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Supply Response in the Northeastern Fresh Tomato Market

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This paper examines the forces that affected the Northeastern fresh tomato supply in the post-WWII period. A simultaneous equation model is developed which incorporates a composite price expectation model, supply response, and factors affecting regional price. Findings reveal that data are consistent with the Rational Expectation Hypothesis. Urban pressure played a major role in shifting supply response while shipments from competing areas had a modest impact on regional production or price. The positive elasticity of producers' revenue with respect to local production highlights the aggregate benefits of increasing yields.

Introduction

The Northeastern United States experienced a drastic decline in the production of summer fresh vegetables in the post-WWII era. Between 1950 and 1980, Northeastern vegetable production decreased by 44 percent whereas vegetable production in the United States increased by 60 percent (Wysong, Leigh, and Ganguly). In the same period, the production of fresh tomatoes, the most important Northeastern vegetable in terms of farm cash receipts, decreased by 46 percent in the region while production of fresh tomatoes in California (the major West Coast producing state and Northeastern competitor) increased by 445 percent (Table 1).

This shift in comparative advantage has mainly been attributed to improvement in transportation technology from the West Coast, attainment of economies of scale in other regions, increasing urban pressure in the Northeast, and increasing preference of buying institutions to acquire produce from year-round sources rather than seasonal suppliers (Porter, Swackhamer, Takos). Although it is not generally disputed that these factors play a major role in shaping the competitive position of Northeastern vegetables, there is generally less agreement and understanding on the extent and importance that each plays in affecting production, and the price received by local farmers. Some authors argue that there are sufficient price incentives for Northeastern producers to take on a larger share of the market (Dhillon, 1980, and Wysong et al.) but they do not clarify the role played by nonprice factors, such as urban pressures, in shaping competitiveness.

Since the early 1970s, the Northeastern competitive position in fresh tomato production seems to be reversing as production continues to increase from the record low in 1973. The reversal in production coincides with the beginning of the energy crisis and proliferation of direct (roadside) marketing of tomatoes. This period also coincides with sluggish population growth in the Northeast as migration toward the Southern and Western United States was taking place (Naisbitt). This may be viewed as alleviating urban pressure on Northeastern agriculture. The energy crisis argument (increases in transportation cost for competing areas) has been challenged by Dunn who argues that the energy crisis had no lasting impact on the Northeastern agricultural competitive position. On the other hand, direct marketing tends to expand outlets for the product beyond the supermarket (usually supplied by permanent rather than seasonal suppliers). In addition, localized marketing can enhance revenues by internalization of marketing margins.

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Table 1. Fresh Summer Tomato Production in the Northeast, California and the U.S., 1950-80

State	1950	1960	1970	1980	Percentage Change 1950-1980
		Year (1000 cwt.)			
Maryland	373	264	247	232	− 38
Massachusetts	367	247	143	143	− 46
New Jersey	1,058	803	570	540	− 49
New York	992	624	437	416	− 58
Pennsylvania	311	352	294	456	+ 47
Connecticut	190	231	150	-0-	−100
Delaware	57	36	-0-	-0-	−100
Rhode Island	65	50	-0-	-0-	−100
Northeast Total	3,313	2,607	1,841	1,787	− 46
California Total	742	2,378	2,774	4,043	+445
U.S. Total	7,200	8,548	7,709	8,517	+ 18
Northeast Percent of U.S. Total	46	30	24	21	− 54

Source: U.S. Department of Agriculture, *Agricultural Statistics*, 1950-82.
Note: Zero entries may reflect small production or lack of reporting rather than absence of production.

The purpose of this paper is to determine the extent to which alternative factors affect the supply of fresh tomatoes in the Northeast. To this end, an econometric model which incorporates the structure of farmers' price expectations, supply response, and price determination, is developed and estimated. Although the model specification draws on the work of Shonkwiler and Emerson, several novel factors have been introduced. The market model uses a composite price expectation model in which alternative hypotheses are simultaneously considered in the estimating model rather than restricting the model to a single expectation hypothesis. In addition, the acreage response equation includes the effects of the price of substitute crops as well as urban pressures. The paper also provides static and dynamic measurements of the effect of economic factors on Northeastern production and prices. Finally, the implications of the results are explored.

Model Specification

Following conventional specification of market models which include supply response, an econometric model can be specified with three behavioral equations to capture acreage, yield and demand responses, plus an identity to represent market equilibrium. In addition, a composite price expectation model will be introduced.

Acreage Response

Since the grower's decision making consists of two main concerns in fresh tomato production, namely, acreage and yield, the supply side is divided into two representative equations. The rationale behind this is that different timing and information are used for decisions regarding acreage and yield. At planting time (usually around April), growers do not know with certainty what prices they will receive unless they forward contract production. Hence, the decision of how many acres to plant must be based on expectation of output prices.

The number of acres planted is hypothesized to be a function of the expected price of fresh tomatoes and expected price of substitute crops. Planted tomato acreage in the preceding year and costs of production are also considered to influence planting decisions in the current year. Producers make partial adjustments to changing economic conditions based upon certain fixed factors and psychological inducements to continue tomato production. In addition, urban pressure is included as a function shifter since, according to Porter, the process of suburbanization is a critical factor affecting vegetable production in the Northeast which is the most densely populated and highly urbanized region in the country. Increases in urban pressure not only increase the opportunity cost of land as urban development becomes juxtaposed with agriculture, but also result in increased regulation of agricultural activities as well as technical spillovers which can significantly affect production choices (Berry, Lopez, Adelaja, and Andrews).

Total fresh tomato production is the product of harvested acreage and yield. With regard to this paper, planted acreage is assumed to be the same as harvested acreage since, on the average, only about two percent, if any, of the planted tomato acreage remains unharvested.

Yield Response

Tomato yields are mainly affected by weather conditions throughout the production period and by the number of times the crop is harvested. Weather is often one of the most important variables influencing yield and production of a given crop. The harvest-frequency decision also affects tomato yields since tomatoes may be picked two to five times depending upon the planting technique used (field staked or ground plants). Hence, yield is expected to be inversely related to wage rate because growers would increase (decrease) harvesting frequency as wage rate decreases (increases). Conversely, higher current tomato prices would lead to higher yields as growers have an incentive to harvest the field more frequently.

Demand

Once harvested, the supply of tomatoes produced in the Northeast is fixed. Hence, a price dependent for demand for Northeastern fresh tomatoes is specified. This specification follows the one given by Shonkwiler and Emerson and is consistent with the work reviewed by Nuckton (1978). The price of fresh tomatoes at the grower level is determined by the magnitude of Northeastern tomato production, available quantity from competing areas, and factors affecting consumers' demand. Given that fresh tomatoes are perishable, tomato price is influenced by contemporaneous shipments from competing areas and quantities regionally produced. Farm level demand is derived from consumers' demand. Hence, consumers' income is included as a derived demand shifter in the model.

Price Expectations

Since acreage response is an *ex ante* decision, such behavior is based on expected rather than actual values. Further, since expected values of variables are not usually recorded or observed, hypotheses have to be based on how expectations are formed. Typically, agricultural economists have modeled expected output prices as being determined by past prices (Cobweb behavior, distributed lags, and adaptive expectation models). Alternatively, the Rational Expectation Hypothesis (REH) postulates that producers base their expectations on current market information. This hypothesis has been applied to agricultural problems by Goodwin and Sheffrin, and Shonkwiler and Emerson. It is conceivable and perhaps even plausible that both types of expectations, using historical and current market information, may take place in the market (Lopez). Therefore, both types of expectations are simultaneously included in the model.

A Simultaneous Equation Model

The econometric specification of the market model follows directly from the preceding discussion. The behavioral equations to capture the above choices, with all variables *in logarithms*, are specified as follows:

$$(1)\quad A_t = \beta_{10} + \beta_{11}(P^*_t - C_t) + \beta_{12}A_{t-1} + \beta_{13}(S_t^* - C_t) + \beta_{14}Z_t + U_{1t},$$

$$(2)\quad Y_t = \beta_{20} + \beta_{21}(P_t - L_t) + \beta_{22}W_t + U_{2t},$$

$$(3)\quad P_t - D_t = \beta_{30} + \beta_{31}Q_t + \beta_{32}M_t + \beta_{33}(I_t - D_t) + U_{3t},$$

$$(4)\quad Q_t = A_t + Y_t,$$

$$(5)\quad P_t^* = \alpha E(P_t) + (1 - \alpha)P_{t-1},$$

where

A_t = log of acres of tomatoes planted,
P_t^* = log of expected tomato price,
A_{t-1} = log of acres of tomatoes planted in previous year,
C_t = log of production costs,
S_t^* = log of expected price of substitutes,
Z_t = urban pressure,
Y_t = log of yield per acre,
P_t = log of actual fresh tomato price,
L_t = log of wage rate,
W_t = weather conditions,
Q_t = log of Northeastern fresh tomato production,
M_t = log of fresh tomato shipments from competing regions,
I_t = log of consumer disposable income,

D_t = log of consumer price deflator,
$E(P_t)$ = log of rationally expected price, and
α, β_{ij}, U_{it} = parameters and disturbances.

Equations (1), (2), (4) and (5) capture the supply side of the model while equation (3) captures the demand side. Shipments from competing areas and local production could have been collapsed into one variable, but separate variables are specified to learn about the effect of imports on Northeastern price and production. Equation (4) represents the equilibrium condition where the log of quantity of tomatoes supplied equals the log of acreage planted plus the log yield (quantity equals acres times yield). In addition, a price expectation equation is specified with equation (5) which is discussed below. Homogeneity of degree zero in prices is imposed in equations (1), (2) and (3) by deflating prices and income by an index of production costs, wage rate, and a consumer price deflator, respectively.

The fifth equation can be called the aggregate price expectation function. This equation basically indicates that expected price may be a weighted average of rationally expected price and lagged price. This specification allows flexibility in expectation specification, recognizes that growers may use past as well as current information, and provides endogenous weights and testing for alternative expectation hypotheses within the model being estimated (Lopez).

The weight α indicates that some producers may forecast expected price via a Rational Expectation Hypothesis while others may use the "naive" cobweb forecasts procedure in formulating their expectations. In the extreme case where $\alpha = 1$, one may argue that producers form their expectations solely as in the REH. On the other extreme, where $\alpha = 0$, one may argue that producers form their expectations based solely on past prices. When $0 < \alpha < 1$, one may argue that some producers are rational in an expectational sense while others use a Cobweb-type forecast. Alternatively, all producers may use a mixed type of forecast by combining current and lagged price information. Moreover, the single expectation cases considered by Shonkwiler and Emerson (REH and Cobweb) are just special cases of the expectation structure postulated in equation (5).

The rationally expected price is obtained, following Shonkwiler and Emerson, and Wallis, by solving the system for the market equilibrium price of tomatoes and taking the expectation of the resultant expression. In this context, the rationally expected price is the expected equilibrium price given information on other market variables and knowledge of the structural parameters of the model. As the disturbances are assumed to be independently and identically distributed, $E(U_{2t}) = E(U_{3t}) = 0$. Substituting the expression for the rationally expected price into equation (5), and the result of this into equation (1), the following acreage response equation is obtained:

$$
\begin{aligned}
(6) \quad A_t = {} & \beta_{10} + \beta_{11}\alpha(\beta_{31}{}^{-1} - \beta_{11}\alpha - \beta_{21})^{-1} \\
& \{\beta_{10} + \beta_{11}(1 - \alpha) P_{t-1} + \beta_{12}A_{t-1} \\
& + \beta_{13}S^*{}_t - (\beta_{11} + \beta_{13})C_t + \beta_{14}Z_t \\
& + \beta_{20} - \beta_{21}L_t - \beta_{22}W^*{}_t + \beta_{31}{}^{-1}[\beta_{30} \\
& + \beta_{32}M^*{}_t + \beta_{33}I^*{}_t + (1 - \beta_{33})D^*{}_t]\} \\
& + \beta_{11}(1 - \alpha)P_{t-1} + \beta_{12}A_{t-1} + \beta_{13}S^*{}_t \\
& - (\beta_{11} + \beta_{13})C_t + \beta_{14}Z_t + U_{1t}.
\end{aligned}
$$

Let asterisks denote expected values in the above equation. The estimating systems of equations now consist of equations (6), (2), (3), and (4), where equation (6) incorporates equation (5). For the use of REH models, Wegge and Feldman have shown that as long as the number of exogenous variables imperfectly anticipated is not less than the number of equations, the classical rank condition suffices for identification. In our case, this requirement is met.

The Data

For data sources, we relied primarily on *Agricultural Statistics* (USDA) and other reports of Federal Government agencies. Sources also included *Economic Indicators of the Farm Sector* (input expenditures and prices), *Fresh Fruit and Vegetables Unloads in Eastern Cities* (imports from other areas), *Vegetable Situation* (vegetable prices and other tomato data), *Survey of Current Business* (income and consumer price deflator) and *Statistical Abstract of the United States* (nonurban population). Annual observations were collected for the time period 1949–83. The production/harvesting season for which prices, production, and imports were collected, includes July, August, and September.

A Northeastern fresh tomato price was obtained as the weighted sum of state prices, where the weights were their shares of total tomato receipts in the region. For substitute crops for tomato production, a Divisia price index was computed from prices and quantities of commodities whose production season and planning coincides with that of fresh tomatoes in the Northeast. These included peppers, sweet corn, field corn, soybeans, and processing tomatoes.

The cost of producing tomatoes is not reported by any government agency; however, since production costs are considered to be an important factor in influencing production decisions, a proxy for production cost was derived based on the works of Dhillon (1979), Dhillon and Latimer, and Westcott for tomato production in New Jersey, the major Northeastern producer. Hence, 1983, 1979, and 1961 were used as benchmark years to generate a cost estimate. Production costs were divided into four categories: materials, labor, machinery, and miscellaneous. Then, regional price indices for each cost category were used to extrapolate cost through the benchmark years and throughout the entire observation period. Although this procedure is somewhat *ad hoc,* it was necessary due to the lack of time series data on tomato production costs.

Urban pressure was measured by the log of population in the Northeast excluding New York City, Boston, Philadelphia, Baltimore, and Newark. The rationale behind this measure is that the process of suburbanization involves forces in the movement of nonagricultural economic activities away from urban centers into rural and agricultural areas. Hence, suburban population is used as a proxy of urban pressure relevant to agriculture (Lopez, Adelaja, and Andrews).

A Northeastern wage index was constructed by dividing total Northeastern labor expenditures by a regional labor quantity index obtained from the U.S. Department of Agriculture. The effect of weather on yields was measured with a Stallings' Index based on detrended yields of peppers and sweet corn—two vegetables whose growing seasons coincide with that of fresh tomatoes in the Northeast. First, expected yield for peppers and sweet corn was obtained by regressing yield on time and using the predicted yield as expected yield. Then weather was measured as the weighted ratio of actual to expected yield of peppers and sweet corn, where the weights were their respective revenue share. In this context, the expected value of weather is one so that $W^*_t = 1$. The main advantage of using the Stallings' index instead of direct weather variables is that it is simpler to obtain. In addition, this index includes not only the effects of various direct components of weather such as rainfall and temperature, but also indirect effects such as insects, disease and pests (Stallings).

Monthly shipments from other competing regions to the Northeast for the summer months (July, August, and September) are only available back to 1961. Therefore, it was necessary to estimate imports from competing regions for time-series observations prior to 1961. For the period 1961–83, imports were regressed against the ratio of total U.S. consumer income to total Northeast consumer income, the ratio of U.S. tomato yields to the Northeastern tomato yields, wholesale price of gasoline (proxy for transportation costs), a trend variable, tomato price, and marketing margin (retail price minus wholesale price). Then, imports were forecasted for the 1949–60 period using the same regressors.

Expected variables other than tomato price and weather were obtained by first order autoregression. Once all the variables of the model were operational, the structural model was estimated with the Full Information Maximum Likelihood estimator technique using the Time Series Processor (TSP) computer package. Results are presented in the following section.

Results

Structural Parameters Estimates

The Maximum Likelihood parameter estimates of the structural model are presented in Table 2. To test homogeneity of degree zero in prices, a version of the model was estimated when separate coefficients were estimated for deflators in equations (1), (2), and (3). Using the likelihood ratio test, one fails to reject the homogeneity restriction at the 5 percent level of significance. Moreover, the significance of the coefficients increased considerably as the restriction was imposed. Given the theoretical and statistical plausibility of the results in Table 2, they were adopted for further analysis.

The estimated coefficients represent short-run, partial elasticities since the variables are expressed in logarithmic form. In general, the results are plausible and conform with *a priori* expectations of signs and magnitudes. Four out of 13 coefficients were less than twice their

Table 2. Maximum Likelihood Parameter Estimates

Equation	Parameter	Variable	Coefficient	Standard Error
Acreage	β_{10}	Intercept	23.314	13.129
	β_{11}	$P_t^* - C_t$	.463	.230
	β_{12}	A_{t-1}	.901	.403
	β_{13}	$S^*_t - C_t$	−.016	.195
	β_{14}	Z_t	−1.910	.801
	α	$E(P_t)$	.922	.383
Yield	β_{20}	Intercept	4.878	.448
	β_{21}	$P_t - L_t$	.157	.569
	β_{22}	W_t	.301	.112
Demand	β_{30}	Intercept	7.294	4.328
	β_{31}	Q_t	−.324	.148
	β_{32}	M_t	−.153	.172
	β_{33}	$I_t - D_t$	.348	.133
Log of Likelihood			205.32	

standard errors. The results for the structural parameters are similar to the ones obtained by Shonkwiler and Emerson, except that their price flexibility coefficients with respect to demand arguments were at least twice as large as those in the present study. Results indicate that Northeastern demand for tomatoes is more price-elastic with respect to imports, local production, and income changes than the U.S. fresh tomato winter demand. This conforms to Nuckton's (1985) argument that the price elasticity of demand tends to increase as the region under consideration becomes smaller. Furthermore, demand results are similar to those obtained by Chern and Just for California processing tomatoes, and to results for other states and regions reported by Nuckton (1978).

The weight of REH (α) was found to be insignificantly different from one but significantly different from zero at the 5 percent level of significance. Based on this result, the data were found to be consistent with a pure Rational Expectation Hypothesis. This means that Northeastern farmers utilize a good deal of current information when they form their expectations.

Turning next to the acreage equation results, with the exception of the expected price of substitute crops, the coefficients of all variables were statistically at the 5 percent level of significance. The short-run partial elasticity of acreage with respect to expected tomato price is approximately 0.46 while the implied long run elasticity is 4.67. Planted acreage in the previous year has an elasticity of approximately 0.9, indicating a low degree of partial adjustment and slowness to respond to changing economic conditions. This conclusion is further reinforced by considering the weak effect of price substitutes on tomato acreage. Finally, results also indicate that increasing urban pressure greatly discourages tomato planting even in the short-run.

Yields are inelastic with respect to changes in tomato price and wages, implying that, once fresh tomatoes are planted, producers can do little to affect tomato yields, and that there are diminishing marginal returns to harvesting. Not surprisingly, weather was found to have a significant effect on yields.

Since price is the dependent variable in the demand equation, the coefficients are price flexibilities. However, one can derive the own-price elasticities from the price flexibilities by dividing each price flexibility coefficient by the own-price flexibility of demand. From Table 2, the own-price partial elasticity of demand was estimated to be −3.09. The fairly elastic demand suggests that increases in supply lead to higher total producer's revenue. The elasticity of Northeastern quantity with respect to imports is estimated at −0.47. The income price flexibility of demand suggests an income elasticity of 1.07. Given the estimated income elasticity of demand, it may be argued that fresh Northeastern fresh tomatoes may be considered somewhat of a luxury good. The smaller impact of a percent change in imports on price, relative to local production (price flexibility), may be due in part to the smaller share of imports compared to the total supply to the region. Between 1970 and 1980, shipments from competing areas accounted for approximately 30 percent of total summer supply (Takos). Coincidently, these estimates of Shonkwiler and Emerson imply a ratio of imports to local supply price flexibilities of approximately one while Mexican tomato imports accounted for approximately 50 percent in the winter seasons between 1970 and 1980 (Simmons, Pearson, and Smith).

Net and Dynamic Effects

While the structural parameters measure "partial" effects, the reduced-form parameters measure "net" effects by relating each endogenous variable to all predetermined variables. The estimated simultaneous equations system was used to solve the current endogenous variables in terms of exogenous and lagged endogenous variables. The derived reduced-form parameters, obtained from the parameters are presented in Table 3. These coefficients can be interpreted as net elasticities. A 1 percent increase in urban population results in a 1.6 decrease in tomato production. Expected and current imports, however, show a modest effect on local production and price.

To analyze the dynamic effects of exogenous factors, the Final Form was derived and the interim as well as impact and total multipliers were obtained (Theil). The multipliers for selected time lags of imports, costs of production and urban pressure variables are presented in Table 4. Results in Table 4 further illustrate that shipments from competing areas have neither a great nor a lasting impact on Northeastern tomato prices or production. Urban pressures, however, do play a major role in shifting supply response. The dynamic analysis also shows that changes in urban pressure and costs of production have a lasting impact on Northeastern production.

Effects on Regional Income

The effect of economic forces on producers' well-being may be further analyzed by determining their impact on total producers' revenue. Total revenue elasticity is

$$\eta_{pq,z} = \eta_{p,z} + \eta_{q,z},$$

where z denotes any variable affecting price and/or quantity, p denotes price, q quantity, and η elasticity. Hence, the total revenue elasticity is equal to the sum of the partial elasticities of Northeastern price and elasticity of quantity with respect to z.

Total producers' revenue elasticity with respect to imports was estimated to be −0.17. By the same token, the total producers' revenue elasticity with respect to own-production was estimated at 0.54. This implies that gains in productivity would lead to increased revenue due to price elastic demand. Hence, investment in research and development for improving yield is one effective way to help fresh tomato farmers in the Northeast.

Conclusions

Regarding price expectations, empirical results point out that Northeastern fresh tomato production data are consistent with the Rational Expectation Hypothesis. This implies that growers use current market information, as if it were incorporated in a complete demand and supply model, in order to formulate their "rationally expected" price. A simultaneous equation supply response and demand model was developed, using, as expected, tomato price, a linear combination of the "rational" and lagged prices. The weight given by the data to the rationally expected price was 0.922.

Empirical findings show that acreage planting decisions are mainly affected by expected tomato price, partial adjustment, and urban pressures. Short run elasticity of acreage with respect to expected tomato price was 0.463 and the implied long run elasticity was 4.67. The high partial adjustment coefficient (0.9)

Table 3. Derived Reduced Form Results

Dependent Variable	Intercept	Predetermined Variables													
		P_{t-1}	A_{t-1}	C_t	S_t^*	Z_t	L_t	W_t	D_t	M_t	I_t	W_t^*	M_t^*	I_t^*	D_t^*
A_t	22.653	.029	.796	−.395	−.014	−1.688	−.139					.266	−.055	.125	.218
Y_t	4.635	−.015	−.038	.019	.001	.082	−.143	.301	.097	.023	.052	.042	.003	.006	.011
Q_t	27.288	.014	.758	−.376	−.013	−1.606	.282	.301	.097	.023	.052	.308	−.052	.131	.229
P_t	−1.548	−.095	−.245	.122	.004	.520	.090		.621	−.146	.331	.069	.017	−.039	−.067
P_t^*	−1.428	.069	−.227	.112	.004	.479	.040					−.076	−.119	.270	.511

Table 4. Impact, Interim, and Total Multipliers of Selected Variables on Endogenous Variables

Time Lags	A_t	Y_t	Q_t	P_t	P_t^*	A_t	Y_t	Q_t	P_t	P_t^*	A_t	Y_t	Q_t	P_t	P_t^*
	1% Change in Imports					1% Change in Population					1% Change in Cost				
0	.000	.023	.023	−.146	.000	−1.688	.082	−1.606	.520	.479	−.395	.019	−.376	.122	.112
1	−.004	.002	−.002	.014	.101	−1.329	.056	−1.272	.364	.024	−.311	.013	−.298	.085	.005
3	−.002	.000	−.002	.001	.000	−.825	.035	−.790	.229	.037	−.193	.008	−.185	.053	.009
5	−.001	.000	−.001	.000	.000	−.512	.022	−.490	.142	.023	−.119	.005	−.115	.033	.005
7	−.001	.000	−.001	.000	.000	−.312	.014	−.302	.088	.014	−.074	.003	−.071	.021	.003
Total Multiplier	−.018	.026	.007	−.129	.093	−7.954	.350	−7.604	2.255	.729	−1.861	.082	−1.779	.528	.170

points out the difficulty of response to changing economic conditions. Urban pressure, as measured by urban population growth, had the highest relative impact on acreage (elasticity of −1.9). Structural parameter results also suggest that yields are inelastic with respect to tomato price or wages, and that Northeastern demand for regional supply is price elastic.

The Derived Reduced Form and dynamic multiplier analysis reveal that shipment from competing areas have neither a great nor a lasting impact on Northeastern tomato prices or production. However, the same analysis shows the large and lasting impact of urban pressures and cost of production on Northeastern production. The present study, therefore, shows that urban pressure has severely shifted supply response of fresh tomatoes in the Northeast in the post-WWII period.

A final conclusion is that given the positive elasticity of producers' revenues with respect to Northeastern tomato production, gains in tomato productivity would be beneficial to farmers. This is consistent with previous studies (Wysong, Leigh, and Ganguly; Dhillon (1980); and Cain and Toensmeyer) which found that Northeastern vegetable growers can profitably expand their share of the market if they increased productivity via improved technology and management. The introduction of new technologies such as plastic mulch, irrigation, and new tomato varieties would increase tomato production and farmers' revenues. Thus, expenditures on research and development for improving yields is one effective way to help fresh tomato farmers in the Northeast.

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