Testimony by Harry M. Kaiser, Ph.D.
Charles H. Dyson School of Applied Economics and Management
Cornell University

August 20, 2023

My name is Harry Kaiser, and I have been asked to be an expert witness on behalf of the National Milk Producers' Federation (NMPF) concerning the expected impacts on milk product demand accompanying regulated price changes. I am the Gellert Family Professor of Applied Economics in the Charles H. Dyson School of Applied Economics and Management at Cornell University, located in Ithaca, New York. I was the Dean for Academic Affairs for the Dyson School for seven years, and the Chair of the Applied Economics and Policy Area for the Cornell S.C. Johnson College of Business at Cornell University in 2023. In 1985, I received a Ph.D. in agricultural and applied economics from the University of Minnesota. For the past 38 years, a large part of my research program at Cornell University has been in the areas of price analysis, marketing, and policy. I have published over 150 refereed journal articles, five books, 17 book chapters, and over 150 research bulletins. I was the editor of the academic journal, *Agricultural and Resource Economics Review*, from 1999 though 2001, served as associate editor of *Agribusiness: An International Journal* for over 10 years, and was on the editorial board of the *American Journal of Agricultural Economics* from 1999 through 2001.

The focus of my testimony is on the expected impacts on milk product demand accompanying regulated price changes. The price elasticity of demand for milk is inelastic, which means that consumers are not very sensitive to adjusting their purchases in response to price changes. A price elasticity measures the percentage change in demand, given a 1% change in price. Technically, any elasticity that is lower in absolute value than 1.0 indicates that demand is relatively price inelastic since changing the price by 1% results in a less-than 1% change in quantity demanded. When firms have control over price setting, they will strive to raise the price when the current price is in the inelastic range of demand since doing so will result in a higher percentage increase in price than the corresponding percentage decrease in quantity, and therefore revenue will increase.

The overwhelming majority of empirical studies that have measured the price elasticity of demand for milk have found it to be inelastic. For instance, based on 38-peer-reviewed studies (Table 1, about half of which have been published since 2000) that have measured the price elasticity of demand for milk at the retail level, the average estimated elasticity indicates that a 1% increase in the retail price of milk would cause a 0.35% decrease in per capita quantity demanded, holding all other milk demand drivers constant. The median elasticity from these 38 studies is even smaller in value, i.e., a 1% increase in price reduces per capita quantity demand by 0.2%. In other words, half of the 38 studies find the price elasticity to be less than 0.2% in absolute value while the other half find it to be higher than 0.2%. These studies span 60 years and have consistently shown the same result, i.e., the price inelastic nature of milk.

While Table 1 does not list all studies that have measured the milk demand price elasticity, they represent the bulk of peer-reviewed published studies. The finding that milk demand is inelastic is consistent with the use of classified pricing that charges the highest regulated price for milk utilized in Class I products while charging lower prices for milk used for more price elastic manufactured dairy products.

Of the 38 studies cited here, only the study by Davis et. al. (2012) estimated milk to be price elastic. The researchers reported a 1% increase in retail price would cause milk quantity (average of skim, 1%, and 2% grocery milk) demanded to decrease by 1.633%. However, the 37 remaining studies all found milk to have a price inelastic demand ranging as low as -0.003 (Zheng and Kaiser, 2008) to -0.873 (Aviola and Capps, 2010).

Why is the demand for milk inelastic? Milk is considered a "staple good" in that milk buyers regularly consume it usually in the same amount regardless of price level. For regular milk consumers, milk is considered more of a necessity than a luxury, which explains why consumers are not very sensitive to price changes. They regularly buy milk and do not significantly alter their purchases in response to price changes. For non-milk consumers, such as vegans, people who are lactose intolerant, or people who simply do not like to drink milk, the price of milk has no impact at all on their decision whether or not to consume it. For example, for people who practice of vegan diet, the price of milk could be zero, and they would still not consume it. The net result is that for people ranging from those who consume a lot to those consuming little to no milk, price is not much of a deciding factor in their purchasing decisions.

In addition, other economic demand drivers such as the price of substitute and complementary products to milk have been found to not have a large impact on milk demand. You may have heard this referred to as cross-price elasticity of demand. For example, Zheng and Kaiser (2008) estimated that the most important substitute for milk is bottled water products, and that a 1% increase in the price of bottled water would cause a 0.32% increase in the demand for milk, holding other demand drivers constant. Most empirical studies on milk demand have also shown that own and cross-price elasticities of milk demand are inelastic. In other words, changing the price of beverage options, up or down, does not proportionately impact milk consumption up or down.

Another way to demonstrate how unimportant price changes are in terms of driving milk demand, consider the fact that the *real* price of milk relative to all goods and services in the U.S. economy has fallen by 7% since 2013. (The *real* price is adjusted for inflation to remove any bias in the milk price over time). That means that milk has become less expensive to purchase relative to all other goods and services in the U.S. economy since 2013. Yet, during the same time period, per capita milk consumption actually decreased by 18.3%. That is, even though the price of milk has decreased relative to other products, per capita demand has decreased since 2013. Of course, there are other demand drivers that have helped cause this decline, but if the price of milk was actually elastic, one would expect the 7% decrease in the real milk price would have resulted in an increase rather than an 18.3% decrease in per capita demand.

What has caused the steady decline in per capita milk demand over time? There are at least three reasons for this, and they do not include the retail price of milk. First, the beverage market has become increasingly competitive with many new products introduced over time. In the distant past, milk lost significant market share to soda. More recently, bottled water, sports drinks, and plant-based milk products have taken tremendous market share away from milk. The steady downward trend in per capita milk sales, in large part, has been due to milk drinkers switching to these alternative beverages.

Second, another cause of declining per capita fluid milk consumption has been the increasing trend in food consumed away from home. As people consume more food away from home, fluid milk consumption may be diminished by the lack of availability of many varieties of fluid milk products at restaurants as well as the expanding availability of fluid milk substitutes. Many eating establishments carry only one type of fluid milk product, which causes some people who would normally drink fluid milk to consume a different beverage if the preferred fluid milk product is not available. Between 2013 and 2019 (prior to Covid), the trend in food consumed away from home measured in food expenditures increased by over 34% (these expenditures decreased significantly due to Covid, but were still 15.4% higher in 2021 than in 2013). Thus the increase in food consumed away from home appears to be responsible for some of the decrease in per capita fluid milk consumption.

Finally, an important demographic change causing a decrease in milk demand is the proportion of young children in the population, which is lower than it was in 2013. Since young children are one of the largest fluid milk-consuming cohorts, any decline in that cohort negatively impacts per capita fluid milk consumption. Between 2010 and 2021, the proportion of the population under 19 years of age in the U.S. fell from 26.9% to 24.8%, which represents almost an 8% decline in the youngest (and largest fluid milk-consuming) cohort of the population. Therefore, there is a positive correlation between per capita fluid milk consumption and this age cohort—both have declined over this period.

How would increasing the Class I price differential impact retail fluid milk demand? NMPF's proposal recommends a nationwide increase of the Class I price differential by an average of $1.49 per cwt. At current Class I prices, this is an 8.6% increase. To translate the Class I price increase to the retail level, we need an estimate of the price transmissions from the farm price to the retail price. Based on monthly Class I and retail price data from 2013 through May 2023, I estimate that a 1% change in the Class I price would cause a 0.55% change (in the same direction) in the retail CPI for all milk products (calculations for this are available from the author). Based on this estimate, an 8.6% increase in the Class I price would result in a 4.7% increase in the retail price for milk products. Based on the average retail price elasticity of demand from Table 1 (0.35), a 4.7% increase in the retail milk price would cause per capita fluid milk demand to decrease by 1.6%. Alternatively, using the median retail price elasticity of demand at 0.2% (from Table 1), a 4.7% increase in the retail milk price would cause per capita fluid milk demand to decrease by 0.9%. Using either estimate, the decrease in demand would be substantially lower than the increase in the Class I price, and would therefore increase gross revenues to dairy farmers.

In summary, practically all past studies that have measured the price elasticity of demand for milk has found it to be inelastic. Likewise, many of these studies have found the cross-price elasticities of demand for milk substitutes to also be inelastic. These results suggest that increasing the Class I price by increasing Class I differentials will increase gross revenues to dairy farmers while not having a significant negative impact on milk sales volume.

These insights are essential to validating the ongoing justification or rationale for establishing higher minimum prices for Class I milk. The underlying economic rationale hinges on two factors, one is the higher cost of serving Class I processors. The second relates to the economic argument that setting a higher price for the most inelastic use of milk will result in higher gross revenues to dairy farmers, even if there is a consequent lower price(s) for other uses of milk as markets find new supply and demand equilibria.

It is important to understand clearly that the fact that the consumer demand for Class I products is price inelastic in no way conflicts with the obvious fact that per capita and total sales of those products have been trending down for over a decade. What the research indicates is that those sales trends are 1) caused by other factors than the price of milk and 2) would exist even if minimum Class I prices were lowered. This is not to say that changes in minimum Class I prices would have no impact on sales, but rather that those impacts would be minor in comparison to the other factors that are driving milk sales.

Table 1. Estimates of Price Elasticity of Demand for Fluid Milk.

Study	Estimated? Price Elasticity
Zheng and Kaiser (2008)	-0.154
Zheng and Kaiser (2008)	-0.003
Dong and Kaiser (2008)	-0.710
Dong, Schmit, Kaiser (2012)	-0.735
Schmit and Kaiser (2007)	-0.051
Dong, Chung, and Kaiser (2004)	-0.107
Schmit and Kaiser (2004)	-0.039
Schmit et al (2002)	-0.060
Vande Kamp and Kaiser (1999)	-0.196
Tomek and Kaiser (1999)	-0.036
Pritchett, Liu, and Kaiser (1998)	-0.042
Kaiser and Liu (1998)	-0.009
Kaiser (1997)	-0.175
Suzuki and Kaiser (1997)	-0.158
Reberte et al (1996)	-0.124
Kaiser (1994)	-0.041
Wang, Kaiser, and Boisvert (1994)	-0.042
Kaiser et al (1994)	-0.036
Kaiser (1992)	-0.476
Liu, Kaiser, Mount, and Forker (1991)	-0.282
Kaiser, Streeter, and Liu (1988)	-0.045
Capps (2022)	-0.071
Heien and Wessells (1988)	-0.630

Heien and Wessells (1990)	-0.770
Aviola and Capps (2010) conventional milk	-0.873
Davis et al (2012) (simple average of their skim, 1%,2% and skim)	-1.633
Gould 1996 (simple average of skim, 2% and whole milk	-0.636
Park et al. (1996) simple average of poverty and non-poverty estimate	-0.501
Gould et al. (1990) average of lowfat and whole milk	-0.381
Li, Peterson, Xia (2018) (average of whole,1%,2% skim milk)	-0.838
Bartlett (1964)	-0.625
Boehm (1975)	-0.650
Yen, Lin, Smallwood and Andrews (2004)	-0.590
Dharmasena and Capps (2014)	-0.53
Gulseven and Wohlgenant (2015), whole milk (2015)	-0.525
Gulseven and Wohlgenant (2015), organic milk	-0.384
Yang and Dharmasena,(2021), whole milk	-0.120
Chen, Saghaian, Zheng (2018), private label conventional + organic	-0.338
Average	-0.354
Median	-0.196
Standard deviation	0.354

References

Alviola, Pedro A. and Oral Capps. “Household Demand Analysis of Organic and Conventional Fluid Milk in the United States Based on the 2004 NielsenHomescan Panel.” *Agribusiness: An International Journal*. 26(2010):369-88.

Bartlett, Roland W. “Fluid Milk Sales as Related to Demand Elasticities.” *Journal of Dairy Science*. 47(1964):1314-21.

Boehm, William T. “The Household Demand For Major Dairy Products In The Southern Region.” *Southern Agricultural Economics Association*. 7(1975):1-10.

Capps, Oral. Chapter 3 of *USDA Report to Congress on the National Dairy Promotion and Research Program and the National Fluid Milk Processor Promotion Program*. USDA, Washington, D.C., 2022.

Chen Bo, Sayed Saghaian, and Yuqing Zheng. "Organic labelling, private label, and U.S. household demand for fluid milk," *Applied Economics*. 50(2018):3039-3050.

Dharmasena, Senarath and Oral Capps, Jr. “Unraveling Demand for Dairy-Alternative Beverages in the United States: The Case of Soymilk.” *Agricultural and Resource Economics Review*. 43(2014):140–157.

Davis, Christopher G.,Diansheng Dong, Donald Blayney, Steven T. Yen, and Richard Stillman. "U.S. Fluid Milk Demand: A Disaggregated Approach." *International Food and Agribusiness Management Review. 15(2012):25-50.*

Dong, Diansheng and Harry M. Kaiser. "Studying Household Purchasing and Non-Purchasing Behavior for a Frequently Consumed Commodity: Two Models." *Applied Economics*. 40(2008):1941-1951.

Dong, Diansheng, Chanjin Chung, and Harry M. Kaiser. "Modeling Milk Purchasing Behavior with a Panel Data Double-Hurdle Model." *Applied Economics*. 36(2004):769-779 (lead article).

Dong, Diansheng, Todd M. Schmit, and Harry M. Kaiser. "Modeling Household Purchasing Behavior to Analyze Beneficial Marketing Strategies." *Applied Economics*. 44(2012):717-725.

Gould, Brian W. "Factors Affecting U.S. Demand for Reduced-Fat Fluid Milk." *Journal of Agricultural and Resource Economics*. 21(1996): 68-81.

Gould, Brian W., Thomas L. Cox, and Federico Perali. "The Demand for Fluid Milk Products in the U.S.: A Demand Systems Approach." *Western Journal of Agricultural Economics*. 15(1990): 1-12.

Heien, Dale and Cathy Roheim Wessells. "The Demand for Dairy Products: Structure, Prediction, and Decomposition." *American Journal of Agricultural Economics*. 70(1988):219-28.

Heien, Dale and Cathy Roheim Wessells. "Demand Systems Estimation with Microdata: A Censored Regression Approach." *Journal of Business & Economic Statistics*. Vol. 8, No. 3 (Jul., 1990), pp. 365-371.

Kaiser, Harry M. "Market Impacts of Bovine Somatotropin: A Supply and Demand Analysis." *Southern Journal of Agricultural Economics*. 24(1992):271-82.

Kaiser, Harry M. "An Analysis of Policy Alternatives to the Dairy Price Support Program." *Agricultural and Resource Economics Review*. 23(1994):158-70.

Kaiser, Harry M. "Impact of National Dairy Advertising on Dairy Markets, 1984-95." *Journal of Agricultural and Applied Economics.* 29(1997):303-14.

Kaiser, Harry M., Deborah H. Streeter, and Donald J. Liu. "Welfare Comparisons of U.S. Dairy Policies With and Without Mandatory Supply Control." *American Journal of Agricultural Economics*. 70(1988):848-58.

Kaiser, Harry M., and Donald J. Liu. "The Effectiveness of Generic vs. Branded Advertising: The Case of U.S. Dairy Promotion." *Review of Agricultural Economics*. 20(1998):69-79.

Kaiser, Harry M., Olan D. Forker, John Lenz, and Chin-Hwa Sun. "Evaluating Generic Dairy Advertising Impacts on Retail, Wholesale, and Farm Milk Markets." *Journal of Agricultural Economics Research*. 44(No. 4, 1994):3-17.

Li, Xianghong, *Hikaru Hanawa Peterson* and Tian Xia. *"*Demand for Organic Fluid Milk across Marketing Channels*." Agricultural and Resource Economics Review*. 47(2018):505-532.

Liu, Donald J., Harry M. Kaiser, Olan Forker, and Timothy Mount. "Modeling the U.S. Dairy Sector Under Government Intervention." *Western Journal of Agricultural Economics*. 16(1991):360-73.

Gulseven, Osman and Michael Wohlgenant. "A quality-based approach to estimating quantitative elasticities for differentiated products: an application to retail milk demand." *Quality & Quantity: International Journal of Methodology*. 49(2015): 2077-2096.

Park, John L., Rodney B. Holcomb, Kellie Curry Raper and Oral Capps, Jr. "A Demand Systems Analysis of Food Commodities by U.S. Households Segmented by Income." *American Journal of Agricultural Economics*. 78(1996): 290-300.

Pritchett, James G., Donald J. Liu, and Harry M. Kaiser. "Optimal Choice of Generic Milk Advertising Expenditures by Media Type." *Journal of Agricultural and Resource Economics*. 23(1998):155-69.

Reberte, J. Carlos, Harry M. Kaiser, John Lenz, and Olan D. Forker. "Generic Advertising Wearout: The Case of the New York City Fluid Milk Campaign." *Journal of Agricultural and Resource Economics*. 21(1996):199-209.

Schmit, Todd M. and Harry M. Kaiser. "Decomposing the Variation in Generic Advertising Response Over Time." *American Journal of Agricultural Economics*, 86(2004):139-153.

Schmit, Todd M. and Harry M. Kaiser. "Optimal Seasonal Allocation of Generic Dairy Advertising Expenditures." *Journal of Agricultural and Applied Economics*. 39(2007):187-199.

Schmit, Todd M., Chanjin Chung, Diansheng Dong, Harry M. Kaiser, and Brian Gould. "Identifying the Effects of Generic Advertising on the Household Demand for Fluid Milk and Cheese: A Two-Step Panel Data Approach." *Journal of Agricultural and Resource Economics*. 27(2002):165-186.

Suzuki, Nobuhiro, and Harry M. Kaiser. "Imperfect Competition Models and Commodity Promotion Evaluation: The Case of U.S. Generic Milk Advertising." *Journal of Agricultural and Applied Economics*. 29(1997):315-26.

Tomek, William G. and Harry M. Kaiser. "On Improving Economic Analyses of Generic Advertising Impacts." *Agribusiness: An International Journal*. 15(1999):485-500.

Vande Kamp, Philip R. and Harry M. Kaiser. "Irreversibility in Advertising-Demand Response Functions: An Application to Milk." *American Journal of Agricultural Economics*. 81(1999):385-96.

Wang, Fude, Richard Boisvert, and Harry M. Kaiser. "U.S. Dairy Policy Alternatives under Bovine Somatotrophin." *Applied Economics*. 26(1994):283-95.

Yang, T.; Dharmasena, S. "U.S. Consumer Demand for Plant-Based Milk Alternative Beverages: Hedonic Metric Augmented Barten's Synthetic Model. *Foods*. 10(2021):265. https://doi.org/10.3390/foods10020265

Yen, Steven T., Biing-Hwan Lin, David M. Smallwood, and Margaret Andrews. "Demand for Nonalcoholic Beverages: The Case of Low-Income Households." *Agribusiness: An International Journal*. 20(2004):309-21.

Zheng, Yuqing and Harry M. Kaiser. "Estimating Asymmetric Advertising Response for U.S. Nonalcoholic Beverage Demand." *Journal of Agricultural and Applied Economics*. 40(2008):837-850.

Zheng, Yuqing and Harry M. Kaiser. "Advertising and U.S. Nonalcoholic Beverage Demand." *Agricultural and Resource Economics Review*. 37(2008):147-159. (lead article).

Appendix. Econometric Output for Farm-to-Retail Price Transmissions

Dependent Variable: LOG(RETAILPRICE*8.6)
Method: Least Squares
Sample (adjusted): 2013M06 2023M05
Included observations: 120 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.708673	0.092766	18.41916	0.0000
LOG(T)	0.025642	0.006818	3.761060	0.0003
PDL01	0.094099	0.022694	4.146391	0.0001
PDL02	-0.015676	0.006126	-2.559104	0.0118

R-squared	0.746673	Mean dependent var	3.374618
Adjusted R-squared	0.740121	S.D. dependent var	0.105646
S.E. of regression	0.053856	Akaike info criterion	-2.972223
Sum squared resid	0.336460	Schwarz criterion	-2.879307
Log likelihood	182.3334	Hannan-Quinn criter.	-2.934490
F-statistic	113.9685	Durbin-Watson stat	0.155322
Prob(F-statistic)	0.000000		

LOG(CLASS1ALL)lag		Coefficient	Std. Error	t-Statistic
. * |	0	0.07842	0.01660	4.72409
. * |	1	0.12549	0.02109	5.95075
. *|	2	0.14121	0.01402	10.0739
. * |	3	0.12557	0.01098	11.4395
. * |	4	0.07859	0.04132	1.90212
Sum of Lags		0.54929	0.02985	18.4030