

EFFECT ON CONSUMERS' WILLINGNESS TO PAY ON "LOCAL"  
INFORMATION FOR STRAWBERRIES

A Thesis

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## ABSTRACT

This paper conducts an economic experiment to analyze the effect of “locally grown” information on consumers’ willingness to pay (WTP) and perception of quality for three types of strawberries (one California grown and two New York State grown). We use a Becker-DeGroot-Marschak (BDM) auction to elicit consumers’ WTP and use preference rating to examine their quality perception. The results show that consumers are willing to pay a price premium when they know the strawberries are “locally grown” (NYS grown) even when NYS grown strawberries are not rated as highly based solely on their look or taste without the local information. The motivation of this study is to examine whether regional local produce can compete with those from a single region which dominates nation production, providing insights for members in the food supply chain.

## BIOGRAPHICAL SKETCH

Zhe Fu has studied Food Science and Technology at UC Davis, where she realized it is not enough to achieve her goal which is to help more people access to nutritious and safe food all over the world. Policies from management level that prevent accidents and incidents from happening, and knowledge on consumers' behavior to understand what they are thinking are needed to make a bigger impact. She minored at Managerial Economics to further understating the whole food supply chain, but it is still not enough. At Cornell, she has studied consumers' behavior more in depth, and did a research on consumers preference. This gives her opportunity to better understand the food supply chain.

感谢我的家里人对我无条件的支持  
特别是我的大姨  
没有她超前的视野，也没有我的今天的成就

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## TABLE OF CONTENTS

Biographical Sketch.....	iii
Dedication.....	iv
Acknowledgements.....	v
Introduction.....	1
Increasing Popularity of Local Food.....	1
Strawberry Types and Seasonality.....	2
Methods and Objectives.....	3
Literature Review.....	4
Local Food Definition.....	4
WTP Study Methods in Agricultural Commodity.....	5
Hypothetical Approach - Contingent Valuation.....	5
Hypothetical Approach - Choice Experiment.....	5
Experimental Approach - Second-price Auction.....	6
Experimental Approach - BDM Auction.....	6
Methodology.....	9
Sample.....	9
Strawberry Description.....	9
Survey and Experiment Design.....	10
Econometric Approach.....	12
Estimate WTP Using Tobit Model.....	12
Marginal / Partial Effects.....	15
Seemingly Unrelated Regression Model for Ratings.....	16
Data and Results.....	16
Demographic Information & Summary Statistics.....	17
Average WTP.....	19
Average Ratings.....	20
Estimates of WTP Based on Appearance.....	20
Estimates of WTP Based on Taste.....	22
Estimates of Perceived Quality.....	25
Conclusion.....	29

## **Introduction**

### Increasing Popularity of Local Food

Local food has become increasingly popular in the United States in recent years (Martinez 2010). Consumers want to purchase local food as they perceive that purchasing local food helps local farms, stimulate the local economy, and contribute to lower carbon emissions (King 2010). Moreover, consumers associate local food with freshness because they are consumed in a shorter time after being picked compared to non-local food (Li, Zepeda, and Gould, n.d.; Edwards-Jones 2010). Supermarkets, both large and small, are increasingly using “locally grown” as a marketing strategy to satisfy consumers’ desires. Walmart made a commitment to its consumers in 2014 that it would purchase 20% of fresh fruits and vegetables from local sources (Kumar and Smith 2017). Similarly, Wegmans claims that 30% of produce it sells are locally grown (Greibitus, Printezis, and Printezis 2017).

There is much literature that discusses consumers’ preference and WTP for local food products globally. Researchers find that consumers from a specific farmers market in New Zealand are unwilling to pay more for non-local produce through a survey, and they also conclude that consumers’ premium in WTP for local products is positively associated with age and income (Berg and Preston 2017). Fan, Gómez, and Coles (2019) study consumers’ WTP and quality perceptions of three broccoli varieties and they find consumers are willing to pay a price premium for local broccoli when they are told that the the product is locally grown. Moreover, the local attribute also positively affects consumers’ quality perception of local foods. Onken,



Bernard, and Pesek (2011) study consumers' WTP and preference through a choice experiment for strawberry preserves that are either local, state marketing program promoted, or non-local in the Mid-Atlantic region in the U.S. They find that consumer preferences for local food extend to value added products. Shi, House and Gao (2011) study consumer WTP for blueberry attributes (freshness, organic, price, local), and find that consumers value local attributes more than organic attributes. Studying WTP and perception of quality on local food, especially fresh produce, can provide insights for policy makers and other members in the food supply chain to create better policies and marketing strategies to increase the market share of local food.

#### Strawberry Types and Seasonality

According to the Agricultural Marketing Resource Center (n.d.), per person consumption of strawberries in the United States has increased over the past two decades. The per capita consumption of strawberries increased from 4.86 pounds in 2000 to 6.8 pounds in 2019 (Shahbandeh 2021b). From a survey conducted in 2020, strawberries are the most consumed fruits in the United States other than bananas and apples (Shahbandeh 2021a).

Strawberry varieties have been commonly classified into three: June-bearers, ever-bearers, and day-neutral types based on their photoperiodic responses (Bradford, Hancock, and Warner 2010). June-bearing strawberry varieties normally produce the largest strawberries which makes this type very popular among consumers. Therefore, June-bearing strawberry varieties is a major item in any list of strawberry varieties (Strawberry Plants Organization 2021) June-bearing varieties form flower buds as days are getting shorter (typically the fall) and produce fruit mid to late June (Darrow 1936). Everbearing varieties form flower buds when days get longer (Darrow and

Waldo 1934). They begin producing fruit at the same time as June-bearing varieties but continue as long as the temperature is warm enough. Day-neutral variety's flower bud production is independent of daylight (Bringhurst et al. 1978).

Strawberries are one of many typical crops grown in California, and California produced over 91% of the entire United States strawberry crop (Agricultural Marketing Resource Center, n.d.). For strawberries grown in California, according to Pick Your Own Organization (n.d.) the harvest season is from January through August. By comparison, in the Northeastern United States where June-bearing varieties dominate, strawberries produce fruit for only 3-4 weeks beginning in mid to late June.

Ongoing research focuses on extending the strawberry season through everbearing varieties and modified growing environments in regions that do not support long growing seasons (Igarashi et al. 1994; Okimura and Igarashi 1997; Cantliffe, Castellanos, and Paranjpe 2007; Durner 1999; Kroggel and Kubota 2017, Gude et al. 2018; Gu, Guan, and Beck 2017; Neri et al. 2012).

Controlled-environment agriculture has the potential to extend the strawberry season in areas such as New York State and the Northeast and can potentially increase annual yields (Beacham, Vickers, and Monaghan 2019). Beacham and others claim that maintaining controlled growing conditions year-around can potentially increase the yield of short-period crops due to additional harvest window, but this is an emerging industry and there is not much academic data currently available.

## Methods and Objectives

In this study, we use an economic experiment to collect data, and then quantify perceived quality and WTP of different strawberries. The experiment asks subjects to rate three strawberries on a 1-9 scale based on their observation and taste. The three strawberries used are: *California*, *NYS Open Field* and *NYS Hydroponic*. An experimental auction to elicit consumers' willingness to pay for one pound of each type of strawberries based on their appearance and taste is then conducted. To understand consumer preferences from the data collected in the experiment, we use a Seemingly Unrelated Regression Model to analyze the preference ratings and a Tobit Model to analyze the WTP.

The aim of this study is to examine the effect of “locally grown” information on consumers’ WTP and quality perception of strawberries and provide the first understanding of consumer preference for strawberries grown using controlled-environment agriculture (hydroponic). While this study focuses on strawberries, this study is an example of consumer preference for a locally grown product compared to the same product from a region that dominates the national production and the potential influence of local information. Using information on consumer preferences can help retailers, farmers, and policy makers design appropriate strategies to support local food systems. With emerging controlled-environment methods to extend the strawberry season, this study provides the first measure of consumers' preferences for this type of strawberry.

## **Literature Review**

### **Local Food Definition**

There are various definitions of “local food”, but there is no consensus in the literature.

According to the National Agricultural Law Center, “local food” often refers to food deriving from within the same geographic region to where it is consumed. However, different parties such as local markets, consumers, companies and organizations understand geographic distance in different ways (Martinez 2010). Since the experiment is conducted in New York state, NYS grown are classified as “locally grown” strawberries.

### WTP Study Methods in Agricultural Commodity

There are several common ways to conduct experiments to gather willingness to pay for data to be used for econometric analysis, and we categorize them into two groups: hypothetical approaches and experimental approaches.

#### 1. Hypothetical Approaches - Contingent Valuation

Contingent valuation is one of the hypothetical methods to estimate willingness to pay in the absence of a real purchasing situation, providing a direct estimation of WTP through elicitation techniques (Boccaletti and Moro, 2000). Consumers have to answer how much money they would be willing to pay or answer if they would be willing to pay a price premium for a specific product in this approach (Carmona-Torres and Calatrava-Requena 2006). For instance, Rodríguez used a contingent valuation method to study the willingness to pay for organic products in Argentina, where consumers choose if they would pay a price premium for each selected organic product (Rodriguez, Lacaze, and Lupin 2008).

#### 2. Hypothetical Approaches - Choice Experiments

Choice experiments have been widely used to value consumer preferences for food product attributes (Bitzios 2011). In a choice experiment, subjects are given a hypothetical setting and asked to choose their preferred alternative among several alternatives in a set of choices, and they are often asked to perform a sequence of such choices (Alpizar, Carlsson, and Martinsson 2001). Loureiro and Umberger (2004) use choice experiments to study US consumers' relative preferences and willingness-to-pay for various attributes in labeled ribeye beef steaks. Darby and others (2006) use a choice experiment in the study of estimating the willingness to pay for fresh strawberries in Ohio, where they conduct 530 face-to-face interviews at 17 midwestern locations. Through the data collected from the interview, Darby (2006) finds that the demand for local foods does exist and this demand is independent of other attributes that are often associated with locally produced food such as freshness.

### 3. Experimental Approaches - Second-price Auction

However, there are concerns that using a hypothetical approach such as contingent valuation does not get the true WTP of consumers because subjects tend to overestimate the real WTP in hypothetical situations (Blumenschein et al. 1998). Recent studies use experimental approaches more often (Cagalj, Haas, and Morawetz 2016; Hellyer, Fraser, and Haddock-Fraser 2012). In second-price auctions, bids are kept private and the highest bidder wins the product but pays at the price of the second highest bid (Vickrey 1961). Second-price auction is used in some studies to estimate the WTP of consumers for food products. (Elbakidze, Nayga, and Li 2013; Higgins, Hutchinson, and Longo 2020).

### 4. Experimental Approach - Becker–DeGroot–Marschak (BDM) Auction

The BDM auction is another common experimental approach to measure WTP. In BDM auctions, each individual generates a bid. The bid is compared to a randomly generated price. If an individual's bid is higher than the random price, he/she buys the item at that price. If an individual's bid is lower than the random price, he/she does not buy the item and pays nothing. BDM auction is used in Italy and Spain to estimate the WTP of consumers for sulfites-free label wines, and paper surveys are given to consumers in the wine market (Amato et al. 2017).

Since the product (strawberry) is available, experimental auctions are preferred as those methods are theoretically incentive compatible (Van Loo et al. 2011). In this study, we choose to use BDM auctions to study the effect of locally grown information by eliciting consumers' true WTP of three types of strawberry. A BDM auction is an incentive-compatible type of auction (Becker, Degroot, and Marschak 1964), and it can directly elicit the WTP at the point of purchase during the experiment, enhancing external validity (McDaniel and Gates 2001). Moreover, BDM auction provides stronger incentives for truthful bidding than second-price auction when researchers are interested in the WTP of low-value ("off-margin") individuals (Lusk 2004). In our case, all subjects are low-value bidders.

There are many articles studying the effect of local information on the WTP for produce and consumers' quality perception. Grebitus et al. (2013) conduct an experiment on how consumers' WTP varies with the distance apples and wine traveled by using second-price auction in Germany, and he concludes that average WTP is falling in distance traveled. Fan, Gómez, and Coles (2019) study the WTP and perception of broccoli, which is closely related to our study, and they find out that consumers are willing to pay a price premium for locally-grown varieties.

However, Xu, Loke, and Leung (2015) study the WTP on local lettuce in Honolulu, and consumers are not willing to pay price premium for local lettuce.

We use the broccoli study by Fan, Gómez, and Coles's (2019) as a reference on survey design, Tobit and seemingly unrelated regression (SUR) model designs and analysis of estimates of quality perception and WTP. They collect data from an economic experiment conducted in New York State on three types of broccolis (one commercial variety from California and two grown in NYS) that consists of two parts as well, asking consumers' ratings on appearance and taste and consumers' willingness to pay for one pound of broccoli. Fan, Gómez, and Coles's (2019) analyzed the rating data using SUR model and the WTP using Tobit model. The results show that consumers evaluate two local varieties lower than California one but their evaluations of two local varieties improve significantly after being told they are locally grown. Moreover, consumers are willing to pay a price premium for the two local broccolis after they are told they are locally grown.

Results from a study from Onken, Bernard, and Pesek (2011) shows that consumers preference for local food extends from produce to value added products, such as strawberry jam. They conduct large-scale mail surveys, a hypothetical method, in Mid-Atlantic states, asking what hypothetical strawberry preserves with various attributes of local and non-local they will choose to buy. The study shows that people living in the area are willing to pay a high price premium for value-added products identified as local products, especially in farmers markets. This study provides evidence that there is a consistent trend between the food product in its raw and a value-added product. Consumers prefer local food both raw and value added.

## Methodology

### Sample

This study recruits non-undergraduate consumers in the Ithaca area, New York, to conduct an economic experiment on the effect of local information on the perception of strawberries and WTP. These experiments are conducted in the Lab for Experimental Economics & Decision Research (LEEDR) at Cornell University. Subjects were recruited from the Cornell LEEDR Lab email list who are not undergraduates and are 22 years old or over.

### Strawberry Description

There are three types of strawberries used in the experiment. The first strawberry used in the experiment (*California*) is an unknown type grown in an open field in California. The second strawberry used in the experiment (*NYS Open Field*) is a June-bearing strawberry grown in an open field in New York State. The third strawberry used in the experiment (*NYS Hydroponic*) is an everbearing strawberry grown in a controlled environment in New York State. Figure 1 shows examples of these strawberries used in the experiments. *California* and *NYS Open Field* strawberries have similar appearances. They are uniform in size and have a bright red color. *NYS Hydroponic* strawberries have smaller size, and a less consistent appearance than the other types. Experiments were conducted in early July 2019, which is considered the end of New York's strawberry peak season. *California* strawberries were bought from a grocery store, and *NYS Open Field* and *NYS Hydroponic* were purchased directly from farms. All three types were stored in the same fridge before the experiment. Since the experiments were conducted in New



York State, we define *NYS Open Field* and *NYS Hydroponic*, New York State grown strawberries as “local”. Subjects in the treatment group are not told any additional information about the growing method or other unique attributes.



*California*



*NYS Open Field*



*NYS Hydroponic*

Figure1. Images of three types of strawberries used in the experiments.

### Survey and Experiment Design

The survey was conducted through Qualtrics, and there were 5 parts of the questionnaire. All subjects were compensated with a \$20 value including the possible purchase of strawberries. They were given \$20 as compensation in total, and they automatically got \$5 for showing up and would use \$15 to purchase the strawberries.

After subjects read and signed the consent form, they were given a brief introduction on the background of the experiment. The first section was a practice round so participants understand how the BDM auction works. They selected the number of pennies to use to purchase a one dollar bill. The second section was a second practice exercise with a box of crackers to get subjects familiar with the BDM auction used throughout the experiment. They were asked to provide a 1-9 rating and price they would pay based on appearance. This was a replica of

strawberry questions that subjects were about to answer next. Any questions about the process were answered so participants fully understood the questions during the questions relating to strawberries.

In the third section, subjects observed three types of strawberries, and first rated each of the strawberries based on the appearances on a 1-9 scale, with 1 being the worst looking and 9 being the best looking. Then they were asked to put a value from \$0~\$15 of what they would pay for one pound of each berry. The order of berries was randomized in each session. In the fourth section of the survey, subjects tasted all three types of berries, and evaluated ratings of the strawberries based on both appearance and taste on a 0~9 scale. Then they evaluated how much they would pay for one pound of each berry in the range of \$0~\$15, and answered the price in the survey. The last section was a demographic survey asking about themselves and their personal shopping habits.

Instructions were given throughout the whole experiment, and the subjects were also told that once they rated a berry they could not go back and change their response. They waited for everyone in their session to finish a section before entering the next part of the experiment. One pound of each variety of strawberry was demonstrated on the front desk in the lab. Three strawberries, labeled A, B and C, were put in a plate for the subjects to observe and taste in front of their individual desks. Palate cleansers of water and plain crackers were provided.

There were a total of 163 subjects in 9 separate sessions. Subjects in 5 sessions were told the local information of all the three types of strawberries, and we referred to them as the treatment

group. Subjects in the other 4 sessions were not told local information, who were the control group. By having these two groups, we were able to calculate the premium associated with knowing the local information.

Compensation was determined by one of the prices participants list as how much they would be willing to pay for the strawberries. One of the six values for their willingness to pay (three based on appearance and three based on taste) from the experiment was randomly selected to determine compensation. By randomly selecting a round to determine if participants purchased a pound of strawberries, participants would treat each rating as a possible real purchase. The subject purchased the strawberry if their entered price for the randomly selected round was equal to or higher than a randomly generated market price. If they did purchase the strawberries, they would be compensated with one pound of strawberries and cash equal to \$20 minus the randomly generated market price. If their price or that round was lower than the market price, they did not buy the strawberry, and they would be compensated with \$20 cash.

## **Econometric Approach**

### Estimate WTP Using Tobit Model

To test whether the locally grown information would affect the WTP of consumers, we use a random effect Tobit model. According to Fan, Gómez and Coles (2019), the Tobit model is commonly used in agricultural economics to study consumers' WTP for attributes of food products. A random effects model is used because we have panel data, given that multiple WTP are retrieved from the same individual in the experiment. The Tobit model is used to

accommodate the left censored WTP data, where the lower range is \$0. Subjects are given \$20 in total for compensation, and they get \$5 for showing up, \$15 to spend on real purchasing of strawberries in experiment. The maximum consumers are willing to pay for all experiments is \$10, which is lower than the upper boundary, \$15. Because of this we do not employ an upper bound during the analysis. The minimum price subjects could put is \$0, and we assume consumers pay \$0 even if they do not want to buy strawberries. During the experiment participants were not allowed to enter a willingness to pay value which was negative. As the dependent variables are left censored, we use the Tobit model. Table 1 shows the number of zeros in the auctions when doing WTP for strawberries based on appearance and taste. There are big clusters of zeros in WTP based on taste, so using the Tobit Model is the most appropriate choice to accommodate the data.

**Table 1. Number of zeros subjects put for WTP based on appearance and taste for strawberries.**

WTP_Appearance			WTP_Taste		
# of zero		Percentage (%)	# of zero		Percentage (%)
Total			Total		
<i>California</i>	7	4.29	<i>California</i>	71	43.56
<i>NYS Open Field</i>	5	3.07	<i>NYS Open Field</i>	10	6.13
<i>NYS Hydroponic</i>	12	7.36	<i>NYS Hydroponic</i>	42	25.77
Information			Information		
<i>California</i>	5	5.49	<i>California</i>	50	54.95
<i>NYS Open Field</i>	3	3.30	<i>NYS Open Field</i>	7	7.69
<i>NYS Hydroponic</i>	7	7.69	<i>NYS Hydroponic</i>	29	31.87
No Information			No Information		
<i>California</i>	2	2.78	<i>California</i>	21	29.17
<i>NYS Open Field</i>	2	2.78	<i>NYS Open Field</i>	3	4.17
<i>NYS Hydroponic</i>	5	6.94	<i>NYS Hydroponic</i>	13	18.06

The individual's latent WTP and observed WTP based on appearance is defined as:

$$Lookprice_{ij}^* = \alpha^{LP} + \beta_j^{LP} V_j + \gamma^{LP} T + \delta_j^{LP} V_j T + \theta^{LP} C_i + v_i^{LP} + \varepsilon_{ij}^{LP} \quad (1)$$

$$Lookprice_{ij} = \max \{0, lookprice_{ij}^*\} \quad (2)$$

$Lookprice_{ij}^*$  = latent/unobserved WTP for one pound of the strawberry without boundary based on look

$Lookprice_{ij}$  = observed WTP for one pound of the strawberry variety based on look

Similarly, the individual's latent WTP and observed WTP based on taste is defined as:

$$Tasteprice_{ij}^* = \alpha^{TP} + \beta_j^{TP} V_j + \gamma^{TP} T + \delta_j^{TP} V_j T + \theta^{TP} C_i + v_i^{TP} + \varepsilon_{ij}^{TP} \quad (3)$$

$$Tasteprice_{ij} = \max \{0, tasteprice_{ij}^*\} \quad (4)$$

$Tasteprice_{ij}^*$  = latent unobserved WTP for one pound of the strawberry without boundary based on taste

$Tasteprice_{ij}$  = observed WTP for one pound of the strawberry variety based on both taste

V= variety of the strawberry

T= dummy variable indicates whether subjects get information treatment

C=individual characteristics

v=individual disturbance

$\varepsilon$ =error term of individual  $i$  on variety  $j$

In equations (1) and (3),  $\alpha$  is the average price the subjects are willing to pay for the one pound of *California* without the information.  $\beta$  captures the price premium that consumers are willing to pay more for the NYS varieties compared to *California* without the information treatment. Treatment is the dummy variable, 1 means information is given and 0 means no information is given.  $\gamma$  tells the effect of the local information on all of the strawberries. The parameter  $\delta$  captures the interaction between the variety and treatment, and it tells the joint effect of information treatment and NYS grown strawberries on consumers' WTP. The vector of parameters  $\theta$  represents the impact of subject's characteristics characteristic, and  $C$  includes each individual's demographic information: gender, age, education, income, number of people in the household and whether they are primary shoppers or not.

### Marginal/ Partial Effects

For the Tobit Model we use above, which is a left-censored regression model, only includes WTP greater than 0, and anything under than 0 is considered as value 0. We are interested in learning how the expected value of the latent/unobserved dependent variable varies with the explanatory variables. In other words, we are interested in how the willingness to pay without the \$0-\$15 limit varies with variety type, information treatment, interaction between variety type and information, and individual characteristics. As a result, we use marginal effects to measure the effect of a unit change on exploratory variables on the dependent variable which is willingness to pay.

For marginal effects, WTP is uncensored and it includes negative values as well. The uncensored WTP values are the actual dollar amount consumers are willing to pay without the limit set in the experiment. The coefficient from marginal effect is the effect of each variable on overall WTP without the \$0-\$15 limit (Susmel 2021). The marginal effects are more useful when evaluating consumers' willingness to pay outside this experiment and in the real world.

### Seemingly Unrelated Regression Model for Ratings

We used a Seemingly Unrelated Regression (SUR) to estimate the coefficients in equation (5) and (6), examining the change of the attitude towards appearance and taste of various varieties after knowing the locally grown information. Subjects observe the strawberries and then taste them, and we choose the SUR model to accommodate that an individual's evaluations of the appearance and the taste of the strawberries varieties may be correlated (Fan, Gómez, and Coles 2019). The regression equations are very similar to the WTP equations, and  $L$  denotes attributes in look or appearance;  $t$  denotes attributes in taste.

$$Look_{ij} = \alpha^L + \beta_j^L V_j + \gamma^L T + \delta_j^L V_j T + \theta^L C_i + v_i^L + \varepsilon_{ij}^L \quad (5)$$

$$Taste_{ij} = \alpha^t + \beta_j^t V_j + \gamma^t T + \delta_j^t V_j T + \theta^t C_i + v_i^t + \varepsilon_{ij}^t \quad (6)$$

The two error terms  $\varepsilon_{ij}^L$ ,  $\varepsilon_{ij}^t$  are independently distributed but may be correlated across each individual because an individual looked and tasted the same set of strawberry samples.

### **Data and Results**

### Demographic Information & Summary Statistics

Table 2 shows the demographic information and shopping habits of subjects. There are 163 subjects participating in this study after validation, and the sample size is 489 because each individual rated three types of strawberries. 76.07% participants are female, and 70.55% of all subjects have received at least a bachelor's degree. Most of the subjects have an income range above \$50,000 with an average income of \$50,000-\$75,000 range. The median income in New York State, where the experiment occurs, in 2019 was \$72,108 (United States Census Bureau 2019). This income range matches the NYS income in general. The ages of subjects are distributed normally with an average age of 41.72 years old. New York has a median age of 39.2 years old, which is close to our data. We exclude undergraduate students from the recruitment to make a sample that better represents the NYS population. 71.17% of the subjects identify as white. 82.82% claim that they are the primary shoppers of the household.

**Table 2: Demographic information and shopping habits of individual subjects from economic experiments.**



<b>Variables</b>	<b>Percentage</b>	<b>s.d.</b>
<b>Gender</b>		
Male	23.93%	0.43
Female	76.07%	0.43
<b>Education</b>		
At least Bachelor's degree	70.55%	0.46
Others	29.45%	0.46
<b>Income</b>		
< \$35,000	12.27%	0.33
\$35,000~\$50,000	9.82%	0.30
\$50,000~\$100,000	47.85%	0.50
> \$100,000	30.06%	0.46
<b>Age</b>		
<20	1.84%	0.13
20~29	24.54%	0.43
30~39	23.31%	0.42
40~49	15.34%	0.36
50~59	23.31%	0.42
60~69	9.82%	0.30
70~79	1.23%	0.11
<b>Ethnicity</b>		
White	71.17%	0.45
Non-white	28.83%	0.45
<b>Household number</b>	2.44 (Average)	0.05 (se)
<b>Primary shopper</b>	82.82%	0.38
<b>Purchasing local frequency</b>		
Half of the time or less	71.78%	0.45
More than half of the time	28.22%	0.45
<b>Purchasing strawberry frequency</b>		
At least weekly	24.54%	0.43
When in season	43.56%	0.50
Once a month or less	31.90%	0.47
<b>N/Sample Size</b>	489	N/A

Some behavioral questions related to strawberry purchasing are also asked. 28.22% of the participants purchase “locally grown” food more than half of the time. 43.56% of the subjects buy strawberries when they are in season, and 24.54% of the people buy strawberries at least weekly.

#### Average WTP

Table 3 shows the average stated price the subject is willing to pay for one pound of strawberries and the ratings based on appearance and taste evaluations. The average willingness to pay for all three types of berries based on appearance is \$2.62, which is higher than the average WTP based on taste, \$1.92. This means that on average, consumers are willing to pay less after tasting all the strawberries. Both with information and without information sessions have the same trends, too.

Based on appearance, consumers are willing to pay more for *NYS Hydroponic* after they know the local information compared to before they receive the local information, increasing from \$2.34 to \$2.51. Based on taste, subjects are willing to pay more for *NYS Hydroponic* than *California* after they receive the local information.

**Table 3: Summary statistics of WTP based on appearance and taste, ratings based on appearance and taste.**

	Observations	WTP_Appearance	WTP_Taste	Rating_Appearance	Rating_Taste
Overall	489	2.62 (1.34)	1.92 (1.55)	6.33 (1.80)	6.05 (1.99)
No information	216	2.56 (1.18)	2.03 (1.43)	6.23 (1.75)	5.87 (2.06)
<i>California</i>	72	2.61 (1.12)	2.03 (1.63)	6.13 (1.69)	6.76 (1.66)
<i>NYS Open Field</i>	72	2.73 (1.17)	2.62 (1.33)	6.90 (1.40)	6.42 (1.60)
<i>NYS Hydroponic</i>	72	2.34 (1.24)	1.69 (1.23)	5.67 (1.92)	4.43 (2.07)
Information	273	2.67 (1.45)	1.83 (1.64)	6.40 (1.84)	6.19 (1.93)
<i>California</i>	91	2.77 (1.45)	1.38 (1.83)	6.07 (1.97)	6.63 (1.85)
<i>NYS Open Field</i>	91	2.72 (1.47)	2.61 (1.56)	6.69 (1.62)	6.40 (1.76)
<i>NYS Hydroponic</i>	91	2.51 (1.45)	1.59 (1.42)	6.44 (1.88)	5.55 (2.02)

### Average Ratings

Experiment participants rated average appearance scores higher than tasting scores among all three types of strawberries, which is consistent with the WTP differences discussed above. Based on appearance, subjects rate *NYS Hydroponic* lower than *California* on average when they do not know the local information, but they rate *NYS Hydroponic* higher than *California* after they know the product is local. This is not consistent with WTP based on appearance. Based on taste, *California* receives the highest score among all three types regardless of information treatment.

This is also not consistent with WTP based on taste trends. This table gives a general idea of how consumers respond to production origin information treatment, but we will look more in depth on data in the following.

#### Estimates of WTP Based on Appearance

Table 4 shows parameter estimates from the Tobit Model and the associated marginal effects.

The estimates are very close, and the significance level of each variable remains the same.

Coefficients of marginal effects are slightly lower than those from the Tobit Model, which means that the Tobit Model overestimated the WTP of consumers in general. As a result, we only discuss the results from marginal effects from here except for the intercept as there is no marginal effect for the intercept parameter estimate.

The first row is the intercept from the Tobit Model, and 2.594 means that without any information, average consumers are willing to pay \$2.59 for one pound of *California* based on appearance. According to Western Growers Association (2019), the retail market price of one pound of strawberries in New York State in 2019 is \$2.66. This number (\$2.59) is almost the same as the market price.

The two rows under “Type” are the price premium consumers are willing to pay for two types of NYS grown strawberries when no local information is given. *NYS Hydroponic* has a \$0.28 lower price than *California*, and the result is statistically significantly different at the 5% level. This may be due to the *NYS Hydroponic* strawberry being a smaller size and less uniform in shape than the *California* strawberry. Consumers are willing to pay \$0.11 more for *NYS Open Field*

than *California*, and the estimate is not significant at 10% significance level. *NYS Open Field* has a very similar appearance as the *California*. For the “Information” estimate, it is the difference of WTP for *California* with local information provided and without local information, and the result is not statistically significantly different at 10% level.

The two rows under “Interaction Terms” are the joint effect of information and types of strawberries. Based on appearance only, consumers are willing to pay \$0.03 more for *NYS Hydroponic* when they are told this type is locally grown, and the result is not statistically significantly different at 10% level. Similarly, consumers are willing to pay \$0.15 less for *NYS Open Field* when they are told this type is locally grown, and it is not statistically significant at 10% level.

In the demographic estimates, gender, income, ethnicity, household number and primary shopper are possible factors that may affect consumers WTP based on appearance. Female shoppers are willing to pay on average \$0.40 more than male shoppers, and the result is statistically significantly different at 10% level. People who earn more than \$100,000 annually are willing to pay \$0.39 more than the others, and the result is statistically significant at a 10% level. People who identify as white are willing to pay \$0.46 more than people that identify as other ethnicities, and the result is statistically significant at a 5% significance level. Households with greater than 2 members are likely to pay \$0.34 more, and the result is statistically significant at the 10% significance level. The primary shoppers in a household are willing to pay \$0.59 less than non-primary shoppers, and the result is statistically significant at 5% significance level. The reason

may be that primary shoppers are more familiar with product prices than someone who purchases those items more infrequently.

#### Estimates of WTP Based on Taste

Similarly, for the estimates based on taste, we only discuss the intercept from the Tobit Model and interpret the rest of the estimates from marginal effects. 2.485 is the intercept of the Tobit Model for tasting. Consumers are willing to pay \$2.49 for one pound of *California* without knowing local information. This is lower than \$2.59, when rated by appearance only.

For the two rows under “Type”, consumers are willing to pay \$0.20 less for *NYS Hydroponic* than *California* when no information is given, and the result is not statistically significant different at 10% level. However, consumers are willing to pay a price premium of \$0.67 for one pound *NYS Open Field* without knowing the local information, and the significance level is at 1%. People are not willing to pay more when only looking at the *NYS Open Field*, but after they taste them, they are willing to pay more for this type of strawberries.

For “Information” estimates, consumers are willing to pay \$0.88 less for *California* in the treatment group (where local information is revealed) than in the non-treatment group (where no local information is revealed). The result is statistically significant at 1% significance level.

For the two rows under “Interaction Terms”, consumers are willing to pay a price premium of \$0.62 per pound for the *NYS Hydroponic* when they are informed that this type is locally grown. This result is statistically significantly different at 10% level. Consumers are willing to pay even

more, a \$0.80 per pound premium for *NYS Open Field* strawberries after they know they are locally grown. This result is statistically significant at 5% level. After giving the local information, consumers are willing to pay more for both NYS grown strawberries. For demographics, only household size and primary shoppers are two possible factors that affect WTP. Households with more than 2 people are willing to pay an average of \$0.30 price premium. Primary shoppers are willing to pay \$0.57 less than non-primary shoppers on average. Subject demographics such as gender, income and ethnicity do not affect WTP based on tasting the strawberries.

Relative to the California variety, we find that consumers are willing to pay less for *NYS Hydroponics* based on appearance and local information does not help with this. Consumers are willing to pay a price premium for *NYS Open Field* both with and without local information. This result shows that NYS grown strawberries, specifically June-bearing varieties, have great potential to outcompete traditional Californian strawberries that dominate the national market. Scientists who grow strawberries in a controlled-environment may try some other varieties to see whether they can win over Californian grown strawberries.

**Table 4. Willingness to Pay Estimates Using Tobit Model and Marginal Effects.**

Notes: The p values are in parentheses (\*p&lt;0.1, \*\*p&lt;0.05, \*\*\*p&lt;0.01). NYS, New York State.

Explanatory Variables	Appearance(\$)	Dy/dx Appearance(\$)	Taste(\$)	Dy/dx Taste(\$)
Intercept	2.594*** (0.000)	N/A	2.485*** (0.000)	N/A
<u>Type</u>				
<i>NYS Hydroponic</i>	-0.290** (0.033)	-0.281** (0.033)	-0.250 (0.414)	-0.199 (0.414)
<i>NYS Open Field</i>	0.118 (0.385)	0.114 (0.385)	0.846*** (0.005)	0.673*** (0.005)
<u>Information</u>	0.187 (0.375)	0.181 (0.375)	-1.112*** (0.000)	-0.884*** (0.000)
<u>Interaction Terms</u>				
<i>NYS Hydroponic</i> × Information	0.0285 (0.875)	0.0276 (0.875)	0.778* (0.062)	0.619* (0.062)
<i>NYS Open Field</i> × Information	-0.159 (0.382)	-0.154 (0.382)	1.000** (0.015)	0.796** (0.015)
<u>Demographic</u>				
Gender	-0.411* (0.071)	-0.398* (0.071)	-0.389 (0.111)	-0.309 (0.110)
Age	-0.00172 (0.800)	-0.00167 (0.800)	-0.0110 (0.129)	-0.00872 (0.128)
Education	0.0811 (0.701)	0.0786 (0.700)	0.00466 (0.983)	0.00371 (0.983)
Income	0.398* (0.071)	0.386* (0.071)	0.110 (0.640)	0.0872 (0.640)
Ethnicity	0.474** (0.036)	0.460** (0.036)	0.357 (0.138)	0.284 (0.138)
Household number	0.354* (0.084)	0.343* (0.083)	0.372* (0.087)	0.296* (0.086)
Primary shopper	-0.613** (0.017)	-0.594** (0.017)	-0.720*** (0.008)	-0.573*** (0.008)



### Estimates of Perceived Quality

Table 5 shows the estimated effect of “locally grown” information on consumer’s perception of quality, based on the appearance and taste of the strawberries from consumers' ratings in the experiment. For “Appearance”, the intercept is 6.093, which means the *California* variety receives an average score of 6.093 (out of 9) without any information, and the result is statistically significant at 1% significance level.

When coming to “Type”, *NYS Hydroponic* receives a 0.458 lower rating than *California*, but there is no statistically significant difference. *NYS Open Field* receives 0.778 points higher than *California*, and this difference is statistically significant at the 1% level. For the “Information” row, consumers rate *California* 0.0117 higher in the treatment group (given local information) than the non-treatment group (local information is not revealed), and the result is not statistically significantly different at 10% level.

For “Interaction Terms” estimates, they show how many points more consumers give to *NYS Hydroponic* and *NYS Open Field* when they are told they are locally grown. Consumers rate *NYS Hydroponic* 0.832 points higher than *California* when they are told *NYS Hydroponic* is *NYS* grown, and the result is statistically significantly different at 5% level. Subjects rate 0.151 points lower for *NYS Open Field* when they are told this type is locally grown, and the result is not statistically significant at 10% significance level. We can see that *NYS Hydroponic* has a great improvement based on appearance when local information is revealed.

**Table 5: Estimates of consumers' perception of quality: appearance and tasting.**

Notes: The p values are in parentheses (\*p&lt;0.1, \*\*p&lt;0.05, \*\*\*p&lt;0.01). NYS, New York State.

Explanatory Variables	Appearance	Taste
Intercept	6.093*** (0.000)	6.820*** (0.000)
<u>Type</u>		
<i>NYS Hydroponic</i>	-0.458 (0.114)	-2.333*** (0.000)
<i>NYS Open Field</i>	0.778*** (0.007)	-0.347 (0.246)
<u>Information</u>	0.0117 (0.966)	-0.149 (0.602)
<u>Interaction Terms</u>		
<i>NYS Hydroponic</i> × Information	0.832** (0.032)	1.256*** (0.002)
<i>NYS Open Field</i> × Information	-0.151 (0.696)	0.116 (0.771)
<u>Demographic</u>		
Gender	-0.474** (0.019)	-0.442** (0.035)
Age	0.00488 (0.419)	-0.00983 (0.115)
Education	-0.0335 (0.859)	-0.0784 (0.686)
Income	0.194 (0.324)	-0.0721 (0.723)
Ethnicity	-0.191 (0.343)	0.365* (0.079)
Household number	-0.141 (0.438)	0.391** (0.038)
Primary shopper	0.0718 (0.754)	0.154 (0.514)

For the “Taste” column in Table 5, similarly, consumers give an average 6.820 points in *California* without knowing any local information. For the two rows under “Type”, *NYS Hydroponics* receives 2.333 lower points than *California* without the information treatment at 1% significance level. *NYS Open Field* receives 0.347 points lower than *California* without given local information, and the result is not statistically significant at 10% significance level. Recall that *NYS Open Field* has a significantly higher score based on appearance than *California*. This indicates that the *NYS Open Field* looks better than *California* but does not taste better when rating based on a 1~9 scale. *NYS Hydroponic* are rated significantly lower based on taste than *California* even though they are not rated differently based on appearance.

For “Information” estimates, consumers rate *California* 0.149 lower when they receive local information compared to consumers who do not receive local information, and the result is not statistically significant at 10% level. For the two rows under “Interaction Terms”, consumers rate *NYS Hydroponic* 1.256 points higher than *California* when they are told *NYS Hydroponic* are locally grown. This result is statistically significant at 1% level. Participants rate *NYS Open Field* 0.116 points lower than *California* when they are told *NYS Open Field* is *NYS* grown, but this result is not statistically significant at 10% significance level.

Gender, ethnicity and household number are three demographic factors that will possibly affect consumers' perception of quality when told local information. Female shoppers tend to rate 0.474 points higher than male shoppers based on appearance, and rate 0.442 points higher based on taste. Self-identifying as “White” does not affect ratings based on appearance, but the “White” tend to rate 0.365 higher than those who do not identify as white based on taste. Number of

people in a household does not have an impact on ratings as well based on appearance, but it does significantly impact the rating based on taste. Households with more than two people rate 0.391 points higher (based on taste) than households with two or less people, and this result is statistically significant at 5% level.

Comparing the estimates of the WTP table and the rating table, we do not find a strong connection between how consumers perceive the attributes of the strawberries and how much they want to pay for them. For example, without the local information, consumers rate *NYS Hydroponics* taste lower than *California* but they are not willing to pay less. They rate *NYS Open Field* 0.778 higher than *California* when no local information is revealed, but they are not willing to pay a price premium. When consumers know the local information, there tends to be a more consistent linkage between perception of quality and WTP. Consumers rate *NYS Hydroponic* 1.256 points higher when they are given the local information, and they are willing to pay a price premium of \$0.62.

## **Conclusion**

In this study, we conduct an economic experiment to quantify the effect of “locally grown” information on consumers’ willingness to pay for two types of local strawberries and one type of strawberries from a single region that dominates the market: *NYS Hydroponic*, *NYS Open Field*, and *California*. After collecting all the data from the economic experiment, we use a Tobit Model to quantify the WTP and a Seemingly Unrelated Regression (SUR) to estimate the perception of quality of three types of strawberries.

From the quality perception experiment, we find that given “locally grown” information has the potential to compensate for less attractive appearance attributes such as product size and uniformity of size. Specifically, when consumers are given the “locally grown” information, *NYS Hydroponic* receives a higher score than *California* based on both appearance and taste. This is an interesting observation because *NYS Hydroponic* received an appearance score that was 2.33 points lower than those *California* during blind tasting on average. *NYS Hydroponic* strawberries tend to be smaller and less uniform than *California* strawberries.

However, we also find that consumers’ WTP is not always consistent with their perception of quality. Without providing information on the local attribute, consumers rate *NYS Open Field* higher than the others based on appearance but they are not actually willing to pay more for it based on appearance. When they receive the local information, consumers rate *NYS Hydroponic* higher than *California* both on taste and appearance. However, they are not willing to pay a price premium for it based on appearance. Knowing that consumers are inconsistent tells growers that marketing in a proper way can help boost the demand for local produce from a small regional area.

The experiment demonstrates that local strawberries have the potential to outcompete the strawberries brought in from a single region that dominates the market. Consumers are willing to pay a \$0.67 premium for *NYS Open Field* based on taste, and locally grown information could further raise the premium for *NYS Open Field*. Promoting purchasing locally can be used as an effective marketing strategy. Moreover, *NYS Hydroponic* tastes the worst during blind tasting but

consumers are still willing to pay a \$0.62 premium for it when they have the local information. Local information can compensate for the less good looking and taste strawberries for the everbearing *NYS Hydroponic* strawberries in our case. In the real world, local information can also help produce items that have less attractive attributes sell at higher prices. If everbearing varieties are able to emulate the taste and appearance of the June-bearing strawberries grown in New York, they could successfully extend the length of the strawberry season in the state and potentially boost income for growers. Further research can be done to examine the effect of information on growing practices and how knowing a product is grown in a less traditional environment such as controlled-environment impacts the WTP of consumers.

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