IDFA EXH. 53

CONCERNING THE OWN-PRICE ELASTICITY OF DEMAND FOR MILK PRODUCTS

TESTIMONY AT THE FEDERAL MILK MARKETING ORDER HEARINGS

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Dr. Oral Capps, Jr.
Executive Professor and Regents Professor
Co-Director, Agribusiness, Food, and Consumer Economics Research Center
Holder of the Southwest Dairy Marketing Endowed Chair
Certified Business Economist™
Department of Agricultural Economics
Texas A&M University

Definition of Own-Price Elasticity

- Simply put, own-price elasticity is tantamount to sensitivity
- This concept measures the sensitivity of the demand for any product due to changes in its price.
- The concept of own-price elasticity originated with Alfred Marshall, 1890

***Own-price elasticity* for any product** $= \dfrac{\%\Delta Q_{milk}}{\%\Delta P_{milk}}$

Interpreting the Own-Price Elasticity of Demand

- Measures the percentage change in quantity demanded due to a 1% change in the price of the product.

- The own-price elasticity of demand is not only negative but also unitless.

- If greater than 1 in absolute value, then the demand for the product is characterized as elastic (sensitive to changes in price)

- If less than 1 in absolute value, then the demand for the product is characterized as inelastic (not sensitive to changes in price)

- If equal to 1 in absolute value, then the demand for the product is characterized as unitary elastic.

Emergence of Plant-Based Milk Alternatives

Based on data available from Circana, plant-based milk products account for about 10% of the market associated with all milk products.

Market Share of Plant-Based Alternatives (on average)

Pre-Pandemic Period	Period of	Period of
January 8, 2017 to March 15, 2020	June 28, 2020 to May 15, 2022	March 22, 2022 to August 13, 2023
Market Share = 7.75%	Market Share = 10.30%	Market Share = 10.32%

Increasing sales of plant-based milk alternatives contributed to the accelerated rate at which U.S. per capita fluid milk consumption decreased during the 2010s (Badruddoza, 2020; Stewart, *et al.*, 2020).

Tasks Undertaken

To investigate demand interrelationships among fluid milk products and various alternatives.

In my analysis, **the fluid milk category is disaggregated into five segments: traditional white milk, traditional flavored milk, organic milk, lactose-free milk, and health-enhanced milk** (products with added protein, calcium, or other health benefits).

This disaggregation in my view more accurately captures what consumers face when shopping at various retail outlets.

Alternative products to fluid milk include **plant-based milk alternatives** (the aggregate of almond, oat, cashew, coconut, rice, and soy), **bottled water, refrigerated juices and drinks as well as shelf-stable bottled juices, sports drinks, refrigerated yogurt, and protein beverages**.

Tasks Undertaken

Separate analyses were carried out for the United States market as well as eight regional markets or Census regions:
California, West, Mid-South, Northeast, Great Lakes, Plains, South Central, and Southeast

Attention is centered on the U.S. market in my testimony. While differences in the magnitude of the own-price elasticities are evident for the five fluid milk segments across regions, the trends across the three respective periods are similar both nationally and regionally. Hence, coverage is limited to the U.S. market exclusively.

Tasks Undertaken

I provide a timely up-to-date demand systems analysis for fluid milk products as well as for plant-based beverages and other alternatives to milk currently lacking in extant literature, both regionally and nationally.

Importantly, this research is the first to deal with a **granular array of fluid milk product segments** as well as **various alternatives to fluid milk**. Also, my research addresses **the impact of the pandemic concerning own-price and cross-price elasticities** associated with the previously mentioned product categories. Cross-price elasticities refer to percentage changes in the quantity of any product attributed to a 1% change in the price of ***another product***. **Cross-price elasticities then serve to ascertain whether products are substitutes, complements, or independent.** Hence, this study adds measurably to the economic literature associated with the demand for fluid milk.

Data Source Used and the Time Period Covered

Weekly data procured from Circana (formerly Information Resources, Inc. (IRI)) over the period January 8, 2017, to August 13, 2023.

The data provide information on:

- **Volume**
- **Dollar sales**
- **Average price per volume**
- **Total points of distribution** (a measure associated with market reach)

To discern the impact of the COVID-19 pandemic, the data are divided into three periods:

1. The pre-COVID period
   January 8, 2017 to March 15, 2020
2. The COVID affected period
   June 28, 2020 to May 15, 2022
3. The moving-past COVID period
   May 22, 2022 to August 13, 2023

This separation into the pre-COVID and COVID-affected periods is consistent with that of Zhao, Wang, Hu, and Zheng (2022). Like Das, Sarkar, and Debroy (2022), we investigate the impact of COVID-19 on changing consumer behavior.

The Reliability of the Data Procured from Circana

Based on the all-channel tracking report provided by Prime Consulting (May 2023), the syndicated retail data from Circana constitute 64% of milk volume.

The remaining 36% of milk volume is attributed to:

(1) untracked retail (12%);
(2) foodservice (15%);
(3) schools (8%); and shrink/other (1%).

Therefore, the **Circana data cover roughly 76% of the milk volume sold at retail outlets**.
The foodservice category encompasses limited-service restaurants, full-service restaurants, and other establishments including but not limited to colleges/universities, long-term care and senior living, hospitals, and correctional institutions.

Selecting the Products Examined in the Demand Analysis

My approach is consistent with the work of Zhen *et al.* (2014) in estimating the demand for 23 foods and beverages using weekly scanner data for 2006. Whole milk, lower fat milks, carbonated soft drinks (regular and diet), bottled water, and juices were included among the products. Additionally, Heng *et al.* (2018) estimated a demand system for 15 beverages including plain milk and flavored milk using weekly scanner data from April 2013 to April 2015.

In my analysis, the fluid milk category is disaggregated into five segments: traditional white milk, traditional flavored milk, organic milk, lactose-free milk, and health-enhanced milk (products with added protein, calcium, or other health benefits). As noted previously, I also include juices, bottled water, sports drinks, plant-based milk alternatives, and refrigerated yogurt.

Estimated Own-Price Elasticities

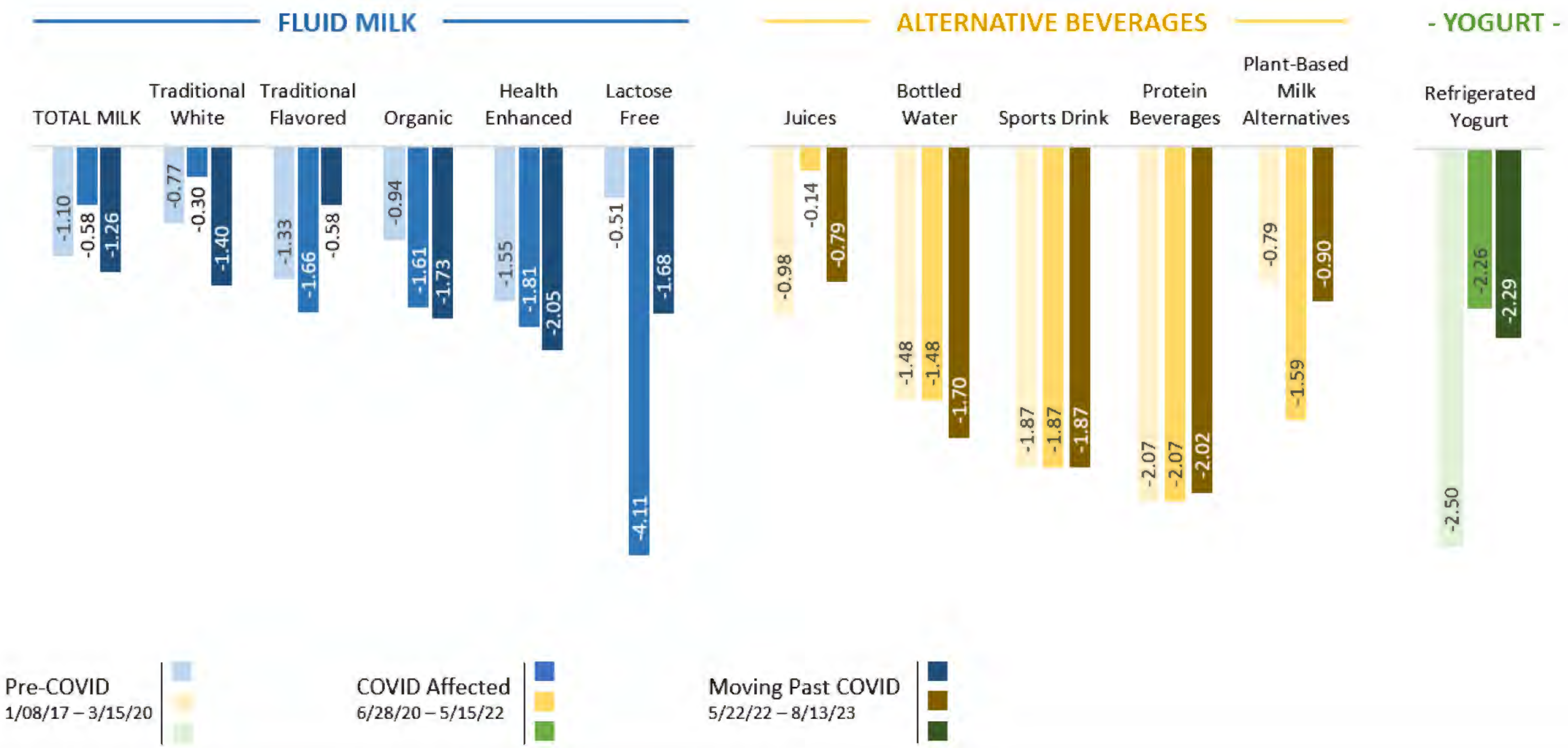
My estimates of the own-price elasticities for the respective products are derived using the Barten Synthetic Demand Systems Model (BSM). This model has been used in numerous economic studies since the 1990s.

Own-price elasticities are derived for three periods:

(1) for the Pre-COVID Period (January 8, 2017-March 15, 2020);

(2) for the COVID-Affected Period (June 28, 2020-May 15, 2022), and

(3) for the Moving Past COVID Period (May 22, 2022-August 13, 2023)



Pictorial Summary of Estimated Own-Price Elasticities

Major Takeaways

The **more expensive milk sub-categories had higher own-price elasticities**, except for lactose-free milk in the pre-COVID period.

The own-price elasticities are not uniform across the three respective time periods considered.

The **own-price elasticity for traditional white milk** changed from -0.77 in the pre-COVID period to -0.30 in the COVID-affected period, and to -1.40 in the moving-past COVID period.

The own-price elasticity for **traditional flavored milk** changed from -1.33 in the pre-COVID period to -1.66 in the COVID-affected period, and to -0.58 in the moving-past COVID period.

The **own-price elasticity for lactose-free milk** in the pre-COVID period was estimated to be -0.51, -4.11 in the COVID-affected period, and -1.68 in the moving-past COVID period.

Finally, the own-price elasticities for **organic milk and health-enhanced milk** were not only in the elastic range but also rose monotonically across the three periods.

Major Takeaways

Using a demand systems analysis (technically the use of the Exact Affine Stone Index (EASI) model) and weekly data from IRI over the period 2012 to 2017, **Ghazaryan, Bonanno, and Carlson (2023) estimated own-price elasticities to be -1.30 for skim milk, -1.67 for reduced fat milk, and -1.45 for whole milk**. As well, using a demand systems analysis (technically the use of the Almost Ideal Demand System (AIDS) model) and weekly data from IRI from the second week of March 2018 to the first week of December 2022 provided by **Nielsen, Son and Lusk (2023) estimated the own-price elasticity for regular dairy milk to be -0.95 and for lactose-free milk to be -1.39**.

Each of these studies employed a demand systems approach coupled with the use of weekly data from IRI and from Nielsen. Hence, these respective studies further support my contention that **the demands for disaggregated milk products are sensitive to changes in prices.**

Major Takeaways

A fundamental economic principle associated with own-price elasticities is that the greater the number of substitutes for any product, the greater the magnitude of the own-price elasticity.

Based on the substitution relationships among the various products considered in my analysis, the magnitudes of the estimated own-price elasticities reported are consistent with this economic principle.

Major Takeaways

When the categories of fluid milk were **combined into a single category (total milk)**, **the own-price elasticity for total milk** was estimated to be -1.10 in the pre-COVID period, -0.58 in the COVID-affected period, and -1.26 in the moving-past COVID period.

Again, the own-price elasticities were larger than those cited in the economic literature. Based on the aggregated analysis, the magnitude of the own-price elasticity for total milk in the moving-past COVID period was comparable to its magnitude in the pre-COVID period. **Consequently, my analysis reveals that the demand for *total milk* was elastic in the pre-COVID period and in the moving-past COVID period.**

Major Takeaways

Because of the **pandemic**, a structural shift in the demand for fluid milk occurred across all fluid milk segments.

The frequency of the time-series data in my analysis is weekly, whereas in most studies cited in the economic literature, the frequency of the time-series data was either monthly, quarterly, or annual. Elasticity estimates based on shorter time periods usually differ from those based on longer time periods (Manderscheid, 1964; Pasour and Schrimper, 1965; Capps and Nayga, 1990). **Elasticities based on shorter-term frequencies are likely to be greater in magnitude than elasticities based on longer-term frequencies.** Given the finding of the elastic nature of the respective demands for products associated with my analysis, my empirical results support this contention. Presumably, consumers shop at retail outlets on a weekly basis rather than on a monthly, quarterly, or annual basis, especially for milk and beverages. Consequently, own-price elasticities based on weekly data represent a more realistic picture of the frequency of consumer shopping behavior.

Comparison with Testimony Provided by Dr. Kaiser

Based on testimony from Dr. Kaiser, the National Milk Producers Federation proposal recommended increasing the Class I price by 8.6%. Assuming the elasticity of price transmission from the farm level to the retail level to be 0.55% as calculated by Dr. Kaiser, this 8.6% increase in the Class I price **results in a 4.72% increase ↑ in the retail price for milk products**. The elasticity of price transmission denotes the percentage change in the retail price attributed to a 1% change in the farm price.

Using the estimated elasticities of traditional white milk, traditional flavored milk, organic milk, lactose-free milk, and health-enhanced milk from **the moving-past COVID period**, the most recent period in my analysis, **the 4.73% increase ↑ in retail price for milk products translates to a**:

- 6.28% decrease ↓ in the quantity purchased of traditional white milk.
- 2.40% decrease ↓ in the quantity purchased of traditional flavored milk.
- 4.11% decrease ↓ in the quantity purchased of organic milk.
- 2.75% decrease ↓ in the quantity purchased of lactose-free milk; and
- 5.67% decrease ↓ in the quantity purchased of health-enhanced milk

Comparison with Testimony Provided by Dr. Kaiser

For the aggregate total milk category, the **4.72% increase ↑ in retail price translates into a 5.98% decrease ↓ in the quantity purchased**. This result is at odds with the inference drawn by Dr. Kaiser based on his calculations who assumed that the own-price elasticity of total milk was either -0.20 or -0.35. To illustrate, based on the average retail price elasticity of -0.35 from his literature review, Dr. Kaiser calculated that a 4.72% increase in the retail price of milk would decrease ↓ the quantity of milk purchased by **1.66%**. Based on the median retail price elasticity of -0.20 from his literature review, Dr. Kaiser calculated that a 4.72% increase in the retail price of milk would decrease ↓ the quantity of milk purchased by **0.95%**.

Comparison with Testimony Provided by Dr. Kaiser

Based on my analysis, the 8.6% increase in Class I price would lead to a 2.1% increase in gross revenue for dairy farmers. But based on Dr. Kaiser's analysis, the 8.6% increase in Class I price would lead to a 6.8% to 7.6% increase in gross revenue for dairy farmers.

Bottom line, unlike previous studies cited by Dr. Kaiser in his testimony as well as the own-price elasticity of demand for milk estimated in the recent ERS study (-0.035), **retail purchases of milk products indeed are far more sensitive to price changes than suggested by conventional wisdom**.

Other Analyses that have Reached Similar Conclusions

Using data from Nielsen from the first week of January 2017 to the second week of July 2020, Zhao, Wang, Hu, and Zheng (2021) derived own-price elasticities for plant-based meat alternatives, beef, chicken, turkey, pork, fish, and other meats **for pre-COVID and COVID-affected periods** based on the Almost Ideal Demand System (AIDS).

This study reported changes in own-price elasticities for various meat products and plant-based meat alternatives that are **congruent** to those derived in my analysis for various milk products and plant-based milk alternatives. Consequently, **the work of Zhao, Wang, Hu, and Zheng (2021) reinforces the credibility of my work**.

How and Why My Results May Differ from those Performed in Prior Studies, and Why My Results are Nonetheless Reliable

Dr. Kaiser in his recent testimony presented at the Federal Milk Marketing Order hearings, suggests that the own-price elasticity of demand for milk is inelastic, that is, not very sensitive to price changes. **The own-price elasticities of demand cited by Dr. Kaiser ranged from -0.003 to -0.873 with one exception, a study by Davis *et al*. (2012), where the own-price elasticity for fluid milk was estimated to be -1.63**.

The own-price elasticity based on the U.S. Dairy Sector Model developed by the USDA Economic Research Service (Cessna, DelCurto, Teran, and Crouse, 2023) was estimated to be **-0.035 for fluid milk**. This estimate was arrived at using **annual data** from 1990 to 2020, a total of 31 observations.

How and Why My Results May Differ from those Performed in Prior Studies, and Why My Results are Nonetheless Reliable

Of the 38 studies cited by Dr. Kaiser, only two were published after 2021. The remaining articles were published over the period 1964 to 2020. Also, only a few of the studies dealt with milk by fat type and organic milk. These venerable studies are dated and consequently do not reflect the current retail marketplace for milk. None of the studies cited considered health-enhanced milk or lactose-free milk as separate segments.

How and Why My Results May Differ from those Performed in Prior Studies, and Why My Results are Nonetheless Reliable

Data available from the Agricultural Marketing Service (AMS), pertain to monthly estimated fluid milk products sales (volume in terms of millions of pounds). Unlike the data obtained from Circana, the USDA, AMS data correspond to dispositions (deliveries) of fluid milk products in consumer type packages from milk processing (bottling) plants to outlets in Federal Order marketing areas. These outlets include food stores, convenience stores, warehouse stores/wholesale clubs, non-food stores, schools, food service industry, and home delivery. The USDA data are available nationally and regionally for **total milk** in the 11 Federal Milk Orders.

Importantly, it is likely that the own-price elasticity of milk based exclusively on data dealing with schools, colleges/universities, long-term care and senior living, hospitals, and correctional institutions is **highly inelastic**. That is, not much sensitivity is evident concerning quantities purchased with respect to price changes in these instances. As such, studies based on the estimated fluid milk sales data provided by USDA, AMS should result in **lower** own-price elasticities than studies based on the sales reported at various retail outlets. Many of the studies cited by Dr. Kaiser as well as the USDA Economic Research Service U.S. Dairy Sector Model study, rely on estimated fluid milk sales data. **The issue, as stated previously, is that studies which rely solely on estimated fluid milk sales, do not reflect the current retail marketplace for milk.**

How and Why My Results May Differ from those Performed in Prior Studies, and Why My Results are Nonetheless Reliable

The more accurate measurement of own-price elasticity for purposes of the FMMO system needs to consider current market conditions, more frequent information regarding consumer behavior (e.g., weekly data in lieu of quarterly, monthly, or annual data as well as consideration of the impacts of the pandemic), and most importantly the primary competitors of various milk products. My research at present is the only study which fulfills these conditions.

Thank You!