Using Retail Scanner Data to Assess the Demand for Value-based Ground Meat Products in Canada

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***Abstract*— We apply a set of weekly Nielsen retail scanner data for the period 2006-2007 to estimate consumer demand of value-based ground meat products in the Canadian retail market. Our demand system results indicate that price responses are stronger for organic than for extra lean meat products. Additionally, while rising disposable incomes may shift consumers' attention and purchases towards extra lean ground meat products, this result does not hold for organic ground beef. Our findings strongly suggest that ground meat demand is affected by traditional meat consumption patterns. Our analysis inform retail managers meat producers about potential market opportunities and expected consumer responses to changing economic determinants of popular retail ground meat demand.**

***Keywords*— Meat demand, value-based labelling, scanner data.**

I. INTRODUCTION

Retail food demand in across Europe and North America has reached market saturation, shifting retailer's focus on distribution channels and food quality [1]. With public concerns over food-intake related health issues on the rise, consumers in Canada and elsewhere allocate more disposable income to higher value foods, and increasingly demand a wider selection of better quality products to choose from [2]. In addition, over recent years more affluent consumers have shown a growing awareness and interest in environmental issues around food. Certified organic labelling has gained much attention by retail managers and policy makers. Consumers interpret the term "organic" in a variety of ways also depending context. Subjective experiences matter as well as the overall perception of organic foods [3]. Forge provides a Canadian definition of "organic" [4].

Numerous studies have been published that provide a great deal of information on conventional meat sectors. The majority of studies apply econometric methods to investigate demand patterns and consumer behaviour related issues across meat categories [5-16] or individual cuts [17-19]. While the use of aggregate monthly or quarterly disappearance data still prevails, more recent studies are able to make use of more detailed retail or household-level scanner data [17].

Empirical evidence on the fast growing retail segment of meat products with enhanced health and/or environmental attributes, such "certified organic" or labelled low fat contents "extra lean" has been neglected so far, mostly due to lacking data. With the exception of studies by Dhar and Foltz [20] on rBST-free and organic labelled milk, and Glaser and Thompson [21,22] on organic milk and frozen vegetables in the United States, studies of consumer demand for organic products widely relied on self-reported purchase behaviour [3]. Quantitative evidence based on long enough time series scanner-data to obtain reliable estimates of own-, cross-price and expenditure elasticities for organic and products with enhanced health attributes (low fat) as opposed to their conventional and regular counterparts are rare.

In this paper we estimate Canadian retail demand for different value-based labelled ground meats using Nielsen MarketTrack scanner data in weekly aggregation for the period 2000-2007. Sales of ground meat accounts for almost 20 % of all fresh meat sales in Canadian retail stores [23]. The objective of our study is twofold. First, we examine consumer's responsiveness to price changes across different value-based ground meat products - extra lean and organic - versus their regular and conventional counterparts using the original non-linear Almost Ideal Demand System of Deaton and Muellbauer [24]. Second, we discuss the obtained results with regards to their impact on retail strategy and whether increasing consumer for value-based labelled food products offers new and promising opportunities to food industries in Europe and North America.

The following section briefly introduces the demand system approach, hypotheses to be tested and the retail scanner dataset, and presents the demand system results. A discussion of major findings regarding the

marketing of value-based labelled meat products in Canada and implications for European retail strategy follows.

II. MODELLING RETAIL DEMAND FOR VALUE-BASED LABELLED GROUND MEATS

A. Model

The Almost Ideal Demand System (AIDS), introduced by Deaton and Muellbauer [24], is selected as the specification for the empirical analysis of ground meat demand in the Canadian retail sector. The AIDS model has been used extensively in applied demand analysis as it satisfies the axioms of choice and allows an aggregation over consumers. Standard demand theory assumes perfectly informed consumers with constant tastes and preferences [25]. But in today's grocery retail environment, consumer meat demand is characterized by non-constant preferences and continuous changes in purchase behaviour. Consumer taste and hence demand patterns may change with seasonal preferences, while general preferences may change over time as new or better information becomes available. Relaxing the assumption of constant preferences, the original AID system can be extended to incorporate elements of dynamic consumer behaviour by allowing selected parameters to vary with preference changes [12]. We follow the procedure proposed by Verbeke and Ward [26] and extend the AID system with seasonal shifters S_i and a time trend T since Canadian consumers express strong seasonal demand patterns for different meat types and categories [8]. Eq. 1 depicts the extended version of the AIDS model [27]:

$$w_{it} = \alpha_{it} + \sum_j \gamma_{ij} \log p_{jt} + \beta_i \left(\log x_t - \log P_t \right) , \quad (1)$$

$$\varphi_{it} = \alpha_i \lambda_{i1} S_i + \lambda_{i2} T , \quad (2)$$

where w_{it} is the budget share of meat i in period t; p_{jt} is the price of meat j, x_t is total category expenditure. P_t is a translog price index defined by:

$$\ln P_t = \alpha_0 + \sum_i \alpha_i \log p_{it} + \frac{1}{2} \sum_i \sum_j \gamma_{ij} \log p_{it} \log p_{jt} \quad (3)$$

To account for habit formation in meat demand that may have hindered the adoption of meat products with enhanced health and/or environmental attributes in Canadian retail stores, we include the lagged expenditure θ_{ij} in the demand system.

$$w_{it} = \alpha_{i0} + \lambda_{k1} \sum_{k=0}^{2} \omega_{k1} \log I_t + \lambda_{k2} \sum_{k=0}^{2} S_t + \sum_{j=1}^{n} \theta_{ij} \; w_{j,t} \; \frac{1}{n} \quad (4).$$

B. Hypotheses

Previous research has aimed at identifying differences in purchase patterns between regular and occasional consumers of value-based labelled food products. Schifferstein and Ophuis (1998, p. 119) state that for regular consumers of organic foods (RCOFs) "…consumption is part of a way of life. It results from an ideology, connected to a particular value system that affects personality measures, attitudes, and consumption behaviour." [28] We hypothesize a similar underlying value system and hence consumer behaviour exists with regards to fat reduced and organic meat choices in the Canadian market place. Meat with a distinguishable lower fat content and clearly labelled as such may be perceived healthier especially by more health-conscious consumers who then might prefer such products over their regular counterparts.

Based on evidence of the purchase behaviour of Canadian consumers classified "ethical" [29] we assume that consumer responses to retail price changes for organic and "healthier" ground meat options will vary considerably. The explicit hypotheses to be tested in the analysis are:

1. Canadian consumers overall show price sensitive reactions to price changes of value-based labelled meat products;
2. Cross-price elasticities between value-based and regular meat products are small (insignificant) as occasional consumers of value-based or regular ground meats are likely to switch between both products, but larger (significant) within each category as regular consumers of either fat reduced or organic ground meat show more persistent consumption habits due to preference in health, taste or environmental issues.
3. Income elasticities for value-based ground meats are larger than for regular ground meat products.

C. Data

In analyzing point-of-sale demand for value-based labelled and conventional fresh meat products in Canada, we set out to estimate retail level own-price, cross-price and expenditure elasticities across different ground meats with varying attributes. We apply 2000-2007 Nielsen MarketTrack retail scanner data in weekly aggregation from week 48 (December) of 2000 to week 28 (July) of 2007. Nielsen Canada collects weekly sales data and prices (in Canadian $) for a wide range of branded and generic meat products across participating stores in all Canadian provinces. Our data consist of average retail prices, quantities sold and sales values for a set of ten different beef, pork, chicken and other ground meat products (other = turkey, lamb), including organic products and products with additional health attributes. Healthier, extra lean ground meats have a 10% fat content while normal the regular fat content is max. 30%. Additionally, we selected organic ground beef and the conventional counterpart. Our product selection covers both, branded and generic fresh ground meats with the majority of product being sold as generic. Summary statistics for the variables used in the analysis are presented in Table 1.

Table 1: Descriptive statistics of different extra lean, regular, organic and conventional ground meat products

	N	Mean retail price ($/kg)[a]	Mean quantity (kg)[a]	Mean expenditure share[a,b)]
Ex Lean Ground Beef	344	7.82	282371.8	62.00
		(0.42)	(95413.6)	(0.07)
Regular Ground Beef	344	4.41	193871.2	25.00
		(0.64)	(98775.8)	(0.07)
Ex Lean Ground Chicken	321	8.32	4984.0	25.00
		(3.25)	(409.0)	(0.07)
Regular Ground Chicken	344	7.93	9694.2	2.00
		(1.48)	(5857.8)	(0.01)
Ex Lean Ground Pork	286	5.52	2621.5	0.40
		(2.93)	(4238.4)	(0.005)
Regular Ground Pork	344	5.15	50433.7	6.00
		(0.36)	(44350.7)	(0.04)
Ex Lean Ground Other[c)]	281	13.71	1356.8	0.20
		(8.63)	(2285)	(0.004)
Regular Ground Other[c)]	344	14.72	6653.4	1.30
		(5.17)	(6663.9)	(0.01)
Organic Ground Beef[b)]	189	16.81	430.3	42.36
		(5.31)	(647.6)	(18.15)
Conventional Ground Beef	344	5.89	13211904	35.09
		(0.35)	(1149745)	(3.14)

[a)] Standard deviation in parentheses.
[b)] Organic and conventional expenditure shares are separated due to the small expenditure share of organic meat products. Organic ground beef accounts for 42% of total expenditure for organic beef. Conventional ground beef (sum of regular ground beef and all reduced fat products) is 35% of all beef sales.
[c)] Other ground meat is turkey and lamb grounds.

The average retail prices for value-based labelled ground meats in Canada indicate that extra lean and organic products receive a substantial price premium over regular and conventional products. Interestingly, despite a mark-up of $3.41 for extra lean over regular ground beef it is the most popular consumer choice with an overall expenditure share of 62%, followed by regular ground beef with 25%. Organic ground beef and extra lean other ground meats command a significant 70% above-average price mark-up, but show overall much lower retail sales volumes.

D. Results

Our discussion of findings from the two demand system analyses for extra lean/regular and organic/conventional ground meats focuses primarily on the presentation of own- and cross-price elasticities and seasonal patterns of retail ground meat demand [1)].

In both cases, Marshallian and Hicksian own-price elasticities presented in Tables 2 and 3 show the expected negative sign across all different ground meat products. Organic ground beef holds the most

price elastic consumer reaction with an elasticity of -2.7 / -3.2 (Table 2 and 3). Overall, as was expected, Canadian consumers show an elastic reaction to retail price changes. The exemptions are extra lean ground beef and regular ground chicken with inelastic price elasticities indicating stronger consumer preferences for both ground meat categories. With regards to the estimated cross-price elasticities, a number of results warrant discussion.

First, it is an interesting result that most cross-price elasticities between extra lean ground meats carry negative signs, indicating complementary relationships between products with labelled perceived health attributes. Increasing retail prices for extra lean ground meats overall result in decreasing sales. However, with regards to the estimated cross price elasticities, hypothesis (2) can be confirmed to a large extent. First, the cross price elasticities between extra lean and regular ground meats are either insignificant (nine cases) or small positive (six cases). Only between extra lean ground beef and regular ground chicken a strong complementary relationship exists (-0.91). Second, most cross price elasticities between different extra lean products carry a negative sign and are larger than the estimated cross price elasticities between extra lean and regular ground meats as well as the estimated cross price elasticities between different regular products. In fact, our findings suggest that health-conscious consumers overall do show a significant level of price-responsiveness.

Table 2: Uncompensated 'Marshallian' Price Elasticities [a)]

	Extra lean and regular ground meats								**Organic and conventional ground beef**	
	Ex Lean Beef	**Regular Beef**	**Ex Lean Chicken**	**Regular Chicken**	**Ex Lean Pork**	**Regular Pork**	**Ex Lean Other**	**Regular Other**	**Organic Beef**	**Conv. Beef**
Price Ex Lean Beef	-1.05*** (-9.66)	-0.24*** (-5.03)	0.90* (1.91)	-0.93*** (-2.69)	1.18 (0.52)	0.34 (0.73)	0.02 (0.03)	0.08 (0.25)		
Price Regular Beef	0.24*** (-5.03)	-1.70*** (-14.87)	-0.001 (-0.25)	0.03*** (2.60)	-0.03 (-1.55)	-0.04 (-0.69)	0.01 (1.08)	-0.02*** (-2.78)		
Price Ex Lean Chicken	0.90* (1.91)	-0.001 (-0.25)	-1.17*** (-4.92)	-0.01 (-0.05)	-0.36*** (-2.74)	0.35 (1.43)	-0.53*** (-2.61)	-0.005 (-0.02)		
Price Regular Chicken	-0.93*** (-2.96)	0.035*** (2.60)	-0.01 (-0.05)	-0.34* (-1.66)	0.11* (1.79)	-0.06 (-0.52)	0.10 (1.39)	-0.21*** (-2.60)		
Price Ex Lean Pork	1.18 (0.52)	-0.03 (-1.55)	-0.36*** (-2.74)	0.11* (1.79)	-1.45*** (-2.68)	1.14 (0.92)	-0.99*** (-3.45)	-0.15 (-0.92)		
Price Regular Pork	0.34 (0.72)	-0.04 (-0.69)	0.345 (1.43)	-0.06 (-0.52)	1.14 (0.92)	-1.65*** (-5.11)	0.05* (1.78)	-0.03 (-1.31)		
Price Ex Lean Other	0.02 (0.02)	0.01 (1.08)	-0.53*** (-2.61)	0.10 (1.39)	-0.99*** (-3.45)	0.05* (1.78)	-0.96** (-2.18)	-0.14 (0.60)		
Price Regular Other	0.08 (0.24)	-0.02*** (-2.78)	-0.005 (-0.02)	-0.21*** (-2.60)	-0.15 (-0.91)	-0.03 (-1.31)	-0.14 (-0.60)	0.05 (0.24)		
Price Organic Beef									-2.71*** (-6.43)	-0.001 (-0.07)
Price Conv. Beef									-0.001 (-0.07)	-1.40*** (-14.03)

***, **, *, Statistically significant at the 99%-, 95%-, 90%-level. [a)] Elasticities for the products groups ex-lean/regular and organic/con-ventional were derived from two independent model regressions. t-values in parentheses.

Table 3: Compensated 'Hicksian' Price Elasticities [a)]

	Extra lean and regular ground meats								Organic and conventional ground beef	
	Ex Lean Beef	**Regular Beef**	**Ex Lean Chicken**	**Regular Chicken**	**Ex Lean Pork**	**Regular Pork**	**Ex Lean Other**	**Regular Other**	**Organic Beef**	**Conv. Beef**
Price Ex Lean Beef	-0.59*** (-6.22)	0.40*** (8.43)	0.91* (1.92)	-0.91*** (-2.64)	1.18 (0.52)	0.40 (0.87)	0.02 (0.03)	0.09 (0.28)		
Price Regular Beef	0.40*** (8.43)	-1.32*** (-11.10)	0.10** (2.22)	0.08*** (7.32)	-0.02 (-1.15)	0.11* (1.87)	0.02** (2.19)	0.004 (0.57)		
Price Ex Lean Chicken	0.91* (1.92)	0.01** (2.22)	-1.16*** (-4.90)	0.005 (0.02)	-0.35*** (-2.72)	0.40 (1.65*)	-0.53*** (-2.59)	0.003 (0.00))		
Price Regular Chicken	-0.91*** (-2.64)	0.08*** (7.32)	0.005 (0.02)	-0.32 (-1.55)	0.12* (1.85)	0.01 (0.11)	0.10 (1.46)	-0.20** (-2.47)		
Price Ex Lean pork	1.18 (0.52)	-0.02 (-1.15)	-0.35*** (2.72)	0.12* (1.85)	-1.44*** (-2.67)	1.29 (1.04)	-0.98*** (-3.43)	-0.13 (-0.79)		
Price Regular Pork	0.40 (0.87)	0.11* (1.87)	0.40* (1.65)	0.01 (0.11)	1.29 (1.04)	-1.54*** (-4.74)	0.06** (2.01)	-0.01 (-0.60)		
Price Ex Lean Other	0.02 (0.03)	0.02** (2.19)	-0.53*** (-2.59)	0.10 (1.46)	-0.98*** (-3.43)	0.06** (2.01)	-0.96** (-2.17)	-0.13 (-0.58)		
Price Regular Other	0.09 (0.28)	0.004 (0.57)	0.003 (0.98)	-0.20** (-2.47)	-0.13 (-0.79)	-0.01 (-0.60)	-0.13 (-0.58)	0.06 (0.28)		
Price Organic Beef									-3.24*** (-6.27)	012*** (48.80)
Price Conv. Beef									0.12*** (48.80)	-1.07*** (-11.61)

***, **, *, Statistically significant at the 99%-, 95%-, 90%-level. [a)] Elasticities for the products groups ex-lean/regular and organic/con-ventional were derived from two independent model regressions. t-values in parentheses.

Organic and conventional ground beef exhibit a substitutive relationship. For instance, with a 10% price increase for organic ground beef, Canadian consumer's increase their consumption of conventional ground beef by 1.2% and vice versa. However, our results also emphasize that neither of the significant cross-price elasticities does exceed unit elastic values, adding up to overall weak cross-product substitution effects.

When the effects of changes in overall consumer income are considered, we find the following relative changes in point-of-sale expenditures for the selected ground meats: Overall, seven out of ten expenditure elasticities in Table 4 are significant and positive as predicted by demand theory. As consumers' disposable income for meat increases, ground meat purchases rise, the only exception is organic ground beef. This fact can be explained in the broader context of the AIDS model for organic meat demand.

Table 4: Expenditure Elasticities for Different Ground Meats [a)]

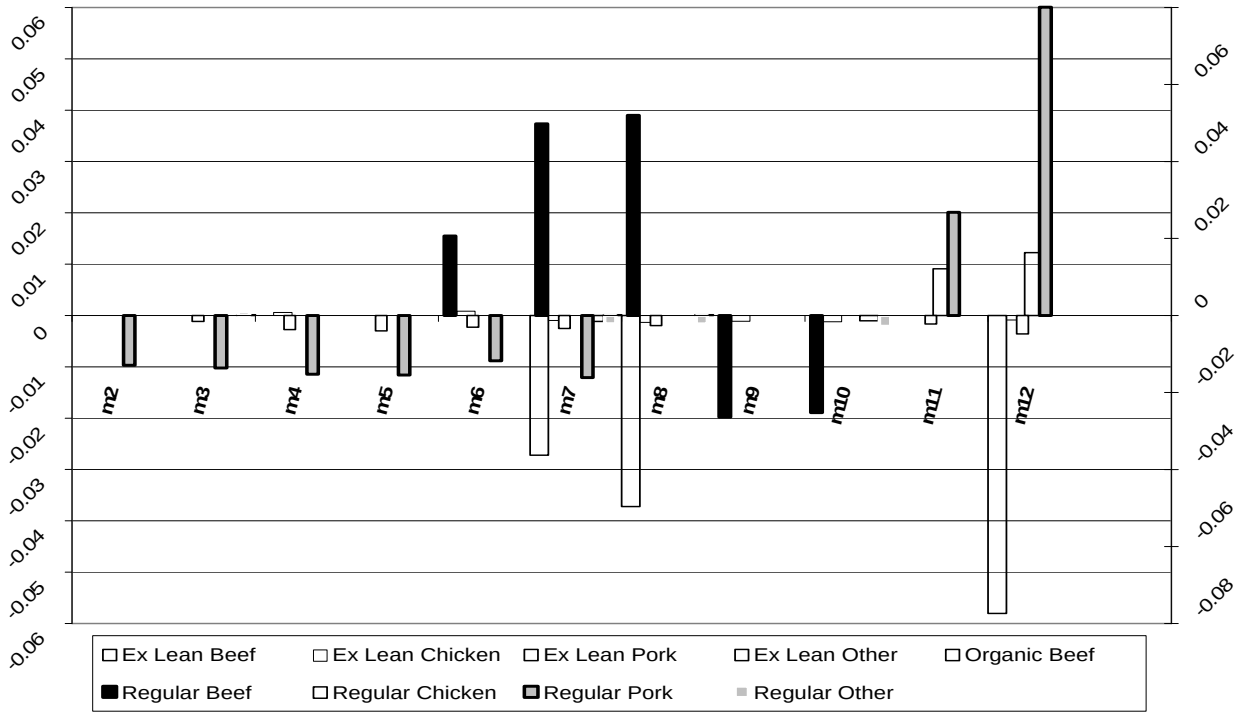
Value Based labelled ground meats				
Ex Lean Beef	**Ex Lean Chicken**	**Ex Lean Pork**	**Ex Lean Other**	**Organic Beef**
0.74*** (9.81)	0.62*** (4.05)	1.61 (1.51)	0.49 (1.52)	-2.87* (-1.95)
Regular, conventional ground meats				
Regular Beef	**Regular Chicken**	**Regular Pork**	**Regular Other**	**Conv. Beef**
1.69*** (9.07)	0.86*** (6.93)	1.25*** (4.87)	0.64*** (4.20)	0.99*** (9.88)

***, **, *, Statistically significant at the 99%-, 95%-, 90%-level. [a)] t-values in parentheses.

As incomes increase Canadian consumer expenditure shifts away from ground meat products and towards steak and beef roast cuts. Interestingly, the expenditure elasticities for regular ground beef and regular ground chicken exceed those of their extra lean counterparts. Against our previous hypothesis increasing consumer income has a stronger effect on retail sales of ground meats with regular fat contents compared to health-consciousness-driven extra lean ground meat demand.

In addition to the major economic drivers of meat consumption, income and prices, Canadian consumer

reveal distinct seasonal demand patterns induced by traditional consumption patterns and habit formation presented in Figure 1. This result is largely confirmed by Lambert et al. [8]. Figure 1 summarizes the significant seasonal AIDS model demand shifters (S_i) for the months of February through December.



[a] Shown are only seasonal coefficients at the 90 % level of significance and higher. Based on estimated seasonal coefficients from full non-linear AIDS model estimation (reference period is January). Significant but marginal trend coefficients are not pictured.

Fig. 1 Seasonal Patterns in Canadian Retail Ground Meat Demand [a]

Retail expenditure for regular ground beef clearly peaks during the summer month (m6 - m8) when the popular Canadian barbeque season is on. During this time the demand for extra lean ground beef is below its January level. One possible explanation is the inferior usability of lean ground meat for barbecue compared to regular ground with up to 30% fat. The demand for extra lean ground beef also decreases substantially in the month of December, when retail demand for regular ground pork and extra lean ground pork increases significantly. Regular ground pork demand is below average during the first seven month of the year, probably due to its perceived higher fat contents, reflected in the purchase decision process of health conscious ground meat consumers.

III. RETAIL DEMAND FOR VALUE-BASED PRODUCTS – FOOD INDUSTRY IMPLICATIONS

The detailed knowledge of the major economic determinants of consumer point-of-sale purchase decisions, price and income elasticities, are critical components to the evaluation of future retail strategies. In an otherwise saturated Canadian meat retail market value-based labelled products, signalling additional utility from enhanced search and credence attributes have been regarded as a promising opportunity for retailers and food industry at the same time. While demand for organic and healthful products specifications experience acute supply shortages due to strong consumer retail demand in the United States and across Europe, the Canadian retail market for value-based labelled meat products is yet in its

infancy. But, a growing segment of increasingly concerned and well informed Canadian retail consumers may provide the basis for the replication of U.S. and European market trends in the near future.

Our findings are intended to inform retail decision makers and meat producers about the potential market opportunities and expected consumer responses to changing economic determinants of popular retail ground meat demand. By comparing value-based labelled ground meats with health benefits or organic production attributes we are able to present three major and interesting results. First, the own-price elasticity of organic ground beef is much higher than for extra lean ground meats. Our results indicate that consumers may very likely respond to lower prices for organic ground beef with substantial demand increasing and hence, rising retail market shares. Second, whereas rising disposable incomes may shift consumers' attention and purchases towards extra lean ground meats, this result may be unlikely for organic ground beef. Last but not least, our findings suggest that the demand for different ground meats is clearly affected by underlying traditional Canadian meat consumption patterns. Our findings from non-economic demand drivers imply that more and better informed consumers will likely recognize the additional health benefits and lower calorie burden of consuming lean and extra lean meat products, especially during the popular barbeque and holiday seasons.

Attribute labelling such as organic labels and nutrition information may help to mitigate consumers' uncertainty about experience and credence product attributes of different meat products. On September 2nd 2006, the federal Canadian government released its "Organic Products Regulation" - a draft production and labelling regulation that will control the definition and marketing of organic food products in Canada for the first time. As soon as such labels gain wider recognition, the new information may reduce consumers' costs to verify the authenticity of value-based labelled products, subsequently opening opportunities for the establishment of new retail segments potential for market growth.

NOTE

[1] For the following results were derived from two separate AIDS models. The price elasticity for regular ground beef stemming from the estimation of the "extra lean / regular" model, can - in magnitude - not be directly compared to the elasticity for conventional ground beef which was derived from the "organic / conventional" AIDS model.

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