AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

Will Consumers Pay a Premium for "Raised Carbon Friendly" Beef? Evidence from a Contingent Valuation Experiment

Xiaogu Li, Kimberly L. Jensen, Christopher D. Clark, and Dayton M. Lambert

Xiaogu Li (xli41@utk.edu), Kimberly L. Jensen (kjensen@utk.edu), Christopher D. Clark (cclark3@utk.edu), and Dayton M. Lambert (dlamber1@utk.edu) are, respectively, graduate research assistant, professor, associate professor and associate professor, Department of Agricultural & Resource Economics, University of Tennessee, 302 Morgan Hall, 2621 Morgan Circle, Knoxville, TN 37996.

Selected Poster prepared for presentation at the Agricultural & Applied Economics Association's

2014 AAEA Annual Meeting, Minneapolis, MN, July 27-29, 2014.

Copyright 2014 by Xiaogu Li, Kimberly L. Jensen, Christopher D. Clark, and Dayton M. Lambert. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.

Will Consumers Pay a Premium for "Raised Carbon Friendly" Beef? Evidence from a Contingent Valuation Experiment

Xiaogu Li, Kimberly L. Jensen, Christopher D. Clark, and Dayton M. Lambert
Department of Agricultural & Resources Economics, University of Tennessee

United States Department of Agriculture
National Institute of Food and Agriculture

Acknowledgements
This project was supported by Agriculture and Food Research Initiative Competitive Grant no. 10642663 from the USDA National Institute of Food and Agriculture.

Introduction

- The U.S. cattle industry contributes about 2.2 % of total U.S. greenhouse gas (GHG) emissions (IPCC 2006; USEPA 2010).
- Adoption of prescribed grazing (PG) can reduce GHG emissions from beef cattle production, but may increase production costs.
- Grass-fed beef commands a price premium among consumers (e.g. Umberger et al. 2009; Xue et al. 2010), but consumer willingness-to-pay (WTP) for grass-fed beef produced with a management-intensive prescribed grazing program that reduces GHG emissions is unknown.

Objectives

Estimate the WTP for beef produced using PG, along with the product- and individual-specific factors that determine WTP.

Survey and Data

Data collected via an online survey of beef consumers administered by GfK® Custom Research in April/May of 2013. Survey fielded to 1,705 panel members, with 905 complete responses. Hypothetical "Raised Carbon Friendly" (RCF) label designed to differentiate beef grown using a PG program from other beef products. Survey instrument provided consumers with information about current climate issues, GHG emissions from agriculture and beef production, andan overview of PG and the hypothetical RCF beef label.

Survey collected information about:

- Beef consumption behavior of respondents;
- Support for the RCF program and, for those who expressed support, WTP for beef with RCF label using a single-bounded, referendum type, contingent valuation question (CV) where WTP bids were stated in dollar amounts but based on a percentage (5%, 10%, 20%, 30%, or 40%) of the individual household's estimated annual beef expenditures; and
- Familiarity with PG and grass-fed beef, participation in environmental organizations, sources of environmental information, and opinions about the food industry, food safety, food policy, environmental regulation, and climate change.

Responses to survey questions were supplemented with previously-collected demographic information for panel members.

Methodology

Two models used:

First, a Generalized Ordered Logit model (Fu 1998; Williams 2006) was used to analyze the likelihood of consumer support and positive WTP for the RCF program (the dependent variable was characterized by a set of ordered choices). Model was chosen over other ordinal dependent variable models because it relaxes the proportional odds assumption so effects of independent variables are allowed to vary with cut points.

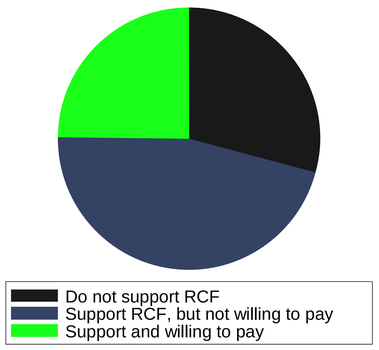
Second, a Probit with Sample Selection model (Heckman 1979; Greene 2003) was applied to estimate WTP values for the RCF certification. This approach assumes that choice made in CV question and choice made in support RCF question are correlated.

Empirical Models

Generalized Ordered Logit

- Alternatives: 1 ("Do not support RCF"), 2 ("Support RCF, but not willing to pay") and 3 ("Support and willing to pay").
- GOL model is: $$P(H_i > j) = g(\boldsymbol{X\theta_j}) = \frac{\exp(\alpha_j + \boldsymbol{X_i\theta_j})}{1+\exp(\alpha_j + \boldsymbol{X_i\theta_j})}, j = 1,2$$

  where H_i is an ordinal dependent variable reflecting the extent of individual support for the RCF program and RCF-labeled beef; X is vector of independent variables; and θ_j is vector of parameters.
- Probabilities of each outcome are: $P(H_i=1) = 1 - g(\boldsymbol{X_i\theta_1})$; $P(H_i=2) = g(\boldsymbol{X_i\theta_1}) - g(\boldsymbol{X_i\theta_2})$; $P(H_i=3) = g(\boldsymbol{X_i\theta_2})$



Probit with Sample Selection

- Selection equation for support RCF: $s_i^* = \boldsymbol{z_i\gamma} + \xi_i$ where $s_i = \begin{cases} 1, if\ s_i^* > 0 \\ 0, if\ s_i^* \le 0 \end{cases}$
- Outcome equation for WTP for RCF-labeled beef : $y_i = \boldsymbol{x_i\beta} + \mu_i$ if $s_i = 1$, i.e. respondents choose to accept/reject the WTP bids conditional on supporting the RCF program. The error terms μ_i and ξ_i are jointly normally distributed with zero means and variances equal to 1, with correlation between the two error terms corr(μ_i, ξ_i) = ρ.
- The log-likelihood function is: $$\ln L_i = \sum_{\substack{s_i=1 \\ y_i\neq 0}} \ln\{\Phi_2(\boldsymbol{x_i\beta}, \boldsymbol{z_i\gamma}, \rho)\} + \sum_{\substack{s_i=1 \\ y_i=0}} \ln\{\Phi_2(-\boldsymbol{x_i\beta}, \boldsymbol{z_i\gamma}, -\rho)\} + \sum_{s_i=0} \ln\{1-\Phi(\boldsymbol{z_i\gamma})\}$$

  where the parameters ($\boldsymbol{\beta}$,$\boldsymbol{\gamma}$,ρ) can be estimated using the maximum likelihood method.
- WTP is: $$WTP = -\frac{\sum_{i\neq p} \bar{x}_i\hat{\beta}_i}{\hat{\beta}_p}$$

Results and Conclusions

Generalized Ordered Logit Model Regression Results

Variable	Estimates (Support = 3 is the base case)		Marginal Effects		
	Support = 1	Support = 2	Support = 1	Support = 2	Support = 3
Age	-0.0119 (0.00637)		0.00182 (1.87)	-0.0000590 (-0.24)	-0.00176 (-1.82)
Household Income ($1,000)	**0.00728*** (0.00358)**	**0.00782*** (0.00356)**	**-0.00111*** (-2.11)**	-0.0000433 (-0.07)	**0.00115*** (2.17)**
Beef Expend.	-0.00167 (0.0106)		0.000255 (0.16)	-0.00000829 (-0.13)	-0.000247 (-0.16)
Black	-0.253 (0.349)		0.0410 (0.68)	-0.00598 (-0.38)	-0.0350 (-0.78)
HS Graduate	-0.0996 (0.290)		0.0154 (0.34)	-0.000881 (-0.20)	-0.0145 (-0.35)
Some College	-0.00957 (0.300)		0.00146 (0.03)	-0.0000510 (-0.03)	-0.00141 (-0.03)
Bachelors Degree	-0.0151 (0.331)		0.00231 (0.05)	-0.0000840 (-0.04)	-0.00222 (-0.05)
Female	-0.208 (0.182)		0.0315 (1.13)	-0.000769 (-0.18)	-0.0308 (-1.12)
Married	-0.0244 (0.200)		0.00371 (0.12)	-0.000119 (-0.11)	-0.00359 (-0.12)
Household Size	-0.0164 (0.0782)		0.00250 (0.21)	-0.0000812 (-0.16)	-0.00242 (-0.21)
Metro Area	0.309 (0.252)		-0.0501 (-1.14)	0.00762 (0.58)	0.0425 (1.32)
Northeast	**-0.772*** (0.340)**	-0.314 (0.370)	0.137* (1.97)	-0.0934 (-1.40)	-0.0433 (-0.93)
Midwest	-0.0898 (0.221)		0.0139 (0.40)	-0.000863 (-0.24)	-0.0130 (-0.41)
West	-0.376 (0.284)		0.0610 (1.21)	-0.00919 (-0.56)	-0.0518 (-1.44)
Republican	-0.307 (0.198)		0.0476 (1.53)	-0.00337 (-0.49)	-0.0443 (-1.56)
Climate Change Concern	**1.037*** (0.137)**	**0.799*** (0.168)**	**-0.158*** (-8.50)**	0.0403 (1.55)	**0.118*** (5.10)**
Low Food Prices	**-0.473*** (0.131)**	**-0.637*** (0.136)**	**0.0720*** (3.61)**	0.0219 (0.89)	**-0.0939*** (-4.82)**
Government Subsidize Farmers for Environmental Practice	**0.845*** (0.143)**	**0.652*** (0.130)**	**-0.129*** (-6.45)**	0.0326 (1.32)	**0.0961*** (4.95)**
Food Quality> Food Price	-0.151 (0.0924)		0.0229 (1.61)	-0.000746 (-0.23)	-0.0222 (-1.61)
Source of Mitigation Costs	**0.531*** (0.133)**	**0.290* (0.126)**	**-0.0809*** (-4.19)**	0.0382 (1.66)	**0.0427* (2.27)**
Buy Organic/Local Produced Food	0.0794 (0.115)	**0.540*** (0.121)**	-0.0121 (-0.71)	**-0.0675** (-3.20)**	**0.0796*** (4.71)**
Donate to Environmental Groups	0.409 (0.232)		-0.0583 (-1.83)	-0.00607 (-0.55)	0.0643 (1.65)
Threshold 1	**1.716** (0.641)**				
Threshold 2	**-1.342* (0.611)**				
N	817				
Pseudo R^2	0.234				
AIC	1376.6				

Standard errors in parentheses *ρ < 0.05, ** ρ < 0.01, *** ρ < 0.001

Sample Selection Probit Model Regression Results

	Outcome	Selection
Variable	Estimates	
Payment level for RCF	**-0.00555*** (0.00151)**	
Age	0.0124 (0.00663)	-0.00771 (0.00471)
Household Income ($1,000)	-0.000579 (0.00298)	0.00320 (0.00204)
Beef Expenditures	-0.00635 (0.0152)	-0.00503 (0.00780)
Black	-0.112 (0.342)	-0.210 (0.250)
HS Graduate	-0.0172 (0.392)	0.0316 (0.260)
Some College	-0.453 (0.416)	0.247 (0.252)
Bachelors Degree	-0.104 (0.416)	0.185 (0.269)
Female	0.234 (0.196)	-0.212 (0.132)
Married	0.277 (0.197)	0.0300 (0.150)
Household Size	0.180 (0.125)	-0.0395 (0.0681)
Metro Area	-0.470 (0.288)	0.0910 (0.172)
Northeast	-0.164 (0.315)	-0.0661 (0.220)
Midwest	0.166 (0.267)	-0.0641 (0.176)
West	0.291 (0.288)	-0.0489 (0.174)
Republican	**0.564* (0.264)**	-0.288 (0.152)
Climate Change Concern		**0.384*** (0.0825)**
Low Food Prices		**-0.365*** (0.0688)**
Government Subsidize Farmers for Environmental Practice		**0.337*** (0.0734)**
Food Quality>Food Price		**-0.148* (0.0644)**
Source of Mitigation Costs		**0.148* (0.0663)**
Buy Organic/Local Produced Food		**0.266*** (0.0648)**
Donate to Environmental Groups		**0.391* (0.154)**
Constant	1.280 (0.773)	-0.573 (0.443)
ρ	**-1.282** (0.466)**	
N	817	
Log-likelihood	-426.3353	
AIC	934.7	

Standard errors in parentheses *ρ < 0.05, ** ρ < 0.01, *** ρ < 0.001

Results

Respondents who are younger (*Age*), earn higher incomes (*Household Income*), have made donations for environmental purposes (*Donate to Environmental Groups*), believe climate change is occurring and are concerned about climate issues (*Climate Change Concern*), are more concerned about food prices (*Low Food Prices*), agree that the government should subsidize farmers for costs of reducing impact of agriculture on the environment (*Government Subsidize Farmers for Environmental Practice*), agree that food retailers and taxpayers should pay GHG mitigation costs (*Source of Mitigation Costs*), and purchase organic foods and local products (*Buy Organic/Local Food*) are more likely to support the RCF program.

Annual household WTP of those who support the RCF program for the RCF-certified products estimated at the sample means is $194.44 (confidence interval at 5% = [194.36, 194.53]), or about 9.75% of the sample mean of estimated annual household expenditures on beef ($1,995).

Conclusions

- Results suggest some consumers value and would pay a premium to help cover the costs incurred in reducing GHG through the adoption of PG.
- Market mechanisms (i.e., production certifications or labels) could be used to indirectly subsidize beef farmer participation in program to reduce GHG emissions.
- Results helpful in designing consumer supported PG program such as an RCF program.
- Additional research is needed to compare the aggregate premium with costs of producing beef using PG.

References

Fu, Vincent. Estimating generalized ordered logit models. Vol. 8, in Stata Technical Bulletin Reprints, 160-164. College Station, TX: Stata Press, 1998.
Greene, William H. Econometric Analysis. Upper Saddle River, NJ: Prentice Hall, 2003.
IPCC. "Guidelines for National Greenhouse Inventories, Vol. 4: Agriculture, Forestry and other Land Use." 2006. http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4 (accessed September 17, 2013).
Umberger, W., P. Boxall, and R. Lacy. "Role of credence and health information in determining US consumers' willingness-to-pay for grass-fed beef." The Australian Journal of Agricultural and Resource Economics 53 (2009): 603–623.
USEPA. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2008. Washington D.C.: United States Environmental Protection Agency, 2010.
Williams, R. "Generalized ordered logit/partial proportional odds models for ordinal dependent variables." The Stata Journal 6, no. 1 (2006): 58-82.
Xue, H., D. Mainville, W. You, and R. Nayga Jr. "Consumer preferences and willingness to pay for grass-fed beef: Empirical evidence from in-store experiments." Food Quality and Preference 21 (2010): 857-866.