Growing Interdependence of the World Food Economy: A 20 Year Perspective

Klaus Frohberg, Günther Fischer, Odd Gulbrandsen, and Jan Morovic[1]

Abstract The evolution of the world food economy between 1980 and 2000 is analyzed based on results obtained with the basic linked system of national and regional models developed by the Food and Agriculture Program of the International Institute for Applied Systems Analysis. Two scenario runs are made. In one scenario, past behaviour of the main driving forces of the world food system is assumed to remain in the future as it was observed in the past. According to that scenario, world trade in agricultural products continues to grow over the next 15 years. The developed market economies increase their exports of cereals and livestock products, while the developing countries import those commodities in growing quantities. The reverse pattern in trade can be found for other food and nonfood agricultural products. The CMEA and China do not show such a clear pattern of changes in trade. In terms of economic self-sufficiency in agricultural products, the CMEA shows an increase and China a decrease. The other scenario assumes that aid is tripled to the developing countries from countries with a trade surplus. The donor countries receive a return from that aid large enough to meet the costs of the additional aid But a multiplier effect cannot be observed. The impact of increasing aid on the receiving countries varies from country to country and is largely dependent on investment behaviour.

Introduction

Talking about an increasingly interdependent world has become commonplace in recent years. Usually "increasing interdependence" is used in a qualitative way because it is not substantiated by empirical evidence. Moreover, a clear indication about what is meant by "interdependence" is also missing in most cases. Yet one generally agrees with this observation.

In this paper, "interdependence" refers only to economic relationships among countries, irrespective of whether the sources of establishing these international relationships are economic considerations in the participating countries or other power factors (e.g., politics or military). With this definition, interdependence is seen as a gauge of the sensitivity of economic behaviour of a country with regard to the development of the economic environment outside its borders.

On the one hand, an increase in interdependence is much welcomed because it can lead to higher specialization, more efficiency, and competition through growing international market integration and thus raising of output, income, and the standard of living. On the other hand, a growing sensitivity of national economies to events originating outside the borders beyond their control is well recognized. Cooper (1968) puts this dichotomy into the following worlds: "The central problem of international economic cooperation is how to keep the manifold benefits of extensive international economic intercourse free of crippling restrictions while at the same time preserving a maximum degree of freedom for each nation to pursue its legitimate economic objectives."

The evidence used for showing that, under certain circumstances, a growing interdependence of the world food system will occur between 1980 and 2000 is based on results obtained with the basic linked system (BLS) of national and regional models developed by the Food and Agriculture Program of the International Institute for Applied Systems Analysis.[2] Two scenario runs made with the BLS are analyzed. The first scenario is the so-called "reference scenario," where the behaviour of the essential driving forces of the world food system is extrapolated from the past into the future. This scenario should not be interpreted as a forecast; it represents one possible state that the world food system might reach in the future. In the second scenario, interdependence through aid is analyzed. Financial aid obtained by the developing countries with a trade deficit from the trade surplus countries is tripled.

An Analysis of the Reference Run

Table 1 shows the development of global net trade in the nine agricultural commodities (or commodity groups) identified in the BLS for three country groupings and for China during 1980-2000.[3] According to this scenario, trade continues to grow in all agricultural commodities but with varying intensity. With the exception of bovine/ovine meat and dairy products, growth in agricultural trade slows down or does not significantly change in the 1990s compared to the 1980s at the world level. An especially strong decline can be observed in the annual average growth rate of net trade in rice, which falls from 5.06 percent to 1.91 percent. Growth of net trade in coarse grains is very strong in both decades but declines too. Other animal products (pigmeat, poultry, eggs, and fish), protein feed, and other food (fruits, vegetables, fats and oils, sugar, and beverages) show little change in net

trade growth. The first of these latter commodity groups grows by more than 2 percent, and those of the other three by around 1.6 percent. Net trade in nonagricultural products declines in the 1980s but increases in the following decade. Since this is a highly aggregated commodity group, its gross trade might very well increase in both decades.

Wheat and coarse grains are the two commodity groups for which the developed market economies (DME) show a strong increase in net exports. These additional exports are shipped to the developing countries excluding China (DC*). The DC* depend more and more on grains from the DME and even become net importers of coarse grains by the year 2000 because feed use of wheat and coarse grains increases by more than 3 percent per year, which leads to a higher growth in total

Table 1—Net Trade in 1980 and Change in Net Trade, 1980-2000

	World	DME	DC*	CMEA	China
		- - - *Net trade, 1980*† - - -			
Wheat (1,000 t)	71310	50796	-28542	-19692	-7340
Rice, milled (1,000 t)	8007	1624	-2385	-666	2159
Coarse grains (1,000 t)	78803	29617	-475	-12981	-1868
Bovine/ovine meat (1,000 t)	3385	411	-729	-10	54
Dairy products (1,000 t)	22976	18390	-13384	601	-641
Other animal products (1,000 t)‡	798	523	-164	-2	99
Protein feed (1,000 t)‡	17963	1793	4197	-801	427
Other food (million $)	18245	-3496	12002	-297	1164
Nonfood agriculture (million $)	5400	-2634	1883	-1159	130
Nonagriculture (million $)	58055	-18798	426	2836	-1141
		- - - *Change in net trade, 1980-90, percent* - - -			
Wheat	3.95	4.20	5.28	1.23	4.80
Rice, milled	5.06	2.56	11.20	-2.59	10.50
Coarse grains	4.98	6.03	16.60	0.50	-2.54
Bovine/ovine meat	2.08	1.23	1.95	[1]7.70	4.05
Dairy products	0.43	0.62	1.42	1.55	[1]3.55
Other animal products	2.51	3.75	4.58	[1]8.18	[2]-5.04
Protein feed	1.62	-5.08	2.40	-2.78	-6.15
Other food	1.70	1.99	0.92	13.36	3.24
Nonfood agriculture	1.66	-0.12	3.25	3.45	[2]-4.86
Nonagriculture	-1.22	-33.11	[2]308.20	4.06	1.26
		- - - *Change in net trade, 1990-2000, percent* - - -			
Wheat	2.33	2.28	3.99	0.24	0.17
Rice, milled	1.91	3.86	-4.99	-2.26	-17.30
Coarse grains	3.90	5.33	9.64	0.75	-1.22
Bovine/ovine meat	3.23	1.75	1.43	0.71	[2]-9.38
Dairy products	2.51	2.67	3.59	1.06	-12.60
Other animal products	2.17	0.93	3.93	0.71	-2.44
Protein feed	1.68	-7.79	1.10	-51.50	[2]-5.72
Other food	1.77	1.11	0.16	1.77	-1.22
Nonfood agriculture	1.47	0.13	-0.01	2.28	[1]17.34
Nonagriculture	2.27	[1]45.77	5.24	0.37	-2.06

[†At the world level, net export figures are given. For the country groupings, no sign indicates net exports, and a negative sign indicates net imports. ‡Measured in protein equivalents. [1]Switch from being an importer to becoming an exporter. [2]Switch from being exporter to becoming an importer.]

demand than in production for these two commodity groups. Related to the high increase in feed consumption of grains is a strong growth in livestock production in the DC*, which, however, is not sufficient to meet demand. Therefore, imports of livestock products by the DC*, especially other animal products, also increase.

The DME use more of their protein feed for livestock production and hence reduce the level of exports, whereas the DC* increasingly export protein feed, which is mainly due to Brazil's strong export performance. The DC* improve their world market share of nonfood agriculture in the 1980s but lose part of it in the 1990s. Both the CMEA and China show (for some commodities) rather large growth rates of their net trade figures, but the base year level is quite small in those cases. They both remain net importers of wheat and coarse grains and have a relatively small share of the world trade in livestock products. The CMEA become net exporters of bovine/ovine meat and of other animal products by 1990 and so does China for dairy products.

Table 2 shows how the agricultural trade balance valued at current prices develops between 1980 and 2000. While the DME improve their positive agricultural trade balance, the DC* lose half the trade surplus they had in 1980 by the year 2000. The CMEA increase their trade deficit in agricultural products by 50 percent and China ends up in the year 2000 with almost the same agricultural balance of trade it had in 1980.

The foreign trade ratios increase in the DME regardless of what kind of commodity grouping one considers (Table 2).[4] The increase is, however, especially strong for cereal products. No special trend can be identified for the DC* except in the case of cereal products. All three foreign trade ratios decrease for CMEA, especially the one with all products included. According to the foreign trade ratio for all products, China depends less on the world market in the year 2000 than in 1980. This is also true in terms of agricultural products, but its dependence increases first in the 1980s and then falls considerably in the 1990s.

If one sets the agricultural balance of trade in relation to the agricultural GDP, a figure is obtained that might be interpreted as economic self-sufficiency in agricultural products. According to this measure, the economic self-sufficiency of the DME increases, that of the DC* declines, while the CMEA and China show hardly any change (Table 2).

Table 2—Agricultural Trade Balance, Growth Rates, Foreign Trade Ratios, and Self-Sufficiency in Agricultural Products

	Year	DME	DC*	CMEA	China
Agricultural trade balance (million $)	1980	3422	7458	-2836	1142
Growth rates (percent)	1980-90	3.53	-0.15	4.06	1.26
	1990-2000	4.32	-6.30	0.37	-2.07
Foreign trade ratio, all agricultural products (percent)	1980	15.35	11.73	2.00	5.44
	1990	17.69	11.29	2.04	7.20
	2000	19.18	10.48	1.67	5.38
Foreign trade ratio, cereal products (percent)	1980	4.55	1.63	1.22	1.94
	1990	6.42	2.50	1.03	2.77
	2000	8.26	3.17	0.76	1.85
Foreign trade ratio, all products (percent)	1980	0.26	0.47	0.45	2.53
	1990	0.28	0.52	0.30	2.51
	2000	0.29	0.48	0.19	1.43
Self-sufficiency in agricultural products (percent)	1980	104.6	106.5	98.1	103.0
	1990	107.1	104.3	97.8	103.1
	2000	108.8	102.0	98.3	102.4

Interdependence Through Aid

Developing countries need additional financial resources over and above their own savings performance to accelerate economic development. Some argue that untied aid is the most efficient type of foreign savings as it gives freedom to buy goods where they are cheapest. If not repayable, it also does not cause any debt servicing problem. If aid is used effectively for investment purposes, it has a multiplier effect, bringing about faster growth, more demand for imports from the donors, and, ultimately, contributes to an acceleration of the donors' growth.

To test this often-advanced assertion regarding positive interdependence effects of aid, a study of tripling aid was made with the BLS. The question asked was: What effects would a tripling of the trade deficit of the developing countries have on the economy, in particular on agriculture? All countries having trade surpluses, regardless of whether developed or developing (such as several oil exporters), would contribute as donors, and the aid receiving countries are those with a trade deficit.

The results obtained by the general equilibrium solution show that agriculture would take a more than proportional share of the aid. The higher income created by aid would be spent on food to such an extent that supply would not be able, without an extra price incentive, to meet the increased demand. This additional food demand would not only be produced in the aid receiving countries but also by donors. In other words, a positive economic return would come to donors in the agricultural sector even without tying aid to agriculture. For the overall economy of the donors, the return to aid does not lead to accelerated growth but is high enough practically to offset the entire cost of the aid.

In Table 3, results for some selected countries are shown. The developing countries listed would receive additional aid, amounting to 5-20 percent of their GDP. Most invest relatively more of this aid in agriculture, which can be seen from the higher expansion of capital stock of this sector as compared to nonagriculture. The incentive to do so comes from a relative price improvement for agriculture of 2-5 percent. Consequently, output of agriculture grows faster than nonagriculture unless the productivity of capital is lower in agriculture (compare Pakistan and Kenya with Thailand).

On the demand side, people in the developing countries are satisfying their need for a higher nutritional level by consuming more calories. The increase in demand is, in fact, so large that the expansion in domestic production does not suffice. This also explains why some donors, like Australia, expand their agricultural output to meet the larger demand on the world market.

The discrepancy between demand and supply growth is, however, particularly large for nonagricultural products, for which demand in the developing countries expands by 2-5 times more than the supply. This is partly the consequence of a low degree of industrialization in these countries, which leads to high imports. However, the expansion of the nonagricultural capital stock is in several countries well below agricultural, and scope certainly exists for much larger expansion.

In the short run, aid in this form is immediately spent on industrial goods purchased from the donors. Short-run aid would have the same demand effect as national budget deficit spending. In the long run, however, the multiplier effect is lacking. If more aid were spent on investments, not only would the agricultural part of the donors' economy benefit, but growth in the agricultural sector could produce growth for the overall economy rather than the slight fall now obtained.

Table 3—Economic Effects of Tripling of Trade Deficits by the Year 2000
(percentage change in relation to the reference scenario)

	Pakistan	Kenya	Egypt	Thailand	Australia	EC	Japan
Aid as a percent of GDP	20.2	12.7	8.5	5.3	-0.5	-0.9	-1.1
Agricultural/nonagricultural prices	4.3	4.0	2.6	4.6	2.1	0.4	2.2
Agricultural capital stock	20.4	14.5	7.6	7.9	1.5	-1.1	0.3
Nonagricultural capital stock	12.6	11.0	10.1	6.1	-0.4	-0.5	-0.8
Food calorie demand	5.7	13.7	2.9	2.1	-0.2	-0.1	-0.1
Nonagricultural demand	27.3	15.7	14.2	11.6	-0.7	-0.2	-1.4
Value added in agriculture	8.6	6.7	1.7	3.3	0.7	0.2	-0.1
Nonagricultural production	5.4	2.5	8.4	5.8	0.0	-0.2	-0.3
GDP	6.1	3.5	7.7	5.5	0.0	-0.2	-0.3

Looking at the effects of tripling aid on volumes traded in agriculture at the world level, rice shows relatively the strongest expansion (Table 4). Among all other agricultural products, only livestock products—bovine/ovine meat, dairy products, and other animal products—indicate a substantial change in their volume of world trade. From Table 4, one also obtains a view on the development of trade for the two country groupings—DME and DC*. Except for wheat and protein feed, the DME expand their exports and the DC* their imports. Both country groups reduce trade in wheat, other food, and nonfood agriculture. While the DME decrease their exports of protein feed, the DC* take up some of this lost share in world trade. Altogether, the DME improve their agricultural trade balance, whereas the DC* show a substantial decline in their trade surplus. Since the DME countries are donors, one can conclude that the aid-receiving countries pay for the additional aid with higher dependence on the donor countries' agricultural exports.

Table 4—Effects on Agricultural Trade of Tripling Aid (in percent)

	World†	DME	DC*
Wheat	-0.7	-0.6^x	-0.4^m
Rice	25.8	28.9^x	32.9^m
Coarse grains	0.7	5.0^x	5.3^m
Bovine/ovine meat	-1.1	17.2^x	18.1^m
Dairy products	5.8	7.1^x	10.3^m
Other animal products	5.1	6.0^x	11.0^m
Protein feed	0.5	-10.9^x	1.5^x
Other food	-0.4	-12.8^m	-1.2^x
Nonfood agriculture	0.3	-0.6^m	-0.8^x
Agricultural trade balance	–	11.7	-25.4

[†Changes in net exports. ^{x}Exports in the reference run in the year 2000. ^{m}Imports in the reference run in the year 2000. Note: Both the DME and DC* have a surplus in agricultural trade in the reference run in the year 2000.]

Summary

This brief analysis shows that a growing interdependence over the next one and a half decades can be expected if the main driving forces of the world food system remain largely unchanged. The developing countries (excluding China) increasingly import agricultural products (especially grains) from the developed market economies without adequately increasing their agricultural exports. As a result, their surplus in agricultural trade shrinks substantially while that of the DME increases. In essence, the same relationship would emerge in the case where the DME (and some developing countries with trade surpluses) were to give aid to the DC* with trade deficits.

Notes

[1]International Institute for Applied Systems Analysis.
[2]For a description of the BLS, see Fischer and Frohberg (1982).
[3]The net trade figures may underestimate total trade. The more aggregated a commodity grouping, the stronger the underestimation might be.
[4]The foreign trade ratio is calculated as the ratio of the sum of exports plus imports of the commodities indicated to the appropriate figure of gross domestic product.

References

Cooper, R.N., *The Economics of Interdependence*, McGraw-Hill, New York, 1968.
Fischer, G. and Frohberg, K., "The Basic Linked System of the Food and Agriculture Program at IIASA: An Overview of the National Models," *Mathematical Modelling*, Vol. 3, 1982, pp. 453-486.