

Assessing Cross-Price Effects of Meat Alternatives on Beef, Pork, and Chicken Retail Demand in 2022

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Recent years have seen a spike in interest around the evolution of meat alternatives and their impact on incumbent meat industries (e.g., Lusk et al, 2022).¹ Given the multitude of events and market adjustments that have occurred in recent years, this article seeks to provide a current and concise assessment of how changes in meat alternative prices impact retail demand of U.S. consumers for beef, pork, and chicken. To accomplish this goal, we use a generalized almost ideal demand system (GAIDS) to estimate elasticities that characterize U.S. retail demand in 2022 for beef, pork, chicken, and meat alternatives. Rather than include an extended discussion of the GAIDS model, we note the methods employed are consistent with Piggott and Marsh (2004) and Tonsor and Marsh (2007).

Data used in this analysis is national scanner data available from Nielsen. Weekly data for calendar year 2022 is used in final estimates presented here. Given our interest in how changes in meat alternative prices impacts beef, pork, and chicken demand, we focus our assessment on these categories with particular focus on cross-price elasticity estimates.

Table 1 provides summary statistics on the utilized 2022 data along with estimated expenditure shares allocated to beef, pork, chicken, and meat alternatives. On average within the evaluated data for 2022, residents purchased 0.84 combined pounds of beef (0.29 lbs.), pork (0.15 lbs.), chicken (0.39 lbs.), and meat alternatives (0.01 lbs.) per week, per person. Note this corresponds with 15.08 lbs. of beef, 7.8 lbs. of pork, 20.28 lbs. of chicken, and 0.52 lbs. of meat alternatives per person in 2022. These 2022 volume estimates are reasonable given LMIC (2023) estimates per capita consumption (combined retail and food service) in 2022 was 58.89 lbs. of beef, 50.88 lbs. of pork, and 100.13 lbs. of chicken. Table 1 also reveals meat alternatives

¹ Here the term “meat alternatives” is used consistently with how Nielsen builds retail data categories. Broadly speaking, this captures products currently available in the U.S. retail market not derived from live animals.

are second only to beef in average retail prices with pork having the lowest average price. Chicken and beef combine to over 80% of average expenditures while mean expenditure share was 1.4% for meat alternatives.

Table 2 presents elasticity estimates from our preferred GAIDS model. First, we discuss the compensated, own-price elasticities to facilitate comparison with available estimates in the literature, which vary in time-period, data utilized, and demand assessment methods employed. Beef demand is estimated here to be inelastic with a 1% increase in price corresponding with a 0.26% reduction in quantity demanded. Our -0.26 own-price elasticity of demand estimate for beef compares with existing estimates of -0.42 (Tonsor, Mintert, and Schroeder, 2010), -0.49 (Tonsor and Olynk, 2011), -0.62 (Patalee and Tonsor, 2019), and -0.72 (Taylor and Tonsor, 2013).

Our pork demand, own-price elasticity estimate is -1.12. This -1.12 own-price elasticity of demand estimate for pork compares with existing estimates of -0.74 (Tonsor, Mintert, and Schroeder, 2010), -0.88 (Tonsor and Olynk, 2011), -0.43 (Patalee and Tonsor, 2019), and -2.38 (Taylor and Tonsor, 2013). Taken together, this aligns with our finding of pork consumption being much more responsive to own-category price changes than beef.

Our own-price elasticity of chicken demand estimate is -0.04. Consistent with other studies (Tonsor, Mintert, and Schroeder, 2010; Tonsor and Olynk, 2011) this estimate is not statistically different from zero indicating there is not statistical evidence that consumers reduce (increase) the quantity demanded as chicken prices increase (decrease). Finally, our own-price elasticity of meat alternatives demand is -1.22 indicating a high level of price sensitivity. In turn, this large own-price elasticity estimate of -1.22 suggests that if the meat alternatives industry succeeds in reducing production costs, which correspond with lower offer prices to consumers,

than the quantity demanded may respond strongly (on a % basis relative to its currently small expenditure share).

Moving to the impact of changes in meat alternative prices on beef, pork, and chicken demand, we find small cross-price effects. Specifically, we estimate for each 1% increase (decrease) in meat alternative prices that beef demand increases (decreases) 0.03%, pork demand increases (decreases) 0.13%, and chicken demand decreases (increases) 0.03%. Each of these three meat-alternative cross-price effects are estimated to be statistically significant and different from zero. This suggests that meat alternatives are weak substitutes for beef and pork and weak complements to chicken. The term *weak* is used here to reflect the low, direct magnitude of cross-price impacts. For instance our own-price elasticity estimate suggests a 1% decrease in pork price increases the quantity of pork demanded by 1.12% while our cross-price estimate indicates a 1% increase in meat alternative prices would increase the quantity of pork demanded by 0.13%, nearly one-tenth the effect of own-category price changes.

The small cross-price effects of meat alternatives on beef demand align with findings of Tonsor, Lusk, and Schroeder (2022). Moreover, our findings align with those of Taylor et al. (2022), who identified there are more households who consume both beef and plant-based proteins than those who eat plant-based proteins only, indicating the two categories are not strong substitutes. Further consistent with our findings here, Neuhofer and Lusk (2022) found ground meat consumption did not fall after households made their first meat alternatives purchase.

As a final step we also include a short, external validity assessment on the conclusion of small cross-price effects of meat alternatives on beef, pork, and chicken demand using Meat Demand Monitor (MDM) data from January through March 2023. Specifically, the data used is from an “open-ended” choice experiment where respondents are presented a list of eight common protein products with randomized offer prices and are prompted to select an option from “Zero (None)” to “Five or More, 1-lb packages” the quantity of each product they would buy. The eight products examined are ribeye steak, ground beef, pork chops, bacon, chicken breast, plant-based patty, shrimp, and beans and rice. Using a multivariate tobit model, we can see how changes in plant-based patty offer prices impact demand. As indicated by the compensated elasticity estimates presented in table 3, there is not statistical evidence that changes in plant-based patty prices impact ribeye steak, ground beef, pork chop, bacon, nor chicken breast demand. Beyond observing that none of these cross-price effects being statistically different from zero, it is worth noting the point estimates are all below 0.12 (in absolute value). Combined, this supports our Nielsen 2022 retail data-based assessment above of small effects from changes in meat alternative prices on beef, pork, and chicken demand, lending further confidence in our findings.

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Table 1. Summary Statistics of Weekly Retail Data (Nielsen Retail, 2022)*

	Mean	Minimum	Maximum
Beef Quantity	0.294	0.253	0.339
Pork Quantity	0.146	0.120	0.180
Chicken Quantity	0.387	0.331	0.423
Meat Alternatives Quantity	0.012	0.009	0.015
Beef Price	\$ 2.26	\$ 2.09	\$ 2.49
Pork Price	\$ 1.17	\$ 1.10	\$ 1.22
Chicken Price	\$ 1.46	\$ 1.41	\$ 1.50
Meat Alternatives Price	\$ 1.57	\$ 1.51	\$ 1.68
Beef Expenditure Share	0.351	0.336	0.389
Pork Expenditure Share	0.174	0.163	0.195
Chicken Expenditure Share	0.461	0.407	0.483
Meat Alternatives Share	0.014	0.012	0.016

*Quantities are per capita, per week retail estimates from available scanner data. Prices are in real (Food CPI 1982-84=100), \$/lb units.

Table 2. GAIDS Model Estimated Uncompensated, Compensated, and Expenditure Elasticities (Nielsen Retail, 2022)

Uncompensated elasticities				
	Beef	Pork	Chicken	Meat Alternatives
Beef	-0.665 ^{*a}	0.114	-0.611 [*]	0.010
Pork	0.136	-1.362 [*]	-0.300	0.108 [*]
Chicken	-0.318 [*]	0.006	-0.381 ^{*a}	-0.041 [*]
Meat Alternatives	0.383	1.476 [*]	-1.376 [*]	-1.232 [*]
Compensated elasticities				
	Beef	Pork	Chicken	Meat Alternatives
Beef	-0.261 ^{*a}	0.315 [*]	-0.079	0.025 [*]
Pork	0.633 [*]	-1.115 [*]	0.354 [*]	0.128 [*]
Chicken	-0.060	0.134 [*]	-0.043 ^a	-0.031 [*]
Meat Alternatives	0.645 [*]	1.607 [*]	-1.031 [*]	-1.221 [*]
Expenditure elasticities				
Beef	1.152 ^{*b}			
Pork	1.418 ^{*b}			
Chicken	0.734 ^{*b}			
Meat Alternatives	0.748 ^{*b}			

*Denotes elasticities significantly different from 0 at the 5% level; *a* denotes own-price elasticities significantly different than -1.0 at the 5% level; *b* denotes expenditure elasticities significantly different than +1.0 at the 5% level. The columns and rows of this table correspond to price and quantity changes, respectively.

Table 3. Meat Demand Monitor, Multivariate Tobit Implied Compensated Elasticities (MDM Survey Data, January-March 2023)

	Ribeye Steak	Ground Beef	Pork Chop	Bacon	Chicken Breast	Plant- Based Patty	Shrimp	Beans and Rice
Ribeye Steak	-1.05	0.11	0.09	0.07	0.15	-0.03	-0.09	0.12
Ground Beef	-0.18	-0.79	0.01	0.02	0.06	0.11	-0.04	0.03
Pork Chop	-0.12	0.01	-0.74	0.00	0.03	-0.06	-0.01	0.07
Bacon	-0.13	0.07	0.04	-0.86	0.13	0.07	0.00	0.10
Chicken Breast	-0.13	0.05	0.03	0.08	-0.61-*	-0.03	-0.03	0.02
Plant-Based Patty	-0.02	0.18	0.09	0.12	0.15	-0.23-*	0.07	0.11
Shrimp	-0.17	0.22*	0.18*	0.15	0.24*	0.07	-0.42-*	0.19*
Beans and Rice	-0.03	-0.03	0.04	0.06	-0.04	-0.01	0.03	-0.63-*

*Denotes elasticities significantly different from 0 at the 5% level; - denotes own-price elasticities significantly different than -1.0 at the 5% level. The columns and rows of this table correspond to price and quantity changes, respectively.