programs to DC agriculture create net social gains for exporters in the MDCs, it is possible to achieve Pareto optimality after compensation in these latter countries except at incredibly high levels of private discount rates. This is done by taxing industrial exporters on part of the benefits they derive from aid programs to compensate agricultural exporters. Under this scheme, harmony of interests between MDC and DC agriculture is indeed achieved.

Footnotes

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