Effects on French Soyabean Demand of an Import Duty Imposed by the European Community

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Abstract: Policies affecting agricultural trade are a source of uncertainty for participants in international markets. Soyabeans and soyabean products are currently imported without duties by the European Community and are used extensively in livestock feed. Some have suggested that import levies or duties on soyabeans in Europe would encourage the use of domestically-produced feedstuffs and contribute to reducing excess supplies of livestock products. To analyze the implications of such a policy change, least-cost feed rations were developed for broilers, laying hens, pigs, and dairy cattle in France. Those linear programming models can be used to estimate the changes in both the price and composition of feed rations by varying the price of soyabean meal to reflect an import levy. Input demand equations are estimated and the elasticities derived from those equations are used to examine the adjustments in feed use and output resulting from the higher compound feed price. The total effect of a higher soyabean meal price is shown to be composed of the change in ration composition and the adjustment of livestock producers to the higher price of compound feed. The results indicate that import duties would have to raise the price of soyabean meal by 40 percent or more substantially to reduce its use in French livestock rations. Preliminary results also suggest that the impact of a higher soyabean meal price on French livestock production and the use of domestically-produced feed grains and oilseeds would be relatively small.

Introduction

Agricultural policies implemented for domestic reasons usually affect world agricultural markets. These policies and changes in them are a source of uncertainty for market participants involved in international agricultural trade. The Common Agricultural Policy (CAP) of the European Community (EC) contains a series of measures to protect EC producers from lower-priced imports. Since soyabeans are not extensively produced within the EC, trade barriers were not instituted for this commodity, and negotiations within the context of the General Agreement on Tariffs and Trade (GATT) resulted in a binding agreement not to tax imported soyabeans or soyabean products. Feed grain prices in the EC have generally been higher than world prices, making duty free soyabeans and soyabean products relatively inexpensive ingredients in livestock feed. Some have argued that low-cost feed ingredients, including maize gluten, citrus pellets, and manioc, as well as soyabeans, have contributed to surplus production of livestock products in Europe and reduced the use of European cereals and oilseeds in feed rations. Restrictions on imports of manioc and maize gluten have been established and some policy makers in the EC feel that an import duty on soyabeans and soyabean products would help to resolve the problem of costly surpluses of livestock products (particularly milk) and European cereal grains such as soft wheat and barley (*Agra Europe*, various issues).

This policy change would be in violation of current GATT accords and would invite retaliation from the USA and Brazil, the major exporting countries. In this context, one needs to have a better understanding of the effects of such a measure on the use of soyabean meal and other feed ingredients in livestock rations and on livestock production in the EC. Several estimates of the price elasticity of demand for soyabean meal in the EC indicate little responsiveness to price changes (Knipscheer and Hill, 1982). If these estimates are realistic, import duties or other trade barriers on soyabeans designed to increase the price would have neither the desired consequences within the EC nor the negative impact on exports feared by the USA and Brazil.

Support for the relative lack of price responsiveness stems from the fact that alternative protein sources (rapeseed and sunflowerseed, for example) are not perfect substitutes for soyabean meal, which has a particularly advantageous amino acid profile. On the other hand, econometrically-estimated elasticities may only be valid for small price changes. Large price increases could result in a much greater reduction in demand than these estimates would suggest. The purpose of this paper is to determine how soyabean meal use in France would change as its price is raised to successively higher levels.

Research Approach

The principal use of soyabeans in France is as a protein source in compound feed rations. Conceptually, the impact of a higher soyabean meal price can be decomposed into two parts. First, the composition of the feed rations is likely to change as other protein sources are substituted for the relatively more expensive soyabean meal. Second, the use of compound feed may change as livestock producers adjust both output and input use to the more expensive compound feed. To explore these effects, a two-stage model is developed for the four most important livestock enterprises in France (layers, broilers, pigs, and dairy cattle). Since feed producers in Europe use linear programming models to determine least-cost feed rations, an obvious approach to analyzing the effect of a higher price on ration composition is to develop cost-minimizing linear programming models for the four livestock enterprises. The four models used in this research are based on average annual prices and represent an estimate of a typical feed ration in each sector. By varying the soyabean meal price, one can estimate the change in the use of soyabean meal as well as other ingredients. The four rations constitute the most important categories of compound feed produced in France. Other types of compound feed are assumed to be adjusted in proportion to the aggregate changes in these rations so that the results can be used to compute the total change in soyabean meal demand due to the adjustment of ration composition.

The second stage of the analysis involves the estimation of input demand equations. The equations estimated are of the form:

$$(1)\ log(QD_{it}) = a_i + b_i log(P_{it}) + c_i log(OP/FP)_{it} + d_i T + e_i log(T) + u_{it},$$

where QD is the quantity of compound feed demanded, P is production, OP is the price of the livestock product, FP is the price of compound feed, i is an index for the four sectors, and u is the error term. Since compound feed use has increased over time, variables for time (T) have been included to remove the effects of technological change (Surry and Meilke, 1982). Since these equations include the output variable, the estimates of the price elasticity of demand for compound feed are only valid if output is held constant. To allow for variation in output, four output equations were estimated:

$$(2)\ log(P_{it} = g_i + h_i log(OP/FP)_{t-1} + k_i log(OP/W)_{t-1} + v_{it},$$

where W is a proxy for agricultural wages and v is the error term. Assuming constant returns to scale and constant output prices, substitution of equation *(2)* into equation *(1)* allows the feed demand elasticities to be adjusted for output changes. The estimated elasticities are computed as $-c_i-h_ib_i$.

The linear programming models not only indicate the change in ration composition but also the change in the price. Applying the estimated feed demand elasticities to the price change provides an estimate of the reduction in feed demand following an increase in the soyabean meal price. The total change in soyabean meal use in France is the sum of the effect on ration composition and the adjustment of livestock producers to the higher feed price. In order to explore the implications of restrictions on French imports of soyabeans and soyabean products, assume that some type of trade barrier is imposed by the EC that raises the price feed compounders face for soyabean meal. The soyabean meal price is raised 10 percent, 20 percent, 40 percent, and 80 percent to determine how demand would change in response to several levels of higher prices.

Results

The least-cost feed rations are described in Auerbach (1984). The four programming models use here resulted in feed rations that appeared reasonable in the light of the total soyabean meal use in France and the prices reported for the various compound feeds (Auerbach, 1984). Based on these models, soyabean meal constituted 14.1 percent of the layer ration, 29.1 percent of the broiler ration, 20.4 percent of the pig ration, and 24.5 percent of the dairy ration in 1982. Applying those percentages to the quantity of each compound feed produced in France in that year gives the amount of soyabean meal used in the rations. The four rations account for about 55 percent of total soyabean meal disappearance.

As the soyabean meal price is raised, the percentages change, and total use declines. Other rations are assumed to be adjusted in a similar manner so that the percentage decline in soyabean meal use can be applied to total soyabean meal disappearance. The results are presented in Table 1. On the basis of the programming models, a 10 percent increase in the price of soyabean meal leads to a 2.4 percent decline in demand as a result of changes in the composition of the rations. Price increases of 40 percent or more lead to much greater percentage decreases in demand.

Table 1—Percentage Changes in Soyabean Meal Demand and Livestock Output Due to Soyabean Meal Price Increases

Soyabean meal price change	10.0	20.0	40.0	80.0
Soyabean meal demand change due to ration adjustment	-2.4	-3.1	-21.1	-21.1
Total change in soyabean demand:				
Constant output	-3.4	-5.1	-24.0	-26.5
Variable output	-4.6	-7.3	-26.5	-31.2
Change in egg output	-1.1	-2.2	-4.3	-8.7
Change in broiler output	-1.2	-2.4	-4.7	-9.4
Change in pigmeat output	-3.3	-6.7	-9.9	-17.1
Change in milk output	-2.6	-5.3	-9.8	-17.0

Preliminary estimates of the feed demand equations are presented in Table 2 (page 298), preliminary estimates of the output equations are presented in Table 3 (page 299). Most of the equations have been corrected for autocorrelation, and the standard errors for the price variables are often large relative to the estimated coefficients. Nevertheless, the estimated price elasticities of demand for feed (shown in Table 2) appear to be consistent with prior expectations.

The price of compound feed will rise by a smaller percentage than the percentage increase in the price of soyabean meal. All other ingredient prices are assumed to remain unchanged. Thus, a 20 percent increase in the soyabean meal price results in feed price increases ranging from 3.5 percent to 6.7 percent. In simulating the impact of an increase in the soyabean meal price, the constant output elasticities were used as a lower bound, with the variable output elasticities considered the more realistic estimates. The results presented in Table 1 indicate that the adjustment of livestock producers to higher feed costs contributes significantly to the total change in demand, although, at higher soyabean meal prices, the major source of the fall in demand is due to the change in ration composition.

To measure the effects of these changes on the output of the various livestock products, the feed conversion ratios were assumed to remain constant (which is justified since the linear programming models impose a constant nutritional value on the feeds), although the composition and price can change. The decline in compound feed use is multiplied by these constant feed conversion ratios to determine the effect on livestock production due to the increase in the soyabean meal price. The results, included in Table 1, suggest that large increases in the soyabean meal price would be required substantially to reduce the production of most livestock products.

Conclusion

The main conclusion to be drawn from this analysis is that relatively large increases in the soyabean meal price would be required significantly to reduce its use in livestock rations in France. Even with large increases, the impact on livestock production may not be as great as some European policy makers might expect. The results reported here are consistent with the hypothesis that the low elasticities of soyabean meal demand in the EC estimated by other researchers apply only to small variations in price. Estimates of the fall in demand range from 1.7 percent to about 4.4 percent for a 10 percent increase in the soyabean meal price (Knipscheer and Hill, 1982). Applying those elasticities to a 40 percent price increase suggests a fall in demand of 6.8 percent to 17.6 percent, as opposed to the estimate in this study of 26.5 percent.

Other results (not reported here) suggest that an increase in the soyabean meal price in France would not substantially increase the demand for barley, soft wheat, rapeseed, sunflowerseed, or skim milk powder. As the price of soyabean meal is raised, greater use of fish and animal meals in combination with maize occurs (Auerbach, 1984). Thus, the results of this research suggest that even fairly substantial increases in the price of soyabean meal would have only moderate impacts on livestock production and on the use of alternative protein sources and cereals in French feed rations. From the point of view of Brazil and the USA, an import duty of less than 20 percent would have only a moderate effect on French demand for soyabean meal.

These results should be seen as preliminary. More research is needed on the demand for compound feed and the relation of feed prices to the production of livestock products. More accurate estimates of the feed demand elasticities could modify the results reported in Table 1. More importantly, the French market for soyabean meal is different from the markets in other EC countries. France does not have a large soyabean crushing capacity and is more than self-sufficient in maize. As a result, French feed compounders import soyabean meal, mainly from Brazil, and pay a lower price for maize. In countries such as the Netherlands, most feed ingredients are imported (including soyabeans from the USA) to supply large crushing industries. Feed compounders in the Netherlands would probably be more responsive to changes in the price of soyabeans than their counterparts in France. Thus, the overall impact of restrictions on soyabean imports by the EC might be greater than suggested by these results.

Table 2—Feed Demand Equations

	Layer Feed	Broiler Feed	Pig Feed	Cattle Feed
Intercept	1.170	2.895	-3.971	6.960
	(3.34)	(1.44)	(4.21)	(5.12)
T	0.037	0.045	0.051	0.099
	(0.013)	(0.012)	(0.025)	(0.007)
log(T)	0.173	0.092	0.047	–
	(0.075)	(0.068)	(0.129)	–
log(P)	0.942	0.595	1.579	0.071
	(0.592)	(0.246)	(0.660)	(0.483)
log(OP/FP)	0.341	0.219	0.127	0.778
	(0.145)	(0.263)	(0.347)	(0.466)
Dummy variable	–	0.374	–	–
	–	(0.051)	–	–
R^2	0.971	0.987	0.905	0.978
ρ	0.568	0.361	0.679	–
	(0.161)	(0.199)	(0.147)	–
D.W.	–	–	–	1.975
Elasticity (constant output)	-0.34	-0.22	-0.13	-0.78
Elasticity (variable output)	-0.62	-0.36	-1.03	-0.79

[Note: Standard errors in parentheses.]

Table 3—Output Equations

	Eggs	Broilers	Pigmeat	Milk
Intercept	7.730	6.164	2.550	11.195
	(0.380)	(1.075)	(1.390)	(0.507)
log(OP/FP)	0.302	0.244	0.560	0.125
	(0.084)	(0.192)	(0.177)	(0.193)
log(OP/W)	-0.269	0.012	-0.239	-0.254
	(0.040)	(0.184)	(0.086)	(0.059)
log(T)	0.132	–	–	–
	(0.021)	–	–	–
T	–	0.056	–	–
	–	(0.015)	–	–
Lagged dependent variable *(P)*	–	–	0.840	–
	–	–	(0.150)	–
R^2	0.969	0.963	0.954	0.498
ρ	0.350	0.497	–	0.596
	(0.191)	(0.205)	–	(0.167)

[Note: Standard errors in parentheses.]

Note

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