A Comparative Study of Soyabean Import Demand in Taiwan and Japan

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Abstract: Simultaneous equation models of the soyabean sectors in Japan and Taiwan are developed and estimated through seemingly unrelated regressions. The models integrate domestic supply and demand for soyabeans, soyameal, and soyaoil as well as the livestock market. Based on the established models, the impacts of economic growth and policy simulations on these markets are evaluated and compared by performing dynamic simulation analyses. Growth factors had greater impacts on soyabean import demand than did policy factors, and growth impacts themselves were more significant in Taiwan than in Japan. A 10-percent currency devaluation with respect to the US dollar would only decrease soyabean import demand in Japan and Taiwan by 0.17 and 0.35 percent, respectively. A 10-percent increase in the soyabean support price would stimulate growth in domestic soyabean import plantings of 16–54 percent in Taiwan and 9.93 percent in Japan. A 10-percent increase in Taiwan's net livestock exports or a 10-percent decrease in Japan's net livestock imports would increase soyabean import demand by 0.12 and 0.48 percent, respectively. Increased demand for soyameal and a decline in demand for soyaoil were also noticed. If the profitability of soyabean crushing were improved, soyabean import demand would increase and demand for meal and oil would decrease.

Introduction

Japan and Taiwan are two of the most important and dynamic growth markets for US soyabeans in East Asia. US soyabean exports to these areas increased from 1.21 Mt in 1962 to more than 6 Mt (about 30 percent of total US soyabean exports) in 1988.

Many intriguing questions surround the past and future growth of soyabean import demand in these economies. For example, the main factors that influence import demand for soyabeans in these natural-resource-poor East Asian economies with different degrees of economic development are the extent to which these factors exert their influence, whether these soyabean markets will continue to expand as the economies continue to grow, and how policy interventions, such as domestic soyabean support prices and livestock import controls, would affect these soyabean markets.

The general objective of this study is to develop econometric models and give quantitative descriptions of these soyabean markets as well as to analyse and compare the impacts of economic growth and policy interventions upon these markets.

The Conceptual Model

The conceptual model of the soyabean sector for these soyabean-importing economies is presented in Table 1. Partly for simplicity and partly because almost all the soyabeans imported by Taiwan and Japan are from the USA, a small-country assumption was adopted in building the model. The regional model specified is a recursive equation system comprising equations for domestic soyabean supply, soyabean crushing demand, soyabean food demand, soyameal demand, livestock demand, soyaoil demand, price linkages, and trade clearance identities. The salient characteristic of this model is that it integrates domestic supply and demand for soyabeans, soyameal, and soyaoil, as well as the livestock sector, for these important US soyabean markets in Asia.

Model Estimation and Validation

Seemingly unrelated regressions, or joint generalized least squares, were adopted to estimate the empirical models (for details, see Woo, 1985). Four major conclusions can be drawn from the estimated results. First, the soyabean support price has a positive influence

on domestic soyabean acreage in both economies. However, the acreage level in each economy is inelastic with respect to the support prices. The soyabean acreage of an ensuing crop year is significantly influenced by the acreage planted in the current year in each economy. These results indicate a slow soyabean production adjustment to changing economic incentives in these soyabean-importing economies. Therefore, although policy makers in Taiwan and Japan have been encouraging domestic soyabean production through price-supporting policies, it is unlikely that these policies will substantially expand domestic soyabean production or dramatically influence their soyabean import demand in the near future.

Table 1—Conceptual Model of the Soyabean Markets in Japan and Taiwan

(1) Soyabean acreage = f (deflated soyabean support price, lagged soyabean acreage, others)

(2) Soyabean crushing demand = f (deflated soyabean crushing ratio, crushing capacity, others)

(3) Soyameal demand = f (deflated soyameal retail price, deflated livestock price, livestock production, others)

(4) Livestock consumption, per capita = f (real income per capita, deflated livestock price, others)

(5) Soyabean food demand, per capita = f (real income per capita, deflated soyabean price, others)

(6) Soyaoil demand, per capita = f (real income per capita, deflated soyaoil retail price, others)

Price Linkages:

(7) Soyabean import price = f (US soyabean export price times the exchange rate, others)

(8) Soyameal retail price = f (US soyameal export price times the exchange rate, others)

(9) Soyaoil retail price = f (US soyaoil export price times the exchange rate, others)

Identities:

(10) Soyabean excess demand = soyabean crushing demand + soyabean food demand
+ soyabean seeds demand and waste
+ soyabean net stock change
− soyabean acreage times soyabean yield

(11) Soyameal excess demand = soyameal demand + soyameal net stock change
− soyabean crushing demand times soyameal yield

(12) Soyaoil excess demand = soyaoil demand + soyaoil net stock change
− soyabean crushing demand times soyaoil yield

(13) Livestock production = livestock consumption + livestock net stock change
+ livestock net exports

(14) Soyabean crushing ratio = (soyameal retail price times soyameal yield
+ soyaoil retail price times soyaoil yield)/
soyabean import price

Second, domestic livestock production is a decisive determinant of soyabean crushing demand in each economy. The results suggest that growth in soyabean crushing demand keeps pace with the growth of the livestock sector. Consequently, policies discouraging domestic livestock production, such as trade liberalization on livestock products, will decrease domestic soyabean crushing demand and import demand in both countries. The crushing ratio has a positive influence on soyabean crushing demand in each economy. Since the estimated elasticity in each economy is very small, policies increasing profitability in the soyabean crushing process have only limited effects on soyabean crushing demand and import demand.

Third, soyameal demand in each economy is inelastic with respect to its own price, but is influenced primarily by domestic livestock production. These findings imply both that soyameal is an essential ingredient of formula feed for livestock and that changes in soyameal price will not greatly influence demand.

Fourth, per capita real income and the price of meat are the major factors influencing per capita meat demand in each economy. If domestic livestock production is defined as the sum of total domestic meat consumption, changes in livestock ending stocks, net meat exports, and egg production, then it is the major factor influencing soyabean crushing demand and soyameal demand. Income and population growth therefore have important influences on demand for soyabeans and soyameal. These results indicate that per capita real income and population growth have been the major factors facilitating the rapid growth of these soyabean markets. As these economies continue to grow in the near future, these soyabean markets are likely to expand continuously because of the demand potential for meat among the large affluent population and the limited potential for soyabean production in these natural-resource-poor economies.

Impacts of Economic Growth and Policy Intervention

To evaluate the impacts of economic growth and policy changes on these soyabean markets, exogenous changes in each economy were hypothesized, individually, to perform dynamic simulation analyses using the established models. The hypothetical changes, which were assumed to have been introduced since 1975, included a devaluation of the domestic currency, an increase in the soyabean support price, technological improvements in the domestic soyabean-crushing process, and an increase in net livestock exports (or a decrease in livestock imports).

After adjustment for each policy change, the dynamic simulation was repeated for the period of study. The difference between the new simulation results and the base simulation results represented the impacts of each policy change on the endogenous variables. The average percentage impacts of different policies on several interested endogenous variables are summarized in Table 2. In order to measure the impacts of economic growth on the soyabean market, population and per capita real income in these economies were, individually, assumed to be fixed at 1970 levels. The differences between the new simulation results and the base simulation results of the last period indicated the impacts of population growth and per capita real income growth since 1970. These results are also reported in Table 2.

These simulations of growth and policy impacts lead to six results. First, growth factors had greater impacts on soyabean import demand than did policy factors. Population and income growth stimulate growth in the livestock sector, which, in turn, is the major factor causing growth in soyameal demand and soyabean crushing demand. As a result, growth factors have an important influence on soyabean import demand in Japan and Taiwan. On the other hand, because domestic soyabean production is relatively small compared with total soyabean demand and because the supply elasticity with respect to the support price is low, agricultural production policies usually have only limited effects on domestic soyabean production and soyabean import demand. Moreover, the elasticities of demand for soyabeans and their products with respect to their own prices are generally low. Therefore, policies (such

Table 2—Relative Impacts of Economic Growth and of Policy Changes

Variable	Country	Simulation Base		10-Percent Devaluation	10-Percent Increase in Soyabean Support Price	10-Percent Increase in Soyabean Crushing Ratio	10-Percent Decrease in Livestock Net Imports	Population Growth Effect since 1970	Real Income Growth Effect since 1970
		Average Value since 1975	Last Period						
Soyabean acreage	T	21,680 ha	7,967 ha	—	16.54	—	—	—	—
	J	114,520 ha	150,081 ha	—	9.93	—	—	—	—
Soyabean crushing demand	T	809,340 t	900,960 t	−0.19	—	1.25	0.14	14.87	22.73
	J	3,174,600 t	3,594,460 t	−0.22	—	1.59	0.60	7.73	5.79
Soyabean food demand (per capita)	T	10.71 kg	10.79 kg	−0.98	—	—	—	—	4.18
	J	6.44 kg	6.06 kg	—	—	—	—	—	23.39
Soyabean import demand	T	992,770 t	1,089,210 t	−0.35	−0.28	1.03	0.12	16.11	19.58
	J	3,929,030 t	4,153,170 t	−0.17	−0.43	1.28	0.48	8.79	9.07
Soyameal demand	T	641,440 t	721,630 t	−0.79	—	—	0.14	14.87	22.73
	J	2,744,150 t	3,114,620 t	—	—	—	0.70	8.60	6.34
Soyameal import demand*	T	6.720 t	18,900 t	−3,753 t	—	−72,005 t	17 t	2,810 t	4,300 t
	J	280,090 t	316,730 t	5,390 t	—	−288,720 t	4,437 t	54,560 t	35,340 t
Soyaoil demand (per capita)	T	8.27 kg	8.98 kg	−0.78	—	—	—	—	32.13
	J	4.97 kg	5.38 kg	−1.19	—	—	—	—	20.93
Soyaoil import demand*	T	−901 t	3,280 t	−867 t	—	−16,447 t	−191 t	9,790 t	16,290 t
	J	5,805 t	7,460 t	−5,354 t	—	−66,761 t	−3,437 t	29,630 t	97,760 t
Meat demand (per capita)	T	46.51 kg	50.87 kg	—	—	—	—	—	31.32
	J	24.95 kg	38.83 kg	—	—	—	—	—	8.85
Livestock production	T	991,810 t	1,118,680 t	—	—	—	0.16	17.20	26.29
	J	4,642530 t	5,215,880 t	—	—	—	0.63	7.96	5.80

*Impacts upon soyameal imports and soyaoil imports are reported in quantity change; the other impacts are in percentage change.

as a devaluation in domestic currency) influencing domestic prices of soyabeans and their products cannot have much influence on soyabean import demand.

Second, the growth impacts on the soyabean markets in Taiwan were more significant than those in Japan. These simulation results indicated that, without per capita real income growth since 1970, soyabean import demand in the last period of study would have decreased by 20 and 9 percent, respectively, in Taiwan and Japan. The simulation results also revealed that population growth impacts on soyabean import demand in Taiwan and Japan were 16 and 9 percent, respectively, of their import demands. The results can be explained by noting that the elasticity of per capita livestock demand with respect to per capita real income in Taiwan is higher than in Japan. In addition, the elasticity of soyabean crushing demand with respect to domestic livestock production in Taiwan is also greater than that in Japan. Therefore, growth factors had greater effects on the livestock sector, soyabean crushing demand, and soyabean import demand in Taiwan than in Japan.

Third, a 10-percent devaluation of the Japanese yen or Taiwanese dollar with respect to the US dollar would decrease soyabean import demand in Japan and Taiwan by only 0.17 and 0.35 percent, respectively. Such a devaluation would raise domestic prices of soyabeans and products. The higher domestic prices would, in turn, decrease soyameal demand, per capita soyaoil demand, and per capita soyabean food demand. On the other hand, the soyabean crushing ratio in Japan and Taiwan would decrease, causing domestic soyabean crushing demand, soyameal production, and soyaoil production to decline. As a result, net imports of soyabeans, soyameal, and soyaoil in these economies (except for soyameal imports in Japan) would decrease. These results suggest that domestic soyaoil and soyameal supply elasticities with respect to their own prices in these economies (except for soyameal supply elasticity in Japan) were lower than the demand elasticities with respect to their own prices.

Fourth, a 10-percent increase in the soyabean support price would stimulate increases in domestic soyabean acreage planted in Taiwan and Japan of 17 and 10 percent, respectively. However, since the percentages of domestic soyabean production with respect to the total demand for soyabeans in these soyabean-importing economies were small, the increase in domestic soyabean production would have no significant impacts on the import demand for soyabeans. The estimated percentage impacts on soyabean imports were −0.43 and −0.28 percent in Japan and Taiwan, respectively.

Fifth, a 10-percent increase in Taiwan's net livestock exports or a 10-percent decrease in Japan's net livestock imports, assuming domestic meat demand is not affected, would increase soyabean import demand in Taiwan and Japan by 0.12 and 0.48 percent, respectively. Since domestic livestock production would increase, soyameal feed demand and soyabean crushing demand would be stimulated, so that soyabean import demand would rise in each economy. The simulation results also indicated an increase in soyameal import demand and a decline in soyaoil import demand in Taiwan and Japan. Since domestic soyaoil demand was unaffected, increased soyabean crushing demand would raise domestic soyaoil production and decrease soyaoil import demand in each economy. On the other hand, since domestic soyameal production and demand changed in the same direction in each country, the net impacts on soyameal import demand would depend upon the supply and demand elasticities. The simulation results implied that the soyameal demand elasticity with respect to livestock production was greater than the supply elasticity in each country. Furthermore, since net livestock imports (or exports) were relatively small compared with total production volume, the impacts of changes in net livestock imports (or exports) on soyabean markets would not be overwhelming, especially in Taiwan.

Sixth, an improvement in the profitability of the soyabean crushing process would increase soyabean import demand but decrease soyameal and soyaoil import demand in each economy. In Japan and Taiwan, the demand for soyabean meal as a livestock feed is growing more rapidly than the demand for soyabean oil as a food. The imbalance in growth of demand for meal and oil has resulted in excess stocks of soyabean oil and has reduced the profitability of crushing. Policies augmenting the profitability of the soyabean crushing industry, such as encouraging soyaoil exports, would thus raise soyabean crushing demand and import demand and make formula feed producers less dependent upon soyameal imports.

Note

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Reference

Woo, R.J., "The Effects of Economic Growth and Policy Intervention in Japan, Taiwan, and South Korea upon the Import Demand for Soybeans," Ph.D. dissertation, Iowa State University, Ames, Iowa, USA, 1985.

Discussion Opening—*Mary Bohman* (University of British Columbia)

The paper analyses soyabean import demand in Japan and Taiwan by estimating domestic supply and demand for related products. The absence of general information on agriculture in these countries makes it difficult to evaluate the model.

The estimated supply elasticity is an example of an important parameter for policy analysis that cannot be evaluated based on information provided in the paper. It would be helpful to know if land constraints or institutional factors cause the low supply response. Omission of relevant structural details would bias the estimate of the elasticity.

In the Japanese case, rice diversification policies play an important role in soyabean production. In order to reduce rice surpluses, farmers receive money for planting alternative crops. Commodities where Japan has a low level of self-sufficiency including soyabeans receive the most generous payments. The data used by USDA's Economic Research Service to calculate the PSE (producer subsidy equivalent) show that more money is transferred via this mechanism than by direct price supports for soyabeans. In the model, only past acreage and price are included to explain acreage response. The policy information suggests that changes in rice diversification payments affect soyabean acreage. Therefore, exclusion of this variable causes a biased estimate of the elasticity.

Misspecification of the model has resulted in biased parameter estimates. Although the model appears satisfactory for forecasting, I would be hesitant to use the results for policy purposes. A revised model could be interesting for domestic policy analysis of alternative policies. To facilitate this, the author should provide more complete results, including budgetary costs.

What does the model tell us about direction of future soyabean import demand? First, policy changes in the livestock sector make a large difference. Second, domestic production is not important, as shown by the fact that in Taiwan a 10-percent increase in the soyabean support price resulted in a 17-percent increase in acreage and only a 0.28-percent reduction in imports. This result is driven by the small share of domestic supply relative to consumption and not strongly affected by the supply elasticity. Finally, income growth will have an impact. Although I do not believe the parameters are precisely estimated, the numbers suggest that this is a major task.