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Factors Influencing Producers' Marketing Decisions in the Louisiana Crawfish Industry

Narayan P. Nyaupane and Jeffery M. Gillespie

Factors influencing farmer selection of a crawfish marketing outlet were analyzed using 2008 survey data from the Louisiana crawfish industry. Most farmers sell to wholesalers, followed by direct to consumer, direct to retailer, and finally to processors. A relatively high percentage of farmers grade crawfish prior to sale, with fewer washing, peeling, and purging crawfish. Probit results show farm size, farm income, household income, age, education, and pre-market grading and washing operations significantly affecting farmer selection of marketing outlet.

Introduction

Farmers generally choose a market for their products considering a number of factors, with economic profit likely of greatest importance for most. Louisiana has a significant crawfish industry with crawfish being marketed using a variety of market outlets. Four of the main outlets through which farmers market crawfish are: processors, wholesalers, direct to consumers, and direct to retailers. Furthermore, some farmers conduct various combinations of value-added activities such as washing, peeling, purging, and grading crawfish prior to sale. Little information has been available regarding the extent of use of various marketing and value-added activities of crawfish farmers, limiting the ability of researchers, extension personnel, and agribusiness persons with an interest in the crawfish industry to adequately characterize the industry in terms of cost of production and potential for increased industry efficiencies. Characterization of these facets of the industry are particularly important today, considering recent significantly increased competition from abroad (Lee 2007), along with the need to accurately estimate cost of production (Boucher and Gillespie 2010) in years of significant loss from weather events such as hurricanes.

Nyaupane is a graduate student; Gillespie is a Martin D. Woodin endowed professor in the Department of Agricultural Economics and Agribusiness, Louisiana State University Agricultural Center, Baton Rouge, Louisiana.

In this study, we seek to characterize the marketing and value-added production activities of crawfish farmers by extent of use and farm type. The objectives are to determine: (1) the portions of farmers using each of the four main marketing outlets for crawfish, (2) the portions of farmers conducting each of four value-added activities in crawfish production, and (3) the types of farmers using each of the four main marketing outlets for crawfish. In accordance with the structure-conduct-performance paradigm, we focus on the first two phases, proceeding by providing background information on the structure of the industry, followed by a discussion of marketing practices (conduct), data and methods, results, and finally conclusions.

The United States Crawfish Industry

Louisiana is the largest crawfish producer in the United States with almost 1,600 farms on more than 184,000 acres (LSU AgCenter 2008). Most of the state's production (70%) is consumed in Louisiana and neighboring states, with much of the remaining United States demand being supplied via imports, especially from China (Lee 2007). Crawfish farm sizes vary widely. In the survey from which the data for this study were collected, of 64 farms reporting crawfish acreage, 6 farmed ≤20 acres while 4 farmed >950, for an average of 211 acres. Gillespie and Nyaupane (2010) show a variety of crawfish production systems, with 62% of farmers either double-cropping with rice or rotating crawfish

with a field crop. Furthermore, approximately 12% of the crawfish marketed in 2008 was wild-caught, rather than farm-raised and roughly equal numbers of producers were engaged in farm-raised and wild-caught production (LSU AgCenter 2008). Considering the range of operation sizes, competition from the wild-caught segment, and variety of production systems used, it is evident that scale economies are not forcing farmers into large-scale, homogeneous operations – the structure of the primary production segment remains quite heterogeneous in nature.

In 2002, Louisiana per capita consumption was higher (10.4 lbs) than that of the rest of the United States (0.25 lbs) (Lee 2007). Crawfish is sold in the United States in two main forms: live or as cooked, peeled tail-meat. Live crawfish are sold primarily for crawfish boils in the spring, particularly around Easter, and peeled tail meat is used in various Cajun dishes such as crawfish etouffee and crawfish pie, which are consumed year-round. In addition to limited demand for crawfish outside southern Louisiana, restricted geographical production areas, seasonal production, and unstable prices are among the reasons for the limited national supply of crawfish meat from China, which is priced lower than the domestic product (Lewis and Gillespie 2008). (McClain et al. 2007). Moreover, the U.S. crawfish industry must compete with peeled tail-

Peeled tail-meat can be sold in fresh or frozen form. The harvesting schedule and market distribution of live crawfish is highly influenced by its short shelf life (Romaire et al. 2005). All of the whole and live crawfish and most of the fresh tail-meat are provided by domestic producers while China is the major supplier of frozen tail-meat, allowing the domestic product to be somewhat differentiated from the imported product. In addition, the domestic product generally contains the yellow "fat" or hepatopancreas, which adds flavor, while the imported product does not.

Value-added Production Practices and Methods of Crawfish Marketing

A farmer may sell crawfish directly to a consumer, processor, primary wholesaler, and/or retailer depending upon access to the market and production practices used (McClain et al. 2007). Figure 1 provides a chart depicting the marketing conduct of crawfish. Some farmers market crawfish directly to consumers and/or retailers.

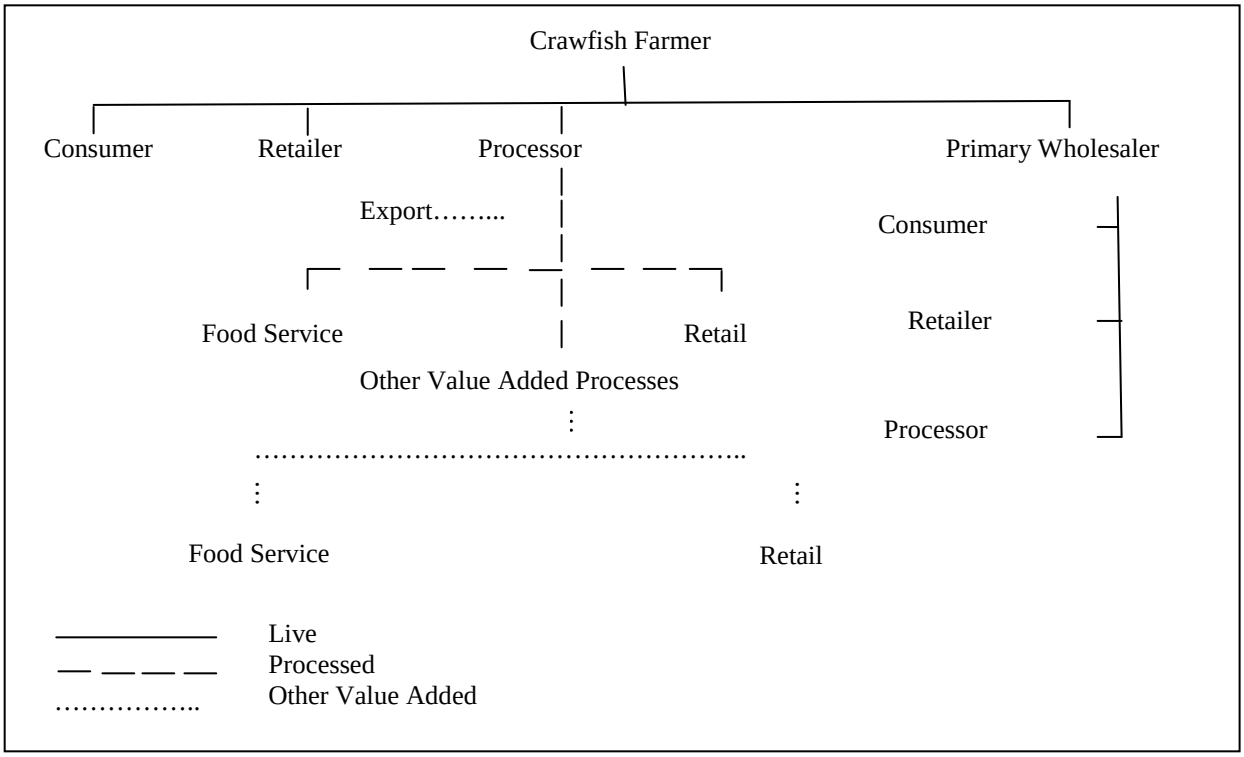

Figure 1. Marketing Outlets for Louisiana Crawfish
Source: Romaire et al., 2005

In some cases, consumers go directly to the farm to purchase crawfish, though this is unlikely to occur to a great extent for larger-scale farmers high transactions costs, as discussed by Coase (1937) and later by Williamson (1990), for the large-scale farmer. Producers may sell directly to retailers, with retailers having an interest in dealing with farmers who can guarantee a consistently high quality product.

Farmers may sell to processors, who in turn sell to food service and/or retail firms. Processors often peel some (generally smaller) crawfish and sell it as cooked, peeled tail meat. Partially because of the lower priced tail-meat imports from China, a reduction of licensed processors has resulted; in 1996, Gillespie and Capdeboscq (1996) identified 80 processors for surveying, but by 2004, just over 30 processors were identified for surveying by Gillespie and Lewis (2005); thus, the peeling capacity of the industry has decreased (McClain et al. 2007). Primary wholesalers have docks throughout the major crawfish production area of southern Louisiana. Farmers may sell crawfish to these wholesalers or, in some cases, wholesalers arrive at the farm to purchase crawfish. Wholesalers, in turn, re-sell the product to retailers, processors, and/or consumers. The wholesaler is an additional firm in the supply chain, introducing an additional transaction (and thus transaction cost) before the product reaches the final consumer. However, from the farmer's perspective, transaction costs may be reduced since the entire day's catch can be marketed to these local buyers rather than perhaps sell to multiple firms that may be located further away (increased transportation costs) and may require additional value-added activities. Likewise, the processor or retailer may incur lower transaction costs if he or she can purchase in bulk from the wholesaler rather than from a greater number of individual producers. Though this study is not designed to fully compare the net transaction and other costs associated with each of the marketing alternatives, it is important that these costs be recognized.

When there is market saturation, size grading is a commonly used practice, allowing uniform-sized crawfish to be distributed to the target marketing unit. Larger crawfish have greater appeal for use in crawfish boils, so consumers generally purchase large crawfish live, whether directly from the farmer or from a primary wholesaler. Smaller-sized crawfish are generally peeled by processors for sale as tail-meat. Usually, grading is done in wholesaler or processing units by using modified vegetable graders or custom-made graders (Romaire et al. 2005). To enhance the appearance and, thus, market value of the product, external wash with ascorbic or citric acid is sometimes done.

The practice of confining crawfish in water without food supplements for one or two days, termed "purging", is one of the ways to increase the market value of live crawfish. It helps to clean external mud, debris and excretory products from the intestine. An additional cost of 15-25% is expected for purging crawfish (Romaire et al. 2005). Value is added, but increased mortality risk is associated with purging (McClain et al. 2007).

In areas where live crawfish is available, there are generally a number of small retail outlets and restaurants specializing in serving boiled crawfish. When the live crawfish market is saturated, smaller-sized crawfish are processed for tail-meat production or sold to the processing industry, leaving large crawfish for the live market. Some firms cater boiled crawfish to parties and festivals using custom boiling rigs (Romaire et al. 2005).

Data and Methods

The Survey

The types of marketing arrangements and value-added activities used in Louisiana crawfish production are assessed using crawfish producer responses obtained from a mail survey conducted during Fall, 2008, to 770 Louisiana crawfish producers. As discussed by Gillespie and Nyaupane (2010) and Nyaupane and Gillespie (2011), surveyed farmers were on the LSU Agricultural Center mailing list for crawfish newsletters. Dillman's (1978) Total Design Method was followed for implementing the survey, which was eight pages long. Producers were asked questions about marketing practices, general production practices, tenancy arrangements, adoption of best management practices and rec-

ord-keeping systems, demographics, and general farm information.

Four mailings were used. The first, in September 2008, included the questionnaire and a letter that was personally addressed and signed; first-class mail was used. Non-responders were sent a postcard reminder approximately 1 ½ weeks later. A second copy of the survey followed the postcard reminder 1 ½ weeks later. Finally, a second postcard reminder was sent to non-responders 1 ½ weeks after the second survey. Several area aquaculture extension agents and LSU Agricultural Center aquaculture faculty were consulted in developing the survey. All area aquaculture extension agents were informed when it was sent to producers. Announcements were made in the July, 2008, Crawfish News, a newsletter distributed to all known Louisiana crawfish farmers, and at the Louisiana Farm Bureau annual meeting in July. Of the 770 surveys sent,, 75 were returned as completed, , 185 were returned with the producer stating he or she did not produce crawfish during the 2007-2008 production season, and 79 were returned as non-deliverable, for an adjusted response rate of 15%. Though the response rate was lower than hoped for, individuals working closely with the industry were generally "enthusiastic" about the return rate, given past data collection experiences with the population. This population has been less likely to participate in government programs since there is no crawfish-specific program, so it has been surveyed less than other farm populations.

To determine sample representativeness, statistics are first compared with those of the 2005 Census of Aquaculture, which reports 605 Louisiana crawfish farms, 433 of which utilized cropland for production. The average acreage of those utilizing croplandwas 176 acres, which is 35 acres less than our survey average of 211 acres. In contrast, *Louisiana Summary, 2008,* estimated that, for Louisiana, there were 139 acres of crawfish per farm on 1,320 farms. Louisiana Cooperative Extension Service agents were used to estimate numbers of farms and acreage on a parish-by-parish basis for *Louisiana Summary, 2008*. The difference in our sample farm size with the estimated population farm size depends upon whether *Louisiana Summary, 2008* or Census numbers are used.

Examining the Census of Aquaculture's 738 Louisiana freshwater aquaculture farms, of which 605 would be crawfish, 49% of the farmers leased land and 54% of the land was leased. Our sample suggests 63% leased land, while 42% of the land was leased. Partially because crawfish is often double-cropped or rotated with rice, land leasing arrangements in crawfish are generally more common than with most aquaculture enterprises. Thus, the higher percentage of producers leasing land in our sample versus the non-crawfish-specific Census sample is as expected. According to the 2007 Census of Agriculture, approximately 42% of all Louisiana farmers had farming as their primary occupation, compared with 56% of crawfish farms from our sample. Our survey average age of crawfish farmers is 54; the 2007 Census average age of all Louisiana farmers was 57. An overall comparison of our survey sample with Census numbers suggests our surveyed crawfish farms to be more likely to lease land and 20% larger than the average crawfish farm. Assuming crawfish farmers are typical of all Louisiana farmers, our sample is younger and more likely to list farming as their primary occupation. A number of studies have foundfarm respondents to mail surveys to be somewhat larger than non-respondents (e.g., Gillespie et al. 2007).

Farmers were asked to choose any of the four marketing outlets applicable to their scenario. The choices include: "I sell to a processor," "I sell to a wholesaler," "I sell to a retailer," and "I sell directly to consumers". Following this, they were asked, "Do you, at least sometimes": "Grade your crawfish prior to selling them?", "Wash your crawfish prior to selling them?", "Purge your crawfish prior to selling them?", and "Own or run a commercial crawfish peeling operation?" The survey also included information on other crawfish production practices, farm characteristics, and farmer characteristics.

Econometric Model

Probit models are used to analyze factors influencing crawfish producers' choice of marketing outlet. Marketing outlets (dependent variables) include whether the farmer markets crawfish via processors, wholesalers, retailers, and/or consumers. Using the probit model, which assumes

a normal distribution, the probability of adoption is modeled as shown in Greene (2000):

$$(1) \quad \Pr(Y = 1) = \int_{-\infty}^{\beta' x} \phi(t)dt = \Phi(\beta' x)$$

where $\phi(.)$ denotes the standard normal distribution, (Y=1) suggests the marketing outlet was adopted, and x represents independent variables expected to influence adoption. Marginal effects for continuous variables are estimated as:

$$(2) \quad \frac{\partial E[Y|x]}{\partial x} = \phi(\beta' x)\beta$$

Marginal effects for dummy variables, d, are estimated as:

$$(3) \quad \Pr[Y = 1|\bar{x}_*, d = 1] - \Pr[Y = 1|\bar{x}_*, d = 0]$$

where $\bar{x}_*$ refers to all variables other than d held at their mean values. Though we originally considered using the multivariate probit model to examine market choice among the four marketing outlets, similar to Fu et al. (1988) and assuming correlated error terms for each of the equations, several runs using the model suggested that the sample size was insufficient to support this framework. Since farmers may market their crawfish via multiple outlets, the multinomial logit would be infeasible due to the resultant very large number of possible choices: 16.

We proceed by discussing independent variables included in the models. Our "expectations" for variable effects are based primarily on economic theory, industry observations, and previous research. Though observations have been made over a number of years working with the crawfish industry, this represents the first attempt we are aware of to quantify portions of producers using various marketing practices and the types of farmers using them; thus our "expectations" are tested as hypotheses.

Independent Variables

Farm Size and Diversification. Independent variables include *Acres* of land used in crawfish production (divided by 1,000 in the regression for computational purposes), a measure of crawfish production. Greater production is expected to be associated with sales to the wholesaler and processor market because of buyers' capacity to purchase in bulk. This lowers transaction costs to the producer as he or she need not enter into separate transactions with multiple buyers. Moreover, processors and wholesalers generally also have grading facilities in cases of oversupply.

Percent of farm income from crawfish production (*%FarmCF*) shows the degree of specialization of a farm. Percent of household income from the farming operation (*%HHFarm*) allows for analysis of the influence of the farmer's financial dependence from farm operations on choice of market outlet. Though diversification is sometimes used in marketing studies as a measure of the risk faced by a producer (e.g., Gillespie et al. 2004), in our case, there is no known or hypothesized difference in price risk among the alternatives. However, since marketing direct to consumers or retailers is likely to require additional management on the part of the producer (scheduling, dealing with specific requirements, etc.), it is expected that producers who are more highly specialized in crawfish production will more likely market via those outlets. A farmer who is more economically dependent on agriculture is expected to use more innovative production and marketing practices. Fu et al. (1988) showed a relationship between the number of farm enterprises in which a peanut farmer was involved and market choice. Gillespie et al. (2004) and Davis and Gillespie (2007) found farm size and diversification variables to influence farmer choice of cattle marketing and hog market outlets, respectively.

Demographic. Previous marketing studies for other agricultural enterprises (i.e., Gillespie et al. (2004) for beef and Davis and Gillespie (2007) for pork) have examined the influence of producer *Age* and education on the adoption of a market outlet. We divide producer education into two categories, one without a high-school degree *(NoHighSch)*, the other having at least a four-year *College* degree. Though additional education categories were available, they were not included due to statistical non-significance and limited observations for the entire sample. The base category, which includes high school graduates and those with some college, repre-

sents 63% of the sample. The number of *Years* a farmer has been farming crawfish is a continuous variable in increments of seven years, as defined in Table 1. This variable allows for examination of the impact of experience on market selection.

Production Practices. Two dummy variables, whether the producer *Grades* and/or *Washes* crawfish prior to selling, were included to determine the impact of premarketing practices on the selection of marketing outlets. Farmers who grade and/or wash crawfish prior to selling are expected to be more likely to sell directly to consumers; most processors have their own grading facilities (Gillespie and Lewis 2005), so grading would not be as important in selling to them. Peeling and purging variables were not included in the model due to there being too few farmers using each for inclusion in the model. The number of *Months* crawfish are produced annually is also likely to influence marketing options available to farmers. Generally, the early harvesting season runs from November-January when most of the crawfish are immature, mid-season is February-May, an late season is June-July. The price is generally highest early in the production season (winter and early spring) when the demand is highest, while it decreases in the peak and late seasons when the supplies of other seafood products such as shrimp and crabs increase (Romaire et al. 2005).

Results

General Overview of the Louisiana Crawfish Industry

Table 1 provides a general overview of the Louisiana crawfish industry, as provided by the survey responses. The average crawfish farm size is 211 acres of crawfish. Although the mean percentage of farm income from crawfish and percentage of household income from farming were found to be in the 20-39% and 40-59% ranges,

Table 1. Variables, Descriptions, and Means

Independent Variables	Description	Mean
Acres	Cts: Number of crawfish acres on the farm, divided by 1,000	0.211
%FarmCF	Cts: Percent of farm income from the crawfish operation; 1: 1-19%; 2: 20-39%; 3: 40-59%; 4: 60-79%; 5: 80-100%	2.15
%HHFarm	Cts: Percent of household income from the farming operation; 1: 1-19%; 2: 20-39%; 3: 40-59%; 4: 60-79%; 5: 80-100%	3.03
Age	Cts: Farmer's age; 1: ≤30 years; 2: 31-45 years; 3: 46-60 years; 4: 61-75 years; 5: ≥76 years	3.07
College	Dummy: Producer holds a college bachelor's degree or more = 1	0.30
NoHighSch	Dummy: Producer without a high school degree = 1	0.07
Years	Cts: Number of years a producer has been farming crawfish; 1: 1-7; 2: 8-14; 3: 15-21; 4: 22-28; 5: 29-35; 6: 36-42; 7: ≥43	3.26
Grade	Dummy: Producer grading crawfish prior to selling = 1	0.63
Wash	Dummy: Producer washing crawfish prior to selling = 1	0.32
Months	Cts: Number of months a producer harvests crawfish	5.60

Note: Two other education categories were (1) High School Diploma / GED and (2) Some College or Technical School. Means for these categories were 0.34 and 0.29, respectively.

respectively, half of the population responded that their farm income generated from crawfish was <20%, while a range of percentage of household income from farming suggested wide diversity in that measure among farms. It is common for producers to rotate crawfish, rice and soybeans, or double-crop rice with crawfish. Furthermore, a typical producer harvests crawfish for 5-6 months during the year (mean=5.6 months), leaving time for other production activities during the remaining portion of the year. Of the respondents, 29.3% held college degrees, while only 6.6% did not hold a high school diploma. The modal range of age of producers was 46-60 years. The modal years of farming experience was 15-21 years.

Farmer Premarketing Operations and Selection of Marketing Outlets

Table 2 provides framers' premarketing practices conducted before selling. Most of the respondents (62.5%) grade their crawfish prior to selling. As mentioned earlier, smaller crawfish are more often used in tail-meat production, and thus have a possible route to processors. Compared to grading, the percentages of farmers washing (31.8%), purging (4.8%), or peeling (7.7%) prior to selling are lower. The lower inclination towards purging could be partly due to associated mortality risks and higher fixed cost. A peeling operation is generally conducted manually and would usually be considered a labor-intensive separate enterprise with extensive specific associated equipment.

Farmer selection of marketing outlets and their proportions are provided in Table 3. Most of the farmers (64.2%) sold crawfish via wholesale markets. Percentages of producers selling crawfish directly to consumers, retailers, and processors were 30.3%, 22.7%, and 17.9%, respectively.

Table 2. Farmer Use of Value-added Production Practices.

Grade: Do you, at least sometimes, grade your crawfish prior to selling them?		
Categories	*Frequency*	*Percentage*
Yes	45	62.5
No	27	37.5
Total	72	100.0
Wash: Do you, at least sometimes, wash your crawfish prior to selling them?		
Yes	21	31.8
No	45	68.2
Total	66	100.0
Purge: Do you, at least sometimes, purge your crawfish prior to selling them?		
Yes	3	4.8
No	60	95.2
Total	63	100.0
Peel: Do you, at least sometimes, own or run a commercial crawfish peeling operation?		
Yes	5	7.7
No	60	92.3
Total	65	100.0

Table 3. Farmer Selection of Crawfish Marketing Outlets.

Which of the following marketing outlets do you use to sell crawfish? (Please check all that apply.)

Categories	Total Responses	Frequency	Percentage
I sell to a processor	67	12	17.9
I sell to a wholesaler	67	43	64.2
I sell to a retailer	66	15	22.7
I sell directly to consumers	66	20	30.3

Note: A farmer may choose to market in more than one outlet during a production season, thus the sum of these percentages is >100%.

Probit Results of Farmers' Choosing a Marketing Outlet

Appendix Table 4 shows the factors affecting farmer choice of a crawfish marketing outlet. Larger farmers were found to be more likely to market via retail outlets, likely the result of their ability to guarantee significant volume to supply those markets, reducing transaction costs to the retailer. An additional 1,000 acres of crawfish increased the probability of the farmer marketing via retailer by 0.34. As initially expected, farmers with higher portions of their farm income from crawfish were more likely to market crawfish direct to consumers: a 20% increase in the percent of farm income derived from crawfish increased the probability of marketing direct to consumers by 0.10. This specialization in crawfish production affords them the opportunity to market crawfish via an outlet that likely involves higher transaction costs, but potentially higher return if customers are willing to pay higher prices to a farmer whose product is perceived to be of higher quality. On the other hand, as expected, those with greater percentages of income coming from off-farm sources were more likely to market via wholesalers: a 20% increase in the percent of household income derived from the farm increased the probability of marketing via wholesalers by 0.14.

Farmer age was positively associated with selling crawfish to processors, while negatively related to selling to wholesalers: an additional 15 years of age increased the probability of marketing via processors by 0.13 and decreased the probability of marketing via wholesalers by 0.16. The reduction in the number of processors over a number of years may partially explain this result, as older farmers continue to market to processors with whom they have built business relationships over a longer time frame. Farmers with college degrees were more likely to sell their product via wholesalers and less likely to market via processors. Holding a college degree increased the probability of marketing via wholesalers by 0.19, but the marginal effect for processors was non-significant. Those without high school diplomas were inclined towards processors and direct to consumers rather than through the wholesale market.

Producer grading of crawfish also had a positive relationship with the wholesale market, while producers washing crawfish were less likely to sell their product to wholesalers and more likely direct to consumers. Producers who graded their crawfish prior to sale had a 0.34 higher probability of marketing via a wholesaler than producers who did not grade their crawfish. Producers who washed their crawfish prior to sale had a 0.63 higher probability of marketing direct to consumers and a 0.66 lower probability of marketing via wholesalers than producers who did not wash their crawfish. Washing crawfish just after harvesting not only removes external debris, but also improves quality by providing a cleaner looking product, so it is not surprising that washing would be done when marketing direct to the consumer. The wholesaler can sell crawfish to processors, retailers, or direct to consumers, so they may conduct grading and/or washing if not already done by the producers.

Summary and Conclusions

This paper deals with factors associated with crawfish farmers' use of alternative marketing outlets. We use 2008 survey data from a survey of Louisiana crawfish farmers. Four types of marketing outlets commonly used in the industry are analyzed using probit models. Although a farmer can choose a single outlet or a combination of outlets during a production season, the wholesale market was the most commonly used in the industry. A total of 64.2% of the survey sample was found to sell to wholesalers, 30.3% sold directly to consumers, 22.7% to retailers, and 17.9% to processors; given these numbers do not sum to 100%, we see that 35.1% of farmers sold via more than one market type. Understanding how crawfish are marketed is of importance when examining the ways in which an industry can regain its competitiveness in an international market. From an international competitiveness standpoint, one would need to take this the next step and examine the transaction costs and market efficiency associated primarily with the wholesale market to determine whether appreciable increases in efficiency (reductions in the cost of getting crawfish to the final consumer) could be gained.

It was found that 62.5% of producers grade and 31.8% wash crawfish prior to selling. Purging is not frequently done by producers, and few producers are involved in the peeling segment. Increased mortality in purging and high costs associated with peeling operation are likely to be two major reasons for lower adoption of those value-added activities.

Younger farmers with higher percentages of household income from farming, with a college degree, and those who grade and do not wash crawfish are more likely to choose the wholesale market. Scale of operation was the major determinant of whether farmers would sell directly to retailers, as larger farmers are the ones who have the volume required to sell directly to the retail market. Farmers who wash crawfish before selling and have higher percentages of their farm income coming from crawfish are the more likely farmers to market direct to consumers. Older, less highly educated farmers were more likely to market direct to processors. As expected, demographics, farm characteristics, and pre-market activities significant impacted on market choice.

From working with the crawfish industry over a number of years, we have identified a number of issues that have prevented its growth into a larger, national industry, though the industry has had an interest in advancing it as such. Many of these issues are structural, such as seasonal production, limited production during the season, lack of extensive mechanization in the peeling sector, and the lack of vertical and/or horizontal coordination through either formal contracting or looser strategic alliances. If, however, the industry is to expand significantly beyond Louisiana's borders, close attention must be paid to development of an industry structure that can perform such that sufficient volume of consistent quality product can be produced year-round and distributed efficiently outside Louisiana. For this to occur, significant attention must be paid to marketing – the existing wholesaler and direct-to-processor outlets are likely to be the best places to begin in sourcing these markets. However, significant attention will need to be paid to increasing market efficiency, such as by lowering transaction costs, as the product will need to compete with other seafood products – what must be exported from Louisiana to other United States regions is peeled tail meat, which China currently dominates due to lower prices. Lower-cost domestic production of that product, which currently benefits from its product differentiation (fresh, contains "fat," and "local"), will also be needed. We see determination of an optimal marketing structure for crawfish industry expansion as a fruitful area of future research.

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Appendix

Table 4: Probit Results of Marketing Outlet Analysis.

	Processors		**Wholesalers**		**Retailers**		**Consumers**	
	Coefficient (Robust Std. Error)	Marg. Effect	Coefficient (Robust Std. Error)	Marg. Effect	Coefficient (Robust Std. Error)	Marg. Effect	Coefficient (Robust Std. Error)	Marg. Effect
Acres	-0.2498 (0.9455)	-0.0254	-0.3986 (0.9745)	-0.0789	1.1965 * (0.6242)	0.3385 *	0.1028 (0.5158)	0.0319
%FarmCF	0.1004 (0.2754)	0.0102	0.0860 (0.2154)	0.0170	-0.2642 (0.1918)	-0.0748	0.3067 * (0.1752)	0.0951 *
%HHFarm	0.2312 (0.1674)	0.0235	0.6900 *** (0.1960)	0.1365 ***	-0.3029 (0.2080)	-0.0857	-0.1461 (0.1514)	-0.0453
Age	1.2420 ** (0.5234)	0.1264 **	-0.8132 * (0.4563)	-0.1609 *	0.2508 (0.3844)	0.0710	0.2535 (0.3662)	0.0786
College	-1.0519 * (0.6145)	-0.0904	1.1558 ** (0.5863)	0.1925 *	0.0623 (0.5765)	0.0177	-0.1647 (0.5205)	-0.0502
NoHighSch	1.8391 * (1.0811)	0.5018	-2.4214 *** (0.8589)	-0.7727 ***			1.8646 ** (0.9475)	0.6439 ***
Years	-0.0801 (0.1428)	-0.0082	0.0887 (0.1622)	0.0176	0.0348 (0.1569)	0.0099	0.0377 (0.1338)	0.0117
Grade	-0.9328 (0.6333)	-0.1132	1.4759 *** (0.5736)	0.3373 **	0.3782 (0.3998)	0.1042	-0.4690 (0.5073)	-0.1492
Wash	0.2365 (0.8045)	0.0262	-2.3827 *** (0.8879)	-0.6626 ***	0.6413 (0.7982)	0.1974	1.9029 *** (0.6462)	0.6336 ***
Months	-0.0891 (0.2906)	-0.0091	0.2760 (0.2344)	0.0546	-0.1181 (0.2465)	-0.0334	-0.0946 (0.1833)	-0.0293
Constant	-4.6791 (1.5415)		-1.0142 (1.5761)		-0.1886 (1.5640)		-1.6056 (1.2969)	
Obs.	48		48		45		47	
Pseudo R^2	0.2417		0.4033		0.1620		0.2921	

Notes: *** indicates the variable is significant at the 0.01 level; ** indicates the variable is significant at the 0.05 level; *indicates the variable is significant at the 0.10

Brand Premiums in the U.S. Beef Industry

Steve Martinez

The U.S. beef industry has experienced considerable reductions in beef demand over the past 30 years. One possible factor in declining beef demand is lack of progress in the development of consistent, high-quality branded beef products. This article uses Nielsen Homescan data and hedonic models to estimate the value that U.S. consumers place on various beef attributes, including brand.

Beef demand indexes suggest a greater long-term decline in beef demand compared to other meat products. The beef demand index involves calculating the real beef price that we would expect to observe if beef demand was consistent with demand in the base year. This is compared to the real beef price actually observed to indicate changes in underlying beef demand. A beef demand index value of 55 in 2006 (1980=100) suggests beef retail prices were 45 percent lower in 2006 than they would have been if beef demand was at its 1980 level (Tonsor, 2010). That is, beef demand fell by 45 percent since 1980. This compares to a pork demand index of 65, which suggests that pork demand fell by 35 percent over the same period. Along with changing consumer preferences and heightened health consciousness, poor quality assurance has been offered as one reason for the decline in beef demand (Brester, Schroeder, and Mintert, 1997; Ferrior and Lamb, 2007; Purcell, 2002; Purcell and Hudson, 2003). Marketing of differentiated beef products may be hampered by the fact that beef quality is unknown when cattle are sold, and quality variation related to genetics makes it difficult to establish branded products (Bailey, 2007; Ward, 1997; Ward, undated).

According to Ward (1997), one of the biggest obstacles to greater vertical coordination in the beef sector is difficulty in controlling quantity, quality, and consistency. Large capital requirements are involved in controlling a large number of small and geographically dispersed cow-calf producers. Measuring and controlling quality and end-product consistency also is a problem because of several factors, including the wide genetic base, longer production cycle required to quickly change the genetic base, greater number of production stages, and lack of economical measuring technology.[1]

Brand premiums can provide the necessary incentives for sourcing cattle of higher quality and consistency, and they can provide opportunities for increasing revenues to be allocated across the supply chain (i.e., producers, processors, distributors). Yet, limited research exists on how consumers value branded beef products. Parcell and Schroeder (2007), using a national survey of about 2,000 households from 1992 to 2000, found price premiums for branded roasts and steaks (mostly Certified Angus Beef®) compared to store brands, but not for branded ground beef. Based on data collected from grocery stores in three metropolitan areas from July-August 2006, Ward et al. (2008b) found price premiums for branded roast/steak and ground beef compared to unbranded/generic beef. In this study, we conduct a hedonic analysis to estimate implicit prices of branded beef using more recent data than Parcell and Schroeder (2007) and, unlike Ward et al. (2008b), uses scanner panel data that is national in scope from a panel of representative U.S. households.

Role of Brands

Consumers may be willing to pay a premium for branded products because branding can help to overcome problems that have limited beef sales. Branding provides a means for signaling quality. Brands can help consumers process, interpret, and store large quantities of information about products. As a source of information, brands

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[1]Other factors noted by Ward include capital requirements, and management skills required to manage many, small, and geographically dispersed cattle operations through several production stages.

serve as substitutes for the time and skills required for evaluating product quality (Jin, Zilberman, and Heiman, 2008).

Brands are particularly important in cases where information necessary for obtaining an objective determination of quality is limited at the time of purchase, as with experience and credence attributes (Jin, Zilberman, and Heiman, 2008).[2] For unprocessed beef, there may be only minor detectable quality differences at the store for products within the same category. Yet, considerable biological variation may exist, which results in different quality experiences. This situation compels consumers to search for other informational cues in the evaluation of unprocessed beef at the store. Branded beef has been shown to serve as the predominant cue for expected eating and health quality (Bredahl, 2003).

When companies develop products with unique quality attributes, these products are generally sold as branded products. Producers of branded products must support their brands by investing in quality control because perceived average quality levels and quality variation can affect premiums paid for branded products. Perceived quality is based on consistency of product characteristics, such as eating satisfaction and safety, from one purchase to the next. Brands can increase consumers' confidence regarding the purchase decision because of past experience with the product or familiarity with the brand and its characteristics.

Consumers may be willing to pay a higher price for branded products because of reduced search costs, and companies' commitment to quality to prevent losses in brand name investments and reputation (Fernandez-Barcala and Gonzalez-Diaz, 2006). In addition, if a brand is well positioned with respect to a key attribute, such as tenderness, competitors will find it difficult to differentiate their products based on the same attribute.

Nielsen Homescan Data

This research uses Nielsen Homescan data for household purchases in calendar years 2004 and 2005. Consumer panel participants were selected based on demographic and geographic targets to match the U.S. population as closely as possible. The nationally representative panel contains about 8,000 households per year who participated for at least ten months. These households recorded both their non-UPC-coded random-weight and UPC-coded purchases after each shopping trip using an electronic scanner located at their home.[3] For non-UPC-coded random-weight products, information is manually recorded using Nielsen's "Category Code Book For Non-UPC Barcoded Items."[4] The individual household food purchase data contains information on expenditures, quantities and date purchased, package size, number of units, price promotions (coupons, store features, and other deals), and brand. The data also contain demographic information for each household, such as geographic location, income, race, household size, education, and age.

Nielsen Homescan data include brand information for fresh, frozen, and precooked ground beef, steak, roast, and other beef cuts (e.g., beef for stew, ribs, liver, brisket).[5] Table 1 summarizes Nielsen's brand classifications for non-UPC random-weight and UPC-coded beef. Non-UPC coded random-weight beef has three broad brand descriptors: an actual brand name (e.g., Coleman Natural Beef, Swift); an "all other brands category;" and "no brand." UPC-coded beef cuts have four basic brand descriptors. These include

[2]Experience attributes are those that are costly to measure by the consumer prior to purchase, but are easily measured as the product is consumed (e.g., tenderness, taste). Credence attributes are those that are difficult to measure before and after purchasing (organic, natural). On the other hand, search attributes have a low cost of measuring at the time the purchase (e.g., color, visible fat). For search attributes, additional information provided by the brand is less likely to have significant value to the buyer (Pearson, 2003).

[3]Random-weight items are products that do not have a standard weight.

[4]The category code book is used for products with non-UPC barcodes and those without any barcodes. Panelists are instructed to first scan non-UPC barcoded items before using the code book.

[5]Our analysis excludes further processed products, including sausages and hotdogs, canned meat, jerky, meat snacks, frozen entrees, lunch meat, refrigerated and frozen ready-made sandwiches, sandwich spreads, and soups.

Table 1. Classification of Branded Beef in the Nielsen Homescan Data, Calendar Years 2004 - 2005

Product modules	Brand descriptors	Branded?
Non-UPC coded random-weight beef	No brand (includes those cuts branded with the store name)[1]	No
	Brand name (e.g., Sterling Silver, Swift, Store-specific brands that are not the store name)	Yes
	All other brands	Yes
UPC-coded beef	Brand name	Yes
	CTL BR (all private label/store brands)[2]	Yes
	NBL-no company listed	No
	Supplier name-NBL (e.g., Tyson Fresh Meats-NBL)[3]	No

[1]According to the Nielsen code book for non-UPC barcoded items, panelists are instructed to type the brand name into the scanner as it appears on the package label. If there is no brand name on the package, or if the store's name is the brand name, they are asked to press the "no" key on their scanner. Hence, private label products where the brand name is the store name (e.g., Kroger or Giant) are included in the "no brand" category, there is no way to segregate these brands from the category.
[2]Includes all private label products, including those brands where the brand is the name of the store.
[3]These products identify the supplier, but the company name is not the brand name.

the actual brand name; "CTL BR," which are private label (i.e., store brand) products (e.g., Giant or Safeway's Rancher's Reserve brand);[6] a company name followed by "NBL" (no brand label) (e.g., Tyson Fresh Meats---NBL); and "NBL---no company listed." The "NBL- no company listed" identifier means that the item did not have a label identifying the supplier. For random-weight beef, Nielsen considers private label products to be unbranded if the store name is the brand.[7]

Extent of Beef Branding

In this section, we use household projection factors (weights) contained in the Homescan data to aggregate household purchase data, which we then use to describe branded beef purchases in the United States. Each household is assigned a projection factor based on its demographics to make aggregate statistics representative at the national level. Each household is weighted by its projection factor according to its representation in the U.S. population based on U.S. Census data. A weighted quantity and expenditure is calculated for each recorded transaction, which can then be aggregated over all household transactions to obtain totals that are representative of national purchases. Nielsen recalculates the weights each year to maintain consistency with Census updates.[8]

Due to differences in brand classifications, as discussed earlier, we used Nielsen Homescan data to conduct separate analyses of non-UPC-coded random-weight beef, which accounted for 87 percent of beef poundage purchased in 2005, and UPC-coded beef. Consumers spent $3.1 billion on 1 billion pounds of random-weight branded beef cuts in 2005, or 25 percent of random-weight beef pounds purchased. In comparison, branded products accounted for 63 percent of random-weight chicken pounds purchased and 46 percent of random-weight pork pounds purchased in 2005 (Nielsen Homescan data).

For random-weight beef, we focus on ground beef, steaks, and roasts, which accounted for 85

[6]Private label or store-branded beef is exclusively developed, manufactured, and produced for a retailer. According to the Private Label Manufacturers Association, the brand can be the store's own name or a name created exclusively by that store.
[7]Information on the frequency distribution of purchases by type of brand, including those that have no brand present, are included table 3 for non-UPC random weight beef and table 5 for UPC-coded beef.
[8]More details on the projection factors can be found in Harris (2005).

percent of random-weight beef pounds purchased in 2005, the latest year in our sample (Nielsen Homescan data). Twenty-two percent of random weight ground beef carried a brand, compared to 25 percent of steaks and roasts. A smaller percentage of branded ground beef may be due to the fact that the degree of leanness is the primary factor that distinguishes ground beef (Parcell and Schroeder, 2007). In 2005, 87 percent of ground beef purchased carried a leanness specification, and accounted for 95 percent of all beef with information on leanness (Nielsen Homescan data).

In 2005, the percentage of beef purchased through some type of price promotion, including store and manufacturer coupons, store features, and other deals, was slightly higher for branded versus unbranded beef; 43 percent compared to 41 percent (Nielsen Homescan data). Price promotions and competition between store types can create incentives to improve product quality and consistency of branded products. Price promotions provide a quick and measureable means of increasing sales. However, promotions that simply offer a price discount may also cheapen the value of a brand, harm the brand image, and reduce the likelihood of future brand purchases (Aaker, 1991; Gedenk and Neslin, 1999). In the long term, price promotions can increase sales, but should be used in conjunction with advertisements and product improvements to increase the likelihood of future brand purchases (Gedenk and Neslin, 1999).

One of the most important developments in the food retail sector has been the growth in food sales by stores that did not traditionally sell many food items, especially wholesale clubs and supercenters. Homescan Panel data distinguishes stores by store type. The share of branded random-weight beef purchased at wholesale clubs was highest compared to grocery stores and supercenters. In 2005, 34 percent of random weight beef purchased at wholesale clubs carried a brand label, compared to 23 percent at grocery stores and 12 percent at supercenters.

Beef that is UPC-coded allows consumers to select beef cuts quicker because they don't have to search through packages to find the preferred weight or price. UPC-coded items also facilitate tracking of product movement by the supplier, and tracing of product by the buyer back to the supplier. In this study, we focused on UPC-coded ground beef, which accounted for 96 percent of UPC-coded purchases in 2005.[9] Branded UPC-coded ground beef purchased as a share of total UPC-coded ground beef was 69 percent in 2005. Grocery stores and supercenters accounted for 82 percent of UPC-coded ground beef purchases, and 86 percent of this beef was branded at grocery stores compared to 31 percent at supercenters.

Hedonic Regression Model Results

To examine price premiums associated with specific beef brands, we estimated a hedonic regression model using sample data on household purchases contained in the Nielsen Homescan data for 2004 and 2005. The hedonic price model assumes that consumers derive utility from the characteristics of goods rather than the goods themselves (Ladd and Suvannunt, 1976; Unnevehr and Bard, 1993). Price differences are assumed to be due to differences in product attributes which include *intrinsic* and *extrinsic* quality attributes (Parcell and Schroeder, 2007; Pearson, 2003). Intrinsic attributes are those associated with the actual characteristics of the product, such as fat content, taste, smell, and color. Extrinsic attributes relate to promotional or informational characteristics that can also affect consumer choice, including brand. We also assume that prices may vary by location of the household, as well as month and year of purchase.

To estimate price differences between branded and unbranded beef, we first classified brands into specific categories. There is no consensus in the literature on how to categorize brands. Ward et al. (2008b) identified four specific types of brands including special, program, store, and all other brands, along with an "unbranded" category. Special brands were those that carried a label identifying production practices, such as "all natural." Program brands were breed specific, such as Certified Angus Beef. In addition to store brands and unbranded beef, Schulz et al. (2010) classified beef into three brand categories

[9]Steak accounted for most of the remainder, and nearly all of it was branded.

based on the range of distribution. A national brand is distributed nation-wide and is controlled by the company that owns the brand. A local private brand is distributed locally and is privately owned and controlled by a small company. A regional private brand is distributed regionally and is owned and controlled by a private company. In addition to store brands, the National Cattlemen's Beef Association (NCBA) (undated) identified two other types of branding programs, similar to those defined by Ward et al. (2008). A breed-specific branded beef program selects beef from a specific breed. Company-specific branded beef is not breed specific, but includes other criteria, such as premium grade, no antibiotics or hormones, source verified, or grass-fed. Examples include Sterling Silver™ Beef or Maverick Ranch.

In this study, we combine the brand nomenclature described above to classify beef into six categories: 1) breed-specific/program brands, 2) company-specific/special brands, 3) private label/store brands, 4) national brands, 5) all other brands, 6) unbranded beef. Private label brands can be further classified into three general types: generic, no frills, low-priced products; national-brand equivalents (i.e., copies the national brands, but sold at lower price); and premium, value-added private label that is priced near or above the brand leader (Rivkin, 2006; Forgrieve, 2007). National brands are established brands that do not fall into any of the other brand categories, such as Hormel and Tyson.

Random-Weight Beef

Table 2 contains summary statistics for the continuous variables and table 3 contains the frequency distribution for all discrete variables used to estimate the random-weight hedonic models in this study. For random-weight beef, Nielsen data contain 12 brand names of substance (i.e., those with at least 15 observations per year, and 250,000 pounds purchased annually based on weighted and aggregated quantities across households to obtain a nationally representative total), including six national brands, four private label brands, a company-specific brand, and a breed-specific brand. National brands were less prevalent for ground beef and roast, while the other types of brands were well represented across each cut. To protect proprietary information, we do not divulge the names of specific brands.

The following equation was estimated for each of the three leading cuts of beef:

$$
\begin{aligned}
(1)\quad P = {} & \alpha + \beta_1 YEAR + \beta_2 SIZE + \beta_3 SIZESQ \\
& + \beta_4 ProductForm + \sum_{i=1}^{4} d_i Promotion_i \\
& + \sum_{i=1}^{3} f_i StoreTypes_i + \sum_{i=1}^{3} r_i Region_i \\
& + \sum_{i=1}^{3} l_i PercentLean_i + \sum_{i=1}^{2} q_i SteakCut_i \\
& + \sum_{i=1}^{13} b_i Brand_i + \sum_{i=1}^{11} m_i Month_i + \mu
\end{aligned}
$$

where P is price per pound,[10] the $Brand_i$'s are dummies for the 12 brand names of substance and an "all other brands" category (base=no brand), SIZE is the unit weight of the package purchased by the household, SIZESQ is unit weight squared, the $Promotion_i$'s are dummy variables that account for the four promotion categories (store feature, store coupon, manufacturer coupon, other deal, base=no deal), the $StoreTypes_i$'s are dummies for three store types (supercenter, warehouse club, other, base= grocery stores), the $Region_i$'s are dummies for three of the four regions (South, West, Central, base=East), the $PercentLean_i$'s are dummies for percent lean classifications of ground beef (less than 80%, 80% to 89%, 90% or greater, base=lean not specified), ProductForm is equal to 1 if ground beef is purchased as preformed patties and is equal to 0 if it is purchased in bulk form, the $Month_i$'s are monthly dummy variables (base=December), and μ is a random error term. A dummy variable, YEAR, takes the value 1 for purchases in 2005, and 0 for those in 2004. The $SteakCut_i$'s are dummies for quality of steak cut (Medium, High, base=Low) among fifteen cuts of steak identified in the data.

[10]Beef prices were imputed by dividing expenditures (incorporating any price promotions that may have accompanied the purchase, such as store coupons) by the amount purchased.

Table 2. Description of variables and summary statistics for non-UPC-coded random-weight beef continuous variables

Variables	Description	Ground Beef		Steaks		Roasts	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
		Dependent variable					
P	Price ($/lb)	2.57	0.89	5.23	2.90	2.99	1.40
		Independent variables					
SIZE	Unit weight of the meat (pounds)	2.19	1.70	1.66	1.35	2.87	1.57
SIZESQ	SIZE squared	7.66	15.28	4.59	12.15	10.69	16.37
Number of observations		115,287		87,717		37,851	

Following Parcell and Schroeder (2007), the steak cuts were identified as high, medium, or low quality. High quality steaks included rib, ribeye, tenderloin, and filet mignon. For medium quality steaks, T-bone, sirloin, NY strip, porterhouse, and round were aggregated. Low quality steaks included chuck, flank, blade, London broil, and cube. Although quality grade is an important determinant of prices, this attribute was excluded from this study because it is not included in the Nielsen Homescan data.[11]

Table 2 contains summary statistics for the continuous variables, and Table 3 (see Appendix) presents the frequency distribution for each discrete variable. Ordinary least squares regression models were applied to the data to determine the contribution of each of the variables to retail purchase prices.

Complete regression results for random-weight beef are presented in Table 4 (see Appendix). The goodness-of-measure, as indicated by the adjusted R^2's, ranged from 0.13 for roasts to 0.40 for ground beef. The overall low R^2's reported do not indicate poor model fit, and are to be expected given that panel data are used. In general, the regression results appear reasonable because most of the regression coefficients are statistically significant with expected signs. As noted by Parcell and Schroeder (2007), the low R^2 for roasts is not surprising given the variety of types for which we lack information, while leanness is an important price determinant for ground beef.

For promotions across all cuts, the largest price reductions were associated with manufacturer coupons, followed by store coupons. Price differences across grocery stores, supercenters, and wholesale clubs varied by beef cut. Warehouse clubs had the highest prices for steak and roast, while ground beef was priced the highest at grocery stores. Supercenters had the lowest prices for ground beef and steak. Results also show that as package size increases, price falls at a decreasing rate for each of the cuts, which suggests a volume discount.

Most brands were priced higher compared to unbranded beef. All but one of the ground beef brands were purchased at a premium price. Premiums ranged from $0.12/lb for the "all other brands" category to $1.41 for the company-specific brand. Similarly, all but one of the roast brands were priced at a statistically significant premium. Premiums ranged from $.19/lb for the "all other brand" category to $1.13/lb for "grocery store 2." For steak, all but 3 brands were priced at a premium, with the "grocery store 3" brand priced at a statistically significant discount. Premiums ranged from $.22/lb for "grocery store 1" to $4.08/lb for the company specific brand. Except for "grocery store 3" steak, all other store brands were purchased at a premium price compared to unbranded beef.[12]

[11]According to an analysis of three metropolitan areas of the United States, a considerable percentage of branded beef carried no designation of quality, which suggests that the brand may substitute for the USDA quality grade (Ward, Lusk, and Dutton, 2008a).

[12]Using more recent (2004 through March 2009) retail scanner data from stores across the nation, Schulz, L.L., T.C. Schroeder, and K. White (2010) found that all steak brands analyzed received premiums in excess of $2.00/lb, ranging from $2.05/lb for store brands to $2.95/lb for local private brands.

The highest premiums were found for brands produced through alternative pricing and marketing arrangements. For the company-specific branded ground beef and steak, a family-owned beef company produces the source-verified lines of natural, organic, and grass-fed beef, using enhanced food safety practices. It was one of the first branded beef systems to pay producers according to the true value of each animal, rather than paying an average price for the entire pen of cattle.[13] The company uses contracts with feedlots and ranches where the cattle are born.[14]

Among the five national steak brands, three were purchased at a statistically significant premium compared to unbranded steak, with sizeable differences across brands. National brands 3 and 6 had relatively high premiums. To qualify for national brand 3's program, producers must choose genetics that provide non-black hided cattle with specific quality and yield grade requirements.[15] Cattle supplies are obtained from an alliance between the company, a breed association, and a marketing services provider. Strategic alliances enable firms to share risks and benefits from mutually identified objectives, while allowing partners to maintain their independence (Brocklebank and Hobbs, 2004).

The company that produces national brand 6 was purchased prior to 2004 by a producer-owned "new generation" cooperative. New generation cooperatives are distinguished from traditional cooperatives because they add value to a raw agricultural product through further processing, thereby allowing producers to capture a larger portion of downstream value. Members of the branded beef company purchase or lease shares that entitle them to deliver one head of cattle for each share. Producers are rewarded for delivering high quality cattle based on a grid pricing system that prices individual cattle based on quality and yield grade.[16]

The breed-specific brand premium also ranked among the highest for ground beef, steaks, and roasts. Breed-specific brands are often organized as a brand licensing program (licensed by the breed organization) that typically requires that cattle meet certain genetic requirements (often breed-based), and uses the breed as a proxy for quality (Brocklebank and Hobbs, 2004). They tend to involve loose contract arrangements with the only requirements being that participants are certified to sell beef under the program name and that the breed of cattle can be verified. Producers may choose to sell all or no cattle through the program, and premiums are generally based on yield or quality. Less formal marketing arrangements are possible because of the broad requirements and focus on breed, which can be easily observed.

Regarding ground beef leanness and product form, and quality of the steak cut, ground beef that was 90 percent lean or greater commanded a premium of $0.68/lb compared to ground beef without a leanness specification. Ground beef that was 80 to 89 percent lean received a premium of $0.12/lb, while the less than 80 percent lean category was discounted by $0.16/lb compared to no leanness specification.[17] Preformed ground beef patties were purchased at a premium of $0.26/lb compared to bulk ground beef. This may reflect further processing costs associated with the beef patties or the convenience preferred by time-pressed consumers. For steak, as expected, the higher quality cuts received the largest premiums.

Prices also varied by geographic location and season. All cuts were priced lower in the Central region, and highest in the East or West. Prices were lowest from January to June for

[13]When compensation is based on average price, differences in quality among cattle within the pen are not considered, which quells economic incentives to produce higher quality cattle. High-quality cattle will be under compensated, while low-quality cattle will be over compensated.

[14]The company also has diversified its product offerings to include buffalo and chicken. A strong brand with respect to perceived quality can be exploited by extending the brand to other product categories (Aaker, 1991).

[15]A quality grade is a composite evaluation of factors that affect palatability of meat (tenderness, juiciness, and flavor). Basic quality grades include Prime, Choice, and Select, where Prime represents the highest quality and Select represents the lowest. Yield grades reflect the amount of boneless, closely trimmed retail cuts.

[16]With grid pricing, the price paid for an animal depends on various quality attributes, in addition to weight (Hueth and Lawrence, 2006). This differs from traditional spot markets where price is based on live or carcass weight, with no explicit adjustments for quality.

[17]These results are consistent with previous studies that found a price premium for leaner ground beef (Brester, Lhermite, Goodwin, and Hunt, 1993; Parcell and Schroeder, 2007; Ward, Lusk, and Dutton, 2008b).

ground beef, and February to October for roast, while steak exhibited much more price variation across months.

UPC-Coded Ground Beef

Table 5 (see Appendix) contains summary statistics and frequency distributions for UPC-coded ground beef data used to estimate the hedonic price model (equation 1). The brand names examined include those associated with the top 20 brands in purchase volume, along with the private label category in 2004 and 2005.[18] In addition to ground beef purchased as preformed patties, the UPC-coded data also provides information on ground beef purchased in chub packages.

Regression results are presented in Table 6 (see Appendix). The model explains more of the variation in prices compared to random-weight ground beef, as indicated by the adjusted R^2 of 0.56 compared to 0.40 for random-weight beef. Other than brands, results for most variables were similar to those found in the non-UPC coded random-weight ground beef model.

Brand premiums/discounts ranged from -$1.06/lb to $1.12/lb. The number of brands and brand categories priced at a statistically significant discount compared to unbranded beef was nearly equal to the number that received premiums. As with random-weight beef, the highest premiums were paid for brands produced through alternative pricing systems and vertical coordination arrangements, including brand 12 and brand 7. Brand 12 garnered the highest premium. According to company literature, the line includes natural beef and beef that is cobranded with a breed-specific label. The company that produces cattle for the breed-specific label operates as a division of a breed association to produce high quality, tender, and flavorful beef. The company does not own cattle or beef at any stage of production or processing. As part of the program, cattle must comply with certain carcass specifications, and licenses are sold to processors, distributors, retailers, and restaurants to harvest, fabricate, and sell the beef. In May 2010, it was one of 62 programs certified by USDA inspectors that go beyond requirements for official USDA grades to facilitate the marketing of branded beef products.

The brand 7 company, which had the second highest premium of $1.06/lb, produces naturally-raised, lean beef. Price premiums, relative to the spot market, are paid for lean, heavily muscled cattle that are free of antibiotics and added growth hormones. The beef achieves its leanness through specialized inputs, including the selection of cattle breeds and a feed program that includes grazing and natural feeds. Farmers who produce cattle for the program sign a legal contract agreeing to adhere to the company's requirements regarding feed and other management. Bonus or discounts apply to the contract price on an individual carcass basis.

Among those brands receiving the largest discounts, brand 11 frozen beef patties had the largest discount of $1.06/lb, followed by brand 2 which was purchased at a $0.87/lb discount. In 2005, brand 2 beef patties were voluntarily recalled because of possible E. coli contamination. Following the recall, the brand price was discounted an additional $0.15/lb.[19] According to company literature, the brand 11 company offers a range of branded products are offered to appeal to different customer preferences, including one that is targeted to the cost-conscious consumer. Private label brands were priced at a discount of $0.13/lb compared to unbranded beef, which suggests that these brands are generally positioned as generic, lower-priced alternatives.

We found discounts for less than 80 percent lean (-0.28/lb), and higher premiums for leaner beef ($0.20/lb for 80 to 89 percent lean and $0.63/lb for 90 percent lean or greater) compared to packages with no leanness specification. Premiums were also paid for ground beef purchased in preformed patty form ($0.34/lb) and in chub packages ($0.44/lb) compared to bulk ground beef. The largest price discounts were found in the South (-$0.08/lb), followed by the Central region (-$0.03/lb) (relative to the East). Prices were highest in the West. There was no statistically significant price difference

[18]In 2005, over 100 UPC-coded beef brand names were listed in the Nielsen Homescan Panel data, compared to only 46 non-UPC-coded random-weight brand names.

[19]To capture price adjustments following the recall, an additional dummy variable was added that equals one in the months following the recall, and zero otherwise.

between the East and West. Price discounts were greater at warehouse clubs (-$0.25/lb) than supercenters (-$0.11/lb) (relative to grocery stores). Seasonal differences were also found as prices were statistically significantly lower from January to June compared to the rest of the year. For package size, resulting coefficient estimates were similar to those of random-weight beef, suggesting volume discounting.

Implications and Conclusions

Nielsen Homescan data were used to estimate the effect of observable beef product attributes on retail beef prices. Our results indicate that beef cuts on sale are significantly less than nonsale items, and larger package sizes are purchased at a significant discount. Prices also vary by store format (grocery store, supercenter, or warehouse club), depending on type of beef cut. Use of more recent data (after 2007) would allow us to examine the effect of the recession on sales discounts. Steak prices are higher at warehouse clubs and lower at supercenters, compared to grocery stores. For roasts, prices are higher at both warehouse clubs and supercenters compared to grocery stores, while for both random-weight and UPC-coded ground beef, prices are highest at grocery stores.

The data were national in scope and collected over the 2004 and 2005 calendar years. Results indicate that prices vary by region, with the lowest prices occurring in the Central region for random-weight beef. For UPC-coded ground beef, the lowest prices are found in the South, but regional differences are smaller than random-weight ground beef. Random-weight steaks and roasts exhibit greater seasonal variation than both random-weight and UPC-coded ground beef.

Most random-weight beef brands contained in the Nielsen Homescan data garner premiums compared to unbranded products, but premiums varied widely across brands. For example, for steak, premiums range from $0.21/lb for a store brand to $4.15/lb for a brand produced with specific production protocols, including grass fed and source verified. There is much greater variation in brand premiums across specific steak brands than for the aggregate brand categories found by Schulz et al. (2010). For most private-label brands, random-weight beef brands are purchased at a premium compared to unbranded beef. Conversely, the UPC-coded ground beef private label category as a whole is discounted. UPC-coded ground beef brands are evenly split between those purchased at a premium and those purchased at a discount compared to unbranded beef. This suggests that a considerable number of these brands target cost-conscious consumers. While the classification of brand types is restricted by the data source used, efforts to develop common nomenclature would facilitate brand comparisons across studies.

By evaluating specific brands, we were able to identify the production protocols used for the branded products. The highest premiums are paid for those brands with specific production or quality requirements. Branding programs receiving the highest premiums also rely on alternative marketing arrangements (e.g., alliances, contracts, cooperatives). This suggests that premiums for value-added, branded products may strengthen incentives for producers and processors to enter into these arrangements to achieve the necessary coordination and quality control.

Shifts to alternative marketing arrangements in the beef industry have led to concerns about market power, and policy proposals to restrict the types of marketing arrangements used (Anderson and Hudson, 2008; Ferrell and Rumley, 2011). The potential role of these arrangements in facilitating industry efforts to capture premiums associated with consumers' willingness to pay for quality attributes in branded product lines should also be considered. Less market-distorting policy alternatives to restrictions on marketing arrangements may be those that facilitate the marketing of value-added, branded products, such as USDA quality certification programs.

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Appendix

Table 3. Description of variables and frequency distribution for non-UPC-coded random-weight beef discrete variables

		Percent of total		
Variables	Description	Ground beef	Steaks	Roasts
	Independent variables			
YEAR	= 1 in 2005, 0 otherwise	47.6	49.1	48.0
$Promotion_i$	Type of promotion (base=no deal)	70.9	57.0	49.6
	i= store feature	23.9	35.7	44.0
	store coupon	3.6	5.4	4.8
	manufacturer coupon	0.2	0.2	0.2
	other deal	1.5	1.7	1.5
$StoreType_i$	Type of retailer (base=grocery stores)	84.2	85.2	85.7
	i= supercenter	4.8	4.1	3.3
	warehouse club	5.0	5.3	6.2
	other	6.0	5.4	4.8
$Region_i$	Region of household (base=East)	23.3	20.3	27.9
	i= South	42.9	40.4	35.1
	West	15.8	20.8	20.6
	Central	18.1	18.5	16.4
$PercentLean_i$	Ground beef percent lean (base=lean not specified)	12.4	N/A	N/A
	i= less than 80%	13.9	N/A	N/A
	80%-89%	45.0	N/A	N/A
	90% or greater	28.7	N/A	N/A
ProductForm	= 1 if ground beef purchased as preformed patties, 0 if bulk	8.2	N/A	N/A
$SteakCut_i$	Quality of steak cut (base=low)	N/A	25.7	N/A
	i= Medium	N/A	52.6	N/A
	High	N/A	21.7	N/A
$Brand_i$	Brand name (base=no brand)	79.4	75.8	76.4
	National brands			
	i= National brand 1	0.1	N/A	N/A
	National brand 2	N/A	0.2	0.1
	National brand 3	N/A	0.1	N/A
	National brand 4	N/A	0.1	N/A
	National brand 5	N/A	0.1	N/A
	National brand 6	N/A	0.04	N/A
	Private label			
	Grocery store 1	0.4	0.5	0.2
	Grocery store 2	0.4	0.4	0.4
	Grocery store 3	0.1	0.1	N/A
	Club store	1.1	1.3	1.2
	Company-specific brand	0.2	0.1	N/A
	Breed-specific brand	0.1	0.2	0.3
	All other brands	18.3	21.1	21.3
$Month_i$	Purchase month (base=Dec.)	6.5	5.8	8.2
	i= Jan.	10.7	9.5	10.7
	Feb.	8.4	8.1	8.3
	March	8.4	7.9	8.7
	April	8.5	8.4	8.8
	May	9.1	9.4	8.0
	June	7.9	9.0	7.5
	July	8.3	9.5	7.2
	August	8.2	9.4	7.7
	September	8.0	8.6	8.2
	October	8.6	8.4	9.7
	November	7.2	6.2	7.1

N/A=Not applicable.

Table 4. Regression results for non-UPC-coded random-weight beef prices, 2004-2005

	Ground beef		Steaks		Roasts	
	Parameter estimate	*Standard error*	*Parameter estimate*	*Standard error*	*Parameter estimate*	*Standard error*
Intercept	3.15*	.014	5.35*	.043	4.62*	.048
Year (base=2004)	.14*	.004	.11*	.016	.11*	.014
Unit size (pounds)	-0.33*	.006	-.85*	.020	-.39*	.022
Unit size squared	.02*	.001	.05*	.003	.03*	.003
Price promotions (base=no sale)						
Store feature	-.38*	.005	-.76*	.018	-.46*	.015
Store coupon	-.77*	.012	-1.61*	.036	-1.03*	.035
Manufacturer Coupon	-1.19*	.060	-2.35*	.193	-1.30*	.180
Other deal	-.40*	.022	-.76*	.063	-.28*	.054
Store format (base=grocery stores)						
Supercenters	-.28*	.008	-.59*	.030	.07*	.024
Warehouse clubs	-.22*	.012	1.07*	.038	.61*	.034
Other	-.71*	.011	-.72*	.040	-.33*	.036
Percent lean (base=lean not specified)[1]						
Less than 80%	-.16*	.008	N/A	N/A	N/A	N/A
80%-89%	.12*	.007	N/A	N/A	N/A	N/A
90% or greater	.68*	.008	N/A	N/A	N/A	N/A
Product form (base=bulk ground)						
Preformed patties	.26*	.009	N/A	N/A	N/A	N/A
Steak quality (base=low)						
Medium	N/A	N/A	1.53*	.015	N/A	N/A
High	N/A	N/A	4.00*	.027	N/A	N/A
Region (base=East)						
South	-.18*	.005	-.26*	.023	-.12*	.017
West	.09*	.007	-.36*	.027	.03	.022
Central	-.25*	.006	-.62*	.027	-.40*	.020
Brands (base=no brand)						
National brands						
National brand 1	-.14*	.037	N/A	N/A	N/A	N/A
National brand 2	N/A	N/A	.03	.191	.05	.124
National brand 3	N/A	N/A	1.99*	.446	N/A	N/A
National brand 5	N/A	N/A	-.02	.211	N/A	N/A
National brand 6	N/A	N/A	1.09**	.450	N/A	N/A
Private label						
Grocery store 1	.43*	.036	.22**	.088	.25*	.095
Grocery store 2	.42*	.029	.41*	.098	1.13*	.107
Grocery store 3	.33*	.063	-.51*	.195	N/A	N/A
Club store	.22*	.015	.78*	.063	.39*	.078
Company-specific brand	1.41*	.063	4.08*	.264	N/A	N/A
Breed-specific brand	.49*	.053	.82*	.168	.43*	.112
All other brands	.12*	.006	.30*	.022	.19*	.018

Table 4. (Continued)
Regression results for non-UPC-coded random-weight beef prices, 2004-2005

	Ground beef		Steaks		Roasts	
	Parameter estimate	*Standard error*	*Parameter estimate*	*Standard error*	*Parameter estimate*	*Standard error*
Month (base=Dec.)						
Jan.	-.07*	.010	-.21*	.042	-.54*	.036
Feb.	-.08*	.011	-.18*	.043	-.64*	.037
March	-.09*	.011	-.17*	.043	-.59*	.038
April	-.08*	.011	.06	.044	-.65*	.038
May	-.08*	.010	.14*	.043	-.69*	.038
June	-.07*	.011	.13*	.043	-.70*	.038
July	-.05*	.011	.01	.043	-.67*	.038
August	-.02**	.011	-.10**	.042	-.71*	.037
Sept.	-.02	.011	-.05	.043	-.69*	.038
Oct.	-.04*	.011	-.17*	.042	-.67*	.036
Nov.	-.03*	.011	-.12*	.045	-.37*	.041
No. of observations	115,287		87,717		37,851	
Root MSE	.69		2.40		1.31	
Adjusted R^2	.40		.31		.13	
Highest condition index[2]	17.07		15.81		16.68	
White's Test[3]	3899.0		7301.0		1499.0	

N/A=Not applicable.
Notes: One asterisk indicates the coefficient is statistically significant at the 1% level. Two asterisks indicates significance at the 5% level.
[1]Ground beef only.
[2]Low condition indices for each regression suggest that collinearity is not strong.
[3]White's test for heteroskedasticity was significant for each regression. Standard errors are from White's asymptotic consistent covariance matrix, which provides heteroskedasticity-consistent test results for parameter estimates.
Source: Underlying data from Nielsen Homescan data.

Table 5. Summary statistics (continuous variables) and frequency distribution (discrete variables) for UPC-coded ground beef

Summary statistics for continuous variables

Variables	Description	Mean	Std. Dev.
	Dependent variable		
P	Price ($/lb)	2.25	0.84
	Independent variables		
SIZE	Unit weight of the meat (pounds)	2.99	2.02
SIZESQ	SIZE squared	13.01	17.08

Frequency distribution for independent discrete variables

Variables	Description	Percent of total
YEAR	= 1 in 2005, 0 otherwise	52.5
$Promotion_i$	Type of promotion (base=no deal)	47.5
	i= store feature	78.4
	store coupon	19.4
	manufacturer coupon	1.2
	other deal	0.3

Table 5. (Continued)
Summary statistics (continuous variables) and frequency distribution (discrete variables) for UPC-coded ground beef

Variables	Description	Percent of total
$StoreType_i$	Type of retailer (base=grocery stores)	65.1
	i= supercenter	22.6
	warehouse club	9.5
	other	2.8
Region	Region of household (base=East)	12.4
	i= South	45.4
	West	23.4
	Central	18.7
Percent $Lean_i$	Percent lean (base=lean not specified)	50.1
	i= less than 80%	14.6
	80%-89%	18.6
	90% or greater	16.6
Product $Type_i$	Product type (base=bulk)	59.2
	i=ground chub	4.8
	preformed patties	35.9
$Brand_i$	Brands (base=no brand)	32.0
	Top 20 brands	
	i=Brand 1	2.7
	Brand 2	2.0
	Brand 3	3.2
	Brand 4	2.7
	Brand 5	1.7
	Brand 6	0.3
	Brand 7 (company-specific brand)	2.2
	Brand 8	4.5
	Brand 9	0.6
	Brand 10	2.3
	Brand 11	0.4
	Brand 12	2.4
	Brand 13	0.3
	Brand 14	0.3
	Brand 15	0.3
	Brand 16	0.5
	Brand 17	0.6
	Brand 18	0.4
	Brand 19	0.4
	Brand 20	0.4
	Private label brands	35.2
	All other brands	4.8
$Month_i$	Month (base=Dec.)	6.2
	i= Jan.	8.7
	Feb.	6.6
	March	7.1
	April	8.1
	May	10.4
	June	9.8
	July	11.0
	August	9.4
	Sept.	8.4
	Oct.	7.9
	Nov.	6.5
Number of observations	19,381	

Effects of Elicitation Method on Willingness-to-Pay: Evidence from the Field

Jared G. Carlberg and Eve J. Froehlich

This paper compares willingness-to-pay (WTP) estimates elicited using three separate methods: in-store experimental auctions, a mailed survey with a cheap talk script included, and the same survey with no script. The products in question were four steaks bearing hypothetical brands representing various brandable attributes. It is found that WTP elicited using experimental auctions was the lowest, followed by WTP elicited by the mail survey with a cheap talk script, then the mail survey with no cheap talk script. Tobit and double-hurdle econometric models are used to identify factors influencing respondents' WTP; model results are largely consistent with previous findings.

A considerable number of empirical studies have been undertaken to determine willingness-to-pay (WTP) for a variety of products. Methods for eliciting WTP have evolved considerably since the earliest work in the field, resulting in a rich variety of experimental auction and contingent valuation methods now being available to researchers. Differences in cost and complexity among elicitation methods are considerable, and as a result, a wide variety of methods are commonly used in both the field of experimental economics and for practical purposes in market research.

The body of literature exploring the effects of elicitation method upon WTP is vast. Extensive work has been undertaken to develop techniques to ensure precise estimates of WTP. However, some issues relating to effects of elicitation method upon WTP estimates remain unexplored; for example opportunities remain to compare results from field experiments with those from a mail survey using a common product. Additionally, the literature comparing econometric estimates based on data from different elicitation methods is relatively sparse.

There are three principal objectives of the research reported in this paper. The first is to determine the effect of elicitation method upon stated WTP for brand-name steaks in Canada. No researchers have previously attempted to compare WTP estimates from experimental auctions with those from mail surveys. The second objective is to quantify the effects of "cheap talk" (i.e. instructions regarding the presence and reasons for overstatement of bids in a hypothetical buying situation) in reducing hypothetical bias. If the form of experimental auction chosen is incentive compatible, then a comparison of bids from these auctions with results from a survey incorporating cheap talk should illustrate the extent to which cheap talk mitigates hypothetical bias. The third and final objective is to model the factors affecting WTP for the fictional steak brands developed for the research. The finding that econometric models based upon experimental auction vs. survey results have substantially different results has important implications from a research perspective.

Five sections comprise the remainder of this paper. First, the fictional steak brands developed for this research are described. An overview of the survey and experimental auction methodologies is then provided, followed by a section outlining the theory behind and econometric procedure used to estimate the WTP models. Results of the experimental auctions and surveys are then presented and discussed, along with estimates from the econometric models. The concluding section summarizes findings, acknowledges limitations, and makes suggestions for future work.

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Steak Brands

Froehlich, Carlberg and Ward (2009) observe there are almost no fresh brand-name beef offerings in Canada, a marked difference from the

U.S. case. Accordingly, it was necessary to develop fictional brands to assess WTP. Four steak brands were developed for this research: a local/Canadian brand, a guaranteed tender brand, a natural beef brand, and an Angus brand. Froehlich, Carlberg and Ward (2009) provide further details on the process used to develop the brands and provide complete descriptions for each. Logos for the brands are given in Figure 1. WTP for Canada AAA beef, the second-highest grade of beef available (only 2% of beef grades above AAA) was also elicited from auction participants and survey respondents.

(a) Prairie Prime logo

(b) Tender Grill logo

(c) Nature's Diamond logo

(d) Original Angus logo

Figure 1. Steak Brand Logos

Prairie Prime was the fictional local Canadian brand developed for the research. Steaks bearing this brand were described as being born and raised in the Canadian Prairies and were certified to grade AAA (equivalent to USDA choice) or higher. Additionally, Prairie Prime beef was guaranteed to be aged a minimum of 14 days. The guaranteed tender brand used to measure consumer WTP was called *Tender Grill*. Participants were informed this brand of beef was tested for tenderness using the Warner-Bratzler shear force test, which allowed the steaks to be certified as tender. The steaks were also described as having been aged a minimum of 21 days, but no grade guarantee was given.

The beef brand marketed as being derived from cattle never given growth hormones or antibiotics was called *Nature's Diamond*. This "natural" beef brand also claimed animals were pasture-fed for 15 months prior to 120 days of grain finishing, were raised using environmentally friendly production methods, and received only chemical-free, natural feed and clean water. No guaranteed minimums for grade or dry aging time were provided. *Original Angus* was the fictional brand used in this research to represent the breed-specific characteristic that has enjoyed widespread demand for many years in the U.S. Steaks bearing this brand were positioned as being derived from beef that was grain fed, dry aged a minimum of 14 days, and verifiably Angus in origin. Emphasis was placed upon careful selection of animals for inclusion in the branding program as well as upon involvement of both the national Angus breed association and independent federal inspectors in monitoring and inspection along the supply chain.

Experiment and Survey Methodology

The use of experimental auctions to elicit WTP has risen as the selection of contemporary auction mechanisms has grown. An experimental auction can be used to elicit a participant's WTP in a manner that is designed to reflect their true valuation of a product. In an experimental auction, measurement of WTP involves the use of actual money; this distinguishes the method from the hypothetical situation that exists when a survey method is used (Lusk et al 2001).

An experimental auction is *incentive compatible* if it elicits values that reflect participants' true WTP. There are numerous different experimental auction designs available to researchers, and incentive compatibility is often of paramount importance in choice of design. For this condition to be met, the participant must have an incentive not to over or understate their bid: if a participant understates their bid, they risk not purchasing a product that is valuable to them, whereas overstatement may result in a situation where the respondent is forced to purchase a product for more than it is worth to them (Feldkamp, Schroeder and Lusk 2005; Umberger and Feuz 2004).

Various types of experimental auctions can be used by researchers to elicit WTP. One of the most popular in recent years has been the Becker-DeGroot-Marshack (BDM) (1964) method. A number of agricultural economists have used this technique; examples include Feldkamp, Schroeder and Lusk (2005); Lusk et al (2001); and Lusk and Fox (2003). In a BDM auction, participants do not bid against one another; rather they evaluate a particular good then are asked to submit a bid. If their bid is greater than a randomly selected price, the participant is obliged to pay *the randomly selected price* (i.e. not the amount they bid) for the item. BDM auctions are incentive compatible.

The BDM method was chosen for this research for a number of reasons. First, the approach is easy to explain to participants and it is easy for them to understand relative to other auction designs (Lusk et al 2001). The BDM auction does not take repeated practice rounds for participants to learn how the auction works. Second, BDM auctions tend to have fewer non-responses and thus less non-response bias than other auction mechanisms and certainly less than contingent valuation (Lusk et al 2001). The BDM design has fewer non-responses because of ease of participation. Participants do not have to go out of their way on second day and drive to a location where another type of experimental auction would be conducted in a group setting (Feldkamp, Schroeder and Lusk 2005). In other words, there is less opportunity cost for the participants to partake in the study than in other experimental auction procedures. Response rates are also generally higher than when contingent valuation is used and a mail survey is simply sent out.

The major alternative to experimental auctions is contingent valuation, a popular method used to elicit willingness-to-pay values from consumers. In agribusiness applications, typically a novel product is described in detail and the participant is asked to state hypothetically in monetary terms how much they would be willing to pay for the good in question or are asked whether they are willing-to-pay a stated amount for the good. When consumers make decisions about what goods to purchase, they evaluate the utility of the attributes of each of the goods and maximize their expected utility by choosing a good with the optimal combination of attributes (Ness and Gerhardy 1994). Sometimes the consumer must make trade offs to achieve the most important attributes they desire in a good. For example, if a consumer's primary concern is a 'natural' beef product, the consumer must be willing to trade off a low price attribute to obtain the 'natural' beef product. Contingent valuation is used to determine a consumer's most preferred attributes and ultimately most preferred goods. This type of method has been used by agricultural economists such as Neill et al (1994), Brown et al (1996) and Loomis, Gonzalez-Caban and Gregory (1996), among others.

The use of a "cheap talk" script involves instructing participants to respond as if they were making a real-world rather than hypothetical purchasing decision. Much of the early work behind cheap talk originated with Loomis, Gonzalez-Caban and Gregory (1996), though they neither coined the term nor actually developed cheap talk itself. Using an open-ended survey instrument, they requested the subjects refrain from bidding what they thought to be the fair market value of the good and instead bid as though they were in a real market and actually had the opportunity to buy the good. Additionally, participants were asked to take their budget constraints into consideration when formulating their bid. Despite these efforts, the authors were unable to demonstrate that that these reminders were effective in eliminating hypothetical bias. Later work by Cummings and Taylor (1999) introduced cheap talk the way most researchers

use it today, and List (2001, 2003) extended the applicability of Cummings and Taylor's cheap talk method to a real functioning market as opposed to a classroom setting.

Data for this study were obtained using 274 BDM experimental auctions carried out in seven grocery stores from two major chains in and around the city of Winnipeg, Manitoba. Auctions were conducted at various times of the day during normal store hours on both weekdays and weekends and about 75% of the persons invited to participate agreed to do so. Each auction, conducted near the meat counter in participating grocery stores, took between five and seven minutes to complete after participants had read a two-page information sheet detailing the steak brands and their attributes. Additional information on the auction methodology and information provided to auction participants can be found in Froehlich, Carlberg and Ward (2009).

A mailed survey of 5,100 recipients was also conducted on a random sample of Canadian consumers excluding Quebec (due to its large francophone population) and the three Canadian territories (mostly only frozen beef is available in the northern territories). The survey was designed to be as similar to the BDM auction as possible. Random addresses were purchased from a reputable market research firm. A Canadian one-dollar coin was included with the cover letter of each survey to provide an incentive to complete and return the questionnaire. A reminder postcard was mailed to recipients three weeks following the original survey mailing.

Survey recipients also received a "Steak Fact Sheet" which described the hypothetical brands; this was the same information that was provided to experimental auction participants. Recipients were requested to complete a two page questionnaire and mail it back in the prepaid postage envelope provided. Two separate treatments of the survey were used: the first contained, in addition to the survey package (cover letter, business reply envelope, steak fact sheet and survey instrument), an information sheet discussing how people tend to overstate their willingness-to-pay for products and services in a hypothetical setting (this is referred to as the "cheap talk script"). This cheap talk script was identical to the one used in Lusk (2003) who made small modifications to the original devised by Cummings and Taylor (1999). The script provides an overview of the problem of hypothetical bias, discusses why it may occur and requests that the respondent avoid hypothetical bias when completing the survey. The other survey treatment simply received no cheap talk script.

Theory and Econometric Procedure

Lancaster (1966) observed that a major weakness of consumer demand theory at the time was that it omitted consideration of a good's intrinsic properties. He noted that it is a good's characteristics, rather than the good itself, that determine its value. This concept was extended by Ladd and Martin (1976), who modeled demand for a good as a function of a product's characteristics, along with prices and income. A substantial number of subsequent empirical price analyses have employed this type of framework.

Hedonic price functions are commonly used to empirically estimate the relationship between a good's price and its attributes. Goodman (1998) observes that although earliest use of this type of function is often attributed to Griliches (1958), in fact Court's (1939) work on automobile price indices was the first use of such functions. A simple yet accurate description of hedonic price functions is provided by Nesheim (2006), who observes they "…describe the equilibrium relationship between the economically relevant characteristics of a product or service (or bundle of products) and its price." This definition seems in line with the Lancastrian framework outlined above, and so a hedonic function is employed in this paper to model WTP. Hedonic models are sometimes criticized for a variety of reasons, including the so-called "adding up" problem whereby the value of all attributes, when summed, does not equal a product's price. The reader is thus urged to interpret results with caution.

The model used to describe the relationship between stated WTP and the attributes of the branded steak in question as well as the demographic characteristics of participants is

(1) $WTP_{ij} = \alpha + \beta_1 \times beef\ eaten + \beta_2 \times like\ name + \beta_3 \times confidence + \beta_4 \times gender + \beta_5 \times age + \beta_6 \times income + \beta_7 \times education + e,$

where WTP_{ij} gives the willingness-to-pay for the j^{th} steak stated by the i^{th} respondent, *beef eaten* is the number of times per week the respondent eats beef, *like brand* is the respondent's rating of how much they like the fictional brand on a 7-point Likert scale, *confidence* is the respondent's self-assessment of their ability to select beef on a 7-point Likert scale, the remainder of variables are demographic characteristics of respondents, and *e* is the error term. All of age, income and education were measured as categorical variables.

Because auction participants and survey respondents were not allowed to state negative amounts for premiums, the WTP data are left-censored (censored from below) (Lusk and Shogren 2007). As such, any econometric procedure used to estimate equation (1) must take this characteristic of the data into account; failure to do so could result in biased estimates (Amemiya 1973). The tobit model (Tobin 1958) can be used when left-censored data are encountered. This method explains the relationship between a non-negative latent dependent variable and one or more independent variables, and unlike ordinary least squares, takes explicit account of the limited nature of the dependent variable, yielding unbiased parameter estimates.

Cragg's (1971) double-hurdle model recognizes that left-censored and uncensored data could be affected in disparate ways by various factors included in a model. For example, a given regressor could exert a positive (negative) influence upon a respondent's stated WTP, but a negative (positive) influence upon the likelihood that a respondent reports a zero bid for the good in question (Lusk and Shogren 2007). In order to use the double-hurdle technique, three separate models must be used: tobit, binomial probit, and truncated tobit. The log-likelihood statistic is captured from each, then used to calculate the following likelihood ratio statistic:

(2) $LR = -2[lnLF_{Tobit} - lnLF_{Binomial\ Probit} - lnLF_{Truncated\ Regression}]$.

This test statistic is then compared to a critical value from the chi-squared distribution, with the degrees of freedom equal to the number of independent variables in the model. If the null hypothesis that the tobit model is the correct specification is rejected, then the double-hurdle model should be used. The interested reader is invited to consult Lusk and Shogren (2007) for additional details on use of the double-hurdle model.

Results

Table 1 shows the mean WTP by elicitation method for each of the fictional steak brands along with Canada AAA beef. Stated WTP elicited via the "conventional" survey is highest for each fictional brand, WTP from the survey containing a cheap talk script is the second-highest, and bids from the experimental auctions are the lowest. In general, WTP was highest for the Original Angus steak, followed by Nature's Diamond, Tender Grill and Prairie Prime. Generic Canada AAA beef generally had the lowest stated WTP. Table 1 also provides results of t-tests for statistical equivalence of average WTP by elicitation method.

Table 1. Mean Consumer Willingness-to-pay in each treatment and t-test results

Steak	Experimental Auction ($/steak)	Cheap Talk Survey ($/steak)	Conventional Survey ($/steak)
Canada AAA	1.116	1.425[a]	1.472[a,d]
Prairie Prime	1.205	1.406[a]	1.481[a,d]
Tender Grill	1.317	1.431[c]	1.567[a,d]
Nature's Diamond	1.312	1.576[a]	1.767[a,e]
Original Angus	1.308	1.641[a]	1.810[a,e]

[a] indicates statistically different from the experimental auction at $\alpha = 0.05$.
[b] indicates statistically different from the experimental auction at $\alpha = 0.10$
[c] indicates not statistically different from the experimental auction
[d] indicates not statistically different from the cheap talk survey
[e] indicates statistically different from the cheap talk survey at $\alpha = 0.10$

The effectiveness of the cheap talk script in mitigating hypothetical bias can be quantified

approximately by calculating the difference in stated WTP for the five steaks across the two survey treatments. It should be noted that although average WTP for the cheap talk survey was lower than for the conventional survey for every beef brand, the WTP were only *statistically* different for two brands; this implies that caution should be exercised in interpreting these results. In percentage terms, the cheap talk script appears to have lowered stated WTP by between 2.8% (for Canada AAA beef) and 12% (for Original Angus). In general, the reduction in bids was smallest for the steaks with the fewest premium quality attributes (Canada AAA and Prairie Prime) and highest for those with several (Original Angus and Nature's Diamond). If WTP estimates elicited by the BDM auction are regarded as incentive compatible, then the difference between auction and cheap talk survey results approximates the amount of hypothetical bias remaining despite the use of a cheap talk script, of course recognizing that there are other potential reasons for the differences in stated WTP. Results from the auctions are lower by amounts ranging from 8.3% (for Tender Grill) to 27.7% (for Canada AAA beef).

Willingness-to-pay estimates elicited via BDM auctions were thus 20% lower on average than those elicited by a mail survey incorporating a cheap talk script. This is a potentially important finding for those engaged in market research—given the ease and relatively low cost of reaching a wide range of respondents via mail survey, the benefits of using this method are clear. However, researchers should interpret results of such surveys with caution, noting the results here imply a significant amount of hypothetical bias exists in this contingent valuation method, even when a cheap talk script is used.

Treatment costs invariably influence selection of elicitation method. For this research, per-survey costs were calculated to be $3.72, including stationary, printing, postage, student assistance and the $1 monetary incentive provided. Costs for the BDM auction amounted to $16.39 per response, including steaks, stationary (for steak information sheets), student assistance, and miscellaneous related costs. Though this cost discrepancy seems considerable, it must be remembered that the response rate for auctions is effectively one hundred percent—almost no costs are incurred for people who choose not to participate. By contrast, survey costs (except business reply postage, if it is used) are incurred for each recipient, regardless of whether they complete and return the survey.

Given this research's survey response rate of 28%, approximately 3.57 surveys were required to generate one usable response, yielding a cost per usable response of $13.29 (3.57 × $3.72). It should be noted that this response rate is unusually high for a "cold" mail survey (i.e. one being administered by an institution with whom the recipient has no prior relationship and pertaining to an issue with which the recipient has no expected prior specialized knowledge); a lower response rate would result in a higher cost per usable response—for example, a 20% response rate would result in a cost of $18.60 per response, even higher than the BDM auction cost of $16.39. Given the apparent bias associated with survey results compared to the incentive compatible BDM auctions, the benefits of employing a "cheap" mail survey instead of experimental auctions to measure WTP are somewhat questionable. Having said that, the costs of conducting market research across a wider geographic region will increase dramatically if experimental auctions rather than mail surveys are chosen.

Results of the tobit and double-hurdle econometric models of WTP for each elicitation method and fictional brand are shown in Table2. Fifteen models were estimated (four brands plus Canada AAA for each of three elicitation methods). The tobit model was rejected in favor of the double-hurdle model in most (but not all) cases. *Like name* exerted a positive and statistically significant influence upon WTP in nearly every model, demonstrating the importance of careful development of brand name and logo, as well as product information, when measuring WTP for a new product.

Though not statistically significant in all cases, most of the demographic variable coefficients were of the expected sign. There was no strong expectation on the sign for gender (female = 0; male = 1); Feuz et al. (2004) found males willing to pay more than females for steaks with various quality attributes whereas

Lusk, Feldkamp and Schroeder (2004) discovered a higher WTP for females. This variable was only statistically significant in three models; in each case, males were found to have the higher WTP. An interesting observation from the cheap talk survey was that for females, the brand with the highest mean willingness-to-pay was Nature's Diamond, whereas for males it was Original Angus.

Respondent age was statistically significant in four models and exerted a negative influence upon WTP in each of those cases, indicating that older respondents were less receptive to the attributes associated with the brand name steaks than younger ones. This is in line with the findings of Feuz et al (2004) and Lusk, Feldkamp and Schroeder (2004) who also discovered a negative relationship between respondent age and WTP. Several other researchers, including Lusk et al (2001), found this relationship to be indeterminate.

As predicted by economic theory, respondent income exerted a pervasively positive impact upon WTP, although the relationship was only statistically significant in five of the models. This reaffirms the findings of Lusk and Fox (2002). Results for education, the final demographic variable, were mixed: a positive and statistically significant result was discovered for two of the models; in two others the coefficient was negative and significant. Perhaps most interestingly, the coefficient was positive and significant in the experimental auction and conventional survey models for the Nature's Diamond brand, but negative and significant in the cheap talk model. Other research has discovered similarly mixed results: Lusk, Feldkamp and Schroeder (2004) found the relationship between education and WTP to be inverse, whereas Lusk and Fox (2002) found it to be positive. Similar to the findings of the present research, Lusk et al (2001) discovered the variable to have opposite signs in different treatments.

Econometric results for *beef eaten* are among the most intriguing—the relationship between WTP and this variable is significant and positive in three cases and negative in two others. Each of the positive findings is for WTP measured using an experimental auction, whereas both the negative findings come from data gathered using the conventional survey treatment. Given the BDM auction has been demonstrated to be incentive compatible and that auction participants were actual grocery shoppers approaching the meat counter in a supermarket, it is probably logical to characterize the experimental auction results as more reliable. This may indicate that purchasing decisions made in an experimental auction vs. hypothetical environment have consequences that go beyond mere differences in WTP estimates; it may be the case that results from mailed surveys are highly questionable in terms of reliability for this type of good. Similarly, each of the three cases where a negative and significant relationship was discovered between WTP and *confidence* used experimental auction data in estimation, while the two instances where a positive relationship were found used survey data. Again, it may be appropriate to characterize the BDM auction results as superior to those from the mailed surveys.

The fact that coefficients for the same variables within a common model can possess statistically significant coefficients opposite in sign depending upon WTP elicitation method is a potentially important finding for researchers. Auction participants were active shoppers approaching the meat counter in a grocery store whereas survey recipients are most likely in their home completing the survey; thus the importance of market research using "active" vs. "passive" (or hypothetical) shoppers may be important. Understanding of factors affecting consumers' purchasing decisions should be of extreme importance to firms in a marketplace. Decisions on market segmentation and advertising expenditures can depend critically on this understanding. Results reported here suggest careful selection of marketing research tools is in order—quantitative analysis based upon biased data has the potential to lead to suboptimal decision making by firms.

Conclusions

The three objectives of the paper were to determine the effect of elicitation method upon WTP for brand name steaks in Canada, to quantify the effects of cheap talk in reducing hypothetical bias, and to model the factors affecting WTP for

four fictional brands representing various steak attributes. Data from experimental auctions as well as cheap talk and "conventional" treatments of a mail survey were used in a hedonic model of consumer WTP.

Results of the research suggest that for each of the four fictional brands (as well as the generic Canada AAA steak), average stated WTP from the "conventional" mail survey treatment was the highest, followed by that from the cheap talk treatment. Average WTP from the incentive compatible BDM auctions was the lowest. Although a cheap talk script does result in lower stated WTP than the "conventional" treatment in a mail survey, stated WTP is still much higher than that elicited using incentive compatible BDM experimental auctions. This indicates that significant bias remains, even when a cheap talk script is used. It was also discovered that there exists a relatively small per-response cost difference between the two methods if non-responses by survey recipients are taken into account.

Findings from tobit and double-hurdle econometric modeling suggest consumer preference for brand name and logo results in higher WTP for steaks bearing brands that represent various desirable steak attributes. Demographic variables were found in several cases to exert statistically significant effects upon WTP that were mixed in some cases, but largely in agreement with both economic theory and the findings of previous researchers.

It was discovered that data gathered using different WTP elicitation methods can generate conflicting results within a common model. Respondents' self-assessed confidence in selecting beef was found to exert a negative effect upon WTP using experimental auction data, but a positive effect (though only for Canada AAA steak) using survey data. Similarly, the frequency with which respondents eat beef exerted a positive effect upon WTP using data from experimental auctions but negative effects when survey data were used. This is potentially important to not only experimenters, but also to firms hoping to use quantitative analysis of market research data for strategic purposes.

A number of opportunities exist to extend this work. Similar comparisons of WTP data from different elicitation methods should be used to determine whether the findings of this research are robust across experimental methods. This research used experiments in the field to measure WTP from auctions and compare it to results from a mail survey; perhaps experiments in a laboratory setting could be used to reaffirm these findings. Alternative products could also be used—it would be worthwhile to explore the extent to which various factors affect WTP for other types of goods, and whether there are similar effects of treatment upon stated WTP levels for alternate products.

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Appendix

Table 2. Tobit and double-hurdle econometric model results, all treatments

	Canada AAA			Prairie Prime			Tender Grill			Nature's Diamond			Original Angus		
	EA[a]	CT[b]	Conv.[a]	EA[a]	CT[a]	Conv.[a]	EA[b]	CT[a]	Conv.[b]	EA[a]	CT[a]	Conv.[a]	EA[a]	CT[a]	Conv.[a]
Intercept	0.22	1.01*	-1.52	-0.69	-0.54	0.10	0.85*	2.46	1.68**	-3.34*	2.67**	-3.13	-0.71	1.34	-0.19
	(0.74)	(0.58)	(1.54)	(1.05)	(1.29)	(1.74)	(0.45)	(1.62)	(0.53)	(1.75)	(1.07)	(2.34)	(0.70)	(1.74)	(1.58)
Beef Eaten	0.19**	0.10	-0.02	0.10	0.06	-0.24*	0.12**	0.03	-0.12*	0.06	-0.11	0.19	0.24**	-0.18	-0.11
	(0.08)	(0.07)	(0.10)	(0.11)	(0.10)	(0.14)	(0.06)	(0.11)	(0.07)	(0.16)	(0.10)	(0.12)	(0.09)	(0.13)	(0.12)
Like Name	n/a	n/a	n/a	0.34**	0.04	0.12	0.26**	0.03	0.42**	0.39**	0.34**	0.52**	0.24**	0.60**	0.60**
	n/a	n/a	n/a	(0.14)	(0.09)	(0.14)	(0.06)	(0.12)	(0.07)	(0.15)	(0.08)	(0.13)	(0.11)	(0.14)	(0.17)
Confidence	-0.10	0.10*	0.19*	-0.26**	-0.08	0.15	-0.11*	-0.11*	0.06	-0.27**	0.06	0.01	-0.10	0.04	0.04
	(0.07)	(0.06)	(0.10)	(0.11)	(0.08)	(0.11)	(0.06)	(0.09)	(0.06)	(0.14)	(0.08)	(0.12)	(0.08)	(0.10)	(0.10)
Gender	0.18	0.17	0.04	0.73**	0.03	0.22	0.21	-0.02	0.44**	0.13	-0.16	-0.09	0.58**	0.26	-0.03
	(0.19)	(0.18)	(0.30)	(0.26)	(0.26)	(0.34)	(0.15)	(0.30)	(0.17)	(0.36)	(0.24)	(0.39)	(0.21)	(0.30)	(0.31)
Age	-0.11	-0.22**	-0.02	-0.16	0.03	0.04	-0.07	-0.45**	-0.31**	0.04	-0.24	0.11	-0.18*	-0.12	-0.20
	(0.09)	(0.07)	(0.23)	(0.14)	(0.17)	(0.29)	(0.05)	(0.23)	(0.07)	(0.18)	(0.15)	(0.26)	(0.09)	(0.25)	(0.22)
Income	0.20**	0.26**	0.49	0.01	0.59**	-0.20	0.02	0.58**	-0.01	0.06	0.43**	0.20	0.14	0.10	0.31
	(0.09)	(0.08)	(0.23)	(0.15)	(0.20)	(0.23)	(0.06)	(0.21)	(0.07)	(0.23)	(0.15)	(0.23)	(0.11)	(0.20)	(0.21)
Education	0.01	-0.09	0.06	0.16	-0.16	0.20	-0.07	-0.32**	-0.01	0.76**	-0.24**	0.56**	0.09	0.27	0.06
	(0.08)	(0.07)	(0.19)	(0.17)	(0.13)	(0.25)	(0.05)	(0.14)	(0.06)	(0.36)	(0.11)	(0.27)	(0.08)	(0.17)	(0.15)

Notes: Standard errors are given in parentheses. double and single asterisks denote statistical significance at the 5% and 10% levels, respectively. a indicates the double-hurdle model was used. b indicates the tobit model was used. EA denotes model results using data from the BDM experimental auction; CT denotes model results using data from the mail survey that incorporated a cheap talk script; Conv. denotes model results using data from conventional mail survey (i.e. no cheap talk script).

Political Economy of Medical Food Reimbursement in the U.S.

Adesoji O. Adelaja, Amish Patel and Yohannes G. Hailu

Medical foods, which fall in the gray area between food and drugs, are a necessity for persons with inborn errors of metabolism. Being more expensive than regular foods, some U.S. states have mandated insurance companies to provide coverage for the afflicted community. To investigate the legislative adoption process, this paper develops a political economy model of medical food reimbursement and coverage policy. Analytical cross-state logit regression models confirm the positive influences of metabolic clinics and the political clout of the afflicted community on the probability of adoption. The countervailing interest of the insurance industry and the afflicted community were also confirmed. Results suggest that efforts by medical food companies to influence the political process could yield food market and distribution channel opportunities in states contemplating legislative adoption.

Introduction

A medical food is "a food which is formulated to be consumed or administered entirely under the supervision of a physician and which is intended for the specific dietary management of a disease or condition for which distinctive nutritional requirements, based on recognized scientific principles, are established by medical evaluation" (U.S. Congress, 1988). Like prescription drugs, the costs of which are typically covered by insurance companies (via state legislative mandates), medical foods are a necessity for a healthy and normal life for individuals with metabolic disorders. However, medical foods are also close to regular foods, whose costs are typically absorbed by consumers and are not covered under drug insurance. Because medical foods are at the boundary between food and drugs, they are controversial and represent a gray area of food and health policy.

Drug reimbursement policy falls within the realm of powers granted to the states. States, however, differ in demographic and other characteristics, and therefore the propensity to adopt insurance-mandated medical food reimbursement policy and the level of reimbursement chosen. Prescription drugs are subsidized or reimbursed by healthcare plans from insurance companies based on the state's reimbursement schedule. However, prescription or medical foods are not always covered, due in part to opposition by insurance companies[1].

The afflicted and members of their family stand to gain by lobbying for adoption of medical food reimbursement policy. Given the disparity in the costs of medical and non-medical foods, the health, purchasing power and quality of life of the afflicted community are impacted

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[1] By voluntarily extending coverage to medical foods, an insurance company can attract a disproportional number of the afflicted. Hence, the company may still not extend coverage unless forced by legislation even when the cost of mitigating the adverse effects of ingesting the wrong food exceeds the cost of providing coverage for medical foods. Products within the medical foods category include special formulations for patients with celiac sprue (CS), phenylketonuria (PKU), irritable bowel disease (IBD), Urea Cycle Disorder (UCD), Glycogen Storage Disorder (GSD), Propionic Acidemia (PA), Methyl Malonic Acidemia (MMA), maple syrup urine disease (MSUD), and diabetes. For patients with these disorders, medical foods are almost unavoidable as the afflicted must avoid specific foods, components or nutrients to prevent illness or death or must ingest increased amounts of certain metabolites to stimulate a specific metabolic pathway for survival (Bistrian, et al., 1976). Studies have shown that even small reductions in intake can yield substantial health benefits. (Browner, et al., 1991; Zarkin and Anderson, 1992).

by such adoption. The physicians and dieticians of the afflicted, the medical food industry, and facilities that provide metabolic treatment, also called metabolic clinics[2], usually join the afflicted in advocating for legislative adoption of such policy. The medical foods industry could benefit from legislative adoption as such policy can lower the prices of their products and enhance consumer affordability and market penetration. The medical foods area is one where efforts by producers and distributors to organize the proponents of adoption lobby law makers can create a game-changer in the development of new market opportunities in a state.

Insurance companies are known to almost consistently oppose such legislation based on the argument that it decreases profitability by increasing insurance payout per capita and the cost of insurance to the non-afflicted community. Perhaps, their real concern is that once a state adds some medical foods to the reimbursement schedule, it becomes easier to add other items that may not be real medical necessities. Consistent with their stand on healthcare in general, the non-afflicted community has been silent in the reimbursement debate. Perhaps, the small size of the afflicted community suggests minimal impacts on their budget, especially when many of them are covered by employer paid insurance. Information on the determinants of legislative adoption, including the marginal impact of lobbying efforts on the probability of adoption, is therefore of significant value, not only to the afflicted community and other pro-reimbursement advocates, but also to the insurance companies and other opponents of reimbursement. Medical food producers and distributors are particularly interested, as legislative adoption can bring the entire community of afflicted people into the market, due to the cost eliminating nature of adopted legislation. Such information can be used in predicting the likelihood of policy change, medical food legislation in states that have not yet adopted, the potential benefits of lobbying efforts, as well as in choosing optimal strategy for impacting such change.

Regarding the political dynamics of legislative and policy adoption, several studies suggest various legislative causal factors, including (1) the characteristics of the policy and its goals (Bardach, 1997; Derthick, 1972; Rosenbaum, 1976; Sabatier and Mazmanian, 1983); (2) the characteristics of implementing agencies (Edwards, 1980; Nakamura and Pinderhughes, 1980); and (3) the beliefs and attitudes of key policy actors (Bardach, 1997; Marshall et al., 1986; Mitchell, 1981; Sabatier and Mazmanian, 1983; Van Horn and Van Meter, 1976). Aaron (2002) identified the escalating costs of health care expenditures, access to healthcare, the quality of healthcare and competition between healthcare insurance companies as important determinant factors in adopting health care policies. In addition, Weekes (1997) identified consumer demand for alternative health care services and the growing interest of private insurers in providing coverage for various alternative treatments as another determinant in adopting health care policies.

While some literature exists on the usage and need for medical foods, despite the intense controversy surrounding the issue, to the best of our knowledge, nothing is available in the economic, political and marketing literature on the legislative adoption process. Given the importance of such analysis, this study conceptualizes the determinants of legislative adoption of medical food reimbursement policy, including (1) political and economic powers and motives, (2) socio-economic, demographic, and other legislative adoption factors, and (3) interstate proximity to other adopters (spillover effects). An empirical logit model is estimated to evaluate the effects of key factors hypothesized to determine the passage of medical food laws mandating insurance industry reimbursement. Implications for the lobbying efforts of medical foods companies are also highlighted.

[2] A metabolic clinic is a facility focused on helping patients with metabolic disorders. It has a broad range of specialists ranging from nutritionists, nurses and social workers to metabolic geneticists, genetic counselors and psychologists. According to the Mayo Clinic, such clinic provides comprehensive diagnostic and management services for people with known or suspected inborn errors of metabolism (http://www.csmc.edu/2548.html).

Background

Like prescription drugs, medical foods are necessary for healthy and normal life for individuals with metabolic disorders. According to FDA, for a product to be considered as Medical Food, it must be 1) food for oral or tube feeding 2) labeled for a specific medical disorder, disease or condition and 3) intended to be used under medical supervision. Diabetes mellitus (DM), malabsorption, phenylketonuria (PKU), homocystinuria and maple syrup urine diseases (MSUD) are examples of metabolic disorder diseases (Otles and Akcicek, 2002). An example of medical foods is gluten-free cereal to avoid wheat allergies, health bars with added medication, and transgenic plants for oral vaccination against infectious diseases, and transgenic cows and lactoferrin for immune enhancement.

The high procurement cost limits the ability of the afflicted to enjoy good health and quality of life. As shown in Table 1, using the example of PKU, medical foods solutions can be 131% to 3833% more expensive than its normal food counterpart.[3] Clearly, for families with individuals whose survival depends on medical foods, staying healthy could be a financial challenge.

In response to concerns about the burdens on individuals/families with metabolic disorders requiring medical food for survival, the U.S. Congress adopted the Orphan Drug Amendments (U.S. Congress, 1988) and the Nutritional Labeling and Educational Act (U.S. Congress, 1990). These legislations better defined the drug status of medical foods and provided the foundation for state mandates requiring the provision of insurance company reimbursement. Today, the adoption of medical foods reimbursement policy varies by state.[4] When reimbursement legislation exists in a state, typically, governing laws provide reimbursement schedules for medical formula and/or food which may set a limit on the annual dollar amount of reimbursement and/or on age.[5]

The chronology and features of state adoption of medical food reimbursement policy are depicted in Table A.1 in the Appendix. The criteria for medical foods reimbursement by state is presented in Table A.2. The timeline for federal policies on medical foods is further delineated in Table A.3. As of July 2003, consumers in 29 states could expect to receive reimbursement or coverage for medical food expenditures they incur through insurance companies, while consumers in 21 states could be expected not to.

Table 1. Cost Comparison of Low Protein Products and their Regular Counterparts

Description of Food	Regular Food	Low Protein Food	Percentage Increase	Shipping & Handling
Spaghetti (16 oz)	$1.25	$5.00	300%	
Flour (1 pound)	$0.18	$7.08	3833%	
Crackers (16 oz)	$0.79	$15.85	1906%	$5 to $25
Cream Filled Wafers	$0.49	$2.95	502%	per order
Jello (3 oz.)	$0.55	$1.27	131%	
Tomato Sauce (4 oz.)	$0.25	$4.07	1528%	

Source: National PKU News, Table of Data on Food Costs, http://www.pkunews.org/rights/lobby5.htm July, 2003.

[3] By extrapolation, per capita annual cost of medical foods is about $14,000, compared to $3,800 for normal food. By adding one afflicted member, the food bill for an average family of 3 with a 1999 mean family income of $62,636 (US Census Bureau, 1999) could rise from $11,400 (18%) to $21600 (36%).

[4] For example, Kentucky limits reimbursement of medical foods to $4,000 annually with no age restriction. Maryland sets no dollar or age restrictions. Colorado only covers males below the age of 22 and females below the age of 36 and imposes no annual dollar restriction.

[5] A "reimbursement schedule" is a legislative mandate on a state agency or insurance industry.

The checkered pattern of legislative adoption, coupled with the typical deliberate nature of such processes, suggests the need to explain the factors that lead to state of adoption of medical foods reimbursement policy. The fledgling medical foods industry, whose survival or emergence depend largely on state-level legislative adoption, is particularly interested in understanding this process as it could inform the efforts to allocate marketing funds toward organizing, advocacy and lobbying for legislative adoption.

Conceptual Framework

The political environment of states may play an important role in shaping public policies. States vary in terms of the adoption of health policies and particular health care programs (Miller, 2005). For example, in the case of medical foods, some states have adopted full or partial reimbursement and other states have not (Table A.1). What influences some states to likely support medical food reimbursement legislation? Understanding the fundamental factors that influence states' adoption of specific policies or legislation is crucial for both the afflicted community and insurance companies to influence the political process towards their respective advantages.

Dye (1966) identified several additional political, socio-economic and demographic factors that determine legislative adoption: interparty competition, division of party control, the electoral system and voter participation, and degree of inequality in voter representation[6]. Interparty competition refers to the initiation of new legislation as a means of competing for votes. Division of party control refers to the extent of control of the state government by either party, Democrats or Republicans. Each party tends to favor certain types of legislation. For instance, usually Republicans support legislations that promote less regulation while Democrats support more regulation and government intervention (Cook et al., 1988; Grogan, 1994). Considering Medical Foods Reimbursement, Democrats may favor medical food reimbursement legislation while Republicans may oppose this legislation as they favor less regulation and government intervention. Since people differ in their needs, the policy intervention they support differs with their socio-economic characteristics such as income, age and race groups (Shingles, 1989; Brown, 1988; Coughlin, 1980). Dye (1966) suggests that adoption of legislations is influenced by policy preference of the constituencies, for example, urban versus rural constituencies or rich versus poor constituencies.

The political processes of neighboring states will tend to have an impact on the legislative process of nearby states. Rosenbaum (1976) highlights the influence of neighborhood political process and its spillover effect. Politicians tend to follow the political process of their neighboring states mainly because nearby states tends to face similar challenges, and to avoid movement of people from neighborhood states (Miller, 2005; Rosenbaum, 1976).

This paper, therefore, utilizes the political economy framework to identify the determinants of medical foods reimbursement policy adoption. The framework is based on Dye's basic infrastructure (Dye 1975). We focus mainly on the choice by the government to pass legislation mandating the insurance industry to reimburse for medical foods.

The competing interest groups include the insurance community and the afflicted community. The interest of the non-afflicted community is accounted for in the objective function of the insurance community. Hence, both the insurance industry (as an agent of the non-afflicted) and the afflicted community (supported by their sympathizers) exert pressure on the legislature to make choices based on their relative strength in the political arena and their economic interests.

The insurance industry's actions are based on the desire to maximize the utility it derives from collecting insurance premiums, turning a profit, and generating any beneficial externalities. It tries to keep premiums down to optimize the utility of its clientele and its own long-term sur-

[6] The dominant party is expected to be more likely to get its policies passed. Lower income, lower status, poorly educated, and non-white groups, which typically support democrats, are expected to have lower voter participation rates. Finally, less well represented groups are less likely to have policies evolve that benefit them (Dye, 1966).

vival (such as increased public health and increased patronage). Therefore, it is expected that the larger the size of the insurance community (companies, clients and employees), the more influential the opponents of legislative adoption, and the less support for legislation. On the other hand, afflicted households wish to maximize utility (or quality of life) from insurance coverage of traditional healthcare costs plus medical foods.[7] Hence, the afflicted population is hypothesized to have a negative impact on the profit objective of the insurance industry by increasing healthcare payouts per capita.

The legislature (the ultimate decision maker) must then balance the interests of these interest groups in maximizing its own objectives, subject to pressures from the electorate and from competing economic and political interest groups (Tullock, 1967; Stigler, 1971; Peltzman, 1976). It, therefore, advances legislation that maximizes public acceptance.

Insurance Companies

The representative insurance company earns income, y^i, from providing health insurance coverage to the community of covered people (q): such that $y^i = pq - c(q) - \alpha\beta(x)$, where p is the average premium collected for health insurance coverage, c is the marginal cost of providing health insurance coverage, x is the number of individuals with the need for medical foods or the afflicted community size, β is expected cost per unit to provide medical food reimbursement for the afflicted community, $\beta(x)$ is the total expected cost of providing medical foods reimbursement for the afflicted community (where $\beta_{x,}$, $\beta_{xx} > 0$) and α is a measure of the proportion of the total or maximum medical foods reimbursement cost that insurance companies are expected to bear. Increased premiums or reduced healthcare coverage are irksome to both the afflicted and non-afflicted communities. $\alpha\beta(x)$ is the externality by the afflicted community that can be either absorbed by the insurance company (with an impact on premiums) or by the afflicted community. $q - x$ is the number of people in the non-afflicted community. The extent of externalities associated with medical foods is assumed to be an increasing function of the community of covered people since the larger the population, the larger the afflicted community (i.e. x_q , $x_{qq} > 0$)[8].

The insurance industry attempts to prevent the afflicted community from transferring their externality to them by lobbying the government not to legislate regulations that would force reimbursement and thereby result in premium increases. Alternatively, the afflicted community would seek to have government force on the insurance industry such measures that reduce the burden on them and spread the cost of medical food to others. Whether or not the externality is transferred or not is given by α. When α is low enough, one might observe the absence of medical food reimbursement law. High values of α might imply the presence of medical food reimbursement law. In the extreme scenario of $\alpha = 0$, the afflicted community assumes responsibility for full medical food cost while $\alpha = 1$ may imply that insurance companies are responsible for the full reimbursement of medical food cost. Afflicted households are likely to lobby for α=1 or full coverage and insurance companies for α=0 or avoid complete reimbursement. The government must carefully weigh the sentiments of the two communities and the possible electoral impacts of their decision in choosing α.

The utility function of the insurance company may be expressed as:

$$(1)\quad u^i(g) = u^i(y^i, x, h) = u^i[pq - c(q) - \alpha\beta(x(q)), x, h],$$

where h is the health index or a measure of the general level of health in the community. Healthy people reduce health insurance payouts. While general health is important, and insurance companies generate a lot of it, its impact on

[7] Non-afflicted household also try to maximize their utility, except that the need for medical food coverage is not a big issue for those who prefer not to bear the cost of the afflicted community.

[8] We assume that the non-afflicted community and insurance companies are not in conflict regarding the desire to keep premiums down.

medical foods is likely to be miniscule. Therefore, we assume the marginal utility of the general level of health is very low to insurance companies. Thus, for simplicity, it is ignored in the insurance companies' utility function. The utility function obeys the restrictions $u^i_y > 0$, and u^i_x, u^i_{xx}, u^i_{yy}, $u^i_{xy} < 0$ where the superscript *i* denotes the insurance companies. The convexity of the cost function implies c_q, $c_{qq} > 0$. The insurance company chooses the scale of health insurance coverage to the public to maximize utility as defined by (1). The first order condition for an interior maximum is:

$$(2)\quad p = c_q + \alpha\beta_x x_q - x_q(u^i_x / u^i_y).$$

As shown in equation (2), the scale of insurance enrollment is chosen optimally so as to equate the price charged for healthcare coverage (through premiums) to the sum of (1) the marginal cost of providing standard health insurance coverage to the public (2) the marginal cost of covering medical food purchased by the afflicted community, and (3) the money value of the disutility of incremental externalities. Solving this equation, we can express the optimum enrollment by the insurance company as a function of $\alpha(q^* = q^*(\alpha))$. That is:

$$(3)\ \frac{dq^*}{d\alpha} = \frac{u^i_y\beta_x x_q - \beta(\theta u^i_{yy} + x_q u^i_{xy})}{\theta(\theta u^i_{yy} + x_q u^i_{xy}) + x_q(\theta u^i_{xy} + x_q u^i_{xx}) - u^i_y(c_{qq} + \alpha\beta_x x_{qq} + \alpha(x_q)^2\beta_{xx}) + x_{qq}u^i_x} < 0,$$

where $\theta = p - c_q - \alpha\beta_x x_q > 0$. From equation (3), the insurance company's optimum coverage is a monotonically decreasing function of α.

To establish the curvature of the $q^*(\alpha)$ function, further assumptions are necessary. If utility function is linear and c, x and β functions are quadratic, then equation (3) reduces to:

$$(4)\quad \frac{dq^*}{d\alpha} = \frac{u^i_y\beta_x x_q}{u^i_y(c_{qq} + \alpha\beta_x x_{qq} + \alpha(x_q)^2\beta_{xx}) + x_{qq}u^i_x};$$

and

$$(5)\quad \frac{d^2q^*}{d\alpha^2} = \frac{(u^i_y\beta_x x_{qq} + u^i_y(x_q)^2\beta_{xx})(-u^i_y(c_{qq} + \alpha\beta_x x_{qq} + \alpha(x_q)^2\beta_{xx})\frac{dq^*}{d\alpha} + (u^i_y)^2\beta_x x_q(3\alpha x_q x_{qq}\beta_{xx}\frac{dq^*}{d\alpha} + \beta_x x_q + (x_q)^2\beta_{xx})}{(-u^i_y(c_{qq} + \alpha\beta_x x_{qq} + \alpha(x_q)^2\beta_{xx}) + x_{qq}u^i_x)^2}$$

A sufficient condition for $d^2q^*/d\alpha$ to be positive is that $\beta_x x_{qq} + (x_q)^2\beta_{xx} > -3\alpha x_q x_{qq}\beta_{xx}dq^*/d\alpha$. This is automatically satisfied if either *x* or β is linear in its argument. If both of them are linear, then $d^2q^*/d\alpha^2 = 0$, implying that $q^*(\alpha)$ is a linear function. For the rest of the analysis we assume that $d^2q^*/d\alpha^2 \geq 0$.

Afflicted Community

The utility function of the afflicted community is given by: $u^d(y^d, x, h)$. Afflicted households favor healthcare coverage for medical food, and unlike insurance companies, value such increases in healthcare coverage at the margin. Such health index comprises of the private industry healthcare coverage λ and government provision of coverage ω. Therefore $h = \lambda + \omega$. Since the health index is monotonically related to providing health insurance coverage to the public, it is possible to write λ as an inverse function of insurance company enrollment. That is, $\lambda = \lambda(q)$, and $\lambda_q > 0$ such that $h_q > 0$.

The afflicted community chooses the level of q by choosing x such that $u^d{}_x x_q + u^d{}_h h_q = 0$. That is, the disutility associated with covering the afflicted community is set equal to the utility derived from the positive externality of the health index. This equation may be solved to express afflicted community desired enrollment q as a function of afflicted community income and government expenditure on health issues. That is:

$q^d = q^d(y^d, \omega)$. It can be shown that:

$$(6)\quad \frac{dq^d}{dy^d} = \frac{u^d_{xy}x_q + u^d_{hy}h_q}{u^d_y x_{qq} + u^d_{xx}(x_q)^2 + h_q x_q u^d_{xh} + \lambda_q(x_q u^d_{xh} + h_q u^d_{hh})}; \text{ and}$$

$$(7)\quad \frac{dq^d}{d\omega} = \frac{u^d_{xh}x_q + u^d_{hh}h_q}{u^d_y x_{qq} + u^d_{xx}(x_q)^2 + h_q x_q u^d_{xh} + \lambda_q(x_q u^d_{xh} + h_q u^d_{hh})}$$

That is, an increase in the afflicted community income should raise the demand for health coverage but lower the demand for insurance companies' coverage of medical food expenditures, $u^d_{hy} < 0$. The marginal utility associated with coverage also declines if coverage implies much higher premiums, $u_{xh} < 0$. The law of diminishing marginal utility ensures that $u^d_{hh} < 0$. It is seen that under these conditions dq^d/dy^d and $dq^d/d\omega$ are both unambiguously negative.

Government

The government comprises elected representatives of the afflicted community and insurance industry. It behaves rationally in the sense that it only decides on such measures (or legislation) as it believes would raise its electoral prospects. Recall that the non-afflicted community is very silent in the reimbursement debate on medical foods. However, insurance industry employees are not and such companies, though their financial support for candidates, can mobilize votes of the non-afflicted. The government's utility function may thus be regarded the same as the expected total vote function.

The utility function of the government is expressed as:

$$(8)\quad u^G = V = I\Pi^i(\alpha, \gamma; \theta) + A\Pi^d(x, y^d, \omega, \upsilon; \Omega);$$

where I = a proxy for voting influence of insurance companies on the non-afflicted community (including its employees), A = voting population of the afflicted community, Π^j = probability that the average j^{th} group will vote for the government, j = i, d; γ = an index of the political clout of the insurance companies and the non-afflicted community, υ = an index of the political clout of the afflicted community, and θ, Ω = other exogenous variable that may influence Π^j.

Since an increase in α raises the cost of coverage and reduces insurance companies income or ability to cover, insurance companies are likely to reduce political support for a government that imposes a higher α on them, such that $\Pi^i_\alpha < 0$. On the other hand, an increase in α reduces the burden on the afflicted and raises the probability that the afflicted community would vote for the government; $\Pi^d_x < 0$. At any given level of α, x and q, an increase in the income of the afflicted households makes them desirous of an increase in α such that they are less likely to politically support the government unless it takes measures to raise α, implying $\Pi^i_{x\alpha} < 0$. For a similar reason, $\Pi^d_{x\omega}$, $\Pi^i_{\alpha\gamma}$, < 0. It is further assumed that $\Pi^i_{\alpha\alpha}$ and Π^d_{xx}, are also negative.

The government chooses α in order to maximize electoral support. The first order condition for maximization is:

$$(9)\quad I\frac{\delta\Pi^i}{\delta\alpha} + A\frac{\delta\Pi^d}{\delta\alpha}x_q\frac{\delta q}{\delta\alpha} = 0$$

This equation defines a maximum, provided $d^2V/d\alpha^2 < 0$. Hence,

$$(10)\quad \frac{d^2V}{d\alpha^2} = I\Pi^i_{\alpha\alpha} + A\Pi^d_x x_q\frac{d^2q}{d\alpha^2} + A\Pi^d_x x_{qq}\left(\frac{dq}{d\alpha}\right)^2 + A(x_q)^2\Pi^d_{xx}\left(\frac{dq}{d\alpha}\right)^2$$

Given the earlier assumptions, this expression is negative such that the equation above unambiguously defines a maximum. The equation simply states that in order to maximize V, the government sets the value of α such that the expected marginal decrease in insurance companies' and non-afflicted community votes due to an increase in x is just offset by the expected marginal increase in afflicted community's votes. Solving the equation, we can find optimum α^* as a function of the exogenous variables:
$\alpha^* = \alpha^*(I, A, \gamma, \theta, y^d, \omega, \upsilon; \Omega)$.

To show the determination of α^* graphically, one can define an isovote line in q-α space by setting dV = 0 and holding all the exogenous variables constant such that

$$(11)\quad \frac{dq}{d\alpha} = \frac{-I\Pi^i_\alpha}{A\Pi^d_x x_q}.$$

The slope of the isovote line is negative. To establish the curvature of the isovote line differentiate the slope with respect to α:

$$(12)\quad \frac{d^2q}{d\alpha^2} = \frac{I}{A(\Pi^d_x x_q)^2}[x_q\Pi^d_x\Pi^i_{\alpha\alpha} - (\Pi^i_\alpha\Pi^i_x x_{qq} + \Pi^i_\alpha (x_q)^2\Pi^i_{xx})\frac{dq}{d\alpha}].$$

Equation 12 is negative which indicate that isovote lines are concave downward. Three concave lines are shown in Figure 1 (see Appendix B). Lower isovote lines represent higher total expected votes. The government would therefore want to be on as low an isovote line as possible. In choosing a lower isovote line, the government is constrained by the insurance community's output response function q* = q* (α) which is similar to a budget line. The optimum choice of α is determined at the tangency point between an isovote line and the insurance companies response function. At the tangency point, the slopes of the two functions are equal, as required by the first order condition (10). The fact that the isovote lines are concave downward and $q^*(\alpha)$ is either convex or linear guarantees that there is a unique tangency point which defines a maximum.

Equation (12) shows that the slope of the isovote line is proportional to the ratio of the scope of the influence of insurance companies to afflicted community population. If the ratio falls due to, say, a faster increase in afflicted population, the absolute value of this slope falls such that the isovote lines become flatter at any α. This has the implication that the tangency point *E* between the isovote and insurance enrollment response functions shifts to the right. Hence, an increase in the relative population of afflicted community raises the optimum. The opposite happens when the scope of insurance companies rises relative to the population of the afflicted community.

To formally demonstrate the effects of changes in the exogenous variable on α^*, totally differentiate equation (10) and rearrange as follows:

$$(13)\quad \Pi^i_\alpha dI + I\Pi^i_{\gamma\gamma}d\gamma + \Pi^d_x x_q(\frac{dq}{d\alpha})dy^d + Ax_q\Pi^d_{x\omega}(\frac{dq}{d\alpha})d\omega + Ax_q(\frac{dq}{d\alpha})\Pi^d_{x\upsilon}d\upsilon + \phi d\alpha = 0,$$

where

$$(14)\quad \phi = I\Pi^d_{\alpha\alpha} + A\Pi^d_x x_q(\frac{d^2q}{d\alpha^2}) + Ax_{qq}\Pi^d_x(\frac{dq}{d\alpha})^2 + Ax_q(\frac{dq}{d\alpha})^2\Pi^d_{xx} < 0.$$

Therefore, the following can be obtained:

$$(15)\quad \frac{d\alpha^*}{dA} = -\frac{\Pi^d_x x_q(\frac{dq}{d\alpha})}{\phi} > 0, \qquad (17)\quad \frac{d\alpha^*}{d\gamma} = -\frac{I\Pi^i_{\alpha\gamma}}{\phi} < 0,$$

$$(16)\quad \frac{d\alpha^*}{dI} = -\frac{\Pi^i_\alpha}{\phi} < 0, \qquad (18)\quad \frac{d\alpha^*}{dy^d} = -\frac{A\Pi^d_{xy}x_q(\frac{dq}{d\alpha})}{\phi} > 0,$$

$$(19)\quad \frac{d\alpha^*}{d\omega} = -\frac{A\Pi^d_{x\omega} x_q (\frac{dq}{d\alpha})}{\phi} > 0, \text{ and}$$

$$(20)\quad \frac{d\alpha^*}{d\upsilon} = -\frac{A\Pi^d_{x\upsilon} x_q (\frac{dq}{d\alpha})}{\phi} > 0.$$

Equations (15) through (20) confirm the diagrammatic results. That is, an increase in the scope and size of the insurance industry (with afflicted population constant) will reduce α^*; an increase in afflicted population will raise α^*; as the political clout of the insurance community and their non-afflicted allies increases, the government finds it more electorally beneficial to reduce α^*; as the political clout of the afflicted community increases, the government finds it less beneficial to reduce α^*; a rise in the incomes of the afflicted community will raise the level of α; and an increase in the health index will also raise α. This directly contradicts the expected effect of afflicted community income on the interest in raising the health index.

The theoretical model above is helpful in identifying the determinants of insurance industry mandated medical foods reimbursement policy adoption. However, it is important to note that the model does not preclude other determining factors. θ and Ω are incorporated into the model as exogenous factors to capture other factors.[9] It suggests that whether or not a polity adopts mandatory reimbursement and the scope of the coverage actually adopted depend on political motives, legislative adoption factors, the clout of the afflicted community, healthcare industry profit motive, spillover and proximity effects and other exogenous socio-economic factors to empirically implement the theoretical model and other exogenous socio-economic factors to empirically implement the theoretical model above, since the choice variable in reality is binary, representing adoption or non-adoption, a binary choice endogenous variable is preferred.

Empirical Framework

The logic model framework is specifically utilized in this research. The conceptual model helped in identifying determinants and their potential effects. With the logit function, the regression coefficients describe the change in the logarithm of the odds of a state having MFA (Medical Food Adoption) law mandating insurance industry to reimburse those that do not, given a unit change in the value of the independent variable (Laio, 1994). Given the nature of the decision by government, the logit model is used in estimating the impact of determinants on the probability of legislative adoption of medical food reimbursement policy mandating insurance companies to reimburse.

The logit model assumes that the probability of observing a specific outcome (i.e. an individual state to pass legislation mandating medical food reimbursement by insurance companies), *P*, is dependent on a vector of independent variables (X_{sr}) associated with state *s* and variable *r*, and a vector of unknown parameters, Υ_k. The likelihood of observing the outcome of the dependent variable as a function of explanatory variables can be given using the following logit function:

$$(21)\quad P[MFA_r = 1 | x_{1r},...,x_{kr}] = \frac{1}{1+\exp(-\Upsilon_1 x_{1r} - ... - \Upsilon_k x_{kr})} = \frac{1}{1+\exp(-\sum_{s=1}^{k} \Upsilon_s x_{sr})}.$$

where MFA_r = 1 if a state passes legislation mandating medical food reimbursement by insurance companies, else MFA_r = 0 if there is no legislative mandate. X_{sr} is the set of explanatory variables, and Υ represents model parameters to be estimated.

[9] Other possible determinants of medical food reimbursement may include rapid population changes and political dynamics.

To obtain the estimates for explanatory variables in the logit model, the changes in probability, MFA_i, brought about by a change in any of the independent variables, X_{ij}, is given by:

$$(22)\quad (\partial MFA_r / \partial X_{sr}) = [\Upsilon_j \exp(-\Upsilon X_{sr})] / [1+\exp(-\Upsilon X_{sr})^2].$$

Marginal probabilities associated with change in any of the explanatory variables are given by:

$$(23)\quad (\Delta MFA_i / \Delta X_{sr}) = MFA_r(X_{sr}=1) - P_i(X_{sr}=0).$$

The maximum likelihood function for expression in (22) can be given as:

$$(24)\quad \ln(L(\Upsilon_1,...,\Upsilon_k)) = -\sum_{i=1}^{n}(1-MFA_r)\sum_{s=1}^{k}\Upsilon_s X_{sr} - \sum_{i=1}^{n}\ln(1+\exp(-\sum_{r=1}^{k}\Upsilon_j x_{sr}))$$

Therefore, the specification for medical food adoption is estimated by a maximum likelihood procedure that generates estimator values by maximizing the log-likelihood function in (24), i.e.,

$$\ln(L(\hat{\Upsilon}_1,...,\hat{\Upsilon}_k)) = \max \ln(L(\Upsilon_1,...,\Upsilon_k)).$$

Data

The data came largely from a survey of the Unites States medical food reimbursement law status which was collected between 1999 and 2003. Relevant parties in all 50 states were contacted directly to find out if medical food insurance reimbursement laws existed. This was followed by pulling relevant legislation in these states. Data obtained were used to create a cross-sectional database for the fifty states.[10] Other sources of data included U.S. Census, Bureau of Labor Statistics and others as depicted in Table 2. Data on independent variables used in the analysis were for the latest year available before state legislative adoption, except in the case of states with no legislation where the data used was for the last year before 2003.

Consider first the political and economic variables. To measure the size, strength and political clout of the afflicted community, the number of existing metabolic clinics in the state (META) and the size of the afflicted community (AFFLICT) were chosen as proxies. These measures of political clout are consistent with the notion that size, and not percentage, are the prerequisite for coalition. The number of Metabolic and Disease Clinics is hypothesized to positively relate to legislative adoptions. Metabolic clinics provide an area where the afflicted community can gather in numbers for food procurement, promoting public awareness and staging lobbying efforts. AFFLICT (AFFLICTSQ) was added to test the hypothesis that at lower levels of afflicted population, an increase in the population of the afflicted raises concerns about legislative adoption and lowers the likelihood of adoption, up to the point where the numbers become large enough for the afflicted coalition to form and fight for reimbursement legislation. To measure the political strength and clout of parties opposing medical food reimbursement, the percentage of state residents covered by private insurance companies (PERINSUR) is used. To capture the political structure of the legislature and voters, the percentage of the state legislators that are Democratic (DEMOC) and the percentage of the voting population above 18 (VOTE) were used to test whether democrats are more favorable in their support of families and individuals with medical conditions and whether those over 18 are more likely to support medical food reimbursement policy.

Now consider the socioeconomic and demographic factors. State's per capita income (INCOME) is introduced to measure the affordability of the medical food expenditure by the public through legislative provision for insurance reimbursement. Whites Americans have a higher incidence rate of certain metabolic diseases like phenylketonia[11] and this could influence the political landscape.

[10] This survey was directed by the primary author and conducted primarily through a special undergraduate research course taught by the primary author and other instructors in 1999. The authors continued the survey effort until 2003. Legislative adoptions through July 2003 were included in the modeling exercise.

[11] Phenylketonuria is most common in whites in United States. (*http://emedicine.medscape.com/article/947781-overview*)

Table 2. Description of Independent Variables and Data Sources

Variable Name	Description of Variable	Source
	Political and Economic Variables	
META	Number of Metabolic and Disease Clinics	Health Directory
AFFLICT	Afflicted population in the State	U.S. Census Bureau
PERINSUR	Percentage of Residents Covered by Private Insurance Companies	U.S. Census Bureau
DEMOC	Dummy Variable for State Legislature Controlled by Democratic Party	Statistical Abstract of United States
VOTE	Percentage of Population above 18 that voted	U.S. Census Bureau
	Socioeconomic and Demographic Variables	
INCOME	Per Capita Personal Income	U.S. Census Bureau
WHITE	Percentage of Total White	U.S. Census Bureau
HEALTHPERCAP	Per Capita Expenditure on Healthcare	U.S. Census Bureau
HIGH	Percentage that Completed High School	U.S. Census Bureau
ILLNESS	Non-fatal Illness incidence rate per 100 full-time workers	Bureau of Labor Statistics
	Proximity and Time Variables	
NEIGH	Presence of medical food reimbursement legislation in neighboring state	Direct Survey

Similarly, state legislators may find it easier to cater to White Americans who dominate the electorate. Hence, the state percentage of White population (WHITE) was included as an explanatory variable. The percentage of the state's expenditure on healthcare and hospitals (HEALTHPERCAP) was used as another proxy for income impact and economic burden on the non-afflicted. High health care costs should trigger an adverse vote.

Other socioeconomic and demographic factors include the percentage of the population with a high school education (HIGH) and the number of non-fatal illness incidence rate per 100 full-time workers (ILLNESS). HIGH suggests greater public awareness and mobilization potential of citizens for government lobbying. ILLNESS provides information on the access to healthcare. Finally, the recent adoption of medical food reimbursement policy in a neighboring state (NEIGH) is used to proxy the spillover effect on own passage of medical food reimbursement legislation.

Empirical Results

Table 3 provides the parameter estimates of equation (21). The model correctly predicted the state of the dependent variables in 86 percent of the states when the actual values were plugged into the predicted model. The chi-square statistic led to the rejected of the null hypothesis that the explanatory variables as a set were insignificant in explaining variation in the dependent variable, at the 0.02 percent level of significance. The McFadden's R^2 result for the model was 0.45, which indicates that 45 percent of the variations in the dependent variable was explained by the model.

Table 3. Parameter Estimate for Medical Food Reimbursement Model

Independent Variable	Estimate	Standard Error	Change in Probability
Intercept**	-26.496	13.554	
	Political and Economic Variables		
META*	0.895	0.522	0.113
AFFLICTED**	-0.005	0.002	-0.0006
AFFLICTSQ*	7.92×10^{-6}	0.45×10^{-6}	0.99×10^{-7}
PERINSUR**	-0.172	0.152	-0.022
DEMOC	2.463	3.138	-
VOTE	-0.107	0.094	-
	Socioeconomic and Demographic Variables		
INCOME*	0.001	0.0004	0.0001
WHITE	-4.185	6.777	-
HEALTHPERCAP**	-0.040	0.021	-0.005
HIGH**	0.362	0.191	0.045
ILLNESS	0.267	0.540	-
	Proximity and Time Variables		
NEIGH*	2.306	1.381	0.209

Significance of Chi-square Statistic: 0.002
McFadden's R^2: 0.45
*: Significant at the .10 level
**: Significant at the .05 level
Marginal effects on probability adoption are not reported
for variables where the estimated coefficients are not statistically significant.

Prediction Success

	Predicted		
Actual	0	1	Total
0	17	4	21
1	3	26	29
Total	20	30	50

Number of Corrected Predictions= 43
Percent of Corrected Predictions =86

The findings are largely consistent with a priori expectations. The results suggest that the more metabolic clinics in a state (META), the more likely the state would pass medical food reimbursement legislation. For every metabolic clinic in the state, the chance of medical food reimbursement legislation being enacted increases by 11.3 percent. This finding suggests that metabolic clinics are support infrastructure for the afflicted community and reflect the existing political clout of the afflicted community. The large size of the marginal effects of metabolic clinics suggests that this is a primary determinant of medical foods insurance reimbursement laws.

The findings regarding the impact of the size of the afflicted community on probability of adoption is captured by AFFLICT and AFFLICTSQ, the later testing for structural change in the relationship between the size of the afflicted community and the likelihood of legislative action to reimburse. The results suggest that as the size of the afflicted community (AFFLICT) increases, the likelihood of legislative adoption marginally decreases by 0.06 percent, possibly signifying resistance by a more powerful insurance lobby against a small and perhaps less organized afflicted community.

However, at larger and larger afflicted community sizes, the probability of adoption from a marginal increase in the afflicted community size will actually increase by 0.99×10^{-5} percent. This effect reinforces the positive effects of metabolic clinics. Since the afflicted community has a vested interest in reimbursement and is the driving force to push reimbursement legislation into state legislators' hands, it is not surprising that the results suggest the afflicted community bears significant weight on the probability of whether medical food reimbursement legislation will pass through state government successfully.

The results suggest that for every one percent of the state covered by private insurance companies (PERINSUR), the likelihood of medical foods insurance reimbursement legislation adoption drops by 2.2 percent. The result suggests the

influence of insurance companies on their clientele, and that they have a stake in the negative outcome of medical foods insurance reimbursement legislation and thus oppose the passage of reimbursement laws.

Both the VOTE and DEMOC political variables were not statistically significant. These results challenge Dye's voter participation and party affiliation theories. These results can be explained by the fact that the medical foods issue is not a major political and voting issue as it affects few non-afflicted individuals. The notion that democrats are more liberal and offer broad welfare enhancing programs (medical foods reimbursement in this case) is therefore not supported by this study.

The (HEALTHPERCAP) variable captures existing state commitment to public health and state financial support for such care. The finding suggests that for every additional 10 dollar spent per capita on healthcare in a state, the likelihood of medical food reimbursement decreases by 5 percent. In other words, it suggests that the more money a state spends on healthcare per capita, the less likely medical food reimbursement legislation will pass. This result suggests that a state already spending a considerable amount on healthcare expenditures and subsidies is less likely to pass additional legislation increasing the total amount of money spent in healthcare.

Income (INCOME) is also a significant determinant of legislative adoption. Holding all else constant, a state registering a 100 dollars more per capital income has a 1 percent additional probability to adopt medical foods reimbursement legislation. The result confirms the income effect on legislative adoption, more so if a given state has a wider per capita income gap compared to the sample average. The coefficient of the white population (WHITE) was not significant, suggesting race is immaterial to legislators when it comes to medical foods.

The likelihood of medical food reimbursement increases as the percentage of the state population with a high school education or higher (HIGH) increases. Hence, those states with higher education levels seem to have the necessary intellectual and financial resources to mobilize their citizens to press for measures that attempt to reimburse medical food. For every 1 percent increase in the percentage of people in a state with high school education, the probability of medical food reimbursement legislation adoption increases by 4.5 percent.

Spillover effects of legislative adoption from neighboring states that already adopted the reimbursement legislation (NEIGH) is an important determinant. If a state is surrounded by other states that already adopted reimbursement legislation, the likelihood of adoption in that state is expected to increase by 20.9 percent. This result provides strong evidence that legislative spillovers have significant relevance to adoption of a program, perhaps due to the visibility and noticeability of legislative adoption in neighboring states by state legislators, and perhaps due to yardstick competition against which legislators want to excel.

Conclusion

This paper is unique in its application of the political economy framework to the emerging area of medical foods and the challenge medical food producers and marketers face in expanding their markets in an environment where policy is a game-changer. Because of the blurred line between food and drugs, medical foods are controversial, especially because the adoption of legislation mandating reimbursement forces the insurance industry to incur new costs (payouts) and possibly raise premium levels. While the size of the afflicted community is small in the United States, the resistance of insurance companies has been strong and palpable. One of the explanations for the strong resistance of the insurance industry is the fear that if states open the door for food reimbursement through medical foods, all sorts of things could eventually be reimbursed. Currently, there are many non-drug substances that confer significant health benefits to the afflicted. Examples include vitamins, certain botanicals, various medicinal plants, and various food substances. Insurance companies have a vested interest in protecting the reimbursement schedule for their state from what they consider to be frivolous practices in order to maintain profitability and industry integrity.

Confirmation of the political clout and other hypotheses suggest the endogeneity of public

choice even in an area as controversial as medical foods where the afflicted community is limited in number. What is intriguing about medical foods is that despite the small size of the pro-reimbursement movement, more states have passed medical food reimbursement laws than those that have not. Obviously, the role of the metabolic clinics complements the activities of the afflicted community.

While the issues surrounding medical food reimbursement are largely below the radar screen due to the limited size of the afflicted community, these products provide us with a glimpse of what may come as higher and more educated baby-boomers age, pursue healthier diets, and seek food that offer more than nutrition. Despite their preventative properties and potential health-care cost benefits, insurance companies have scoffed at reimbursing for expenditure on medical foods. This suggests that foods that confer health benefits but are not medical foods would also be opposed by them. On the other hand, it seems likely that baby-boomers will seek coverage for these foods. Given the fact that medical insurance laws are implemented at the state level and they are subject to the demographics and politics of each state, the ultimate determination of what happens to foods at the boundaries of traditional foods and drugs will be made as a consequence of the size and political clout of parties to the coverage debate.

Contentious debates will likely ensue in the future between the demanders of more liberal policies and those that wish to limit medical foods coverage. The fact that the insurance community is experiencing consolidation may suggest more favorable chances for adoption in the future.

Finally, results from this study should interest medical foods producers, wholesalers, distributors and marketers. The supply chain of this high technology component of the food industry is checkered at best, largely because legislative adoption is a silver bullet that can help crystalize the distribution system by reducing the cost of the product from what is typically very high to about zero. This creates instantaneous effective demand. The results suggest that medical foods companies can focus their efforts on states with high income, with a high education of the afflicted, with fewer health insurance companies, with more metabolic clinics, with high per capita income, with high levels of education and that border other states that have adopted legislation. They may avoid states with high healthcare costs and those that have stronger private insurance tradition. The fact state racial and party compositions are irrelevant suggest that medical foods companies need not employ differential strategies due to these factors. We conclude by restating that findings here could be relevant to other food industries where policy plays a major role in the establishment of markets.

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Appendix A

Table A.1 Chronology of Medical Foods Insurance Reimbursement Legislation by State through July 2003

State	Date Effective	State	Date Effective
Texas	September-89	New York	January-98
Alaska	May-91	Utah	February-98
South Dakota	March-92	Nebraska	April-98
Massachusetts	November-93	Vermont	October-98
Maine	February-95	California	January-99
Florida	May-95	Hawaii	January-99
Maryland	May-95	Arkansas	April-99
New Hampshire	June-96	Montana	April-99
Tennessee	July-96	Virginia	March-00
Pennsylvania	December-96	Arizona	April-00
Oregon	May-97	Kentucky	April-02
Nevada	July-97	Colorado	June-01
North Dakota	August-97	Louisiana	June-01
Connecticut	October-97	Minnesota	Date Unknown
New Jersey	December-97		

Source: 1991 through 2001 personal interviews with state representatives by study team plus information from the national PKU News Website, October 2003, http://www.pkunews.org/.

Table A.2 Criteria for Medical Foods Insurance Reimbursement Across the United States as of July 2003.

State	Additional metabolic disorders	Annual dollar limit	Age Limit	State	Additional metabolic disorders	Annual dollar limit	Age Limit
Alabama	-	-	-	Montana*	All	No	No
Alaska*	None	No	No	Nebraska*	Select	2,000	No
Arizona*	Select	2,500	No	Nevada*	Select	2,500	21
Arkansas*	None	2,400	No	New Hampshire*	Select	1,800	No
California*	All	No	No	New Jersey*	All	No	No
Colorado*	All	No	21/25[1]	New Mexico	-	-	-
Connecticut*	Select	No	No	New York*	All	2,500	No
Delaware	-	-	-	North Carolina*	-	-	-
Florida*	Select	2,500	24	North Dakota*	MSUD	3,000	No
Georgia	-	-	-	Ohio	-	-	-
Hawaii*	All	No	No	Oklahoma	-	-	-
Idaho	-	-	-	Oregon*	All	No	No
Illinois	-	-	-	Pennsylvania*	MSUD	No	21
Indiana	-	-	-	Rhode Island	-	-	-
Iowa	-	-	-	South Carolina	-	-	-
Kansas	-	-	-	South Dakota*	Unknown[2]	No	No
Kentucky*	All	4,000	No	Tennessee*	Select[3]	No	No
Louisiana*	All	2,400	No	Texas*	Select	3,500	No
Maine*	Select	3,000	18	Utah*	Select	No	No
Maryland*	Select	No	No	Vermont*	Unknown	2,500	No
Massachusetts*	Select	2,500	No	Virginia*	Unknown	2,000	18
Michigan	-	-	-	Washington*	-	-	-
Minnesota*	-	-	-	West Virginia*	-	-	-
Mississippi*	-	-	-	Wisconsin*	-	-	-
Missouri*	-	-	-	Wyoming	-	-	-

Note: * indicates states with insurance reimbursement for phenylketonuria while - indicates otherwise. Colorado limits vary with age - 21 for males and 35 for females; for states labeled "Unknown", there exists no interpretive state legislation on additional metabolic disorder coverage. For states labeled Select, only select metabolic disorders are covered.
Source: Personal interviews with State Representatives and information from the National PKU News website, October 2003, http://www.pkunews.org/.

Table A.3 Timeline of Federal Policies and Regulations Related to Medical Food

Year	Activity/Legislator
1906	Passage of the Pure Food and Drug Act.
1938	Passage of the federal Food, Drug and Cosmetic Act, regarding medical food as prescription drugs to assure that their use would be supervised by physicians and to prevent misuse by individuals.
1972	FDA revised its classification of medical food from "drugs" to "special dietary food" (21 CFR 105.3).
1973	The FDA defined medical food in 21 CFR 101.9(h)(4) as "food represented for use solely under medical supervision to meet nutritional requirements in specific medical conditions."
1976	The Proxmire Amendment to the FD&C Act (Section 411) differentiated regulation of vitamin and mineral supplements from medical food.
1980	Congress passed the Infant Formula Act (FD&C Act, Section 412), which led to specific regulations (21 CFR 107.10 wt seq.) for the manufacturing of infant formula.
1988	FDA initiated a Compliance Program to enable the agency to evaluate how the medical food industry ensures proper formulation, appropriate microbiological standards, and reasonable therapeutic claims for these products. Passage of the Orphan Drug Act. Congress amended the Drug Act to include the first legal definition of medical food (21 U.S. Code 360ee (b)(3))
1990	The definition for medical food in the U.S. was incorporated into the Nutrition Labeling and Education Act of 1990, (NLEA) (P.L. 101-535) (21 U.S. Code 343) The NLEA, however, exempted medical food from the requirements of nutrition labeling to ensure that other specific regulations would be developed to control medical food.
1991	The Codex Alimentarius Commission approved standards for food for special medical dietary uses.
1994	The passage of the Dietary Supplement Health and Education Act, which expanded the vitamin-mineral category to include herbs, botanicals, proteins, extracts, and metabolites and renamed them as dietary supplements. It also allowed for structure function claims.
1995	The FDA announced the agency's general policy on the development and use of standards with respect to international harmonization of regulatory requirements and guidelines
2001	The FDA issued Food Compliance Program – "Medical Food – Import and Domestic" which provides regulations on the quality control standards and procedures for medical food.

Appendix B

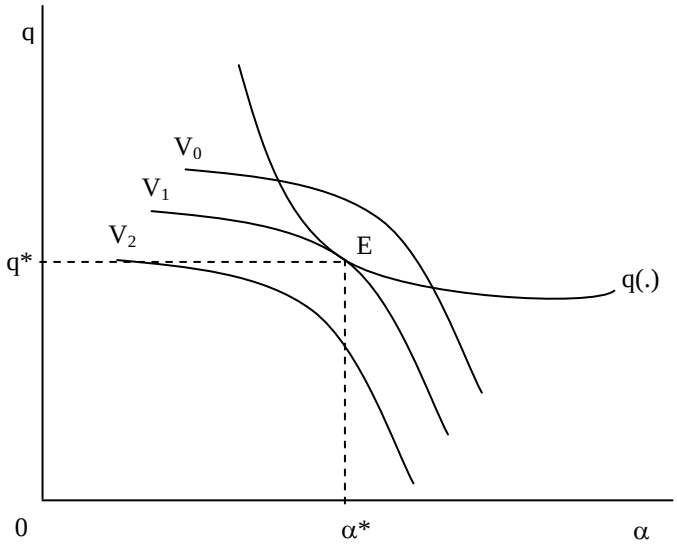

Figure 1. Optimal Level of Medical Food Reimbursement Protection

Consumer Perceptions of Environmentally Friendly Products in New Foundland and Labrador

Morteza Haghiri

A stated-preference model was specified by a logit model to analyze consumers' willingness-to-pay a five-per cent premium to purchase environmentally friendly products in Newfoundland and Labrador. Although the industry suffers from insufficient number of certified producers in the region, the findings from the model reflect the existence of potential demands for environmentally friendly products. Results showed that survey respondents were willing to pay at least a five-per cent premium, as they believed pesticide residues would have negative impacts on their health conditions. In addition, being married, higher degree of education, knowledge about new methods of farming practices, such as integrated-pest management, and early adopters in trying newly introduced products were among the factors affecting consumer decisions in paying the premium.

Environmentally friendly products (EFPs) are produced without the use of pesticides, herbicides, chemical fertilizers, antibiotics, and artificial animal growth hormones in any stages of the production. In the case of EFPs sustainability and the ecological balance of natural resources in their production processes are assumed to be as important as the quantity of products. The main objective of producing EFPs is to optimize the overall productivity of scarce resources while considering the fitness of diverse communities within the agroecosystem including soil organisms, plants, livestock and people. To do this, policy makers and market analysts have been trying to define new strategies that lead to a development of new farms that are sustainable and harmonious with the environment (Agriculture and Agri-Food Canada, 2005). The idea of producing EFPs has been strengthened by the recent increase of public concerns and favors toward the production, consumption, and distribution of these groups of products. As a result, the market for EFPs has been dramatically increased in Canada since the beginning of 1990 and its growth is predicted to be increased steadily in the future. The environmentally friendly crop production is growing worldwide with an annual turnover of more than $US25 billion offering a range of market opportunities for these group of farmers. This has been a significant movement from the 1980s when the industry was recognized as a niche market.

Canada then is an appropriate country for producing EFPs because of its large land base and its mainly intemperate climate, which together tend to reduce various plant disease and pest problems. In 2004, more than 1.2 million acres of arable land in Canada were allocated to grow EFPs. It was also predicted that additional 141,000 acres were in transition to be cultivated under these groups of products (Macey, 2005). Evidence shows that the number of certified producers who commercially grew EFPs have been increasing significantly from 2002 to 2004 in the country. In 2002, there were a total of 3,120 certified farms producing EFPs while this figure was raised to 3,670 in 2004; an average increase of 8.1 per cent per year (Macey, 2004). Nevertheless, it only represents 1.5 per cent of total farms in Canada if the Census of Agriculture in 2001 is considered as the base year (Statistics Canada, 2001).

The Canada's crop map displays that EFPs are dispersedly grown in the country, given their bioregional characteristics. For example, environmentally friendly grains and oilseeds are mainly produced in the Prairies, whereas dairy products in Quebec and Ontario, fruits in British Columbia, and fresh vegetables and herbs, forages, permanent pastures, and green manure crops are grown in all provinces. Moreover, Atlantic Canada and Quebec are the center of berry

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production including cranberries and wild harvested blueberries.

Macey (2005) reported that total value of EFPs in Canada was ranged between 250 to 350 million dollars. Most of the Canada's EFPs is exported to France, Germany, Italy, the United Kingdom, Japan, and the United States. Among them, grains and oilseeds have great share in Canada's total exported products. Of the $65 million of Canada's total exported EFPs in 2005, wheat was in the first place with an estimated value of 14 million dollars (Agriculture and Agri-Food Canada, 2005). Since Canada cannot produce all types of EFPs (e.g., bananas and citrus fruits), more than 75 per cent of households' consumption of these types of products are provided from the foreign markets. It is predicted that the industry would increase its domestic retail market share to 10 per cent by 2010.

Despite the increase in the area under cultivation of EFPs, producers in Atlantic Canada have not yet responded appropriately to meet the ongoing increase in the demand for EFPs. In 2004, there were only 115 certified environmentally friendly producers in Atlantic Canada. Of these, only four producers (three farms active and one farm in transition) were operating in the province of Newfoundland and Labrador (Macey, 2005). Moreover, there were at least 79 acres of arable land were under the cultivation of environmentally friendly production (vegetables and blueberries) and 30 acres were in transitions in the same year (Macey, 2005). Although these figures demonstrate that the industry is underdeveloped in the province it does not necessarily mean that the demand for EFPs do not exist. There is not much information on the consumer market for EFPs in Newfoundland and Labrador. Studies like this research will help regional policy makers, market developers, investors, processors, handlers, traders, and environmentally friendly producers recognize the availability of demands for EFPs in the province.

The objectives of this paper are two-fold. First, to find the availability of the demand for EFPs in Newfoundland and Labrador we identify factors motivating consumers to purchase EFPs. The production cost of EFPs is usually higher than that of the conventional agricultural products (Govindasamy and Italia, 1999). This difference, known as the premium, would therefore be passed onto the consumers. The amount of the premium depends on the EFPs prices and the demand drivers including consumers' income, tastes and preferences, and the prices of related products. The amount of the premium ranges from five to 25 per cent and varies regionally on a product basis. Second, we use the concept of willingness-to-pay (WTP) the premium as a way of maximizing consumer's satisfaction to examine the impact of factors affecting Newfoundlanders and Labradorians' decisions to purchase EFPs in the market. The WTP is modeled through a binary-choice logit framework as a function of a series of independent continuous and dummy variables including socio-demographic, socio-economic, media, and public perceptions toward EFPs.

The rest of the paper is organized as follows. Next section provides recent studies in Canada in which consumers' WTP are examined followed by a brief review on the binary-choice logit models. The sections following present a summary of data collected from the consumer survey, a justification for the selection of independent variables, and a discussion of the results. The final section concludes the paper, presents some policy implications, and introduces further research topics required advancing this analysis.

Recent Studies on EFPs in Canada

Few studies in Canada investigated consumer perceptions on EFPs in the recent decade. Here we review only those studies whose methodologies and dependent and independent variables are similar to those of this study to avoid biased outcomes in comparing findings.

Veeman and Adamowicz (2001) conducted a research to examine consumer perceptions of environmental risks and the demand for food safety in Alberta. They used the contingent value method to assess Albertans' purchasing behavior towards EFPs raised from a range of environmental risks, such as pesticide residues arisen in conventional agricultural foods and hormonal treatments derived from biotechnological farming practices. The result showed that consumers in Alberta were less susceptible to-

wards the use of hormones than the use of pesticide in the food production. In addition, being female and higher levels of education and income had positive effects on the WTP a premium, ranged from 13 to 25 per cent, to purchase EFPs. Veeman and Adamowicz (2001) also used a conditional logit model of consumer choice to examine Albertan's purchasing behavior towards the consumption of milk produced by using the recombinant bovine somatotrophin (rBST) in the production process. They considered other characteristics including fat content, price, and freshness as well as the use of rBST identified by labeling. Since the use of rBST in Canada is prohibited the objective of the research was to simulate market conditions and consumer responses towards a twofold scenarios: production milk with and without the use of rBST. The result showed that consumers were worse-off with the introduction of rBST. The losses were less for male than that of female households and for those consumers with higher levels of income and education. A small welfare gain was identified when households were offered a full range of rBST and non-rBST milk. The researchers concluded that consumers could abate their welfare losses if the produced milk labeled "rBST-free" milk.

Using the contingent valuation method Cranfield and Magnusson (2003) classified Canadian consumers based on the degree of their acceptance toward the consumption of pesticide-free products. The degree of acceptance of these groups of EFPs was measured by how much extra money consumers would like to spend on pesticide-free products than of what they normally pay for non-pesticide-free products. The result showed that 67 per cent of the sample observations were willing to pay the premium ranged from one to 10 per cent and only five per cent of the respondents tended to pay a premium of 20 per cent over conventional food prices.

Larue et al. (2004) collected data from a sample of 1,008 consumers to analyze their responses to buy various foods produced by different methods of production including conventional, organic, and genetically modified procedures. The researchers chose chicken breast, tomato sauce, and potato chips to assess an expansion of organic nich food markets for a combination of organic tomato sauce and organic chicken breasts. Larue et al. (2004) hypothesized that households would consume these products for their sanitary characteristics including anti-cancer for tomato sauce and heart-healthy for chicken breast. The researchers failed to reject their hypothesis implying that households would be willing to pay additional money to purchase organic tomato sauce and organic chicken breast as long as sanitary properties are attached to these products.

The assessment of market demand for a group of pesticide-free products including pasta, breakfast cereal, dry peas, sunflower seed, beer, multigrain bread, canola oil, and dry lentils was the main objective of a research conducted by Magnusson and Cranfield in 2005. Using a probit model, the researchers found that some socio-demographic, socio-economic, and market-oriented factors, such as switching grocery stores to purchase pesticide-free products, being less than 36 years of age, and high level of household income could have potentially impact on consumer decisions to purchase the pesticide-free products.

The review studies show that consumers are willing to pay a premium, which varies from one region to another, to purchase EFPs as long as they believe the use of pesticide and chemical materials would seriously affect their health condition and environment. This will certainly open a new era for environmental friendly producers to identify different market segments in each region. The production of EFPs has not yet been developed in Newfoundland and Labrador. Several reasons may justify the lack of farmers' interests in growing these types of products. These reasons are climatological conditions, lack of liquidity for farmers, resistance to adopt new technology, and finally the lack of information on the demand side in the province. This paper will draw on these insights to develop a methodology for assessing consumer preferences for EFPs in Newfoundland and Labrador.

Methodology

We used a binary-choice logit model whose parameters are estimated by the maximum-likelihood (ML) technique. Logit models are

widely used in the consumer survey studies because their asymptotic properties guarantee the predicted probabilities to be in the range of zero to one (Greene, 2008). In a likelihood function, a joint probability density function of dependent variables $Y_1, Y_2, ..., Y_n$ is constructed as independent variables that are randomly derived from a Bernoulli distribution with probability π_i, which varies from one observation to another. The expected value of the dependent random variable and its variance, respectively, is

$$E(Y_i) = \Pr[Y_i = 1] = \pi_i \text{ and}$$
$$\text{Var}(Y_i) = \pi_i (1 - \pi_i).$$

We assume a positive outcome as a probability of observing a success derived from the behavior of a representative consumer who is willing to pay at least a five-percent premium to purchase EFPs. The probability of success is $\pi_i = \pi(\boldsymbol{X}_i)$ in which X_i represents a vector of independent variables including demographic characteristics, socio-economic variables, media factors, and public awareness of hazardous on health condition and environment involved with the consumption of agricultural products that are produced from conventional farming practices. The five per cent premium is drawn from the information collected from the sample observations in the survey. Since the probability of success ranges from zero to one, the value of $\pi(\cdot)$ falls in the unit interval (0,1). Therefore, we can write the probability of success as

$$(1) \quad \pi_i = \Lambda(\Omega_i) = \Lambda(\boldsymbol{X}_i' \boldsymbol{\gamma}) = \frac{\exp(\boldsymbol{X}_i' \boldsymbol{\gamma})}{1 + \exp(\boldsymbol{X}_i' \boldsymbol{\gamma})}$$

in which Ω_i represents the information set consisting of independent variables, $\boldsymbol{X}_i' \boldsymbol{\gamma}$ is the index function that maps a linear combination of independent variables from the covariate vector $\boldsymbol{X}_i$ and the vector of unknown parameters $\boldsymbol{\gamma}$, and $\Lambda(\Omega_i)$ is the value of the logistic cumulative density function. In light of this, equation [2] specifies a logit model

$$(2) \quad \Omega_i = \log\left(\frac{\pi_i}{1-\pi_i}\right) = \boldsymbol{X}_i' \boldsymbol{\gamma} = \gamma_0 + \gamma_1 x_1 + \gamma_2 x_2 + ... + \gamma_n x_n + \varepsilon,$$
$$i = 1, 2, ..., n$$

that Ω_i represents the log odds of choice for the i^{th} observation, x_i indicates the i^{th} independent variable associated with each dependent variable, $\gamma_1, ..., \gamma_n$ are the unknown parameters that must be estimated, and ε is the random error term. The signs of the estimated parameters in equation [2] will show the direct impact of a change in any of the explanatory variables on the probability of a success $(Y = 1)$ quantified by the marginal effects (ME). Equation [3] measures the ME of the j^{th} independent variable on the probability of a success,

$$(3) \quad \frac{\partial \pi(Y_i = 1 | x_i)}{\partial x_{ij}} = \text{scale} * \gamma_j \quad \text{where} \quad \text{scale} = \frac{\exp(\boldsymbol{X}_i' \boldsymbol{\gamma})}{[1 + \exp(\boldsymbol{X}_i' \boldsymbol{\gamma})]^2}$$

In practice, the impact of MEs is evaluated at the sample mean for continuous independent variables, whereas equation [4] is used when the explanatory variables are either discrete variables or dummies.

$$(4) \quad \pi(Y = 1 | x_j = 1, X_\Theta) - \pi(Y = 1 | x_j = 0, X_\Theta)$$

In equation [4], X_Θ is defined by setting all dummy variables to their modal values and all continuous independent variables to their mean values. Equation [4] calculates the change in the probability of a success $(Y = 1)$ yielding from a change in x_j between zero and one, holding all other variables at some fixed values X_Θ.

To predict a representative consumer's WTP at least a five per cent premium to purchase EFPs in the region of the study, we developed the following regression model:

$$(5)\quad WTP_{EFPs} = \gamma_0 + \gamma_1\, gen + \gamma_2\, age2 + \gamma_3\, age3 + \gamma_4\, age4 + \gamma_5\, marit2 + \gamma_6\, fsz + \gamma_7\, edu2 + \gamma_8\, edu3 + \gamma_9\, edu4 + \gamma_{10}\, emp2 + \gamma_{11}\, emp3 + \gamma_{12}\, inc2 + \gamma_{13}\, inc3 + \gamma_{14}\, inc4 + \gamma_{15}\, visg + \gamma_{16}\, visfm + \gamma_{17}\, purog + \gamma_{18}\, trnew + \gamma_{19}\, psh + \gamma_{20}\, psen + \gamma_{21}\, ipm + \gamma_{22}\, med + \gamma_{23}\, arti + \gamma_{24}\, loc + \varepsilon,$$

Prior to estimate equation [5], we dropped one category from each of the group-category independent variables to avoid the perfect collinearity in the model (see Table 1). It is expected that consumers with higher levels of income or education are more likely to pay the premium. In addition, respondents who have seriously concerns about the status of health and the environment will tend to purchase EFPs.

Empirical Analysis

Data Description

To analyze consumers' WTP to purchase EFPs, we elicited a consumer survey using a stated preference methodology during winter 2007 in the province of Newfoundland and Labrador. In particular, sample observations were randomly selected from St. John's, Mount Pearl and Grand-Falls Windsor in the east, and Deer Lake, Pasadena, Corner Brook, and Port aux Basque in the west of the province. The survey was conducted during weekday and weekend periods in various time of the day. We set up a table in shopping centers, handed in a two-page questionnaire to each one of the participants approaching the table, and collected the questionnaires in the same day. To minimize bias in sampling, participants were told the purpose of the survey was about their perceptions towards the consumption of various foods in general without mentioning the term EFPs. Prior to completing the survey, participants were given a one-page "consent and contact" letter that describes the objectives of the research and emphasizes that their contribution is completely voluntarily and they can quit the survey at any time.

We are aware of the limitations facing studies in which the stated preference methodology is selected as the focus of the research. Consumer survey studies are usually time-and-location variant that might cause an inaccurate collection of information received from respondents. Nevertheless, such research as being done here still yields useful information and contributes to the body of literature. The questionnaire was designed based on what Govindasamy et al (2001) and Hobbs et al (2005) used in their studies with slight changes made to reflect the characteristics of the region. Due to the budget limitations the survey was not conducted in Labrador. In total, 447 individuals were approached and 222 completed questionnaires were collected, yielding a 49.6 per cent response rate. Of these, 108 questionnaires were completed in eastern Newfoundland and the rest (51.3 per cent) was completed in the west part of the province. Prior to the main survey, we tested the model in a small scale in Corner Brook and its suburbs, and excluded the results of the pilot survey from the final analysis.

Table 1 presents a descriptive analysis of the variables used in the study. Of the 222 total number of survey participants, 45 per cent were male and the rest were females, which, to some extent, conforms to the 2006 Census Provincial Population in which 49.5 per cent of the residents in NL was male and 50.5 per cent was females (Statistics Canada, 2007). The survey showed that 63.1 per cent of the participants were between 31 to 60 years of age and 33 per cent of them were singles. In addition, more than 70 per cent of the respondents declared that they had either a college or a university degree. The result also showed that near 42 per cent of the survey respondents earned an annual income between $30,000 to less than $50,000, whereas only seven per cent reported an annual household income of more than $80,000. Table 1 displays that the annual household income of near 75.2 per cent of the survey participants was less than $50,000. This implies that the information drawn from the sample observations conform to

the data released by Statistics Canada in 2006 indicating that the annual per capita income in the province of Newfoundland and Labrador was $31, 234 (Statistics Canada, 2007).

Table 1 (See Appendix A) shows that 64 per cent of the survey respondents visited grocery stores to purchase advertised products and 63 per cent visited farmers' markets in the past five years. In total, more than 74 per cent of the participants believed that the use of pesticides poses a serious risk to human health, and 81.1 per cent thought that the use of various pesticides has negative impacts on the environment. Of the 222 sample observations, 22 per cent knew about the integrated-pest management as one of the new methods of farming practices prior to this survey. Finally, 49 per cent of the respondents expressed that they saw on television or heard from radio few programs aired about EFPs and 33 per cent declared that they had read articles about these types of products in magazines and newspapers, and on-line. Overall, 66.2 per cent of the survey participants stated that they were willing to pay at least a five-per cent premium to purchase EFPs. Since the majority of the survey respondents chose such a percentage, the five per cent premium was used to specify the dependent variable.

Estimation Results

Table 2 displays the estimation results of the logit model used to analyze consumers' choices by paying five per cent more than what they used to pay for conventional food to purchase EFPs in the province of Newfoundland and Labrador. The parameters of the regression model were estimated through the ML approach by using NLOGIT (Version 3.0). In the model, the dependent variable (**WTP_{EFPs}**) was coded as 1 indicating a representative consumer's WTP the five per cent premium for EFPs and zero otherwise. Overall, using the likelihood ratio (LR) statistic test, the calculated chi-square statistic was found to be 164.6, which rejects the null hypothesis that all slope coefficients were zero at the 0.01 level of significance. The Pseudo R–squared figure (0.5769) also represents a reasonable goodness-of-fit for the entire regression model although as Pindyck and Rubinfeld (2000) expressed that binary choice models with cross sectional data are not expected to be estimated with high R-squared values.

Table 2 shows that married people (**MARIT2**) were 30 per cent more likely to pay a five-per cent premium to purchase EFPs than that of singles in the province. The **MARIT2** variable was positive and statistically significant at the 0.06 level. The result indicates that the level of education is positively related to the consumption of EFPs. Evidence shows that as respondents have higher level of education, they are more likely to pay the premium to purchase EFPs. Table 2 shows those respondents holding an undergraduate degree (**EDU3**) were 20 per cent more likely to pay the five-per cent premium than that of people with a high school degree to buy EFPs. The coefficient of **EDU3** was positive and statistically significant at the 0.05 level. In addition, respondents with a graduate degree (**EDU4**) were 17 per cent more likely to pay the premium when compared to those holding a high school diploma or those who did not finish high school. This is shown by the partial slope coefficient of **EDU4** that was positive and statistically significant with 99 per cent confidence. These results support those of Magnusson and Cranfield (2005), but in contrast with what Govindasamy and Italia (1999) and Boccaletti and Nardella (2000) reported. This comparison would not be feasible if the dependent and independent variables used in the studies were not similar to each other.

The dummy variable indicating that the respondents usually consider EFPs in their basket of foods (**PUREFPs**) was positive and statistically significant with 99 per cent confidence. The magnitude of the coefficient was 0.5077 implying that these group of consumers were approximately 51 per cent more likely to pay at least a five-per cent premium to purchase EFPs than those who did not tend to buy these types of products. Other studies also reported similar consumer behavior towards the consumption of EFPs (see, e.g., Govindasamy and Italia, 1999; and Batte et al., 2004). Batte et al. (2004, p.14) expressed that consumers who were willing to pay a premium to purchase EFPs were usually less concern about the prices of these products. We observed similar consumer behavior, but

Table 2. Estimation Results

Variable name	Estimate (*p*-value)	Change in Probability (*p*-value)
Constant ***	-3.9341 (0.0029)	-0.5091 (0.0167)
GEN	-0.0738 (0.9036)	-0.0095 (0.9035)
AGE2	-0.3753 (0.6556)	-0.0501 (0.6677)
AGE3	-1.1628 (0.3052)	-0.1827 (0.3850)
AGE4	-0.1001 (0.9446)	-0.0132 (0.9460)
MARIT2 *	1.8559 (0.0362)	0.2959 (0.0633)
FSZ	-0.3458 (0.1569)	-0.0447 (0.1581)
EDU2	0.4852 (0.4318)	0.0591 (0.4159)
EDU3 **	1.7143 (0.0317)	0.2000 (0.0303)
EDU4 ***	2.6338 (0.0738)	0.1682 (0.0033)
EMP2	0.4543 (0.5470)	0.0633 (0.5796)
EMP3	0.4558 (0.7212)	0.0523 (0.6885)
INC2	0.0995 (0.8697)	0.0128 (0.8692)
INC3	-0.1185 (0.9065)	-0.0157 (0.9089)
INC4	-0.3465 (0.8210)	-0.0496 (0.8383)
VISG	-0.8805 (0.1463)	-0.1053 (0.1147)
VISFM	0.1476 (0.8112)	0.0193 (0.8145)
PUREFPs***	3.4867 (0.0000)	0.5077 (0.0000)
TRNEW ***	1.6999 (0.0089)	0.2016 (0.0047)
PSH *	1.8381 (0.0217)	0.3142 (0.0623)
PSEN	-0.1561 (0.8351)	-0.0195 (0.8294)
IPM **	1.1017 (0.1055)	0.1159 (0.0459)
MED	0.7099 (0.2054)	0.0918 (0.2009)
ARTI	0.6344 (0.2760)	0.0765 (0.2679)
LOC	0.5138 (0.3625)	0.0669 (0.3857)
Number of observations	222	
McFadden R-squared (Pseudo R–squared)	0.57698	
Likelihood ratio statistic	164.6154	
Degrees of freedom	24	
Prob [ChiSqd > value]	0.0000	

* Significant at 0.10, ** Significant at 0.05, *** Significant at 0.01.

with a mitigated reflection in the region of the study. The dummy variable denoting whether individuals classify themselves as among the very first to try newly introduced food products (**TRNEW**) was positive and statistically significant with a p-value of 0.0089. This implies that, everything else being equal, these groups of respondents were 20 per cent more likely to pay a five-per cent premium to buy EFPs than those who were not classified themselves as first-adopter consumers.

Table 2 shows that the independent dummy variable representing the participants' concerns about the use of pesticide in farming practices and its effects on their health condition (**PSH**) was positive and significant at the 0.06 level. The magnitude of the estimate of the **PSH** variable was 0.3142 implying that environmentally friendly consumers, on average, were 31 per cent more likely to pay the premium than those of nonbelievers in the adverse effects of the conventional food products. This finding support those reported by Haghiri et al. (2006). The last explanatory variable that was statistically significant at the 0.05 level was the public knowledge about the new method of agricultural farming

practices, known as the integrated-pest management (**IPM**). This method of farming practice is an ecosystem-based method used to control pests and weeds through a series of different techniques, which are least injurious to the environment and most specific to the particular pest and weed. The IPM method includes biological control, habitat manipulation, modification of cultural practices, and the use of pest resistant plant varieties. The result shows that respondents having knowledge of **IPM** are 12 per cent more likely to pay the premium to purchase EFPs when compared to those who did not know anything about new method of farming practices

Finally, we examined the effects of other variables on the WTP the premium to purchase EFPs in the model and found none of them was statistically significant. These variables were gender, age, family size, income levels, employment status, visiting grocery stores and farmers' markets, believed in the negative impact of synthetic pesticides use on environment, media, articles read about EFPs, and location.

Table 3 presents the frequencies of actual and predicted outcomes. Overall, the estimated regression model correctly identified 198 observations out of 222 total sample of observations (89.2 per cent). However, the correct percentage of predictions against the naive predictions (herein, all one) is 65.7 per cent of the total observations (146/222), suggesting a reasonable prediction.

Table 3. Frequencies of Actual and Predicted Outcomes[a]

		Predicted		
		0	1	Correct
Actual	0	63	13	63/76
	1	11	135	135/146

a Total number of observations: 222. Total number of correct predictions: 198

Conclusion and Suggestions for Managers

The recent global appearance of a series of communicable diseases including Avian Flu, Bovine Spongiform Encephalopathy, and Polychlorinated Biphenyls in Atlantic farmed salmon have affected human lives especially infants, young children, and the elderly people worldwide. To date, the food incidence of salmonella outbreak in Mexican tomatoes has not been solved and attentions have now been made toward Mexican cilantro and peppers. In addition, the existence of harmful microorganisms, agricultural chemicals, non-tested GM foods, and the misrepresentation of food origin placed a level of distrust in the food markets. As a result, households concern seriously about the quality of food they consume. The fear of being exposed by adverse effects of consuming conventional food on health and environment has brought substantial motivations for consumers to increase their demands for EFPs in the province of Newfoundland and Labrador.

The production of EFPs needs to be expanded in Newfoundland and Labrador. The lack of a developed sector of producing these groups of products can be imputed to several reasons; none of them stems from the demand side. The lower amount of the premium, which has lessened the motivations of producers and distributors of EFPs to increase their production scale, is one reason why the industry has not been developed.

Several points are drawn from the results of this study. First, different level of market segments for EFPs are available among consumers in Newfoundland and Labrador. Second, the martial status and high level of education have positive relationships with willingness-to-pay the premium strengthened by the public awareness of new farming methods including integrated-pest management. Third, consumers favor their health status against environment when making decisions to purchase EFPs. Fourth, a tendency toward the consumption of newly introduced products among consumers has been observed as the estimated parameter of the model was translated in paying the premium.

Due to the structure of the research we were unable to measure the sensitivity of consumers' decisions to pay the premium with respect to the changes in the levels of incomes and the EFPs prices. Thus, further studies are suggested to estimate the price and income elasticities of demands for EFPs. In addition, to encourage producers to grow EFPs, the provincial government should implement appropriate policies in support of the industry so that certified producers will have cost advantages in producing these types of products and as a result they will be become

more competitive in Canada. Meanwhile, public awareness of the advantages of consuming EFPs should be steadily raised. The aid of media (radio, television, and newspapers) in promoting the consumption of EFPs will help the industry grow consistently.

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Appendix

Table 1. Summary statistics for the independent variables [a]

Variable name	Frequency	Mean	S.D.
Gender			
Male *	100	0.4505	0.4987
Female	122	0.5495	0.4987
Age			
AGE1 (less than 30 years of age) *	52	0.2342	0.4245
AGE2 (31-45 years of age)	85	0.3829	0.4872
AGE3 (46-60 years of age)	55	0.2478	0.4327
AGE4 (more than 60 years of age)	30	0.1351	0.3426
Marital Status			
MARIT1 (singles) *	73	0.3288	0.4708
MARIT2 (married)	149	0.6712	0.4708
Family Size			
FSZ	222	2.7703	1.0070
Education			
EDU1 (high school diploma and less) *	46	0.2072	0.4062
EDU2 (some college certificate)	71	0.3198	0.4675
EDU3 (undergraduate degree)	86	0.3874	0.4883
EDU4 (graduate degree)	19	0.0856	0.2804
Employment Status			
EMP1 (unemployed) *	32	0.1441	0.3520
EMP2 (employed)	164	0.7387	0.4403
EMP3 (retired)	26	0.1172	0.3327
Annual Household Income			
INC1 (less than $30,000) *	74	0.3333	0.4725
INC2 ($30,000 - $49,999)	93	0.4189	0.4945
INC3 ($50,000 - $79,999)	39	0.1757	0.3814
INC4 ($80,000 or more)	16	0.0721	0.2516
Visiting grocery stores to purchase advertised specials (VISG)			
Yes	142	0.6396	0.4812
No*	80	0.3604	0.4812
Visiting farmers' markets (VISFM)			
Yes	139	0.6261	0.4849
No*	83	0.3739	0.4849
Purchasing environmentally friendly produce (PUREFPs)			
Yes	120	0.5405	0.4995
No*	100	0.4595	0.4995
Try newly introduced food produce (TRNEW)			
Yes	89	0.4009	0.4912
No*	133	0.5991	0.4912
Believed in negative impact of pesticides use on health (PSH)			
Yes	166	0.7477	0.4353
No*	56	0.2523	0.4353
Believed in negative impact of pesticides use on environment (PSEH)			
Yes	180	0.8108	0.3925
No*	42	0.1892	0.3925

Table 1. Continued

Knowledge of integrated-pest management (IPM)			
Yes	49	0.2207	0.4157
No*	173	0.7793	0.4157
Media (radio, Television) programs aired about environmentally friendly produce (MED)			
Yes	109	0.4910	0.5010
No*	113	0.5090	0.5010
Articles read about environmentally friendly produce (ARTI)			
Yes	74	0.3333	0.4725
No*	148	0.6667	0.4725
Location (LOC)			
	108	0.4865	0.5009
	114	0.5135	0.5009

Repeat Buying Behavior for Ornamental Plants: A Consumer Profile

Marco A. Palma, Charles R. Hall and Alba Collart

This paper used an electronic survey conducted in Texas to study the main factors affecting the frequency of purchase, measured in transactions per month, for ornamental plants. While we found several differences in demographic characteristics of respondents, the two major factors impacting the frequency of buying for ornamental plants were the purpose of the purchase (self use vs. gifts) and seasonality. Respondents with a college degree in the older age groups, and higher income levels had a lower frequency of buying while individuals with medium income levels increase frequency of buying. Several ornamental plant attributes were also included in the analysis.

The floriculture and nursery industry has evolved rapidly in recent years. The introduction of mass-market retailers such as supermarkets, department stores and Internet-based businesses has changed the marketing paradigm of floriculture and nursery products. Floriculture and Nursery crops, often referred to as the green industry are an important sector of the U.S. agricultural economy with grower cash receipts of $16.9 billion in 2006 (Jerardo, 2007). All green industry sectors, including growers, landscaping design and maintenance, and retail, are estimated to contribute over $148 billion in economic impacts to the U.S. economy and add almost 2 million jobs (Hall et al., 2006).

In general, the demand for all products is highly dependent on its characteristics or attributes, which include satisfying nutritional needs and/or taste (Hanemann, 1984). Even though ornamental plants do not satisfy any nutritional needs, they possess other important attributes that influence the buying decision including their aesthetic value; In addition to ornamental attributes, consumer demand for ornamental products is also affected by consumer demographics and the buying occasions and periods (Palma and Ward, 2010). Understanding how consumers make choices of whether to buy ornamental products or not, and the intensity and frequency of purchase is essential to understanding ornamental demand. Floriculture and nursery products are purchased for various reasons such as expression of love or friendship, a way to express thankfulness or appreciation, and beautification purposes either for self use or as gifts. Plant and flower attributes are not easily quantified and very subjective; therefore the satisfaction (utility) gained from the consumption of ornamental products can be influenced by the characteristics or preferences of buyers (demographics) and the reasons for buying the products (Girapunthong, 2002). This situation becomes evident during special seasonal buying occasions (i.e., Mother's Day, Valentine's Day, etc), where the consumption of ornamental products is substantially higher compared to non-calendar occasions.

The main objective of this paper is to analyze the effects of product attributes, consumer characteristics (demographics) and seasonal factors affecting consumer demand for ornamental plants. Specifically, we will look at the frequency of buying, measured in transactions per month as a function of ornamental plant features, socio-economic characteristics, and consumer habits (including seasonality). Frequency of purchasing multiplied by expenditures per transaction yields total sales for the ornamental plant industry. Understanding what factors influence buyers to increase frequency of purchasing is essential for ornamental plant grower's profitability.

There is extensive literature regarding demand analysis for traditional agricultural products, such as milk (Gould et al., 1990), meat (Glynn et al., 2010), fruit and vegetables (Rickard et al., 2009), etc.; however, studies on the demand side for floriculture and nursery products are very limited in the literature, with the

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majority of consumer demand and preferences studies focusing in floricultural crops. Miller (1983) performed an extensive sub-sector analysis for the fresh cut-flower industry in the U.S. by analyzing the structure, conduct and performance of the existing conditions of the industry in an attempt to predict future trends. Miller observed that there were special calendar occasions when the demand for flowers was substantially higher and other non-calendar occasions where the demand was substantially lower. He also determined that the demand for flower arrangements was inelastic, meaning that consumers are not highly responsive to changes in price of floral products.

Tilburg (1984) analyzed a panel of cut flower and potted plant consumers in the Netherlands to relate aspects of consumer behavior to marketing variables and demographic characteristics of households. He identified three market segments: the first segment consisted of 44 percent of the households and was sensitive to prices but insensitive to national advertisements; the second segment consisted of 40 percent of the households, and was insensitive to both prices and advertisements; and the third segment, with 13 percent, was sensitive to both prices and advertising.

Behe (1989) analyzed consumer floral purchasing behavior of Pennsylvanians at the retail level. She recommended three ways to segment retail flower markets: by product, volume of purchase, and by location of the purchase. Behe et al. (1992a) carried out an analysis of consumer purchases of floral products in Ohio supermarkets using principal components analysis that yielded 34 independent factors accounting for 64% of the total variance affecting floral purchases. These factors were grouped into five main categories, including, product, consumer, store, use (gift), and location. Behe et al. (1992b) followed up on her previous study and applied cluster analysis to identify the most important factors affecting floral buying decisions by market segments. She used demographic characteristics and purchase factors identified in her previous work to profile market segments and distinguishing elements. Becker (1993) studied differences in service quality between supermarkets and florists in Texas. He found that the differences on the types of retail outlets were based on the types of products sold, custom design and other in-store services, delivery options and convenience. Rimal (1998) analyzed the effects of generic and brand promotions on sales of fresh cut-flowers at the retail level in the U.S.

Girapunthong (2002) analyzed the demand drivers for fresh cut-flowers and their substitutes in the U.S. Girapunthong found that all direct price effect coefficients with the seasonal and actual variables were statistically significant and changes in the relative prices had a significant impact on flower market shares among fresh cut-flowers, potted flowering plants, and dry/artificial flowers. Ward (2004) evaluated the impacts of the Flower Promotion Organization (FPO) advertising campaign on cut-flower sales, concluding that the promotions have impacted the demand for flowers through increasing buyer frequency and through attracting new buyers. He found that about 87 percent of the increase in demand for the promotional programs is from the increased number of transactions per buyer. Ward found that the demographic group that responded the most to the promotional program were female buyers that purchase flowers for self-use. This was consistent with the target of the FPO promotion program. Yue and Behe (2008) analyzed consumer preferences for different floral retail outlets. They used a consumer panel data collected by the American Floral Endowment from 1992 to 2005 were used to evaluate consumers' choice of different floral retail outlets among box stores, traditional freestanding floral outlets, general retailer, other stores, and direct-to-consumer channels. Palma and Ward (2010) estimated ornamental demand for four different ornamental products, including cut flowers, plants, dry/artificial and outdoor. They divided demand into two components, market penetration and buying frequency. They concluded that demand drivers for ornamental consumption was driven by the entry of new buyers rather than repeat buying customers increasing their number of transactions.

When studying the aforementioned literature regarding the demand for floral and nursery products, it is apparent that there are many factors that affect their demand. These factors can

be grouped into three main categories: external, controlled, and seasonal factors. External or macro-factors of demand are those affecting industry businesses but for which firms have no mechanism to change their output. These include inflation, wages, prices, unemployment rate, demographic factors and other macro-economic variables. Controlled factors of demand are those factors that may be used to influence perceptions and awareness with the use of promotions, product development and innovations. Seasonal factors are also important for floral and ornamental plants because of the nature of the products and the reasons for buying (Ward, 1997).

Because ornamental plants are not satisfying nutritional needs like most food products, in a typical month the percentage of the population that buys flowers and ornamental plants is relatively low. Hence, it is important to understand how ornamental plant buyers make the choice to purchase and to have a measure or profile of consumer purchase intensity. Demand analyses for ornamental products differ among other agricultural commodities in the sense that for other agricultural commodities, the quantity consumed is used directly in the analysis. In the case of floriculture products, a consumer purchase quantity is ambiguous and closely tied to the type of ornamental plant; for example, a quantity of one may refer to one single stem rose, or an arrangement of a dozen roses and several other plants. Hence, this study replaces quantity (number of units) observed by the number of transactions given on a defined period of time. In doing so, all properties (or restrictions) of the demand function are still satisfied.

Repeat buying occurs when a consumer buys a product more than once in a given period of time. Consumers are influenced by pre-purchase needs, perspectives, attitudes, the experience of previous usage, and external influences such as advertising and promotion programs, retail availability, personal selling and word of mouth effects, and differences in products, services and prices. The consumer has to make decisions regarding what products to buy and at what prices and where to buy the products. All of these characteristics form a post-buying experience in the customer's mind after the purchase takes place; based on all these factors a consumer would choose depending on the level of satisfaction or utility obtained from the product or service whether to re-purchase the product or not.

There are basically three cases of repeat buying situations that can be defined. First, if a consumer buys more than one product in one or more purchase occasions (transactions) in a given time period. In this case, consumers differ in how often they repeat buy the products. The frequency of buying would be 0 for a consumer that did not purchase the product and 1 for consumers that purchased the product once. For repeat buyers, the frequency will be 2, 3, 4, etc., depending on the number of repeat buying occasions they purchased the product. The second way of repeat buying refers to consumer that may buy the product in more than one time period, or multiple transactions in a given period. Then a model can be formulated for repeat buying behavior under stationary and no trend conditions. The third and last form of repeat buying behavior is that more than one unit may be purchased on the same purchase occasion (Ehrenberg, 1988).

Data and Methods

The conceptual framework for this study is based in the random utility theory. A random utility model assumes that the utility function for a consumer has two components, one that is deterministic, and one that is not observable and therefore treated as random variables (Carpio et al., 2008). The unobservable portion treated as random variables could be characteristics of the consumers or the products. Following Hanemann (1984), the utility obtained from consuming ornamental plants can be written as:

$$(1)\quad u(x,b,z,s,\varepsilon)$$

where x represents a vector of ornamental plant commodities, z is all other commodities, b represents ornamental plant features (attributes), s represents consumer socio-demographic characteristics, and ε is a random vector of unobservable consumer or ornamental plant characteristics. The consumer chooses (x,z) to maximize utility subject to a budget constraint:

(2) $\sum p_j x_j + z = y$

And the non-negativity constraints:

(3) $x_j \geq 0, z \geq 0$

The data were obtained through an electronic mail survey conducted in July of 2008 to a representative sample of the Texas population following Dillman's tailored design method (Dillman, 2007). The survey sample consisting of 880 individuals provided by MarketTools Corporation, a company specialized in market research and online survey services. From the total sample, approximately 31% were actual consumers of the ornamental industry's products, lowering the final number of usable responses to 274 observations.

The dependent variable is frequency of buying for ornamental plants. It is defined as the number of transactions per month ($f_i = 0,1,2,3,...,n$) and it is a function of the purpose of the purchase (PP), seasonality (S), price (P), ornamental plant features including low care demanding (LCD), organically grown (ORGANIC), light demanding (LD) Guaranteed growth (GG), drought tolerant (DT), vibrant colors (VC), and several demographic characteristics, including age, gender, marital status, income, ethnicity, education, and region. The purpose of the purchase is to use the ornamental plants for self consumption or gifts. The frequency of buying of flowers is affected by seasonal factors. As an example, the frequency of buying and the total number of buyers increase during special calendar occasions such as Mother's Day, Valentine's Day, Christmas, etc. Since our data are not time series, monthly seasonality cannot be evaluated. The variable seasonality is a discrete variable that identifies self described special occasion buyers only (non-habitual buyers), versus habitual ornamental buyers. There is also a random term ε that represents unobserved consumer or ornamental plant features. The dependent variable frequency of buying is censored and therefore the Tobit model is used for the estimation. The general frequency of buying econometric model can be written as:

(4)

$$f_i = \beta_0 + \beta_1 LCD + \beta_2 ORGANIC + \beta_3 LD + \beta_4 GG + \beta_5 DT + \beta_6 COLOR + \beta_7 P + \beta_8 AGE2 + \beta_9 AGE3 + \beta_{10} AGE4 + \beta_{11} FEMALE + \beta_{12} MARRIED + \beta_{13} INC2 + \beta_{14} INC3 + \beta_{15} INC4 + \beta_{16} ET2 + \beta_{17} ET3 + \beta_{18} EDU2 + \beta_{19} EDU3 + \beta_{20} REG2 + \beta_{21} REG3 + \beta_{22} PP + \beta_{23} S + \varepsilon_i$$

where all variables used in the model and their definition are presented in Table 1 (see Appendix).

Because the dependent variable in our regression model equation has a lower limit (i.e. zero), and the dependent variable takes the value of zero for a large number of sample observations (24.8%), conventional multiple regression analysis is not an appropriate technique to be used (Lung-Fei and Maddala, 1985). In order to account for this truncation on the data set the Tobit model can be specified as follows (Greene, 2000):

(5) $f_i^* = x_i'\beta + \varepsilon_i$,

where x_i' is the (1 × K) vector of explanatory variables and $\varepsilon_i \sim N(0, \sigma^2)$ and it is independent of other errors. Thus for any household the buying frequency model would take the form:

(6) $f_i = f_i^*$ if $f_i^* > 0$
$f_i = 0$ if $f_i^* \leq 0$.

From the total number of observations N in the sample, the number of observations can be divided into two groups; one for which $f_i = 0$, N_0; and another for the number of observations for which $f_i > 0$, N_1. In order to observe the statistical problems arising from the censored sample problem, consider leaving out of the analysis the N_0 observations for which $f_i = 0$. For the remaining N_1 sample observations, they are complete observations. Hence, one can use least squares estimators to estimate β. The problem is that this estimator is biased and inconsistent. In order to prove that, one can write

down the expectation of the observed values of f_i conditional on the fact that $f_i > 0$:

$$(7)\quad E[f_i \mid f_i > 0] = x_i'\beta + E(\varepsilon_i \mid f_i > 0)$$

If the conditional expectation of the error term is zero, then the estimates of the least square regression on N_1 would provide an unbiased estimator for β. However this is not the case; if the ε_i are independent and normally distributed random variables, then the expectation would be:

$$(8)\quad E[\varepsilon_i \mid f_i > 0] = E[\varepsilon_i \mid \varepsilon_i > -x_i'\beta] > 0$$

It can be shown that this conditional expectation can also be expressed in the following manner:

$$(9)\quad E[\varepsilon_i \mid \varepsilon_i > -x_i'\beta] = \sigma \phi_i / \Phi_i$$

where ϕ_i and Φ_i are the standard normal probability distribution function (p.d.f), and cumulative distribution function (c.d.f.) evaluated at $(x_i'\beta/\sigma)$; therefore in the regression model, if $f_i > 0$, then,

$$(10)\quad f_i = x_i'\beta + \varepsilon_i$$
$$= x_i'\beta + \sigma\frac{\phi_i}{\Phi_i} + u_i$$

if we apply the regular least squares procedures the term $\sigma\frac{\phi_i}{\Phi_i}$ is omitted. Since that term is not independent of x_i the results are biased and inconsistent.

The parameters were estimated with Time Series Processor (TSP) version 4.5 (Hall, 1992). The estimation procedure uses the analytic first and second derivatives to obtain maximum likelihood estimates via the Newton-Raphson algorithm. The starting values for the parameters are obtained from a regression on the observations with positive f values. The numerical implementation involves evaluating the normal density and cumulative normal distribution functions. The cumulative distribution function is computed from an asymptotic expansion, since it has no closed form. The ratio of the density to the distribution function, used in the derivatives, is also known as the Inverse Mills Ratio.

Results and Discussion

As shown in Table 2 (see Appendix), the survey sample was a fair representation of the Texas' population based on selected socio-demographic characteristics including marital status, gender, ethnicity, and income. About 60% of respondents were married compared with 54% of the population in Texas. The percentage of females in the sample was 53% versus 50% for Texas; and 53% of the total number of respondents had an income of more than $50,000 compared to 47% of Texas' population. The ethnical distribution of the sample was similar to the U.S. Census Bureau data, with Caucasians accounting for the majority of responses in the survey and comprising the majority of the true population, followed by Hispanics. The highest educational degree obtained from 78% of the sample population was a bachelor's degree compared with 92% of Texas' population.

Most respondents (78.5%) reported to be non-habitual ornamental buyers or purchasers of ornamental plants during special calendar buying occasions only. Most (84%) ornamental products in Texas were purchased for self-consumption purposes. The preferred outlets to purchase ornamental products were garden centers (72%), followed by nurseries (40%), chain stores (32%), and supermarkets (30%).

Respondents were also asked to rate, from 1-5, the importance of several aspects in the purchase decision including price (3.89), vibrant colors (3.85), low-care demand (3.83), drought tolerance (3.64), season (3.57), guaranteed growth (3.51), light demand or requirement (3.34), and organic (2.58). The weighted average rating of these aspects clearly suggests that price is the most important feature, followed very closely by vibrant colors and low-care demand (low maintenance). The rating of organically-grown and light requirement implies that these two features are typically not very important to Texas consumers when making purchasing deci-

sions for ornamental plants. For instance, 45% of the respondents assigned low ratings of 1 or 2 to organically-grown products and 36% confirmed that light requirement was not a feature they carefully seek for when buying an ornamental plant.

The parameter estimates of the buying frequency model for ornamentals are presented in Table 3 (see Appendix). The strong significance of the sigma parameter suggests that for the data truncation, the lower limit level of zero can not be ignored and the estimation method must deal with the asymptotic distribution of the data. This parameter refers to the estimated standard deviation of the residual. In this model, 184 out of 249, or 73.9% of the usable observations were positive. The frequency of buying for the average respondent was 1.36 transactions per month. The sign of the parameters can be interpreted as an increase (positive), or decrease (negative) in the monthly frequency of buying measured in number of transactions per month. The marginal effects represent the change in the monthly frequency of buying for an additional unit of the variable. Since most of the variables in the model are dummy variables, then marginal effects are interpreted as the change in the number of transactions per month associated to that dummy variable. For example, low care demanding plants (LCD) would increase the monthly frequency of purchasing by 0.0256. On the contrary, if a plant is not low care demanding, then the monthly frequency of purchase would be reduced by 0.0256 transactions

The price coefficient is, as expected, negative, in accordance to economic theory (Nicholson, 1998). There was no statistical significant influence associated with younger age groups and frequency of buying. Age2 (25-39 years old), Age3 (40-55 years old) and Age4 (more than 55 years old) all decreased frequency of buying. For individuals of 25-39 years of age, frequency of buying was reduced by 0.03 transactions per month, while 40-55 years of age had 0.08 less transactions per month, and individuals older than 55 had 0.05 less transactions per month. Respondents with incomes between $25,000 and $49,999 had a higher frequency of buying, with 0.06 more transactions per month. No other income groups had statistically significant effects on frequency of buying. Higher income groups (Inc3 and Inc4) had negative marginal effects of about 0.02 less transactions per month. Ethnicity was not found to have statistically significant effects on buying frequency. Individuals with a college degree tend to make 0.08 less transactions per month. The two variables with the highest effects on frequency of purchasing were purpose of the purchase (PP) and seasonality (S), with both variables increasing the frequency of buying. When the purpose of the purchase was for self-use, the model showed an increase in the number of transaction per month of 0.09. The seasonality variable sought to differentiate between those individuals making most of their ornamental purchases during special calendar occasions, such as Valentine's Day, Mother's Day and Christmas, etc. and those individuals who also purchase ornamentals in non-calendar occasions (year-round). Respondents who purchase ornamentals year-rounded increase frequency of buying by 0.2165 transactions per month. No statistically significant differences in frequency of buying were found among Texas regions.

Summary and Conclusions

This paper used an electronic survey conducted in Texas to study the main factors affecting the frequency of purchase, measured in transactions per month, for ornamental plants. The frequency of buying for the average buyer was 1.36 transactions per month. Major factors affecting consumer frequency of purchase in transactions per month were grouped into ornamental plant features, socio-demographic characteristics (including regional differences), and consumer habits. While several differences in demographic characteristics of respondents and ornamental plant features were found, consumer habit factors impacted the frequency of ornamental plants buying the most, including the purpose of the purchase and seasonality. The marginal effects for each variable shown in Table 3 show the increase/decrease in the number of transactions per month if everything else is held constant. When the purpose of the purchase was to use ornamental plants for self-consumption the frequency of transactions per month increased 0.09

or 6.9%. Those respondents who were self-described as habitual buyers (bought products during non-special seasonal occasions) increased the number of transactions per month by 0.21 or 15.9%. In terms of ornamental plant features, light demanding plants and purchase price had a negative effect in frequency of purchase. Light demanding plants reduce consumer frequency of purchase 0.04 per month (3.0%). Drought tolerant plants had a positive effect in frequency of purchasing by increasing it 0.03 (2.8%). There were also socio-demographic factors that influenced consumer frequency of purchasing. Older age groups (Age3: 40-55 years, and Age4: 55 or older) and respondents with a college degree had a lower frequency of buying. Individuals with medium income levels ($25,000 to $49,999) increase frequency of buying by 0.06 transactions per month (4.5%). No statistically significant effects of ethnicity or regional differences in the state of Texas were found on frequency of buying.

While there may have been some product or consumer features not included in the specification of our econometric model, these results provide useful insights for ornamental plant growers in terms of the factors affecting frequency of purchase for ornamental plants. Frequency of purchase measured in number of transactions per month multiplied by expenditures per transaction yield total sales. Understanding which ornamental plant features affect the number of transactions during non-special seasonal occasions is vital information for growers. Socio-demographic characteristics of ornamental plant consumers and their effect in frequency of buying can be used to target specific groups for promotions.

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Appendix

Table 1. Description of Variables Included in the Ornamental Plant Buying Frequency Model.

Variable	Description
Ornamental plant features	
LCD	Low care demanding
ORGANIC	Organically grown
LD	Light demanding
GG	Guaranteed growth
DT	Drought tolerant
COLOR	Vibrant colors
P	Price
Socio-demographic characteristics	
AGE2	Age between 25-39 years old (= 1 if true and 0 otherwise)
AGE3	Age between 40-55 years old (= 1 if true and 0 otherwise)
AGE4	More than 55 years old (= 1 if true and 0 otherwise)
FEMALE	If gender is a female (= 1 if true and 0 otherwise)
MARRIED	Married marital status (= 1 if true and 0 otherwise)
INC2	Income level (= 1 if income between $25,000- $49,999 and 0 otherwise)
INC3	Income level (=1 if income between $50,000-$74,999 and 0 otherwise)
INC4	Income level (=1 if income is $75,000 or more, and 0 otherwise
ET2	Ethnicity (=1 if ethnicity is Hispanic, and 0 otherwise)
ET3	Ethnicity (=1 if ethnicity is other, and 0 otherwise)
EDU2	Education level (=1 if college degree, and 0 otherwise)
EDU3	Education level (=1 if graduate school, and 0 otherwise)
Consumer habits	
S	Seasonality (= 1 if habitual buyers – non special occasion only- and 0 otherwise)
PP	Purpose of the purchase (= 1 if self consumption and 0 otherwise)
Region	
DREG2	Region: Central Texas (= 1 if true and 0 otherwise)
DREG3	Region: South Texas (= 1 if true and 0 otherwise)
Dummy variables base levels	
AGE1	Age group of under 25 years
INC1	Income group of under $25,000
ET1	Ethnicity is Caucasian
EDU1	Education level is high school or less
REG1	Region is north

Table 2. Representativeness of the Survey Respondents Relative to the Texas Census Population Data.

Demographic variables		Survey Data		Census Data
		Frequency	Percentage	Percentage
Marital status	Married	163	59.9	53.5
	Single	109	40.1	46.5
Gender	Male	129	47.3	49.8
	Female	144	52.7	50.2
Education level	High School	32	11.8	48.4
	College	181	66.5	43.5
	Graduate School	59	21.7	8.1
Ethnicity	African American	10	3.7	11.5
	Caucasian	210	76.9	47.0
	American Indian	6	2.2	0.7
	Hispanic	29	10.6	36.0
	Asian/Pacific Islander	12	4.4	3.4
	Other	6	2.2	1.3
Age	Less than 25	35	12.9	38.7
	25-39	69	25.5	15.2
	40-55	81	29.9	28.4
	More than 55	86	31.7	17.6
Income	Under $25,000	45	16.4	26.7
	$25,000-$50,000	85	31.0	26.6
	$50,001-$75,000	57	20.8	17.9
	$75,001-$99,999	36	13.1	11.3
	$100,000-& above	51	18.6	17.5

Source: U.S. Census Bureau, 2000 and 2005-2007 American Community Survey

Table 3. Results from a Tobit Model Analyzing the Frequency of Buying Ornamental Plants.

	Tobit			
Variable	*Coefficient*	*Standard Error*	*t-value*	*Marginal Effects*
Intercept	0.5946	0.8983	0.6620	0.0904
Ornamental plant features				
LCD	0.1687	0.1568	1.0755	0.0256
ORGANIC	0.1781	0.1196	1.4890	0.0271
LD	-0.2686***	0.1580	-1.7004	-0.0408
GG	0.1709	0.1527	1.1189	0.0260
DT	0.2542***	0.1496	1.6995	0.0386
COLOR	-0.0660	0.1540	-0.4283	-0.0100
P	-0.2974**	0.1469	-2.0245	-0.0452
Socio-demographic characteristics				
AGE2	-0.1984	0.2309	-0.8592	-0.0301
AGE3	-0.5265**	0.2115	-2.4895	-0.0800
AGE4	-0.3173	0.2176	-1.4582	-0.0482
FEMALE	0.0800	0.2593	0.3084	0.0122
MARRIED	0.2223	0.2749	0.8086	0.0338
INC2	0.4008***	0.2088	1.9199	0.0609
INC3	-0.1176	0.2360	-0.4981	-0.0179
INC4	-0.1038	0.2325	-0.4467	-0.0158
ET2	-0.0734	0.3161	-0.2321	-0.0115
ET3	0.0782	0.2867	0.2729	0.0119
EDU2	-0.5342*	0.1837	-2.9076	-0.0812
EDU3	0.3178	0.2344	1.3560	0.0483
Consumer habits				
PP	0.6183***	0.3491	1.7709	0.0940
S	1.4246*	0.3164	4.5030	0.2165
Region				
REG2	-0.1542	0.1753	-0.8795	-0.0234
REG3	0.2994	0.2463	1.2157	0.0455
SIGMA	1.8173*	0.1002	18.1449	
Number of usable observations		**249**		

* P-value ≤ 0.1, ** P-value ≤ 0.05, *** P-value ≤ 0.01

Does the WTO Increase Trade? The Case of U.S. Cocoa Imports from WTO-Member Producing Countries

Osei-Agyeman Yeboah, Saleem Shaik, Shawn J. Wozniak and Albert J. Allen

This study analyzes U.S. cocoa bean imports from twenty-one major cocoa-producing and exporting countries during the pre- and post-liberalization period of 1970-2008 using the gravity equation and a linear one-way fixed effects model. The objective was to measure trade creation for a World Trade Organization (WTO) member that has undergone trade liberalization. Cocoa beans can serve as a proxy for any tropical commodity upon which a developing country heavily relies on for export revenue, such as is the case with cocoa for Côte d'Ivoire and Ghana, for example. Our results find participation in free trade agreements (FTAs) and WTO membership do contribute to increased U.S. cocoa bean imports at the one percent and five percent confidence levels, respectively.

U.S. imports of cocoa beans have grown in recent years. This is due to increased cocoa production, lower world prices, greater centralization and efficiency in the supply chain, greater consumer demand for chocolate products due to the introduction of various niche markets, increased consumer per capita income, and trade liberalization, among other causes. Market access to export cocoa beans in many cocoa producing countries has improved greatly due to trade liberalization in the cocoa sector. This has been accomplished through a variety of policy instruments, primarily structural adjustment programs (SAPs).

In reducing or eliminating the role of state-owned and operated marketing and exporting boards, cocoa-producing countries have opened themselves up to foreign-owned corporate agribusiness exporting companies and producers have received a higher share of a lower world price. U.S. and European transnational corporations have become increasingly involved in more aspects of the cocoa bean supply chain, becoming the buyers and exporters of cocoa beans in producing countries with the scaling back or dissolution of commodity marketing boards in those countries. These corporations have also centralized grindings from a number of companies into the control of a few, larger corporations and have increased grindings in the producing countries.

Trade liberalization was also accomplished through free trade agreements (FTAs) in a few countries from which the United States imports fewer cocoa beans than those that underwent SAPs. Free trade agreements are those in which a designated group of countries have agreed to reduce or eliminate tariffs, quotas and trade preferences on many or most goods and services traded between them. This study also discusses the role that the World Trade Organization (WTO) has in agricultural negotiations. The World Trade Organization is an intergovernmental body regulating tariffs and trade. This section presents an overview of trade liberalization in the cocoa industry, changes in the market structure of exporting and marketing companies, and the U.S. market for cocoa beans and products.

Prior to trade liberalization, cocoa trade was inefficient and the share of the f.o.b. price received by farmers was small (Varangis & Schreiber, 2001). Marketing boards were largely responsible for these faults, taking the lion's share of the f.o.b. in taxes while returning only some of it in the form of extension services and seed varieties. Many farmers smuggled cocoa to neighboring countries when those countries' market price was higher than their own, inflating export figures for the higher-priced countries and deflating prices for lower-priced countries

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(Bulíř, 2003). Cocoa exports were on the decline in many countries, such as Nigeria, where exports in 1985 – after the implementation of SAPs – were still below their 1970 levels, as oil became more vital to that country's economy (Kwanashie, Ajilima & Garba, 1998).

Following historically low prices in the 1970s, many cocoa producing countries underwent trade liberalization under SAPs from the World Bank and International Monetary Fund (IMF). In Nigeria, SAPs were used as the "only alternative" toward improving agricultural output (Kwanashie, Ajilima & Garba, 1998). Marketing boards were restructured, replaced or eliminated and opened up to competition from private marketing and export companies. Beginning in the 1980s, these processes are still underway in Ghana and Côte d'Ivoire, the two highest-volume cocoa-producing countries in the world.

Trade liberalization has had both positive and negative impacts. It has brought a greater share of the f.o.b. price to cocoa bean farmers (Varangis & Schreiber, 2001). This greater share, though, is of a lower world price as production has grown and prices have harmonized across borders (Figure 3, Gilbert & Varangis, 2003). Marketing boards' roles have been reduced or eliminated and transnational corporations have replaced them in buying and exporting cocoa beans (Fold, 2002). Exporting has also undergone centralization, as these transnational firms have exercised comparative advantage against smaller firms (Fold, 2001). But by opening up markets to foreign competition, farmers have become more vulnerable to price fluctuations, great and small, on the world market. World prices have also converged between countries and fallen during the trade liberalization period (Figure 1). For U.S. imports, trade liberalization has signaled lower world prices for firms buying cocoa beans from producing countries and lower prices for U.S. consumers buying the cocoa and chocolate products derived from them.

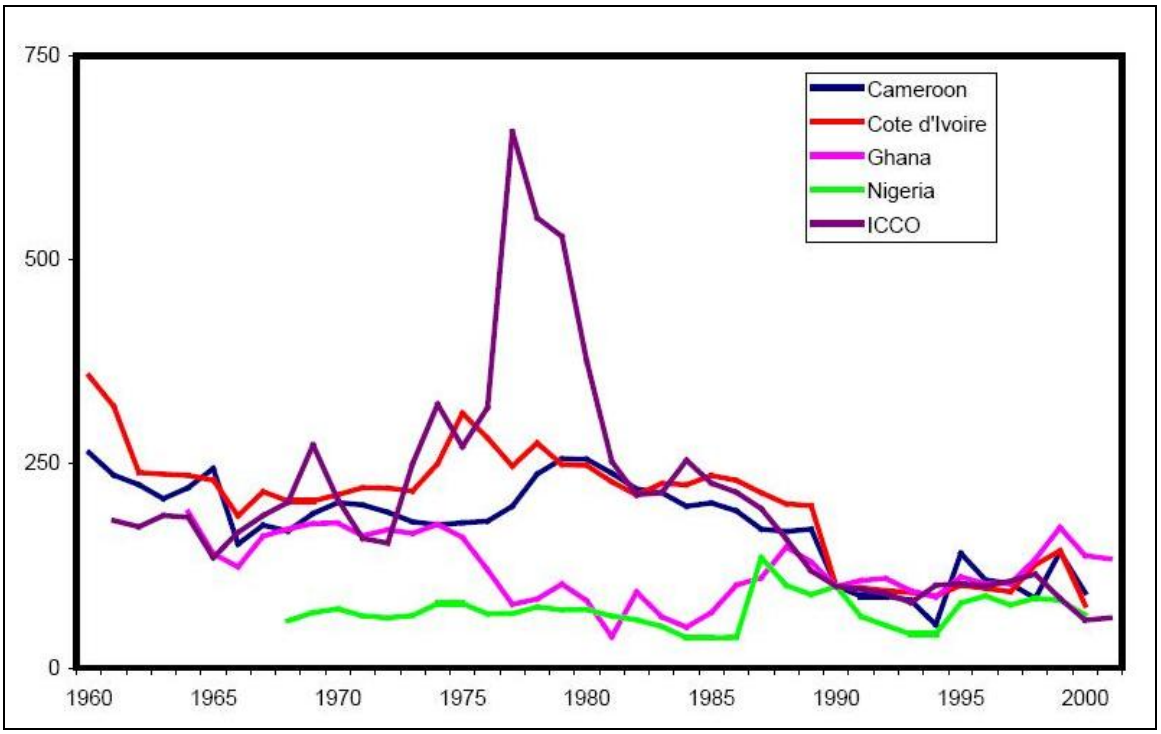

Figure 1. Deflated Cocoa Producer Prices and Deflated ICCO Indicator Price, West African Countries (1985 = 100)

The move under trade liberalization from protectionist agricultural commodity policies toward open market policies for cocoa beans has implications for other commodities, as well, such as coffee, tea, sugar and cotton. These issues are especially relevant during the current Doha Round of WTO negotiations, which are at an impasse as developing countries whose economies are dependent on agriculture square off against industrial countries seeking the developing countries' full market liberalization for agricultural goods.

This study researches the effects of trade liberalization and U.S. cocoa bean imports from twenty-one cocoa-producing and exporting countries for the pre- and post-liberalization period of 1970-2008. These countries are Brazil, Cameroon, Colombia, Costa Rica, Côte d'Ivoire, Dominican Republic, Ecuador, El Salvador, Ghana, Guatemala, Haiti, Honduras, Indonesia, Malaysia, Mexico, Nicaragua, Nigeria, Panama, Papua New Guinea, Trinidad and Tobago and Venezuela. At issue is not the countries' unwillingness to liberalize trade, as their governments have taken, willingly or unwillingly, the first steps through SAPs, FTAs and GATT/WTO membership to liberalize their agricultural markets, but to measure the potential export growth for cocoa bean-exporting countries if trade were further liberalized under WTO negotiations. The United States represents the second-largest export market for cocoa beans, behind the Netherlands, and there has been a growth in exports of cocoa beans to the United States under trade liberalization. Increased trade liberalization could be stalled due to the impasse in WTO negotiations, which could slow development through trade for the developing countries.

As the United States, European Union (E.U.), the WTO, World Bank and IMF promote trade liberalization for developing countries, analysis of its benefits needs to continually be taken into consideration. Improper sequencing of trade liberalization could lead to disruptions for any economy, and for a country like Côte d'Ivoire, which receives 15% of its GDP from cocoa exports, this can be disadvantageous. Also, given trade's potential for lifting millions of people out of poverty, trade liberalization has some potential to be extremely beneficial for farmers. Improved terms of trade for these countries can lead to further development in agriculture, as well as in other sectors. Increasing market access for their cocoa bean exports can help them achieve greater development and lift themselves out of poverty.

This study's objectives are to measure trade creation for WTO member countries that have undergone trade liberalization and to measure the impacts of further trade liberalization of cocoa markets using the gravity model. The specific objectives are to provide descriptive analysis of marketing/distributing channels of U.S. cocoa bean imports from these ten countries, apply gravity models to econometrically determine the effects of trade liberalization and other economic factors on cocoa exports in a panel data setting; and to provide policy recommendations.

Gravity Model

Originally inspired by Newton's gravity equation in physics, the gravity model has become popular in regional science for describing and analyzing spatial flows. Anderson (1979) was the first to draw linkages to economic theory that was pioneered in the analysis of international trade by Tinbergen (1962); Pöyhönen (1963); and Linneman (1966). The generalized framework Anderson developed incorporates the Armington assumption, that goods produced by different countries are inherently imperfect substitutes by virtue of their provenance. Under the assumption of monopolistic competition, each country is assumed to specialize in different products and to have identical homothetic preferences. Zero balance of trade is also assumed to hold in each period. Anderson built on the ordinary variables of dollar flow of a good from one country (or group of countries) to another as the dependent variable, and both parties' incomes (often measured as GDP), populations, and the distance between the two parties and an error term, lognormally distributed with an expected value of 0, as the independent variables.

The basic gravity model is often expressed as follows:

$$(1) \quad tf_{ij,t} = f(G_{i,t}, G_{j,t}, d_{ij,t})$$

where

$tf_{ij,t}$ = value of trade between countries *i* and *j*,
$G_{i,t}$ & $G_{j,t}$ = income of countries *i* and *j* and is positively related to trade,
$d_{ij,t}$ = a negative function capturing the distance between the two trading partners and transaction costs of commercial activity.

The generalized framework Anderson developed assumes Cobb-Douglas expenditure system and incorporates the Armington assumption that goods produced by different countries are inherently imperfect substitutes by virtue of their origin. Each country specializes in different products and has identical homothetic preferences under the assumption of monopolistic competition. Zero balance of trade is also assumed to hold in each period.

Recently, the application of gravity models has enjoyed a big revival. However, this has not so much been driven by its more rigorous theoretical foundation (Anderson, 1979; Bergstrand, 1985, 1989, and 1990; Helpman & Krugman, 1985; and Helpman, 1987) but the opportunity to project bilateral trade relations (Hamilton & Winters, 1992; Baldwin, 1994). According to the traditional concept of the gravity equation, trade can also be explained by GDP and/or GDP per capita figures and both trade impediment (distance) and preference factors (common border, common language, etc.). The economic framework in most cases was cross-section analysis (Wang & Winters, 1991; Hamilton & Winters, 1992; Brulhart & Kelly, 1999; and Nilsson, 2000). Only a few authors made use of (random effects) panel econometric methods (Baldwin, 1994; Gros & Gonciarz, 1996; Mátyás, 1997; and Egger, 2002). Mátyás, (1997 and 1998) provides insights into the question of proper econometric specification without dealing with the issue of trading potentials.

The Econmetric Model

According to the endowment-based new trade model with Dixit & Stiglitz (1977) preferences, bilateral trade is an increasing sum of factor income *G*, relative size *S*, the difference in relative factor endowments *R*, and real bilateral exchange rate denoted by *E*. We use purchasing power parity, denoted by *PPP*, in place of *E*. The presence of a free trade agreement between the producing country and the United States is measured with the dummy variable *FTA*, and the effect of GATT/WTO membership is measured by the dummy variable *GATTWTO*. As this organization enforces trade liberalization and we can be certain of steps toward trade liberalization in agriculture for all countries only for years the Agreement on Agriculture (AoA) is in force, it could have been separated into pre-WTO and pre-AoA years denoted by a dummy variable 0, and post-WTO and post-AoA years denoted by a dummy variable with value 1. However, trade liberalization is not a process where a researcher can observe an import value and assign causation in a regression equation for increased or decreased import values under any liberalization policy. As such, if the country were a member of GATT or WTO, the value for *GATTWTO* is 1, and 0 if a non-member. Applying the typical cross-section gravity equation to study trade effects of liberalization policies, we can specify the model as follows:

$$(2)\quad IMPVAL_{ijt} = \beta_0 + \beta_1 GDP_{it} + \beta_2 GDP_{jt} + \beta_3 PPP_{ijt} + \beta_4 FTA_{ijt} + \beta_5 GATTWTO_{ijt} + \varepsilon_{ijt},$$

where all variables except FTA_{ijt} and $GATTWTO_{ijt}$ are in real figures. The one-way random effects model representation is

$$(3)\quad e_{ijt} = u_{ij} + w_{ijt}$$

and the two-way random effects model representation is

$$(4)\quad e_{ijt} = u_{ij} + v_t + w_{ijt}$$

where *ij* represents the cross-section and *t* represents time, with u_{ij} as the (one-way fixed or random) unobserved bilateral effect, v_t as the (two-way fixed or random) unobserved time effect and w_{ijt} as the remaining residual error. The one-way fixed effects model representation is

$$(5)\quad IMPVALijt = \beta_0 + \beta_1 GDPit + \beta_2 GDPjt + \beta_3 PPP_{ijt} + \beta_4 FTA_{ijt} + \beta_5 GATTWTO_{ijt} + \beta CS_{ij-1}\ CS_{\ dummies} + \varepsilon_{ijt},$$

where *CS*= number of cross sections or countries. The Heckscher-Ohlin (H-O) bilateral trade determinants can be formulated as the GDP of the cocoa bean-producing country GDP_{it} and the U.S. GDP_{jt}.

$IMPVAL_{ijt}$ represents U.S. cocoa bean imports deflated in real 2005 dollars from exporting country *i* to the United States, denoted as *j*. GDP_{it} is the real GDP of the exporting country *i* in the year *t*. GDP_{jt} is the real GDP the importing country *j* in the year *t*. PPP_{ijt} represents the purchasing power parity between country *i* and country *j* in year *t*, expressed as national currency value of GDP divided by the real value of GDP in international dollars. The international currency has the same purchasing power over total U.S. GDP as the U.S. dollar in a given base year (PWT 7.0 is in base year 2005) (Penn World Table 2011). FTA_{ijt} and $GATTWTO_{ijt}$ represent the dummy variables of interest and take the value of 1 if the country is a party to each respective trade liberalization policy and 0 if otherwise.

For the panel econometric projection of potential bilateral trade, many researchers have concentrated on the random effects model (REM), which requires that $u_{ij} \sim (0, \sigma_u^2)$, $v_{tj} \sim (0, \sigma_v^2)$, $w_{ijt} \sim (0, \sigma_w^2)$, and that u_{ij} and v_{tj} are independent of the w_{ijt}. Moreover, the X_{ijt} (i.e. the explanatory variables) have to be independent of u_{ij}, v_{tj} and w_{ijt} for all cross-sections (*ij*) and time periods (*tj*). Whereas the fixed effects model (FEM) is always consistent in the absence of endogeneity or errors in variables, the REM is only consistent if the above-mentioned orthogonality conditions are fulfilled. Then, the REM has the advantage of more efficiency as compared to the FEM. If these conditions do not hold, only the FEM is consistent since it wipes out all the time-invariant effects (u_{ij}) and spatially-invariant effects (v_{tj}). The decision between the FEM and the REM models can be based on the Hausman (1978) test. Heteroskedasticity rarely occurs in time-series and panel data, but this study has corrected the errors through unequal variances resulting from different cross-sections through the FEM which assumes the intercept of each cross-sectional unit is different from the other and it never happened by chance.

The choice between a one-way FEM and a two-way FEM was determined through problems with multicollinearity. GDP_{jt} was found to be collinear with $IMPVAL_{ijt}$ in the two-way fixed effects model and an estimate was not able to be calculated. Dropping GDP_{jt} from the regression equation presents problems for our analysis because importing country GDP is an important theoretical predictor for import demand, measured by $IMPVAL_{ijt}$. Also, a Hausman statistic could not be calculated due to problems with rank between the REM and FEM. Because an estimate for GDP_{jt} could not be determined, a Hausman statistic could not be calculated through the comparison of the REM and FEM estimates. Thus, this study utilizes the one-way fixed effects model as the aforementioned orthogonality conditions were not met.

Data

The gravity model is applied using panel data for the period 1970 to 2008 for U.S. imports of cocoa beans from twenty-one cocoa producing countries (fourteen Latin American, four African, and three Asian). Data on nominal trade values (in $1000) for cocoa imports to the U.S. are from the U.S. Census Bureau publication, "U.S. Imports for Consumption" for the years 1970-1988 and the U.S. International Trade Commission's Interactive Tariff and Trade Data Web from 1989 to 2008, at http://dataweb.usitc.gov/. These were deflated with CPI data obtained from the Federal Reserve Bank of St. Louis' Economic Research Division, at http://research.stlouisfed.org/. PPP data was obtained from Penn World Table 7.0, http://pwt.econ.upenn.edu/, and GDP data (in U.S. $Billion) were obtained from the USDA Economic Research Service International Data Sets, http://www.ers.usda.gov/Data/macroeconomics/. Data for FTA and GATT/WTO were obtained from Rose's (2004) WTO data set at the University of California-Berkeley Haas Business

School at http://faculty.haas.berkeley.edu/arose/. As trade liberalization is not a process whereby a country "flips a switch" and becomes liberalized overnight or from one year to the next, a dummy variable for FTA and GATT/WTO membership simplifies this political procedure greatly. However, as there are few measures of trade liberalization (tariff reduction would be one), using a dummy variable is at least practical. The United States does not have tariffs on cocoa beans, but rather processed cocoa products.

The GATT/WTO dummy variable was constructed with 1 representing full membership for greater than three months' membership for that year, and 0 representing less than three months' membership for that year. Three months were chosen because WTO *could* have some effect on a country's exports of its larger late harvest in autumn. Entry years were obtained from the WTO web site. Trade liberalization was also measured by including a free trade agreement variable, FTA. Of the observed countries, the United States only has FTAs with Mexico, the North American Free Trade Agreement (NAFTA), since 1994, and with the Dominican Republic and Central American countries that are a part of the Dominican Republic – Central American Free Trade Agreement (DR-CAFTA). This free trade agreement between the United States, Dominican Republic, Costa Rica, Honduras, Guatemala, El Salvador, and Nicaragua started at different dates per country after 2006.

Estimation Procedure

Problems with a zero-value dependent variable were present. Taking the natural logs of these would provide undefined values. If a zero import value is present for a given country in a given year, it was left as zero in the analysis. In this analysis, the one-way fixed effect model is used while the two-way FEM, the one-way REM, and two-way REM are used as robustness checks. The dependent variable, observed real value of U.S. cocoa imports $IMPVAL_{ijt}$, was regressed on each exporting country's GDP GDP_{it}, the U.S.' GDP GDP_{jt}, purchasing power parity PPP_{ijt}, and the presence of trade liberalization policies, FTA_{ijt} and WTO_{ijt}. Estimates for the other observable determinants impeding or inducing bilateral trade (distance, common border, and common language) dropped out in the final models together with distance as they are all time-invariant dummy variables. Linear variables were used following goodness of fit tests on the panel dataset. Other specifications of the model were conducted as robustness checks on the linear model.

Results and Discussion

To examine the empirical validity of the gravity model with respect to cocoa bean trade potential between the United States and twenty-one exporting countries from 1970 to 2008 equation (2) is estimated. The descriptive statistics of the variables in the model are reported in Table 1. On average, the value of cocoa imports to the United States from 1970-2008 from a given country is about $38.4 million. This statistic is no surprise as the U.S. chocolate industry uses very little of cocoa as an input – 5 to 10 percent of the value of the bar (Gilbert and Varangis 2003). The mean of GDP for exporting countries was $85.7 billion, with a minimum and maximum of $2.04 billion and $1.1 trillion, respectively. U.S. GDP ranged from $4.3 trillion to $13.2 trillion. PPP ranges from nearly 0 units of currency to 4974 units of currency, with the mean being 113 units of currency. Exporting countries were members of FTAs 3.5 percent of the observations, and GATT/WTO 74 percent of the observations.

Table 2 presents the country effect results for the one-way fixed effect panel (country) estimators, while Table 3 presents the parameter estimation results for this regression. According to the test statistics we cannot ignore the cross-sectional effects as the F-value coefficient for the one-way FEM is significant at ($P < 0.0001$) with R^2 of 0.65. Thus, the probability that there are no effects in the model is 0 and thus the probability of the one-way or two-way REM being a better fit is 0.

Many country effects were also significant, relative to Venezuela. Venezuela is the omitted country variable because it was alphabetically last in our list of countries. For a $1000 increase in Brazil's cocoa bean exports to the United

Table 1. Descriptive Statistics (N=819)

Variable	Mean	Std. Dev.	Minimum	Maximum
$IMPVAL_{ij,t}$ ($1000)	38385.15	78831.12	0	529610.60
$GDP_{i,t}$ ($Billion)	85.68	182.49	2.05	1126.15
$GDP_{j,t}$ ($Billion)	8125.78	2726.61	4262.25	13220.02
$PPP_{i,t}$ *(see Data section for description)*	112.59	420.97	1.62E-12	4973.59
$FTA_{ij,t}$ *(Dummy, 1=FTA, 0 otherwise)*	0.04	0.19	0	1
$GATTWTO_{i,t}$ *(Dummy, 1=FTA, 0 otherwise)*	0.74	0.44	0	1

Table 2. Fixed One Way Country Effect Parameter Estimates

Number of Cross Sections			21
Time Series Length	39		
Fit Statistics			
SSE	1.78E+12	DFE	793
MSE	2.25E+09	Root MSE	47416.9
R-Square	0.65		

F Test for No Fixed Effects

Num DF	Den DF	F-Value	Pr > F
20	793	62.96***	<.0001

Country	DF	Estimate	Std. Err.	Pr > |t|
Brazil	1	207229.2***	25193.0	<0.0001
Cameroon	1	-43295.6***	12026.9	0.0003
Colombia	1	-38980.0***	11797.9	0.0010
Costa Rica	1	-24515.1**	11550.6	0.0341
Cote d'Ivoire	1	205900.1***	12244.2	<0.0001
Dominican Republic	1	51274.7***	11679.6	<0.0001
Ecuador	1	35388.0***	11372.7	0.0019
El Salvador	1	-27614.7**	11565.7	0.0172
Ghana	1	68237.9***	11699.6	<0.0001
Guatemala	1	-23334.6**	11449.1	0.0419
Haiti	1	-29150.4**	11706.5	0.0130
Honduras	1	-27256.7**	11686.5	0.0199
Indonesia	1	-6638.6	16526.9	0.6880
Malaysia	1	-9951.8	11172.4	0.3733
Mexico	1	69576.6***	18520.0	0.0002
Nicaragua	1	-35562.1***	11868.8	0.0028
Nigeria	1	34574.2***	11230.2	0.0022
Panama	1	-22729.3**	11565.6	0.0497
Papua New Guinea	1	2011.1	11624.8	0.8627
Trinidad and Tobago	1	-28418.9**	11682.0	0.0152

* - Significant at 10%
** - Significant at 5%
*** - Significant at 1%

Table 3. Fixed One-Way Parameter Estimates

Variable	DF	Estimate	Standard Error	Pr > |t|
Intercept	1	54543.45	7230.99	<0.0001
GDP_i	1	-202.82***	39.75	<0.0001
GDP_j	1	-4.00***	1.16	0.0001
PPP_i	1	58.68***	9.41	<0.0001
FTA_{ij}	1	32131.11***	7562.86	<0.0001
$GATTWTO_i$	1	12192.38**	4861.22	0.0117

* - Significant at 10%
** - Significant at 5%
*** - Significant at 1%

States, Venezuela's cocoa bean exports will increase $207,229. For a $1000 increase in Côte d'Ivoire's cocoa bean exports, Venezuela's exports to the United States will increase by $205,900, suggesting that the United States will be purchasing more cocoa beans from more countries to satisfy greater consumer demand. Indonesia, Malaysia and Papua New Guinea were the only countries that showed no significant impact on exports from Venezuela to the United States.

The coefficient of the exporting country's GDP (GDP_i) is negative and statistically significant at ($p < 0.0001$). Thus, the larger the per capita GDP for the exporting countries the smaller the trade value of cocoa bean exports. A US$1 billion increase in the GDP of the exporting country will lead to a -$202,820 decrease in the export value of cocoa beans to the United States, possibly because that country is slowly developing and shifting away from the agricultural sector and into manufacturing or services.

The GDP of the importing country, the United States (GDP_j), is also negative and significant at the 1% level. A $1 billion increase in U.S. GDP leads to a $4,000 decrease in U.S. cocoa bean import value. This may be because cocoa is an inelastic good, and cocoa products comprise a small share of the United States' food expenditures and an increase in GDP would not necessarily mean an increase in cocoa bean imports. The reason could also be that consumers with higher incomes are more often more educated about health issues and thus consume fewer cocoa products, due to their high fat and sugar contents. However, during the recent recession, chocolate is a good that Americans still seem to be buying, perhaps more than before the recession began (U.S. News and World Report, 2009).

PPP_i is significant and positive at ($P< 0.0001$). An increase of one unit in PPP will lead to a $58,683 increase in U.S. cocoa bean import value as the terms of trade improve for producers and they are able to purchase more inputs and other goods.

The dummy variables that are the focus of this study on trade liberalization, FTA_{ij} and $GATTWTO_i$, are significant at ($P\leq 0.0001$) and ($P\leq 0.05$) and positive. Trade liberalization appears to increase cocoa exports from producer countries per annum. Participation in FTAs leads to a $3.2 million increase in the amount of cocoa beans imported by the United States. Also, membership in GATT/WTO increases U.S. cocoa bean imports $12.2 million. This could also incorporate gains made under SAPs and other measures, showing that trade liberalization on the whole has been beneficial under GATT/WTO, SAPs, FTAs and other measures to increase U.S. cocoa bean imports. This lends support to Subramanian and Wei (2003) that there is empirical evidence that membership in the GATT/WTO increases trade, though with a 5 percent threshold, this study's results only lend mild support for the cocoa and the WTO tropical products deal.

Conclusion

International trade theory informs us that at the individual country level, border relaxation reduces domestic prices that help local consumers and increases the profit for low-cost exporters

through increased sales in the foreign market. At the global level, trade liberalization causes demand and supply to expand, both of which improve price signals and improves world welfare.

Theory also teaches us that there are many other socio-economic and political-institutional determinants of cross-border trade, including market size, geographical proximity, tastes and preferences, cultural ties, and financial linkages. This paper used a linear one-way fixed effect panel estimation to determine the influence of the various factors driving the value of U.S. imports from major cocoa exporting countries.

One noteworthy finding is that increases in the GDP of exporting and importing countries decreases cocoa bean trade. PPP also matters, as the terms of trade for cocoa-producing countries improve, so does their ability to produce as they choose to invest in cocoa forests and not in timber or products requiring fewer inputs. But as producers' share of world price of cocoa through trade liberalization grows, production increases and the volume of exports rises. Finally, important to this study on the effects of trade liberalization of cocoa bean producer markets on U.S. imports, trade liberalization through membership in the GATT/WTO and FTAs is shown to positively influence U.S. cocoa bean imports from producing countries.

Comparative advantage under trade liberalization has been shown to have a positive effect on U.S. cocoa bean imports, which would lead us to believe this trade would contribute positively to the terms of trade, holding other agricultural goods and industries equal. This would lead to greater development for the cocoa bean producers and give them a means to invest in their development, making increased education for the community, increased infrastructure, health care, or other goods harder for producers to afford. It could also lead to an investment in improving the quantity or quality of cocoa beans they produce or a divestment from growing cocoa altogether as demand from the United States increases.

For the United States, trade liberalization has given consumers more cocoa beans with which to produce cocoa products. Though a small share of consumer income spent, it is still beneficial to consumers to purchase goods at a lower price, so long as producers benefit on the production end for a mutually beneficial relationship between trading partners. Ensuring that current and future agreements have language protecting both the consumers and producers so that the trading relationship continually improves between both partners for the development of the producers and the financial welfare of the consumer is important to the success of trade liberalization. As FTAs were part of the trade liberalization analysis and have a significant and positive effect on cocoa bean exports, there is evidence that future FTA negotiations and legislation, such as those with Colombia and Panama, and with cocoa-producing countries possessing FTAs with the United States, such as Mexico, the DR-CAFTA countries, Chile and Peru, can be structured such that the welfare of producers is improved through these agreements. FTAs can help producers increase their share of the cocoa price to improve the livelihoods of these people and their communities and their local environment. Fair Trade certification under FTAs is one such way to accomplish this.

As trade liberalization under GATT/WTO was shown to have a significant and positive effect on U.S. cocoa bean imports, as the Doha Round of WTO negotiations goes forward, WTO membership should benefit the development of producing countries specializing in tropical export products, like Côte d'Ivoire and Ghana, and benefit U.S. consumers of chocolate and other cocoa products. The current negotiations of a broad deal on the treatment of tropical products, with the new WTO exception for bananas, in the Doha Round should offer producing countries a path toward increased development through increased market access, and not vice versa (ICTSD, 2010). Trade liberalization under SAPs has not proved well for import-substituting industrialization. For example, Ghana's economy is still very much focused on gold, cocoa and timber (Mkandawire & Soludo, 1999). Smallholder dynamism can play a mitigating role in this, as evidenced by the Kuapa Kokoo cooperative in Ghana and its relationship with the Day Chocolate Company and Fair Trade Certification (Tiffen 2002; Doherty and Tranchell 2007).

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Market Quality of Pacific Northwest Pears

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This study uses data collected from retail grocery chains during marketing season 2003-2004 to examine the external quality and price variations of Pacific Northwest pears. Quality refers to overall fruit appearance and presence of external disorders. Results from a bivariate probit model show that fruit weight and firmness had a positive effect on overall appearance. Results from a hedonic price model show that the recurrence of external disorders is not necessarily negatively correlated with price variations. Overall, this study shows the need to investigate methods of storage, packing, and transportation to achieve the ideal fruit characteristics that appeal to consumers, wholesalers, and retailers.

The largest volume of pears produced in the United States is grown in the Pacific Northwest (PNW) (Washington and Oregon). For years 2009-2010, 71 percent of the total pear production was concentrated in the PNW (USDA 2010). For the same years, total PNW pear production for the fresh market reached 522 million pounds. About 52 percent of this volume was sold through domestic retail grocery chains, 33 percent was exported, and 15 percent was sold through other channels (e.g., foodservice) (Washington Growers Clearing House Association 2010; Yakima Valley Growers-Shippers Association 2009; and Producer Market Guide 2011). Typically, fresh pears sold to retail grocery chains are transported from the PNW to population centers in the western, mid-western, and eastern regions of the country. One major problem the industry faces is that it is possible for pears to be damaged during shipping, storage, and display. Kupferman et al. (1992) reported that various types of damages to pears appear during harvest, packing, after storage, during transport, or in the marketplace. These damages represented losses to the industry totaling $1.5 million for Anjou pears, in 1991. Given the importance of retailers (52 percent of all fresh production is sold through this channel), PNW pear growers would like to mitigate potential fruit damage during transit to retail stores by optimizing methods to ensure delivery of pears with visual and edible quality to consumers. One step towards this goal is to determine which damages are most important by assessing the quality of fresh pears in grocery stores across the nation and identifying external quality differences across states, season during the year, and cultivars.

Few studies have focused on fresh fruit quality variability through the marketing chain; most previous research related to pear quality assess consumers' preferences; for example, Kappel et al. (1995), Predieri et al. (2002), Turner et al. (2005), Combris et al. (2007), Zhang et al. (2010), and Gallardo et al. (2011). Overall, these studies provide useful insights on consumers' preferred fresh pear size, color, shape, flavor, texture, and overall quality. Very few studies have evaluated the appearance of fresh fruit at the grocery store level. Durham et al. (2005) measured the effect of quality on the purchase of fresh fruit (i.e., pears; Gala, Fuji, and Red Delicious apples; other sweet apples; tart apples; bananas; and oranges) at a grocery store. They found that fruit shine had a positive effect on the quantities sold, while bruising and marking reduced fruit sales.

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While previous research on fresh pear quality has increased awareness on the quality characteristics of pear fruit on consumers' preferences, this study presents findings of a unique experiment analyzing quality variability in grocery stores in five states across the U.S. This manuscript presents a case for analysis during specific months of one marketing year, with the goal of providing cues on quality variability and explanations for price variations. This, we hope, will add to the overall purpose of providing consistent and acceptable fruit quality being delivered through retail grocery chains. Specific objectives are threefold. First, determine if weight and firmness of pears affect overall external appearance and recurrence of external disorders. Second, investigate if factors such as grocery chain type, location, and season have an effect on external appearance of pears. Third, analyze potential correlations between prices and pear characteristics (i.e., weight, firmness, external appearance, and presence of external disorders).

Methods

During the 2003-2004 marketing season, PNW pears were purchased, when available, from retail grocery stores across five U.S. states on four sampling dates (October 2003; January, April, June, and July 2004). Retail locations included: Wenatchee and East Wenatchee, WA; Ithaca, NY; Raleigh and Cary, NC; East Lansing, MI; and Davis, CA.

Fruit purchased was conveyed to a laboratory in each state, and evaluated following a detailed protocol. The protocol included photographs of appearance and external disorders to ensure the same ratings were used across laboratories. In each location, fruit were kept at room temperature and tested for color, weight, overall appearance, external disorders (e.g., bruising, decay, marking, punctures, and shrivel) and internal quality (e.g., firmness). Evaluations were conducted on the first and fourth day after the fruit was purchased. Because the purpose of this study was to evaluate quality as consumers perceive it at the grocery store, we considered evaluation results only on the first day. Color was evaluated visually using a standard 0.5-5 color chart, where 0.5 was green and 5 was yellow. This characteristic was measured for Anjou and Bartlett only, given the complexity of having a uniform criterion to measure color on Bosc and Red Anjou. Appearance and external disorders were also evaluated visually, following the protocol and photographs distributed to each laboratory. The first step of this procedure was to determine the presence or absence of an external disorder. Then, based on the comprehensive evaluation of external disorders, overall appearance was examined.

The external cosmetic disorders (e.g., bruising, skin marking, shrivel, and skin punctures) included in this study are the most prevalent cosmetic disorders for PNW pears. Cosmetic refers to defects that negatively affect the appearance of the fruit, but, unlike decay, does not render the fruit inedible. For this study, bruises were defined as dark brown spots affecting the skin and the tissues immediately beneath, that could be consumed without risk of compromised food safety. This defect is known to result from either one or a combination of friction, impact, or pressure and imply rough handling procedures. Bruising was recorded as presence or absence only; severity was not estimated. Skin marking was defined as browning apparently caused by scuffing or superficial scald. Scuffing is typically caused by friction on the brush or belt when packing or by handling by consumers on retail display (Kupferman et al. 1985). Superficial scald in Anjou pears is due to immaturity at harvest, high temperatures, and high relative humidity in storage (Chen et al. 1996). Shrivel is defined as wrinkles in the fruit surface resulting from water loss. Skin punctures were determined as any break in the surface of the skin that might be caused by an impact with the stems of other fruit. The presence of decay symptoms on the skin surface was the only non-cosmetic surface disorder assessed. Because decay often accompanies wounding of the fruit, (Kupferman et al. 1985) we were careful to inspect decay sites for puncture wounds, which might otherwise be obscured.

Flesh firmness was measured on two sides per fruit. The instruments used were standard, destructive firmness testers, such as a Fruit Texture Analyzer (Güss Manufacturing, Strand

South Africa) or a handheld penetrometer (Effegi) fitted with an 8-mm tip. Other internal quality factors (e.g., juiciness and soluble solids) were measured but not included in this study since consumers would not be able to assess them before purchase.

Price per pound data was also collected, as was the type of grocery store chain where the fruit was purchased. Here, a distinction was made between grocery store chains with fewer than 100 and more than 100 stores nationwide. To account for the effect of seasonality on price, as might be affected, for instance, by the potential presence of pears' substitutes, we use month as an indicator variable. Note that not all fruit were available in all months when the analysis took place. For example, Bartlett pears were only available in October 2003 and January 2004. Finally, indicator variables for states were included in the model. Overall, 810 pear samples were purchased and analyzed for this study.

Data Analysis

Variables for appearance and external disorders are correlated given that the recurrent presence of external disorders in the fruit will lead to an unacceptable appearance. However, the presence of each external disorder is not necessarily correlated with each other. For example, pears with bruises will not necessarily exhibit shrivel or punctures. However all bruises, shrivel, and punctures will affect the overall appearance of the fruit. In view of this situation, we used a bivariate probit model. This specification allows having two regressions to be estimated simultaneously, assuming that both have correlated disturbances (Greene 2008). Moreover, we conducted likelihood ratio tests and results favored the bivariate rather than the univariate specification (likelihood ratio statistics for all five models ranged between 17.7 and 118.1; leading one to reject the null hypothesis that the univariate specification yielded better estimates). The general specification for the two-equation model is:

$$\begin{aligned} Appearance &= \beta_{10} + \beta_{11} \ln weight \\ &+ \beta_{12} \ln firmness + \beta_{13} grocerystore \\ &+ \beta_{1k} cultivar_k + \beta_{1l} state_l + \beta_{1m} month_m + \varepsilon_1 \end{aligned} \quad (1)$$

$$\begin{aligned} External disorder_i &= \beta_{20} + \beta_{21} \\ &\ln weight + \beta_{22} \ln firmness + \beta_{23} \\ &grocerystore + \beta_{2k} cultivar_k + \beta_{2l} state_l \\ &+ \beta_{2m} month_m + \varepsilon_2 \end{aligned} \quad (2)$$

where Appearance is a binary variable that equals 1 if appearance is found acceptable and 0, otherwise. External disorder is a binary variable that equals 1 if the i^{th} external disorder is present and 0, otherwise (i=bruise, decay, marking, puncture, and shrivel) (a total of five bivariate equation systems were conducted). The set of independent variables for both equations in the system was the same and included weight, firmness, grocery store, cultivar, state, and month. The variables weight and firmness were nonlinearly transformed into a logarithmic form to achieve a regression curve. This approach was chosen on the assumption that the effects of these characteristics on appearance were not linear (Gutman et al. 2002). The variable grocery store was equal to 1 if the grocery retail chain had less than 100 stores, and 0, otherwise. The variable cultivar was equal to 1 if the cultivar corresponded to any of the k pear cultivars in the study (k=Anjou, Bartlett, Bosc, and Red Anjou) and 0 otherwise. The variable state was equal to 1 if pears were purchased in the state corresponding to any of the l states in the study (l=New York, Michigan, North Carolina, and California). The variable month was equal to 1 if pears were bought in any of the m months when the study took place (m=January, April, June, July, and October). β_{10} to β_{13}, β_{1k} to β_{1m}, β_{20} to β_{23}, and β_{2k} to β_{2m} were the parameters to be estimated.

To avoid having perfect multicollinearity when including the whole set of indicator variables (i.e., four indicator variables for cultivar, five for state, five for month, and an intercept term), one variable for each group was dropped. The dropped variable serves as the basis for comparison for the rest of the variables in the group. For example, variable Red Anjou was

dropped, and the parameter estimates for Anjou, Bartlett, and Bosc indicate the effect of each variable on appearance compared to Red Anjou, with all of the other variables unchanged. State and month variables were treated similarly; for state the base variable was Washington and for month, the base variable was October. Parameters were estimated by maximum likelihood.

Hedonic Price Regression

We were interested in analyzing variations in prices across fruit purchased. For this, a set of eight hedonic price regressions were used. A separate equation was estimated for each pear cultivar in the study, and the first four, out of the eight equations, had appearance among the set of explanatory variables and the last four have each external disorder, as the explanatory variables. This section of the study follows Rosen (1974) who postulated that hedonic prices are the implicit prices of each quality attribute of the good in analysis. These implicit prices are revealed from observed prices and varying amounts of the good's quality characteristics. Hence this approach assumes that the price for pears can be expressed as a function of its quality attributes, controlling for factors such as aggregate supply, location, and month.

We used a fixed effects model to control for heterogeneity known to be stable across observations. In our specific case, variable state was the classification variable and it is assumed to be the equivalent of a treatment. As noted by Allison (2005) classifying observations' variability across treatments helps reducing error variance.

As explained previously, a total of eight regressions were conducted. The first four regressions modeled each cultivar including "appearance" as explanatory variable, and follows:

$$\begin{aligned} Price_k &= \alpha_0 + \alpha_1\, indexmo \times appearance_k \\ &+ \alpha_2 indexmo \times color_k + \alpha_3 indexmo \times firmness_k \\ &+ \alpha_4 indexmo \times weight_k + \alpha_5 indexmo \times volumeship_k \\ &+ \alpha_6 grocerystore_k + \alpha_{7l} state_{lk} + \alpha_{8m} month_{mk} \end{aligned} \quad (3)$$

where Price is the price for the k^{th} cultivar and is used in its logarithmic form. Indexmo represents an index variable for months when the experiment took place. We included interaction effects of indexed month with appearance, color, firmness, weight, and volume shipped to account for potential substitution effects from other fruits that were available in specific months. Volume ship is a proxy variable for aggregated pear supply. This variable depicts the total volume of all pear cultivars in millions of pounds that were shipped from PNW packing houses to both domestic and export markets. These data were obtained from the Washington Growers Clearing House Association (2010) monthly summary reports. Here, α_0 to α_8 are the parameters to be estimated.

The other four regressions included each external disorder in the set of explanatory variables, following:

$$\begin{aligned} Price_k &= \lambda_0 + \lambda_1\, indexmo \times bruise_k \\ &+ \lambda_2\, indexmo \times marking_k + \lambda_3\, indexmo \times shrivel_k \\ &+ \lambda_4\, indexmo \times decay_k + \lambda_5\, indexmo \times puncture_k \\ &+ \lambda_6 indexmo \times color_k + \lambda_7 indexmo \times firmness_k \\ &+ \lambda_8 indexmo \times weight_k + \lambda_9 indexmo \times volumeship_k \\ &+ \lambda_{10} grocerystore_k + \lambda_{11l} state_{lk} + \lambda_{12m} month_{mk} \end{aligned} \quad (4)$$

Similar to previous regressions, when using indicator variables, one variable was dropped from each group, to avoid perfect multicollinearity (e.g., Washington for state, and October for month). In both equations (3) and (4) dependent variable price is in log form, given that this specification leads to a well-fitting model with statistically significant coefficients. Also in an attempt to establish a regression curve with 13 independent variables, color, firmness, and weight were transformed to their logarithmic form to achieve the regression curve (Gutman et al. 2002).

Results

Appearance and External Disorders

Results from the bivariate probit model are listed in Table 1 (see Appendix). Only parameter estimates that were significantly different from zero, at the 5% and 10% level, are discussed.

Holding all other factors constant; an estimate with a positive sign indicates that the variable contributes to an acceptable appearance, while a negative sign indicates a detriment for appearance. Parameter estimates for the appearance equation were consistently similar across all five models. In general, pears' firmness had a positive effect on the probability that appearance was acceptable. Bartlett cultivars were less acceptable than Red Anjou pears. Overall appearance of pears sampled in Michigan, North Carolina, and California was more acceptable than in Washington. Pear appearance in January, April, June, and July was rated less acceptable than in October.

With respect to external disorders, holding all other factors constant, a positive sign in the parameter estimate indicates a positive effect for the presence of each disorder. Pears' firmness had a negative effect on all external disorders listed in this study. As expected, the more firm the pear, the less prone it would be to exhibit bruises, marking, shrivel, decay, and punctures. This proves that firmer pears are easier to handle since they arrive with less cosmetic damages to the grocery stores shelves. However, excessive firmness could be a detriment for consumers' preferences. Previous studies (Kappel et al. 1995; Gallardo et al. 2011) have shown pears that are too firm are not preferred by consumers. Industry programs, like the conditioning program managed by the Pear Bureau Northwest attempt to minimize the delivery of underripe, excessively firm fruit to the consumer by inducing ripening at warehouses. The overall goal of this and similar programs is to supply fruit with optimal quality characteristics (including firmness) while minimizing potential losses due to handling less firm fruit (Moffitt 2011).

In relation to cultivars, Anjou pears exhibited more marking and shrivel, but less decay and punctures than Red Anjou. Given that marking is a skin discoloration disorder, it is reasonable that such defects are less evident in dark-colored Red Anjou pears. Bartlett had more marking, but fewer punctures; and Bosc more marking and shrivel, but less decay than Red Anjou.

In general, the type of grocery retail chain (based on the number of stores) had no effect on acceptable appearance or presence of external disorders, with the exception of punctures. Pears in grocery chains with less than 100 stores exhibited more punctures when compared to large chains. As for the effects of states, when compared to Washington, pears in New York had more bruises, but less marking. Pears in Michigan had more bruises, marking, and punctures; whereas in North Carolina, more bruises, marking, and decay, but less shrivel; and in California, more bruises, marking, decay but less shrivel. When considering months, in general, pears in October exhibited less disorders than in January, April, June, or July. Marginal effects are listed in Table 2 (see Appendix).

Results presented in this section are interesting considering the negative effect of firmness on the recurrence of external disorders. Also interesting is the recurrence of disorders according to the cultivar. Some disorders, like marking, are more evident in light colored pears, thus Red Anjou consistently exhibited less of this defect. It is difficult to infer conclusions about the grocery store type, state and month, due to the short period of analysis (five months of one marketing year 2003-2004). However, results are aligned to one's expectations. First, one would expect that fruit in the state of Washington would exhibit fewer disorders due to the proximity to production sites. Despite not observing this tendency when evaluating overall appearance, one can observe fewer disorders in Washington with only two exceptions: less marking in New York and less shrivel in North Carolina. Second, winter pears in the PNW are typically harvested in September and October. Thus, one would expect that fruit in October show fewer disorders.

Hedonic Price Regression

Results for the first four regression models with appearance in the set of explanatory variables are reported in Table 3 (see Appendix). Holding all other factors constant, acceptable visual appearance was positively correlated with prices for Anjou and Bosc, but not for Red Anjou. Firmness had a positive effect on Red Anjou prices. An increase in weight led to higher Bosc prices. The negative effect of appearance in Red Anjou prices could indicate the lack of substi-

tutes for this variety, in the period of study. In other words, Red Anjou consumers appeared to be loyal to this cultivar, and preferred to purchase it despite its appearance. In relation to the aggregate supply, the volume of PNW pears shipped had a negative effect on Anjou and Bosc. A positive shift in the aggregate supply curve, holding all other factors constant, could have led to a decrease in Anjou and Bosc prices.

In relation to price variations across grocery store type, grocery chains with less than 100 stores had lower prices than chains with more than 100 stores. In general, fruit was less expensive in Washington, with the exception of Bosc pears in New York. Relevant to month, all cultivars were more expensive in October.

Table 4 (see Appendix) lists results for the hedonic model including external disorders in the set of explanatory variables. Contrary to expectations, the presence of bruises in Anjou pears had a positive correlation with prices. This could be explained by the fact that despite presenting this cosmetic defect consumers are loyal in their preference for this fruit. Marking was positively correlated with Anjou, but negatively correlated with Bosc and Red Anjou prices. Shrivel had a negative correlation with Anjou and Bosc prices, but positive with Red Anjou. Puncture was positive for Anjou prices, but negative for Bosc. Unexpectedly, decay was positively correlated with Red Anjou prices. One could infer that the grocery store would adjust their prices according to the movement of the fruit. It is probable that at the moment this fruit with decay was purchased, prices were held at a high level, but this could have changed after store managers notice the recurrence of this defect.

Conclusions

Grocery store chains account for 52 percent of all pears shipped from the PNW. Given the importance of this distribution channel for the industry, this study aims to provide information about potential factors affecting appearance and external disorders of pears displayed at grocery store outlets, the point of purchase for about half of the PNW pear production. We used data collected on specific months during the 2003-2004 marketing season. In general, fruit firmness had a positive effect on appearance, that is, firmer fruit overall had more acceptable appearance compared to less firm fruit. Firmness was negative for presence of external disorders. Also, there were no significant differences between external appearances, in grocery store chains with less than 100 stores, compared to chains with more than 100 stores. As for price variations, cosmetic disorders did not show a consistent negative correlation with prices.

Visual appearance of fruits on the grocery store shelf is often cited as an important factor consumers consider when deciding whether to purchase fruit or not. Equally important for repeated purchases are internal quality characteristics such as firmness. The fact that firmness and the occurrence of external disorders and fruit appearance were negatively correlated indicates the need to investigate methods of storage, packing, and transportation to achieve the ideal fruit firmness that appeal to consumers, wholesalers, and retailers. Current commercial programs such as pear conditioning aimed to supply consumers with fruit with the "right" quality characteristics, emphasizing flesh firmness. Finally, this study demonstrates the additional need to improve handling, shipping, storing, and retail display practices to avoid fruit damage, and potentially increase per capita fresh pears consumption.

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Appendix

Table 1. Parameter Estimates for the Bivariate Logit Model, PNW Pears' Appearance and External Disorders

	Parameter Estimate									
	Appearance	Bruise	Appearance	Marking	Appearance	Shrivel	Appearance	Decay	Appearance	Puncture
Intercept	-1.955	0.895	-1.606	-0.135	-2.042	-0.910	-1.971	-3.898	-1.884	-1.774
	(2.165)	(1.985)	(2.179)	(1.893)	(2.175)	(2.534)	(2.250)	(4.168)	(2.205)	(1.903)
Weight	0.260	-0.088	0.191	-0.008	0.278	0.134	0.262	0.174	0.244	0.361
	(0.401)	(0.367)	(0.404)	(0.351)	(0.403)	(0.470)	(0.417)	(0.755)	(0.408)	(0.353)
Firmness	0.936**	-0.958**	0.931**	-0.499**	0.956**	-0.936**	0.962**	-0.149	0.934**	-0.439**
	(0.110)	(0.106)	(0.109)	(0.094)	(0.111)	(0.132)	(0.111)	(0.199)	(0.109)	(0.095)
Anjou	0.057	-0.045	0.075	0.751**	0.049	0.700**	0.054	-0.544**	0.072	-0.435**
	(0.159)	(0.142)	(0.161)	(0.138)	(0.161)	(0.226)	(0.165)	(0.258)	(0.159)	(0.133)
Bartlett	-0.489**	-0.145	-0.471**	1.271**	-0.493**	-3.761	-0.497**	0.371	-0.455**	-0.401**
	(0.205)	(0.190)	(0.206)	(0.182)	(0.206)	(56.666)	(0.205)	(0.265)	(0.207)	(0.176)
Bosc	-0.158	0.051	-0.128	0.425**	-0.137	1.626**	-0.188	-1.610**	-0.112	-0.217
	(0.167)	(0.150)	(0.167)	(0.144)	(0.167)	(0.224)	(0.168)	(0.440)	(0.167)	(0.141)
Grocery store	-0.152	-0.105	-0.114	0.061	-0.103	-0.049	-0.117	0.021	-0.137	0.412**
	(0.156)	(0.147)	(0.158)	(0.134)	(0.160)	(0.192)	(0.158)	(0.250)	(0.158)	(0.132)
New York	0.269	0.517**	0.326	-0.556**	0.258	0.111	0.265	0.396	0.274	0.109
	(0.213)	(0.209)	(0.213)	(0.176)	(0.214)	(0.246)	(0.216)	(0.534)	(0.213)	(0.186)
Michigan	0.489**	0.972**	0.508**	1.134**	0.461**	0.005	0.460**	0.475	0.499**	0.821**
	(0.196)	(0.185)	(0.197)	(0.168)	(0.196)	(0.228)	(0.199)	(0.467)	(0.196)	(0.164)
North Carolina	0.337**	0.579**	0.388**	0.408**	0.348*	-0.412*	0.383**	1.707**	0.349*	-0.082
	(0.191)	(0.188)	(0.191)	(0.169)	(0.190)	(0.228)	(0.193)	(0.373)	(0.191)	(0.181)
California	0.570**	-0.031	0.607**	0.571**	0.593**	-0.252	0.603**	0.617*	0.580**	-0.114
	(0.169)	(0.173)	(0.171)	(0.153)	(0.173)	(0.205)	(0.173)	(0.363)	(0.170)	(0.155)
January	-0.443**	0.305**	-0.453**	0.568**	-0.526**	0.037	-0.479**	0.400	-0.440**	0.090
	(0.164)	(0.145)	(0.166)	(0.132)	(0.167)	(0.181)	(0.169)	(0.458)	(0.165)	(0.133)
April	-0.572**	0.282*	-0.602**	0.706**	-0.634**	-0.008	-0.615**	1.070**	-0.589**	-0.037
	(0.184)	(0.160)	(0.186)	(0.150)	(0.189)	(0.187)	(0.190)	(0.504)	(0.186)	(0.150)
June	-0.751**	0.684**	-0.700**	0.719**	-0.773**	-0.202	-0.752**	1.718**	-0.758**	0.356**
	(0.218)	(0.195)	(0.225)	(0.188)	(0.225)	(0.263)	(0.227)	(0.500)	(0.221)	(0.183)
July	-1.074**	0.044	-1.083**	0.442**	-1.099**	-5.633	-1.038**	2.484**	-1.072**	-0.432
	(0.395)	(0.399)	(0.390)	(0.398)	(0.388)	(0.000)	(0.396)	(0.706)	(0.390)	(0.440)
Rho	-0.587**		-0.341**		-0.525**		-1.000**		-0.460**	

Note: Numbers in parenthesis are standard errors. * Indicates $P \leq 0.05$; ** Indicates $P \leq 0.01$

Table 2. Marginal Effects for the Bivariate Logit Model, PNW Pears' Appearance and External Disorders

	Appearance	Bruise	Marking	Shrivel	Decay	Puncture
Weight	0.122	0.007	0.184	-0.052	0.005	0.075
	(0.056)	(0.002)	(0.062)	(0.038)	(0.005)	(0.015)
Firmness	0.195	-0.247	-0.143	-0.160	-0.035	-0.107
	(0.088)	(0.082)	(0.048)	(0.116)	(0.034)	(0.021)
Anjou	0.061	-0.030	0.230	0.056	-0.031	-0.147
	(0.028)	(0.010)	(0.077)	(0.041)	(0.029)	(0.030)
Bartlett	-0.081	0.024	0.490	-0.197	-0.002	-0.150
	(0.037)	(0.008)	(0.164)	(0.143)	(0.002)	(0.030)
Bosc	-0.028	0.053	0.150	0.295	-0.022	-0.096
	(0.013)	(0.017)	(0.050)	(0.213)	(0.021)	(0.019)
Grocery store	-0.016	0.002	-0.007	0.018	-0.005	0.103
	(0.007)	(0.001)	(0.002)	(0.013)	(0.005)	(0.021)
New York	0.127	0.118	-0.183	0.024	0.020	0.046
	(0.058)	(0.039)	(0.061)	(0.018)	(0.019)	(0.009)
Michigan	0.076	0.265	0.315	0.035	0.071	0.216
	(0.035)	(0.088)	(0.105)	(0.025)	(0.068)	(0.043)
North Carolina	0.058	0.240	0.151	-0.079	0.111	0.036
	(0.026)	(0.079)	(0.051)	(0.057)	(0.107)	(0.007)
California	0.158	-0.007	0.143	-0.177	0.032	-0.006
	(0.072)	(0.002)	(0.048)	(0.128)	(0.031)	(0.001)
January	-0.072	0.036	0.211	0.013	-0.014	-0.024
	(0.033)	(0.012)	(0.071)	(0.009)	(0.013)	(0.005)
April	-0.114	0.086	0.197	0.008	0.013	-0.064
	(0.052)	(0.028)	(0.066)	(0.006)	(0.013)	(0.013)
June	-0.206	0.185	0.233	-0.056	0.052	0.065
	(0.094)	(0.061)	(0.078)	(0.041)	(0.050)	(0.013)
July	-0.358	0.158	0.157	-1.115	0.096	-0.014
	(0.163)	(0.052)	(0.053)	(0.807)	(0.092)	(0.003)

Note: Numbers in parenthesis are standard deviations.

Table 3. Parameter Estimates for the Hedonic Price Model for PNW Anjou, Bartlett, Bosc, and Red Anjou Pears, Including Appearance in Set of Explanatory Variables

Variable	Parameter Estimate			
	Anjou	Bartlett	Bosc	Red Anjou
Intercept	0.994**	0.243**	0.859**	0.702**
	(0.196)	(0.026)	(0.129)	(0.101)
Month x Appearance	0.010**	-0.001	0.009**	-0.041**
	(0.004)	(0.006)	(0.004)	(0.008)
Month x Color	-0.007	0.009	--	--
	(0.006)	(0.007)	--	--
Month x Firmness	0.000	0.004	-0.004	0.033**
	(0.003)	(0.003)	(0.003)	(0.006)
Month x Weight	0.004	0.008	0.015*	-0.032
	(0.011)	(0.009)	(0.009)	(0.020)
Month x Volume shipped	-0.017*	-0.012	-0.022**	0.011
	(0.010)	(0.007)	(0.008)	(0.018)
Grocery store	-0.208**	-0.316**	-0.061**	-0.090**
	(0.022)	(0.032)	(0.025)	(0.031)
California	0.092**	0.184**	0.055*	0.459**
	(0.022)	(0.038)	(0.029)	(0.039)
New York	0.029	0.061*	-0.093**	0.063
	(0.025)	(0.032)	(0.029)	(0.045)
Michigan	0.189**	0.076**	-0.018	0.229**
	(0.024)	(0.033)	(0.029)	(0.042)
North Carolina	0.033	0.184**	0.068**	0.385**
	(0.027)	(0.040)	(0.029)	(0.045)
January	-0.642**	--	-0.437**	-0.354**
	(0.177)		(0.115)	(0.090)
April	-0.427**	--	-0.252**	-0.173**
	(0.118)		(0.077)	(0.053)
Jun	-0.220**	--	--	--
	(0.079)			

Note: Numbers in parenthesis are standard errors.
* Indicates $P \leq 0.05$
** Indicates $P \leq 0.01$

Table 4. Parameter Estimates for Hedonic Price Model: PNW Anjou, Bartlett, Bosc, and Red Anjou Pears

Variable	Estimate			
	Anjou	Bartlett	Bosc	Red Anjou
Intercept	0.893**	0.244**	0.779**	0.747**
	(0.195)	(0.026)	(0.123)	(0.105)
Month x Bruise	0.006*	0.005	-0.003	0.007
	(0.004)	(0.005)	(0.003)	(0.006)
Month x Marking	0.009**	-0.003	-0.007*	-0.011*
	(0.003)	(0.003)	(0.004)	(0.006)
Month x Shrivel	-0.004	--	-0.002	-0.002
	(0.004)	--	(0.004)	(0.016)
Month x Decay	-0.004	-0.003	0.004	0.033**
	(0.010)	(0.012)	(0.031)	(0.010)
Month x Puncture	0.006*	0.002	-0.007**	0.005
	(0.003)	(0.004)	(0.003)	(0.006)
Month x Color	-0.009	0.007	--	--
	(0.006)	(0.007)		
Month x Firmness	0.002	0.004	-0.005**	0.024**
	(0.003)	(0.003)	(0.003)	(0.006)
Month x Weight	-0.002	0.009	0.014	-0.032
	(0.011)	(0.009)	(0.010)	(0.021)
Month x Volume shipped	-0.010	-0.012	-0.017**	0.008
	(0.010)	(0.007)	(0.008)	(0.018)
Grocery store	-0.210**	-0.317**	-0.053**	-0.093**
	(0.021)	(0.032)	(0.025)	(0.032)
California	0.093**	0.185**	0.069**	0.395**
	(0.022)	(0.038)	(0.029)	(0.039)
New York	0.051**	0.060*	-0.096**	-0.012
	(0.026)	(0.032)	(0.029)	(0.048)
Michigan	0.175**	0.072**	0.012	0.169**
	(0.024)	(0.034)	(0.030)	(0.044)
North Carolina	0.040	0.186**	0.064**	0.313**
	(0.027)	(0.041)	(0.029)	(0.049)
January	-0.550**	--	-0.370**	-0.341**
	(0.176)		(0.110)	(0.094)
April	-0.378**	--	-0.205**	-0.142**
	(0.117)		(0.073)	(0.055)
Jun	-0.210**	--	--	--
	(0.079)			

Note: Numbers in parenthesis are standard errors.
* Indicates $P \leq 0.05$
** Indicates $P \leq 0.01$

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