Willingness to Pay, Quality Perception, and Local Foods: The Case of Broccoli

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A large and growing body of literature has studied consumer willingness to pay (WTP) for local foods in the United States. However, these studies implicitly assume that consumers perceive local foods to have superior quality than nonlocal foods. Little is known about WTP for local foods when taking into account differences in consumer perception of food quality between local and nonlocal foods. In this article, we conduct an economic experiment to assess the effect of locally grown information on consumer WTP and quality perceptions of three broccoli varieties (one commercial variety grown in California and two newly developed local varieties). Our results show that consumers rate both the appearance and the taste of the two local broccoli varieties lower than the California variety when evaluating food quality blindly. However, consumers' evaluations of the two local varieties improve substantially after being told the two varieties are locally grown. Results also indicate that consumers are willing to pay a price premium for the two local varieties after being told that they are locally grown. Our results provide evidence that locally grown information has a positive effect on both consumer WTP and quality perception of local foods.

Key Words: broccoli, consumer preference, local foods, quality perception, willingness to pay

JEL Classifications: D12, D90, L66, Q13

Introduction

Locally grown is increasingly becoming an important characteristic that consumers consider when making food purchasing decisions. Consumers often perceive locally produced food to have higher quality with superior attributes such as freshness and flavor. Local foods are also associated with such benefits as reduced environmental impacts and stronger local economies (King, Gómez, and DiGiacomo 2010; Martinez et al. 2010). These perceived benefits may influence consumer willingness to pay (WTP) for local foods.

A large body of literature has studied consumer preferences and WTP for local foods in the United States (see Martinez et al. [2010] and Feldmann and

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Hamm [2015] for detailed overviews). Most studies find that consumers are willing to pay a price premium for local foods. However, these studies implicitly assume that consumers perceive local foods to have superior quality compared with nonlocal foods. Little is known about WTP for local foods taking into account differences in consumer perception of food quality between local and nonlocal foods. In addition, extant literature has not examined the effect of locally grown information on consumer perceptions of quality and how these perceptions are related to consumer WTP. Studying these issues can help farmers and supply chain channel members develop superior strategies for marketing local foods.

In this article, we study consumer WTP and quality perceptions of locally grown versus nonlocal broccoli varieties. We use the term "New York Grown" to represent "locally grown."[1] The broccoli sector is an excellent setting for studying such issues. Broccoli, like many U.S. fresh fruits and vegetables, is produced mainly in California (U.S. Department of Agriculture, National Agricultural Statistics Service 2017), whereas the majority of the demand occurs on the East Coast of the country. However, potential water shortages in California, higher transportation and handling costs, and increasing consumer demand for local food have encouraged industry stakeholders to increase broccoli production on the East Coast, including in New York State (NYS) (Atallah, Gómez, and Björkman 2014).

One challenge of growing broccoli on the East Coast is the lack of appropriate varieties suited to eastern growing conditions. Most broccoli consumed in the United States is harvested from varieties specifically developed for California production environments. The combination of warmth and humidity common in East Coast production regions creates deformities and often prevents high-quality head formation (Griffiths et al. 2012). Consequently, researchers are developing new broccoli varieties better adapted to eastern agroecological conditions. One marketing strategy is to increase East Coast broccoli varieties' competitiveness by promoting them as "locally grown." However, before adopting this strategy, stakeholders need to be informed of the influence of the "locally grown" attribute on consumer WTP and the perception of quality.

We conduct an economic experiment with nonstudent subjects to assess the effect of locally grown information on consumers' WTP and perceptions of the appearance and taste of the three broccoli varieties (one commercial variety grown in California and two new varieties developed for NYS growing conditions and produced in this state). Appearance and taste are two of the

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[1] There is no mandate for using the "locally grown" label in New York State. However, there is a voluntary program called "New York State Grown & Certified" (New York State Department of Agriculture and Markets 2019). This voluntary program is a cooperative effort among producers, processors, wholesalers, retailers, restaurants, and the New York State Department of Agriculture and Markets. A certified grower can use the official seal to indicate that the product is grown and distributed locally.

most important quality attributes considered by consumers when making purchasing decisions (Moser, Raffaelli, and Thilmany-McFadden 2011). We employ a Tobit model[2] to study the effect of locally grown information on consumer WTP to account for the truncated nature of the data. Additionally, we use a seemingly unrelated regression (SUR) model to examine the influence of locally grown information on consumer perception of product appearance and taste. Our results show that consumers rate both the appearance and the taste of the two local broccoli varieties lower than the California variety when evaluating food quality blindly. However, consumers' evaluations of the two local broccoli varieties improve substantially when they know the product is locally grown. Results also indicate that consumers are indifferent in their WTP for the NYS-grown varieties and the California variety when locally grown information is not provided. However, consumers are willing to pay a price premium for the two NYS-grown varieties after being told that they are locally grown.

Our results provide evidence that locally grown information has a positive effect on both consumer WTP and quality perception. Our results shed light on appropriate marketing strategies for the two newly developed local broccoli varieties. Our results are relevant for other U.S. fruit and vegetable commodities (e.g., carrots, celery, endive, and lettuce, among others) produced primarily in California but which have the potential to be produced on the East Coast.

Literature Review

As consumers' interest in local food is growing steadily, so is the number of studies on topics and issues related to local foods (see Martinez et al. [2010] for an overview). However, there is not a universally accepted definition of "local food" (Martinez et al. 2010). Definitions of local food are usually based on one or more of the following features or characteristics: geographic proximity (DePhelps et al. 2005; Hu et al. 2012), political boundaries (e.g., Washington apples, Idaho potatoes, California peaches, and Florida citrus) (Zepeda and Leviten-Reid 2004), how local food is retailed (e.g., farmers' market and community-supported agriculture), and length of the supply chain (Marsden, Banks, and Bristow 2000), among others. In this article, we adopt the political boundary definition, which is "grown and available for purchase within a State's borders" (Martinez et al. 2010, 13). This definition is also the most popular definition among the top 10 grocery retailers (Martinez et al. 2010).

Most local food studies focus on consumer preferences and WTP for local products. Martinez et al. (2010) summarize a series of studies on WTP for a

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[2]   The Tobit model is designed to estimate linear relationships between variables when the dependent variable is truncated (i.e., there is either left or right censoring in the dependent variable).

wide range of locally produced food in the United States. Not surprisingly, they find that consumers are willing to pay higher prices for local foods. A number of studies examine the effect of multiple factors that influence consumer preferences and WTP for local food, including quality perception (Brown 2003; Carpio and Isengildina-Massa 2009), nutritional reasons (Eastwood, Brooker, and Gray 1999; Loureiro and Hine 2002), better value for the price (Wolf, Spittler, and Ahern 2005), support for the environment and local economy (Darby et al. 2008), and demographic characteristics (Brown 2003). Other studies analyze how the values of "local" and "organic" interact and influence consumer WTP (James, Rickard, and Rossman 2009; Yue and Tong 2009; Roosen, Kottl, and Hasselbach 2012).

Several methods have been used by researchers to study consumer preferences and WTP for local food. Earlier studies tend to use hypothetical approaches such as personal interviews, as well as online, mail, and telephone surveys (Eastwood 1996; Brown 2003; Zepeda and Leviten-Reid 2004). In a hypothetical survey, respondents answer WTP questions where the payment of the stated WTP is hypothetical. These studies have been criticized for not being incentive-compatible to reveal the real consumer WTP (Wertenbroch and Skiera 2002). In recent years, experimental auctions have become increasingly popular to investigate the impact of labeling on WTP for food attributes (Dickinson and Bailey 2002; Umberger et al. 2002; Lusk, Feldkamp, and Schroeder 2004). Real money and real products are exchanged in an experimental setting so that participants have a greater incentive to reveal their true valuation of a product than in a hypothetical survey setting (Lusk 2003; Lusk, Feldkamp, and Schroeder 2004). For example, Grebitus, Lusk, and Nayga (2013) use second-price auctions to study the effect of distance of transportation on consumer WTP for local food. Similarly, Shi, House, and Gao (2013) use a Becker-DeGroot-Marschak (BDM) auction to determine in what way purchase intentions affect WTP for organic and locally grown blueberries. Other methods of studying consumer preferences and WTP for local food include conjoint analysis (Darby et al. 2008) and choice experiments (Alfnes et al. 2006; Yue and Tong 2009).

In this article, we employ BDM auctions of broccoli to study the effects of locally grown information on (1) consumer WTP and (2) consumer perception of product quality. In a BDM auction, subjects submit sealed bids for a good. A random price is then drawn from a predetermined distribution. Individuals with bids higher than the randomly drawn price "win" the auction and purchase a unit of the good at that randomly drawn price. Because the bids of respondents do not determine the purchase price, the BDM auction creates an optimal environment for rational respondents to reveal their actual WTP (Becker, DeGroot, and Marschak 1964; Lusk and Shogren 2007).

Our article is related to a stream of literature that studies the effect of country of origin (COO) on consumer WTP and perception of product quality. According to Elliott and Cameron (1994), consumer attitudes about local and nonlocal

products are similar to the effect of COO, which has long been discussed in the literature. Newman et al. (2014) provide an overview of research related to COO labeling and implications for food marketing systems. This literature generally agrees that consumers tend to perceive domestic food to be of superior quality than imported food products (Umberger 2005; Lobb and Mazzocchi 2007; Pouta et al. 2010). Consumer WTP for COO information has also been widely researched by marketing and consumer behavior literature. For example, Lim et al. (2013) study U.S. consumer preference and WTP for COO-labeled beef steak and food safety enhancements. In many cases, consumers' higher WTP for domestic food is associated with their perceptions of superior quality (Dickinson and Bailey 2002; Umberger et al. 2002). Loureiro and Umberger (2003) find that consumers are willing to pay an average of $1.53 and $0.70 per pound more for steak and hamburger labeled as "U.S. Certified."

Despite the importance of quality perception in deciding consumer preference and WTP for local food (Durham, King, and Roheim 2009), little has been done to examine the effect of locally grown information on consumer perceptions of local food quality and how these perceptions relate to consumer WTP, which is the focus of this study. One exception is a study by Stefani, Romano, and Cavicchi (2006), who examine the impact of alternative definitions of the region of origin on consumer WTP and consumer evaluation of food quality. Another study that is closely related to our work is by Bi et al. (2012), who use experimental auctions to study the effect of sensory attributes (viewing, peeling, and tasting) on consumer WTP for two new tangerine varieties. They find that consumers change their WTP based on the different attributes of the tangerines and that internal fruit attributes (e.g., flavor, juiciness, and ease of peeling) are more important to consumers than external attributes (e.g., appearance).

Experimental Design

We designed and implemented an economic experiment with nonstudent subjects to examine consumer WTP for three broccoli varieties: a commercial variety from California (from here on referred to as "California variety") and two newly developed NYS grown varieties (from here on referred to as "NYS 1" and "NYS 2") that are undergoing field trials before being launched to market. The California variety was bought from a local grocery store and had a dark-green, firm, uniform, and domed head. The two NYS varieties were harvested from an agricultural experiment station where the field trial for the new broccoli varieties was conducted. NYS 1 had a light-green, flat, and nonuniform head. NYS 2 was designed by researchers to have a very similar appearance to the California variety. To maintain similar postharvest product attributes, we stored the two NYS varieties under the same conditions that the California variety was stored before arriving at NYS grocery stores. After harvested, the two NYS varieties were stored in a cooler, packed with flake ice around and on top of the broccoli heads. The cooler was then placed in a

forced-air room for 5 to 7 days, which is the estimated time to ship broccoli from California to NYS. All three broccoli varieties were then parboiled at the same time and packed in small samples for use in the economic experiments.

We collected WTP information from subjects who were exposed to one of two treatments regarding the origin of the three broccoli varieties. In the first treatment (from here on referred to as the "no information" treatment), subjects did not receive information about the origin of the varieties. They revealed their WTP for the three varieties solely based on their evaluations of the appearance and the taste of the three broccoli varieties. In the second treatment (from here on referred to as the "information" treatment), subjects were told that the two NYS varieties were grown in NYS, and the third variety in California.

Subjects were recruited through a local experimental economics research laboratory's email system.[3] They were seated randomly at individual computer terminals with privacy shields, were informed that all decisions they made would be kept strictly confidential, and were given $25 for participating and told they might have the opportunity to actually purchase broccoli. A maximum of 24 computer terminals were available per session, and the number of subjects in each session ranged from 15 to 24. After signing a consent form, subjects were given a brief introduction of the experiment, which included the amount of money they would earn and the rules of the experiment. We began each session with two practice rounds to demonstrate how the BDM auction would be conducted. In the practice round, subjects submitted bids for a dollar bill and a chocolate bar so they would become familiar with the bidding process of the auctions.

We follow the principles of good practice to perform sensory evaluation of food suggested by Lawless and Heymann (2010) when conducting the broccoli sensory evaluation experiment. We use the affective test method, the most widely used sensory test method in the food industry to determine

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[3] The experimental economics research lab was used to conduct the broccoli tasting experiment for this study. All students, staff, and alumni of the university, as well as local community members, can register/create an account to participate in research studies. These people constitute the lab's database. The lab has a fairly large participant pool, and researchers have used the lab to study a wide variety of economic and psychological phenomena, including behavioral anomalies in public goods, the efficiency of energy markets, charitable giving, the funding of commodity advertising, the causes of obesity, and the impacts of stigma. In our study, we exclude students from participating because they do not shop regularly for groceries. We did not screen for broccoli nonbuyers when recruiting participants. However, we did ask a question about participants' broccoli consumption frequency. Our data show that 58.2% of the participants consume broccoli at least once a week. These participants might still consume broccoli but less than once a week. This share is close to the broccoli purchasing behavior suggested by Anesbury et al. (2018), which shows that 49% of U.S. consumers buy broccoli at least once in 2 weeks. We include broccoli nonbuyers because they might be the potential buyers of local NYS-grown broccoli even if they are consuming broccoli less than once a week. Our data show that 81% of the participants are the primary grocery shopper in their households, whose food choice matters the most to the supply chain members of local broccoli.

consumer preference of products (Chambers and Wolf 1996). The affective test method asks untrained assessors to answer a set of questions to measure preference, liking, and impression of various sensory attributes (Kemp, Hollowood, and Hort 2011). At the beginning of the broccoli sensory evaluation experiment, subjects were verbally informed of the evaluation procedure. After that, lab assistants displayed one crown (approximately 1 pound) of each of the three broccoli varieties in a tray so that subjects could examine the appearance of the broccoli varieties closely. The three varieties were labeled broccoli "A," "B," and "C." After observation, subjects were guided to record their evaluation of the appearance of the broccoli varieties on a 9-point scale (from 1 to 9, with 9 being most favorable) on an information sheet provided on their table. After all subjects completed the appearance evaluation, the subjects were then guided to proceed to the tasting evaluation portion. Participants at each station were provided small parboiled samples of the three broccoli varieties. The labels on the container of the parboiled samples matched the labels of the broccoli crowns shown during the appearance evaluation portion. Palate cleansers (water and unsalted crackers) were provided to subjects to minimize taste bud fatigue and to remove flavor carryover from the previous sample. After the tasting evaluation, participants were also asked to provide their evaluations (on the same 9-point scale used in the appearance evaluation portion) of the taste of the broccoli varieties.

After observing the appearance and having tasted the three broccoli varieties, subjects were asked to place bids for 1 pound of each variety in the auction. Each subject submitted bids between $0.00 and $5.00 for 1 pound of each variety.[4] The BDM auction method was used to elicit maximum WTP for the broccoli varieties. Although subjects bid for all three varieties, they were informed that only one of the three auctions would result in an actual transaction. After bids for all auctions were submitted, one out of the three auctions was randomly chosen to be binding. In this case, the subjects who won their bids for the randomly selected auction would be "required" to purchase 1 pound of broccoli at the market price, which would be deducted from their participation endowment. After the auctions, subjects completed a computerized survey asking demographic and purchasing habit information, including gender, age, education, income, cooking frequency, broccoli consumption in their meals, and whether the subject was the primary shopper in the household (please see supplementary Appendix for the survey used in the experiments).

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[4] We capped the maximum bid at $5 per pound because the highest retail price of organic broccoli was $4.99 per pound for the year before the experiments were conducted (U.S. Department of Agriculture, Agricultural Marketing Service 2019). USDA does not report price data for local broccoli, and we assume that the price of local broccoli is lower than the price of organic broccoli.

Data and Empirical Model

We collected 240 observations from 80 nonstudent subjects in the broccoli tasting experiment sessions. Table 1 shows descriptive statistics of demographic information about experimental subjects based on responses to questions in the survey. We also compared the subjects from our experiments with the U.S. grocery shopper sample reported by the Food Marketing Institute (FMI). In summary, our sample is representative of the U.S. grocery shopper sample. The percentage of female subjects in our experiment (72.5%) is very close to that of the FMI sample (69.7%). Subjects (in our data) aged 25–34 are slightly less represented in our study than in the FMI sample, whereas subjects aged 35–49 are slightly more represented than in the FMI sample. This is because we excluded students from our study, so the age is biased upward. For the same reason, the percentage of subjects in the lowest income band is also smaller than that of the FMI sample. Regarding education, the percentage of subjects who received a bachelor's degree or more in our experiment (33.8%) is close to the FMI sample (33%). In regard to cooking frequency, 27.5% of subjects cook their meals 4–5 times a week, and 41.3% cook their meals more than 5 times a week. More than half of the subjects include broccoli in their meals at least once a week. On average, 81.25% of the subjects are the primary shopper in their households.

Table 2 provides subjects' average WTP and their evaluation scores of the appearance and taste of the three broccoli varieties, by locally grown information treatment. Forty-one subjects participated in the no information treatment sessions, and 39 subjects participated in the sessions with locally grown information. Subjects in the two treatments have similar demographic characteristics, and there are slightly more female and primary shopper participants in the "no information" treatment (see Table A1 in the Appendix). Table 2 shows that the average WTP for all 80 subjects is $1.60 per pound of broccoli, which is comparable to retail prices in local supermarkets. For the no information treatment, the average WTP is $1.53, which is slightly lower than the average WTP for the whole sample. When subjects are given the locally grown information, the mean WTP becomes $1.68, which is slightly higher than the average WTP for the whole sample. Subjects' evaluation scores of appearance and taste in the two treatments follow a similar pattern.

A simple comparison of the descriptive statistics among the three broccoli varieties within each treatment reveals intriguing information. For the no information treatment, subjects' average WTP for the California variety is $1.62, whereas their WTP for NYS 1 and NYS 2 are much lower, $1.44 and $1.52, respectively. Meanwhile, the average score of appearance for NYS 1 is 4.22, which is much lower than the score for the California variety (7.83). For NYS 2, the difference in the scores for both appearance and taste are modest relative to the California variety. The average score of appearance for NYS 2 is 6.59, which is 1.24 lower than the California variety, and the average score of taste for NYS 2 is 6.4, which is 0.28 lower than the California variety.

Table 1. Demographic Characteristics of Participants from the Broccoli Experiment Compared with Food Marketing Institute (FMI) Grocery Shopper Sample (Frequency: %)

	Data from Experiment	FMI Grocery Shopper Report[a]
Female	72.5	69.7
Age		
25–34	13.8	29.3
35–49	41.3	27.6
50–69	38.8	33.1
70 and older	6.3	10.1
Household income ($1,000)		
35 or less	(<30) 18.8	39.6
35–49.9	(30–50) 40	19.1
50–75	(50–70) 20	21.3
75 or more	(70+) 21.3	20.1
Education		
Bachelor's degree or more	33.8	33
Others	66.3	67
Cooking frequency		
Less than once a week	3.8	/
1–3 times a week	27.5	/
4–5 times a week	27.5	/
More than 5 times a week	41.3	/
Broccoli in meal		
Less than once a week	41.8	/
1–3 times a week	53.2	/
4–5 times a week	3.8	/
More than 5 times a week	1.3	/
Primary shopper in household	81.25	/
N/sample size	80	1,548

[a]FMI Grocery Shopper Trends Report 2013 (https://www.fmi.org/forms/store/ProductFormPublic/u-s-grocery-shopper-trends-2013-data-tables).

In contrast, the subjects' WTP and evaluations of appearance and taste are substantially different in the information treatment, in comparison with the no information treatment. First, both the WTP and the taste for the two NYS varieties become higher than for the California variety (recall they were lower for the no information treatment). Interestingly, appearance evaluations of the two NYS varieties in the information treatment (5.82 and 6.38) are lower than

Table 2. Summary Statistics for Willingness to Pay (WTP) and Score of Appearance and Taste

	Observations	WTP ($/lb.)	Appearance	Taste
Overall	240	1.6 (0.82)	6.47 (2.04)	6.76 (1.87)
No Information	123	1.53 (0.89)	6.21 (2.18)	6.39 (2.03)
California	41	1.62 (0.91)	7.83 (1.22)	6.68 (1.91)
NYS 1	41	1.44 (0.88)	4.22 (1.82)	6.10 (2.12)
NYS 2	41	1.52 (0.89)	6.59 (1.66)	6.4 (2.05)
Information	117	1.68 (0.74)	6.74 (1.85)	7.13 (1.62)
California	39	1.62 (0.73)	8.00 (1.17)	6.59 (1.55)
NYS 1	39	1.7 (0.75)	5.82 (1.55)	7.21 (1.76)
NYS 2	39	1.71 (0.75)	6.38 (2.01)	7.59 (1.39)

Notes: Standard deviation in parentheses. NYS, New York State.

for the California variety (8.00), which is similar to the no information treatment. In addition, although evaluations of the appearance and taste of NYS 2 (6.38 and 7.59) are both higher than those of NYS 1 (5.82 and 7.21), the WTP for them is practically the same ($1.70 and $1.71).

When comparing data between the two treatments (information and no information), the descriptive statistics suggest that subjects' WTP and evaluations of appearance and taste of the California variety are very close. For example, subjects' WTP values for the California variety in the two treatments are both $1.62, and their score of appearance is only slightly higher when given information of locally grown (8.00) compared with when they are not provided information (7.83). In contrast, WTP and evaluation of appearance and taste of the two NYS varieties are all markedly higher in the information treatment than in the no information treatment. The only exception is that the appearance evaluation score for NYS 2 in the information treatment (6.38) is slightly lower than that of the no information treatment (6.59).

To test whether subjects' WTP is affected by the provided locally grown information, we run two random effects models. We first run a simple generalized least squares (GLS) random effects model with and without demographic variables. We also run a Tobit model to account for the censored nature of the WTP data. The Tobit model has been widely used by

agricultural economists to study consumer WTP for attributes of food products (e.g., Bernard and Bernard 2009; Kanter, Messer, and Kaiser 2009). The latent value of individual i's WTP for variety j, denoted as WTP_{ij}^*, is expressed as a function of the variety V_j, the dummy variable I to indicate whether the subject receives locally grown information treatment, and the subjects' demographic characteristics X_i. Because individuals submitted bids for different broccoli varieties in the experiment, we employ a random effects Tobit model to account for the panel nature of the data. The parameter v_i is an individual-specific disturbance for subject i, and ε_{ij} is the error term that is assumed to follow a normal distribution with mean zero and standard deviation σ. In equation (1), we assume a linear functional form for the WTP equation. The relationship between the observed variable WTP_{ij} and the latent variable WTP_{ij}^* is shown in equation (2). If we assume the observed WTP_{ij} and the latent WTP_{ij}^*, to be the same, then equation (1) collapses to the GLS random effects model.

$$WTP_{ij}^* = \alpha + \beta_j V_j + \gamma I + \delta_j V_j I + \theta X_i + v_i + \varepsilon_{ij} \tag{1}$$

$$WTP_{ij} = \max\{0, \ WTP_{ij}^*\} \tag{2}$$

In the model specified previously, α is the WTP for 1 pound of the California variety when no information about the origin of the three types of broccoli are revealed; β_j captures the price premium that consumers are willing to pay for the NYS variety j (relative to the California variety) when the locally grown information is not provided; γ is the effect of locally grown information on consumer's WTP for the California variety; δ_j describes the interaction effects between varieties and information treatment, which captures the effect of locally grown information on the price premium that consumers are willing to pay for the NYS variety j (relative to the California variety); and θ is a vector of parameters of consumer characteristics.

It is also important to examine how subjects' perceptions of the quality (appearance and taste) of the three broccoli types are affected by the locally grown information provided. We employ the SUR model to take into account that a subject's evaluations of the appearance and the taste of the broccoli varieties might be correlated. The regression equations (equations 3 and 4) in the SUR model are similar to equation (1) with the exception that the subjects' evaluations of the appearance and taste of the three broccoli types are now the dependent variables. We use superscripts "A" and "T" to denote the parameters in the *Appearance* and the *Taste* equations, respectively. We assume that the error terms for different subjects are independently distributed. However, the two error terms ε_{ij}^A and ε_{ij}^T may be correlated for each subject i.

$$Appearance_{ij} = \alpha^A + \beta_j^A V_j + \gamma^A I + \delta_j^A V_j I + \theta^A X_i + v_i^A + \varepsilon_{ij}^A \tag{3}$$

$$Taste_{ij} = \alpha^T + \beta_j^T V_j + \gamma^T I + \delta_j^T V_j I + \theta^T X_i + v_i^T + \varepsilon_{ij}^T \tag{4}$$

Results and Discussion

In this section, we present the estimation results from the GLS and Tobit models specified previously, using the data collected in our experiments. Table 3 presents the estimated parameters from the GLS and Tobit random effects models in equations (1) and (2). Given that the results from the GLS model are very close to those from the Tobit model, from here on we only discuss the results from the Tobit model with demographic variables.

The estimated intercept in the first row of Table 3 is $1.994 per pound, which describes consumers' WTP for the California variety without information. The estimated WTP is comparable to the retail price of commercial Californian broccoli in grocery stores. The next two rows describe the premium consumers are willing to pay for the two NYS varieties (relative to the California variety) when no locally grown information is revealed. The results suggest that consumers are willing to pay $0.182 and $0.104 less per pound for the two NYS varieties relative to the California variety. These two estimates are not significant at 10% significant level. The next row shows the estimated difference in WTP for the California variety in the no information treatment and from the information treatment (i.e., the group received locally grown information). The estimated coefficients for the interaction terms for the two NYS varieties are $0.259 and $0.199 per pound, respectively, and both are statistically significant at the 10% level. These are the price premiums consumers are willing to pay when they are told the two NYS varieties are NYS grown. The last seven rows show the impacts of demographic variables and purchasing habit on consumers' WTP for the broccoli varieties included in our experiment. None of the estimated coefficients for the demographic variables is significant, which means that consumers' WTP is not affected by their socioeconomic or demographic characteristics.

We show the effect of locally grown information on consumers' perceptions of appearance and taste of the three broccoli types in Table 4. To better summarize the relationship between the effects of locally grown information on appearance and taste, and WTP, we also include WTP results from the Tobit random effects model (demographic information included) in Table 4.

The estimated intercept with for the 'appearance' equation is 7.814. This means that the average consumer (i.e., male, mean age, mean education, mean income, mean cooking frequency, mean broccoli in meal, and nonprimary shopper) in the no information sessions gives the California variety an average score of 7.814. The two estimated coefficients under the subheading *Variety* (NYS 1 and NYS 2) are -3.846 and -1.256, respectively. This suggests that consumers in the no information treatment rate the appearance of the two NYS varieties lower than the California variety by simply observing the appearance of the three broccoli types. The estimated coefficient of *Information* is not statistically significant, indicating that consumers in the no information treatment and the information treatment give the same score for the appearance of the California variety. The

Table 3. Willingness to Pay Estimates Using Generalized Least Squares (GLS) and Tobit Random Effects Models

Explanatory Variables	GLS Model		Tobit Model	
Intercept	1.621***	1.997***	1.610***	1.994***
	(0.000)	(0.000)	(0.000)	(0.000)
Variety				
NYS 1	−0.181	−0.185	−0.180	−0.182
	(0.100)	(0.105)	(0.105)	(0.110)
NYS 2	−0.098	−0.100	−0.103	−0.104
	(0.188)	(0.195)	(0.179)	(0.149)
Information	−0.001	−0.071	0.010	−0.071
	(0.997)	(0.681)	(0.956)	(0.688)
Interaction terms				
Information × NYS 1	0.258*	0.263*	0.257**	0.259*
	(0.050)	(0.054)	(0.043)	(0.058)
Information × NYS 2	0.193*	0.195*	0.198*	0.199*
	(0.088)	(0.093)	(0.079)	(0.072)
Demographic				
Gender		0.104		0.105
		(0.586)		(0.604)
Age		0.030		0.030
		(0.305)		(0.382)
Education		−0.067		−0.066
		(0.294)		(0.324)
Income		0.041		0.041
		(0.467)		(0.476)
Cooking frequency		−0.043		−0.045
		(0.755)		(0.762)
Broccoli in meal		−0.115		−0.113
		(0.400)		(0.451)
Primary shopper		−0.042		−0.042
		(0.877)		(0.886)

Notes: The p values are in parentheses (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$). NYS, New York State.

estimated coefficient for the interaction term *Information × NYS 1* is 1.667. That is, when consumers are told this variety is grown in NYS, their appearance score for this variety is higher by 1.667 points than the California variety. We do not find the same effect for NYS 2 (the coefficient is not statistically significant). One possible reason is that this variety was bred to have a similar appearance to the California variety. Consumers already give a high score for the appearance of this variety, and consequently, telling them that it is grown in NYS does not change their perception of appearance. Variety NYS 1, on the other hand,

Table 4. Comparison of the Effect of Locally Grown Information on Willingness to Pay (WTP), Appearance, and Taste

Explanatory Variables	WTP	Appearance	Taste
Intercept	1.994***	7.814***	6.829***
	(0.000)	(0.000)	(0.000)
Variety			
NYS 1	−0.182	−3.846***	−0.590
	(0.110)	(0.000)	(0.132)
NYS 2	−0.104	−1.256***	−0.282
	(0.149)	(0.000)	(0.471)
Information	−0.071	0.147	0.028
	(0.688)	(0.683)	(0.944)
Interaction terms			
Information × NYS 1	0.259*	1.667***	1.205**
	(0.058)	(0.001)	(0.030)
Information × NYS 2	0.199*	−0.359	1.282**
	(0.072)	(0.476)	(0.021)
Demographic			
Gender	0.105	0.438*	0.808***
	(0.604)	(0.080)	(0.003)
Age	0.030	−0.005	−0.349
	(0.382)	(0.918)	(0.500)
Education	−0.066	0.010	−0.017
	(0.324)	(0.901)	(0.846)
Income	0.041	0.047	0.148***
	(0.476)	(0.364)	(0.010)
Cooking frequency	−0.045	−0.230*	−0.313**
	(0.762)	(0.062)	(0.021)
Broccoli in meal	−0.113	0.274	0.315*
	(0.451)	(0.113)	(0.097)
Primary shopper	−0.042	−0.320	−0.845***
	(0.886)	(0.256)	(0.007)

Notes: The p values are in parentheses (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$). NYS, New York State.

looks quite different (light-green color and no uniform dome like the California variety). Thus, when consumers are told that this variety is NYS grown, they are more forgiving of the fact that it looks quite different from the commercial broccoli typically found in supermarkets. Our results show that female subjects tend to rate the appearance of the broccoli 0.438 higher than male subjects. In addition, results suggest that the more often the subject cooks meals in the households, the more likely he/she rates the appearance of the broccoli lower (by 0.230 points).

Table 4 also presents the results of the factors influencing attribute taste scores. The results are substantially different from that for the attribute appearance. Subjects in the no information treatment give the California variety an average score of 6.829 in taste. The estimated coefficients of *NYS 1* and *NYS 2* are not statistically significant. This means that subjects in the no information treatment rate the taste of the two NYS varieties the same as the California variety. Similar to the results of appearance, the estimated coefficient of *Information* is not statistically significant, indicating that consumers in both no information and information treatments give the same score for the taste of the three varieties. The estimated coefficients for the two interaction terms (*Information* × *NYS 1* and *Information* × *NYS 2*) are both statistically significant at the 5% level. This suggests that, when told the two NYS varieties are grown in NYS, consumers rate the taste of these varieties higher by 1.205 and 1.282, respectively, in comparison with the California variety. Similar to the results for the appearance attribute, female subjects tend to rate broccoli's taste higher than male subjects. Income and broccoli in meal also have a positive impact on the subject's taste evaluation. The more often the subject cooks, the lower this subject rates the taste of broccoli. Finally, primary shoppers tend to rate the taste of broccoli 0.845 lower than nonprimary shoppers.

When comparing the results in Table 4, we find that the impact of locally grown information on consumers' perception of product appearance and taste are related to the impact on the price premium they are willing to pay. In particular, for variety NYS 1, subjects' evaluations of appearance and taste are higher when locally grown information is provided. At the same time, subjects are willing to pay a price premium of $0.259 for this variety when locally grown information is provided. Considering the variety NYS 2, results suggest that only consumers' evaluation of taste is higher when locally grown information is provided. This increase in taste scores is consistent with the price premium of $0.199 that consumers are willing to pay for this variety. Taken together, these results indicate that although the impact of the locally grown information on WTP for NYS 1 is larger than for NYS 2, this does not necessarily mean consumers are willing to pay less for the latter: Table 2 shows that consumers have almost the same WTP for the two NYS varieties in the information treatment.

Conclusion

Consumers place value on local foods for both social and product quality reasons. However, little research has been conducted examining the effects of locally grown information on consumer WTP and quality perceptions, which is important for vegetable marketing strategies. In this article, we designed an economic experiment to examine consumer WTP and quality perception (i.e., product appearance and taste) of three broccoli varieties, one commercial variety from California and two new NYS-grown varieties that

are undergoing field trials before being launched to market. In the experiment, we assessed how consumers' WTP for and perception of product quality are affected by the provided locally grown information.

Experimental data on consumers' WTP and evaluation of the appearance and the taste of the three broccoli varieties, demographic information, and purchasing habits were collected from nonstudent subjects. In our analysis, we used a Tobit model to account for the censored nature of the WTP data. Our results show that when no locally grown information is provided, consumers are willing to pay more for the California variety relative to the two NYS varieties. Consumers also rate both the appearance and the taste of the California variety higher than the two NYS varieties when no locally grown information is provided. However, when consumers are told that the two NYS varieties are locally grown, their perception of both the appearance and the taste of the two NYS varieties (relative to the California variety) increases, and their WTP for the two NYS varieties also increases. The impact of locally grown information on the price premium consumers are willing to pay for the two NYS varieties (relative to the California variety) are $0.259 and $0.199 per pound. These results indicate that although consumers may still prefer the California broccoli variety, they are willing to pay a price premium when the two new broccoli varieties are promoted as locally grown.

These findings have two important policy implications. First, our results show that consumer perception of broccoli quality is affected by locally grown information. Even if the quality of the NYS-grown broccoli varieties is rated lower than the quality of the California variety, consumers appear to be more forgiving when they are promoted as locally grown. As the quality perception of the local broccoli increases, consumer WTP for these varieties increases as a result. Second, the positive price premium shows that New York broccoli can benefit from the increased interest in local foods. Broccoli producers and channel members can use the estimated price premium from our article as a reference when making their growing, pricing, or promotion decisions.

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Conflict of interest

None.

Supplementary material

The supplementary material for this article can be found at https://doi.org/10.1017/age.2019.21

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