Market Dynamics and Consumer Responsiveness: Analyzing Price Elasticities of Demand for Meat Products at Farmers Markets

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Background

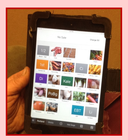
- Farmers markets (FMs) support local agriculture by offering unique opportunities for farmers to control their own prices.
- However, due largely a lack of detailed data, understanding consumer price sensitivity in these markets is compromised.
- Despite extensive studies on meat price elasticities in conventional retail environments, the nuances of smaller markets where retailers are also the producers have received far less attention.

Objectives

- Estimate price elasticities of aggregated meat product categories (beef, pork and chicken) from customer transaction data of farm vendors at FMs in NYS.
- Incorporate meat product category composition variables to directly address the "unit value" problem.
- Evaluate robustness of results to alternative model specifications: **single equation (OLS)** and **system of equations (LA/AIDS).**

Hypotheses

- **H1:** Given the heightened connection between customers and farm vendors at FMs, along with customer preferences for quality, freshness, and locally sourced products, own price elasticities will be **lower** than observed in traditional retail outlets.
- **H2:** Given that most vendors are limited in species variety, cross-price elasticities will not be statistically different from zero.



POS Software: Allows farms to quickly and easily collect detailed data. Before this became widely adopted, farms used counters, pad and paper, inventory counts, daily sales, or nothing at all to monitor market metrics. Pen and paper records were often lost, incomplete, and not as detailed. POS software for tablets present an opportunity for fast, easy, & detailed recordkeeping.

Data

- Customer transaction Point-of-Sale (POS) data of specific meat cuts aggregated by week across farms (6) and FMs (15) and species (3).
- Excluded farms with limited (seasonal) FMs participation.
- 68 weeks over year 2021 and 2022.

Project Totals & Averages

3 Species	40,321 Items sold	6 Farms	15 Markets	68 Weeks Observed

Methodology

- Compute total quantities and weighted average prices by species.
- Address "unit value" problem by adding product category quantity shares for each species.
  - ⇒ **Beef:** Chuck, Loin, Rib, Round, Thin Cuts, and Trim.
  - ⇒ **Pork:** Belly, Butt, Ground, Ham, Loin, and Shoulder.
  - ⇒ **Chicken:** Cuts and Whole.
- Farm and FMs endogeneity effects controlled for with Herfindahl–Hirschman index variables.
- Control for seasonality effects (Spring, Summer, Fall and Winter).
- Estimate single equation OLS and LA/AIDS.

Econometric Models

Log-Log Model (Unrestricted)

$$lnQ_{j,t} = \alpha_0 + \beta_1 lnX_t + \sum_j \gamma_j lnP_{j,t} + \sum_{j,c-1} \delta_{j,c} QS_{j,c,t} + \sum_j \theta_j HHI\_F_{j,t} + \sum_j \mu_j HHI\_M_{j,t} + \sum_{s-1} \tau_s S_{s,t} + \varepsilon_{j,t}$$

LA/AIDS Model (Restricted)

$$share_{j,t} = \alpha_j + \beta_1 ln(X/P)_t + \sum_j \gamma_j lnP_{j,t} + \sum_{j,c-1} \delta_{j,c} QS_{j,c,t} + \sum_j \theta_j HHI_{F_{j,t}} + \sum_j \mu_j HHI\_M_{j,t} + \sum_{s-1} \tau_s S_{s,t} + \varepsilon_{j,t}$$

Where for *j* species (beef, pork, chicken), *t* weeks (1 through 68), *c* product categories for each species *j*, and *s* seasons (fall, winter, spring, summer):

$Q_{j,t}$ = *quantity sold (pounds)*
$share_{j,t}$ = *budget share*
X_t = *total customer expenditures on meat (farm sales)*
$P_{j,t}$ = *quantity-weighted average price per pound*
P_t = *Stone Price Index*
$QS_{j,c,t}$ = *product category quantity share for each species j,*
$HHI\_F_{j,t}$ = *Herfindahl-Hirschman farm quantity sales index*
$HHI\_M_{j,t}$ = *Herfindahl-Hirschman farmers market quantity sales index*
$S_{s,t}$ = *season dummy variable*

Adding up, symmetry, and homogeneity restrictions for LA/AIDS model

Results

Log-Log Model Price Elasticities

	P_Beef	P_PorK	P_Chicken
Q_Beef	-1.378**	-1.979*	0.283
Q_Pork	0.023	-0.719*	-0.007
Q_Chicken	0.529	-0.883	-1.434

LA/AIDS Model Price Elasticities (Uncompensated)

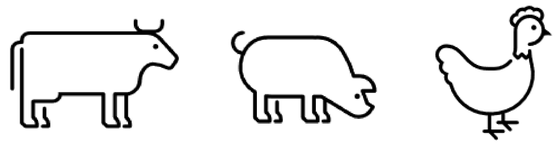
	P_Beef	P_PorK	P_Chicken
Q_Beef	-0.750	-0.319	-0.408
Q_Pork	-0.125	-1.089***	-0.021
Q_Chicken	0.414	0.717	-1.239***

***, **, and * represent statistical significance at the 1%, 5% and 10% levels, respectively.*

Price Elasticities observed in Traditional Retail Outlets

(Jeon et al., 2023)

	Mean	SD	Min	Max
Beef	-0.742	0.383	-2.227	0.283
Pork	-0.815	0.464	-2.351	-0.007
Chicken	-0.609	0.371	-1.665	-0.047



- Our preferred LA/AIDS model results demonstrate a higher elasticity compared to the average values reported in meta-analyses of traditional retail outlets (Gallet, 2010; Jeon, 2023).
- Nevertheless, our results remain within the range previously documented in the literature (Gallet, 2010; Jeon, 2023).
- No cross-price elasticity was statistically different from zero in LA/AIDS model.

Conclusion and Implications

- Results enhance understanding of consumer behavior at FMs.
- This discrepancy with previous literature may be attributed to the increased competition for like products in traditional retail environments and enhancing consumer price sensitivity at FMs.
- Selecting appropriate elasticity measures is complex due to variability in estimates derived from different datasets and research methodologies, highlighting the importance of precision in analysis (Gallet, 2010; Jeon, 2023).

Future Research

- Expand dataset by including additional years, farms and FMs.
- Incorporate price endogeneity directly through a two-stage regression approach to address potential biases in price determination.
- Disaggregate species into more narrowly defined product groups (e.g., high and low price products) to allow for substitution between high and low priced products.
- Further disaggregate product categories to specific cuts of meat, contingent upon data availability, which may be limited due to inventory constraints and sell-outs from farms (not all products are available year-round).
- Such approaches would facilitate a more detailed understanding of demand elasticity, thereby enhancing the strategic decision-making capabilities of farmers as they adapt to changing market trends and consumer preferences.

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