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Estimating the Optimal Premium Rates for Credential Food Attributes: A Case Study in the Northeast United States

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Abstract

Using data from the *2010 Taste of Place* survey conducted in Vermont and three metropolitan areas in the northeast United States, this study examines consumer willingness to pay (WTP), estimates price elasticity, and calculates the optimal premium rates for selected credence food attributes. The empirical results indicate that respondents' WTP varies significantly across attributes and is closely associated with certain demographic factors. The estimated optimal premium rates and estimation procedures presented in this paper can help producers and retailers identify the optimal premium rates for each attribute in association with geographical or socioeconomic segments of consumers.

Keywords: consumers, willingness-to-pay (WTP), organic, local, made in Vermont

Introduction

Although consumers traditionally judge the quality and value of food products by their physical attributes such as freshness, color, nutrient contents, and taste, recent studies have reported that consumers are paying more attention to social and environmental attributes including environmental impacts of production methods, fairness of trade, and impacts on local farms and communities (Moon et al. 2002; Auger et al. 2003). Such social and environmental attributes are generally referred to as credence attributes – the product features that consumers cannot evaluate or verify before, during or even after consumption (Caswell and Mojduszka 1996). For farmers and retailers, appropriate marketing and pricing policies should consider consumers' valuation and willingness to pay (WTP) for both physical and credence attributes (Marn 2003). Using data collected through a consumer survey in Vermont and three metropolitan areas in the northeast United States, this paper estimates the demand elasticities and optimal premium rates for selected food attributes, with a focus on the "made in Vermont" attribute, and examines the impacts of demographic factors.

Because most of the environmental and social attributes of food products are credence attributes, various labeling systems and regulations have been established to provide verifiability and credibility for these attributes (Golan et al. 2000). Some of the well-known labels include certified organic, rBST-free, and GMO-free. These labels refer either to a specific feature of production like GMO-free or to a "compound attribute" that indicates several basic attributes. For example, "organic" foods are produced without synthetic inputs and, at the same time, are GMO-free.

The increase in labeling options has posed both opportunities and challenges for food producers and retailers. First, producers and retailers need to make judicious choices among overlapping and sometimes competing labels. Because the amount of information that consumers can absorb from food labels is limited, producers and retailers must choose the most important information and avoid providing unclear or unnecessary information (Mueller 1991; Einsiedel 2000). Also, the benefits of a labeling system have to be weighed against its costs (Golan et al. 2000). Second, since a new label generally targets on a new or specific segment of the market (Wedel 2000; Boone and Kurtz 2011), food products with certain labels, such as certified organic, require supporting marketing strategies to realize the potential benefits of the labels. Finally, for food producers who want to sell their products at optimal prices that maximize their profits or total sales, they need to understand consumers' response to price changes and WTP for both physical and credence food attributes.

This study is motivated by the growing needs for information on consumers' WTP for credence food attributes and the lack of such information in the literature. Specifically, this paper calculates the price elasticity of demand for several food attributes, estimates the revenue-maximizing price premiums for these attributes on the basis of the estimated demand elasticities, and highlights the revenue-maximizing price premium for the attribute "made in Vermont" in different market segments. Data used in this study are from the Taste of Place (TOP) survey developed by the Vermont Agency of Agriculture, Food and Markets and the Center for Rural Studies at the University of Vermont in 2010. The survey was designed to collect empirical evidence for helping Vermont's state legislature promulgate labeling rules and develop certification strategies.

Literature Review

The price premium of a product is closely associated with consumers' WTP for its specific attributes. As summarized by Breidert et al. (2006) and Lee (2001), various methods have been developed to measure the WTP. These methods include laboratory and field experiments, direct customer surveys, discrete choice analysis, conjoint analysis, etc. Direct customer survey, the simplest method, is used in this study. Although this method has been criticized for the hypothetical nature of the questions (Mitchell and Carson 1989; Cummings 1995), a study by Loureiro et al. (2003) showed that a consumer who stated that he or she would pay a premium for a product was more likely to actually purchase the product. The main reason for choosing this method for this study is that it allows us to ask about multiple food attributes in the same survey.

Recently, measuring consumers' WTP for social and environmental food attributes such as organic has been an active research area. For example, Moon et al. (2002) conducted a direct consumer survey in the former West and East Berlin and reported that the residents of the two districts had significantly different WTP for environmentally friendly production methods. Batte et al. (2004) used a choice experiment survey in seven central Ohio grocery stores to measure consumer WTP for alternative levels of organic content in breakfast cereals. Bernard et al. (2006) conducted a lab experiment and found that, when the GMO-free attribute is nested in the organic attribute, the incremental WTP for the latter is insignificant.

The WTP for locally produced food has also received considerable attention in recent years. For example, Giraud et al. (2005) used discrete choice analysis to measure WTP for locally grown specialty food products in Maine, New Hampshire, and Vermont. They found that consumers in the three states were willing to pay a small premium for locally made specialty foods and that the premium was not significantly different across the three states. Carpio et al. (2009) evaluated South Carolina (SC) consumers' WTP for "SC grown" products. Their results indicated that consumers in South Carolina were willing to pay an average premium of 27% for local produce and 23% for local animal products. Loureiro et al. (2001) used a direct survey to assess consumer WTP for local, organic, and GMO-free potatoes in Colorado. They found that the WTP for "locally produced" was higher than that for the other two attributes. Burchardi et al. (2005) investigated consumers' WTP and the underlying preferences for locally produced milk and concluded that there was a demand for local milk but the demand was price elastic. Their conclusion was based on aggregated demand without explicit calculation of any demand elasticity.

Another area of WTP studies is rBST-free milk and GMO-free food, both characteristics of organic food. Wang et al. (1997) evaluated consumer WTP for rBST- free milk using data collected from a consumer survey in Vermont. They found that a majority of consumers were willing to pay a premium for rBST-free milk and that the WTP was affected by consumers' sociodemographic factors as well as by consumer attitudes toward the use of rBST. Using a hedonic model, Kolodinsky (2008) studied the effect of attitude on consumers' valuation of rBST-free and organic attributes and found that the effect was significant in 2001 but insignificant in 2004, suggesting that the negative effects of rBST likely decreased over the study period. Onyango et al. (2006) conducted a choice experiment to analyze U.S. consumers' valuation of cornflakes. They found that, compared to products with no labels, consumers would pay 6.5%

less for products labeled "genetically modified corn" and 10% more for those labeled "contains no genetically modified corn."

Although many researchers have studied consumer WTP for food attributes, few studies have used the WTP to forecast market response to price changes or to develop optimal pricing strategies (Hanna and Dodge 1995; Nagle and Holden 2002; Monroe 2003). This study focuses on a less studied but practically important aspect of the WTP research–estimating the demand elasticities and optimal premium rates for selected credence food attributes based on survey data.

Methods

This section describes the survey instrument, introduces the methods for calculating the price elasticity of demand and revenue-maximizing premium prices, and discusses some limitations of the data and approaches used to address the limitations.

The TOP Survey

Data used in this study are from the TOP survey developed by the Vermont Agency of Agriculture, Food and Markets and the Center for Rural Studies at the University of Vermont. The survey was designed to collect empirical information about the demand for a geographical indication (GI) labeling system for Vermont food products and to provide such information to the Vermont legislature. It covered the state of Vermont and three metropolitan regions in the northeast United States: Philadelphia, New York, and Boston. The three metropolitan regions were chosen because residents there had the highest level of visitation to the state of Vermont (Vermont Department of Tourism 2007). With a contact list obtained from the infoUSA Inc., 10,000 household addresses were randomly selected with 2,500 in each region. The primary food shopper in each selected household was asked to answer the survey, either by mail or online. While the survey was mailed to 10,000 households in November 2010, 706 responses were received by December 15, 2010, with 452 from Vermont and 254 from New York, Boston, and Philadelphia metropolitan areas. With 2,225 valid addresses in Vermont and 6,660 valid addresses in the metropolitan areas, the response rate was 20.3% for Vermont, 3.8% for the three metropolitan areas, and 7.9% for the whole survey. The demographic information of the respondents is summarized in Table 1. More information about the survey and descriptive statistics can be found in the preliminary market study report by the Center for Rural Studies at the University of Vermont (2011).

The survey started by soliciting general opinions on labeling local products and then proceeded to ask about preferences and shopping history for specific Vermont food products. These were followed by questions regarding respondents' WTP and preferences for products with different attributes. The question about WTP was posed thusly: "How much more are you willing to pay for a food product that is (a food attribute) comparing to generic food with none of these attributes?" Fifteen different food attributes, listed in Table 2, were included in the survey. Respondents had 11 choices ranging from "Not a penny more" to "Twice as much," with 10 percent spacing. Although the attributes were selected primarily to explore the labeling options for Vermont food products, the results could also be relevant to producers and policy makers outside Vermont as credence attributes become more popular around the country. The rest of this survey

covered respondents' association with Vermont and their demographic information, ending with room for additional comments.

Table 1. Demographic information from the TOP survey

		Percent	
		Vermont	**Metro areas**
Gender	Male	62.2	65.0
	Female	37.8	35.0
		(n=437)	(n=243)
Age			
	18 to 34	2.1	17.6
	35 to 64	44.7	57.1
	65 and greater	53.2	25.2
		(n=426)	(n=233)
Income	Under $50,000	39.0	19.6
	$50,000 to under$100,000	33.8	38.5
	$100,000 to under $125,000	14.9	32.8
	Prefer not to say	12.3	19.1
		(n=423)	(n=235)
Education	Below college	45.2	27.6
	4-year college degree	22.4	35.1
	Graduate or professional degree	32.4	37.2
		(n=438)	(n=242)

Estimation Elasticity and Optimal Price Levels

The WTP data from the survey assume discrete values proportional to the baseline price p_0 ($p_1 = 1.1p_0$, $p_2 = 1.2p_0$, ……, $p_{10} = 2p_0$). At each price level, the total quantity demanded for food products with this attribute can be expressed as the following:

$$(1) \qquad Q_i = \sum_j^{N_i} q_{ij} = N_i \bar{q}_i$$

The total quantity demanded at the i^{th} price level, denoted as Q_i, equals to the summation of individual demand (q_{ij}) from N_i consumers, where j is the index for each consumer. Q_i also equals to the number of consumers (Q_i) still buying at the i^{th} price level times the average quantity ($\bar{q}_i$) they purchase. As a limitation of the survey, respondents were not asked about the quantity of their purchase and the WTP questions were for food in general. As a result q_{ij} and $\bar{q}_i$ are not available in the data set. This study makes a further assumption that consumers' average purchase quantities $\bar{q}_i$ at different price levels are the same. Thus equation (1) can be simplified as:

$$(2) \qquad Q_i = N_i q$$

This assumption could be a potential limitation of the analysis but it seems reasonable for the purpose of the study with a focus on general food rather than any specific product. With N_i from

the data, the quantity demanded Q_i can be determined up to an unknown constant q, yielding 10 discrete points on a demand function.

Using the definition of arc price elasticity of demand $E^d(p)$ and plugging in (2) results in the following equation:

$$(3) \quad E^d(p_{i,i+1}) = \frac{Q_{i+1} - Q_i}{p_{i+1} - p_i} \cdot \frac{p_{i+1} + p_i}{Q_{i+1} + Q_i} = \frac{N_{i+1} - N_i}{p_{i+1} - p_i} \cdot \frac{p_{i+1} + p_i}{N_{i+1} + N_i}$$

$$where\ i = 1,2, \dots \dots, 10 \quad and\ \ p_{i,i+1} = (p_i + p_{i+1})/2$$

By the aforementioned assumption that consumers' average purchase quantities at all price levels are the same, q can be canceled out. At each price level p_i, N_i can be found from the survey data, and the price elasticity of demand can then be calculated.

Furthermore, the revenue-maximizing price level can be found at the point where the price elasticity of demand $E^d(p) = -1$, meaning that a one percent increase in price would lead to a one percent decrease in demand (Nicholson, 2002). Because we have only discrete $E^d(p)$ values (from equation [3]), an interpolation between the two elasticity values just below and above –1 is performed to estimate the optimal price level ($\hat{p}$) for total revenue maximization.

Because there are no negative WTP options in the survey, all respondents with negative WTP for the attribute (non-buyers at the baseline price) would reply zero WTP and therefore be counted as consumers at the baseline price p_0, causing N_0 to be overestimated. As a result, the first valid elasticity value that we can calculate is at $1.15p_0$ (see equation [3]), and price premiums can be estimated in this study only if they are above $1.15p_0$.

Results

This section first summarizes the major results for all the 15 attributes and then presents a more detailed analysis of the attribute "made in Vermont".

Overall Results for the 15 Attributes

Overall, consumers in the sample show considerable WTP for the food attributes included in the study: the mean WTP ranges from 28.8% to 48.1% above the baseline price for the 15 attributes (Table 2). Although some social and environmental attributes are highly valued by consumers, it is interesting that the compound attribute "certified organic" food, which by its production standards includes the features "environmentally friendly" and "made from traditional methods," received lower WTP than both of the two basic attributes. The same is true for the attribute "imported from a country known for high-quality food," which also received lower WTP than the basic attributes it is intended to represent, such as "has unique flavor that reflects the region where it was made." These results indicate that, although producers intend to use these compound attributes to represent certain basic attributes, consumers may not make the necessary association with the basic attributes without being reminded.

Using the information about WTP, elasticity of demand is calculated at each price level (Table 2). Because the elasticity values at price levels higher than $1.35p_0$ are significantly below –1, they are irrelevant for the purpose of revenue maximization and are therefore not presented in this paper. The price premium of each attribute is within the price range in which elasticity drops below –1 (boldface numbers in Table 2). For example, the price premium for the first attribute "Made on a farm where the farmer and workers make a fair wage" is between $1.15p_0$ and $1.25p_0$.

Table 2. Mean WTP, elasticity of demand, and revenue-maximizing premium price for 15 food attributes, ranked according to the mean WTP

Attribute	Mean WTP (N)	$E^D(1.15p_0)$	$E^D(1.25p_0)$	$E^D(1.35p_0)$	Optimal premium price $\hat{p}$
Made on a farm where the farmer and workers make a fair wage	48.1% (653)	**–0.814**	**–1.534**	–1.634	$1.176p_0$
Made using environmentally friendly methods	47.9% (653)	**–0.926**	**–1.784**	–1.756	$1.159p_0$
Grown on a family farm	47.7% (655)	**–0.671**	**–1.449**	–1.861	$1.192p_0$
Helping to preserve open farmland	45.7% (625)	**–0.644**	**–1.555**	–2.155	$1.189p_0$
Available at only a certain time of year	45.2% (635)	**–0.560**	**–1.756**	–1.808	$1.187p_0$
Made by a cooperative group of farmers	44.5% (547)	**–0.933**	**–1.734**	–2.242	$1.158p_0$
Has unique flavor that reflects the region where it was made	44.5% (630)	**–0.831**	**–1.351**	–2.460	$1.183p_0$
Produced locally	43.8% (641)	**–0.697**	**–1.280**	–2.330	$1.202p_0$
Made in Vermont	42.6% (655)	**–0.864**	**–1.786**	–2.181	$1.165p_0$
Made using traditional production method	37.1% (610)	–1.226	–2.543	–2.046	
New product that I'm curious about trying	36.2% (627)	–1.242	–2.726	–3.265	
Consistent in flavor from one batch to the next	35.9% (612)	–1.156	–2.441	–2.639	
Certified organic	34.0% (639)	–1.168	–2.635	–3.067	
Imported from a country known for high-quality food	28.9% (613)	–1.511	–2.885	–3.179	
A brand thing that I know	28.8% (629)	–1.208	–3.190	–4.082	

Note: Boldfaced elasticity values are the elasticity values used to estimate the optimal premium price through an interpolation method.

Besides the range estimate, the exact price premium $\hat{p}$, calculated from interpolation between the two ends of the range, is displayed in the last column of Table 2. Based on the elasticity calculation, nine food attributes have premium prices above $1.15p_0$, all of which fall between $1.15p_0$ and $1.25p_0$ (Table 2). As explained in the method section, those attributes showing no positive premium may actually have premiums below $1.15p_0$, which cannot be measured in this study due to the data limitation.

Market Segmentation for "Made in Vermont"

In the overall estimation presented in section 4.1 the GI attribute "made in Vermont" receives an average WTP of 42.6%, ranking ninth among the 15 attributes, though the differences are small. On the basis of the elasticity calculation, "made in Vermont" should command a premium price of $1.165p_0$. If we look deeper into different consumer segments, however, it can be shown that "made in Vermont" commands an even higher price premium in particular consumer groups.

First, it is expected that "made in Vermont" should command higher premium among consumers who are more closely associated with Vermont (i.e. Vermont residents or people who visit Vermont frequently), because, on average, they have clearer knowledge about the desirable attributes of Vermont food products (for example many Vermont food products are from family farms). Also, social considerations such as supporting the local economy would also affect these people's purchasing decisions regarding Vermont products. Data from this survey supported the above hypothesis: people living in Vermont have significantly higher WTP than people living outside the state. For those who live outside Vermont, frequent and occasional visitors of Vermont have higher WTP than those who rarely or never visit. In the subsample of current Vermont residents, the premium price ($1.189p_0$, from Table 3) is higher than the overall result ($1.165p_0$). Although the elasticity calculation did not show any price premium for non-Vermonters on either of the two visitation levels, the elasticity values are lower in absolute value (compared to the overall results in Table 2), at $1.15p_0$ and $1.25p_0$ for frequent and occasional visitors, meaning that when raising the price by certain percentage, producers would lose smaller percentage of consumers who are occasional visitor and larger percentage of consumers who are non-visitors.

Table 3. Mean WTP, elasticity of demand $E^D(p)$, and revenue-maximizing premium price for the "made in Vermont" attribute among consumer groups with 3 levels of association with Vermont

Association with Vermont	**Mean WTP (N)**	$\mathbf{E^D(1.15p_0)}$	$\mathbf{E^D(1.25p_0)}$	$\mathbf{E^D(1.35p_0)}$	**Optimal premium price $\hat{p}$**
Vermont Residents	46.6% (441)	**–0.641**	**–1.560**	–2.026	$1.189p_0$
Frequent and occasional visitors	35.3% (109)	–1.144	–1.875	–2.600	
Rarely or never visit Vermont	18.1% (113)	–1.420	–2.941	–2.455	

Note: Boldfaced elasticity values are the elasticity values used to estimate the optimal premium price through an interpolation method.

Second, higher WTP for Vermont products is expected to be found among specialty-store shoppers. Usually when people visit specialty stores, they are looking for high-quality products and so expect higher prices. The data show that, among specialty- store shoppers, "made in Vermont" commands a premium price of $1.211p_0$ (Table 4).

Table 4. Mean WTP, elasticity of demand $E^D(p)$, and revenue-maximizing premium price for the "made in Vermont" attribute among specialty-store shoppers and non–specialty store shoppers

Ever purchased VT product in specialty store or not	**Mean WTP (N)**	$\mathbf{E^D(1.15p_0)}$	$\mathbf{E^D(1.25p_0)}$	$\mathbf{E^D(1.35p_0)}$	**Optimal premium price $\hat{p}$**
Yes	48.3% (306)	**–0.665**	**–1.548**	–2.216	$1.211p_0$
No	37.6% (349)	–1.498	–2.602	–2.054	

Note: Boldfaced elasticity values are the elasticity values used to estimate the optimal premium price through an interpolation method.

Third, Vermont food products should command higher premium among farmers' market shoppers because the "localness" of Vermont food products is consistent with the spirit of farmers' markets. The results in Table 5 show that people who had purchased Vermont products in farmers' markets have higher WTP for "made in Vermont" products. The revenue-maximizing premium price is $1.188p_0$ among farmers' market shoppers (Table 5).

Table 5. Mean WTP, elasticity of demand $E^D(p)$, and revenue-maximizing premium price for the "made in Vermont" attribute among farmers' market shoppers and non–farmers' market shoppers

Ever purchased VT product in a farmers' market or not	**Mean WTP (N)**	$\mathbf{E^D(1.15p_0)}$	$\mathbf{E^D(1.25p_0)}$	$\mathbf{E^D(1.35p_0)}$	**Optimal premium price $\hat{p}$**
Yes	4.64 (465)	**–0.665**	**–1.548**	–2.216	$1.188p_0$
No	333 (185)	–1.498	–2.602	–2.054	

Note: Boldfaced elasticity values are the elasticity values used to estimate the optimal premium price through an interpolation method.

Conclusions and Implications

This paper has examined consumers' WTP for 15 different food attributes using data from the TOP survey and estimated the price elasticity and the optimal premium rate for each attribute. The paper has also reported more detailed analysis on the "made in Vermont" attribute in different market segments.

This study suggests four major conclusions: First, significant WTP for basic social and environmental attributes such as "helping preserving open farmland" and "Made using environmentally friendly methods" were found in this survey. Although some compound attributes, such

as "certified organic" and "made in Vermont," are designed to represent these basic attributes, they received much lower WTP than the basic attributes. This clearly shows that information about the quality and production process of food products has not been effectively conveyed to consumers and there is a need for more effective education and promotion efforts. There is a rich literature on consumers' perception of compound food attributes, such as local (Darby et al. 2008), organic (Padel and Foster 2005), and healthfulness (Drewnowski et al. 2010). Although most of these studies have deconstructed compound attributes into fundamental attributes, few have quantified the degree of trust by consumers. The result of this paper shows that more research is needed in this area.

Second, with estimated price elasticity of demand, producers can predict the market's response to price changes. The estimated price elasticities reported in this paper showed that nine out of the 15 food attributes can be expected to earn a price premium at least 15% over the base price ($1.15p_0$), and price premiums for all the nine attributes fell between $1.15p_0$ and $1.25p_0$. Because of the limitation of the data, price premium under 15% could not be measured. This range of price premium rates is consistent with previous estimations. Producers can increase their sales revenue by moving their current price toward the optimal price. For the given production costs, the increase in sales revenue minuses the additional marketing costs is equal to the increase in profit.

Third, for Vermont food producers, the results by different consumer groups showed that Vermont food products command higher premium among consumers who are more closely associated with Vermont, specialty store shoppers, and farmers' market shoppers. These findings yield three suggestions for Vermont food producers: (a) prices may be marked up for these consumers if possible; (b) link the marketing efforts to tourism promotion efforts; and (c) focus more on farmers' markets than the chain supermarkets.

Fourth, while previous studies have shown that the WTP for multiple attributes is not equal to the sum of the WTP for each individual attribute (e.g., Gao and Schroeder 2009), this study confirms the conclusion. This study also suggests that the WTP for a combination of attributes can even be lower than the WTP for a specific attribute included in the combination. For example, the average WTP for "made using environmentally friendly methods" is higher than that for "certified organic." The interaction between different food attributes requires more empirical studies.

Although this study is limited by survey data without quantity information at each WTP price level, the estimation of price elasticity and the premium rate for each attribute may provide useful information to farmers, retailers and policymakers. Also, while many states are promoting local agriculture, the research findings and estimation procedures are expected to provide a useful reference for food producers, retailers and policy makers in Vermont and other states.

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