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THE EFFECT OF TRADE LIBERALIZATION IN AGRICULTURE ON THE U.S. ECONOMY TO 1991

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1. Introduction

In recent years, two trends have dominated world agricultural markets. First, there has been a steady increase in the rates of protection of the agricultural sector in developed countries. Second, there has been a dramatic drop in world prices of primary commodities. The decline in world prices, which was not met by an increase in demand, has led to spiraling costs of domestic support programs as governments sought to maintain farm incomes in the face of declining revenue from the world markets.

Governments have come to realize that they operate in an increasingly interdependent world. Their domestic support policies have served to exacerbate the excess supply on both world and domestic markets since, in many countries, support has not been accompanied by programs to reduce output. The lesson is that policies with a primarily domestic focus can nonetheless have a significant impact on trade.

It is particularly difficult to measure the welfare effects of policy-induced distortions that have both domestic and international allocative impacts. The theoretical literature, which is largely concerned with the benefits of free trade in undistorted economies, provides little guidance about how to determine whether or not the removal of one of many distortions will improve welfare in a particular country. We might then turn to the second-best literature on gains

from trade. This literature yields some counterexamples to the "universal gains from trade" proposition, but does not provide specific guidelines for assessing the impact on domestic welfare of the removal of a particular distortion.

The welfare gains (or losses) from reducing distortions in a tradeable sector will depend on a number of factors. These include the size of the original distortion, the magnitude of the distortion relative to the difference between the undistorted domestic price and the world price, and the difference between the free trade domestic outputs and prices in the distorted and undistorted equilibria. In turn, the magnitudes of these differences will depend on elasticities of transformation between tradeables and nontradeables, sectoral trade substitution elasticities and trade shares, the price elasticity of demand for exports, and price and income effects on the domestic demand side. These are likely to be commodity, distortion, and economy specific.

To analyze this complex problem, we use an empirical approach by constructing a computable general equilibrium (CGE) model of the U.S. The CGE model consists of a set of parameterized simultaneous equations that simulate a market economy and which are solved to yield equilibrium prices and levels of market activity. The parameters of the model include those required to determine the magnitudes of welfare changes arising from changes in policy instruments: measures of distortion, elasticities, shares, and the initial conditions reflected by sectoral structure of input use, output, and relative prices.

The present paper analyzes the prospective impact of removing a particular set of distortions --producer subsidies in U.S. agriculture-- on the structure of the economy in 1991. Agriculture is a major trading sector and has significant linkages with the rest of the economy, both forward and backward. Agricultural exports contribute significantly to the U.S. balance of trade. The major forward linkage is with the food and fiber processing sectors, the products

of which comprise a large share of consumer expenditure.[1] Finally, agriculture is capital-intensive and competes with other sectors for the employment of capital as well as labor.

In this paper, we first outline the subsidy programs in U.S. agriculture in place through 1990/1991 under the 1985 Farm Bill. We then describe the CGE model which is used to provide a base-run projection from 1986 to 1991, assuming the policies established by the 1985 Farm Bill remain intact. Next, a series of experiments is conducted to analyze the impact of removing the producer subsidies. Finally, we discuss implications for policy.

2. Producer Subsidies in U.S. Agriculture

In the United States, federal and state programs targeting agriculture include some which distort production incentives, some which are intended to be pure income transfers, and others that seek essentially to internalize externalities. Here we are primarily concerned with the programs which influence production and marketing decisions. The criterion used to determine which programs directly influence supply and demand behavior is whether or not the policy instrument is an argument in the agent's behavioral equation. Accordingly, we draw on the voluminous theoretical and applied literature analyzing the effect of U.S. farm programs on agricultural employment and output. We focus on the programs which distort production incentives and the domestic/imported commodity mix in the short run, and which affect the use of land in the medium to long run.

The other program expenditures are intended to be, and are treated as, either lump-sum income transfers or expenditures on public goods. Agricultural

[1]For an analysis of these linkages, see Henry and Schluter (1985).

research and extension can be seen as public goods by virtue of the lack of proprietary control over agricultural production technology. Soil conservation also represents a public-good issue. These programs deal with externalities and are not considered to affect producer behavior at the margin.

In our model there are three agricultural sectors. The "dairy and meat" sector includes milk, eggs, poultry, and meat. The "grains" sector includes food and feed grains, as well as soybeans and cotton. The "other agriculture" sector includes sugar, tobacco, vegetables, and all other agricultural output. Agricultural programs differ between these sectors but are relatively homogeneous within each sector.

Programs which distort production incentives in the short run are measured ex post by a summary "producer incentive equivalent" (PIE) rate, calculated as the value of the subsidies paid to each sector divided by the value of sectoral output. In the U.S. in 1986, $25.9 billion were spent to support the agricultural sector in ways that distort producer incentives. For the three agricultural sectors in the model, these translate into the following PIE rates: 6.24 percent in dairy, 28.39 percent in grains, and 1.26 percent in other agriculture. The dollar values of the sum of price-increasing and cost-reducing transfers per sector are calculated from the data reported in the Mid-Session Review of the Commodity Credit Corporation (July, 1987). The denominators for these rates are calculated using the input-output data that are the basis for the value of output in our model.

The dairy and meat sector subsidies arise from programs that support prices, restrict imports (both directly and through the use of quality controls), and subsidize exports. In particular, the price of milk is supported through a mandatory marketing order program that establishes the minimum price handlers must pay to milk producers. Milk production amounts to 17 percent of the value of output of the "dairy and meat" sector. The support price for milk is

maintained by the existence of import quotas on processed milk products and government purchases of butter, cheese, and nonfat dry milk. As long as the quotas are binding, the domestic price of processed dairy products will be higher than the world prices. Then, if necessary, the government accumulates stocks to support the price processors pay to milk suppliers.

The export program operates by awarding a payment-in-kind to exporters of U.S. products to specified foreign markets that compensates exporters for the low competitive price paid by the importer. This selective export "enhancement" program (EEP) is available for dairy cattle, poultry, and eggs, in the "dairy and meat" sector. An export enhancement program that operates in the same way as the export program in the dairy and meat sector is also in effect for wheat and some minor grains. This program reduces the downward pressure on market prices and loan rates exerted by excess domestic grain stocks.

The EEP is modelled as an ad-valorem subsidy on exports of farm products. The ad valorem rate is the ratio of the EEP bonuses to the value of exports, by sector. In 1986, the export subsidies under the EEP amounted to 20.9 percent in "dairy and meat," 3.6 percent in "grains," and 1.0 percent in "other agriculture."[2]

Direct subsidies in "other agriculture" are available for only a few crops in that sector, including sugar, tobacco, and peanuts. The price paid by processors to producers of sugar (about 5 percent of the value of the "other agriculture" sector) is supported by quotas on sugar imports and by a non-recourse loan program. Government stocking and production quotas help maintain producer prices in the tobacco and peanut industries. Phytosanitary regulations and seasonal restrictions on fruit and vegetable imports also help to raise the

[2]The value of EEP bonuses for "dairy and meat" and "other agriculture" was calculated from FAS REPORT press releases for calendar year 1986. The EEP for "grains" was provided by Mark Smith at ERS/USDA.

market price of domestic production in the other agriculture sector.

In the "grains" sector, market prices are supported by government accumulation of stocks under the non-recourse loan programs, which apply to nearly 80 percent of the sector's output in value terms. Income support is provided to farmers who participate in acreage reduction programs through government transfers called deficiency payments. In 1986, participation in government programs rose to a record high, with (for example) over 85, 90, and 97 percent of farmland in wheat and corn, cotton, and rice, respectively enrolled in the Acreage Reduction Programs; to be eligible for deficiency payments.[3]

The deficiency payment rate is equal to the difference between the "target price" and the higher of the market price or the loan rate price, and is applied per unit of predetermined output. The levels of the target and loan rate prices and the amounts of acreage to be withdrawn from production are determined in accordance with the provisions of the 1985 Farm Bill and announced before planting. The loan rate is set at 75-85 percent of past average market prices for the grains sector. The government's accumulation of commodity stocks in lieu of loan repayment supports the market price to some extent. Nevertheless, in 1986, the average loan rate was over 150 percent of the average market price.[4]

Which (or what combination) of the target, loan rate, or market prices represents the incentive to produce? Clearly, given all the subsidy programs, the market price is not the determinant of the returns to labor, land, and capital in agriculture. For participants, the loan rate price is the value of

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[3]For participation rates for the years 1983 through 1987, see table 22, page 48, in Agricultural Outlook, ERS/USDA AO 139, (March 1988).

[4]The predetermined output is calculated as the five-year moving average yield per acre times the "program" acreage. The "program" acreage is the amount of land that the farmer has previously planted to program crops which he has certified to be part of the base acreage. The 'program' acreage includes the land set aside (not currently in production of program crops) as well as planted acreage. See Glaser (1986).

the production forfeited under the loan program, but it is not a measure of total net returns to producers who participate in farm support programs since deficiency payments would also be included in total returns. Deficiency payments in 1986 almost doubled net farm income on grain farms. Farmers assume that eligibility for future payments depends on the current allocation of resources to program crops, so the target price provides an incentive for current resource allocation and the supply of grains. This conclusion is particularly true when participation in the programs is high, as is currently the case. While the loan rate and the market prices also have some effects on expectations and incentives, the target price appears to be the most important signal.

At issue is how to model supply behavior in the agricultural sectors. Econometric models include the target price relative to the market clearing price as a major determinant of land use under farm programs in agriculture.[5] Similarly, in our model, the incentive signal for farmers is assumed to be the target price for 1985 through 1991, which have already been set according to the provisions of the 1985 Food Security Act.

In the "dairy and meat" and the "other agriculture" sectors, where the target prices are supported largely by the existence of import controls and secondarily by government stock accumulation, we assume that the quotas reduce actual imports to half of their desired value, given observed prices. Also, since the processed dairy products, against which the import quotas are applied, comprise a very small portion of the value in the "light consumer" sector, we assume that the quotas are levied against the raw products.

To model these agricultural programs, we calibrated the model for 1982 with target prices, loan rates, import quotas, export subsidies, land set-asides, and government stocking behavior in place. The model was then benchmarked for

[5]For an exemplary analysis, see Houck et al., (1976).

1986 by setting those policy instruments at the 1986 levels relative to 1982, adding the Export Enhancement Program export subsidies, which were not present in 1982. Given the target prices, resources are employed in the agricultural sector according to profit maximization behavioral rules. Market clearing prices are determined endogenously and simultaneously with production, the levels of government commodity accumulation, export supply, and domestic demand.

Two measures of sectoral subsidization are then calculated ex post, the PIE ad valorem rate and the Producer Subsidy Equivalent (PSE). The PIE rate is calculated as the percentage difference between the exogenous target or support price and the endogenous market clearing price. This wedge represents the part of the output subsidy due to the existence of support prices paid by the government to producers. Since border measures and government stocking raise the market clearing price closer to the support price, the wedge between the market price and the target price does not measure all of the incentive distortion arising from the programs.

The producer subsidy equivalent (PSE) is loosely defined as the amount of direct income transfer necessary to compensate the producer for the loss of the subsidy programs, at the observed level of supply. It is estimated as the amount of income due to the programs in each sector. The PSE can be defined in relation to several bases: with respect to total income, the quantity produced, or the value of production (in terms of domestic or world prices). Following the OECD and Ballenger et al. (1987), we use total sector income as the denominator. The PSE rate is then calculated as the ratio of income generated by the support programs to total income.[6]

The income due to programs includes deficiency payments, the value of excess stocking to support the market price, and part of the premia rent arising

[6]For further discussion of PIE and PSE rates, see Rausser and Wright (1987); Josling and Tangermann (1987); and Tangermann, Josling, and Pearson (1987).

from quantitative restrictions. Since the import controls are on processed farm products, in this model the rents generated by the existence of quotas are first accumulated by the importing sector. The producing sector's share of the quota rents is assumed to be equal to the producer share of the retail value of the item. The value of the market price support provided by government stocking behavior is the value of government stock demand for program commodities in excess of normal carryover demand. Government stock demand is modelled as a function of the ratio the market price to the loan rate, with a demand elasticity of 5.0. The sum of program-related sectoral income elements comprises the numerator of the PSE ratio. The denominator is the sum of the sectoral program income, market income, and any other direct transfer payments to the sector.

3. A CGE Model of the U.S. Economy

Our U.S. CGE model is in the tradition of models developed for the analysis of trade policy.[7] The model equations describe the behavior of the various economic agents in markets for factors and commodities. It is neoclassical and Walrasian in spirit, solving for a set of relative prices, including the real exchange rate, that achieve full-employment, flow equilibria in all markets.

There are ten sectors producing commodities for domestic use and for export: three agricultural sectors, five industrial sectors, and two service sectors.[8] The agricultural sectors are roughly categorized by trade shares. In the "dairy and meat" sector, both exports and imports are very low. In the "grains" sector, exports are very significant. Finally, "other agriculture" produces a

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[7]Our particular model is an extension of the model by Adelman and Robinson (1987). It is close in spirit to the model described in Condon, Robinson, and Urata (1985). Related models are discussed in Dervis, de Melo, and Robinson (1982); and Robinson (1987).

[8]See Appendix I for the industry composition of sectors in the model.

heterogeneous mix of agricultural products for which there are smaller, but still significant, levels of exports and imports.

There are three primary factors of production: labor, capital, and agricultural land. The aggregate supplies of labor and capital are assumed fixed, but both factors are assumed to be freely mobile among sectors. Land is specific to two of the agricultural sectors ("grains" and "other agriculture") and can be freely shifted between them. In this model, based in 1986, when program participation rates were high, the aggregate supply of crop land is bound from above under the set-aside constraints of the farm programs. For the "no program" experiments, land supply for crops is modelled as a fairly inelastic function of the ratio of the solution marginal value product of land relative to the 1986 value.[9]

The model is designed to perform experiments in a comparative static framework spanning a period long enough so that it is reasonable to assume that sectoral investment is affected by changes in relative prices and policies. In equilibrium, the model will determine average rentals for land and capital, and an average wage rate, that clears the markets for land, capital, and labor. Different returns to land, labor, and capital among sectors are taken into account in the model by imposing fixed ratios of the factor return in each sector relative to the economy-wide average rate of return. These ratios are computed from the 1982 base-year data.

Equilibrium solutions under existing policies represent allocations of labor and capital (implicitly, investment) among sectors that maintain the

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[9]The land supply equation is similar in content to the land supply equations in the model "AGSIM" at the Univ. of Illinois (C. R. Taylor, 1988). Estimated elasticities of regional land supply with respect to expected productive returns to land range from 0.06 to 8.89. We assume a 0.5 elasticity of land supply with respect to the relative productive return to land. With this elasticity, the acreage restrictions (on land in crops while subsidy programs are operative) reduce land in crops by about 16%, which is close to the required cropland set-aside rate under the 1985 farm bill.

relative profit and wage distortions observed in the economy in the base year. The results of induced changes in sectoral investment (and disinvestment) are modeled by assuming intersectoral capital mobility. When agricultural subsidy policies are dismantled, these fixed ratios of rates of return to capital in agriculture are exogenously specified to fall to the economy-wide average, and capital investment is reallocated accordingly.

Production technology in all sectors is specified by Cobb-Douglas functions in labor and capital, (and also in land in the two land-using agricultural sectors). Intermediate inputs are assumed to be required according to fixed input-output coefficients. This simple formulation is adequate for our present purposes, but is clearly worth extending.[10] Technological change, which is specified exogenously over time, is assumed to be Hicks (and Harrod) neutral, output-augmenting, productivity growth.

On the demand side, the model includes the following actors who receive income and demand goods: households, government, capital account, and the rest of the world. There are three types of households in the model, categorized by income class, who own capital and land, and receive income from wages, profits, rents, and government transfers. Households pay taxes and save according to fixed average saving rates and then allocate their consumption expenditure according to a simple linear expenditure system.

The Treatment of Foreign Trade

The behavior of the "rest of the world" in the model is characterized very simply. On the import side, the U.S. is assumed to be a "small country" and hence can purchase as much imports as it wishes with no impact on world prices.

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[10]For a discussion of an alternative technology specification, see Hertel (1988).

For non-agricultural exports, the U.S. is also assumed to follow the "small country" assumption, with world prices fixed exogenously. For two of the three agricultural sectors, however, there are equations describing world export demand behavior as a function of U.S. export prices. World prices of exports are assumed to be inversely related to U.S. agricultural export volumes, with fixed price elasticities.[11] The constants in these world demand functions are shifted up exogenously in the base-run projection to 1991, reflecting an assumed increase in world income in the 1986-91 period. The functions are of the form:

$$E = EO * (PWE/PWSE)^{ETA}$$

where EO is a constant, PWE is the world price of U.S. exports, PWSE is the exogenous world price of competing exports from other countries, and ETA is the elasticity of export demand.

The U.S. share of total world exports has fallen in recent years and is currently below 12 percent. For imports, the share is around 15 percent.[12] In world agricultural trade, however, the U.S. is much more important. For example, the U.S. accounts for over half of the world grain trade.[13] These stylized facts imply that agriculture should be treated differently from non-agricultural trade, as we have done in the model.

Products in the model are distinguished by place of origin, domestic or foreign. The sector aggregation of the model was chosen to highlight the differences between sectors with respect to shares of domestic and foreign goods in production and consumption. Imports are assumed to be imperfect substitutes

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[11]Estimates of the price elasticities of world demand for U.S. agricultural exports are based on an examination of a number of econometric studies. Given the medium to long run focus of our analysis, we have sought estimates of long run demand elasticities. The export demand elasticities for both "grains" and "other agriculture" are assumed to equal 3.0.

[12]U.S. Department of Commerce (1986).

[13]Houck (1986).

in consumption for domestically produced goods of the same sector classification.[14] Consumers purchase composite commodities which are constant elasticity of substitution (CES) aggregates of the imported and domestically produced good. The share of imports in sectoral demand is inversely related to the relative price of imports (PM in domestic currency) to domestically produced goods of the same sector classification (PD).

Producers in each sector supply a composite commodity which has to be transformed in order to be shifted between the domestic and export market. The sectoral composite is defined as a constant elasticity of transformation (CET) aggregate of exports and domestic-market goods.[15] Sectoral supply behavior thus depends on the target price (TP) in the agricultural sectors; and on the composite good price (PX) in sectors without explicit distortions. PX is a weighted average of the domestic and export prices (PD and PE), net of indirect taxes. The proportion of output destined for the export market is positively related to the price of the good in world markets (PE in domestic currency) relative to the price in the domestic market (PD).

Given the distinctions in the model between imports and import substitutes; exports and goods destined for domestic demand; and composite commodities, the model specifies a number of different prices associated with each sector. The composite domestic-demand price (P) corresponds to a retail sales price and is a weighted average of the domestic price of imports (PM) and the price of goods sold on the domestic market (PD), with the weights being the quantities of imports (M) and domestic goods sold on the domestic market (XXD) as ratios to composite good supply (X):

$$P = PM * (M/X) + PD * (XXD/X)$$

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[14]This treatment follows Armington (1969).

[15]For a description of this treatment in a CGE model, see Condon, Robinson, and Urata (1985).

The domestic price of an import depends on the world price (PWM in foreign currency), the currency exchange rate (EXR), and any tariff (TM):

PM = PWM * EXR * (1 + TM)

The domestic price of an export (PE) is defined symmetrically, where any subsidy or tax on exports are given by TE:

PE = PWE * EXR * (1 + TE)

The composite producer price (PX) is a weighted average of the domestic price of exports (PE) and the price of goods destined for the domestic market (PD), with the weights coming from the CET export aggregation function. Producers make supply decisions based on the value-added price (or net price), which is defined as:

PVA(i) = PX(i) * (1 - ITAX(i) + PIE(i)) - SUM(j, P(j)*A(j,i))

where ITAX is the indirect tax rate, PIE is the producer incentive equivalent, P is the composite good price (defined earlier), and the A's are the input-output coefficients. The subscripts i and j refer to sectors, and SUM is the summation operator. Given that input-output coefficients are fixed, changes in PVA measure changes in "resource pull" effects. A sector whose relative value-added price rises, whether due to increases in PX or changes in taxes and subsidies, will tend to pull resources away from other sectors.

For the non-agricultural sectors, PIE's equal zero. For the agricultural sectors, as discussed above, it is assumed that producers respond to an exogenous target price, and hence to a value added price where the target price replaces PX. In these sectors, the PIE is determined endogenously to reflect the difference between the target price and the solution market price.

The model is Walrasian in that only relative prices matter. Thus, in addition to these sectoral prices, one must specify a numeraire good whose price is set to one, thereby defining the base for all relative price computations In this model, the GNP deflator is chosen as numeraire and is set to one in the

base year (1982). For the 1986 base, the value of the GNP deflator is set to its actual value, which is then kept fixed in the forward projections to 1991. Thus, all 1991 nominal magnitudes solved in the model can be interpreted as being roughly in 1986 prices, since the model solution is "normalized" on the 1986 GNP deflator. One must also interpret the solution prices as being relative prices, relative to the fixed GNP deflator.[16]

The balance of trade constraint can be written (summing over sectoral imports and exports) as:

SUM((i, PWM(i)*M(i)) = SUM(i, PW(i)*E(i)) + FSAV + FBOR + REMIT

where FSAV represents foreign capital inflows, FBOR is net foreign borrowing by the government, and REMIT is remittance income from abroad. In the base run, each of these items (FSAV, FBOR, and REMIT) is specified exogenously, so the model must adjust to a fixed balance of trade. The equilibrating variable is the exchange rate (EXR). Changes in the equilibrium exchange rate, however, must be seen as changes in a relative price, given the choice of numeraire (the GNP deflator). The equilibrating mechanism is through changes in the real exchange rate, which is the relative price of tradeables to domestic goods sold on the domestic market. Thus, the real exchange rate must increase (devalue) if the exogenous balance of trade is required to improve, or decrease (revalue) if the balance of trade is assumed to worsen. Given the choice of numeraire, there will be a monotonic relationship between changes in the "nominal" exchange rate in the model and changes in the real exchange rate, but the two will not be equivalent.[17]

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[16]This choice of numeraire differs from Adelman and Robinson (1987), who chose as numeraire an index of the price of domestically produced goods sold on the domestic market. They fixed this index at one for all their experiments.

[17]See Dervis, de Melo, and Robinson (1982), chapter 7, for a discussion of this issue. See also de Melo and Robinson (1987).

In the various experiments, an alternative foreign closure is used. The exchange rate is fixed at the 1991 solution level, while foreign savings are allowed to adjust to any change in the endogenous balance of trade. Thus, FSAV indicates the status of the current account.

Macroeconomic Closure

The model determines only flow equilibria and does not include any assets or asset markets. It does, however, incorporate the major macroeconomic aggregate nominal balances:

$$Z = SH + SG + F$$

$$SG = T - G$$

$$F = M - E$$

where Z is aggregate investment, SH is total private savings, SG is government savings, F is foreign savings (the balance on current account), T is total government revenue, G is government expenditure, M is aggregate imports, and E is aggregate exports. Much effort and controversy have revolved around describing how an economy achieves balance among these macro aggregates. For our analysis, in which we assume full employment and exogenous inflation, the issue is relatively straightforward. Our focus is on the impacts of exogenous changes in macroeconomic aggregates on sectoral structure, not on interactions among macroeconomic aggregates.

The government receives revenue from taxes and spends it on goods, transfers to households, program commodity stock accumulation, and subsidies to producers. Government expenditure on commodities is allocated among sectors according to observed shares. The government also borrows from (or lends to) the rest of the world, with the amount fixed exogenously. Aggregate government expenditures on goods and transfers are fixed exogenously, and the government

is assumed not to be subject to a revenue constraint.[18] Any deficit or surplus in the government budget is determined residually and is assumed to be balanced by a withdrawal from, or injection into, the loanable funds market. The model thus embodies the macro assumption of perfect crowding out or in of government deficits or surpluses.

In the model, investment is "savings driven." In effect, there is a loanable funds market which gathers savings from all sources (private, government, and foreign) and allocates them to the purchase of investment goods.[19] Private savings are determined by fixed savings rates out of disposable income. Foreign savings are given exogenously for the base run and projection, but are endogenous in the experiments. Government savings (or deficits) are determined endogenously, given government expenditure and endogenously determined revenue.

In the experiments reported below, major changes in the balance of trade and the government spending are assumed to occur between 1986 and 1991. Given the assumption of full employment, these changes can have little or no effect on aggregate GNP. One focus of the analysis of the forward projection, however, is on the impact of shifts in macro aggregates on the sectoral structure of demand, supply, value added, and prices. For this analysis, we consider only one macro scenario, which is discussed in the next section. The ultimate focus is on the impact of changes in sectoral incentive policies and in world market conditions --trade liberalization-- on the economy. In these experiments, the macro scenario is held constant, although the government budget deficit is still determined residually.

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[18]Aggregate expenditure on goods is fixed in real terms, with sectorally fixed shares. Aggregate transfers are also fixed in real terms, using the GNP deflator to deflate nominal transfers.

[19]Note that the model is static in the sense that this investment is not installed and has no effect on the aggregate capital stock within the period.

The sectoral composition of value added, the shares of exportable good production by sector, the ratio of imported goods to domestic production, and the main parameters of the model for 1986 are presented in Table 1.[20] These data provide a picture of the economy in the base year and are useful for understanding the experiment results reported below.

4. The 1986-91 Base Run

All of our liberalization scenarios start from a baseline, five-year projection from 1986 to 1991. This base run of the model consists of a comparative static experiment which starts from a solution for 1986 and is solved assuming annual rates of growth in exogenous variables over the five years to 1991. These assumptions are compared to recent historical rates of growth in Table 2. The modelled growth in GNP is driven by assumptions about exogenous growth rates of total factor productivity (1.7 percent per year), the capital stock, and the labor force.

We have chosen to model a single macroeconomic scenario for the projection to 1991 as the base solution. Counterfactual experiments consisting of different agricultural policy mixes are conducted with respect to this base; that is, assuming no change in this basic macroeconomic projection. Comparisons of liberalization scenarios against the base are relatively insensitive to variations in the macro assumptions. The projected macroeconomic structure is compared to the current situation in Table 3. The most important assumptions are that as shares of GNP, the government deficit shrinks and net exports increase.

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[20]The data are from a model solution for 1986. The model starts from a 1982 benchmark equilibrium, and the 1986 solution was calibrated to match the national accounts for 1986 as closely as possible. The fit, however, is not exact; the model was not "recalibrated" on 1986.

Table 1:

Sectoral Composition, Trade Shares, and Elasticities, 1986

Sector	Sectoral Composition: Value Added	Gross Output	Exports	Imports	Trade Shares: Exports/ Output	Imports/ Output	Elasticities: Import Subs	Export Trans
	- - - - - - - - - - - - percent - - - - - - - - - - - -							
Dairy and meat	.30	1.20	.06	.14	0.25	0.86	2.00	0.50
Grains	.95	1.18	5.90	.02	26.50	0.11	4.00	4.00
Other agriculture	.77	0.78	.51	1.08	3.36	10.38	4.00	2.00
Sum/average	2.02	3.16	6.47	1.24	7.74	2.99	--	--
Light consumer	6.94	10.90	7.18	10.39	3.48	7.18	2.00	2.00
Basic intermediate	9.94	13.84	11.37	34.46	4.34	18.76	0.75	2.00
Capital goods	5.07	8.37	20.58	20.54	12.99	18.50	0.75	2.00
Construction	4.94	7.31	.02	0.00	.01	0.00	0.90	1.50
Electronics	1.94	2.26	4.76	9.63	11.13	32.08	1.10	2.00
Sum/average	28.83	42.68	43.91	75.02	5.55	13.02	--	--
Trade and finance	16.85	14.47	6.58	0.00	2.40	0.00	0.20	0.00
Other services	52.30	39.69	43.04	23.74	5.73	4.51	0.20	0.60
Sum/average	69.15	54.16	49.62	23.74	4.90	3.29	--	--
Total/average	100.00	100.00	100.00	100.00	5.27	11.35	--	--

note: (--) indicates not applicable

Table 2:

Annual Growth Rates of Selected Variables

Variable	Annual Growth Rates (percent): Actual 1982-1986	Base Run 1986-1991
Consumption	4.6	2.1
Investment	10.0	1.1
Government	4.1	0.7
Exports	1.1	6.6
Imports	11.7	2.2
GNP	4.1	2.1
Agricultural value added	2.8	-2.7
Factor Inputs		
Capital	2.6	2.4
Labor	2.4	1.2

Notes: "Actual" rates of growth calculated from Survey of Current Business data. "Base Run" rates calculated with respect to model solution. "Rate" is the percent annual compound rate of growth.

Table 3:

Composition of GNP
(Percent, in Current Prices)

Share of GNP	- - - actual - - - 1982	1986	Base Run 1991
Consumption	64.8	66.1	65.2
Investment	14.1	15.9	16.3
Government	20.3	20.5	18.8
Exports	11.4	8.9	12.8
Imports	10.6	11.4	13.1
Agricultural value added	2.8	2.2	1.7
Government deficit	3.5	3.5	0.7
Exports - imports	0.8	-2.5	-0.3

Notes: "Actual" data are from the Survey of Current Business, July 1987. "Base Run" data are the results of the base forward projection to 1991. "Agricultural value added" in the National Income and Product Accounts (NIPA) includes, by definition, imputed rent from owner-occupied dwellings, which are included instead in the service sector in the input-output accounts. The model results are adjusted to be consistent with the NIPA definition. The trade deficit (exports - imports) also follows the NIPA convention and equals the current account balance.

Table 4:

Various Price Indices
(1982 = 100)

Variable	Actual 1986	Base Run 1991
GNP Deflator	114.1	114.1
World price of exports	97.8	94.8
World price of imports	88.8	88.8
Nominal Exchange rate	100.0	120.1
Real exchange rate	84.2	99.4
Domestic price of exports	103.6	114.4
Domestic price of imports	92.6	109.8
Domestic sales price	116.6	112.4
Cost of living	113.2	113.1
Real wage	105.1	110.7
Agricultural terms of trade		
Output prices	83.5	82.8
Value added	76.6	80.8
World prices, imports	108.5	109.3
World prices, exports	100.0	57.4

The macro scenario for the 1986-91 period is mildly optimistic. The government deficit is assumed to fall by $113 billion, to $34.5 billion, largely by not permitting significant growth in real government expenditure rather than by tax increases.[21] As the government deficit shrinks, so does the trade deficit, by assumption.

The improvement in the foreign trade balance is accompanied by a devaluation of the real exchange rate. Earlier analysis of the 1982-86 period with a related model indicated that macro policy choices leading to a large government deficit and trade deficit were responsible for the major real revaluation observed in the period.[22] With the assumed reversal of these swings in macro aggregates in the 1986-91 period, the real exchange rate is projected to move slightly above its 1982 value. In both periods, an implication of the analysis is that the movements in real exchange rates are largely the result of U.S. policy choices, rather than any policy choices by other countries.

As shown in Table 4, the real exchange rate (the price of nontradeables relative to the price of tradeables) revalues in the 1982-86 period by 18.8 percent and then devalues in the 1986-91 period, with the index falling to 0.6 percent above the 1982 base value. The devaluation is necessary to boost exports and reduce import demand, according to the projected improvement in the trade balance. The nominal exchange rate also devalues by about 20 percent.

The agricultural sectors benefit from the devaluation and the small improvement in the international terms of trade relative to 1986, with exports increasing 20 percent over the projection period. Otherwise, agriculture's contribution to the overall economy shrinks during the projection period because

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[21]Note that as far as the model results are concerned, it does not matter much whether the government deficit is removed by decreased expenditure or increased taxes.

[22]See Adelman and Robinson (1987).

of the falling value of agricultural output under the assumed conditions of continuing excessive supply at market prices. Although target prices increase to 1991 according to the provisions of the 1985 Farm Bill, loan rates fall closer and closer to the market clearing prices and land set-aside constraints continue to bind. Excess supplies accumulate and government stocking tops out, with the result being relatively low market returns in agriculture. The PSE rates are much higher in 1991 than 1986, with 75% of the net income for "grains" coming from government programs.

5. Trade Liberalization Experiments

All trade liberalization experiments have been conducted with respect to the base solution for 1991. The projected rates of growth of productivity, aggregate supplies of primary factors of production, and the levels of non-agricultural program federal spending for 1991, remain the same throughout the experiments. In order to focus on the effects of agricultural policy changes, we also assume that the exchange rate remains at the projected 1991 solution level, with foreign savings adjusting to maintain balance between the current and the capital accounts at that exchange rate. The experiments consist of varying the agricultural subsidy program instruments, first one-by-one, and then in various combinations.

The first set of experiments demonstrate the impact of the separate components of the U.S. farm programs: resource-use constraints, border measures, and domestic price and income supports. We model the economy with one set of distortions removed, while the other distortions are left intact. These experiments thus measure the direct general equilibrium impact of each distortion on output, trade, and prices. The experiment "Land" relaxes the constraints on land use imposed on the farm sector under the subsidy programs. The experiment

"Border" removes the protection offered by the border measures. The quotas on imports of dairy and other agricultural goods are removed, and the export subsidies are repealed, while the target price and loan rate programs remain operative, and the resource constraints are still binding. The third experiment, "Domestic," maintains the border measures, but repeals the domestic income protection provided by the target price and loan programs. The fourth experiment, "All Subsidies," removes both border and domestic subsidies, while leaving the land use constraints intact.

The removal of distortions alone results in increases in economywide output, while the relaxation of resource constraints in addition leads to further improvements in GNP. In the second set of experiments, both the subsidy programs and the resource constraints are relaxed. The first of this set, "Unilateral," consists of relaxing land constraints and removing all subsidies, without assuming any cooperation from the rest of the world on agricultural trade liberalization. Finally, we calculate the qualitative results of multilateral liberalization in experiment "Multilateral," in which all features of U.S. farm programs are removed and world agricultural prices are assumed to increase.

Summaries of the experiment results are presented in Tables 5 through 9. Table 5 presents the consumption, investment, trade, net absorption, and the government budget deficit results of the various experiments relative to the base run for 1991. Table 6 displays some of the more important agricultural sector results expressed as ratios to the base run results, and Table 7 displays the same variables for the non-agricultural sectors. Table 8 compares the income and value-added by sector under the experiments to the base run. The results in Tables 5 and 8 are further disaggregated into agricultural and non-agricultural subsets. Table 9 presents the elasticities of response of these variables with respect to increases in the prices of competing agricultural products on world markets.

Table 5. Real Absorption in 1986, 1991, and Differences From 1991
(By Experiment, billions of 1982 Dollars)

		-----Level-----		--------Difference From 1991-------				
		1986	1991	LAND	BORDER	ALL	UNI	MULTI
Consumption	total	2482.9	2720.3	15.3	2.6	-18.6	-16.4	-13.8
	ag	27.9	29.9	1.0	0.6	-1.1	-0.8	-1.9
	non-ag	2455.0	2690.4	14.2	2.1	-17.5	-15.6	-11.9
Investment		629.0	690.9	-35.3	0.3	36.0	35.7	12.8
Government	total	755.3	781.2	9.6	0.9	5.2	5.2	5.2
	ag	15.0	4.6	9.6	0.9	5.2	5.2	5.2
	non-ag	740.3	776.6	0.0	0.0	0.0	0.0	0.0
Exports	total	378.8	519.7	12.1	0.9	-7.3	-6.5	8.2
	ag	17.5	21.5	17.2	0.8	-10.8	-10.3	6.4
	non-ag	361.3	498.2	-5.2	0.2	3.5	3.8	1.8
Imports	total	534.5	582.6	-2.6	4.3	9.3	9.1	3.4
	ag	6.8	6.7	-0.0	4.3	4.6	4.4	1.2
	non-ag	527.7	575.9	-2.5	0.1	4.8	4.8	2.2
Real GNP	total	3711.7	4130.0	3.0	0.5	6.7	9.6	9.1
	ag	65.0	95.9	16.7	-1.3	-6.9	-6.2	3.9
	non-ag	3646.7	4034.1	-13.7	1.8	13.6	15.7	5.2
Absorption	total	3867.2	4192.4	-10.5	3.8	22.5	24.4	4.2
	ag	42.9	34.5	10.6	1.4	4.0	4.3	3.3
	non-ag	3824.4	4157.9	-21.1	2.4	18.4	20.1	0.9
Net Exports	total	-155.7	-62.9	14.6	-3.4	-16.7	-15.6	4.8
	ag	10.8	14.8	17.3	-3.5	-15.4	-14.6	5.1
	non-ag	-166.5	-77.8	-2.6	0.1	-1.3	-1.0	-0.4
Govt Deficit		147.9	34.5	31.7	3.0	-25.1	-26.1	-25.7

Table 6: Agricultural Sector Results
(Ratios in Percent to 1991 Base Run Value)

Sector	World Price	Signal Price	Capital Rental	Land Rent	Land	Quantities Labor	Capital	Output	Export	Imports
					LAND					
Dairy and meat	97.7	90.8	83.5	--	--	90.1	108.5	103.2	107.1	100.0
Grains	80.4	100.0	96.4	102.6	132.2	138.9	145.9	136.7	192.2	31.4
Other agriculture	101.7	104.7	129.8	102.6	102.0	107.9	83.6	100.7	95.0	100.0
					BORDER					
Dairy and meat	102.7	98.7	100.1	--	--	99.4	99.4	99.4	92.2	200.2
Grains	98.5	100.0	100.1	100.0	101.9	103.0	102.9	102.3	104.8	80.3
Other agriculture	101.7	100.2	100.1	100.0	93.6	94.6	94.6	94.2	95.1	158.3
					DOMESTIC					
Dairy and meat	102.7	112.6	99.2	--	--	96.4	96.7	96.6	92.3	100.0
Grains	130.7	98.1	99.2	85.6	97.4	82.2	82.4	91.4	44.8	696.6
Other agriculture	99.8	95.9	99.2	85.6	108.9	91.9	92.1	98.8	100.7	100.0
					ALL SUBSIDIES					
Dairy and meat	106.0	111.9	99.2	--	--	94.6	94.9	94.8	83.9	315.9
Grains	132.5	96.7	99.2	81.4	98.0	79.3	79.5	90.6	43.0	656.2
Other agriculture	100.6	94.9	99.2	81.4	106.9	86.5	86.8	94.7	98.3	144.3
					UNILATERAL					
Dairy and meat	104.9	107.1	82.1	--	--	83.5	101.3	96.1	86.5	268.4
Grains	129.8	93.6	94.8	74.4	101.1	75.4	79.2	91.8	45.8	578.0
Other agriculture	100.8	95.4	127.6	74.4	117.0	87.2	68.1	94.8	97.6	147.4
					MULTILATERAL					
Dairy and meat	111.4	107.6	82.2	--	--	84.6	102.3	97.2	89.9	181.5
Grains	148.3	98.6	94.9	87.3	115.5	102.5	107.4	111.9	134.3	145.1
Other agriculture	103.9	99.7	127.7	87.3	109.3	96.9	75.4	97.8	97.8	109.3

Notes:
"World price" is the price foreigners pay for U.S. agricultural products.

"Signal Price" equals the target price or support price when domestic programs are operative; equals market price without programs.

"Capital rental" and "Land rent" are the marginal revenue products of capital and agricultural land.

Table 7: Non-Agricultural Sector Experiment Results
(Ratios in Percent to 1991 Base Run Value)

Sector	PVA	PX	Labor	Capital	Output	Export	Import
				LAND			
Light consumer	100.7	98.9	101.4	100.9	101.2	103.5	98.8
Basic intermed	100.7	100.6	99.9	99.4	99.7	98.5	100.2
Capital goods	100.5	100.5	97.5	97.0	97.5	96.5	98.1
Construction	100.6	100.5	96.9	96.5	96.9	96.2	--
Electronics	100.6	100.5	98.7	98.2	98.6	97.7	99.4
Trade	100.6	100.6	100.0	99.5	99.9	99.6	--
Services	100.7	100.6	100.2	99.7	100.0	99.6	100.1
				BORDER			
Light consumer	100.1	99.7	100.3	100.3	100.3	100.9	99.6
Basic intermed	100.1	100.0	100.0	100.0	100.0	99.9	100.1
Capital goods	100.1	100.1	100.0	100.0	100.0	99.9	100.1
Construction	100.1	100.0	100.0	100.0	100.0	100.0	--
Electronics	100.1	100.0	100.0	100.0	100.0	99.9	100.1
Trade	100.1	100.1	100.0	100.0	100.0	100.0	--
Services	100.1	100.1	100.0	100.0	100.0	100.0	100.0
				DOMESTIC			
Light consumer	99.4	102.5	97.6	97.8	97.7	93.0	103.2
Basic intermed	99.3	99.6	100.5	100.7	100.6	101.5	100.2
Capital goods	99.4	99.6	102.3	102.5	102.3	103.1	101.8
Construction	99.4	99.7	102.8	103.0	102.8	103.3	--
Electronics	99.4	99.7	101.2	101.4	101.2	101.8	100.6
Trade	99.4	99.6	100.1	100.3	100.2	100.4	--
Services	99.4	99.6	99.9	100.2	100.0	100.3	99.9
				ALL SUBSIDIES			
Light consumer	99.4	102.2	97.8	98.1	97.9	93.6	102.8
Basic intermed	99.4	99.6	100.6	100.9	100.7	101.5	100.3
Capital goods	99.5	99.6	102.6	102.9	102.6	103.4	102.1
Construction	99.5	99.7	103.2	103.5	103.2	103.7	--
Electronics	99.5	99.7	101.3	101.6	101.3	102.0	100.8
Trade	99.4	99.6	100.1	100.4	100.2	100.5	--
Services	99.4	99.6	99.9	100.2	100.0	100.3	99.9
				UNILATERAL			
Light consumer	99.5	101.7	98.3	98.6	98.4	95.2	102.1
Basic intermed	99.5	99.7	100.6	100.9	100.7	101.4	100.4
Capital goods	99.6	99.7	102.5	102.8	102.5	103.1	102.1
Construction	99.6	99.7	103.2	103.5	103.2	103.6	--
Electronics	99.6	99.8	101.3	101.6	101.3	101.8	100.9
Trade	99.6	99.7	100.2	100.5	100.2	100.4	--
Services	99.5	99.6	99.9	100.2	100.1	100.3	100.0
				MULTILATERAL			
Light consumer	99.4	101.9	98.1	98.1	98.1	94.4	102.3
Basic intermed	99.4	99.6	100.6	100.5	100.6	101.3	100.2
Capital goods	99.4	99.6	101.2	101.2	101.2	102.0	100.6
Construction	99.4	99.7	101.2	101.2	101.2	101.6	--
Electronics	99.4	99.7	100.7	100.7	100.7	101.4	100.1
Trade	99.4	99.6	100.1	100.1	100.1	100.4	--
Services	99.4	99.6	100.0	100.0	100.0	100.3	99.9

Table 8:

Sectoral Income and Value Added Differences From 1991 Bse Values

----------Nominal Sectoral Income (billions of dollars)----------

Sector	Level 1991	Difference				
		LAND	BORDER	ALL	UNI	MULTI
Dairy and meat	25.9	-2.5	-0.2	-1.6	-4.4	-4.2
Grains	44.7	18.2	1.4	-9.4	-11.1	0.8
Other agric	38.1	3.3	-2.1	-5.4	-5.0	-1.4
Light consumer	315.2	6.0	1.2	-8.5	-6.4	-7.8
Basic intermed	426.4	1.7	0.4	0.3	1.0	-0.1
Capital goods	261.3	-5.3	0.2	5.4	5.5	1.6
Construction	237.5	-6.1	0.2	6.3	6.6	1.4
Electronics	93.7	-0.8	0.1	0.8	0.8	0.1
Trade	687.1	3.7	0.7	-2.5	-1.5	-3.1
Services	2232.5	15.8	2.2	-12.9	-9.9	-12.0
Agriculture	108.7	19.0	-0.9	-16.4	-20.6	-4.8
Non-Agriculture	4253.7	15.1	4.9	-11.1	-3.9	-20.0
Total	4362.4	34.1	4.0	-27.5	-24.5	-24.7
+indirect taxes	368.0					
+tariffs	16.7					
-subsidies	34.7					
-ag premium rents	0.1					
=Value Added	4712.3					

----------Nominal Sectoral Value Added (billions of dollars)----------

Sector	Level 1991	Difference				
		LAND	BORDER	ALL	UNI	MULTI
Dairy and meat	27.7	-2.5	-0.2	-1.4	-4.3	-4.0
Grains	13.0	-13.6	-2.5	23.7	22.0	34.3
Other ag	37.5	3.2	-2.0	-3.4	-3.1	0.6
Light consumer	336.9	6.1	1.2	-8.5	-6.4	-7.8
Basic intermed	474.5	1.8	0.4	0.4	1.2	-0.0
Capital goods	270.1	-5.4	0.2	5.6	5.7	1.6
Construction	244.2	-6.2	0.2	6.5	6.8	1.5
Electronics	95.9	-0.8	0.1	0.8	0.9	0.1
Trade	794.6	4.2	0.8	-2.7	-1.6	-3.4
Services	2417.9	16.7	2.4	-13.3	-10.2	-12.5
Agriculture	78.2	-12.9	-4.7	18.9	14.5	30.9
Non-Agriculture	4634.1	16.3	5.2	-11.3	-3.7	-20.5
Total	4712.3	3.4	0.5	7.6	10.9	10.4

Table 9. Elasticities of Sector Responses to World Agricultural Prices

Sector	PVA	Consumer Price	World Price	Sector Income	Output	Exports	Imports
			increase world "dairy" price				
Dairy	0.0	2.2	82.9	7.5	7.5	48.1	-310.7
Grains	1.3	0.8	0.1	4.0	2.7	-0.2	6.3
Other	0.9	0.5	0.3	0.7	-0.2	-0.8	2.2
Ltcons	-0.0	0.3	0.0	-0.2	-0.1	-0.7	0.6
Basint	-0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1
Kgood	-0.1	0.0	0.0	-0.4	-0.3	-0.3	-0.3
Constr	-0.0	0.0	0.0	-0.5	-0.4	-0.4	0.0
Elec	-0.1	-0.0	0.0	-0.2	-0.2	-0.2	-0.2
Trade	-0.0	-0.0	0.0	-0.1	-0.0	-0.0	0.0
Serv	-0.0	0.0	0.0	-0.0	-0.0	-0.0	-0.0
			increase world "grain" price				
Dairy	0.1	0.3	-0.0	0.3	0.3	0.1	1.4
Grains	9.0	0.4	41.4	27.8	18.7	178.3	-315.3
Other	6.1	3.2	2.0	3.5	-2.6	-5.8	12.2
Ltcons	-0.0	0.2	0.0	-0.2	-0.2	-0.5	0.1
Basint	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1
Kgood	-0.1	-0.0	0.0	-0.9	-0.9	-0.8	-0.9
Constr	-0.1	-0.0	0.0	-1.3	-1.3	-1.3	0.0
Elec	-0.1	-0.0	0.0	-0.5	-0.4	-0.4	-0.4
Trade	-0.0	-0.0	0.0	-0.1	-0.1	-0.0	0.0
Serv	0.0	0.0	0.0	-0.0	-0.0	-0.0	-0.0
			increase world "other ag" price				
Dairy	-0.1	1.8	0.5	-0.8	-0.7	-1.4	6.6
Grains	7.4	4.3	2.6	6.1	-1.3	-7.6	16.7
Other	5.0	13.2	50.5	53.4	48.1	148.1	-282.6
Ltcons	-0.1	0.8	0.0	-1.0	-0.9	-2.5	0.9
Basint	-0.1	-0.0	0.0	-0.5	-0.4	-0.4	-0.4
Kgood	-0.1	-0.0	0.0	-1.7	-1.6	-1.5	-1.6
Constr	-0.1	0.0	0.0	-2.3	-2.2	-2.2	0.0
Elec	-0.1	-0.0	0.0	-1.0	-0.9	-0.9	-0.9
Trade	-0.1	-0.0	0.0	-0.4	-0.3	-0.2	0.0
Serv	-0.1	-0.0	0.0	-0.2	-0.1	-0.1	-0.1
			increase all world agricultural prices				
Dairy	0.0	4.3	83.4	7.0	7.0	46.7	-305.1
Grains	17.7	5.5	44.2	38.0	19.9	169.2	-299.4
Other	11.9	17.0	52.7	58.2	45.8	140.9	-271.9
Ltcons	-0.2	1.3	-1.4	-1.3	-3.8	1.6	0.0
Basint	-0.1	0.0	-0.7	-0.6	-0.6	-0.6	0.0
Kgood	-0.2	-0.1	-3.0	-2.7	-2.6	-2.8	0.0
Constr	-0.2	0.1	-4.1	-3.9	-4.0	0.0	0.0
Elec	-0.2	-0.0	-1.7	-1.5	-1.4	-1.5	0.0
Trade	-0.2	-0.1	-0.5	-0.3	-0.3	0.0	0.0
Serv	-0.1	0.0	-0.3	-0.2	-0.2	-0.2	0.0

Note: The "elasticity" is the percent change in the column variable due to a one percent change in the price (or prices) in the rest of the world, as indicated, multiplied by 100.

Experiment 1: Land Constraints Relaxed

Not all aspects of U.S. agricultural subsidy programs directly promote excess supplies from the U.S. and exacerbate falling world market prices. One of the most important features of the U.S. program is the constraint on resource use required of the major beneficiaries of support. In order to be eligible for deficiency payments and nonrecourse loans, the farmer must take land out of production. The set-aside constraint is intended to offset the production-inducing signal provided by the target price, control total output, and limit budgetary exposure. In principle, the existing program is designed to protect farm income without generating surpluses at the prevailing domestic market prices.

The U.S. has also supported world market prices through the stock accumulation activities under the nonrecourse loan program. In effect, until the 1985 Farm Bill, the loan rates announced in advance of the marketing period represented the U.S. price floor, and since the U.S. share of world agricultural trade is large, also signalled a world price floor. Under the 1985 Farm Bill, loan rates are set in reference to average market prices and are negatively related to the level of stocks. Therefore, market prices indicate the loan rate rather than vice-versa. Nevertheless, even under the current program, farmers repay the loans by forfeiting crops and thus diverting supplies off the market, if the market price is not high enough relative to the loan rate to be profitable. Thus, the loan rate continues to serve as an indicator of U.S. prices to the rest of the world.

In the first experiment, "land," we consider what might happen if U.S. farmers were not subject to resource use constraints while the subsidy programs remain in effect. The experiment consists of projecting to 1991 with subsidies,

while land supply is determined endogenously rather than constrained to the set-aside level under the 1985 Farm Bill. The amount of land in production increases 15.6 percent over the base 1991 projection, which, coincidentally, nearly equals the minimum set-aside rate in 1986 for program crops under the 1985 Farm Bill (Table 6).

The deficiency payment responsibility that arises due to the relaxation of acreage controls is costly to the government. The government budget deficit almost doubles, government stock accumulation increases by almost $10 billion, and foreign capital inflows increase by 60 percent. Real GNP increases by about $3 billion dollars due to the increase in resources used in production (Table 5). Farm income, of course, improves under these assumptions. Subsidy-ridden net returns to land, labor, and capital in the "grains" sector increase by 40 percent. In the other sectors of the economy, value added falls (Table 8). Savings and investment also fall to only 95 percent of the base projection levels. But what havoc is wreaked on international markets for grain!

U.S. exports of "grains" almost double, while imports of "grains" (small to begin with) fall by two thirds (Table 6). The world price of "grains" falls almost 40 percent from the 1986 level, an additional 20 percent lower than the world price relative to the base 1991 projection. This occurs because we have modelled the loan rate following the falling U.S. market prices to a certain extent, according to the provisions of the 1985 Farm Bill. The balance of trade deficit improves by $14 billion. This includes a $17 billion dollar improvement in net agricultural exports, and a $3 billion deterioration in net non-agricultural trade (Table 5).

Experiment 2: Border Policies Removed

Traditionally, the GATT has been concerned with border measures; especially quotas on imports and subsidies on exports. The progenitors of the proposals to the Uruguay Round of the GATT negotiations have correctly identified that the most trade distorting farm support policies are not the border measures but the "domestic" programs. Breaking with the GATT tradition, they have agreed that all agricultural subsidy programs are subject to consideration in this round of the GATT.

The "border" experiment, in which only border distortions are dismantled, is designed to highlight the relative importance of border and domestic measures. In the U.S., border measures supporting exports are relatively minor, while protection against certain imports are very important (e.g., quotas against imported cheese and sugar).[23] The results of this exercise should then be compared with the results of the "domestic" experiment to highlight the importance of bringing domestic measures under the GATT. Including domestic support programs under the GATT is shown to be important, particularly if the objective is to reduce potential budget exposure and to strengthen world agricultural prices.

In the "border" experiment, the quotas against imports of "dairy and meat" and "other agriculture" products are removed, and the ad valorem export subsidies for all agricultural exports are dropped to zero. Meanwhile, the constraints on land in production and the domestic price and income support programs remain

[23]In 1986, the Secretary of Agriculture announced that over $47 million dollars worth of export enhancement program bonuses were awarded. This amounts to only .18 percent of the value of 1986 agricultural exports. On the other hand, U.S. sugar programs supported domestic prices at 3.4 times the 1986 world market price for sugar; Barry and Angelo (1988).

intact.

The removal of the border measures results in a tiny increase in real GNP, a $3.4 billion dollar deterioration in the net balance of trade (due entirely to lower net exports from agriculture), a corresponding increase in foreign savings in the U.S., and an increase in the government budget deficit of about $3 billion, while expenditures to support the farm sector increase by $3.8 billion, or 10 percent. The effect on non-agricultural sector employment, output and prices is likewise negligible. Only the "light consumer" goods sector is affected. Lower domestic costs of raw agricultural product inputs to the "light consumer" goods industries reduce intermediate input costs, increasing value added and income in that sector by about one billion dollars (Table 8).

Imports of "dairy and meat" and "other agriculture" products increase by $0.8 and $3.5 billion dollars, respectively, when the import quotas are removed. Exports fall insignificantly. Land is released from the "other agriculture" sector into the "grains" sector, and production of "grains" increases accordingly by about 2 percent. Exports of "grains" increase by 4.8 percent, and imports fall by 20 percent, affecting a decline in world prices of 1.5 percent (Table 6).

The "border" experiment illustrates how little would be achieved if only U.S. border measures were to be dismantled. The effect on world markets appears quite small. Meanwhile, costs of domestic programs and the government budget exposure increases, although not prohibitively. These results underscore the importance of including both border measure liberalization and domestic programs under the purview of the GATT.

Experiment 3: Domestic Subsidies Terminated

The third experiment, "domestic", focuses on the impact of U.S. domestic policies on domestic resource allocation, the government budget deficit, and net agricultural trade. We remove the income support provided by the target price programs and the part of domestic price support provided by government stock accumulation activities. The constraints on resource use and the border measures remain in effect.

The main impact of the removal of domestic support programs is a movement of labor and capital out of agriculture. Capital and labor both decline to 96, 82, and 92 percent of the subsidy-ridden 1991 levels in the "dairy and meat", "grains" and "other agriculture" sectors. Production likewise falls, although less so in "other agriculture" into which land moves from the "grains" sector. U.S. "grains" exports fall dramatically, imports increase, and domestic "grains" prices increase by 60 percent (Table 6). The cost of living increases by 0.2 percent, as these cost increases at the unprocessed level are passed through to the rest of the economy as farm products are processed.

The "light consumer" goods sector suffers along with the agricultural sectors. Employment, output, and exports decline by a few percentage points, and "light consumer" good imports increase. The $2.0 billion dollar deterioration in net trade in "light consumer" goods accounts for most of the non-agricultural net trade deterioration. Overall, the net trade balance worsens by $12 billion. The loss of $10 billion worth of "grains" net exports accounts for most of this deterioration in the trade balance ("Domestic" results are not shown in Table 5 since they are close to those from the "All Subsidies" experiment).

The savings to the government due to termination of the domestic programs results in a $24.2 billion reduction in the deficit, and hence less of a drain on the loanable funds market. Savings and investment increase by $30.0 billion, and the current account deteriorates by $5.7 billion.

The reduction in U.S. "grain" exports precipitates a 30% increase in the world price of "grains." Taken together, the implications of this experiment are that terminating domestic programs may have the desired effects of strengthening world agricultural markets and reducing government budget exposure.

Experiment 4: All Subsidy Programs Terminated

In the "All Subsidies" experiment, all direct price support activities and border measures in agriculture are removed, without relaxing the acreage constraints that accompany the subsidy programs. This experiment is essentially the sum of experiments 2 and 3. The experiment isolates the impact of the incentive-distorting effects from the resource-constraining effects of the existing farm programs. The direct effect of removing the programs is to reallocate factors out of agriculture into sectors where they are more productive. Overall, real GNP increases by $5.8 billion dollars, and nominal by $6.7 billion, (0.14 percent) when the agricultural subsidy programs are terminated (Table 5).

In particular, in this exercise there are no target prices or loan rates. Government stocking of program commodities to maintain market prices through the non-recourse loan program is discontinued. The import quotas are repealed. The export enhancement program subsidies drop to zero. Having removed the wedges between TP and PX, and the tariff equivalent distortions between the domestic

and world prices for traded agricultural goods, the market clearing price (PX) signals resource allocation economywide.

Economywide, more is produced, consumed, saved, and invested when all distortions subsidizing the agricultural sectors are removed. Real GNP increases by $5.8 billion dollars compared to the subsidy-ridden 1991 projected level of GNP. The federal deficit is reduced from $34.5 billion to only $9.7 billion (Table 5). The reduction in the deficit is due to a $34.7 billion savings from agricultural subsidies no longer paid, net of expenditure on 1991 stock holding.[24] In the 1991 base solution, the government was releasing stocks from previous excessive accumulations, since solution market prices still exceeded the loan rate. Under liberalization, net government demand for agricultural products is set at the level observed in 1982 when carry-over stocking was relatively low.

The net improvement in the government budget deficit results in 5.2 percent more savings and investment. Investment demand consists largely of residential construction and demand for capital goods (machinery, etc.). The increased demand for construction and capital goods is met by increased employment of capital and labor in both sectors, increased output, and almost no change in domestic prices. Output in the construction and capital goods sectors increase by 3.2 and 2.6 percent, respectively (Table 7).

Labor and capital move into the construction and capital goods sectors from the agricultural sectors. With the release of factors of production from agriculture, economywide wages and average returns to capital both fall by about half of a percent. Since agriculture is a very small employer of resources, even major changes in the marginal value product in agriculture will have little effect on the economy-wide wage/rental ratio. On the other hand, the returns

[24]There are also minor revenue changes as the structure of the economy changes.

to land (used only in agriculture) fall almost 22 percent with the removal of agricultural subsidies.[25]

In this experiment we assume no world agricultural price response or reaction by the rest of the world to liberalization in U.S. agriculture, so world prices remain artificially low. Hence, the U.S. appears to be less competitive in world agricultural markets, agricultural exports fall, and imports increase.[26] Thus, the balance of trade deteriorates by $16.7 billion dollars, largely because the contribution of the agricultural sectors to net exports falls by $15.4 billion dollars. Increased net imports of light consumer goods (processed dairy products, animal feeds, textiles) account for the rest of the deterioration in the trade balance (Table 5). With the increase in domestic agricultural prices, domestic output for this sector is priced higher than the substitutable import.

Removing the subsidies without relaxing the acreage constraints reduces income in the agricultural sectors, particularly the export-dependent "grains" sector. Without the export subsidies and high level of domestic supply, "grains" export volume falls to 52 percent of the level in 1986 and is 58 percent lower than the base projection to 1991 with programs intact. Imports of "grains" increase because of the 60 percent increase in the relative price of domestic to imported "grains." Imports of "dairy and meat" products triple with the relaxation of the quota constraints, and "dairy and meat" exports fall 27 relative to the 1991 level (Table 6).

The light consumer goods sector, in which the processing of agricultural products takes place, again suffers along with the agricultural sectors, with

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[25]This result is sensitive to our specification of production technology in the three sectors. If capital and labor were assumed to be less substitutable with land, the quantitative adjustment would be lower and the price adjustments would be smaller.

[26]Also, although the nominal exchange rate is held constant in the experiment at the 1991 solution level, there is a very slight increase in the real exchange rate. It increases by .18 percent.

output falling by 2.25 percent relative to the 1991 base run. Given the size of the sector, this decline is significant. Exports also fall by 6.7 percent and imports also increase as import quotas are relaxed and the domestic price increases 2.5 percent relative to the world price (Table 7).

The net impact of this experiment is a deterioration in the trade balance to accommodate a $22.5 billion increase in total absorption. This lost export income results in $16.4 billion lower farm income (the sum of income in the "dairy and meat", "grains" and "other agriculture" sectors). This result suggests that unilateral liberalization would jeopardize the U.S. trade balance, with negative economywide as well as sectoral consequences. Unfortunately, as the results of the next experiment show, these undesirable results obtain even if the constraints on land in agriculture are relaxed.

Experiment 5: Unilateral Liberalization

The experiments above analyzed the impact of removing parts of the U.S. farm programs. This experiment represents complete unilateral liberalization. All programs that distort returns to production and/or constrain input use are removed. Constraints on land use are relaxed, as in the "land" experiment; border measures are removed, as in "Border;" and domestic programs are dismantled, as in "Domestic." Thus, this experiment is the sum of all previous experiments, but the general equilibrium results are not simply the sum of the component experiment results.

With neither the constraints nor the subsidies, land use in agriculture increases by 4.7 percent (compared to the result of "land" where land use increased nearly 16.0 percent). Even more capital and labor leave the farm sector as land is substituted for the other factors. The use value of land also

falls 34 percent relative to the 1991 base rate of return.[27] Output and exports of "grains" nevertheless increase marginally. Complete unilateral dismantling of U.S. farm programs, even without assuming an impact on world import prices, results in a $9.6 billion dollar increase in GNP.

The effects on factor employment, output, trade, and income in the non-agricultural sectors of this experiment are parallel to the results reported for experiment 4. There is a $15.6 billion dollar deterioration in the balance of trade, a $26.1 billion reduction in the government budget deficit, and a $35.7 billion increase in investment. The construction and capital good sectors also expand. Absorption is $24.4 billion higher than the subsidy-ridden 1991 level. Again, these increases contrast with agriculture's losses. Net agricultural exports fall almost to zero and farm income falls by $20.6 billion (Tables 5 and 8).

Experiment 6: Multilateral Liberalization

While this is not a multicountry model, it can be used to analyze the domestic impact of exogenous changes in conditions on world markets. This is done by resolving the model with respect to the new world market prices of importables and substitutes for U.S. exports. In the sixth experiment, "multilateral," we assume increases in the world prices of competing agricultural goods in addition to the program removal elements of the previous "unilateral" experiment. It is designed to represent multilateral agricultural liberalization. The increase in world prices of competing agricultural goods is assumed to result from a decline in exportable supplies worldwide and an increase in world demand arising from a relaxation of import quotas. The net effect is that

[27]Again, these results are sensitive to the specification of agricultural production technology.

the U.S. sees an outward shift in the world demand curve for its agricultural exports.

We assume an 11.1 percent increase in the world price of "dairy and meat," and increases of 42.9 and 3.1 percent for "grains" and "other agriculture" goods, respectively. These rates of increase relative to 1986 represent zero increases relative to 1982 prices in each sector. In essence, consistent with our basic macro scenario, we are assuming that the world economy returns to the 1980-82 situation, when the U.S. ran a trade surplus and world agricultural markets were not yet suffering from excess supplies.

Demand for U.S. agricultural exports depends on the difference between the U.S. agricultural export price and the price of substitutes in world markets. In the analysis of multilateral agricultural trade liberalization, it is assumed that the world prices of imports and substitute export agricultural goods equalize. The price of U.S. exports is then determined endogenously and simultaneously with the volume of U.S. agricultural exports.

The near $26 billion in government budget deficit reduction allows savings and investment increases of 1.4 percent. The trade deficit also reduces by $4.8 billion, and foreign saving in the U.S. goes down by $10.6 billion. Real GNP increases by $9 billion. Otherwise, multilateral liberalization, if it does indeed result in world agricultural prices regaining their 1982 levels in real terms, results in a picture of non-agricultural output, income, and employment that is very similar to the baseline projection.

On the other hand, there are substantial differences in the structure of agriculture. The increase in world prices stimulates production for export, especially in the "grains" sector. Land in agriculture increases 15 percent over the base projection under the programs. Most of this land is in "grains." Labor and capital also move into the "grains" sector, so that "grains" output increases by almost 12 percent. Of this additional output, 65 percent is

exported. Agriculture's contribution to the balance of trade increases by $5 billion (Tables 5 and 6).

This type of expansion is not observed in the "dairy and meat" or "other agriculture" sectors, because those sectors were not competitive export sectors in the first place. Labor moves out of those sectors and output is down accordingly, relative to the protected 1991 result. Sector income is down the most in "dairy and meat," somewhat in "other agriculture," while it is slightly higher in the "grains" sector.

The fate of the light consumer goods sector, as in the other exercises, is shown to be linked to agriculture. Production and exports are lower, and imports are higher, than in the protected 1991 base run. The higher domestic prices of the raw agricultural products and the relaxation of import quotas squeeze net returns to the light consumer good processing sector.

Experiment 7: Elasticities of Response to World Prices

While we cannot be sure about the exact change in prices due to multilateral liberalization in world markets for agricultural goods, we can determine if the qualitative results are robust with respect to a general change in world agricultural prices. The following experiments provide qualitative information about the response of domestic market prices, output, employment, and trade, to changes in the world prices of agricultural goods. In particular, we numerically compute the elasticities of these economic variables with respect to changes in world agricultural prices. First, one-by-one elasticities are computed. Then, we find the percent change in the variables due to simultaneous 1 percent changes in all three world agricultural prices. The results are presented in Table 9.

The results should be considered in light of the results of unilateral liberalization as well as with respect to the base scenario. As discussed

earlier, domestic market-clearing prices in the three agricultural sectors increase following liberalization. The increase in prices occur because fewer resources are devoted to agriculture when subsidies are discontinued, and hence the supply curve shifts in. Where domestic prices are supported by the existence of quotas against imports, since the share of these imports in consumption are small, the price depressing effects of lower-priced substitutes are outweighed by the price increasing affects of reduced domestic supplies, and these domestic prices rise also. If world market prices rise in addition, domestic prices rise even further.

The observed effect on domestic prices of increases in world prices is thus to raise them, but not by 100 percent, since the importable, the exportable, and the good for domestic consumption are imperfect substitutes. Since foreign and domestic versions of "dairy and meat" are fairly substitutable, the U.S. export price of "dairy and meat" increases 0.83 percent for every 1 percent increase in the price of "dairy and meat" from the rest of the world. The U.S. export price of "grains" increases 0.41 percent for every 1 percent increase in the world price of "grain." This reflects the lower substitutability between domestic and foreign "grain," which is more likely due to the political distinctions between sources of grain which lead to stabilized market shares than to physical differences among the actual products. The U.S. export price of "other" agricultural goods increase by 0.5 percent for each 1 percent increase in world prices. Again, the "other" agricultural goods exported by the U.S. (e.g., temperate fruits, nuts, and seeds) are not easily substituted for the imports (e.g., tropical fruits, coffee, vegetables in season).

The prices faced by U.S. consumers are also positively related to world market prices, but since imported goods comprise such a small portion of the consumption basket, these increases are negligible in the first two agricultural sectors and marginal in the "other" agricultural good sector. The price

consumers pay for the composite "other" agricultural good increases .13 percent for every 1 percent increase in the world price.

The elasticities of U.S. export supply with respect to world market price increases are between .48 for "dairy and meat," and 1.78 for "grains." The elasticity for "dairy and meat" is lowest because production in this sector is largely for domestic consumption. For each 1 percent increase in the world price of "grain," the U.S. increases "grain" exports by 1.78 percent. Likewise, for each 1 percent increase in the world price of "other" agricultural goods, U.S. "other" exports increase by 1.48 percent.

With producer prices rising, and export volumes increasing, resources are drawn back into the agricultural sectors relative to unilateral liberalization. The elasticity of the resource-pull effects of world price increases under multilateral liberalization are indicated by the elasticities of the value-added price (PVA). In each of the elasticity experiments, the agricultural sectors show an increased resource pull at the expense of the non-agricultural sectors. Thus, the qualitative impact of multilateral agricultural liberalization on resource allocation in the U.S. is to offset the tendency for resources to move out of agriculture.

Winners and Losers

Table 8 shows the changes in sectoral income and in aggregate value added (GNP at market prices) arising from the experiments. Although aggregate sectoral income falls in all subsidy removal experiments, it is important to note the distinction between net sectoral income (which includes subsidies) and sectoral value added (or GNP at factor cost, which does not include subsidies). In the experiments, sectoral incomes fall because the policy reform diverts income away from the accounts of "producers" and gives it back to the government. In terms

of the GNP accounts, however, these subsidies are treated as nonproductive transfers. Total value added, or GNP, rises significantly in all experiments (except the "border" experiment where the increase is tiny). The removal of a distortion should lead to an increase in efficiency and, hence, in GNP. Our experimental results indicate that this is indeed the case.

In general, the removal of agricultural subsidies hurts agricultural income: it falls as much as 19 percent under the subsidy removal experiments ("border," "all subsidies," "unilateral," and "multilateral"). Aggregate farm income will be lower without the current farm programs; under the "multilateral" liberalization experiment, it is 4.4 percent lower than the 1991 base run. But labor and capital also move out of agriculture, so that farm income per unit of farm labor actually increases slightly (by 0.76 percent). Aggregate income in the non-agricultural sectors also falls; total non-agricultural income falls by 0.44 percent under the "multilateral" scenario.

The total value of the subsidies is $34.7 billion (in the 1991 base run), but their removal only leads to declines in agricultural incomes of $5-21 billion between the "multilateral" and the "unilateral" experiments. Thus, when market distortions are removed multilaterally, it would cost the government only $4.8 billion dollars of pure transfers to guarantee the farm sector an income comparable to the 1991 base run level.

Across the experiments, changes in the agricultural programs have significant and varying effects on the non-agricultural sectors. The sectors directly linked to agriculture ("light consumer," "trade and finance," and "other services") are most affected. The "construction" and "capital goods" industries are also affected indirectly, due to the increase in savings following the reduction in the federal deficit. General equilibrium linkages are clearly important in determining the ultimate incidence of any changes in agricultural programs.

6. Conclusion

By 1986, domestic policies to support farm income and trends in international markets conspired to reduce prices for agricultural goods to two-thirds of what they were, on average, in 1982. In running our model from 1982 to create a 1986 benchmark, we were able to account for this deterioration endogenously by setting farm policy instruments at their 1986 levels, increasing the U.S. government budget deficit (which put upward pressure on the exchange rate), and setting world market prices at their observed levels. In this paper, we have explored whether or not that process can be turned around, at least for the United States, by dismantling all distorting farm policies under the assumption that by 1991 both the U.S. trade and government budget deficits are significantly reduced.

One of the fundamental macro assumptions underlying our base projection to 1991 is that the U.S. greatly expands exports. The U.S. agricultural sector is competitive in world markets and, given the real devaluation that must accompany macro adjustment, will account for a significant portion of these increased exports. The removal of producer subsidies in U.S. agriculture, if the rest of the world also liberalizes, does not compromise this important role.

If a failure to achieve agricultural trade liberalization should lead to a round of protectionist policies worldwide, the resulting shrinkage of world trade could endanger the ability of the U.S. to achieve macro balance, with potential negative feedbacks to other economies. Thus, as a policy stance, the U.S. should seek liberalization. The question is whether the U.S. is willing to accept the structural adjustments that will necessarily accompany the changes in domestic agricultural policies underpinning liberalization.

Our results suggest that the U.S. faces a classic trade liberalization dilemma. Policy reform leads to an improvement in GNP and a reduction in the trade and government budget deficits. But it also leads to changes in the functional distribution of income and migration of labor out of the agricultural sectors. These are two of the problems that the agricultural subsidy programs were originally intended to redress. On the other hand, our experimental results do show gains outweighing losses from liberalization. Finally, the concomitant structural adjustment, at both the sectoral and macro levels, provides a firmer basis for future growth in an environment of freer trade.

References

Adelman, Irma and Sherman Robinson (1987), "Macroeconomic Shocks, Foreign Trade, and Structural Adjustment: A General Equilibrium Analysis of the U.S. Economy, 1982-1986," Giannini Foundation Paper No. 839, Department of Agricultural and Resource Economics, University of California, Berkeley.

Armington, P. (1969), "A Theory of Demand for Products Distinguished by Place of Production," IMF Staff Papers, vol. 16, pp. 159-78.

Ballenger, Nicole, et. al. (1987), "Government Intervention in Agriculture: Measurement, Evaluation, and Implications for Trade Negotiations," U.S. Dept. of Agriculture, Foreign Agricultural Economic Report, Number 229 (April).

Barry, R. D., and Luigi Angelo (1988), "U.S. Sugar Programs and Program Operations, 1977-1987," in Sugar and Sweetener Situation and Outlook, ERS, U.S. Dept. of Agriculture, March, (forthcoming).

Condon, Timothy, Sherman Robinson, and Shujiro Urata (1985), "Coping With a Foreign Exchange Crisis: A General Equilibrium Model of Alternative Adjustment Mechanisms," Mathematical Programming Study, no. 23, pp. 75-94.

Denison, E. F. (1967), Why Growth Rates Differ, Washington D.C.: Brookings Institution.

Dervis, Kemal, Jaime De Melo, and Sherman Robinson (1982), General Equilibrium Models for Development Policy, New York: Cambridge University Press.

de Melo, Jaime and Sherman Robinson (1987), "The treatment of Foreign Trade in Computable General Equilibrium Models of Small Economies," mimeo, The World Bank.

Dunham, Dennis (1987), Food Cost Review, 1986, U.S. Dept. of Agriculture, Economic Research Service, Agricultural Economics Report No. 574, July, 1987.

Glaser, Lewrene K. (1987), "Provisions of the Food Security Act of 1985," Agriculture Information Bulletin No. 498, U.S. Dept. of Agriculture, Economic Research Service.

Henry, Mark and Gerald Schluter (1985), "Measuring Backward and Forward Linkages in the U.S. Food and Fiber System," Agricultural Economics Research, no. 37(4), pp. 33-39.

Hertel, Thomas (1988), "General Equilibrium Incidence of Natural Resource Subsidies: The Three Factor Case," Journal of Environmental Economics and Management, (forthcoming) vol. 15.

Houck, James P., Martin Abel, Mary Ryan, Paul Gallagher, Robert Hoffman, and J.B Penn (1976), "Analyzing the Impact of Government Programs on Crop Acreage," U.S. Dept. of Agriculture Technical Bulletin No. 1548, August.

Houck, James (1986), "Market Structure, Policy, and Behavior in World Grain and Soybean Markets," chapter 4 in Embargoes, Surplus Disposal, and U.S. Agriculture, U.S. Dept. of Agriculture, Economic Research Service, Agricultural Economic Report Number 564.

Josling, Tim and Stefan Tangermann (1987), "Quantitative Measures for Negotiating and Monitoring Trade Liberalization in Agriculture," (mimeo) paper presented to the International Agricultural Trade Research Consortium Meeting, Airlie House, November.

Monaco, Ralph (1987), "TGM (Trend Growth Model) Description," (draft), U.S. Dept. of Agriculture, Economic Research Service, mimeo, August 1987.

Rausser, Gordon and Brian Wright (1987), "Alternative Strategies for Trade Policy Reform," (mimeo) Working Paper prepared for the Benjamin E. Lippincott Symposium on Policy Co-ordination in World Agriculture, University of Minnesota, April 22-24.

Roningen, Vernon, John Sullivan, and John Wainio (1987), "The Impact of the Removal of Support to Agriculture in Developed Countries," paper presented at the American Agricultural Economics Association Meetings, August 1987, East Lansing, Michigan.

Roningen, Vernon (1986), "A Static World Policy Simulation (SWOPSIM) Modelling Framework," U.S. Dept. of Agriculture, Economic Research Service Staff Report No. AGES860625.

Salathe, Larry E., J. Michael Price, and Kenneth E. Gadson (1982), "The Food and Agricultural Policy Simulator," Agricultural Economics Research, 34(2), 1-15.

Tangermann, Stefan, Tim Josling, and Scott Pearson (1987), "International Negotiations on Farm Support Levels: The Role of PSE's," (mimeo) Institute for Agricultural Economics and Food Research Institute, Stanford University; May.

Taylor, C.R. (1988), "AGSIM: The Crop Supply Component," ERS/USDA Staff Report, (forthcoming).

Tyers, Rod and Kym Anderson (1987), "Liberalising OECD Agricultural Policies in the Uruguay Round: Effects on Trade and Welfare," Working Papers in Trade and Development No. 87/10; Australian National University; July.

U.S. Dept. of Agriculture, A.S.C.S. (1987), "Commodity Credit Corporation Mid Session Review," mimeo, July.

U.S. Dept. of Agriculture (1987), Agricultural Statistics Board, Agricultural Prices: 1986 Summary, PR 1-3(87), June.

U.S. Dept. of Agriculture, Economic Research Service (1987), Financial Characteristics of U.S. Farms, January 1, 1987, Agriculture Information Bulletin No. 525, August.

U.S. Government (1987), Economic Report of the President, 1987.

Appendix: Sector Aggregation

Sector	Industries (major)	BEA Industry Classification
Dairy and Meat	milk, eggs meat animals, poultry	1-1.03
Grains	wheat, corn, rice, soy cotton, peanuts, flax	2.01, 2.0201-2.0203 2.06
Other agriculture	sugar, tobacco, fruits vegetables, nuts, other	2.03, 2.04-2.0503, 2.07, 3.0, 4.0
Light Consumer	food and kindred products leather, footwear, textiles, apparel, furniture containers, printing	14-26, 33-34
Basic Intermediates	mining, petroleum, chemicals plastic, rubber, glass&stone, iron&steel, fabricated metals	5-10, 27-32, 35-42
Capital Goods	munitions, engines, machinery, communications, trucks, motor vehicles, some electrical	13, 43-50, 52-54, 56.03, 56.04, 57.03, 59-61
Construction	private&gov't construction	11-12
Electronics	office equipment, household appliances, semi-conductors, equipment, misc. electronics, TV, radio and other industry	51, 55, 56.01-56.02, 57-57.02, 58, 62-64, 81, 84-85
Trade	wholesale and retail trade, banking and insurance	69-70
Services	real estate, services, non-comparable imports, transportation, and gov't	65-68, 71-79, 80, 82

Note: BEA industry classification from Appendix B: "Industry Classification of the 1977 Input-Output Tables", page 80 Survey of Current Business (May, 1984).