Potential for Increasing U.S-Canadian Trade in Fresh Peaches

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A spatial equilibrium model of the Canadian-U.S. trade in fresh peaches was specified and evaluated to determine the regional impacts of an exogenous increase in Canadian demand for fresh peaches. Results indicate that southeast producers would benefit the most from an increase in the Canadian demand for fresh peaches.

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INTRODUCTION

Canada is the largest importer of U.S. fresh peaches. Exports to Canada have been the fastest growing component of the U.S. peach industry during the past decade. However, fresh peaches are dutiable in Canada at the rate of three cents per pound but not less than 12.5 percent ad valorem. The tariff is effective from mid-July for up to fourteen weeks and coincides with the period when virtually all of the Canadian fresh imports originate from the U.S.

With the major peach producing states in the U.S. planning promotional activities to increase their shares of the Canadian market, a number of practical questions have arisen. What is the expected increase in the Canadian demand for fresh peaches due to promotion? To what extent will this increase be offset by the Canadian tariff? What will be the net increase in regional shares of exports to Canada?

This study seeks to evaluate the interactions of the tariff and an exogenous increase in the Canadian demand for fresh peaches. For the purposes of our study, the increase in the Canadian demand for fresh peaches is assumed to be due to export promotion by the U.S. More specifically, it attempts to determine the distribution of the expected net increase in the Canadian demand for fresh peaches among U.S. producing regions.

Theoretical Background

Let the equilibrium demand quantity of fresh peaches in Canada increase from q_a to q_b as a result of a rightward shift in the demand function due to promotional activities by U.S. producers. With the Canadian tariff, U.S. share of the increase in the Canadian fresh peach demand is given by $\Delta x = \lambda(q_b - q_a)$, where $0 \leq \lambda \leq 1$. The precise level of Δx will depend on the magnitude of the shift in the demand function, the tariff rate, and the price elasticities of demand and supply in the Canadian and U.S. markets. Furthermore, the net increase in exports, Δx, will not be distributed among producing regions evenly because of the relative regional price differentials and regional differences in price elasticities of supply.

Export promotion can be represented as an exogenous factor which shifts the Canadian demand function to the right. Given the structure of the tariff, the increase in the volume of U.S. fresh peaches exported to Canada will expected to be less than the full increase in the Canadian demand due to promotions. On the basis of Hicks' p-theory, for a rightward shift in the demand function or an increase in the quantity demanded at a given price, the increase in the import quantity and the price elasticity of supply are inversely related.

The most direct effect of the tariff is the creation of a differential in the Canadian-U.S. fresh peach prices. In equilibrium, the price of fresh peaches in Canada may rise by the full or less than the full amount of the tariff. U.S.

fresh peach exporters may face a fall in the fresh peach export price amounting to the full or less than the full amount of the tariff. The higher the price elasticity of demand the smaller the expected decrease in the quantity of U.S. fresh peaches exported to Canada for a given level of tariff (Hicks)

There is substantial literature on U.S. agricultural trade but none has specifically considered interaction of a tariff and U.S. fresh peach exports. Most of the studies reflected the growing importance of agricultural exports to the U.S. economy (Hoff and Lawrence; Chichilnisky and Taylor), the interdependence between U.S. agricultural sector and the rest of the world (Johnson; Williams and Thompson); and the effects of tariff and exchange rates (Kost; Carter and Schmitz). Finally, Bauer et al. examined effects of changes in transportation costs on trade flows of fresh peaches, and Tyan and Epperson evaluated the effects of changes in transportation costs on the regional flows of fresh fresh produce.

Our study followed the analytical approaches used by Bauer et al., and Tyan and Epperson but differs significantly in that tariff was explicitly specified as one of the equilibriating elements in a trade model in which supply, demand, and trade quantities and the associated prices are determined endogenously. Our study used the spatial price equilibrium model (Takayama and Judge) and has economic and policy implications for farmers, producer groups, and policy makers concerning strategies to increase export sales of fresh peaches to Canada.

THE EMPIRICAL MODEL, DATA, AND PROCEDURES

The regional consequences of possible increases in the Canadian demand for fresh peaches due to promotion were evaluated within the analytical framework of spatial equilibrium. The model addresses the well known Cournot-Enke problem in which the demand and supply quantities for a product in two or more regions are given in terms of regional market prices. In addition, the unit transportation costs of carrying the product between all possible pairs of trading regions are given. Subsequently, the problem is to determine the equilibrium vectors of prices and quantities (supply, demand, import, and export) for each producing and consuming region. Formal derivations and proofs of the theoretical model are available elsewhere (Takayama and Judge) and will not, therefore, be repeated here.

Table 1 contains definitions of the variables and the model is presented in a compact form in Table 2. The elements of the first row in Table 2 express the requirements that there should be no excess demand, y_j, in region j and if the equilibrium price in region j is positive, the total regional shipments to region j, x_{ij}, from all regions i, (i= 1,2 ,,,. m) equals the total demand in region j. That is,

$$(1) \quad \sum_i x_{ij} - y_j \geq 0, \text{ and } (\sum_i x_{ij} - y_j)p_j = 0.$$

Elements of the second row of Table 2 express the requirements that there should be no excess supply, x_i, in region i, and if the equilibrium regional supply price, p_i,

TABLE 1. DEFINITIONS OF VARIABLES

Vector and Symbol	Description
$D = [p_1, p_2, \ldots, p_n]$	Regional demand prices
$Y = [y_1, y_2, \ldots, y_n]$	Regional demand quantities
$\alpha = [\alpha_1, \alpha_2 \ldots, \alpha_n]$	Regional demand intercepts
$\beta = [\beta_1, \beta_2 \ldots, \beta_n]$	Regional demand coefficients
$S = [p_1, p_2, \ldots, p_m]$	Regional supply prices
$X = [x_1, x_2, \ldots, x_m]$	Regional supply quantities
$\gamma = [\gamma_1, \gamma_2 \ldots, \gamma_m]$	Regional supply coefficients
$\theta = [\theta_1, \theta_2 \ldots, \theta_m]$	Regional supply intercepts
$R = [x_{11}, x_{12}, \ldots, x_{mn}]$	Interregional commodity flows
$T = [t_{11}, t_{12}, \ldots, t_{mn}, r_{11}, r_{12}, \ldots, r_{mn}]$	Unit transportation costs and tariff

TABLE 2. MATHEMATICAL PROGRAMMING TABLEAU FOR THE FRESH PEACH TRADE: LINEAR COMPLEMENTARITY MODEL

	D	S	Y	X	T	RHS
D			$-I$		I	≥ 0
S				I	$-I$	≥ 0
D	I		β			$\geq \alpha$
S		$-I$		γ		$\geq \theta$
$-T'$	$-I$	I				$\geq -T$

is positive, the total shipments from region i to all other regions j, (j = 1,2, ..., n) equal total supply in region i. Or

(2) $x_i - \sum_j x_{ij} \geq 0$, and $(x_i - \sum_j x_{ij})p_i = 0$.

The third and fourth rows of Table 2 consist of the linear regional demand and supply functions, respectively, expressed in inverse form. The demand for each region is expressed as:

(3) $p = \alpha - \beta y$,

where p is the regional demand price, y is the regional demand quantity, α and β are the parameters for each consuming region. The supply for each region is expressed as:

(4) $p = \theta - \gamma x$,

where p is the regional supply price, x is the regional supply quantity, θ and γ are the parameters for each producing region.

Finally, the fifth row of Table 2 represents the spatial price equilibrium conditions to ensure that (a) for each trade flow, x_{ij}, the regional price differential, $p_j - p_i$, will differ by no more than the unit transportation cost, t_{ij}, and (b) when the trade flow is positive, the regional price differential condition holds with equality. That is,

(5) $p_j - p_i - t_{ij} \geq 0$, and $(p_j - p_i - t_{ij})x_{ij} = 0$.

The import tariff, r_{ij}, is incorporated explicitly in the spatial price equilibrium condition (equation 5) as:

(6) $p_j - p_i - t_{ij} - r_{ij} \geq 0$, and $(p_j - p_i - t_{ij} - r_{ij})x_{ij} = 0$.

In equation (6), the tariff is specified as an added cost of distribution. Subsequently, the spatial price equilibrium condition respecifies the regional price differential to be equal to the sum of the unit transportation cost and the import tariff.

Systematic adjustments to an exogenous increase in the Canadian demand for fresh peaches lead to new equilibrium vectors of prices and quantities. The effect of the exogenous increase in Canadian demand and the Canadian tariff on U.S. fresh peach exports were simulated parametrically using three rates of increase in the demand, d, (d=2%, 5%, and 10%).

Suppose the original and the new export quantities of fresh peaches from region, i, in the U.S. was x_{ic} and x^{ic}, respectively. The former refers to the export quantity before and the latter the export quantity after the exogenous increase in the Canadian demand for fresh peaches. The corresponding regional market shares of the Canadian market are λ_i and λ^i, respectively; where $\lambda_i = x_{ic}/\sum_i x_{ic}$, and $\lambda^i = x^{ic}/\sum_i x_{ic}$. Similarly,

the regional export earnings before and after the exogenous increase in demand are π_i and π^i, respectively.

Then for each d, the changes in the regional shares of the Canadian fresh peach market and changes in the regional export earnings are $\Delta\lambda_{di}$ and $\Delta\pi_{di}$, respectively. These values values indicate the relative regional distributions of benefits from export promotions and have implications for developing marketing strategies in the Canadian market by fresh peach producers and producer groups in the U.S.

The data used in the study are from several sources including "Fresh Fruit and Vegetable Unloads in 41 Cities" (USDA, AMS), "Fruits Outlook and Situation" (USDA, ERS). The trade data were from the former and price and production data were from the latter. Canadian production and consumption data were obtained from "Market Commentary" (Agriculture Canada), and the tariff and transportation rates were from the Canadian Fruit Wholesalers Association reports and unpublished private sources.

Monthly supply price and quantity data are for the period 1970 through 1982 and all prices are in U.S. dollars. Regional supply relations for each producing region in the U.S. and the Canadian provinces (British Columbia and Ontario) were estimated using OLS. The demand relations for each consuming region were computed from the estimated per capita demand equations for U.S. and Canada, as appropriate[1].

Four sets of solutions were generated using the LCRAND procedures (Bartilson et al.). The LCRAND algorithm uses estimates of regional demand and supply parameters, trade structure, and unit transportation costs to determine equilibrium vectors of prices and quantities (supply, demand, import, export, consumption) endogenously.

The base solution included a tariff and represented the pre-promotion demand for fresh peaches in Canada. Subsequent solutions were based on increased demand at the rates of 2%, 5% and 10% under the prevailing tariff rate. From these results, $\Delta\lambda_{di}$, changes in the regional share of the Canadian market and $\Delta\pi_{di}$, changes in the regional export revenues were computed.

RESULTS

Table 3 shows, for verification purposes, actual and computed regional shares of the U.S. fresh peach production and regional shares of the U.S. fresh peach exports to Canada. The model underestimated production shares for midwest, southwest and northeast and overestimated production shares for the southeast and the west. Market shares for the midwest and southwest were predicted accurately but all others except the northeast were underestimated.

Table 4 shows the redistribution of regional shares of the Canadian market for each rate of assumed increase in the

TABLE 3 ACTUAL AND COMPUTED REGIONAL PRODUCTION OF FRESH PEACHES AND SHARES OF THE CANADIAN MARKET

Region	Production: Actual	Production: Model	Market Shares: Actual	Market Shares: Model
	----------%		----------%	
Midwest	6.3	5.1	0.0	0.0
Northeast	11.8	8.9	13.9	23.2
Southeast	41.4	44.0	42.1	35.6
Southwest	6.2	4.9	0.0	0.0
West	34.3	37.1	33.4	31.3

Notes: Actual production data are averages over the 1978-82 period.
Exports are for the U.S. fresh peach season (July - September) and do not add up to 100 because the Canadian own share of the market is omitted.

TABLE 4. REDISTRIBUTION OF REGIONAL SHARES OF THE CANADIAN MARKET FOR FRESH PEACHES AND EXPORT EARNINGS

Increase in Canadian demand[1]	Northeast	Southeast	West
(%)	A. Increase in exports (%)		
2.0	1.1	4.2	2.4
5.0	4.2	11.4	6.0
10.0	7.2	20.8	12.8
	B. Increase in export earnings (%)		
2.0	23.2	35.6	31.2
5.0	22.8	36.5	31.3
10.0	21.7	37.8	31.4

Notes:
1. Prespecified rate of increase in the Canadian demand for fresh peaches due to promotions.
2. Percentage increase in the regional export to the Canadian market for fresh peaches.
3. Regional redistribution of additional export earnings due to the increased Canadian imports of U.S. fresh peaches.

Canadian demand for fresh peaches. There were increases in the regional exports to Canada but the rates of these increases varied across regions. The greatest increase in the regional share of the Canadian fresh peach market occurred in the southeast and the lowest in the northeast. For all the three regions the higher the increase in the Canadian demand for fresh peaches the higher the increase in the regional share of the Canadian market.

Regional redistribution of the additional export earnings due to increased Canadian demand for fresh peaches are shown in Table 4, part B. The southeast had the greatest increase in export earnings for each level of increase in the Canadian demand for fresh peaches and the northeast had the lowest gain in export earnings.

At higher rates of increase in the Canadian demand for fresh peaches, there were moderate increases in the regional export earnings for producers in the southeast and west. The export earnings for producers in the northeast declined slightly at higher rates of increase in the Canadian demand.

CONCLUSIONS

The results of the evaluation of regional consequences of the increases in the Canadian demand for fresh peaches indicate that the greatest gains, in terms of the share of the Canadian market and regional export earnings, would accrue to southeast

producers. The other producing regions, the west and northeast, would experience relatively smaller gains in the share of the Canadian market and export earnings.

Such levels of increases in regional exports to Canada suggest that the Canadian tariff has little or no effect on U.S. fresh peach exports to Canada. Previous empirical analysis of the effect of the Canadian tariff on fresh peaches concluded that the tariff has no effect on U.S. fresh peach exports to Canada (Nyankori et al., 1987). This is particularly important since the Canadian tariff which is effective only during the U.S. fresh peach season has been seen by many U.S. producers and exporters as a major barrier to increased growth of the U.S. fresh peach exports to Canada. The Canadian tariff on fresh peaches may be sub-optimal from a trade reduction perspective.

A limitation of this study was the lack of information on the costs and returns to fresh peach promotional activities in the Canadian market. However, to the extent that promotions can increase the Canadian demand for fresh peaches, the results of this study have some implications for fresh peach producers and producer groups who are planning export promotions strategies.

To southeast producers, the results are particularly useful in addressing a host of questions regarding the institutional and strategic aspects of export promotions. Should the southeast producers or producer groups support a national, regional, or state export promotion program? Should the southeast producers

adopt a product differentiation strategy for their fresh peaches in the Canadian market through unique packaging and labeling or the use of a logo?

Since the southeast producers would gain the most from an increase in the Canadian demand for fresh peaches and given that the export market for fresh peaches is characterized by absence of product differentiation, it would be more beneficial for southeast producers to support or create a broadly based export promotion program for fresh peaches. This would include the major peach producing states in the U.S. and would reduce the costs of promotions borne by individual producers.

NOTES

1. Estimates of supply relations were made for 15 producing states in the U.S. and two Canadian provinces. Demand relations were computed for 41 consuming regions. The results are not reported here because of space considerations but are available from the authors upon request. Appendix I contains a summary of the spatial pattern of the fresh peach trade.

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