A DISCUSSION OF LONG-TERM AGRICULTURAL COMMODITY FORECASTS AND FOOD AID NEEDS

by

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PREFACE

This paper compares the long-term projections of prices, supply, demand and trade made by economists from the World Bank, U.S. Dept. of Agriculture and Iowa State University for the XX International Conference of Agricultural Economists. Subsequently, the implications of these projections for food aid were discussed at a U.S. National Research Council workshop on Food Aid Estimations for the 1990's.

It should be noted that all of the projections summarized in this study were made prior to the drought of 1988. Nonetheless, we feel the projections are indicative of the long-run trends in the agricultural sector and perhaps more importantly how these trends can be altered by changes in economic growth, technological change and the trading environment.

1. Introduction

The comparison of the properties and projections of agricultural commodity models is a relatively recent phenomenon (Meilke). However, it is an important way to (1) foster improvements in commodity modeling, and (2) to expose the profession to areas of consensus and disagreement that exist among the handful of large scale models being used on a regular basis. It is equally important for any model commentator to acknowledge that it is far easier to criticize a model than it is to build one. Criticism is easy because model building involves an exercise in constrained optimization. The constraints in model building are capital, labor, data and perhaps just as importantly the ability to assimilate, understand and describe the results of the analysis. Food aid needs modeling is further complicated by factors that cannot be internalized such as weather and political processeses. Because of these constraints, model building involves trade-offs and compromises. These choices are often guided by the original purpose for which the model was developed; and while we sometimes argue the need for all-purpose models what we generally have are models that were developed for a single purpose that then evolve and are adapted to fulfill other roles.

The difficulties are well illustrated by the tasks assigned to the model builders. First, they had to forecast future supply, demand and prices for many commodities and countries (or groups of) in order to compute net imports, also refered to as the import gap; and second, they had to determine the volume of commercial imports and food aid which constitutes the total imports of net importing developing countries. The detail of the models necessary to perform either let alone the two assigned tasks, is very demanding thus forces compromises in model building.

The models presented at this conference fall into two categories. The first category includes models specifically designed to perform the first task. Food aid and commercial imports are not differentiated and hence, are implicitly assumed to be perfect substitutes. It follows that these models do not address food aid needs directly. The FAPRI, World Bank (WB) and SWOPSIM models fit this description. Models belonging to the second category have a comparative advantage in performing the second task since they were designed exclusively for that purpose. The IFPRI model developed by Ezekiel appears to be an improvement on the other models in the second category. Consequently, we will focus on this model when discussing models belonging to the second category. In the remainder of the paper our comments are organized under four broad headings (1) model design and scope; (2) policy implementation; (3) model inputs and assumptions; and (4) model results.

2. Model Design and Scope

The FAPRI (Johnson, et al.) model was initially designed to provide detailed short to intermediate run forecasts of the U.S. agricultural economy. As U.S. agriculture has become more open to international forces, the "foreign" component of the FAPRI model has been expanded to include econometric representations of many major trading nations. Nonetheless, while the country coverage of the FAPRI grains model is now fairly extensive its "U.S. forecasting roots" are still obvious. Detailed and comprehensive evaluations of policy changes on the welfare of nations outside the U.S. are beyond the scope of the FAPRI model because of the limited country/commodity coverage. Even for the U.S. the calculation of standard welfare measures from FAPRI is not a trivial matter. Most commodities involve multiple demands and complex expectations mechanisms that make calculating producer and consumer surplus difficult. The model is particularly useful in computing the import gap, or the difference between domestic use and production but falls short of estimating food aid needs.

Conversely, SWOPSIM (Roningen, et al.) is an example of a model designed to evaluate trade liberalization scenarios. It was not intended to be used in a forecasting mode and it is normally calibrated on a historical time period. SWOPSIM is similar in design to other synthetic models developed by OECD; and Cahill. These models tend to provide comprehensive country coverage, although only five of SWOPSIM's eleven regions are single countries. Twenty-two commodities are produced and consumed in each SWOPSIM region, although in a few cases commodities are aggregated. Given the simple static supply/demand structure of SWOPSIM welfare analysis involves rather straightforward calculations of consumer and producer surplus. We should not leave the impression that SWOPSIM has solved all of the problems involved in analyzing trade liberalization. SWOPSIM is a static model and as such it can say nothing about the time path of adjustment from one equilibrium solution to another. In particular, the biological constraints and dynamics of livestock production are largely ignored. Stockholding, which is crucial in the short and medium run for grains, is modeled explicitly in FAPRI and WB but stocks are assumed fixed in SWOPSIM. In addition, policy interventions are treated exogenously and incorporated as price wedges rather than as explicit policy variables (de Gorter).

FAPRI and the World Bank (Akiyama and Mitchell) models are dynamic, and one of their strengths is their ability to trace the time path of adjustment resulting from a policy change or exogenous shock (eg. drought). Stockholding is modeled explicitly and for the United States most policy instruments, which are set exogenously, are embedded in the structure of the model. The WB model for grains is an annual econometric model as are the coffee, tea, and cocoa models which have features specific to perennial crop modeling. However, like FAPRI, the WB grains model began its life as a U.S. forecasting model. Its eclectic choice of countries to be modeled and the lack of policy detail in non-U.S. countries does not lend itself to an analysis of multi-commodity trade liberalization. The WB models do highlight a serious shortcoming in most of the current generation of multi-region, multi-commodity models in that they are almost without exception focused on temperate zone products and countries, even though the export value of tropical products, sugar and beverages accounts for almost 14 percent of the value of the world's agricultural exports (FAO)[1]. Sugar and rice appear to be the only

[1] In 1985, exports of tropical products, sugar and beverages

commodities of direct interest to LDCs that have been given much attention in current models.

All of the above models are partial equilibrium models, thus negating our ability to calculate the welfare costs and employment effects of agricultural policies on the non-agricultural sector. Similarly, agricultural inputs other than feed have been almost totally ignored in our modeling efforts. This implicitly assumes that agricultural inputs purchased from the general economy have perfectly elastic supply schedules.

Trade and domestic policies have important consequences for the value of agricultural assets. The wealth of the agricultural community is largely determined by the value of land. Thus, it is crucial to know the impact of various types of market interventions on the value of agricultural land since the effects can vary greatly across potential instruments (Hertel).

The IIASA model is a general equilibrium model especially designed to analyze world trade. Its general equilibrium framework is an advantage since it internalizes cross-sectoral effects in addition to cross-commodity effects. As far as this workshop is concerned, the shortcomings of the IIASA model are: (1) its somewhat aggregated commodity coverage and (2) the fact that its imports are not partitioned into food aid and commercial imports.

At first glance, the Ezekiel model appears more useful for the purpose of this workshop than models that do not explicitly model food aid needs. However, it is less efficient at estimating the import gap than the partial equilibrium models in the first category (like the FAPRI model) which also rely heavilly on trend variables such as population growth and GNP per capita growth to generate their forecasts. Unlike the Ezekiel model, models in the first category also allow for cross-commodity effects which may not have a negligible impact on the size of the import gap. Being influenced by the magnitude of the import gap, food aid needs estimates can be severely biased if the import gap estimate is inacurate.

Every commodity is converted into cereal equivalents in the Ezekiel model. Such a transformation implies perfect substitutability between commodities. Alternatively, one can think of the model as a characteristic model with only one relevant characteristic: cereal equivalence. It can be argued that neither assumption is realistic, but that they can be justified on the grounds of simplicity. Characteristic models with one characteristic are not uncommon in the field of International Trade and the assumption is often used in the modeling of international trade of grains where the grade assigned to a given lot is a scalar.

The methodology used by Ezekiel is characterized by two stages. In the first stage, the import gap is estimated as the difference between production and domestic use. As shown in Figure 1, future

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contributed only 2.9 percent to the value of agricultural exports in developed countries as opposed to 36.6 percent for the LDCs (FAO).

production depends on the trend rate of growth for each staple food. Domestic use is the summation of food use, feed use, seed and other uses. Food use is influenced by three parameters: (1) the GNP per capita trend rate of growth, (2) the income elasticities of demand and (3) population growth. Feed use is function of the same parameters except that the income elasticities for feed demand are proxied by the income elasticity for meat. Seed use is estimated as a proportion of production while other uses is determined as a fraction of the sum of food and feed uses.

Food aid needs being the difference between the import gap and commercial imports, the second stage consists of estimating commercial imports and then deriving the residual food aid needs. Commercial food imports can be estimated by regressing commercial food imports on a given set of explanatory variables and by using these estimates to forecast the future. Foreign indebtness, the import gap, foreign exchange earnings and domestic and world prices can all be rationalized as potential explanatory variables. As pointed out by Ezekiel, regressing commercial food imports on these variables yields at best the country's willingness to buy commercial imports. Ezekiel argues that the modellers' objective must be more normative in the sense that it is the capacity to buy commercial food imports that should be calculated in order to get food aid needs and not food aid wants. To achieve this goal, Ezekiel uses actual commercial food imports and multiplies it by the GNP per capita growth rate, which supposedly reflects the country's ability to pay. Indeed, he implicitly assume that the actual commercial food imports in the base year are representative of the country's ability to pay. Another problem with the methodology and its normative ambitions lies in the calculation of the import gap. If the objective is to estimate food aid needs in a normative sense, this should be reflected in the first stage as well by using cereal equivalent requirements instead of demand estimates. The problem goes beyond the semantics. Do we want to estimate food aid needs in its purest (normative) sense or do we want to calculate the difference between what consumers demand (given a budget constraint like per capita GNP) in excess of domestic production and what the central planner can afford to import. The latter concept is difficult to interpret because it estimates food aid needs based on market demand and the central planner's "capability" to satisfy this market demand via commercial imports assuming that prevailing prices are undistorted. Artificially maintained low prices (which are common in LDC's) would overestimate the so-called demand-based food aid needs.

Of greater concern to us is the lack of theory behind the proposed methodology. The import gap is determined in a first stage and assumed constant thereafter even though food aid may affect both production and demand. In a standard micro problem, food aid could be seen as an initial endowment having an income effect affecting both demand and production of the various goods included in the model. There are no reason why the difference between demand and production has to stay fixed when the endowment changes. Unless the receiving country has a minimum target price (a questionable target!), why

Figure 1. Estimation of Food Aid Needs in the Ezekiel Model.

<u>First Stage</u> (Import Gap)

Import Gap = Domestic Use - Production

Domestic Use = Food Use + Feed Use + Seed Use + Other Uses

- Domestic Use -- Food Use = f(GNP/cap. trend rate of growth, income elasticities of demand at 5 yearly intervals, population growth)

  -- Feed Use = f(GNP/cap. trend rate of growth, income elasticities of meat demand, population growth)

  -- Seed Use = f(production)

  -- Other Uses = f(food use + feed use)

- Production = f(trend rate of growth for each staple food)

<u>Second Stage</u> (Commercial Imports and Food Aid Needs)

Food Aid Needs = Import Gap - Commercial Food Imports

- Commercial Food Imports = actual commercial food imports times GNP/cap. trend rate of growth should the demand for food aid not be infinite[2]? Food aid volume would thus be determined on the supply side if there were one in Ezekiel's model. In a country like Canada that uses marketing quotas to avoid excess supplies of grain, the expected grain donation has to be included in the determination of the quotas. Evidence suggests that food aid donations are price responsive in the sense that changes in prices can induce variations around the expected donation at any point in time. Perhaps the best method to model food aid would be to build a disequilibrium model. In practice, this would be next to impossible since political markets would have to be included. We are back to where we started and the Ezekiel compromise appears to be a viable alternative.

3. Policy Implementation

The way in which agricultural policies are accounted for in the SWOPSIM and FAPRI models differs significantly (explicit policy variables do not appear in the WB model outside the U.S. and a trade liberalization scenario was not conducted). SWOPSIM involves more commodities but fewer individual countries than FAPRI. Agricultural trade liberalization in FAPRI is limited to grains in the U.S., E.C., Japan, Brazil, Argentina and most importing countries, plus livestock in the U.S., E.C. and Japan.

In SWOPSIM, policy interventions are accounted for using calculated price wedges (between domestic and world prices) and policy insulation is accounted for by using elasticities of price transmission of less than one. The size of the price wedge in SWOPSIM is equated to the producer subsidy equivalent for each commodity, in each country, using a broad definition of policy intervention (USDA). To illustrate this point and to provide a contrast with FAPRI, we chose to investigate the treatment of Canadian wheat.

In SWOPSIM, the Canadian market price for wheat is 117 C$/mt but the supply inducing price is 200.1 C$/mt. Canada's price transmission elasticity is assumed to be one. To model trade liberalization, the per unit PSE in Canada, as well as in all other countries, is set to zero, and for some countries the elasticity of price transmission is increased. The maintained assumption is that a dollar transferred to producers under <u>any</u> program has the same effect on their production choices. In contrast, in FAPRI, no changes are made to the Canadian grains submodel to simulate trade liberalization. Implicitly it is assumed that the parameters estimated in FAPRI reflect the response of both producers and the Canadian government as prices and policy transfers vary, and that these would be unchanged in the face of trade liberalization by other nations.

Neither of the extreme assumptions utilized in the SWOPSIM and FAPRI models are likely to be correct, with the truth probably lying somewhere in between. In fact, with the exception of the Canadian transportation subsidies, two-priced wheat, and fuel rebates, it is unclear exactly how to model Canadian grain policy. The Western Grain

[2] The demand cannot be infinite if the receiving country has to pay for shipping. We are assuming that food aid is free.

Stabilization Act and the Special Canada Grains Program are prime examples. Johnson, et al. argue that the effect of these programs (53 percent of total support in 1986) on supply decisions is zero and Ronnigen, et al. argue it has raised long-run price expectations by more than 35 percent of the market price. While this example may overstate the differences between SWOPSIM and FAPRI in regions where both have modeled trade liberalization, it does illustrate the different approaches taken by the two models.

Both SWOPSIM and FAPRI assume that the values of policy variables are determined exogenously and are not influenced by the economic environment (FAPRI analysts do interact with the model in determining the baseline forecasts) even though casual empiricism suggests that this is not the case. Why then, have most large commodity models not endogenized policies? First, policy analysis, almost by definition, requires that the value of key policy instruments be treated exogenously. In this way policy variables are easily manipulated to generate alternative "policy scenarios". Second, for short-run forecasting policy variables are often specified in legislation, or are relatively easy to project on the basis of historical trends. In addition, short-run forecasts are normally, although not always, dominated by non-policy factors (drought, livestock cycles, etc.). However, for long-run forecasts, the endogenization of key policy variables would have the advantage of getting away from the assumption of invariant policies (or a policy black box) in the face of a changing economic environment.

The Ezekiel model does not have policy variables which implies that its estimates of the import gap and food aid needs are independent of recent policy changes. Eventually, policy changes would be internalized in the trend variables but short run and intermediate run forecasts would be inaccurate.

4. Model inputs and assumptions

Commodity models can be no better than the data that are used to construct them. It is by now a cliche to state that as a profession we have invested far more resources in model building than in data improvement. Estimates of production, consumption and trade for the major agricultural commodities, in most countries, is generally available. However, reliable data on commodity stocks, producer prices and consumer prices, are spotty or non-existent. Good data on livestock production, herd size, the age/sex composition of livestock populations and average grain consumption per animal type is difficult to obtain for industrial countries and unreliable or not available for most other countries. Our data difficulties also extend to the policy arena where we have little easily accessible information on the policy instruments used in various countries, and the values of these instruments over a reasonable period of time. One of the lasting benefits of the USDA's work in calculating producer subsidy equivalents is likely to be a better understanding of the key policies in a number of countries.

Most of the assumptions embedded in our agricultural commodity models follow from neoclassical economic theory; although most models fail to exploit the full richness of this theory. However, a key assumption of all current large models is that of homogenous products (Goddard; de Gorter and Meilke). We find that for grains, let alone animal products, this assumption is not easy to defend. Trade in animal products often involves two-way trade in differentiated processed and semi-processed products; with trade further restricted to certain trading groups because of technical regulations. If this is a general representation of the trading environment, then the gains from trade liberalization are likely overstated in a homogenous product model unless the demand for new differentiated varieties increases substantially, an effect which is unlikely to be captured in an empirical model.

5. Models Results and Long Term Outlook

The modelers invited to this workshop have different commodity coverage, different levels of aggregation for commodities and countries and different base periods for their simulations. In contrast with the WB and SWOPSIM models, FAPRI's and Ezekiel's predictions do not extend to the year 2000. There are significant differences in the forecasts of the four models. These differences can be attributed largely to the unique nature of each model's design. However, it should be noted that the alternative scenarios and some of the assumptions regarding exogenous variables are not identical across the models.[2] This undoubtedbly contributes to the divergence in the predictions.

5.1 Prices

The SWOPSIM model predicts that by the year 2000 the real aggregate agricultural price index will be 3.8 percent lower than in 1986/87. Wheat, coarse grains, and soybean prices are expected to decline by 8.8, 9.6, and 9.8 percent, respectively, while dairy products and ruminant meats become more expensive by 3.1 and 10.2 percent. Within its narrower commodity coverage, the WB model forecasts larger price declines. Real prices for wheat (No.1 CWRS), corn and soybeans are forecast to be 23.0, 16.4 and 31.6 percent lower in 2000 than in the 1987 base year (table 1). FAPRI's price predictions are more optimistic. Johnson, et al. expect real prices for both wheat and corn to increase slightly by 1995 relative to 1986/87, while the real price of soybeans should decline by 9.2 percent.

To determine the degree of sensitivity of the predictions, the modelers ran different scenarios by modifying exogenous variables such as yields, GDP and population growth rates. In addition, they simulated trade liberalization in developed countries. The predictions of prices prove to be sensitive to the new assumptions. Under a low growth scenario, SWOPSIM projects dairy prices to be 15.7 percent below the base run in 2000 as opposed to a rise of 18.3 percent under optimistic conditions. Such variations clearly reveal

[3] For example, FAPRI uses slightly different GDP growth rates and the WB low and high growth scenarios include different population growth assumptions.

the high income elasticity of demand for dairy products. FAPRI's wheat price under the base run scenario for the year 1995/96 is $124/mt. If high growth or low yield conditions were to prevail, FAPRI anticipates the price of wheat to rise by 41.1 and 48.0 percent, respectively. The low growth/high yield scenarios would reduce the price to $86/mt and $84/mt. WB prices for wheat, corn and soybeans, like SWOPSIM's, do not increase as much as FAPRI's in a high growth scenario. In such a scenario, WB real prices for wheat, corn and soybeans would be 17.7, 16.3 and 22.5 percent higher in 2000[4]. This is somewhat surprising since FAPRI's 1995 projections do not benefit from the high growth taking place between 1995 and 2000. Based on FAPRI's results, it is evident that there is no substitute for rapid economic growth if the objective is to raise prices.

Table 1. Percentage Change in Real Prices for Different Scenarios.

	Base 1995/ Base 1986[a]	Freer Trade[b]/ Base 2000[c]	High Growth/ Base 2000[c]	Low Growth/ Base 2000[c]
WHEAT				
FAPRI	6.0	12.9	41.1	-30.6
WB 1995	-19.3	N.A.	12.5	-5.7
2000	-23.0	N.A.	17.7	-9.4
SWOPSIM	-8.8	25.9	15.9	-13.8
MAIZE				
FAPRI	10.0	18.4	44.8	-29.9
WB 1995	-13.2	N.A.	10.2	-7.5
2000	-16.4	N.A.	16.3	-9.6
SWOPSIM[d]	-9.6	18.8	10.8	-9.8
SOYBEANS				
FAPRI	-9.2	-9.6	52.1	-31.4
WB 1995	-30.1	N.A.	15.0	13.0
2000	-31.6	N.A.	22.5	-14.8
SWOPSIM[e]	-9.8	6.8	14.2	-11.6

[a] The base for WB is 1987.
[b] Trade scenarios differ between models.
[c] FAPRI's farthest projections are for 1995.
[d] Coarse grains prices.
[e] Oilseeds and products.

Note: Prices are not directly comparable across models because the modelers have chosen prices for different products and the wedges between these prices are not constant over time (eg. the WB price for wheat is the Canada No.1 CWRS price while FAPRI's price is for a U.S. No.2 H.W. 13%).

[4] As the time horizon is shortened, the impact of higher or lower GDP growth rates on real prices is reduced. For the year 1995, price increases due to higher GDP for wheat, corn and soybean would be 12.5, 10.2 and 15 percent respectively.

Due to the high level of trade distortions present in animal product markets (eg. quotas and technical regulations), SWOPSIM anticipates freer trade to be more effective in raising animal product prices than high growth. Freer trade's relative efficacy in increasing prices can also be extended to include wheat and coarse grains (in contrast with FAPRI).

FAPRI and SWOPSIM predictions also contrast in a freer trade environment. According to FAPRI, prices for soybeans and its by-products would decrease while the price of corn would rise. This may be attributed to the EC market where trade liberalization would lower the demand for protein meals and increase the demand for coarse grains. SWOPSIM's freer trade world is kinder to oilseeds and its products with a projected 6.8 percent price increase over the base scenario for 2000. According to SWOPSIM, the price for dairy products would experience a tremendous boost in a less distorted world. The Ezekiel model was not designed to forecast prices and cannot be compared to the other models on that basis.

5.2 Production

SWOPSIM's results are aggregated and cannot be directly compared to FAPRI or WB. SWOPSIM projects aggregate supply to be 16 percent larger in the year 2000 than in 1986/87. Freer trade would imply a decrease in aggregate supply of 11 percent when compared to the base run supply for 2000. Moreover, SWOPSIM'S aggregate supply is not very sensitive to changes in GDP growth rates. SWOPSIM and WB agree that production will increase relatively more in LDCs than in developed countries.

Table 2. Percentage Change in Production for Different Scenarios.

	Base 1995/ Base 1986	Freer trade/ Base 1995	High Growth/ Base 1995	Low Growth/ Base 1995
<u>WHEAT</u>				
FAPRI	15.7	-0.5	1.5	-1.0
WB	23.5[a]	N.A.	4.2	-2.0
<u>COARSE GRAINS</u>				
FAPRI	13.2	0.7	1.7	-1.3
WB	17.4[a]	N.A.	2.7	-1.8
<u>SOYBEANS</u>				
FAPRI	28.6	0	3.2	-3.2
WB	41.0[a]	N.A.	7.2	-4.8
<u>Aggregate supply growth</u>				
SWOPSIM[b]	28.0	-1.0	3.0	-4.8

[a] The base used by WB is 1985.
[b] The base used by SWOPSIM is 2000.

As shown in Table 2, both FAPRI and WB expect wheat, coarse grains and soybean production to increase by 1995. The WB model predicts higher production growth for the three commodities that the two models have in common. FAPRI and the WB model seem to confirm that production is not sensitive to changes in GPD with perhaps soybeans in the WB model being the one exception. One may suppose that the income elasticities for wheat and coarse grains are fairly low and/or that their supply curves are very inelastic.

Only FAPRI provided production changes on a commodity basis under a freer trade scenario. According to the model's results (Table 2), trade liberalization would have no impact on aggregate soybean production and very little effect on wheat and coarse grain production (0.5 percent decrease and .7 percent increase respectively).

5.3 Trade

For net trade, SWOPSIM's results are aggregated over commodities which makes it difficult to compare them with the FAPRI and WB

Table 3. Net Trade - The Impact of High Growth (% change).

	Developed Countries (net exports)		LDC's (net imports)		CPEs (net imports)	
	FAPRI	WB	FAPRI	WB	FAPRI	WB
<u>WHEAT</u>						
Volume 1995 (mil. tons)	89.0	100.6	70.8	85.3	17.2	15.3
Base 1995/ Base 1990 (%)	9.9	17.2	14.0	19.1	-9.0	7.0
High Growth/ Base 1995 (%)	6.7	25.9	10.0	21.8	-0.6	49.0
<u>COARSE GRAINS</u>						
Volume 1995 (mil. tons)	62.0	67.8	42.8	40.9	19.2	26.8
Base 1995/ Base 1990 (%)	29.2	45.8	32.1	36.3	23.1	63.4
High Growth/ Base 1995 (%)	19.4	32.3	21.5	31.8	19.8	33.6
<u>SOYMEAL</u>						
Volume 1995 (mil. tons)	-3.9	-4.9	-12.9	-13.7	9.0	8.8
Base 1995/ Base 1990 (%)	-8.3	7.5	-16.2	-7.0	20.0	18.9
High Growth/ Base 1995 (%)	21.1	18.4	-2.3	21.9	12.2	17.0

predictions. SWOPSIM forecasts an improved agricultural trade balance for developed countries by the year 2000 (9.5 percent rise). The same holds for CPEs but to a lesser extent since their net agricultural exports increase by only 2.6 percent as opposed to a fall of 12.1 percent for the LDCs. Higher GDP growth rates would raise developed countries' net exports by 23.3 percent and reduce the LDCs' agricultural trade balance by 6.1 percent. Freer trade would have the opposite effect by increasing the LDCs' self-sufficiency ratio by 9.1 percent and diminishing the developed countries' net exports by 12.5 percent. This could be explained by the higher (world) prices that would prevail in a world where trade was freer. These higher prices would reduce the LDCs' demand for imports from the industrialized world and would induce them to produce more.

Table 3 indicates the net trade of wheat, coarse grains and soymeal in 1995 predicted by the FAPRI and WB models. The two models have very similar forecasts for both soymeal and coarse grains. In the case of wheat, WB anticipates a larger volume of trade than FAPRI whose estimates for developed countries' net exports and LDCs' net imports are smaller.

Table 3 also shows the percentage change in expected net trade between 1990 and 1995. Again, the WB model shows more pronounced growth in developed countries' net exports and in LDCs' net imports than FAPRI. In general both models agree on the direction of the changes (eg. industrial countries' net exports of wheat and coarse grains should rise between 1990 and 1995). The exceptions are CPEs' wheat net imports and soymeal net exports from developed countries. As opposed to WB, FAPRI expects CPEs' wheat imports to decrease between 1990 and 1995 and industrial countries' imports of soymeal to increase during the same time period. FAPRI's net exports in 1995 are not as sensitive to changes in demand assumptions as are the WB forecasts. According to FAPRI, freer trade would have no effect on soymeal net exports and would have only minuscule effects on wheat and coarse grain trade.

The latest results from the FAPRI model show import gap estimates that can be used in a comparison with the estimated import gaps from the Ezekiel model. The comparisons are noisy since the country aggregations are not necessarily identical. Moreover, the FAPRI's

Table 4. Import Gap Estimates (million metric tons of cereal equivalent).

Country/Region	FAPRI	EZEKIEL
High income East Asia	16.0	12.7
Asia less China and India	30.0	18.7
Latin America less Argentina	21.0	8.83

estimates consist of the sum of the import gaps for coarse grains and wheat while Ezekiel's estimate have a broader commodity coverage. Table 4 illustrates some of the differences in the two models. It should be noted that Mexico and Brazil are not included in Ezekiel's country coverage for Latin America. Adding FAPRI's estimates of the import gap for wheat and coarse grains for Mexico and Brazil to Ezekiel's import gap global estimate increases the latter from 8.83 to roughly 19.0. Given its slightly more limited commodity coverage, one would have expected the FAPRI model to yield smaller import gap estimates.

5.4 Food Aid Needs

The model developed by Ezekiel is one that can partition the import gap and hence estimate food aid needs. The FAO model is also capable of accomplishing such a task. The Ezekiel model predicts that total food aid needs will reach 37.21 million metric tons of cereal equivalent by 1990, an increase of 81% over the estimated 1985 level (Ezekiel, 1988a; 1988c). Some previous studies have even larger estimates especially the ones that are nutrition-based (FAO, 1984). As expected, the region with the highest food aid needs is Sub-Saharan Africa with 13.71 million metric tons of cereal equivalents. South Asia has the highest ratio (81%) of food aid needs to the import gap (Ezekiel, 1988a).

6.0 Conclusion

Although there is some disagreement among the models on how real prices will evolve over the next decade, there is a concensus that agricultural price projections are quite sensitive to changes in GDP and that prices would rise under a freer trade scenario (except for soybeans in FAPRI). All three models agree that production will increase in the future. FAPRI does not expect freer trade to change the global production of soybeans, coarse grains and wheat as the production efficiency gains from trade are largely offset by the removal of production subsidies. SWOPSIM on the other hand forecasts that aggregate supply of the developed countries would decline by 11 percent under free trade. Net exports of wheat and coarse grains by developed countries should be higher by 1995 (FAPRI, WB) and more so if trade was liberalized (FAPRI), but a more global outlook shows that the agricultural trade balance for developed countries is likely to deteriorate in a freer trade scenario (SWOPSIM). SWOPSIM's analysis also shows that producer surplus in developed countries would be considerably reduced by trade liberalization which indicates the need for decoupled assistance programs, if maintaining farmers well-being is to remain a major goal of farm policy.

The Ezekiel model is not as elaborate in its design as the other models in estimating the import gap. We believe that its performance would be enhanced if it could borrow import gap estimates from models especially designed for that purpose. Unfortunately, most of the models that specialize in trade forecasts suffer from a higher degree of country aggregation. Food aid needs are growing rapidly and so is the proportion of food aid in the import gap for many regions. This is alarming since most of the countries have already benefitted from the Green Revolution and are not expected to experience much higher growth rates in production. As shown by the simulation results for high economic growth and freer trade, improved market efficiency could have a dramatic effect on production, prices and trade. Perhaps it is time for an "economic revolution". Hopefully, the current GATT negotiations will force DC's and LDC's to make some progress on trade liberalization. Needless to say, the removal of inefficient domestic marketing programs in LDC's would greatly improve food production and distribution and would limit food aid needs.

It is difficult to judge the validity of the above predictions. It was argued at the outset that some of the assumptions used to simplify the structure of the models are too restrictive and perhaps unrealistic. Nevertheless, we believe that this forecasting exercise has generated useful information if it is interpreted with caution. Regardless of the choice of analytical instrument (empirical models vs economic theory), one has to impose assumptions in order to obtain tractable results. As long as the results emerging from the models are consistantly close to reality, the choice of assumptions should not be overly questioned. This rule is not exclusive to empiricists. The Heckscher-Ohlin-Samuelson model is still the best theoretic trade model despite the well-known limitations of its assumptions. Like 2x2x2 theoretical models, econometric models are useful approximations of reality. As such, they do not have to be perfectly accurate to be valuable.

REFERENCES

Akiyama, T. and Mitchell, D. O. 1988. Outlook for Beverages, Grains and Soybeans to 2000. Paper presented at the XX International Conference of Agricultural Economists, Buenos Aires, Argentina.

Cahill, S. 1988 TASS (Trade Analysis Simulation System): Preliminary Documentation. Unpublished paper, International Trade Policy Directorats, Agriculture Canada.

de Gorter, H. 1987. "Agricultural Policies and International Trade Regulations." Can. J. Agr. Econ. 34(May):280-94.

de Gorter, H. and Meilke, K. D. 1987. "The EEC's Wheat Price Policies and International Trade in Differentiated Products." Amer. J. Agr. Econ. 69(2):223-229.

Ezekiel, H. 1988a. Medium Term Estimates of Food Aid Needs and their Variability. International Food Policy Research Institute, Washington, D.C.

Ezekiel, H. 1988b. Medium Term Estimates of Demand-Based Food Aid Needs and their Variability: A Note on Methodology. International Food Policy Research Institute, Washington, D.C.

Ezekiel, H. 1988c. Medium Term Estimates of Demand-Based Food Aid Needs and their Variability. International Food Policy Research Institute, Washington, D.C.

Food and Agriculture Organization of the United Nations. 1984. Assessing Food Aid Requirements: A Revised Approach. FAO: Rome.

Food and Agriculture Organization of the United Nations. 1987. Commodity Review and Outlook 1986-87. FAO: Rome.

Goddard, E. W. 1987. "Imperfect Competition in World Trade." Can. J. Agr. Econ. 34(May):265-79.

Hertel, T. 1988. Negotiating Reductions in Agricultural Support Under the Gatt: Implications of Technology and Factor Mobility. Unpublished Paper, Dept. Agr. Econ., Purdue University.

Johnson, S. R., Meyers, W. H., Westhoff, P. and Womack, A. 1988. Agricultural Market Outlook and Sensitivity to Macroeconomic, Productivity and Policy Changes. Paper presented at the XX International Conference of Agricultural Economists, Buenos Aires, Argentina.

Meilke, K. D. 1987. A Comparison of the Simulation Results from Six International Trade Models. Working Paper 87/3, Dept. of Agr. Econ. and Bus., University of Guelph.

Organization for Economic Cooperation and Development. 1987. National Policies and Agricultural Trade. OECD: Paris.

Roningen, V. O., Dixit, P. M. and Seeley, R. 1988. Agricultural Outlook for the Year 2000: Some Alternatives. Paper presented at the XX International Conference of Agricultural Economists, Buenos Aires, Argentina.

U.S. Dept. of Agriculture 1988. Estimates of Producer and Consumer Subsidy Equivalents: Government Intervention in Agriculture, 1982-86. Staff Rpt. AGES880127, Economic Research Service, Washington, D.C.