A DIFFERENTIATED GOODS MODEL OF THE EFFECTS OF EUROPEAN POLICIES IN INTERNATIONAL POULTRY MARKETS

Julian M. Alston and Grant M. Scobie

Abstract

The Common Agricultural Policy increases European poultry production costs, prohibits imports, increases domestic prices, and subsidizes exports. This policy has displaced some U.S. exports. However, the net impact in the U.S. has been quite modest, even assuming poultry is homogeneous, independent of source country. Costs to U.S. producers are almost entirely offset by gains to U.S. consumers. Effects in the U.S. are even smaller when imperfect substitutability between poultry from different countries is accounted for. A retaliatory U.S. export subsidy would have more dramatic effects in U.S. markets.

Key words: international trade, poultry, Common Agricultural Policy, U.S. markets, differentiated goods model, export subsidies.

The Common Agricultural Policy (CAP) of the European Community (EC) increases poultry production costs, prohibits imports, and subsidizes exports. This has contributed to the EC becoming the dominant poultry exporter, displacing United States exports, especially from the Middle East, the major importing region. The National Broiler Council et al. provide details on changes in these market shares.

A detailed description of the history and operation of the CAP as it affects poultry is provided by Alston and the National Broiler Council et al. In summary, there are two major elements of the CAP which affect the European poultry industry. Variable import levies and domestic price supports raise the price that European producers pay for cereals used in poultry rations. However, in order to compensate producers, subsidies (refunds) are paid on exports of poultry meat to destinations outside the EC. There is no direct intervention in domestic poultry markets. Internal prices are supported indirectly by the export subsidies and the levy system which operates as a prohibitive barrier to imports.

The export refunds have invariably exceeded the increase in costs imposed by the grain policy. In the five years up to 1981, production costs were on average 9 percent higher than they would have been in the absence of the grain policy, while eliminating the refunds would have lowered the producer price by 13 percent (Alston).[1]

Rowan, Mageira, National Broiler Council et al., and McClelland have suggested that import protection and export subsidies have caused significant displacement of United States exports to the EC and other countries, mainly the Middle East. Along with legal redress under the General Agreement on Tariffs and Trade (GATT), retaliatory action by the United States government (as in the "chicken war" of the late 1960's) has been suggested.

The objective of this paper is to examine the consequences of the EC policy, particularly for the United States. Two approaches are used. In the first, poultry meat is treated as a homogeneous product. An equilibrium displacement model is used to predict the effect of EC policies on the world price and hence on the volume of United States exports. In the second approach, poultry meat is treated as

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[1] Some substitutes for cereal grains (e.g., soybeans and maize gluten) are not covered by the CAP, and Koester suggests that this may have led to substitution for the protected cereals. Such substitution would reduce this shift in the poultry supply schedule. However, in poultry production, it appears that the substitution possibilities are quite limited.

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More detailed analysis and results are reported in Alston.

being differentiated by region of origin, so that European and United States poultry are not perfect substitutes. A more detailed equilibrium displacement model is solved for the effects of the EC policies on prices and trade flows among six regional markets and to analyze the effects of a retaliatory export subsidy by the United States.

Theoretically, the two models are identical. Whether poultry meat from different countries is regarded as homogeneous by consumers is an empirical question.[2] The two models differ only in terms of the empirical assumptions made about the elasticities of substitution among poultry products from different countries. The first model may be thought of as a simpler limiting case of the more general second model, with infinite elasticities of substitution assumed.

MODEL 1: POULTRY AS A HOMOGENEOUS GOOD

The following linear-in-logarithms equilibrium displacement model of the EC poultry market assumes poultry is a homogeneous good. A more detailed explanation of this model is provided by Alston. Equations (1), (2), and (3) are the EC poultry supply, domestic demand, and export demand equations, respectively, expressed in terms of percentage changes and elasticities. Equation (4) is a market clearing identity, and equation (5) is an equilibrium identity that reflects the EC price wedge. All of the equations are logarithmic differential approximations to general forms so that for any variable Y, $d\ln Y$ = the percentage change in Y. Equations (1)-(5) may be represented as:

(1) $d\ln Q_e = \epsilon_e(d\ln P_e - \alpha)$,
(2) $d\ln D_e = \eta_e d\ln P_e$,
(3) $d\ln X_e = \eta_x d\ln P_x$,
(4) $d\ln Q_e = (D_e/Q_e)d\ln D_e + (X_e/Q_e)d\ln X_e$,
and
(5) $d\ln P_x = d\ln P_e - \beta$

where Q_e = EC production of poultry, P_e = EC wholesale price of poultry, D_e = EC consumption of poultry, X_e = EC poultry exports, P_x = EC poultry export price (net of subsidy), α = the percentage shift up of the EC poultry supply function (increase in marginal costs) due to the CAP grains, β = the percentage change in the EC domestic relative to export

price as a result of export subsidies, ϵ_e = the elasticity of EC poultry supply, η_e = the elasticity of EC poultry demand, and η_x = the elasticity of export demand for poultry facing the EC.

The solution of this system yields equations for the five endogenous variables ($d\ln Q_e$, $d\ln D_e$, $d\ln X_e$, $d\ln P_x$, and $d\ln P_e$) as functions of the parameters (ϵ_e, η_e, and η_x) and the two policy intervention measures (α and β). To simulate the effects of eliminating the CAP, the policy intervention measures are set at α = −9 percent (a 9 percent reduction in EC production costs due to eliminating the CAP grains, as estimated by Alston) and β = −13 percent (a 13 percent reduction in the EC price relative to the EC export price due to eliminating export subsidies, as estimated by Alston).

The key parameters are elasticities of EC supply, EC domestic demand, and export demand facing the EC. One approach to estimate these parameters would be to do original econometric work, but it would be difficult, given available data, to improve upon existing estimates econometrically. Previous estimates for the EC by Thomson and Harvey suggest a demand elasticity of −0.5. A similar estimate was obtained by Alston for the United States (see also George and King, Wohlgenant and Hahn, and Harling and Thompson). Based on these estimates, a wholesale elasticity of demand of −0.5 is assumed to apply in all regions.

The supply elasticity is more difficult. One could make a fairly strong prior case for a highly elastic long-run supply function for poultry in the EC and other countries. Constant returns to scale in the aggregate seems plausible, and there are no obviously limiting specialized factors given the relative unimportance of the poultry sector in any country.

When choosing a supply elasticity for policy analysis, a balance must be struck between this type of reasoning and the econometric evidence. Some previous studies have relied on the econometric estimates in the literature. For instance, Thomson and Harvey used an EC poultry supply elasticity of 1.0, but given the arguments above, this seems low as an estimate of a long-run supply elasticity. Harling and Thompson used even lower elasticities of supply for the United Kingdom

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[2] Monke and Petzel argue that whether a homogeneous or differentiated goods model is appropriate is largely an empirical question. They propose two tests of the price linkages between different "kinds" of the good, differing by grade or source. However, the time series data for different "kinds" of poultry needed to make such tests are not available.

and the Federal Republic of Germany, 0.2 to 0.5.

Chavas and Johnson developed a detailed model of poultry supply response in the United States which explicitly incorporates the dynamics of response. We regard that model as the best specification in the literature. Chavas and Johnson's estimates can be used to deduce a long-run supply elasticity for United States broilers and turkeys in the neighborhood of 2.0. Even this seems low. The implication is that the econometric estimates are intermediate or short-run elasticities.

In the empirical work, a range of supply elasticities is used to examine the importance of this uncertain parameter. For much of the analysis, long-run supply elasticities of 2 and 5 are used, reflecting the authors' belief that even the best of the available econometric estimates of the supply elasticity (Chavas and Johnson's) may be too small. Results are obtained using a supply elasticity of 1.0 as well, to indicate the effects of using a smaller supply elasticity.

It is notoriously difficult to estimate export demand elasticities directly. The most common approach is to construct estimates using market shares and elasticities of underlying supply and demand curves. That approach is taken here. The export demand elasticity was found using:

$$(6) \quad \eta_X = E_{er}[(D_r/X_e)\eta_r - (Q_r/X_e)\epsilon_r]$$

where D_r = rest-of-world (ROW) total poultry consumption, Q_r = ROW total poultry production, η_r = ROW elasticity of demand at wholesale (-0.5 by assumption), ϵ_r = ROW elasticity of supply, and E_{er} = an overall elasticity of EC price transmission to the ROW—a weighted average of individual elasticities of EC price transmission to other countries.

Assuming perfect price transmission (E_{er} = 1) and using an ROW demand elasticity of -0.5, an ROW supply elasticity of 5, and the 1981 quantity data (Table 3) yields a value for η_x of -301. However, values of -50 and -250 are used reflecting the existence of trade barriers that result in an elasticity of price transmission of less than 1 and the possibility of a lower ROW supply elasticity. To someone not accustomed to dealing with a model of international trade in which only small fractions are traded, even these scaled down elasticities might seem uncomfortably large. However, an elasticity of -50 implies that a doubling of

EC exports would reduce the "world price" by 2 percent, and that is probably an exaggeration of EC market power.

Results of eliminating the CAP policies affecting poultry (both the export subsidies and the effects of grains policies on poultry feed costs) are shown in Table 1. Exports would fall by between 75 and 200 percent; in cases where exports fall by more than 100 percent the EC would become a net importer. Production would decline by between 2.5 and 16 percent, and domestic consumption in the EC would rise about 6 percent following the decline in price of about 11 or 12 percent. The rise in the export price is modest, reflecting the highly elastic export demand. Use of a smaller long-run supply elasticity results in smaller estimates of the fall in EC production and exports. However, only in the cases when a low supply elasticity (2 or 1) is used in conjunction with an export demand elasticity as low as -50 would the EC continue to export poultry in the absence of the CAP, and, even in these cases, exports would be negligible.

TABLE 1. EFFECTS OF ELIMINATING THE CAP ON THE EC POULTRY MARKET, 1981[a]

Elasticity of Export Demand (η_X)	Elasticity of EC Poultry Supply (ϵ_θ)	EC Domestic Price (P_θ)	EC Consumption (C_θ)	EC Production (Q_θ)	EC Exports (X_θ)	EC Price (P_X)
			percentage changes			
-50	5	-10.5	5.3	-7.5	-125	2.5
-50	2	-11.1	5.6	-4.2	-95	1.9
-50	1	-11.5	5.8	-2.5	-75	1.5
-250	5	-12.2	6.1	-16.0	-200	0.8
-250	2	-12.5	6.3	-7.0	-125	0.5
-250	1	-12.6	6.3	-3.6	-100	0.4

[a] Based on $\alpha = -9$; $\beta = -13$; $\eta_\theta = -0.5$; and an export share of 10% for the EC. In cases where exports fall by more than 100 percent, the EC would become a net importer.

While the effects on the EC price and EC consumption of poultry fall within a very narrow range, the effects on production, exports, and the export price are sensitive to the supply elasticity and export demand elasticity. As would be expected, the effect on EC production is relatively sensitive to the supply elasticity, and the effects on exports and the export price are relatively sensitive to the export demand elasticity. The use of a smaller (in magnitude) elasticity of either supply or export demand results in smaller effects on quantities produced and exported. However, a larger supply elasticity implies a greater effect on the export price, while a larger magnitude of export demand elasticity implies a smaller effect on the export price.

The authors favor the use of a supply elasticity of 2 or 5. It is noted that, everything else constant, this results in larger estimates of the effects of eliminating the CAP on production, exports, and the export price of poultry in the EC than would be obtained using a smaller supply elasticity.

The existing policies clearly imply a major transfer from EC consumers to EC producers. The loss in consumer surplus exceeds 10 percent of the value of consumption at wholesale. However, the CAP affects not only production and income distribution in the EC. Also, through its trade effects, it has consequences for other countries. The net effect of the EC policy may be treated as a shift down in the export supply schedule, so that when the export demand facing the EC is less than perfectly elastic, the "world price" will be depressed. Applying equal weights to consumers and producers, net importing regions (Japan, the Caribbean, and the Middle East) will benefit while net exporting regions (mainly the United States and Brazil) will be worse off.

The EC policy causes a shift of the effective export demand facing the United States, such that the price (P_u), production (Q_u), and exports (X_u) are lower, while domestic consumption in the United States (C_u) is greater. Based on Table 1, a decline in the United States export price of either 1 or 2 percent is examined. In 1981, total United States production and consumption of poultry meat were valued at $7.96 billion and $8.46 billion respectively, using a wholesale price of $1.20/kg. The export share was 5.5 percent. Estimates of United States price, quantity, and welfare effects from eliminating the CAP, using these figures, are reported in Table 2.

Eliminating the CAP would reduce United States consumption (0.5 to 1 percent) but would increase production (1 to 10 percent) and exports (27 to 200 percent). The annual loss in United States consumer surplus due to eliminating the CAP ($79 million to $160 million) is always less than the gain in producer surplus ($85 million to $178 million) so that there is a positive net social surplus gain ($6 million to $18 million) to the United States from eliminating the CAP in poultry.

In summary, in the absence of the CAP, the EC would likely be a poultry importer rather than having become the world's major exporting region. The export subsidies overcompensate EC producers for the higher cost of grain imposed by the CAP, and an implicit tax is borne by EC consumers. There is a significant cost borne by United States producers, but from an aggregate viewpoint, this is largely offset by the gain to United States consumers.

MODEL 2: A DIFFERENTIATED GOODS MODEL

In the preceding section, all poultry meat was assumed to be homogeneous, though that assumption may be hedged somewhat through the use of price transmission elasticities of less than 1. Industry sources suggest that chicken meat (the major category of poultry meat) from the EC is significantly different from United States chicken meat. The EC birds are smaller and the fat is whiter (National Broiler Council et al. and Mageira). The Middle East market is reported to prefer the European export style chickens and has special requirements for slaughter methods and packaging. The French seem to have adapted particularly well to these requirements; they may even have contributed to

TABLE 2. EFFECTS OF ELIMINATING THE CAP ON U.S. POULTRY MEAT MARKETS, 1981

Change in World Price %	Elasticity of U.S. Supply	U.S. Production (Q_u)	U.S. Consumption (C_u)	U.S. Exports (X_u)	U.S. Producer Surplus[a]	U.S. Consumer Surplus[a]	U.S. Net[a]
		percentage changes			$m/year		
+ 1	1	1	−0.5	27	85	− 79	6
	2	2	−0.5	45	85	− 79	6
	5	5	−0.5	100	87	− 79	8
+2	1	2	−1.0	54	170	−160	11
	2	4	−1.0	90	173	−160	13
	5	10	−1.0	199	178	−160	18

a The surplus changes were computed as follows:
Producer Surplus (PS) = $P_u Q_u dlnP_u(1 + 0.5dlnQ_u)$;
Consumer Surplus (CS) = $-P_u C_u dlnP_u(1 + 0.5dlnC_u)$;
Net = Change in Consumer Surplus plus Change in Producer Surplus

developing the Middle East preferences. The Brazilians are reported to produce both types of chicken for different markets, and that might help explain their success in displacing EC poultry from the Middle East markets.

These considerations would suggest that poultry meat is differentiated, at least in some places, according to country of origin. This suggestion is supported by the coexistence of imports and exports in many countries. Thus, poultry meat from the United States may not be a perfect substitute for EC poultry. As a consequence, the effects of EC policy in the United States poultry market will be smaller than suggested previously. This section contains a differentiated goods model of world trade in poultry meat which is used to assess the effects of eliminating the CAP. This model takes explicit account of the imperfect substitution between poultry from different sources while providing more detailed information about the effects in the United States and importing countries. Otherwise, the model is theoretically identical to the first model in which poultry was treated as a homogeneous good. The main additional requirements are more detailed, explicit specifications of market shares and demand and supply elasticities in different regions.

For this analysis, the world is decomposed into six regions, including three major exporters: European Community (e), United States (u), and Brazil (b); two major importers: Japan (j) and Middle East (m); and the residual rest-of-the-world or ROW (r).[3]

Demand and Supply

The demand model follows the approach applied by Grennes, Johnson, and Thursby to analyze international trade in wheat, and by Johnson (1984) to analyze flue-cured tobacco trade. In that model (based on Armington), consumers discriminate among products according to geographical origin. To analyze short-run responses, both Johnson (1984) and Grennes, Johnson, and Thursby took supply as exogenous. In this study longer-run responses are of more interest, and supply is treated as endogenous in a system of regional supply and demand functions. The supply and demand models are expressed in terms of percentage changes and elasticities. The

model is closed by a set of market clearing identities that involve policy variables. The system is solved for endogenous percentage changes in prices, production, consumption, and world trade flows as functions of exogenous policies to measure the effects of policy changes.

The three basic assumptions underlying this model are: (1) the marginal rate of substitution between any two kinds of poultry meat (e.g., European and Brazilian) is independent of consumption of any other good, (2) the elasticity of substitution between any two kinds of poultry meat in a given market is a constant, and (3) the elasticity of substitution between any two kinds of poultry meat in a given market equals the elasticity of substitution between any other two kinds of poultry meat in the same market.

In terms of percentage changes, the system of 36 demand equations is given by:

$$(6) \quad dlnD_{ik} = \sum_{h=1}^{6} \eta_{ikh} \, dlnP_{ih}$$

where D_{ik} = percentage change in consumption of poultry meat from country k in country i,

P_{ih} = price of poultry meat from country h in country i (country i's currency), and

η_{ikh} = elasticity of demand for poultry meat from country k with respect to the price of poultry meat from country h, in country i.

The own-price elasticities of demand in country i are defined by:

$$(7) \quad \eta_{ikk} = -(1 - S_{ik})\sigma_i + S_{ik}\eta_i$$

and the cross-price elasticities are:

$$(8) \quad \eta_{ikh} = S_{ih}(\sigma_i + \eta_i)$$

where σ_i = elasticity of substitution for country i,

η_i = an overall demand elasticity for poultry meat in country i, and

S_{ih} = expenditure share of poultry meat from country h in country i.

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[3] The *European Community* (EC9) includes the Netherlands, France, Denmark, Belgium, Luxembourg, the United Kingdom, the Federal Republic of (i.e., West) Germany, Italy, and Ireland. Following the definition used by the United Nations in *Commodity Trade Statistics*, the *Middle East* includes Bahrain, Iran, Iraq, Kuwait, Saudi Arabia, Qatar, United Arab Emirates, Yemen, and Egypt. The United States, Japan, and Brazil are single countries. All other countries are included in the ROW.

Within any country (k), production of poultry meat depends on the price received by producers, the state of technology, the prices of factors of production, and the prices of alternative products which could be produced. In terms of percentage changes, the supply equations are defined as in equation (1) as:

(9) $\ \mathrm{dln}Q_k = \epsilon_k\ (\mathrm{dln}p_k - \alpha_k)$

where p_k = producers' poultry price in country k,

Q_k = poultry output in country k,

ϵ_k = the price elasticity of supply of poultry meat in country k, and

α_k = the percentage shift in the *price* direction (increase in marginal costs of poultry production) of the poultry meat supply function in country k due to the combined effects of changes in factor prices, technology, etc.

To solve the model, the supply equations are transformed to price dependent form.

Market Clearing Conditions and Solution

Demand prices and supply prices are linked by:

(10) $\ \mathrm{dln}P_{ik} = E_{ik}\ \mathrm{dln}p_k + \beta_{ik}$

where P_{ik} = price of poultry meat from country k in country i,

p_k = producers' price of poultry meat in country k,

E_{ik} = the elasticity of transmission of wholesale poultry price in country k *to* country i so that the first term on the right hand side is the percentage change in P_{ik} due to a change in p_k, and

β_{ik} = percentage change in P_{ik} independent of p_k due, say, to transport costs, exchange rates, or tariffs.

The model is closed with the market clearing identities.

(11) $\ \mathrm{dln}Q_k - \sum_{i=1}^{6} b_{ik}\mathrm{dln}D_{ik} = 0$

where b_{ik} = the proportion of the poultry meat produced in country k that is consumed in country i, and the other variables are as previously defined.

The system of equations formed by equations (6), (9), (10), and (11) can be written in matrix form as:

(12) $\ A_N = X_{N \times N}\ Y_N$

where A = a vector of exogenous policy shift variables (α = supply shift, β = price wedge as in equations (9) and (10));

X = matrix of parameters including shares (b_{ik}), demand elasticities (η_{ikh}), price transmission elasticities (E_{ik}), and supply elasticities (ϵ_k);

Y = a vector of endogenous percentage changes in trade flows (D_{ik}), demand prices (P_{ik}), supply prices (p_k), and outputs (Q_k); and

N = 84 (36 demand equations, 6 supply equations, 36 price linking equations, and 6 market clearing identities).

The final solution is given by:

(13) $\ Y = X^{-1}A$

which expresses the endogenous variables (Y) as a function of the parameters (X) and the policy shifters (A). An example of the structure of these matrices for the case of two countries is given in Alston.

Parameter Estimates

To construct the 'X' matrix of parameters and shares requires a trade flow matrix, a basic wholesale demand elasticity (η_j), an elasticity of substitution (σ_j), a supply elasticity (ϵ_j), and six price transmission elasticities (E_{ik}) for each of the six regions. As in Model 1, a value of -0.5 is assumed for the basic demand elasticity in each of the six regions, and the long-run supply elasticity in each region is assumed initially to be 5. As with the previous model, the use of this supply elasticity will place more of the burden of adjustment on quantities produced and traded and less on prices than if a smaller elasticity were used. If this elasticity is too large, the effects of the policy change on the main variables of interest will be overestimated. The trade flow matrix, based on 1981 data, is given in Table 3. Time

TABLE 3. POULTRY MEAT TRADE MATRIX, 1981

Supply	Demand						Total
	U.S. D_u	EC D_e	Brazil D_b	M.E.[a] D_m	Japan D_j	ROW D_r	
			thousand metric tons				
U.S. (O_u)	6,585.4[b]	15.6	0	105.3	64.8	196.9	6,968
EC (O_e)	0	3,585.1	0	276.8	11.6	167.5	4,041
Brazil (O_b)	0	0.1	1,121.2	255.2	0.3	39.2	1,416
M.E.[a] (O_m)	0	0	0	882.0	0	0	882
Japan (O_j)	0	0	0	0	1,134.0	0	1,134
ROW(O_r)	0	47.8	0	112.0	40.3	14,322.9	14,523
Total	6,585.4	3,648.6	1,121.2	1,631.3	1,251.0	14,726.5	28,964

[a] M.E. = Middle East

[b] Entries are flows from "supply" to region to "demand" region. For example, the United States exported 15,600 MT of poultry to the European Community in 1981. Data are from Alston.

series of these data up to 1981 and a description of detailed sources and procedures to compile the data are reported by Alston.

For the initial simulations, all price transmission elasticities are assumed to be 1.0. Later, for sensitivity analysis, all cross-price transmission elasticities are set to 0.5, leaving own-price transmission elasticities (E_{ii}) at 1.0.

It is difficult to have any sort of prior information about the magnitude of the elasticity of substitution (σ_j) between "kinds" of poultry meat in any market. Johnson (1971) suggests a method for estimating the elasticities of substitution, but the only market that consumes significant quantities of poultry meat from a variety of sources is the Middle East market for which quality data in suitably long time series are unavailable. Intuitively, the magnitude of the elasticity of substitution between commodities will vary among commodities depending on the level of aggregation of commodities and countries.

From Johnson's (1971, 1984) work on wheat, cotton, and tobacco, estimates are concentrated around 3 for a range of commodities at a level of aggregation similar to that used here. The simulations use a range of elasticities of substitution, from 3 to 36, to test for sensitivity.

Each value of the elasticity of substitution implies a different matrix of demand elasticities in each region. The matrices will differ between regions depending on shares which differ widely between regions. Elasticities of substitution cannot be evaluated intuitively, but the demand elasticities that they imply can be evaluated. The range of elasticities of substitution is chosen somewhat arbitrarily, but it implies a very wide range of demand elasticities. By way of illustration, estimates

of the own-price elasticity of demand for United States poultry in the Middle East range from −2.8 to −33.7 for elasticities of substitution from 3 to 36.

Removing EC export subsidies would increase the export/domestic price ratio for their poultry by an estimated 13 percent, as in the homogeneous goods model. To measure the effects of removing the EC poultry export subsidies, the price wedge parameters (β_{ek}) were set at 13 percent for EC exports to the Middle East, Japan, and the ROW (i.e., k = m, j, and r). Assuming a variable levy rate equal to the export subsidy rate, removing the import barriers would result in a 13 percent reduction in the price of United States poultry in the EC relative to the export price of United States poultry. Removing the levies on EC poultry imports is incorporated by setting the price wedge parameters (β_{ke}) at −13 percent for EC imports of poultry from the United States, Brazil, and the ROW (k=u, b, and r). Finally, the supply shift parameter (α_e) is set at −9 percent. This captures the effects of eliminating the effects of the CAP grains on the poultry sector as would result from either eliminating the CAP grains altogether or compensating poultry producers for its effects with a feed grains subsidy.

Results

For all of the simulations, the consumption and trade shares were computed using the values in Table 3, and the basic demand elasticities were set at −0.5 for all countries. For the first set of simulations, the price transmission elasticities were all set at 1.0 and the supply elasticities were all set at 5. The results are given in Table 4.

TABLE 4. CHANGES IN POULTRY MEAT SUPPLY AND DEMAND, BY
REGION, DUE TO ELIMINATING THE CAP, 1981

Supply	Demand						
	U.S.	EC	Brazil	M.E.[a]	Japan	ROW	Total
.... thousand metric tons							
Elasticity of Substitution (σ) = 3							
U.S.	−0.5	2.7	0.0	2.4	0.1	0.3	5.0[b]
EC	0.0	146.3	0.0	−30.6	−1.5	−22.0	92.1
Brazil	0.0	0.0	−0.4	5.4	−0.0	0.0	5.0
M.E.[a]	0.0	0.0	0.0	12.8	0.0	0.0	12.8
Japan	0.0	0.0	0.0	0.0	1.1	0.0	1.1
ROW	0.0	8.3	0.0	2.5	0.0	15.4	26.1
Total	−0.5[c]	157.3	−0.4	−7.6	−0.4	−6.3	142.1[d]
Elasticity of Substitution (σ) = 36							
U.S.	−5.5	15.9	0.0	37.0	0.9	10.1	58.4
EC	0.0	122.3	0.0	−175.5	−11.3	−156.5	−221.0
Brazil	0.0	0.1	−3.4	50.0	−0.0	−4.1	42.6
M.E.[a]	0.0	0.0	0.0	44.3	0.0	0.0	44.3
Japan	0.0	0.0	0.0	0.0	10.3	0.0	10.3
ROW	0.0	46.7	0.0	34.6	−1.2	127.3	207.5
Total	−5.5	185.0	−3.4	−9.5	−1.3	−23.2	142.1[d]

[a] M.E. = Middle East
[b] Summing across rows gives total change in supply for each region.
[c] Summing down columns gives total change in consumption for each region.
[d] Note that the total change in world production and consumption is 142,100 metric tons using either elasticity of substitution but the distribution of the total change varies.

The output from the model is percentage changes in prices and quantities. Table 4 shows the absolute changes in quantities traded corresponding to these percentage changes. Using an elasticity of substitution of 3, the effects outside the EC are negligible because the cross elasticities of demand, even in the Middle East, are very small. EC exports would fall 54,000 metric tons (12 percent), and the EC imports would rise by 11,000 metric tons (17 percent). Surprisingly, EC output of poultry meat would rise by 92,000 metric tons (2.3 percent). This results because the increase in EC consumption of EC poultry meat (146,000 metric tons) is greater than the reduction in EC exports. When a larger elasticity of substitution is used, there is greater displacement of EC poultry meat, from both EC and export markets, by poultry meat from other countries. When a value of 36 is used for the elasticity of substitution among "kinds" of poultry meat, EC production would fall if the CAP were eliminated. This is the more plausible result.

Using an elasticity of substitution of 36 and the relatively large (in absolute value) demand elasticities that this implies, the effects of changing the policy are still concentrated in

the EC compared to the results assuming perfect substitutability among "kinds" obtained using the homogeneous goods model. Consumption in the EC would increase by about 185,000 metric tons (5 percent) overall, and EC production would fall by 221,000 metric tons (5.5 percent). EC exports to Japan and the ROW would cease, and exports to the Middle East would fall by 63 percent, a reduction in exports by 75 percent overall, while EC imports from the United States, Brazil, and the ROW would almost double.

While the effect on United States consumption would be small, trade effects would be more important: a 35 percent increase in exports to the Middle East and a doubling of exports to the EC. Total United States poultry exports would increase by about 20 percent (63,900 metric tons), but production would increase by only 0.8 percent.

Reducing the supply elasticities from 5 to 2 places more of the burden of the response to the policy change on prices, rather than quantities, but the differences are small. Reducing the cross-price transmission elasticities from 1 to 0.5 reduces the effects outside, while increasing the effects within, the EC but again the changes are comparatively small.

Effects of a Retaliatory United States Export Subsidy

The effects of a retaliatory subsidy at a rate of 10 percent on United States poultry exports to all destinations were simulated using the basic parameter values described above and elasticities of substitution from 3 to 36. Results of those simulations using an elasticity of substitution of 36 are reported in Table 5. The effects were much smaller using an elasticity of substitution of 3.

The quantitative effects of the United States export subsidy on United States markets would be dramatic compared to eliminating the CAP. The estimates in Table 5 indicate that there would be a 2.4 percent increase in price, a 1.2 percent decrease in consumption, a 12 percent increase in output, and more than a trebling of exports which would increase from 355.6 thousand metric tons to 1,254 thousand metric tons. Exports by the EC, ROW, and Brazil to the Middle East would fall by 20 to 30 percent, and exports by these countries to Japan would fall by 40 to 50 percent. However, the overall effects in the European Community would be fairly small. Output would fall by about 3 percent.

Supply	Demand						
	U.S.	EC	Brazil	M.E.[b]	Japan	ROW	Total
	----------------- thousand metric tons -----------------						
U.S.	−77.6	39.4	0.0	236.3	133.1	489.6	820.8[c]
EC	0.0	−28.3	0.0	−80.4	−5.6	−8.0	−122.2
Brazil	0.0	0.0	4.3	−59.1	−0.1	0.4	−54.4
M.E.[b]	0.0	0.0	0.0	−54.7	0.0	0.0	−54.7
Japan	0.0	0.0	0.0	0.0	−96.5	0.0	−96.5
ROW	0.0	0.5	0.0	−30.5	−18.6	−426.9	−475.6
Total	−77.6[d]	11.6	4.3	11.7	12.3	55.1	17.4

[a] Elasticity of Substitution (σ) = 36
[b] M.E. = Middle East
[c] Summing across rows gives total change in supply for each region.
[d] Summing down columns gives total change in consumption for each region.

With an export price of about $1.20 per kilogram, a 10 percent subsidy would cost the United States government about 12 cents per kilogram or $120 per metric ton. With total exports of 1,254 thousand metric tons in the presence of the subsidy, the total subsidy would cost the United States government $150 million per year.

Some economists would consider a poultry meat supply elasticity of 5.0 as being too large for the United States. If a smaller supply elasticity had been used, the estimated effects of a retaliatory subsidy on quantities produced and traded would be smaller, and the effects would be more concentrated in the United States. Thus, while a retaliatory subsidy is unlikely to offer a significant penalty to the European Community, it could involve significant budget costs to the United States.

CONCLUSIONS

Various analysts have suggested that the EC export subsidies have had important effects on the United States poultry industry (e.g., Rowan, Mageira, National Broiler Council et al., and McClelland). That may be true, but it would be inappropriate to evaluate the effects of the export subsidies in isolation from the grains policies which the subsidies are designed to offset.[4] The effects of eliminating both the export subsidies and grains

policy as they affect EC poultry producers have been analyzed. Implicitly, it has been assumed that these policy changes have no effect on poultry production costs outside the EC. Thus, our results are more pertinent to the effects of compensating EC producers with a subsidy on feed grains or a subsidy on total output instead of an export subsidy, rather than the effects of wholesale elimination of the CAP. Taking account of the effects of the grains policy as well as the export subsidies, the effects of the CAP on the United States poultry industry are smaller than when considering the export subsidies alone.

In the first model, poultry meat from all sources was treated as a homogeneous good in all markets. Using a wide range of values for uncertain supply and price transmission elasticities, the effects of the policies were concentrated in the EC. The "world price" was slightly lower so that United States producers might have lost significant producer surplus, but this was almost entirely offset by concomitant gains to United States consumers. There is some evidence that poultry is differentiated by place of origin in international markets so that the homogeneous goods model most likely overstates the effects of the EC policy in United States markets.

The differentiated goods equilibrium displacement model allows a more disaggregative analysis of the effects of trade policy in international poultry markets while accounting for quality differences associated with country of origin. However, the model requires more detailed specification of parameters which are difficult to measure. Using a wide range of values for the elasticity of substitution between "kinds" of poultry meat, the effects of removing the CAP were concentrated in the EC markets to which the policy applies directly. The effects were smaller, even in the countries that deal directly in significant quantities with the EC, (mainly the Middle East) and the net effects in "third" countries such as the United States were quite small. The magnitudes of effects outside the EC were small compared to the estimates assuming poultry meat is homogeneous, regardless of source.

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4 Harling and Thompson make the same point and argue for the use of effective rates of protection that take into account input distortions as well as output price policies. Harling and Thompson did partial equilibrium analyses of poultry industry protection in three individual countries—Canada, the United Kingdom, and the Federal Republic of Germany—using data for the later 1970s. They treated each country as a price taker. The analysis here differs by (a) allowing a policy change in all EC countries at once that would have significant world price effects, and (b) distinguishing poultry by country of origin. Their results, like those presented here, indicate small changes in production and consumption, but relatively large percentage changes in all quantities traded due to the poultry policy.

It is true that the EC policy has displaced United States exports from the Middle East, but the impact has been quite modest, less than 40,000 tons. This is in a market where total disappearance grew from 0.3 million tons in 1972 to 1.6 million tons in 1981, and total imports were 0.75 million tons in 1981.

Finally, a retaliatory export subsidy by the United States would have little effect on pro-duction and prices in the European Community and, therefore, would not be expected to be a significant sanction. As the CAP effects are concentrated in the European Community, so would the effects of a retaliatory subsidy be concentrated in the United States with potentially large government budget costs.

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