Farm Level Demand for Fresh and Processed Stone Fruit in the United States

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INTRODUCTION

From1980 to 2009 the share of stone fruit for the fresh market has increased, while the share of stone fruit for the processed market decreased

- Stone fruit included are apples, cherries, pears, and peaches/nectarines
- Of the stone fruit produced in the U.S., 53% went to the fresh market in 1980 which rose to 62% by 2009; 47% was for the processing market in 1980 which declined to 38% for processed market by 2009

A novel economic model is used for the demand analysis

- The LaFrance and Pope (2011) implicit cost system approach is applied to improve preciseness and accuracy of parameter estimates

New and improved empirical estimates better explain changes in trends and elasticities for fresh and processed stone fruit

Fig 1. Utilized production for U.S. fruit, 1980-2009

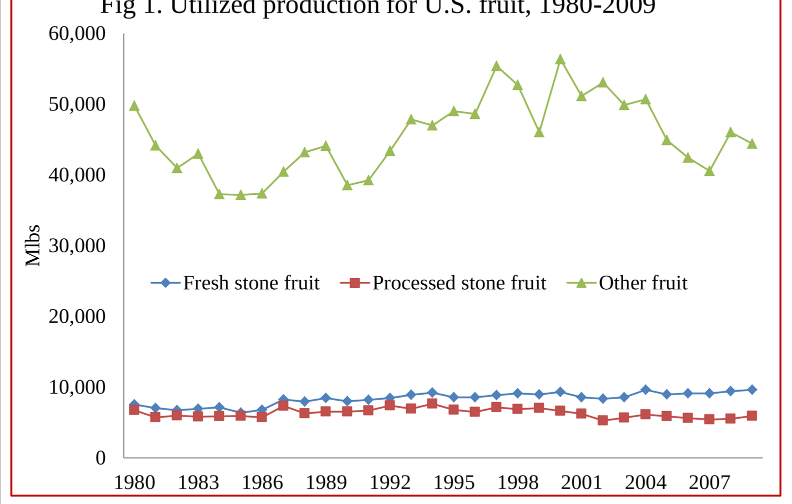


Fig 2. Utilized production of stone fruit for fresh and processed usage, 1980-2009

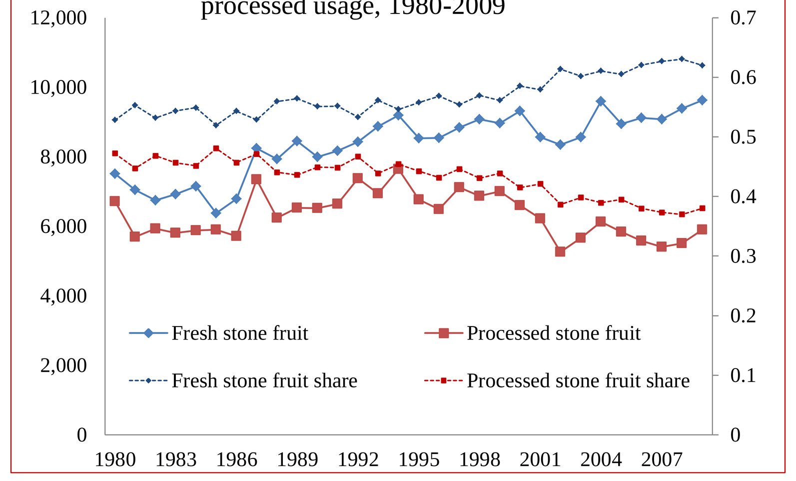


Fig 3. Weighted U.S. fruit price, 1980-2009

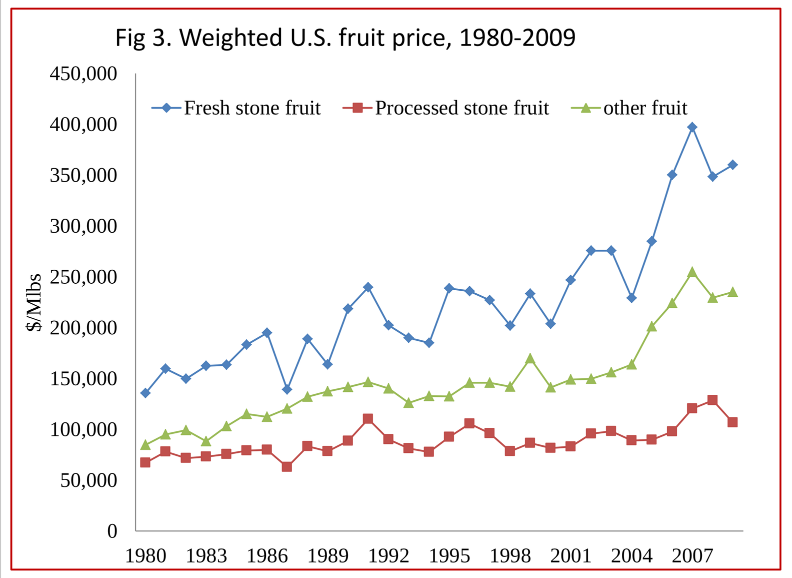
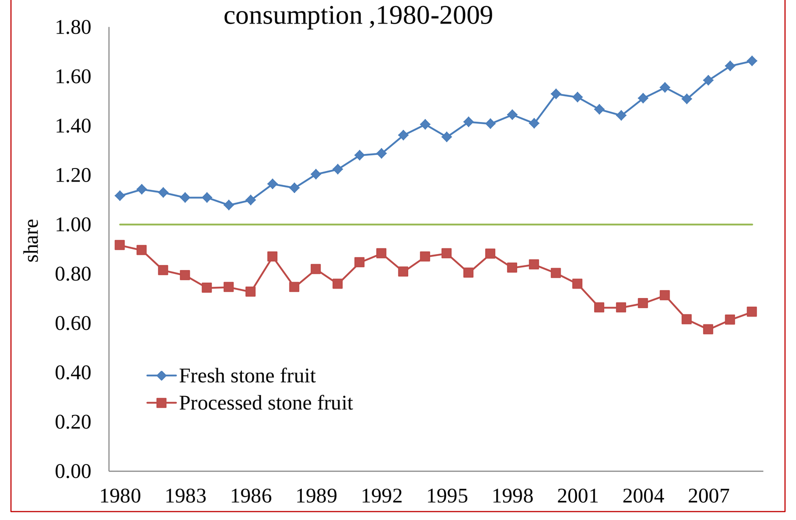


Fig 4. Proportion of utilized production out of U.S. consumption ,1980-2009



OBJECTIVE

The objectives of this study:

- To refine understanding of utilization, market responsiveness, and economic substitution between fresh and processed stone fruit
- To contribute to literature in terms of methodology and empirical application of demand system
- To estimate more accurate measures of economic responsiveness for policy analysis

DATA

Annual time series of quantities and grower prices at the national level for the U.S. from 1980 to 2009

- Quantities for output: summation of utilized production
  - ➢ Fresh equivalent weight adopted for processed stone fruit output
- Input prices: quantity weighted average

Data source

USDA Economics, Statistics and Market Information System (ESMIS)

- Noncitrus Fruits and Nuts Summary
- Fruit and Tree Nut Yearbook

MODEL

Given the restricted cost function as follows:

$$C(p,y) = \min_x \{p \cdot x : x \in V(y)\}$$

where $p \in R^n_{++}$ is prices for inputs x, $x \in R^n$ is the inputs, $y \in R^m$ is the fixed netputs (output), $V(y)$ is the input requirement sets for y

Lafrance and Pope (2011) introduced netputs in implicit form from a partial differential equation approach based on all available data:

$$x = \frac{\partial C}{\partial p} = g(p,y,C)$$

- Properties
  1) $g_p^T p + g_C^T C = 0$ (homogeneity)
  2) $p^T x = C$ (adding up)
  3) $g_{p^T} + g_C x^T$ symmetric, negative semidefinite (concavity)
- A Rank 2 PIGL functional form

$$\begin{cases} x(p,y,C) = \dfrac{\partial\beta(p,y)/\partial p}{\beta(p,y)} C + \beta(\mathrm{p},y)^{\kappa} \dfrac{\partial\alpha(p,y)}{\partial p} C^{1-\kappa} \\ p^T \partial\alpha/_{\partial p} = 0, p^T \partial\beta/_{\partial p} = \beta, \kappa \neq 0 \end{cases}$$

ECONOMETRIC APPROACH

- The estimating equations of the PIGL form are

$$x = \Delta\{p_i^{-1}\}\left[\varsigma C + \prod_{i=1}^{n} p_i^{\kappa\varsigma_i} (B\ln P + D\ln Y) C^{1-\kappa}\right]$$

- The stochastic specification of the netput equations in share form are

$$s_t \equiv C_t^{-1}\Delta\{p_{it}\}x_t = \varsigma + \prod_{i=1}^{n} p_{it}^{\kappa\varsigma_i} (B\ln P_t + D\ln Y_t) C_t^{-\kappa} + v_t, t = 1980 \ldots 2009$$

$$s_t = \begin{bmatrix} s_{1t} \\ s_{2t} \\ s_{3t} \end{bmatrix}, \varsigma = \begin{bmatrix} \varsigma_1 \\ \varsigma_2 \\ \varsigma_3 \end{bmatrix}, B = \begin{bmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{bmatrix}, \ln P_t = \begin{bmatrix} \ln p_{1t} \\ \ln p_{2t} \\ \ln p_{3t} \end{bmatrix},$$

$$D = \begin{bmatrix} d_{11} & d_{12} & d_{13} \\ d_{21} & d_{22} & d_{23} \\ d_{31} & d_{32} & d_{33} \end{bmatrix}, \ln Y_t = \begin{bmatrix} \ln y_{1t} \\ \ln y_{2t} \\ \ln y_{3t} \end{bmatrix}, v_t = \begin{bmatrix} v_{1t} \\ v_{2t} \\ v_{3t} \end{bmatrix}$$

The equations are estimated to be consistent with economic theory subject to symmetric and homogeneity conditions

$$\Sigma_{i=1}^{3}\varsigma_i = 1, \sum_{i=1}^{3} b_{ij} = 0, b_{ij} = b_{ji}, \sum_{i=1}^{3} d_{ij} = 0$$

- Seemingly unrelated regression methods with autocorrelation corrections
  One equation is redundant in share form
- Hypotheses tests
  Vuong test, LR test, Wald-Wolfowitz Runs Test

RESULTS

Table 1. SUR Parameter Estimates

	Factor equation :		
	Fresh stone fruit	Processed stone fruit	Other fruit
		κ=0.0677***	
Fresh stone fruit price	0.3867***	0.0245	-0.4112
Processed stone fruit price	0.0245	0.1709***	-0.1954
Other fruit price	-0.4112***	-0.1954***	0.6066
Fresh stone fruit prod	0.3312***	-0.0378***	-0.2934
Processed stone fruit prod	-0.0366***	0.1081***	-0.0715
Other fruit prod	-0.3783***	-0.1665***	0.5448
Intercept	0.7914***	0.6580***	-0.4494
Adjusted R-Square	0.9983	0.9974	
Durbin-Watson	1.8059	1.5900	

Autocorrelation coefficient ρ = 0.1411**; Significant level: ***1%, **5%, *10%

Table 2. Price Elasticities at Sample Means

	Quantity of:		
With respect to:	Fresh stone fruit	Processed stone fruit	Other fruit
Fresh stone fruit price	-0.0169	0.0203	0.0030
Processed stone fruit price	0.0063	-0.0412	0.0018
Other fruit price	0.0106	0.0209	-0.0048

CONCLUSIONS AND DISCUSSION

- LaFrance and Pope demand system outperformed the Translog system.
- Farm level demand for stone fruit satisfies the law of demand.
- Fresh and processed stone fruit are price inelastic.
- Processed stone fruit at utilization market is most sensitive to price.
- Fresh and processed stone fruit are substitutes at the farm level.
- Prices changes partially explained about 99% of farm level stone fruit demand.
- Why has fresh stone fruit demand increased? Changes in international markets for stone fruit has translated from the wholesale markets through prices into changes at the farm level (see Figure 4).
  - ➢ Domestic consumption was not the primary driver. Annual per capita consumption for fresh stone fruit was 29.56lbs in 1980, which declined to 25.49lbs in 2009.
  - ➢ The U.S. supply of fresh stone fruit to international market changed from at least 11.54% of U.S. consumption in 1980, and increased over time to peak at 66.24% of U.S. consumption in 2009.

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