How local is local? Consumer Preference for Steaks with Different Food Mile Implications

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Abstract

Results from a choice experiment of the Canadian population reveal consumers were indifferent between product labeled as "Local" and "Local: from within 160 km";. Despite the present stricter regulation in place for local food, our results suggest that transition from 50 km limit to 160 km limit equally satisfy consumers while open up access for more farm areas to increase supply of local food. Additionally, consumers willing to pay significantly more for home-province product over local product

Key Words: Local Food Policy, Choice Experiment, Willingness to Pay, Beef

JEL Classification: Q110, Q130, Q180

Introduction

While the steadily rising interest on local food has drawn considerable research interest, one of the unresolved questions has remained as to what constitutes local food. There is no agreement on the geographical and other non-geographical elements that compose local food (Martinez 2010). For example, Darby et al (2008) noted that besides geographical connotation, consumers might consider farm size and freshness as element of localness. While Campbell et al (2012)

found that Canadian consumers displayed high heterogeneity in perceived benefit and geographical definitions of local food.

The regulatory bodies in the US and Canada have used geopolitical and food mileage definitions on local food. The USDA adopted 400 miles radius or in-state products as the statutory definition of local food (Martinez 2010). In contrast, the Canadian Food Inspection Agency (CFIA) requires that only food produced within 50 km radius from the point of sale, or from local municipals or municipals that are directly adjacent could be considered as local food (2003). However, even within Canada, third party certifiers and retailers often adhere to different definitions of local food, which could range from any set of distance to geopolitical definition such as provincial definition (Louden and MacRae 2010). This study's objective is to empirically differentiate consumers' valuation of local food under different distance and geographical definitions. The results from this study could add insights to the discussion on what should be the appropriate guidelines for local food marketing.

We conducted an online choice experiment that targeted nationwide and representative Canadian consumers. The choice experiment enables elicitation of willingness to pay (WTP) associated with local beef with various distance and production origin. This study adds to the present literature in three ways: i. this is one of the first studies that examine the WTP for local food of various definitions, from 160 km to state and country level; ii. this research sheds light consumers preference in regards to local beef; an area which has received sparse coverage in the literature, as most local food studies tends to focus on produce and vegetables, and iii. this study is one of the first larger scale national study in the context of Canadian consumer preference of local beef.

Survey Description

We utilized criterion and guidelines from previous literature to set up the survey, especially in terms of sample size and included attributes. As with Tonsor et al (2009) and Lim et al (2012), our online survey targeted a nationwide Canadian sample of 1000 individuals. We employed Qualtrics, Inc for sample collection in early January 2013. The respondents received a small token of reward for completing the survey.

The survey contained three main sections. Following Dillman (2000), the first section was designed to attract respondent's attention, a set of general questions regarding basic food consumption attitude and believes were included. The second part contains the choice experiment, where respondents were shown one of eight versions of the choice experiment. And lastly, the third part contains questionnaire pertain to respondents perception and attitude towards certain food labels and general demographic questions.

Sample Statistics

The sample consists of 1013 Canadian beef consumers. We deployed two conditions for a respondent to be included, only beef eaters or buyers from the age 19-74 were screened in to the survey. The descriptive statistics of the sample are provided in Table 1. The demographics statistics compare closely to Canadian national statistics in general. The percentage of Quebec respondents is lower than the national ratio because the survey was made available only in English.

Attributes and Levels in Choice Experiment

We included six levels of origin label to investigate consumers' valuation of multiple context of local food. Among the origin labels were three levels of local:

i. *LOCAL*, which we intentionally left out its mileage specification, so that this level reflects the respondents' perception of what local food should be under a generic label.

ii. *LOCAL: From within 160 km*, which differs from (i) as a specific limit on distance were specified, such that it reflects the 100 miles limit popularized by Canadian media (Campbell et al 2012), and

iii. *LOCAL: From within 320 km*, corresponds to roughly 200 miles and half the distance of the USDA's 400 miles limit.

The other three levels included that did not explicitly indicate "local" but were nevertheless commonly used by producers to indicate product origin were:

iv. *PRODUCT OF (RESPONDENT's PROVINCE)*, where we customized the level to display respondent's home province using the Piped Text function in Qualtrics, where the display value was captured using previously entered resident province information by the respondent.

v. *PRODUCT OF CANADA*

vi. *PRODUCT OF USA*.

These levels enable us to empirically compare the utility associated with each of the origin attributes. From these, the values consumers placed on each labels can be drawn. And we could draw implication the labels that were most accepted and valued by consumers.

Other non-origin attributes included in the study were four levels of price, from $9.00/lb to $21.00/lb reflecting the low and high end prices of strip steaks in Canada; and two levels of organic practice (Certified Organic or non-organic), two levels of feeds types (grain or grass),

and three levels of BSE screening practices (standard government screening, BSE tested, verified BSE free). The levels of all attributes are given in Table 2.

Choice Experiment Design

Given the levels of the attributes, a full factorial design[1] is costly in terms of respondent fatigue, as more choice sets are needed to accommodate the large number of choice profile. Instead, we used main-effect partial profiles design to create 110 unique choice profiles based on D-optimality criterion (Kessels et al 2011). The choice profiles were spread into 8 different versions of experiment[2]. Considerations were given to reduce respondent fatigue, each of the versions contained six choice sets, with each choice set containing three non-empty and an empty (Would-not-buy) choice profiles.

In the experimental design stage, we utilized prior means to reduce dominant choice sets (Crabbe and Vandebroek 2012) . The values were based on a combination of prior reporting from previous literature and the authors' best guess (see attached Appendix). Specifically, Organic and LOCAL160 contained almost equivalent partworth (Darby et al 2008), the partworth decline as the radius and the distance expand. Organic, Grass-fed beef were specified to have positive partworth (Abidoye et al 2011), and lastly, values of imported beef, and BSE screening regimes value were adapted from Lim et al (2012).

The Would-not-buy option was included as it provides the option for respondents to opt-out, if the steak options provided were too expensive or were not appealing. Omission of the would-not-buy option results the recorded choices to be a conditional choice as it may force respondents

[1] Full fractional factorial design requires 6 * 4 * 3 * 2 * 2 = 288 choice profiles
[2] Generated using DOE routine in JMP 10.

into making a suboptimal choice of purchasing, especially when a non-purchase decision would be more desirable (Hensher et al 2005).

Model

We used Mixed Logit (ML) to estimates the choice experiment data. The logit models follows Random Utility Model (McFadden, 1974), such that utility (*U*) associated with individual *i* for alternative *j* under choice situation *t* is decomposed into a deterministic portion ($\boldsymbol{\beta'}_i \mathbf{x}_{ijt}$) and a stochastic portion (ε_{ijt}),

$$\mathrm{U}_{ijt} = \boldsymbol{\beta'}_i \mathbf{x}_{ijt} + \varepsilon_{ijt} \qquad \textbf{(1)}$$

The mixed logit model assumes that the vector $\boldsymbol{\beta}$ is random coefficient, such that variations in taste are incorporated in distributions of $\boldsymbol{\beta}$.The vector $\mathbf{x}_{ijt}$ describes the sets of attributes respondent *i* encountered in choice profile *j* of choice set *t*. Mixed logit choice proability is give as:

$$P_{ijt} = \int \frac{\mathrm{e}^{\boldsymbol{\beta'} \mathbf{x}_{ijt}}}{\sum_k \mathrm{e}^{\boldsymbol{\beta'} \mathbf{x}_{ikt}}} f(\boldsymbol{\beta}) \mathrm{d}\boldsymbol{\beta} \qquad \textbf{(2)}$$

, where $f(\boldsymbol{\beta})$ is the mixing distribution, which is specified as normal in this application. The integral in equation (2) does not have a closed form, and is simulated numerically (Train 2003). Solving the equation with Maximum Simulated Likelihood Estimator, the ML produces a set of means and standard deviations of the parameters associated with attribute **x**.

Result and Discussion

The results of the ML model, as well as results from two conditional logit (CL) models for comparison, are given in Table 3. The log-likelihood scores attest that the ML model explained the variations in the data far efficiently than the CL models. Four ($\sigma_{\text{would-not-buy}}$, σ_{local360}, σ_{canada}, σ_{usa}) of six standard deviations of the random parameters were significant, which contributed to the higher explanatory power of the ML model.

Two main differences between the CL1 and ML model were[3]: first, the parameter on Canadian beef, β_{canada}, is statistically insignificant in the CL model, which would suggest that the Canadian beef attribute is statistically equivalent as the local beef attribute. However, the ML model provided a more logical explanation that beef marketed as local is more preferred than beef marketed as product of Canada.

Second, the ML model contains a quadratic price term to reflect non-linear price effect, which was highly significant at 1% level. Quadratic price could arise when consumers perceived quality as correlated with price (Cicia et al 2002) The significant quadratic price transforms the marginal utility with respect to price as:

$$\frac{dU}{dp} = \beta_{price} + 2\beta_{pr\_sq}Price \qquad \textbf{(3)}$$

, making the marginal utility dependent on the price level. The marginal utility crosses zero when the price is less than or equal to \$0.00/lb, or when the price is more than or equal to \$59.09/lb, where both levels are highly improbable and out of the price range tested in this study. The prospect of a positive-sloping demand curve is highly unlikely in normal circumstances.

[3] CL2 contains identical variables as the ML model

We derived willingness to pay estimates, which reveals how much consumers are willing to pay or be compensated in order to switch from LOCAL to other source of origin in $/lb. Formally:

$$WTP_{attribute} = -\frac{\beta_{attribute}}{\beta_{price} + 2\beta_{price\_sq} * price} \quad \textbf{(4)}$$

, where $\beta_{attribute}$ is the mean coefficient of a given attribute, β_{price} and β_{price_sq} are the price and quadratic price coefficients respectively. The WTP formula included the quadratic price terms to reflect our model specification, which makes the WTPs a function of price level. We used calculated the WTP based on the four price levels used in the choice experiment. These WTP estimates presented in Table 4 were simulated with 2000 bootstrap draws (Krinsky and Robb 1986).

For brevity, our subsequent discussions on the hypotheses testing will be based on the results from the ML model, which appears to have superior statistical properties based on the log-likelihood score.

The model suggests that LOCAL is statistically indifferent than local beef from within 160 km. This points to a few possibilities: One could be that Canadian consumers perceived the 160 km or 100 miles distance as synonymous to local food, which could be a result of media promoted "100 miles" diet. In addition, this could indicate that consumers are unaware that LOCAL reflects the stricter 50 km limit of the CFIA's guideline. In both cases, the 160 km or 100 miles definition of local food seems to be appropriate. The estimated WTP to switch from LOCAL to LOCAL160 is statistically insignificant. Considering that the estimated WTP mean were lower than $1.00/lb with relatively tight standard deviation. This strongly indicates that the consumers are generally indifferent about the messages conveyed by LOCAL and LOCAL160.

Moving to the next hypothesis, we observed that on average, LOCAL attribute is valued more than local beef from within 320 km. While this directly imply that consumers believe beef labeled as LOCAL is better than beef produced within 320 km, this may also suggest that the majority of consumers believe 320 km distance is an inferior definition of local food. The significant standard deviation coefficient on LOCAL320 implied a significant variation on how consumers perceived the variable. The model suggested that 62% of the sampled population believe that LOCAL320 is inferior to LOCAL. Referring to the WTP estimates in Table 4, we observed a small premium for LOCAL over LOCAL320, ranging from $0.55/lb to $1.31/lb, which shows that consumers perceived LOCAL more superior than the 320 km limit in LOCAL320. This perhaps suggests that consumers are disapproved of the 320 km distance.

Combining the two observations, we infer that consumers are indicating that 160 km (or 100 miles) distance as an appropriate definition to local food, while 320 km (or 200 miles) is slightly less preferred.

Surprisingly, the model indicated that the provincial label is valued more highly than the LOCAL attribute. This perhaps is due to the more coordinated efforts by provincial government in food marketing. Or alternatively, this could be that consumers value local and home-province product with different motivation, or that Canadians identify strongly with province. However, while the provincial definition were deemed more desirable than local on average, significant taste variation were observed, based on the standard deviation, we estimated that roughly 27% of consumers believe that local is better than product labeled at the provincial level. We observed average WTPs ranging from $1.02/lb to $2.48/lb. While the underlying reason for this somewhat counterintuitive results were unknown to us, the implication drawn from this observation is that provincial label is preferred over LOCAL labels.

Lastly, the model suggested that on average, LOCAL is preferred more than PRODUCT OF CANADA and PRODUCT OF USA. Both the standard deviation estimates on the coefficients, σ_{canada} and σ_{usa}, were significant. The portion of the sample that prefer LOCAL more than PRODUCT OF CANADA were estimated at 69% and 84% of the sample prefers LOCAL over PRODUCT OF USA The premium for LOCAL beef over Canadian beef appears to range from $0.74/lb to $1.82/lb. The modest magnitude of the premium contrasts to other studies that have reported a larger percentage of local food premiums (see Darby et al. 2008, Hu et al. 2011). This could be due to the difference between the taste of Canadian and American consumers, and could also potentially indicating that consumers are less willing to pay a LOCAL premium for meat products than for fruits and processed food products examined in other studies. In contrast, we observed that consumers are willing to pay $4.22/lb to $10.26/lb less for US beef than for local beef, which is comparable with the findings from Lim et al (2012).

Conclusion

One of the thorniest questions in regards to local food is its proper definition. Using a choice experiment, we investigated consumers' valuation of local beef under different definitions. Our results show that the value consumers put to the label LOCAL is statistically indistinguishable to the label claiming a 160 km (100 miles) radius. As a result, we reiterate the policy recommendations of Louden and MacRae (2010) and Campbell et al. (2012) in that the distance of 160 kilometers could be adopted as Canadian standard of local food.

However, our results indicated that consumers value home-province products more than local. A plausible explanation could be that consumers give wider acceptance to provincial label because of the more concrete effort of provincial food products promotion, or that Canadians identify

themselves very strongly with home provinces. This could be an indication that it is more beneficial for food producers to use provincial labels instead of local when marketing product within home province.

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Table 1. Sample Descriptive Statistics

	Sample Statistics		Canada Statistics
	Mean	Std Dev	
Age	44.8	13.98	39.9
Income	65.3	36.42	69.9
Education	13.9	2.21	
Female	48%		50.40%
Primary Shopper	84.7%		
Population Distribution by Provinces and Territories			
Alberta	9.0%		11.1%
British Columbia	15.7%		13.3%
Manitoba	4.8%		3.6%
New Brunswick	3.7%		2.2%
Newfoundland and Labrador	2.0%		1.5%
Northwest Territories	0.0%		0.1%
Nova Scotia	5.3%		2.7%
Nunavut	0.0%		0.1%
Ontario	44.6%		38.7%
Prince Edward Island	0.6%		0.4%
Quebec	11.6%		23.1%
Saskatchewan	2.8%		3.1%
Yukon	0.0%		0.1%

Source of national statistics: Statistics Canada

Table 2. Attribute Levels

Attributes	Levels	Abbreviation
Price ($/lb)		
	9.00	
	13.00	
	17.00	
	21.00	
Origin		
	Local	LOCAL
	Local: From within 160 km	LOCAL160
	Local: From within 320 km	LOCAL320
	Product of (PROVINCE)	PROVINCE
	Product of Canada	CANADA
	Product of USA	USA
Organic Practice		
	None	
	Certified Organic	ORGANIC
Feed Types		
	Grain Fed	
	Grass Fed	GRASSFED
BSE Screening		
	Standard Government Procedure	
	BSE Tested	BTEST
	Verified BSE Free	BFREE

Notes: BSE Tested refers to beef derived from animal tested with BSE Rapid Tests prior to slaughtering. We indicated that the test has a less than (0.1% chance of false negative)

Verified BSE Free refers to a hypothetical test, where the cattle were verified free of BSE with an advanced screening technology; or produced in a manner that ensure the beef is BSE free.

Table 3. Estimation Results

	CL1			CL2			Mixed Logit		
	Coef. Estimates		Std. Err.	Coef. Estimates		Std. Err.	Coef. Estimates		Std. Err.
$\beta_{\text{would-not-buy}}$	-2.5295	***	0.0933	-3.0558	***	0.3349	-6.8504	***	0.4503
β_{price}	-0.2061	***	0.0068	-0.2826	***	0.0472	-0.5549	***	0.0570
$\beta_{\text{price\_sq}}$				0.0024		0.0015	0.0094	***	0.0017
Origin [local]									
β_{local160}	0.0681		0.0623	0.0812		0.0628	0.1079		0.0713
β_{local320}	-0.1002		0.0676	-0.0912		0.0678	-0.2089	**	0.0871
β_{province}	0.3862	***	0.0605	0.3942	***	0.0608	0.3929	***	0.0716
β_{canada}	0.0165		0.0651	-0.0240		0.0699	-0.2882	***	0.0855
β_{usa}	-1.022	***	0.0699	-1.0470	***	0.0717	-1.6243	***	0.1139
Organic Product [non-organic]									
β_{organic}	0.1312	***	0.044	0.1773	***	0.0524	0.4355	***	0.0624
Feed Types [grain fed]									
β_{grassfed}	0.2004	***	0.0376	0.2291	***	0.0415	0.4034	***	0.0487
BSE SCREENING [standard government screening]									
β_{btested}	0.4072	***	0.0471	0.4409	***	0.0515	0.6702	***	0.0613
β_{bfree}	0.7914	***	0.0473	0.8264	***	0.0520	1.1026	***	0.0634

Standard Deviation Estimates					
$\sigma_{would\text{-}not\text{-}buy}$			3.8461	***	0.1897
$\sigma_{local160}$			0.2806		0.1952
$\sigma_{local320}$			0.6742	***	0.1431
$\sigma_{province}$			0.6408	***	0.1109
σ_{canada}			0.5894	***	0.1123
σ_{usa}			1.2633	***	0.1317
Log-likelihood	-7243	-7242	-6090		
AIC/N	2.401	2.401	2.022		
Adjusted R2	0.1343	0.1344	0.2729		

Notes: Baseline attributes level in square bracket
***, **, and * represent significance at the 1%, 5%, and 10% levels respectively
Mixed Logit results were simulated with 300 Halton draws

Table 4. Willingness to Pay Estimates

	Four price levels used in the choice experiment design ($/lb)							
	$ 9.00		$ 13.00		$ 17.00		$ 21.00	
Local160	0.28		0.35		0.46		0.68	
	(0.1880)		(0.2310)		(0.3002)		(0.4719)	
Local320	-0.55	**	-0.68	**	-0.89	**	-1.31	**
	(0.2279)		(0.2804)		(0.3665)		(0.5754)	
Province	1.02	***	1.27	***	1.68	***	2.48	***
	(0.1962)		(0.2360)		(0.2976)		(0.5442)	
Canada	-0.74	***	-0.92	***	-1.23	***	-1.82	***
	(0.1979)		(0.2576)		(0.3623)		(0.6221)	
USA	-4.22	***	-5.24	***	-6.91	***	-10.26	***
	(0.3577)		(0.3752)		(0.4852)		(1.4591)	

Notes: ***, **, and * represent significance at the 1%, 5%, and 10% levels respectively
Baseline attribute: “Local”

APPENDIX: Prior Means Used in Choice sets Design

Attribute						
Origin	LOCAL160	LOCAL320	Local	Province	USA	[Canada]
	0.7	0.6	0.5	0.5	-0.8	
Organic Practice	Organic	[Non-Organic]				
	0.8					
Feed Type	Grass-fed	[Grain Fed]				
	0.5					
BSE Screening	BSE tested	Verified BSE Free	[Standard Government Screening]			
	0.4	0.5				
Price	$21.00	$17.00	$13.00	[$9.00]		
	-1.2	-0.8	-0.4			

Note: Base category in square bracket