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ENVIRONMENTAL AND FARM COMMODITY POLICY LINKAGES IN THE US AND EC

by

David G. Abler

and

James S. Shortle

Assistant and Associate Professors
Department of Agricultural Economics and Rural Sociology
Weaver Building
The Pennsylvania State University
University Park, PA 16802 USA

June, 1990

AAEA 1990

1990

Environment

#8622

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Abstract

This paper analyzes restrictions on agricultural chemicals in the US and EC under various farm commodity policy scenarios using a partial equilibrium simulation model. The model has three regions (US, EC, rest of the world) and four commodities (wheat, corn, coarse grain, soybeans). Medium- and long-run impacts are derived. Given existing farm programs, US landowners gain from chemical restrictions while EC landowners generally lose. Given bilateral elimination of farm programs, both US and EC landowners gain from chemical restrictions. Bilateral farm program elimination without chemical restrictions induces a shift in chemical usage from the EC to the US.

I. INTRODUCTION

Environmental implications of agricultural production practices are becoming increasingly important in both the United States and the European Community (OECD 1989, Bonnieux and Rainelli 1988). Impacts on human health and the ecosystem are hard to quantify, but a consensus seems to be emerging that moderate restrictions on agricultural chemicals are necessary.

Even moderate restrictions, however, could have significant impacts on agricultural production, prices, producer rents, and other key variables. These impacts are likely to depend on the agricultural commodity policies in place in the US, the EC, and other countries. However, little is known about the linkages between environmental and commodity policies for agriculture. These linkages are especially important in light of the GATT negotiations concerning multilateral reductions in farm price support levels.

This paper analyzes the impacts of restrictions on agricultural chemicals in the US, the EC, or both regions under various farm commodity policy scenarios. These scenarios include the status quo and an elimination of commodity programs by the US and/or the EC. A partial equilibrium simulation model of agriculture is constructed with three regions: the US, the EC (12), and the rest of the world. There are four commodities in the model: wheat, corn, coarse grains (barley, sorghum, and oats), and soybeans. The base year is 1982.[1] Particular attention is paid to factor market effects of policy changes, where virtually no research has been done.

The focus of this paper is on medium- and long-run impacts. Thus we rule out effects of chemical restrictions on rental rates on agricultural capital, wage rates for farm labor, returns to farm management skills, and prices of agricultural chemicals. Also, the dynamics of resource adjustment are not studied apart from comparing medium-run and long-run effects.

II. THE MODEL

A. US and EC Supply

All four goods in the model are produced in the US, while the EC produces the first three but not soybeans. Production of soybeans in the EC was nil until only very recently, and even now is still dwarfed by consumption. The production function for each commodity is a two-level CES (Sato 1967) exhibiting constant returns to scale at each level. At the upper level, the commodity is produced from a composite mechanical input and a composite biological input. The lower levels generate the composite inputs: the mechanical input is produced from capital and labor, while the biological input is produced from land and agricultural chemicals (fertilizers, pesticides, herbicides, etc.). The two-level CES production function is parsimonious in parameters and may represent a reasonable approximation at an aggregate level to agricultural production processes (Kaneda 1982).

Let Y be production of the commodity, M be the composite mechanical input, and B be the composite biological input. At the upper level,

$$(1) \quad Y = [aM^{(\alpha-1)/\alpha} + (1 - a)B^{(\alpha-1)/\alpha}]^{\alpha/(\alpha-1)},$$

where $0 < a < 1$ is a distributive parameter and $\alpha \geq 0$ is the elasticity of substitution. Let K be capital, N be labor, L be land, and F be chemicals. At the lower levels,

$$(2) \quad M = [mK^{(\sigma-1)/\sigma} + (1 - m)N^{(\sigma-1)/\sigma}]^{\sigma/(\sigma-1)},$$

and

(3) $B = [bL^{(\beta-1)/\beta} + (1 - b)F^{(\beta-1)/\beta}]^{\beta/(\beta-1)}$,

where $0 < m < 1$ and $0 < b < 1$ are distributive parameters, while $\sigma \geq 0$ and $\beta \geq 0$ are elasticities of substitution. Technology is taken as given. There is no jointness between commodities in production.

The cost function dual to this production structure is also a two-level CES. At the upper level, the cost of production for the commodity, C, is a function of the shadow prices of the mechanical and biological inputs, p_M and p_B, and output:

(4) $C = [a^{\alpha}p_M{}^{1-\alpha} + (1 - a)^{\alpha}p_B{}^{1-\alpha}]^{1/(1-\alpha)}Y.$

Let r be the rental rate on capital, w be the wage rate, ρ be the rental rate on land, and v be the price of chemicals. Then the cost functions for the lower levels are

(5) $C_M = [m^{\sigma}r^{1-\sigma} + (1 - m)^{\sigma}w^{1-\sigma}]^{1/(1-\sigma)}M,$

and

(6) $C_B = [b^{\beta}\rho^{1-\beta} + (1 - b)^{\beta}v^{1-\beta}]^{1/(1-\beta)}B.$

The shadow prices of the mechanical and biological inputs are equal to marginal (and average) production costs: $p_M = \partial C_M/\partial M = C_M/M$ and $p_B = \partial C_B/\partial B = C_B/B$. The price of the commodity itself equals marginal (and average) cost:

$p = \partial C/\partial Y = C/Y$. Factor demands are obtained from Shephard's lemma.

Capital, labor, and chemicals are assumed to have perfectly elastic supply curves. These assumptions are in keeping with the small shares of agriculture in national income and the labor force in both the US and EC. We assume that the stocks of land used for the commodities are imperfect substitutes for each other, so that rental rates on land differ across commodities. The supply of land for the jth crop is a constant-elasticity function of the rental rates for all crops:

$$(7) \quad L_j = \ell_j \Pi_k \rho_k^{\varepsilon_{jk}},$$

where $\varepsilon_{jj} \geq 0$ and $\varepsilon_{jk} \leq 0$ for $j \neq k$. ℓ_j is an exogenous land supply shifter.

B. US and EC Demand

Let the consumption of the jth commodity, Q_j, be a constant-elasticity function of prices:

$$(8) \quad Q_j = q_j \Pi_k p_k^{\gamma_{jk}},$$

where $\gamma_{jj} \leq 0$ and $\gamma_{jk} \geq 0$ for $j \neq k$. q_j is an exogenous demand shifter.

C. US and EC Commodity Policy

In the US, wheat, corn, and coarse grains each have three policies: a price floor, an output subsidy, and a restriction on planted acreage. The price floor is the loan rate, while the output subsidy is an amalgamation of direct payments to producers under the target price, acreage diversion, and disaster programs. The only major program for soybeans is a loan rate program. As an approximation and a simplifying assumption, we assume that the market price exceeds the price floor for each commodity, so that the loan rate programs do not affect market outcomes.[2] We correct for nonparticipation in the commodity programs by dividing total payments to participating farmers by the output of all producers, participants and nonparticipants. The US producer price is then the US consumer price (taken to be the world price) plus direct payments on a per unit basis.

Acreage restrictions are difficult to model because of slippage, which is the natural tendency for farmers to idle their least productive land. The result is that the amount of land idled can be considerably less when measured in quality-adjusted acres. We assume that acreage restrictions lead to a neutral shift inward in the supply curve for land that is less than the amount of land actually idled.[3]

In the EC, three policies form the core of price support activities for wheat, corn, and coarse grains.[4] The first is a system of threshold prices that largely insulate EC markets from world market conditions. Variable import levies maintain the difference between threshold prices and world prices. Second, internal prices are supported by government purchases at intervention prices. The intervention prices are somewhat below the threshold prices, and establish a floor for producer prices. Third, export subsidies, known as restitutions, are used to dispose of government surpluses on world markets.

EC markets for these three commodities are not completely insulated from world markets, however, because EC planners take world prices into account when choosing internal prices. Assume that the internal price for the jth commodity, p_j^{EC}, is related to the world price, p_j^{w}, as

$$(9)\quad p_j^{EC} = \phi_j (p_j^{w})^{\eta_j},$$

where $\eta_j \geq 0$ is a world price transmission elasticity and $\phi_j > 0$ is an exogenous internal price shifter.

EC policy gives soybeans free entry into the EC, so that domestic consumer prices equal world prices. For producers, a deficiency payment system is in operation. Since EC soybean production is negligible, however, this program is not included in our model.

D. Rest of the World (ROW)

Constant-elasticity import demand functions are specified for the rest of the world. The rest of the world is a net importer of all four commodities. Let Z_j be net imports of the jth commodity, and let ψ_j be an exogenous net import shifter. Then

$$(10)\quad Z_j = \psi_j \Pi_k (p_k^{w})^{\mu_{jk}},$$

where $\mu_{jj} \leq 0$ and $\mu_{jk} \geq 0$ for $j \neq k$. This specification does not assume that domestic ROW prices equal world prices. Differences between domestic and world prices are incorporated into the μ_{jk} in a manner described below.

E. Market-Clearing Identities

The market-clearing equations require that world supply equal world demand for each commodity:

$$(11)\quad Y^{US} + Y^{EC} = Q^{US} + Q^{EC} + Z^{ROW}.$$

Changes in government and private stocks are ignored.

III. PARAMETER VALUES AND DATA SOURCES

A. US and EC Supply

The distributive parameters in the production (and cost) functions are derived from base year (1982) factor shares. Letting s_i be the share of factor i, and using the fact that the partial output elasticity of each input is equal to its share of total cost in equilibrium, we have $a = s_K + s_N$, $m = s_K/(s_K + s_N)$, and $b = s_L/(s_L + s_F)$. Factor shares are drawn from USDA cost of production data and Stanton (1986), and are shown in table 1.

Substitution elasticities are derived from existing estimates of Allen elasticities of substitution (AES). Let σ_{ij} be the AES between factors i and j. Then

$$(12)\quad \alpha = \sigma_{KL} = \sigma_{KF} = \sigma_{NL} = \sigma_{NF},$$

$$(13)\quad \sigma = a\sigma_{KN} + (1 - a)\alpha,$$

$$(14)\quad \beta = a\alpha + (1 - a)\sigma_{LF}.$$

Several studies have estimated AES for US agriculture, including Binswanger (1974), Brown and Christensen (1981), Chambers and Vasavada (1983), Hayami and Ruttan (1985), Hertel (1989), Kislev and Peterson (1982), and Ray (1982). Published estimates for the EC relevant to our study are much rarer, and to our knowledge are limited to Bonnieux (1989) for France and Boyle (1981) for Ireland.

One problem is that the own-price output supply elasticities implied by these elasticities of substitution are substantially greater than econometric estimates of supply elasticities.[5] Figures distilled from the econometric studies are in Sullivan, Wainio, and Roningen (1989). For the jth commodity, the base year own-price output supply elasticity implied by our model is

$$(15)\ \eta_{jj} = [\varepsilon_{jj} + a_j b_j \alpha_j + (1 - b_j)\beta_j]/[(1 - a_j)b_j].$$

Regardless of the value assigned to ε_{jj}, η_{jj} turns out to be much larger than the econometric estimates.[6]

Rather than throwing out one set of elasticities, we prefer to see them as emerging from different time perspectives. The econometric studies are probably capturing short- or medium-run effects, while the synthetic supply elasticities obtained from equation (15) indicate what is possible in the long run. Thus we use two sets of figures. The first, representing a medium-run perspective, starts with the econometric elasticities and works backward to substitution elasticities and land supply elasticities. The second, the long-run set, starts with the substitution elasticities and ends up with the synthetic supply elasticities.

Medium-run (MR) substitution elasticities for each commodity in the US are $\alpha = 0$ and $\beta = \sigma = 0.2$. For the EC, $\alpha = 0$ and $\beta = \sigma = 0.1$ for each commodity in the medium run. Long-run (LR) values for both the US and EC are $\alpha = 0.5$, $\beta = 1.5$, and $\sigma = 1$. Implied base-year output supply elasticities are in table 2.[7]

B. US and EC Demand

Estimates of medium-run price elasticities of demand are in Sullivan, Wainio, and Roningen (1989), and are used to obtain our elasticities in table 3. Long-run elasticities are likely to exceed medium-run values as substitutability in livestock feed increases and lags in consumer behavior play themselves out. Thus we set them somewhat higher than the medium-run elasticities.

C. US and EC Commodity Policy[8]

Base-period direct payments to US producers were small, about 8% of the farm price for wheat, 3% for corn, and 5% for coarse grains. Acreage restrictions had a similarly modest impact. Slippage was assumed to cut the effective (quality-adjusted) acreage idled under diversion and set-aside programs by two thirds, leading to a 5% restriction for wheat, 3% for corn, and 2% for coarse grains.

Price transmission elasticities from world prices to EC prices are in Tyers and Anderson (1988a). MR elasticities are 0.1 for wheat and 0.2 for corn and coarse grains. LR elasticities are 0.15 for wheat and 0.45 for corn and coarse grains. EC prices exceed US prices by large margins (in the early 1908s, about 40% for wheat, 50% for corn, 70% for coarse grains). Because of transportation and marketing costs, however, these differences would not completely disappear if the EC eliminated its commodity programs. We assume that elimination would still leave EC prices for wheat, corn, and coarse grains 30% above US prices.

D. Rest of the World (ROW)

Equation (10) expresses net imports by ROW as a function of world prices, which in our model are US consumer prices. Short- and long-run price transmission elasticities relating ROW domestic producer and consumer prices to world prices are drawn from Tyers and Anderson (1988a). Medium-run ROW supply and demand elasticities with respect to domestic prices are taken from Sullivan, Wainio, and Roningen (1989). We set long-run elasticities somewhat above the medium-rum elasticities. We combined these elasticities with the price transmission elasticities and aggregated across countries to obtain the figures in table 4.

IV. EFFECTS OF POLICY REFORMS

We focus our attention on five scenarios. The first involves quantitative restrictions on agricultural chemicals in both the US and the EC given existing farm commodity programs. The second and third involve unilateral chemical restrictions in the US or the EC given existing farm programs. The fourth entails an elimination of commodity programs in both the US and EC without any chemical restrictions. The fifth involves chemical restrictions in both the US and the EC, as well as the elimination of commodity programs in both regions.

Primary attention is focused on bilateral action for the sake of political viability. Unilateral farm commodity policy reform by either region is politically out of the question, as is well known. The only reasonable prospect for change is through bilateral or multilateral agreements. We feel the same is true for environmental policies, and our results bear out this view.

Economists generally think in terms of emissions-based incentives or regulations as solutions to environmental externalities rather than quantitative limits on inputs (Baumol and Oates 1988). However, the nonpoint character of agricultural pollution makes monitoring emissions by firms impractical, thus ruling out the application of emissions-based instruments. Corrective measures must therefore be applied to polluting inputs and/or land use practices (Shortle and Dunn 1986). Because of the level of aggregation in this study, we focus on the single chemical input aggregate.

Furthermore, we limit our analysis in this paper to quotas on chemical use.[9] The tendency in US environmental policy is to use regulations rather than economic incentives, in part because regulations have a lesser impact on producer rents than taxes. This makes them more politically viable. Other reasons have also been noted (Bohm and Russell 1985). Taxes on agricultural chemicals have been recently introduced in several European countries and have been proposed in several others (OECD 1989). However, there is considerable interest in quotas in Europe, especially on fertilizer. Fertilizer demands are generally quite inelastic in own prices but quite elastic with respect to product prices (Burrell 1989). Relatively large tax increases would be needed to reduce use, at least in the short- and medium-run. At the same time, commodity price variations could cause wide swings in use (OECD 1989). Quotas are attractive because they would be less harmful to farmers while offering greater reliability in environmental protection.

Attention is focused on a modest 10 percent reduction in chemical use for each commodity. Large reductions are politically unrealistic given the importance of chemicals to agriculture in both regions. However, a 10 percent cut is large enough to show the impacts of restrictions, and yet small enough to be within the range of year-to-year variations in chemical use.

A. Chemical Reductions With Existing Farm Programs

The impacts of a 10 percent reduction in chemicals in both the US and the EC given existing farm programs are presented in table 5. Limits on chemical use increase production costs in both regions since least-cost input combinations can no longer be used. Unit cost increases are much more pronounced in the medium run than in the long run because elasticities of substitution and land supply elasticities are lower in the medium run. World price increases are dramatic in the medium run. They are much smaller in the long run, however, both because cost increases are smaller and demands are more elastic. EC price increases for wheat, corn, and coarse grains are modest. Changes in world and EC soybean prices are identical by assumption.

Because EC prices are fairly insensitive to world prices, EC producers are only able to shift the burden of the production cost increases forward to consumers to a limited extent. EC land rents fall dramatically in the medium run as the negative output effect of cost increases dominates the substitution effect of land for chemicals. In the long run, however, the changes are negligible (and actually positive for corn and coarse grains). EC production and consumption levels are diminished to a small degree in both the medium run and long run. Production falls slightly less in the long run because substitution elasticities are larger.

In sharp contrast to EC farmers, farmers in the US gain substantially from chemical restrictions. The medium run gains in land rents in the US are equally as dramatic as the EC losses. The long run increases in land rents, although considerably less than in the medium run, are significant as well. Land rents increase because higher output prices, combined with the substitution effect of land for chemicals, outweigh the negative effect of output reductions on the demand for land. US output reductions are small in both the medium and long run, as are decreases in demand.

Although other factors are involved, changes in land rents in the EC and the US correspond to the relative chemical intensity of the crops. Wheat, corn, and coarse grains are about the same in chemical intensity in the EC. As a result, the decreases in land rents are similar for the three crops. In the US, coarse grains and wheat are less chemical intensive than corn and soybeans and thus experience greater increases in rents.

Quotas on agricultural chemicals cause the supply and demand prices of chemicals to diverge. The supply price is constant by assumption. The demand price increases as producers are forced to use fewer chemicals than they would like. Results for the demand price indicate the tax that would have to be levied on chemicals to achieve a 10 percent reduction in use. Huge taxes would be required in the medium run, especially in the US.

B. *Unilateral Chemical Reductions*

The impacts of unilateral restrictions on chemicals in the US or the EC given existing farm programs are shown in tables 6 and 7. Increases in world prices are smaller with unilateral EC restrictions than with unilateral US restrictions. This is to be expected since the EC is mostly isolated from world markets given existing farm programs. Comparing world price increases in the unilateral and bilateral cases, the total is generally greater than the sum of its parts. This is also to be expected since chemical restrictions in one region limit the ability of that region's producers to respond to higher world prices caused by restrictions in the other region. Changes in supply and demand in the US and the EC are small or moderate in the unilateral cases, as in the bilateral case. EC price increases for wheat, corn, and coarse grains are similarly modest.

Rents to US landowners increase even in the case of unilateral US restrictions. The negative direct impacts of chemical restrictions on farmers are outweighed by the substitution effect of land for chemicals. However, US rents increase substantially more under bilateral restrictions. Decreases in EC rents are greater with unilateral EC restrictions than with bilateral restrictions. The conclusion is that, in both the US and EC, given existing farm programs, bilateral restrictions may be more politically viable than unilateral restrictions.

C. Elimination of Farm Programs

The impacts of an elimination of farm programs in both the US and EC are shown in table 8. From the results for unilateral elimination by the US or EC (not reported here), the results in table 8 are derived primarily by program elimination in the EC.[10]

Changes in world prices are modest except for coarse grains. Reductions in EC prices are limited as EC supplies fall and EC corn and coarse grain demands rise. Changes in land rents generally parallel the changes in production. Decreases in land rents for wheat and corn in the US in the medium run are reversed in the long run as supplies become more elastic and EC producers reduce their output to a greater extent. Coarse grain landowners in the US gain significantly as their production increases and EC production drops. EC landowners experience sizeable losses in both the medium and long run.

Chemical use in the EC drops substantially in the long run. Politically, this argues for a coalition between European environmentalists and those opposed to EC commodity programs. However, decreases in EC chemical use are accompanied by increases in US chemical use. With a shift in production from the EC to the US comes a shift in chemicals.

D. Chemical Reductions Without Farm Programs

The impacts of a 10 percent reduction in chemicals in both the US and the EC combined with an elimination of farm programs in both regions are presented in table 10. World prices rise substantially in the medium run, but not nearly as much as in the case where farm programs are in place. In the present case EC producers are much more responsive to world prices. In addition, US producers have previously unavailable acreage to substitute for chemicals, thus moderating the increase in US production costs. In the long run, however, world prices increase somewhat more without the programs than with them. As supplies become more elastic in the long run, EC producers withdraw more resources from production as their prices fall to world levels, raising world prices.

US landowners are largely worse off with both chemical restrictions and farm program elimination than with chemical restrictions alone. Existing farm programs place EC producers at a disadvantage in responding to chemical restrictions and thus give US producers an advantage . On the other hand, US landowners are largely better off with both than with farm program elimination alone. This is because chemical restrictions raise land rents. EC landowners are largely better off with both policy changes than with either chemical limits or farm program elimination alone.

In the medium run, EC prices of wheat, corn, and coarse grains rise as production cost increases dominate the negative effects of commodity program elimination on prices. In the long run, however, cost increases are smaller and it is commodity program elimination that dominates. Thus EC prices fall.

Increases in the demand price of chemicals caused by chemical use limits are generally smaller without farm programs than with them, as one would expect. In fact, without the farm programs, decreases in EC corn and coarse grain production (and thus the derived demand for chemicals) are so large that their demand prices actually fall in the long run. In these cases, chemical subsidies would be needed to hold the reductions in use to 10 percent.

V. SUMMARY AND CONCLUSIONS

This paper analyzed the impacts of restrictions on agricultural chemicals in the US, the EC, or both regions under various farm commodity policy scenarios. A partial equilibrium simulation model of agriculture was constructed with three regions: the US, the EC (12), and the rest of the world. The four commodities included in the model were wheat, corn, coarse grains, and soybeans. Medium- and long-run impacts of agricultural chemical restrictions were projected.

Four conclusions emerge concerning chemical restrictions. First, significant increases in world commodity prices would occur in the medium run, but only small to moderate increases would occur in the long run. Second, changes in production and consumption in the US and the EC would not be substantial. Third, given existing farm commodity programs, US landowners would be the clear winners from chemical restrictions, even restrictions adopted unilaterally by the US. Conversely, landowners in the EC would incur huge losses in the medium run from EC chemical restrictions (whether or not they were accompanied by US restrictions). Long-run losses would be much smaller, though. Fourth, judging from impacts on land rents, bilateral restrictions on chemicals would be more politically viable than unilateral restrictions.

Concerning environmental and farm commodity program linkages, three conclusions emerge. First, a bilateral elimination of farm commodity programs would induce a significant shift in production and thus chemical usage from the EC to the US. These impacts on chemical use generally go unrecognized, especially among environmental groups. Second, judging from impacts on land rents, a bilateral elimination of farm programs would be more politically viable if accompanied by bilateral restrictions on agricultural chemicals. Third, again judging from impacts on land rents, bilateral restrictions on chemicals would be less politically attractive in the US if accompanied by bilateral farm program elimination. Conversely, they would be more attractive in the EC.

ENDNOTES

1. The base year is called 1982, although 1980-84 averages or other multi-year averages centered around 1982 are used wherever possible.

2. About 10% of US wheat production has been acquired by the US government in recent years under the loan program. The percentage for corn has generally been less than 10, while it has generally been less than 5 for coarse grains and soybeans.

3. In practice, price elasticities of land supply in equation (7) are also affected by acreage restrictions. However, the evidence on their impacts is too tenuous to gauge the magnitudes of these effects.

4. Production-weighted averages of country producer prices are used to account for price differences between EC member countries. Differences between EC producer and consumer prices are ignored.

5. There are three other significant problems. First, point estimates of the AES even from a single study do not satisfy the equalities in equation (12). Second, AES estimates differ from one study to another, often substantially. Third, separate estimates are not available for individual commodities. Thus we construct averages and apply them to all the commodities in the model.

6. The base year supply elasticity for commodity j with respect to the price of k is $\eta_{jk} = \varepsilon_{jk}/[(1 - a_k)b_k]$, $j \neq k$.

7. MR land supply elasticities are set so that the model reproduces observed MR output supply elasticities, subject to zero-degree homogeneity requirements imposed on the land supply curves. LR land supply elasticities are set somewhat above the MR values.

8. Base period data for policy, prices, and other variables came from several sources, including the Commission of the European Communities, Herlihy et al. (1989), and the USDA statistical publications listed in the references.

9. We recognize that the administrative structure to regulate chemical use currently does not exist. A self-reporting scheme would probably have to be used. Of course, some evasion of the restrictions would occur.

10. We compared our results with those from three well-known agricultural trade liberalization models: Tyers-Anderson (1988b), SWOPSIM (Roningen and Dixit 1989), and IIASA-BLS (Parikh et al. 1988). Our medium-run results for world prices under unilateral elimination by the US or the EC are the ones most easily compared to these three models. Our results here are quite close to Tyers-Anderson and IIASA-BLS, but significantly different from SWOPSIM.

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Table 1

Factor Shares, 1982
(Percent)

	Commodity							
	Wheat		Corn		Coarse Grains		Soybeans	
Factor	US	EC	US	EC	US	EC	US	EC
Capital	40	30	35	30	45	25	35	---
Labor	15	30	10	25	15	30	10	---
Land	30	20	25	20	25	20	35	---
Chemicals	15	20	30	25	15	25	20	---

NOTE: Rounded to nearest 5 percent.

Table 2

Supply Elasticities, 1982

		Price							
		Wheat		Corn		Coarse Grains		Soybeans	
Supply		US	EC	US	EC	US	EC	US	EC
Wheat	MR	0.5	0.5	-0.2	-0.05	-0.08	-0.1	-0.06	--
	LR	3	5	-0.4	-0.1	-0.2	-0.4	-0.1	--
Corn	MR	-0.07	-0.1	0.7	0.5	0	-0.1	-0.1	--
	LR	-0.1	-0.3	4	5	-0.04	-0.2	-0.3	--
Coarse Grains	MR	-0.1	-0.1	-0.04	-0.05	0.6	0.5	-0.1	--
	LR	-0.2	-0.4	-0.1	-0.1	4	5	-0.3	--
Soybeans	MR	-0.07	---	-0.2	---	-0.08	---	0.4	--
	LR	-0.2	---	-0.4	---	-0.2	---	2	--

NOTE: Rounded to a single digit.

Table 3

Demand Elasticities

Supply		Price: Wheat US	Wheat EC	Corn US	Corn EC	Coarse Grains US	Coarse Grains EC	Soybeans US	Soybeans EC
Wheat	MR	-0.4	-0.3	0.2	0.06	0.1	0.07	0	0
	LR	-0.7	-0.5	0.3	0.1	0.2	0.1	0.01	0.01
Corn	MR	0.04	0.2	-0.2	-0.4	0.05	0.1	0.02	0.01
	LR	0.08	0.3	-0.4	-0.7	0.1	0.2	0.04	0.02
Coarse Grains	MR	0.1	0.1	0.3	0.07	-0.5	-0.4	0	0.01
	LR	0.2	0.2	0.5	0.1	-0.9	-0.7	0.02	0.02
Soybeans	MR	0	0	0.1	0.02	0	0.04	-0.3	-0.4
	LR	0.01	0.01	0.2	0.04	0.01	0.07	-0.6	-0.7

NOTE: Rounded to a single digit.

Table 4

ROW Net Import Elasticities

Imports	Price: Wheat MR	Wheat LR	Corn MR	Corn LR	Coarse Grains MR	Coarse Grains LR	Soybeans MR	Soybeans LR
Wheat	-1	-3	0.2	0.5	0.4	1	0.01	0.03
Corn	0.2	0.5	-1	-3	0.1	0.2	0.05	0.1
Coarse Grains	0.1	0.2	0.1	0.2	-1	-3	0.01	0.03
Soybeans	0.1	0.2	0.1	0.2	0.05	0.1	-1	-3

NOTE: Rounded to a single digit.

Table 5

Chemical Reductions with Existing Farm Programs
(Percentage Change from Benchmark)

Variable	Wheat MR	Wheat LR	Corn MR	Corn LR	Coarse Grains MR	Coarse Grains LR	Soybeans MR	Soybeans LR
Supply:								
US	- 4	- 1	- 6	- 3	- 3	0	- 5	- 2
EC	- 6	- 5	- 7	- 4	- 7	- 4	---	---
Demand:								
US	- 3	- 1	- 3	- 1	- 4	- 1	- 2	- 1
EC	0	0	- 1	- 1	- 2	- 1	- 7	- 2
ROW Imports	-10	- 6	-20	-10	-20	-10	-10	- 9
World Price	40	5	40	6	40	5	20	4
EC Price	3	1	7	3	7	2	20	4
Land Rents:								
US	40	8	30	7	60	10	20	5
EC	-40	- 2	-40	2	-40	1	---	---
Demand Price of Chemicals:								
US	200	20	100	10	200	20	80	10
EC	60	5	70	10	70	9	---	---

NOTE: Rounded to a single digit.

Table 6

Unilateral US Chemical Reductions
(Percentage Change from Benchmark)

Variable	Wheat MR	Wheat LR	Corn MR	Corn LR	Coarse Grains MR	Coarse Grains LR	Soybeans MR	Soybeans LR
Supply:								
US	- 4	- 3	- 6	- 4	- 4	- 3	- 4	- 2
EC	0	1	2	9	1	2	---	---
Demand:								
US	0	0	- 3	- 1	2	1	- 2	- 1
EC	0	0	- 1	- 1	0	0	- 6	- 2
ROW Imports	- 5	- 2	-20	-10	-10	- 2	-10	- 8
World Price	20	2	30	4	20	1	20	3
EC Price	2	0	5	2	3	0	20	3
Land Rents:								
US	9	1	8	3	10	0	6	3
EC	8	1	20	9	10	2	---	---
US Demand Price of Chemicals	90	9	80	10	90	7	80	10
EC Chemical Use	0	2	3	10	1	4	---	---

NOTE: Rounded to a single digit.

Table 7

Unilateral EC Chemical Reductions
(Percentage Change from Benchmark)

Variable	Wheat MR	Wheat LR	Corn MR	Corn LR	Coarse Grains MR	Coarse Grains LR	Soybeans MR	Soybeans LR
Supply:								
US	2	3	1	1	4	5	- 1	0
EC	- 6	- 5	- 7	- 6	- 7	- 5	---	---
Demand:								
US	- 2	0	0	0	- 4	- 1	0	0
EC	0	0	0	0	- 1	0	- 1	0
ROW Imports	- 3	- 2	0	0	-10	- 4	- 1	0
World Price	9	1	3	0	10	2	3	0
EC Price	1	0	1	0	2	1	3	0
Land Rents:								
US	30	4	10	1	40	6	7	1
EC	-50	- 3	-50	- 3	-50	- 2	---	---
EC Demand Price of Chemicals	50	4	40	3	50	5	---	---
US Chemical Use	6	6	2	1	9	10	0	0

NOTE: Rounded to a single digit.

Table 8

Elimination of Farm Programs
(Percentage Change from Benchmark)

Variable	Wheat MR	Wheat LR	Corn MR	Corn LR	Coarse Grains MR	Coarse Grains LR	Soybeans MR	Soybeans LR
Supply:								
US	2	3	2	6	7	50	0	0
EC	0	- 8	- 9	- 40	- 7	- 40	---	---
Demand:								
US	0	- 1	1	1	- 6	- 10	0	0
EC	0	- 1	3	6	4	6	- 1	- 2
ROW Imports	2	- 5	0	- 5	-10	- 40	1	1
World Price	4	8	2	4	20	20	0	1
EC Price	- 7	- 3	-10	-10	-10	- 10	0	1
Land Rents:								
US	-10	0	- 6	4	40	60	1	3
EC	-30	-10	-70	-50	-60	- 40	---	---
Chemical Use:								
US	0	3	2	8	10	100	0	2
EC	- 2	-20	-10	-60	-10	- 60	---	---

NOTE: Rounded to a single digit.

Table 9

Chemical Reductions Without Farm Programs
(Percentage Change from Benchmark)

	Commodity							
	Wheat		Corn		Coarse Grains		Soybeans	
Variable	MR	LR	MR	LR	MR	LR	MR	LR
Supply:								
US	- 2	- 1	- 5	- 2	- 2	10	- 4	- 2
EC	- 6	- 5	- 7	-10	- 7	-10	---	---
Demand:								
US	- 1	0	- 3	- 1	- 6	- 9	- 2	- 1
EC	- 3	- 1	- 1	3	0	6	- 6	- 4
ROW Imports	- 6	- 6	-20	-20	-30	-40	- 9	- 8
World Price	30	10	40	9	40	20	20	4
EC Price	20	- 1	10	- 7	8	-10	20	4
Land Rents:								
US	6	0	4	6	40	30	9	6
EC	-30	- 7	-30	-20	-40	-20	---	---
Demand Price of Chemicals:								
US	100	10	100	20	200	50	80	10
EC	100	1	90	-10	70	-20	---	---

NOTE: Rounded to a single digit.