

**MEASURING CONSUMER ACCEPTANCE AND WILLINGNESS- TO- PAY  
FOR SPECIALTY TOMATOES: IMPACT OF PRODUCT, TASTE, AND  
HEALTH FEATURES**

A Thesis

by

MICHELLE STEFANIA SEGOVIA CORONEL

Submitted to the Office of Graduate and Professional Studies of  
Texas A&M University  
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Chair of Committee,	Marco A. Palma
Committee Members,	David A. Bessler
	Daniel I. Leskovar
	Yvette Zhang
Head of the Department,	C. Parr Rosson

August 2014

Major Subject: Agricultural Economics

Copyright 2014 Michelle Stefania Segovia Coronel

## **ABSTRACT**

The increasing public health awareness and the promotion given to healthy eating habits as a measure to prevent obesity and chronic diseases have pushed consumer's attention towards differentiated products. Many of the differentiated products, such as those with environmental, local, and other health and quality claims, are categorized as credence goods. Credence attributes, such as nutritional characteristics, are unobserved by consumers even after consumption, making the use of information crucial for marketing the benefits of such products. While there have been numerous studies examining the potential impacts of these attributes on consumer demand, few studies combine consumer valuation of credence attributes with sensory analysis of products and information treatments. This study attempts to shed more light on this area by considering both the impact of various attributes on consumer demand and the consistency in consumer valuation under different information treatments. The information treatments refer to tasting, health information, and the location of origin and production system of the products.

A non-hypothetical second-price Vickrey auction was conducted in the Bryan-College Station area of Texas in order to collect the data. Several econometric models were developed to estimate consumers' willingness-to-pay (WTP); however, special attention was paid to the random parameters tobit model as it accounts for unobserved individual heterogeneity as well as bid-censoring. Results show that knowledge of location of origin of tomatoes does have an impact on consumer valuation. The same

holds true for the taste attribute (experience) and the health attribute (credence). Each information treatment was applied to several products and some treatments had contradictory results between products which prevented generalizing the effects of that treatment. In addition, estimates indicate there exists unobserved heterogeneity in valuations across individuals.

Finally, using a Latent Class Analysis, consumers were segmented based on health-related behaviors, and the differences in the valuation of products and information treatments among those classes were measured using random parameters tobit models. Two latent classes were found and characterized as: “Health Conscious”, and “Health Redeemers”. The findings indicate that the classes differed significantly in terms of their preferences, willingness to pay, socio-economic profile, and health-driven motivations.

## **DEDICATION**

I would like to dedicate this work to my beloved family for their continued encouragement and support throughout my academic career. Their unconditional love has always been my motivation and has helped me set high targets and goals in life.

## **ACKNOWLEDGEMENTS**

First, I am thankful to God, who has blessed and guided me through all my experiences and accomplishments. I would like to express my sincere gratitude to my advisor, Dr. Marco Palma, for his wise supervision, patience, encouragement, and trust. Your advice on both my research as well as on my career has been priceless, and I could not have imagined having a better mentor for my graduate studies.

I would also like to thank the rest of my committee members, Drs. David Bessler, Daniel Leskovar, and Yvette Zhang, whose expertise and insightful comments greatly contributed to the quality of this research paper.

A special thanks to my family, who have given me unequivocal support throughout. Words cannot express how grateful I am to you all. I would like to express deepest appreciation to my friend Basheer Kassas, for his help in editing this thesis, and for inspiring me to strive towards my goal. I would also like to extend my gratefulness to my friend Alba Collart, for her friendship and support, and for sharing her knowledge with me whenever needed.

Last but not least, I would like to express my gratitude to my friends and colleagues who contributed to making my experience at Texas A&M University one that I will never forget.

## TABLE OF CONTENTS

	Page
ABSTRACT .....	ii
DEDICATION .....	iv
ACKNOWLEDGEMENTS .....	v
TABLE OF CONTENTS .....	vi
LIST OF TABLES .....	x
LIST OF FIGURES.....	xii
CHAPTER I INTRODUCTION .....	1
CHAPTER II LITERATURE REVIEW .....	11
Experimental Economics and Consumer Valuation .....	11
Determining Willingness-to-Pay in Market Research.....	11
Transactions Data .....	12
Survey Data .....	12
Experimental Data .....	13
Where Experiments Occur .....	14
Experimental Design .....	15
Conjoint Analysis and Discrete Choice Experiments .....	15
Value Theory .....	18
Differences in Willingness-to-Pay and Willingness-to-Accept.....	18
Incentive Compatibility of Auction Mechanisms.....	20
Auction Mechanism.....	23
Previous Studies Combining Experimental Auctions and Product Tasting .....	25
The Effect of Information on Consumer Preferences.....	29
Consumer Attitudes Towards Healthy Foods.....	30
Overweight and Obesity in the US Population.....	31
Prevalence and Time Trends .....	33
Morbidity and Mortality Associated with Obesity .....	34
Organic Foods Tendency.....	38

Organic Foods Market.....	39
Organic Foods vs. Conventional Foods.....	41
Quality and Safety Comparisons of Organic and Conventional Foods .....	41
Pesticides.....	41
Nutritional Value.....	44
Sensory Properties.....	46
Production, Producer Price, and Profitability Comparison between Organic and Conventional Systems.....	47
Consumer Perceptions and Willingness-to-Pay for Locally Grown Foods .....	50
 CHAPTER III THE TOMATO INDUSTRY.....	 58
The Tomato.....	58
Fruit Quality .....	59
Size and Shape.....	59
Chemical and Nutritional Composition.....	59
Taste and Flavor .....	63
Color .....	64
Tomato Production .....	64
Fresh Tomato Unit Costs.....	66
The U.S. Tomato Industry .....	66
Seasonality and Structure of the Industry.....	68
Fresh Tomato Trade .....	69
Import Trends .....	70
Export Trends .....	73
Consumption Trends .....	75
Tomato Prices.....	77
Value Trends .....	78
Quantity Trends .....	78
Marketing Challenges.....	79
 CHAPTER IV METHODOLOGY .....	 80
Auction Description.....	80
Subjects.....	80
Products .....	81
Auction Procedures .....	82
Tasting Treatment.....	84
Health Information Treatment.....	85
Location of Origin and Product Information.....	85
Theoretical Framework for Experimental Auction Mechanism.....	86
Preferences and Utility .....	86

Utility Maximization and Consumer Choice.....	90
Choice Modeling and Random Utility Theory.....	92
Econometric Models.....	94
Econometric Models for Experimental Auction Bids.....	94
Ordinary Least Squares Model.....	97
Constant Parameters Tobit Model.....	97
Random Effects Tobit Model.....	101
Mixed Linear Model.....	102
Random Parameters Tobit Model.....	104
Models for Bid Differences Across Treatments.....	106
Accounting for Endogeneity using Instrumental Variables.....	107
A Latent Class Analysis with Individual Heterogeneity.....	111
CHAPTER V RESULTS AND DISCUSSION.....	114
Demographics and Behavioral Characteristics.....	114
WTP Models for Experimental Auction Bids.....	120
Bid Censoring.....	128
Tobit Models for Full Information Treatment.....	129
Ordinary Least Squares Model.....	134
Tobit Model for Pooled Bids.....	136
Random Effects Tobit Model.....	139
Mixed Linear Model.....	143
Random Parameters Tobit Model.....	145
Comparison of Econometric Models for Full Bids.....	151
Implied Differences in WTP for Tomato Products.....	152
Differences in WTP Across Information Treatments.....	152
Implied Differences for the Tasting Treatment.....	156
Implied Differences for the Product Information Treatment.....	158
Implied Differences for the Health Information Treatment.....	160
Accounting for Endogeneity - IV Approach.....	163
Buying your Way into a Healthy Lifestyle? A Latent Class Analysis with Individual Heterogeneity.....	169
Robustness of Indicators Across Models.....	176
CHAPTER VI SUMMARY AND CONCLUSIONS.....	182
Summary and Conclusions.....	182
Economic and Marketing Implications.....	190
Limitations and Suggestions for Future Research.....	191
REFERENCES.....	193
APPENDIX A.....	231



APPENDIX B .....	232
APPENDIX C .....	263
APPENDIX D .....	264

## LIST OF TABLES

	Page
Table 1 Body Mass Index Categories .....	32
Table 2 Nutritional Information of Red, Ripe, and Raw Tomatoes .....	60
Table 3 Sessions and Information Treatments .....	84
Table 4 Demographic and Behavioral Variables .....	95
Table 5 Demographic and Behavioral Characteristics of Experiment Participants .....	115
Table 6 Comparison of Actual Weight versus Stated Weight Perceptions .....	118
Table 7 Relative Importance of Factors in Tomato Purchase Decisions Based on a Rating Scale .....	119
Table 8 Descriptive Statistics for the Bids .....	121
Table 9 Percentage of Bids Censored at \$0.00 By Round and Product .....	129
Table 10 Tobit Models for WTP by Product, Full Information .....	131
Table 11 Marginal Effects for Tobit Models for WTP by Product, Full Information ....	133
Table 12 Ordinary Least Squares Estimates for WTP for Tomato Products .....	135
Table 13 Constant Parameters Tobit Model Estimates for WTP for Tomato Products ..	138
Table 14 Random Effects Tobit Model for WTP for Tomato Products.....	142
Table 15 Mixed Linear Model Estimates for WTP for Tomato Products.....	144
Table 16 Random Parameters Estimates for WTP for Tomato Products.....	150
Table 17 Paired t-Tests of Information Treatment Effects.....	153
Table 18 Proportions of Positive, Negative, and Zero Differences for Changes in WTP from Baseline Round, Summed for All Products.....	154

Table 19 Summary Statistics for Implied Differences .....	155
Table 20 Mixed Linear Model Estimates for Implied Differences in WTP for Tomato Products, Tasting Information Treatment .....	157
Table 21 Mixed Linear Model Estimates for Implied Differences in WTP for Tomato Products, Product Information Treatment .....	159
Table 22 Random Parameters Tobit Model Estimates for Implied Differences in WTP for Tomato Products, Health Information Treatment.....	162
Table 23 Two Stage Least Squares Model Estimates for Implied Differences in WTP for Tomato Products, IV Approach.....	167
Table 24 Constant Parameters Tobit Model Estimates for Implied Differences in WTP for Tomato Products, IV Approach.....	168
Table 25 Comparison of Latent Class Models .....	170
Table 26 Latent Class Parameter Estimates for Two-Class Model.....	172
Table 27 Demographic and Behavioral Characteristics of Experiment Participants by Latent Class.....	177
Table 28 Random Parameters Tobit Estimates for WTP for Tomato Products by Latent Classes .....	178
Table 29 Random Parameters Tobit Estimates for WTP for Tomato Products by Latent Classes, Full Information.....	180

## LIST OF FIGURES

	Page
Figure 1 North America Greenhouse Tomato and Fresh Field Tomato Shipping Seasons by Region .....	68
Figure 2 U.S. Imports of Tomatoes from Mexico, 2000-2011.....	71
Figure 3 North American Greenhouse Tomato Production Growth.....	73
Figure 4 Monthly U.S. Greenhouse Tomato Imports from Major Suppliers, 2003 .....	73
Figure 5 U.S. Tomato Exports Fluctuate.....	74
Figure 6 Most Commonly Consumed Vegetables .....	76
Figure 7 Indifference Map.....	89
Figure 8 Budget Constraint .....	91
Figure 9 Maximizing Consumer Utility .....	92
Figure 10 Conditional Mean Bids for Tomato Products By Information Treatment.....	122
Figure 11 Median Bids for Tomato Products By Information Treatment.....	123
Figure 12 Distribution of Baseline Round Bids for Tomato Products Estimated with a Gaussian Kernel Density Distribution .....	124
Figure 13 Distribution of Tasting Round Bids for Tomato Products Estimated with a Gaussian Kernel Density Distribution .....	125
Figure 14 Distribution of Health Information Round Bids for Tomato Products Estimated with a Gaussian Kernel Density Distribution .....	126
Figure 15 Distribution of Information Round Bids for Tomato Products Estimated with a Gaussian Kernel Density Distribution .....	127
Figure 16 Distribution of Full Information Round Bids for Tomato Products Estimated with a Gaussian Kernel Density Distribution .....	128

## **CHAPTER I**

### **INTRODUCTION**

The prevalence of obesity in the United States has continued to grow to a point where it is becoming a public health crisis (Wang, Monteiro and Popkin 2002). The spending on national health care costs was \$2.5 trillion in 2009 (Truffer et al. 2010), with direct costs of obesity estimated to be as high as \$147 billion (Finkelstein et al. 2009). The National Health and Nutrition Examination Survey (NHANES) data provides the most recent estimates of overweight and obesity for Americans in all age categories (Ogden et al. 2006). According to the 2009-2010 NHANES survey, approximately 33% of adults are overweight, 35.7% are obese, and 6.3% are extremely obese (Fryar, Carroll and Ogden 2012). Several factors have been attributed as causes of obesity growth. Weight gain results mainly from a combination of excess calorie consumption and/or inadequate physical activity. Swinburn et al. (2011) attribute the current obesity trends primarily to the expansion of the global food system and the success of food processing in providing abundant food at a relative low cost. Additionally, the sharp increase in portion sizes of marketed foods has been identified as a contributor to the overconsumption of food and thus to the increase of obesity in the United States (Young and Nestle 2002).

Obesity is considered a risk factor for numerous chronic diseases, including cardiovascular diseases, type 2 diabetes mellitus, certain cancers, musculoskeletal disorders, and respiratory disorders (Lissner 1994). According to the National Institutes of Health, obesity is the second leading preventable cause of disease and death in the

United States, after tobacco. Due to the impact of obesity on morbidity and mortality, government agencies and industries started to incorporate strategies into health promotion programs in order to reduce obesity, especially those preventing chronic diseases by encouraging healthful diets and physical activity (Seidell and Rissanen 1997). This health awareness movement and the publicity given to healthful eating habits as a measure to prevent obesity and diseases creates an opportunity for businesses to market products that have been known for their beneficial effects on health.

Organic foods are among the many products that have been researched for potential health benefits, especially due to their higher vitamin C levels and polyphenolic content (Caris-Veyrat et al. 2004). Organic demand has increased remarkably as consumers and marketers reacted to popular media about health and environmental effects of pesticides and food safety (Hughner et al. 2007). The US organic industry is experiencing a boom as consumption is increasing by an average of 20% every year (Batte et al. 2007). Consumers are willing to pay price premiums ranging from 10% to 40% for organic products, as they perceived them to be fresher, safer, healthier, and more nutritious (Shepherd, Magnusson and Sjoden 2005; Dhar and Foltz 2005; Lusk and Briggeman 2009; Bernard and Bernard 2009; Thompson 1998). At the same time, consumer's desire to support local producers became an important criterion in organic food purchases, with consumers associating locally grown products to be tastier and fresher than other foods (Bruhn et al. 1992; Darby et al. 2008; Onozaka and McFadden 2011).

Consumers are becoming more concerned about health and quality attributes of food products and their desire for cultural identification is increasing as well. This has caused demand to become more geographically oriented (Loureiro and McCluskey 2000). This has caused researchers to focus on consumer acceptance of differentiated products including local and organic varieties (Loureiro and Hine 2002). Experimental economics offers a controlled way to analyze not only consumer interest in differentiated food products, but also to look at the effect that the provision of information and the quality of the products have on consumer valuations of the products.

Experimental economics provides a framework to analyze consumer preferences and willingness to pay regarding different food products and product attributes. Experimental economics mechanism can be designed to be incentive compatible, which means that it induces consumers to reveal their preferences truthfully to researchers (Alfnes and Rickertsen 2010). In the case of differentiated products, experimental economics methods help researchers evaluate other non-price factors that affect consumer choice in the food marketplace, such as heterogeneity in food quality and in consumer preferences, nutrition and health, and information (Unnevehr et al. 2010).

There is a wide range of experimental methods that can be used for eliciting consumer preferences for food products. The most notable approaches include auction mechanisms, choice experiments, dichotomous choice methods, and choice-based methods. There has been a wide controversy in the experimental economics literature over the benefits and disadvantages of those mechanisms. The decision of which mechanism to use depends on the specific purpose of the experiment, the decisions that

will be made using the information that is gathered, as well as budget and timing allocations.

Many of the differentiated food products, such as those with environmental, local, and other health and quality claims, are categorized as credence goods. Credence attributes, such as nutritional characteristics, are unobserved by consumers even after consumption, making the use of information crucial for marketing the product quality (Lusk 2013b). Foster and Just (1989) pointed out that providing information can help consumers make better choices that align with their preferences especially with uncertainty about product quality. Credence attributes, such as health information, have been the focus of several consumer valuation studies. The procedures used by these studies include surveys (e.g., Capps 1989; Chern, Loehman and Yen 1995), conjoint analysis (Darby et al. 2008), and a range of auctions (e.g., Soler, Gil and Sanchez 2002; Nalley, Hudson and Parkhurst 2006). While there have been numerous studies examining the potential impacts of these attributes on consumer demand, few studies were made regarding the consistency of consumer valuation of credence attributes before and after they consume the product and before and after they obtain information for the product through advertising. This study attempts to shed more light on this area by considering both the impact of various attributes on demand and the consistency in consumer valuation under different information treatments, including tasting and information effects.

Perhaps the most important credence attributes in fruits and vegetables are those associated with human health benefits (Ames, Shigenaga and Hagen 1993), such as



antioxidant compounds. Antioxidants have created new opportunities for the horticulture and food industry to improve fruit and vegetable quality by increasing antioxidant content. Because of their high frequency in the diet, tomatoes are an important source of carotenoids (antioxidants), particularly lycopene (Heber 2000). In the United States, about 80% of the intake of dietary lycopene comes from the consumption of tomato and tomato products (Clinton 1998). Several studies have reported a negative correlation between lycopene and prostate cancer (Giovannucci 1999), cardiovascular disease (Arab and Steck 2000), and atherosclerosis (McQuillan et al. 2001).

Fruits and vegetables are functional foods that combine both credence and experience attributes. Functional foods refer to food products that promise health benefits above basic nutritional value or reduce risk of chronic disease when consumed on a regular basis (Maynard and Franklin 2003; Robinson 2013). Experience attributes are those where consumer valuations cannot be resolved until after consumption. Credence characteristics in tomatoes include its location of origin, the production method, its nutritional content, etc. The experience characteristic is the element of taste where the consumer's uncertainty can only be resolved through sensory analysis. The knowledge of consumer valuations of these attributes will allow producers to develop more effective marketing strategies and allow buyers to formulate consumer driven buying decisions. Particularly, this study attempts to determine the correlation between the sensory tasting and credence attributes, in an attempt to address consumer preference toward the taste of organic, local, or healthy products. This issue will be answered by having an information and sensory treatment.

Tomatoes are second, after potatoes, in both U.S. farm value and vegetable consumption. With a farm value of about \$2 billion (USDA 2012), U.S. annual per capita use of tomato and tomato products has increased 30% over the last 20 years (Lucier et al. 2000). Consumption of fresh-market tomatoes has likely increased over time due to the introduction of improved tomato varieties and the expanding national emphasis on health and nutrition. For example, a USDA breeding program developed tomato varieties with higher  $\beta$ -carotene content than conventional varieties (Stommel 2001). Texas A&M AgriLife Research has been working on producing high-value, specialty tomatoes with added health benefits and improved flavor (Phillips 2011). Domestic producers have recognized opportunity in this market niche and as a result, specialty tomatoes production begun in several States. Differentiated marketing by the producers involved in the specialty tomatoes market may be achieved if more information can be gained about demand for specialty tomatoes and the characteristics of consumers.

The main objective of this analysis is to measure WTP and to determine consumer's preferences for new specialty tomatoes using incentive compatible, non-hypothetical methods. To achieve this purpose, we combined two sciences to help us set up a rigid taste panel and to develop the models necessary for estimating WTP for flavor and health benefits. Specific objectives are to: 1) examine the impact of origin, production technique, taste, and health information on consumer valuation of specialty tomatoes, 2) evaluate how the order of the information presented to panelists in an experimental auction affects bidding prices, 3) link WTP for health benefits and obesity,

4) provide WTP estimates for new specialty tomato varieties with enhanced health benefits and nutritional content, and 5) assess WTP for organic versus conventional, and local tomatoes by comparing blind sensory taste versus information treatment.

Seasonality is a major force affecting the North American tomato industry. Since the study was conducted during an off-season period in the United States, local tomato varieties were limited in availability. The quality of those local tomatoes was lower than usual during this season, which may decrease consumers WTP for them. The pattern points towards the fact that consumers are, on average, willing to pay a price premium for local food products over their foreign competitors. There are a number of indicators that illustrate the increasing public attention towards local food products. In a study that assesses consumer's WTP for directly marketed apples and tomatoes, researchers reported consumers' WTP for local apples was significantly higher than conventional apples. They also found that consumers value the "local" label higher than the organic label (Onozaka and Thilmany 2011). James, Rickard and Rossman (2009) developed a choice experiment to analyze consumers' willingness to pay for differentiated attributes in applesauce. The authors reported a higher WTP for locally-grown applesauce compared to organic, low fat, and low sugar substitutes. However, they found evidence that increased knowledge of agriculture decreases the WTP for organically and locally grown applesauce. Similarly, Loureiro and Hine (2002) conducted a survey in the produce department of Colorado grocery stores to determine consumer's WTP for locally grown, organic and genetically modified organism (GMO) free potatoes. Results showed consumers were willing to pay a price premium of \$0.09 per pound for the

Colorado-grown potatoes, \$0.07 for the organic potatoes, and \$0.06 for GMO-free potatoes. Moreover, results showed that consumers concerned about nutrition were willing to pay an extra premium of between \$0.005 and \$0.01 per pound for organic, GMO-free, and locally-produced potatoes. Carpio and Isengildina-Massa (2009) used contingent valuation to evaluate South Carolina consumers' WTP for locally-grown produce and animal products. The authors reported that South Carolinians had strong preferences for locally grown products as they were willing to pay an average premium of about 27% for state-grown produce and 23% for state-grown animal products compared with out-of-state grown products. Furthermore, they showed that perceived product quality significantly affected the premiums consumers are willing to pay for local products as they found that consumers who perceived those products to be superior in quality were willing to pay an extra 11% premium for produce products and 6.5% higher premium for animal products compared with consumers who perceive quality to be the same. Kompaniyets (2012) evaluated the impacts of nutrition merchadising on consumers' willingness to pay for local tomatoes and strawberries. Results showed that consumers who purchased tomatoes one additional time per week were able to pay a price premium of 9.25 cents more for local tomatoes and 6.06 cents more for local strawberries. Individuals who regularly purchased organic fruit and vegetables were willing to pay a premium of 10.85 cents and 17.31 cents more for local tomatoes and strawberries.

Perhaps the strongest evidence of this behavior in the local foods movement is the recognition of "Locavores" as the 2007 word of the year by the New Oxford

American Dictionary (NOAD). A locavore is “a local resident who tries to eat only food grown or produced within a 100-mile radius,” The term encompasses the different ranks of environmentally-conscious consumers who actively seek out locally produced food products (Thilmany, Bond and Bond 2008).

The main arguments used by locavores in supporting their behavior are: 1) buying local food enhances the local economy, 2) there is an environmental benefit to buying local foods, 3) local food products are superior in freshness and taste, and 4) local food products are healthier (Lusk 2013a). Some researchers deny the existence of all of the benefits of local foods. According to Lusk and Norwood (2011), who refer to those four arguments as the Locavores’ Dilemma, consumers who are willing to pay higher prices for locally produced foods, are buying overpriced goods that do not in fact contain the benefits that are traditionally associated with them. They argue that comparative advantage should be the main factor to consider when making such purchasing decisions. One of the contributions of this study is to test how far consumers would go to support local food products during off-season periods when supply is limited and quality is lower.

The thesis is organized as follows. Chapter 2 is a literature review of value elicitation and experimental methods. Second, a review of the characteristics of organic and locally grown products and its relation to obesity and health issues is presented. Next is a description of the tomato, its chemical composition and the current state of the industry. A description of the experimental procedures used in this study as well as a

discussion of the results follows. Lastly, the study's findings and the possible implications for expansion of the tomato industry are described.

## **CHAPTER II**

### **LITERATURE REVIEW**

#### **Experimental Economics and Consumer Valuation**

Experimental economics methods were integrated into the agricultural economics domain for the purpose of determining consumer demand and willingness to pay in a non-hypothetical manner. This research has helped to identify changes in food markets and consumer choices due to non-price factors such as heterogeneity in food quality and consumer preferences (Unnevehr et al. 2010). The importance of accurately determining what impacts consumers' choices is increasing as the number of consumers' choices and market participants is rising. Another issue of increasing importance is determining whether the experimental results would translate well into real life situations. One contribution of this research is to assist in this endeavor.

#### *Determining Willingness-to-Pay in Market Research*

Willingness to pay (WTP) refers to the maximum amount a buyer is willing to pay for a given quantity of a good (Wertenbroch and Skiera 2002). Different methods have been utilized to measure WTP in marketing research, including transactions data, survey data, and auction experiments (Wertenbroch and Skiera 2002). Such methods seek to elicit the "homegrown-values" of consumers for commodities, because "homegrown-values" are not induced, not controlled and are not known a priori by the experimenter (Harrison, Harstad and Rustrom 2004).

## **Transactions Data**

Transactions data from secondary sources, including revealed preferences from scanner data, have been widely used by market researchers for estimating WTP because they are highly accessible and contain properties that reveal demand (Dickie, Fisher and Gerking 1987). Transactions data are high in external validity because they are based on actual purchases made under real marketing conditions; however, the information researchers obtain from such data are not the actual consumers' WTP, but reveal that the buyer's WTP is at least as high as the transaction price (Werthenbroch and Skiera 2002). Moreover, for environmental goods and new products that have not been sold in real markets, actual transactions data do not exist (Dickie, Fisher and Gerking 1987).

## **Survey Data**

Survey data can be used to elicit willingness-to-pay in a form of conjoint analysis and contingent valuation method (CVM). Conjoint analysis directly examines willingness to pay by presenting subjects with different consumption bundles and studying their pricing and ranking of those bundles (McAdams et al. 2013). External validity in this approach may be limited as there is little incentive for consumers to reveal their true preferences, considering all responses are hypothetical (Lusk and Shogren 2007).

In a contingent valuation method consumers are asked to make choices among alternative hypothetical products and state their WTP, if any, for those products. This approach allows the researcher to standardize selected product characteristics and manipulate key information provided to consumers (Batte et al. 2007). A well-known



shortcoming of the CVM approach is “hypothetical bias”, defined as the difference between values obtained by hypothetical methods and actual statements of value obtained from experiments with real economic commitments (List and Gallet 2001). It is well documented that individuals often overstate their WTP in CVM situations (List and Shogren 1999; Murphy et al. 2005; Seip and Strand 1992).

More recently, choice experiments (CEs) have been used as an alternative and complement to CVM in order to elicit individuals’ WTP (e.g., Jaynes et al. 1996; Lusk, Roosen and Fox 2003; Lusk and Schroeder 2004). Briefly, a choice experiment presents the individual with several choice sets, each containing different products with different attributes and the individual is asked to pick one product from each choice set (Carlsson and Martinsson 2001). Because CE questions simulate real-life purchasing situations, it has been hypothesized that CEs are less prone to suffer from hypothetical bias (Carlsson and Martinsson 2001). Recent work has suggested that CE responses can be affected by hypothetical bias because subjects might behave differently in a hypothetical choice than they do in real life when they actually have to pay for the products (Lusk and Schroeder 2004).

### **Experimental Data**

Experimental methods, including willingness-to-use measurements, willingness-to-accept and willingness-to-pay auctions, have been broadly applied in economic research (McAdams et al. 2013).

The main advantages about experimental investigation are replicability and control (Davis and Holt 1993). Replicability refers to the capacity of generating the same

experimental results on a different data set, either by the original researcher or by others (Tomek 1993); while control refers to the ability of researchers to directly manipulate important variables, either by holding the variable constant at some fixed level (Friedman and Sunder 1994), or by varying the variable with different levels to investigate the effects of the variable. The main advantage of a controlled experiment is that it allows for complete control of confounding factors so that the effect of interest can be isolated (Lusk and Shogren 2007).

Reservations regarding the use of experimental methods have been related to its external validation. For example, Davis and Holt (1993) reported the most common reservations about experimentation include the use of simple laboratories and naïve subjects. First, the extrapolation of laboratory results to the marketplace could be inaccurate due to the simplicity of the laboratory environments compared to the real marketplace. Second, the laboratory decision makers, who most of the time are student subjects, can be less sophisticated or can behave in a different way than the decision makers in the marketplace. However, experimental investigation still holds the benefits of replicability and control.

#### *Where Experiments Occur*

Experiments can take place in the field or in a laboratory. Field experiments or in-store purchase experiments are performed in a real-world shopping environment, whereas lab experiments occur in a more controlled and structured setting where the goods and prices are varied systematically (Breidert, Hahsler and Reutterer 2006). The most fundamental question in lab experiments is whether the findings can be generalized

to broader settings. On the other hand, field experiments can imply higher expenditures and longer time intervals when monitoring market responses to price changes (Nagle and Holden 2002). Both methods present benefits and limitations; however, when lab analysis and field data are combined, they can expand their potential and generate more convincing inference. At the same time, the unexpected behaviors that occur in field experiments can be indicators of key features of economic transactions neglected in lab experiments. Levitt and List (2007) argue that subjects can be observed in natural settings while being controlled at the same time. In order to connect these two approaches, a well-designed field experiment requires a design which incorporates the virtues of true randomization, while maintaining factors that represent the behavior subject to study.

### *Experimental Design*

Since there are several experimental methods that can be used in value elicitation, there are also numerous conditions to be considered when modeling economic experiments. In order to obtain valid results on an experiment, the experimental design needs to meet certain criteria, which is described as follows: 1) the problem the subjects face is not only “simple” in itself, but it also seems simple to the subjects; 2) the incentives provided are sufficient; and 3) the time allowed for trial-and-error adjustment is adequate (Binmore 1999).

### **Conjoint Analysis and Discrete Choice Experiments**

There are a number of conjoint analytical techniques and choice experiments that have been used to analyze consumers’ stated preferences. The methods generally used

for preference elicitation are “conjoint analysis” (CA) or discrete choice experiments (DCEs).

In conjoint analysis, utility “part-worths” are estimated from ranking, rating, and choice data (Bunch, Louviere, and Anderson 1996). Given the individual differences (“part-worths”) in preferences for each product, consumers’ WTP for the whole product can be estimated (Ratcliffe 2000). However, conjoint analysis presents a theoretical problem when price is included as an attribute (Green and Srinivasan 1990). By assessing part-worth utilities to the price levels, the neoclassical economic theory of consumer behavior is violated, as price reflects exchange rates between different utility scales rather than having a utility of itself (Briedert, Hahsler, and Reutterer 2006).

Conjoint analysis has its basis on the theory of “Conjoint Measurement” (CM), which is purely a mathematical method focused on the behavior of number systems, not the behavior of individual preferences. In contrast, discrete choice experiments also known as choice experiments, are based on the random utility theory (RUT), which is considered a well-tested theory of consumer behavior that can help researchers to understand how consumers make choices in the real market (Louviere, Flynn and Carson 2010).

In choice experiments, subjects are presented with several choice sets, which are defined by a set of attributes. Each choice set is composed of several profiles and subjects choose the one alternative they prefer the most (Lusk and Norwood 2005). One of the main reasons researchers choose to use choice experiments is that they can manipulate the choice sets, such that the choice options can be designed to maximize the

amount of information collected from participants (Lusk and Norwood 2005). In order to obtain statistical significant results, a proper experimental design should be developed. Sándor and Franses (2009) found that experimental designs composed from choice alternatives with similar utility result in inconsistent choices and lead to inconsistent estimates of consumer preferences. In contrast, Lusk and Norwood (2005) report that increasing sample size can compensate for poor experimental designs in discrete choice experiments.

A meta-analysis conducted by List and Gallet (2001) suggest that the estimates obtained from DCE can suffer from hypothetical bias, as consumers tend to overstate their preferences (WTP) in a hypothetical setting compared to when real money is on the line. Subsequent research consistently indicates that values derived from surveys typically exceed actual values (e.g., Fox et al. 1998; List and Shogren 1998). Cummings, Harrison and Rutstrom (1995) reported that hypothetical dichotomous choice surveys present statistical differences compared to real dichotomous surveys. Other research comparing the bidding behavior of consumers in experimental auctions and discrete choice experiments found that subjects' WTP values elicited from choice experiment was significantly higher than those from experimental auction (Lusk and Schroeder 2006).

Ding, Grewal and Liechty (2005) indicate that the hypothetical nature of conjoint tasks can indeed be problematic. As a solution, Lusk, Feldkamp, and Schroeder (2004) propose the use of traditional conjoint analysis in conjunction with experimental auctions. This approach uses an auction mechanism that includes individuals actually

making a purchase so as to remove the bias. Several methods for reducing hypothetical bias will be discussed in the incentive compatibility section.

### *Value Theory*

An individual's value for a good can be viewed from two perspectives: his willingness to pay (WTP) to purchase the good or his willingness to accept (WTA) compensation to sell the good. Willingness-to-pay is the reservation price, or the maximum amount of money that a person would pay in order to receive a good. Willingness-to-accept is the minimum monetary amount an individual would receive in order to give up a good he owns. Lusk and Shogren (2007) suggest that whether the person actually owns the product (endowment effect) should be the determining factor when making the decision on which value measure to choose.

### **Differences in Willingness-to-Pay and Willingness-to-Accept**

The differences in elicited values for willingness-to-pay and willingness-to-accept can be large, with WTA values commonly two to five times greater than WTP values (DuBourg, Jones-Lee and Loomes 1994). Studies report both convergence (e.g., Coursey, Hovis and Schulze 1987) and divergence (e.g., Cummings, Brookshire and Schulze 1986) of WTP and WTA estimates. Based on the neoclassical model, WTP and WTA measures should be relatively equivalent under three conditions described as follows: (1) the value of the good is small relative to income, (2) there is the presence of substitutes for the good, and (3) there is no uncertainty about a person's preference for the good (Hanemann 1991). Coursey, Hovis, and Schulze (1987) report that WTA and WTP values tend to converge due to demand revealing behavior and market learning

experiences. These results were in contrast to those of Kahneman, Knetsch and Thaler (1990), who reported that WTA estimates decrease over subsequent rounds of the experiment and suggested an “endowment effect”, or the increase value of a good when the individual acquires property rights over the good. Along with loss aversion (Thaler 1980), this can explain the differences between WTP and WTA. Kahneman, Knetsch, and Thaler (1990) also study the possibility of resorting to the status quo as a result of loss aversion caused by the endowment effect. Tversky and Kahneman (1992) introduced a “reference-dependent” theory of consumer choice, which is based on the premise of loss aversion and deformation of indifference curves about the reference point. The fundamental assumption of the theory is that losses and disadvantages have greater impact on preferences than gains and advantages.

Subsequent theories of reference-dependent preference have been developed. For example, Köszegi and Rabin (2006) build a reference-dependent and loss aversion model that predicts the endowment effect seen in the laboratory will disappear in the real-world market due to trade expectation. Contrasting these results, Plott and Zeiler (2005) report that the gap between WTP and WTA cannot be explained by the endowment effect and propose that the disparity is due to misconceptions related to the elicitation mechanism. This result supports the findings of Shogren et al. (1994) that the WTP-WTA convergence in second price Vickrey versus BDM auctions might not be due to an endowment effect but rather to the contrasting market dynamics of the two types of auctions.

Another meta-analysis conducted by Horowitz and McConnell (2002) of WTA

and WTP estimates, show that WTA is substantially higher than WTP when the goods are less similar to ordinary market goods. At the same time, the authors suggest that the influence of hypothetical versus real experiments, student subjects versus general subjects, and the opportunity of learning do not affect the gap between WTA and WTP. Knetsch (2007) argue that WTP measures should be used for valuing gains and WTA measure should be used for assessing the value of losses and reduction of losses, indicating further support to the “reference relevance” in eliciting valuation. Still, others have attributed this convergence of WTP and WTA to the availability of substitutes for the good (Shogren et al. 1994). Lusk and Shogren (2007) suggest that the WTP-WTA gaps may be partially attributable to the availability of information about the auctioned good, the ease in reversing and delaying the auction transaction, and the availability of similar substitutes outside the laboratory. Furthermore, they propose that the variations between WTP and WTA under conditions of certainty are affected by prices, income, and elasticity of substitution between the auctioned good and substitute/complementary goods. Similarly, Zhao and Kling (2004) demonstrate that the equivalence between WTP and WTA breaks down under conditions of uncertainty, irreversibility, and learning over time. Zhao and Kling (2004) suggest that if policy-relevant factors cause the divergence between WTP-WTA, then WTP values will not be appropriate for welfare analysis since the focus is more on subjects’ responses to a decision rather than their valuation.

### **Incentive Compatibility of Auction Mechanisms**

In implementing an experimental auction, selecting which mechanism to employ becomes a crucial decision because researchers are often restricted by time and monetary



constraints. However, the most important factor to consider in this regard is the incentive compatibility of the auction mechanism. An auction mechanism is incentive-compatible if it induces each bidder to submit a bid that sincerely reflects his or her true value for the good (Lusk and Shogren 2007). The advantage of using an incentive-compatible mechanism is that it gives a better approximation to real market conditions, as real products and real money are exchanged.

As the researcher cannot force participants to give truthful responses, Myerson (1979) points out that a mechanism should be designed in such a manner that it does not provide incentives for dishonesty; however, if participants do not perceive an opportunity to win, then their incentive to reveal truthful values is reduced even if the auction is demand revealing in theory (Shogren et al. 2001). At the same time, subjects should perceive the rewards offered by the experimenter as substantial enough to reveal true information; otherwise hypothetical bias will exist due to their lack of motivation. In particular, subjects answering hypothetical questions may perceive their utilities as being affected by their responses, causing biased results. Cummings et al. (1997) suggest using “instrumental calibration” as a solution to mitigate hypothetical bias. Calibration of WTP estimates was proposed most prominently by the National Oceanic and Atmospheric Administration (NOAA 1994, 1996). They use a formula that corrects any differences between estimated and actual WTP. The NOAA proposed to deflate hypothetical WTP values by dividing them by 2, unless the estimates can be calibrated using actual market data. However, the empirical basis for this 50% calibration is unclear and it has not been universally accepted. Empirical results indicate that

calibration factors differ across several elicitation methods; for example, calibration factors obtained from Vickrey second price auctions are greater than those from random nth price auctions (List and Gallet 2001). Loomis (2011) suggests a calibration procedure based on meta-regression analysis (MRA), where the calibration factor may vary by aspects that influence the magnitude of the hypothetical bias (e.g. public versus private goods, WTP versus WTA).

At least two other approaches are used in discrete choice field experiments to reduce hypothetical bias: “cheap talk” and certainty adjustment. Cheap talk refers to an explicit discussion by researchers of the hypothetical bias problem prior to conducting the experiment (Cummings and Taylor 1999). Certainty adjustment refers to the removal of uncertain responses after asking the individuals how certain they are about their responses. Blumenschein et al. (2008) suggest that hypothetical bias can be removed using a certainty approach and that the cheap talk approach is not effective in the reduction of hypothetical bias. In contrast, List (2001) suggests hypothetical bias can be eliminated by an appropriate cheap talk design.

Given the inconsistency of findings on the effectiveness of cheap talk and certainty adjustment results in reducing hypothetical bias, approaches based on eliciting honest answers started to be investigated. De-Magistris, Gracia and Nayga (2013) proposed an approach to mitigate hypothetical bias in hypothetical CEs, by using a “honesty priming” task. The approach consists on the automatic activation of individual’s honesty without the need for a direct consent. The only requirement is the detection of a stimulus event or object by the individual. The authors suggested that the

honesty priming task can indeed reduce hypothetical bias in hypothetical choice experiments. Specifically, they reported a lower Marginal WTP in the honesty priming treatment than in the baseline hypothetical CE treatment without honesty priming.

Hayes et al. (1995) conducted a non-hypothetical experimental auction to replicate the purchase decisions made by consumers in retail stores. The authors argue the realism of the experiment is due to the use of real goods, real money, repeated participation and market discipline, creating an environment of tangible incentives. An experimental auction is non-hypothetical when the economic values stated by the subjects have real monetary consequences (Jaeger and Harker 2005).

### **Auction Mechanism**

Previous experimental studies have employed a variety of methods to measure consumers' WTP; however, those studies differ mainly in the auction mechanism used to determine the market price and auction winner(s). The mechanisms that have been employed in the literature include: Vickrey second price sealed bid auction, random nth-price sealed bid auction, first price sealed bid auction, Becker-DeGroot-Marschak (BDM), English auction, and Dutch auction (Lusk et al. 2001). Although these auctions differ in the procedures implemented, most of them yield the same result in theory (Lusk and Shogren 2007). Descriptions and implications of those mechanisms will be elaborated on later sections.

The English or "ascending bid" auction starts at a relative low price and bid offers are accepted from participants until no further bids are submitted and the product is sold to the last and highest bidder (Frahm and Schrader 1970). In contrast, the Dutch

or “descending bid” auction starts at a high price and is lowered by the auctioneer until one of the bidders accepts the last price offering (Coppinger, Smith and Titus 1980). A comparison between these two type of auctions concluded that prices generated in English auctions were more variable than those generated in Dutch auctions. It is not possible to conclude that either auction type results in a higher price (Frahm and Schrader 1970).

In a first price sealed bid auction, the subject who submits the highest bid is the winner of the auction and he pays a price equal to his own bid (Vickrey 1961). Recent work in private value auctions has been geared towards explaining the overbidding behavior evident in first-price auction (e.g., Nuegebauer and Selten 2006; Ozbay-Filiz and Ozbay 2007), with contradictory results across experiments. As a solution, Lusk and Shogren (2007) suggest the use of incentive compatible mechanisms such as the Vickrey sealed-bid second price auction, in which participants’ bid reflects exactly their value or WTP for the good. In a sealed-bid second price auction, the subject who submits the highest bid wins the auction but pays an amount equal to the second highest bid for the good (Vickrey 1961). This method has been widely used by researchers due to its demand revealing nature, and the presence of an endogenous market clearing-price. Several experimental studies have shown that subjects tend to overbid in this type of auction (Bernard 2005). Another incentive compatible auction that has been used to elicit consumer WTP in pre-test markets is the Becker, DeGroot, Marschak (BDM) mechanism. With the BDM mechanism, an individual bids against a uniform randomly drawn price, and if the bid is higher than the randomly drawn price, he or she purchases

one unit of the good (Wertenbroch and Skiera 2002). Rousu and Thrasher (2012) state that the BDM auction is demand revealing in that the participants have no incentive to misstate their true value as the market price is determined by a random draw, and not by their bid.

Shogren et al. (2001) introduced the random nth price auction as a combination of the sealed-bid second price auction and the BDM mechanism. In a random nth price auction,  $N$  individuals bid on an item and after bids are submitted, one of the bids is randomly drawn from the sample. All individuals with bids greater than the random nth bid win the auction and pay a price equal to the random nth bid. This auction utilizes qualities from both the BDM and the second price auction by giving all participants a reasonable chance of winning and making them bid against each other (Lusk, Alexander, and Rousu 2007).

Although there is a general agreement on the need to employ elicitation mechanisms that are incentive compatible, theory provides little guidance as to which mechanism should be preferred over another. Theoretically, all mechanisms should yield the same result with people submitting bids equal to their real values. Previous studies suggest that these mechanisms can yield divergent results. Much of the findings seem to relate to how well a mechanism performs for people with high values to those for people with low values in various auction mechanisms.

### **Previous Studies Combining Experimental Auctions and Product Tasting**

Studies have followed several ways to combine experimental auctions with sensory analysis. Some have done so by using a single round experimental auction to

measure consumer willingness to pay for products when only sensory properties were known (Umberger et al. 2002; Killinger et al. 2004). Other studies have used multiple auction rounds in which different product information is revealed in each round and in one of the auction rounds panelists actually taste the products (Chern, Kaneko, and Tarakcioglu 2003; Combris et al. 2009; Napolitano et al. 2008).

The experiments that used a single round experimental auction found that the subjects who report a preference for a particular product, based on overall acceptability ratings, were willing to pay more for that product. Umberger et al. (2002) conducted an experimental auction to elicit Chicago and San Francisco consumers' willingness to pay for beef flavor from U.S., corn-fed beef versus Argentine, grass-fed beef. In the experiment, panelists were asked to taste and to rate paired steak samples. Then, they were asked to bid on each steak. On average, consumers were willing to pay a price premium for their preferred steak. Sixty-two percent of participants preferred the U.S. grown steak to an Argentine steak and they were willing to pay a price premium of \$1.61 per pound for the U.S. steak. On the other hand, 23% of participants preferred the Argentine steak and they were willing to pay a price premium of about \$1.36 per pound. Killinger et al. (2004) conducted a sealed-bid second price auction to measure consumer acceptance and willingness to pay for beef strips with different levels of marbling but with similar tenderness. Based on overall acceptability ratings, participants were divided into three categories: 1) those that had a consistent acceptance for high marbling, 2) those who consistently found low marbling more acceptable, and 3) those that were indifferent. Both consumers who found high-marbled steaks to be more acceptable and

consumers who found low-marbled steaks to be more acceptable were willing to pay more for their preference.

Studies consisting of multiple auction rounds to reveal preferences for food products, demonstrate that the sensory properties of the product have a large effect on consumer willingness to pay. Nalley, Hudson, and Parkhurst (2006) conducted a uniform 5<sup>th</sup> price auction to elicit values for sweet potatoes and found differences in consumers' WTP before and after tasting. The three auction rounds conducted were visual valuation, taste, and health information. Subjects participated in one of two experimental auction treatments in which production location origin was known or unknown for the first auction round. For the unknown-origin treatment group, there was a negative effect between the visual and the taste round for two out of three products, meaning that WTP for those products decreased following tasting. In the treatment group where the origin was known, there was a significant negative effect just for one of the products. Similarly, Combris et al. (2009) used an experimental auction mechanism to analyze how much sensory properties and label information impact consumers' valuation of Chardonnay wines. Two groups of subjects participated in the experiment, subjects were selected from the general population and a group of sensory experts. The two groups participated in sequential auction rounds that served different purposes: the first was to assess their WTP for wine based on label information, and the second to assess WTP on label information in conjunction with tasting. No significant differences were found between the mean bids in those two scenarios. For sensory experts, there was not a significant difference in the mean bids for each sample after tasting the products. After

examination of the product labels, sensory experts appeared to be very sensitive to the label with “Appellation of Origin” information. After the last treatment when experts could see the bottles of wine and tasted it again, their WTP was closed to their bids after blind tasting. The authors conclude that although participants seemed to be highly responsive to product labels, they often relied on their own sensory evaluation rather than the labels when they became fully informed.

Napolitano et al. (2008) used a second price Vickrey auction to investigate whether consumers are willing to pay extra costs for higher animal welfare standards. Participants were asked to state their WTP for plain and low-fat yogurts under three different treatments: blind tasting of the products, information about animal welfare, and tasting in conjunction with animal welfare information. Information about animal welfare was provided to consumers through labels that indicated the level of animal cleanliness and freedom of movement. Consumers were willing to pay higher prices for products with labels indicating high welfare standards compared to yogurts with labels reporting intermediate and low welfare standard. However, consumers’ WTP for low-fat yogurts with labels indicating high welfare standards decreased after tasting. The authors concluded consumers are willing to pay for higher animal welfare standards only if the product quality is acceptable. Additionally, Chern, Kaneko, and Tarakcioglu (2003) conducted a second-price Vickrey auction to elicit consumers’ WTP for orange juice processed with pulse electric field (PEF) technology. In the first round, participants received information about the characteristics, including the processing technique, of PEF juice and three more substitute products, while they observed each one of the



products. In the second round they had the opportunity to taste each product. After tasting the products, consumers were willing to pay a price premium for the PEF juice over two of the substitutes. Despite the positive aspects described for the PEF processing technique, the mean bid prices for the PEF juice declined by 17% after tasting. Similarly, Collart and Palma (2013a) conducted a non-hypothetical second-price Vickrey auction to measure consumer's preferences for specialty melons. In one of the non-hypothetical rounds, subjects had the opportunity to taste all the melon varieties and submitted the corresponding bids. The mean bids for all melons decreased after the tasting treatment, though the effect was not statistically significant for almost all products. McAdams et al. (2013) used an 11<sup>th</sup>-price sealed-bid auction to explain willingness-to-pay for novel food products and found the flavor of the products had a positive influence in WTP, as evidenced by a price premium of \$0.12 following the tasting treatment.

### **The Effect of Information on Consumer Preferences**

Previous studies have found that providing information to consumers influences their preferences. Brown and Schrader (1990) created a cholesterol information index based in medical literature and found that information about the relationship between cholesterol and cardiovascular diseases significantly lowered egg consumption. Ippolito and Mathios (1990) analyze the impact that advertisement about health benefits of fiber had on the ready-to-eat cereal market. The authors observed the market prior to and after the health advertising and found that in fact the market shifted to higher-fiber cereals and that the content of fiber in cereals also increased. Verbeke, Ward and Viaene (2000) evaluated the impact of television media on consumer preferences toward red meat

consumption since the outbreak of bovine spongiform encephalopathy (BSE) in Europe. They found that television coverage had a significantly negative effect on meat demand, with younger people and households with young children being the most susceptible to media coverage. In an experiment conducted by Lee, Frederick and Ariely (2006), patrons of a pub evaluated two beer samples: regular beer and beer adulterated with few drops of balsamic vinegar. The first group did a blind tasting while the second and third groups were informed of the added vinegar content either before or after the tasting. The preference for the adulterated beer was higher in the blind tasting than in either of the two other information treatments. When the information about the added balsamic vinegar was disclosed before the tasting, only 30% of consumers preferred the adulterated beer; and, when the information was disclosed after the tasting, 52% of consumers showed a higher preference for the beer with balsamic vinegar. The authors concluded that the disclosure of information affected consumer preferences by influencing the experience itself. McClure et al. (2004) stated that subjects who had a coke beverage from a cup with the brand label had a higher rating for the product than those who were served with an unmarked cup. Fox, Hayes and Shogren (2002) reported in their study that positive information increased consumers' WTP while negative information had the opposite effect. These studies indicate that providing consumers with information about the product prior to their evaluation has a significant effect on their preferences.

### *Consumer Attitudes Towards Healthy Foods*

Long term food trends in developed countries have resulted in a sustained

increase in consumption of all the major food groups. This increased demand has stimulated more competition among suppliers which has in turn led to product differentiation and price wars (Combris et al. 2009). The benefit to consumers from this came in the form of an abundant and diversified diet which has helped increase health conditions and well-being. This dynamic change and growth in the food industry came with disadvantages as well. The high abundance of cheap food has resulted in an increase in overweight, obesity, and related health issues; not to mention that product differentiation comes with claims and information that is often confusing to the consumer (Combris et al. 2009).

### **Overweight and Obesity in the US Population**

Obesity is a major concern for the health of Americans and many other nations and it has drastically risen since 1960 (Garrouste-Orgeas et al. 2004). The World Health Organization (WHO) defines “obesity as the condition of excessive fat accumulation that may impair health” (WHO 2014a). The principal causes of obesity are the intake of highly fatty food and physical inactivity (WHO 2014a). Overweight and obesity are generally classified using a body mass index (BMI), calculated as follows:

$$(1) \quad BMI = \frac{mass(kg)}{(height(m))^2}$$

The WHO definitions of overweight and obesity are based on the risks of increased mortality and morbidity rates. As presented in Table 1, a BMI below 18.5 kg/m<sup>2</sup> is defined as underweight; a BMI between 18.5 and 24.9 is normal weight.

Overweight individuals, those with a BMI between 25 and 29.9 kg/m<sup>2</sup>, and obese individuals, those of BMIs of 30 kg/m<sup>2</sup> or more, are at a highly increased risk of morbidity. Weight loss is recommended for overweight and obese individuals. Several studies show that BMI is correlated with total body fat content and obesity-related health risks (Wang et al. 2004). However, there is still a debate on whether population-specific BMI cut points are needed due to the variation of body fatness and fat distribution across populations (Visscher and Seidell 2001).

**Table 1. Body Mass Index Categories**

<b>Classification</b>		<b>BMI (kg/m<sup>2</sup>) Principal cut-off points</b>
<b>Underweight</b>	Severe thinness	<16.00
	Moderate thinness	16.00-16.99
	Mild thinness	17.00-18.49
<b>Normal</b>		18.50-24.99
<b>Overweight</b>		25.00-29.99
<b>Obese</b>	Obese class I	30.00-34.99
	Obese class II	35.00-39.99
	Obese class III	≥ 40.00

**Source:** Adapted from WHO, 1995, WHO, 2000, and WHO, 2004.

To date, fatness has universally been measured using BMI. The main advantages of using BMI are that the information needed to calculate it is easy to collect and relatively common in social science datasets (Burkhauser and Cawley 2008). Nevertheless, medical literature considers BMI a limited measure of fatness and obesity since it ignores body composition, resulting in a substantial misclassification of

individuals into weight classes (Burkhauser and Cawley 2008). As a result, more accurate measures of fatness have been undertaken in social science-based outcomes, including total body fat (TBF), percent body fat (PBF), waist circumference (WC), and waist-to-hip ratio (WHR); however, there is no consensus in the medical literature on which of those measures of fatness is best (Freedman and Perry 2000).

### **Prevalence and Time Trends**

In 2009-2010, more than 69% of the US population was overweight ( $BMI \geq 25 \text{ kg/m}^2$ ) with around 36% in the obese category ( $BMI \geq 30 \text{ kg/m}^2$ ) (National Center for Health Statistics 2013). The National Health and Nutrition Examination Survey (NHANES) tracks the prevalence of obesity in the United States (Wang and Beydoun 2007); showing a marked increase in adult's obesity between the first survey cycle in 1960-61 and the third cycle 1988-94 (Flegal et al. 1998). The prevalence of overweight increased only slightly from 37.8% to 39.4% in men and from 23.6% to 24.7% in women, from 1960 to 1994. However, the prevalence of obesity increased from 10.4% to 19.9% in men and from 15.1% to 24.9% in women, during the same time period.

In the United States, the majority of the data available on obesity comes from the Centers for Disease Control (CDC) and Prevention telephone survey data. From 1991 to 1998, adult's obesity increased by around 50%, with higher prevalence rates occurring in eastern states. However, these absolute prevalence rates may be underestimated since they are based on self-reported weight and height (Mokdad et al. 1999). Overweight participants in self-reported studies tend to underreport their weight (Rowland 1999).

Data from the 2003-2004 NHANES shows that approximately 66 million American adults are obese and an additional 74 million are overweight. Assuming that the same trend continues, by 2015, 2 in every 5 adults and 1 in every 4 children in the US will be obese (Wang and Beydoun 2007).

### **Morbidity and Mortality Associated with Obesity**

Obesity has been considered a risk factor not only for morbidity but also for mortality. Worldwide, overweight and obesity are the fifth leading risk for deaths. Approximately, 2.8 million adults die each year as a consequence of being overweight or obese (WHO 2013a). However, the relationship between BMI and mortality is still unclear (Malnick and Knobler 2006).

Obesity is associated with several non-communicable diseases such as diabetes, hypertension, high cholesterol, stroke, heart disease, certain cancers, and musculoskeletal disorders (Malnick and Knobler 2006). At the same time, obesity affects individual's physical and social functioning and quality of life (Visscher and Seidell 2001), due to social stigmatization and discrimination (NIH, 1998). The WHO International Agency for Research on Cancer has estimated that overweight and inactivity account for a quarter to a third of all breast, colon, endometrium, kidney and esophagus cancers (Vainio and Bianchini 2002). A study conducted with more than 900,000 U.S. adults found that members with a BMI of at least 40 kg/m<sup>2</sup> had higher death rates from all cancers combined than those with normal weight. Men were at increased risk of death from stomach and prostate cancer, while women were at increased risk of death from cancers of the breast, cervix, uterus and ovary. The authors

estimated that overweight and obesity in the United States could account for 14% of all deaths from cancer in men and 20% in women (Calle et al. 2003).

In addition to the link between obesity and increased risks for cancer, obesity is considered a risk factor with a strong impact on cardiovascular diseases (CVD) (Kannel 1997). An increased risk of coronary artery disease (CAD) in overweight people was apparent in the Framingham Heart Study and the Nurses Health Study (Wilson, et al. 2002). The Nurses Health Study reported that the relative risk for CAD increased from 1.19 at a BMI of 21-22.9 kg/m<sup>2</sup> to 3.56 at a BMI >29 kg/m<sup>2</sup> (Sjöström et al. 2004). It also reported a significant relationship between high BMI levels and the onset of ischemic stroke (Rexrode, et al. 1998). According to the Framingham Study, coronary disease can be decreased by 25% and stroke and heart failure incidents by 35% by maintaining an optimal weight (Hubert et al. 1983). A 20% weight reduction in the obese could confer a 40% reduced risk of a coronary event (Hubert et al. 1983).

Besides its role in causing CVD, obesity is also considered one of the most important factors causing type 2 diabetes “mellitus” (Visscher and Seidell 2001). Based on the Nurses’ Health Study data, women with BMIs higher than 29 kg/m<sup>2</sup> and men with BMIs higher than 31 kg/m<sup>2</sup> were at increased risk of developing type 2 diabetes mellitus. Also, moderately overweight people were more susceptible to develop type 2 diabetes (Carey et al. 1997). According to WHO, diabetes can be avoided in 64% of men and 74% of women in the US by maintaining a BMI 25 kg/m<sup>2</sup> or lower (WHO 1997). It has been predicted that the number of diabetics worldwide would increase from 135 million in 1995 to about 300 million in 2025 (Seidell 2000). At the same time, obesity

constitutes an important risk factor for musculoskeletal disorders, making osteoarthritis in knees and hip joints the most common traumas related to excess body weight (Malnik and Knobler 2006).

Colditz (1999) estimated that the direct costs of obesity are now around 7% of total health care costs in the United States and around 1% - 5% in Europe (Seidell 1995). Given the link between obesity, mortality and morbidity, obesity is now recognized as one of the most serious public health challenges facing the U.S. (U.S. DHHS 2001). The rapid increase of the obesity epidemic points to the urgent need for strategies to develop global and national programs in order to prevent and manage its occurrence (Visscher and Seidell 2001). Such programs should focus on the development of supportive environments and communities where healthy foods and regular physical activity are accessible, available and affordable for all the population (Kumanyika, et al. 2008). This would imply, for example, restricting the food industry to promoting healthy diets for the consumer by controlling the fat, sugar and salt content of their processed food commodities (WHO 2014b).

The increasing healthcare costs have raised consumers' desire to protect their health. The progressing scientific evidence that diet can alter disease prevalence has pushed the consumers' attention towards healthy diets and food products that provide additional health benefits beyond the provision of basic nutrients (Hu, Woods and Bastin 2009). A clear example is the demand increase of the so-called "functional foods", which include whole foods and foods enriched or fortified with health-promoting additives (Hasler 2002). Barreiro-Hurlé, Colombo and Cantos-Villar (2008) used choice



experiments to measure consumer's WTP for a red wine product enriched with resveratrol (a phenolic antioxidant), and found a 55% premium over the control, non-enriched alternative. Similarly, Markosyan, Wahl, and McCluskey (2007) used a contingent valuation technique to evaluate the use of a coating rich in antioxidants on apples and found a positive attitude towards functional foods in general. McAdams et al. (2013) conducted an experimental auction to study consumer preferences for functional foods such as pomegranate fruits and other pomegranate products. The authors reported that after participants were provided with information about the potential health benefits of pomegranates and their potential anticancer properties, their WTP increased by \$0.09 and \$0.10, respectively. Health benefits in functional foods are considered credence attributes because they cannot be observed directly by consumers even after consumption without incurring in prohibitively high costs (Darby and Karni 1973). This causes the decision maker to base their decision on the information possessed and the level of confidence of such information which is usually obtained from the product's label (Azzurra and Paola 2009). Caswell and Mojdzuska (1996) state that food labeling helps consumers in the case of credence goods. As consumer demand for agricultural food products becomes more complex and dynamic, food labeling is becoming more and more important in food marketing (McCluskey and Loureiro 2003). Consumer decisions are constantly being shaped by the information they obtain from food labels on different products (Lancaster 1966). As a result, agricultural economists have adopted new theories that identify how information influences food demand (Unnevehr et al. 2010).

Organic foods are similar to functional foods in that they are both credence attributes. Organic food has been occupying a bigger market share in the food industry recently. It is the fastest growing sector of the American food industry and demand is primarily driven by consumer concern and awareness over the quality of the food they purchase (Cunha and Moura 2004). Many surveys of consumer attitudes have been conducted to identify the reasons for this increased trend (Thompson 1998). In general, preference for organic food has been associated with an increased interest towards personal health, animal welfare, and environmental protection.

### **Organic Foods Tendency**

The term “Organic Foods” denotes products that have been produced in accordance with the principles and practices of organic agriculture (Bourn and Prescott 2002). The U.S. Dept. of Agriculture (USDA) defined Organic Agriculture as an ecological production management system that promotes and enhances biodiversity, biological cycles, and soil biological activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain, and enhance ecological harmony. The principles of organic production encourage the avoidance of synthetic fertilizers and pesticides, sewage sludge, irradiation, and genetic engineering techniques.

The organic standards state that a USDA-accredited certifying agent must verify all organic operations before products can be labeled as USDA organic. Certification assures that a product was raised, processed and distributed to meet the official organic standards and also reduces the practice of falsely labeling products as organic. All foods labeled with the USDA organic seal must come from a certified farm or handling

operation. The USDA organic seal verifies that the product has 95% or more organic content. The other 5% should come from the National List of Approved Substances. Products label as “100% organic” must contain only organically produced ingredients and may also use the USDA organic seal. Products that contain at least 70% organic ingredients can be labeled as “made with organic ingredients” and may list up to 3 of those ingredients on the principal display panel; however, those products cannot use the USDA organic seal. Products with less than 70% organic ingredients may only list which ingredients are organic on the information label ( USDA 2013a).

### **Organic Foods Market**

Agricultural products were thought of as homogeneous in the past while today various types of agricultural products are being sold in differentiated markets where their attributes are being marketed to different consumers (Bernard and Bernard 2010). One food category that has seen tremendous growth is the organic sector. Over the last decade, the U.S. market for organic foods has been growing at a rate of 20% per year (Dimitri and Greene 2002). Of the total amount of U.S. sales of organic products, fresh products accounted for the largest share, making fresh organic fruits and vegetables the first organic products purchased by consumers (Oberholtzer, Dimitri, and Greene 2005). Of those fresh organic fruits and vegetables, the ones that head the list in terms of sales in the United States are tomatoes, leafy vegetables, carrots, apples, potatoes, peaches, bananas, and squash (The Packer 2002).

As a result of an increase in consumer’s demand for convenient and high quality fresh products, suppliers are increasingly introducing new varieties and retailers are now

offering many fresh, organically produced items. Therefore, organic products are becoming more accessible to consumers as supermarkets, natural food stores, and conventional channels continue to add them to their shelves.

In the USA, about 65% of the population has tried organic foods and beverages (Bernard and Bernard 2010). Americans consider food safety, freshness, health benefits, nutritional value, effect on environment, and support for small and local farmers as the most important reasons for buying organic foods (Whole Foods Market 2005). Such consumers are willing to pay the 10% to 40% price premium that the organic products command (Winter and Davis 2006). Batte et al. (2007) reported the magnitudes of the WTP premiums varied significantly among consumer groups, with specialty grocery consumers willing to pay higher premiums for organic foods than traditional grocery shoppers. The authors described specialty grocery consumers as younger consumers, with higher education, higher incomes, less likely to be non-white and much more likely to be vegetarian or vegan. However, for both groups the results indicated an increasing WTP for foods as the percent of organic content rises. These findings support those of Pearson, Henryks and Jones (2010), who conducted a study in order to identify the characteristics of organic food buyers and found they are in general females with a higher level of education, who have young children living in the household. At the same time, they may be more likely to grow their own fruits and vegetables and be vegetarian or vegan. On the other hand, the price premium, lack of knowledge, and product variability play the role of preventing consumers from buying organic products (Demeritt 2002).

## **Organic Foods vs. Conventional Foods**

Numerous factors have been investigated in studies comparing organic and conventional foods, including product quality, economics, nutritional value, agronomic factors, farm management practices and environmental impact. In order to fully compare both systems of production a broader discussion of the issues above mentioned is necessary.

### ***Quality and Safety Comparisons of Organic and Conventional Foods***

#### ***Pesticides***

Consumers have become increasingly aware of the damaging impacts of pesticide use (Weaver, Evans and Luloff 1992). According to a recent survey, 70% of consumers said that they purchased organic foods to avoid pesticides (Whole Foods Market 2005). The organic food industry has emphasized the difference between organic foods and conventional foods with respect to pesticide use and residues. In an organic production system, the use of synthetic substances is permissible only when they do not contribute to soil, water or crop contamination and when other organic pest control practices are not sufficient. The restrictions and limitations in the use of such pesticides should result in fewer pesticide residues in organic crops compared to conventional crops. However, the number of studies that focused on specific differences between pesticide residues on organic and conventional foods is limited (Winter and Davis 2006). Baker et al. (2002) analyzed three different data sets in order to compare pesticide residues on organic and conventional products and found that organically grown products are less likely to contain pesticides than conventionally grown products. For

example, from the USDA dataset they calculated that 23% of organic samples compared to 73% of conventional samples contained pesticide residues. In this data set, organically grown samples contained residues about one-third as often as conventional samples did. The authors also posit that when residues are present, organic products are less likely to contain multiple residues than conventional products. From the USDA dataset, 46% of conventional samples had multiple residues compared to just 7% of organic samples. In particular, they found 3.0 residues on average in conventional apples, 2.9 residues on conventionally grown peaches, 2.6 residues on conventional celery, strawberry, and sweet bell pepper samples, and 2.3 residues on conventional pears. Organic samples had no residues or a single residue in 15 of 20 cases. Although current growing conditions do not allow organic products to completely avoid pesticide residues, choosing organic food can be a precautionary step to lower risks.

Occupational exposure to pesticides presents a much greater health risk than consumer exposure to pesticide residues. Hence, Organic production provides a measure to reduce illness and injuries in agricultural workers. Also, as organic production limits the use of pesticides it may have a more positive environmental impact than conventional production since pesticides detected in water and air can be a potential risk for organisms such as mammals, birds and fish (Winter and Davis 2006).

The role of the use of pesticides in consumer interest in organic produce has been directly analyzed in several studies. Huang (1996) surveyed Georgia consumers to analyze their preferences toward organically grown produce. The author reported that 45% of the respondents ranked pesticide residues as their main food concern over food

safety hazards. This played as the primary motive behind Georgia's consumer preferences of organic food over conventional food produce. These results support those of Hwang, Roe and Teisl (2005), who analyze ratings of concern toward eight different production technologies and found pesticide use to be the highest consumer concern. Additionally, Govindasamy and Italia (1999) stated that 60% of respondents reported that pesticides are dangerous to human health. Thirty-five percent of respondents would be willing to pay a premium to obtain organic produce.

Several other studies have examined consumer's WTP for pesticide-free fresh produce. Weaver, Evans, and Luloff (1992) conducted interviews at retail grocery locations in order to determine the level of concern consumers have over pesticide use in tomato production and their WTP for chemical pesticide residue-free tomatoes. They found consumers presented high levels of concern about potential harm caused by chemical pesticides and more than 25% of respondents were willing to pay a price premium of more than 15% for pesticide-residue free tomatoes than the price of typical commercial tomatoes. These findings support those of Misra, Huang and Ott (1991), who reported consumers surveyed expressed concern about the use of pesticide and they preferred fresh produce to be tested and certified as free of pesticide residues. However, consumers in general were not willing to pay a premium for fresh produce certified as free of pesticide residues. Palma, Rivera, and Knutson (2014) conducted a choice experiment to evaluate consumer's preferences and willingness to pay for fruit and vegetable attributes, including health benefits, production method, origin, variety, among others. Related to the production method attribute, the authors found consumers had a

negative perception on the use of pesticides in a conventional production method, which was evidenced in a price premium of \$1.04 for pesticide-free fruit and vegetables. In a survey conducted by Baker (1999), consumers were willing to pay for a reduction in pesticide usage in fresh apples. They also accepted some deterioration in the quality of the product as a consequence of the lower use of pesticide as they associated the use of pesticide with a risk of contracting cancer. Bernard and Bernard (2010) conducted an experimental auction in order to measure consumer WTP for conventional and organic potatoes and sweet corn and various versions of those products that featured two characteristics – no pesticide use and non-GM. The authors reported that consumers were actually willing to pay a significantly higher price for the organic products but the premiums for the different versions were not as significant suggesting WTP for attributes is not additively.

#### *Nutritional Value*

Some studies suggest that the motivation to purchase organic and natural products derives from environmental concerns; however, most recently researchers conclude that the primary motive is related to health concerns (Huang 1996). According to the 2005 Whole Foods Market Organic Trend Tracker, 67.1% of consumers are buying organic foods and beverages for health and nutrition reasons. Many respondents believed that organic foods and beverages are “better for their health”. This expectation amongst consumers has led researchers to look for evidence that supports this assumption. Since then, researchers have been comparing organic foods with those



grown conventionally, finding that on average, organic products are more nutritious than conventional products (Chang 2012).

Three major review articles regarding organic foods versus conventional foods have been published. Recently, Woese et al. (1997) evaluated 150 comparative studies published between 1926 and 1994, which examined the nutritional quality of organically and conventionally grown foods. The review includes foods such as cereals, potatoes, vegetables, fruits, nuts, oil seeds, bread, meat, eggs, honey, and dairy products. The authors concluded that no major differences were observed in nutrient levels between the different production methods and those contradictory findings did not permit any clear statements. Worthington (2001) reviewed articles that compared the nutrient content of organic and conventional crops and reported that organic crops contained significantly more vitamin C, iron, magnesium, and phosphorus and significantly less nitrates than did conventional crops. Bourn and Prescott (2002) reviewed several studies that analyzed the effect of inorganic and organic fertilizers on the nutritional value of crops. They concluded that even though the majority of studies have used an acceptable experimental design, the study designs and results are too variable to make clear conclusions about the mineral and vitamin content of crops.

Recently, researchers from Stanford University conducted a similar review of numerous studies regarding the health effects of organic and conventional foods (Chang 2012). They concluded there's no strong evidence to suggest health benefits from consuming organic versus conventional foods, although organic products may reduce the exposure to pesticide residues. They found no large differences between organic and

conventional products regarding vitamins and minerals content. While many studies demonstrate some qualitative differences between organic and conventional foods, it is premature to conclude that either food system is superior to the other with respect to nutritional composition (Winter and Davis 2006).

Research points out that consumers who are more concerned with their health are more likely to pay higher premiums for healthy food products than those who are not as concerned. Batte et al. (2007) reported that consumers with a higher health concern index were paying a premium for organic food that was 70-90% more than those with lower index values. Even though the nutritional value of organic food has been widely analyzed, the unclear and contradictory results across experiments have failed to establish a definite conclusion regarding the health effects of organic food.

#### *Sensory Properties*

Recently, a number of studies have set up to assess the effects of organic growing methods in the sensory properties of foods. Bourn and Prescott (2002) made a review of the major articles that include a sensory comparison between organic and conventional foods. The sensory evaluation techniques used in such studies were as follows: 1) discriminatory tests, to test for the presence of differences; 2) descriptive analysis, that use trained panels to describe the nature and quality of any differences that may be present; and 3) preference analysis techniques, which reflect relative degrees of liking. The authors reported there is unclear, contrasting evidence for sensory differences between organic and conventional foods. For example, some studies reported that consumers perceived no difference between organic food and conventional food (Maga,

Moore and Oshima 1976; Schutz and Lorenz 1976), while other studies report differences in the sensory characteristics of organic products versus conventional products (Vogtmann 1988; Weibel et al. 1999). The authors concluded that some of the contradictory findings from the various comparative studies have been attributed to differences in research methods and experimental conditions. However, it is relevant to point out that the studies did not use WTP measures to quantify the sensory differences between organic and conventional foods.

### ***Production, Producer Price, and Profitability Comparison between Organic and Conventional Systems***

A supply side assessment of the difference between organic and conventional products is important especially for the environmentalist type consumer who is highly concerned about the general environment and for the humanist type consumers who are preoccupied with “factory farming” methods (Davies, Titterington and Cochrane 1995), and for consumers who tend to respond to the social benefits of organic production believing that conventional production systems can generate negative impacts on society (Yiridoe, Bonti-Ankomah and Martin 2006). Consumers favor organic products because they are perceived to be more environmentally friendly and support small scale agriculture and local rural communities (Williams and Hammit 2000).

Economic comparisons of the performance of organic versus conventional agriculture systems have generally focused on yield at a given time period. Unfortunately, many comparative studies of organic and conventional production focused on a single crop and a single year. Such results should be interpreted with

caution, since the performance of organic agriculture needs to be based on whole farm analysis (FAO, ITC and CTA 2001).

Overall, organic production systems generate lower yields compared to conventionally grown alternatives. Some studies report that the degree of yield loss varies and is dependent on several factors such as inherent biological characteristics of the land, farmer expertise, and the state of natural resources (FAO, ITC, and CTA 2001). For example, a study conducted in Denmark by Halberg and Kristensen (1997) reported organic crops have 20% to 30% lower yields compared to conventional crops. The authors attributed this difference to the lower nitrogen mineralization in organic soils, and pest and pathogen problems. A recent survey by Statistics Canada (2001) reported that yields for organically grown fruits and vegetables are generally inferior compared to those grown with alternative production methods. For example, organically grown raspberries and strawberries show a decreased yield of around 10%, whereas organic asparagus and lettuce incurred an average yield that was 55% lower than that of conventional crops (Parsons 2002). On the other hand, the survey found that average yield for organic blueberries, cranberries and pears were higher than conventionally grown alternatives. Parsons (2002) accredited this higher yield in those organically produced items to better control over weeds, pests and diseases. Yield comparisons provide a limited perspective of the different production systems. Profitability and financial viability would serve as better indicators in determining the techniques farm managers should choose. Unfortunately, only few studies have analyzed the long-term profitability of organic production systems (FAO/ITC/CTA 2001).

Profitability in organic agriculture depends on several factors such as input and labor costs, actual production costs, market conditions and the price premiums received for organic products. The transition from a conventional system to an organic system involves higher production and managerial costs due to the intensive use of labor, the specialized equipment required, and the higher prices charged to organic seeds and other inputs (Temple 2000). At the same time, marketing costs may be higher for organic products because of additional processing, transportation, and handling charges. (Ro and Frechette 2001). The additional production costs and the lower yields obtained in organic production are compensated by relatively higher producer prices (Yiridoe, Bonti-Ankomah, and Martin 2006). Studies consistently show higher revenues for organic production due to the premiums received (FAO/ITC/CTA 2001). The most recent survey conducted by the Organic Farming Research Foundation (OFRF) of certified organic farmers, reported that 41% of respondents received price premiums on all of their products sold, and 71% received a price premium on at least half of their sold products. Vegetable and fruit producers blamed many factors for their failure to receive price premiums on their organic products some of which are oversupply, competition from conventional products or cheap imports, and the low demand for organic products in some areas (e.g., corn and strawberries) (Walz 2004).

At the same time, price premiums can negatively affect consumer purchases (Misra, Huang, and Ott 1991). Organic products tend to command impressive premiums at a retail level being on average 20-100 percent more expensive than conventional products (Fox News 2012). In one survey, the main reason Americans are not consuming

more organics, is the higher price organic foods and beverages commanded (Whole Foods Market 2005). It has been observed that as premium increases, the number of consumers willing to pay decreases, because conventional products are always available as substitutes (FAO, ICT, and CTA 2001).

### **Consumer Perceptions and Willingness-to-Pay for Locally Grown Foods**

Another type of credence attribute considered in current studies is the locally grown attribute. Similar to the organic feature, consumers cannot evaluate this attribute through normal consumption of the food but rather must rely on proper labeling. Studies have shown that consumers often attached additional values to food produced locally. For example, Darby et al. (2008) conducted a conjoint analysis in order to measure consumer WTP for locally grown strawberries. The authors found that the grocery store customers were willing to pay an average of 64 cents extra for a carton of strawberries if they are labeled “Grown in Ohio”, while direct market shoppers were willing to pay a premium of \$1.17 per carton of strawberries that were locally grown over those that were labeled only as “produced in the U.S.” Similarly, Mabiso et al. (2005) used experimental auctions to solicit information about consumer’s WTP for country of origin labeling (COOL) “Grown in U.S.” in apples and tomatoes. They ascertained that on average consumers were willing to pay \$0.49 and \$0.48 per pound for U.S. grown apples and tomatoes, respectively. Brown (2003) found that more than half of consumers were unwilling to pay a premium for food products labeled as “locally grown” provided that the unlabeled product were of the same quality, whereas 16%, 5%, and 1% said they would pay more than 5, 10, or 25 percent premia, respectively. There are many reasons

behind consumers' price premiums for food products that are locally produced. A strong signal for this is the boom in farmers markets and specialty food stores that sell locally produced products across the U.S.

Consumers' attitudes towards high quality products and a desire for cultural identification have increased the demand for value-added products that carry a strong identification with a particular geographical region (Loureiro and McCluskey 2000). As a result, researchers have focused their studies on the consumer's acceptance of differentiated products emphasizing on the consumer's willingness to pay for local and organic products (Loureiro and Hine 2002).

According to La Trobe (2002), "local food should be produced and processed as locally as possible using diverse and sustainable agricultural practices and marketed through direct or short supply chains to local people, ensuring a fair price for producers and an affordable price to all people".

Locality and origin of product seem to be important attributes needed to differentiate and create new niche markets, especially for well-known products. Suryanata (1999) shows how growers have attached Hawaii-identity to their products (pineapples and macadamia nuts) as a strategy to capture niche markets. As a result, Hawaii has diversified its agriculture and marketed its products as "exotic". Patterson et al. (1999) studied the "Arizona Grown" program, showing a low level of consumer awareness towards the local promotional program; however, the majority of consumers indicated that they would prefer an Arizona product over products from other regions. Hu, Woods, and Bastin (2009) used a conjoint experiment survey to evaluate consumer

WTP for processed blueberry products, finding that consumers in Kentucky are willing to pay more for products made with Kentucky blueberries. Loureiro and Hines (2002) conducted a study in Colorado in order to assess consumer preferences for local, organic and GMO-free potatoes. The authors concluded that the “Colorado Grown” attribute shows the highest consumer acceptance and premium, however, in order to secure a higher premium, Colorado Grown potatoes must present a high quality. Wang and Sun (2013) conducted a conjoint analysis to determine consumers’ preferences for organic produce in Vermont. They reported that consumers were willing to pay a premium for organic apples and milk that were locally produced and certified by NOFA (Northeast Organic Farming Association).

Europe has also followed this movement and started creating Niche markets for regional products. This happened in the 1970s as a reaction to conventional agriculture after which organic food production was promoted. The main actors in this case were small scale and included NGOs, small growers, cooperatives, small specialized retailers such as organic retailers and they focused on Niche markets (Cordon et al. 2006). In a study conducted in Spain, Loureiro and McCluskey (2000) show how European consumers value locally grown products. The authors used local and foreign meat products to look at how consumers respond toward Protected Geographical Identification labels, finding that consumers were willing to pay a price premium for local meat; however, the premium depended on the quality of the product.

Previous research has revealed that consumers are generally positive about locally grown foods, perceiving that when they buy local products they are consuming



more authentic and higher quality products. At the same time, through buying locally grown produce, consumers feel they are supporting local producers and helping to revitalize rural economies. As the consumption of local products increases there also seems to appear environmental benefits because the fact that people buy products from local farmers and growers reduces the distance that food travels between producers and consumers, which in turn decreases environmental damage from transport pollution (La Trobe 2001). Burchardi, Schröder and Thiele (2005) used contingent-valuation estimates to determine consumer preference for locally produced fresh milk. They reported that consumers preferred fresh milk from local farmers as they thought it was more trustworthy and has a higher quality. They were also interested in supporting local producers. Similarly, in a survey conducted by Darby et al. (2008), consumers reported that taste, freshness, and supporting local producers were the top three reasons behind them purchasing locally grown foods.

Nowadays, small-scale decentralized direct markets known as “Farmers’ Market” have become popular as a way to purchase fresh foods directly from the producers. The number of US farmers’ markets rose from 1,755 to 8,144 from 1994 to 2013 ( USDA 2013b). According to the Agricultural Marketing Service of the USDA, the national average monthly sales at farmers markets were \$31,923 in 2005, with fresh fruits and vegetables as the most popular products customers purchased at the markets (Ragland and Tropp 2009). Farmers’ markets are characterized by farmers selling foods directly to the consumer, which brings additional benefits to consumers. As the food is often picked the same day or the day before, it does not require additives or preservatives to extend its

shelf life or keep it fresh. In this way, consumers have access to fresh, healthy and locally grown products. At the same time, consumers have the opportunity to talk to the farmers at the point of purchase and get all the information related to the products, increasing consumer confidence and trust in producers (La Trobe 2001). Results from the dot survey conducted by the Agricultural Marketing Service of the USDA in 2010, reported that the three main reasons consumers shop at farmers markets were freshness and taste (26.9%), supporting local agriculture (22.1%), and convenience (18.4%) (Ragland, Lakins and Coleman 2011). There are also benefits for the producers and farmers who sell their products at farmers' market. These include having more control over the price of the end product, receiving direct feedback from their customers, and being able to diversify their marketing outlets (Festing 1996).

A study researched by La Trobe on behalf of Friends of the Earth (2002), reported that the major consumer issues regarding local product purchasing are the lack of awareness of the benefits of local products and the lack of accessibility to them. At the same time, people perceive supermarkets present cheaper and more convenient options; they are not prepared to pay for organic or local food. In a survey conducted by Brown (2003) in southeast Missouri, consumers showed a level of support for locally grown produce, however, only 28% of consumers were willing to pay a higher price for local produce. From those households who were willing to pay a premium, the majority were raised in a farm, or their parents were raised in a farm or they were members of an environmental group. Also, those households had higher income and more education than the average household in the region. Similar to other studies, quality and freshness

were the most important attributes consumers in the region look for when purchasing local products.

Currently, researches have focused their studies on consumers' attitudes concerning domestic versus imported products. A study conducted in United Kingdom regarding consumers' behavior toward local, national and imported foods, reported there was a preference among respondents for local or national foods compared to imported alternatives. Consumers perceived local foods were healthier and tastier than other foods, however, they viewed local products as more expensive than national or imported foods. Overall, national foods were viewed as being of higher quality than imported foods, and cheaper than organic foods, being most often purchased by consumers (Zhao et al. 2007).

Several food products, specially fruits and vegetables, obtained at farmers market are seasonal. Seasonality in the food market refers to the availability of the product across seasons (Curhan 1974). Since some local food products are not available throughout the year, farmers should consider producing them locally. However, local production of all of the food products might entail excessive costs.

The increasing interest of consumers in particular food attributes has helped farmers to target specific production lines that produce various differentiated products containing attributes that appeal to those preferences and to be sold for the consumer who recognizes and values those attributes (Canavari, Nocella and Scarpa 2005).

This new trend towards healthier and specialty foods consumption has influenced mainly the fruits and vegetables sector. The Center for Nutrition Policy and Promotion

(CNPP), an organization of the U.S. Department of Agriculture, has been working in the improvement of the health and well-being of Americans by utilizing scientific research to better serve the nutritional needs of consumers. The Center creates four Food Plans (Thrifty, Low-Cost, Moderate-Cost, and Liberal) in order to promote healthy diets at various cost levels. With the Low-Cost Plan, USDA intends to show people how to eat a healthy diet, increasing their vegetable and fruit ingestion, in an economical way. The most recent results of USDA's Healthy Eating Index shows that Americans average intake of vegetables is about 59% of the recommendation and their average intake of fruits is 42% of the recommendation, which demonstrate that American diet need to be improved (USDHHS 2010). It has been shown that people can meet fruit and vegetable recommendations for about \$0.50 per cup (USDA nd). The National average retail price of fresh fruits and vegetables recommended for a 2000 calories diet (4.5 cup equivalent) is \$2.18. The least expensive fruits and fresh fruits and vegetables in the U.S. are watermelon, bananas, apples, peaches, potatoes, lettuce, eggplant, and tomatoes (USDA n.d.). The increase of health consciousness and people's interest in healthy diets, boosted U.S. fruits and vegetables consumption by more than 20% in 2000 compared to the 1970s. This impact was clearly noticeable in the case of tomatoes. Tomatoes are second only to potatoes in both U.S. farm value and vegetable consumption. The increase in domestic use and consumption of tomato and tomato products is likely the result of continued expansion in food-service demand, the rise of public awareness of the health benefits of tomato in the diet, and the highly publicized medical research linking diets rich in tomatoes and tomato products to reduced risk of various diseases (Lucier et al.

2000). Domestic producers seeking to take advantage of the potential opportunities of this market niche have started producing and selling new tomato varieties in the United States, which include fresh and greenhouse tomatoes.

For all those reasons, a closer look at the tomato industry from an agricultural, economic and social perspective is vital to understanding the elements that are causing this trend in production and demand. Also, by closely considering the factors influencing international trade in this industry we will be able to shed more light on the origin of the current trend and predict future trends in similar industries.

## **CHAPTER III**

### **THE TOMATO INDUSTRY**

#### **The Tomato**

Tomatoes (*Solanum lycopersicum*) are part of the *Solanaceae* or nightshade family (O'Connell 2008). Botanically, they are considered a fruit; however, the U.S. Department of Agriculture (USDA) classifies them as a vegetable. Tomatoes rank fourth among the world's leading vegetables in terms of production (Peralta and Spooner 2007). Tomatoes are the second most important vegetable crop in the United States, behind potatoes; and its consumption has significantly increased, either as a fresh, canned, frozen, or dried product (Taylor 1986). Historians considered tomato native of South America, from Ecuador to southern Chile; however, its seed was carried out north to Mexico, where the fruit was domesticated and popularized (Kelley and Boyhan 2010). In 1544, tomatoes were introduced in Europe, appearing initially as ornamental plants and finally accepted as a vegetable crop during the sixteenth century (Razdan and Mattoo 2007).

The demand and acceptance of the fresh tomato fruit is usually based on its flavor, aroma, taste, and nutritional characteristics. High quality is often associated with redness in color and prominence of flavor, which are attributes acquired when the fruit sugar content is at its maximum.

## *Fruit Quality*

### **Size and Shape**

The tomato fruit growth is exclusively through cell expansion, as the fruit pericarp and developing seeds accumulate carbohydrates. The size and shape of the fruit can vary depending on the genetic makeup, the cultivar, environment, and cultural practices; however, consumers usually expect tomatoes to be round and uniform in shape, and to weigh about 75 grams. Frequently, tomatoes grown for processing and canning are pear-shaped and have high solids content. Cherry tomatoes, on the other hand, weigh between 10 and 35 grams and contain sucrose as part of their sugar content, which is unusual in tomato fruit (Picha 1986).

### **Chemical and Nutritional Composition**

Compositionally, the tomato has a distinctive nutritional and chemical profile. It possesses important natural components such as vitamin C, vitamin A, fiber, potassium, and lycopene. Based on data by the United States Department of Agriculture (USDA) National Nutrient Database for Standard Reference, a tomato (weight of 62 g, Plum variety) has 11 calories, 0.55 g of protein, 0.7 g of fiber, and 0.12 g fat. It also contains 8.5 mg of Vitamin C (USDA 2011). The nutrition information of tomatoes is detailed in Table 2.

**Table 2. Nutritional Information of Red, Ripe, and Raw Tomatoes**

Nutrient	Unit	Value per 100 g	Cup, chopped or sliced Plum Tomato	
			180 g	62 g
Water	g	94.52	170.14	58.6
Energy	kcal	18	32	11
Protein	g	0.88	1.58	0.55
Total lipid (fat)	g	0.2	0.36	0.12
Carbohydrate	g	3.89	7	2.41
Fiber, total dietary	g	1.2	2.2	0.7
Sugars, total	g	2.63	4.73	1.63
Calcium, Ca	mg	10	18	6
Iron, Fe	mg	0.27	0.49	0.17
Magnesium, Mg	mg	11	20	7
Phosphorus, P	mg	24	43	15
Potassium, K	mg	237	427	147
Sodium, Na	mg	5	9	3
Zinc, Zn	mg	0.17	0.31	0.11
Vitamin C, total ascorbic acid	mg	13.7	24.7	8.5
Thiamin	mg	0.037	0.067	0.023
Riboflavin	mg	0.019	0.034	0.012
Niacin	mg	0.594	1.069	0.368
Vitamin B-6	mg	0.08	0.144	0.05
Folate, DFE	µg	15	27	9
Vitamin B-12	µg	0	0	0
Vitamin A, RAE	µg	42	76	26
Vitamin A, IU	IU	833	1499	516
Vitamin E (alphatocopherol)	mg	0.54	0.97	0.33
Vitamin D (D2+D3)	µg	0	0	0
Vitamin D	IU	0	0	0
Vitamin K (phylloquinone)	µg	7.9	14.2	4.9
Fatty acids, total saturated	g	0.028	0.05	0.017
Fatty acids, total monounsaturated	g	0.031	0.056	0.019
Fatty acids, total polyunsaturated	g	0.083	0.149	0.051
Cholesterol	mg	0	0	0

**Source: U.S. Department of Agriculture, 2011.**

Tomatoes are the richest dietary source of lycopene in the American diet, representing more than 85% of all dietary sources of lycopene consumed by Americans. As lycopene is one of the most potent antioxidants in foods, it has been associated with



the reduction of disease risk; therefore, the consumption of tomatoes in adequate amounts has also been related to some health benefits (Freeman and Reimers 2010). Giovannucci (1999) made a review of the major epidemiologic articles regarding intake of tomatoes and tomato-based products and blood lycopene level in relation to the risk of various cancers. Out of 72 studies, 57 have reported a negative correlation between tomato consumption, or blood lycopene level, and the risk of several types of cancers. The evidence was strongest for prostate, lung and stomach cancer. The author reported that even though lycopene may account for these benefits, a direct benefit of lycopene has not been proven, and evidence is accumulating to suggest that other potentially beneficial compounds in tomatoes may also be involved. Similarly, the US Health Professionals Follow-up Study reported an inverse relation between the intake of lycopene and the risk of prostate cancer. A 35% risk reduction was observed in subjects with weekly consumption frequency of 10 or more servings of tomato products and the results are more pronounced for subjects suffering from advanced prostate cancer (Rao and Agarwal 1998).

Growing evidence from several epidemiological studies indicates that lycopene might be more important than other carotenoids in preventing atherosclerosis and CVD (Kohlmeier et al. 1997). Mordente et al. (2011) made a systematic review of the major epidemiological and interventional studies evaluating the association between lycopene supplementation and cardiovascular diseases (CVD). Among 61 epidemiological studies identified, 35 (57%) studies found a significant inverse association between plasma or tissue lycopene levels and the incidence of CVD or CVD risk factors. However, due to

contradicting results and the limited number of randomized controlled trials published, it was not possible to support or refute the use of lycopene on the protection from cardiovascular disease based on the interventional studies. It has also been shown that nutrients with redox modulator properties, like lycopene, reduce the risk of chronic diseases including diabetes, neurodegenerative, and ocular disorders (Rao and Rao 2007).

The chemical composition of a fresh tomato is primordial in assessing the quality of the fruit, and it depends on several factors including cultivars, maturity, light, temperature, season, and production practices. One of the most important contributors to tomato quality in terms of flavor is its sugar content. The D-glucose and D-fructose are the main free sugars present in tomatoes, accounting for more than 60% of the solids in the fruit (Salunkhe, Jadhav and Yu 1974). While we observe both sugars in equal amounts, fructose has more of an impact on overall maximum sweetness. In general, the sugar content in tomatoes depends on its stage of maturity, and it increases uniformly from green mature to vine-ripe condition (Rosa 1925). On the other hand, the citric acid content is much more stable throughout the ripening period, and much of the acidity is found in the locular contents. Because the ratio of sugars to acids is such a significant factor in determining the taste of a tomato, these differences are highly important, and both high sugars and high acids are strongly desired traits (Seymour, Taylor and Tucker 1993). Similar to the sugar and citric acid content, the amount of antioxidants, such as carotenoids and anthocyanins, has been reported to be dependent on the ripeness of the tomato fruit (Sadler, Davis and Dezman 1990). The increase of the antioxidant

compounds during the tomato ripening process is often accompanied by fruit softening and a decline in tartness and astringency, improving the overall fruit palatability (Kalt 2005). In particular, lycopene content can increase to more than 7000 $\mu$ g/100g when tomatoes become overripe, soften, and begin to decay compared to immature green fruit, which presents less than 10 $\mu$ g/100g of lycopene content (Thompson et al. 2000). Additionally, the amount of pectin, calcium, and pectase in tomatoes plays a critical role in reaching a satisfactory texture. Appleman and Conrad (1927) reported that there is a progressive softening of the fruit during maturation process due to the decrease of protopectin and a corresponding increase in soluble pectin.

In order to maximize tomato production, a precise recommendation of the nutrient levels is necessary. Analysis concerning the nutrient composition of a typical tomato plant has shown that the fruit contains about 60% of the total N and K, with 25% presented in the leaves. In contrast to potassium, calcium is present in limited amounts, with only 5% fixed in the fruit (Adams 1986). The main factors limiting the calcium concentration in fruit cells are rapid growth, high salinity in roots, high humidity, low temperatures, and excessive use of ammonium-nitrogen (Adams 1990).

### **Taste and Flavor**

The flavor of a product is a combination of the volatile components detected by the nose and the taste compounds sensed by the tongue and adjacent tissues. The tomato taste is mainly determined by the sweetness given by its reduced sugars and sourness caused by the organic acid content. The harvesting of tomatoes before full ripeness has an effect on the peak sugar content and on the development of the full flavour spectrum,

thus affecting consumer acceptability (Stevens 1986) The volatiles, making up the tomato aroma, complement the taste components to give the flavour of the whole fruit. A typical aroma of field-ripe tomato is due to carbonyls (32%), short-chain alcohols (10%), hydrocarbons, long-chain alcohols, and esters (58%) (Shah, Salunkhe and Olson 1967).

### **Color**

For consumers, 'eye' judgment is often relied upon, causing color to be possibly the most important and reliable measure of tomato maturity. As a result, color plays a major role in the grade of raw and processed products. The red color of tomatoes depends on the total carotenoids content as well as the ratio of dominant pigments, *lycopene* (red color) and *beta-carotene* (yellow color) (McCollum 1955). Ferrari and Benson (1961) reported that *beta-carotene* and *lycopene* contribute 7% and 87%, respectively, of the carotenoids in a normal red tomato, with a pronounced effect on color produced by *beta-carotene*. As ripening proceeds, *lycopene* concentration will increase with a corresponding decrease in the yellowing contribution of *beta-carotene* (Dalal et al. 1965).

### **Tomato Production**

Over the last 25 years, tomato production has overtaken that of bananas, pome fruits, and grapes, making it second among the leading vegetables in the US in terms of production (Seymour, Taylor and Tucker 1993). Approximately 151 million tons of tomatoes are produced each year globally (FAO 2012), with the United States, Spain, Italy, and the United Arab Republic as the leading producers of this crop (Salunkhe, Jadhav, and Yu 1974). Much of the production, about 12 million tons, are processed into

various products such as ketchup, canned tomatoes, paste, puree, sauces, and vegetable cocktails. Another 1.8 million tons are produced for the fresh market (Kelley and Boyhan 2010).

The tomato is well known for being a crop easy to grow, perennial, self-fertile, and tolerant of both environmental and nutritional conditions. Its growing period takes around 90 to 150 days, with an optimum daily temperature of 18 to 25 C. Production under temperatures above 25 C, high humidity, and strong winds conditions, will result in reduced yields; thereby, dry climates are preferred for tomato production (FAO 2013). Tomato production can be divided into open field and protected agriculture. Most of the processing tomatoes are grown in open-field systems, while fresh market varieties are often grown in protected systems (Costa and Heuvelink 2005). Growers mostly prefer protected agriculture systems rather than open-field systems because it provides them with some degree of control over various environmental factors, such as controlling light, air temperature, humidity, and carbon dioxide levels in order to achieve higher yields.

There are two types of tomatoes commonly grown, the *determinate* and *indeterminate* varieties. Determinate tomatoes are commercial varieties that present a defined period of flowering and fruit development (Kelley and Boyhan 2010). In contrast, indeterminate tomatoes produce flowers and fruits throughout the life of the plant, and they are mostly greenhouse tomato cultivars (Hochmuth and Hochmuth 1990). The most common commercial varieties are the mature green and vine ripe tomatoes. Mature green tomatoes dominate the U.S. fresh tomato industry and food service market,

and are grown principally in Florida and California. Usually, mature green tomatoes present higher transaction cost as they received special treatments before marketing; however, consumers are willing to pay high prices for the product due to its firmness and long shelf life (Cook and Calvin 2005). Currently, other types of tomatoes are becoming popular in retail stores and food service markets including cherry, grape, pear, and organic tomatoes.

#### *Fresh Tomato Unit Costs*

The total cost of producing greenhouse tomatoes is significantly higher than that of field tomatoes because greenhouse production dictates higher investment and operating costs. The total initial investment cost of greenhouse production in the U.S. is estimated to be around 1.25 million dollars per hectare. However, greenhouse tomato yields average 500 metric tons per hectare in the US and Canada compared to field tomato yields of 36 metric tons per hectare in California and 34 metric tons per hectare in Florida. In addition, the most experienced farmers in the US and Canada can reach yields as high as 700 metric tons per hectare in greenhouse production. Yet, the cost per unit of greenhouse production remains consistently higher than that of field production in all respects. This resulted in large premium which was charged to greenhouse production in the past, but the scaling up of greenhouse production recently has decreased the price differential between those production types.

#### *The U.S. Tomato Industry*

Florida and California are the primary domestic sources of fresh field tomatoes in the United States; however, another thirty-one States produce fresh tomatoes

commercially. From 1994-96, Florida and California accounted for 43% and 30%, respectively, of the U.S. fresh tomato production (Love and Lucier 1996). In Florida, due to its humidity and warm climate, most of the production is harvested as mature green tomatoes, as the weather represents a limitation for growers to produce vine ripe tomatoes. On the contrary, in California, tomato production is increasingly focusing on vine ripe and specialty tomatoes. But much of its production is located on leased land in coastal areas with high rents, water costs, and environmental regulations, making the California industry not well suited to respond to the growing consumer demand for vine ripe tomatoes.

In the late 1990s, California and Mexican firms began to grow extended shelf life (ESL) vine ripe tomatoes. ESL vine ripe tomatoes presented higher quality in terms of color and softness than mature green tomatoes, intensifying the competition for mature green growers especially in retail channels (Thompson and Wilson 1997). In 2003, a vine ripe tomatoes shortage caused prices to increase significantly leading some Baja California growers to sell their greenhouse beefsteak tomatoes in the United States as vine ripe tomatoes. Consequently, the State established a legal definition of greenhouse tomatoes produced or marketed there.

The U.S. greenhouse tomato industry produces on a round-year basis, ranking second in North America, behind Canada. Currently, the four largest U.S. greenhouse tomato firms are now located in Arizona, Texas, Colorado, and coastal southern California, representing 67% of domestic production in 2003. In addition, about seven medium-size firms established in the market produced an estimated 11% of the total U.S.

greenhouse production during the same year, selling most of their products via larger U.S. and Canadian marketers. However, in order to get a better understanding of the fresh tomato industry, factors such as seasonality, product differentiation, trade, and consumption trends should be explained.

**Seasonality and Structure of the Industry**

Seasonality is a major force affecting both greenhouse and field tomatoes in the North American fresh tomato industry (Cook 1995). Field tomato grows in Florida and Mexico only during the winter season (Jordan and VanSickle 1995). This forces the industry to develop regional and seasonal supply relationships (Figure 1). Imports of field tomatoes from Mexico increase during the winter season when very little alternative production sources are available. But in the spring, when Mexican tomato production decreases, Florida becomes the dominant supplier.

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Field grown	California												
	Florida												
	Rest of U.S.												
	Sinaloa, Mexico												
	Baja California, Mexico												
	Canada												
Greenhouse	Canada												
	U.S. <sup>1</sup>												
	Sinaloa, Mex.												
	Imuris, Sonora, Mex.												
	Central Mexico												
	Baja California, Mexico <sup>1</sup>												

**Figure 1. North America Greenhouse Tomato and Fresh Field Tomato Shipping Seasons by Region (USDA, 2005)**



On the other hand, as greenhouse tomatoes have become a mainline commodity, their total volume and diversity of tomato types in the market have significantly increased, with retailers requesting consistent year-round volumes from their suppliers. As a result, field producers in Florida, California, and Mexico are feeling remarkable competition from the Canadian greenhouse tomato industry (Le Strange, Schrader and Hartz 2000). Canada production is a market force during the summer, due to its favorable climate and long daylight hours. However, the industry lacks supply during the winter season. In contrast to Canada, Mexico reaches the highest production levels during the winter months, accounting for 28% of North American production in 2003 (Cook and Calvin 2005). Similar to Mexico, the U.S. industry also benefits from the winter season, recovering from the very low prices during the summer season when Canadian volume inflates supplies.

### **Fresh Tomato Trade**

In 2002, fresh tomato producers in Canada, the United States, and Mexico established the North American Tomato Trade Work Group (NATTWG) to address trade issues among the three trading partners. In 2003, NATTWG was recognized as an advisory committee to the NAFTA Committee on Agriculture, giving official membership to all three countries.

The NATTWG presented the industry with many benefits because it featured initiatives from all countries. A NATTWG effort succeeded in harmonizing Canadian and U.S field tomato arrival standards, with Canada adopting the U.S. standard, benefiting U.S. exporters to Canada. Also, pesticide residue tolerances between the

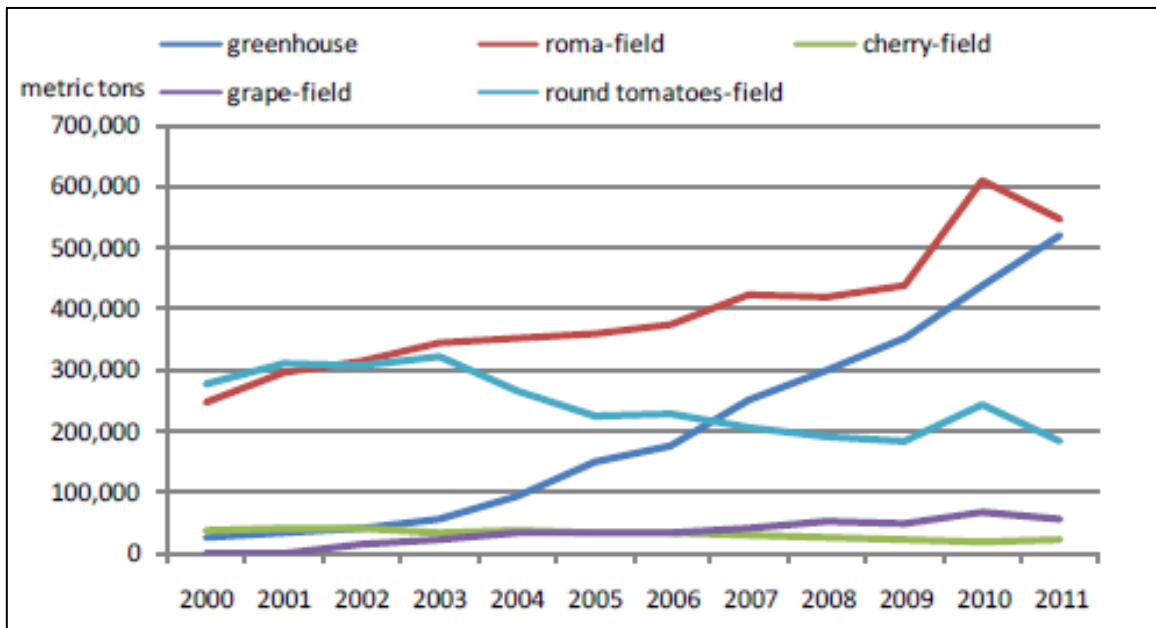
United States and Mexico have been harmonized. Mexican members of NATTWG recently supported the U.S. effort to encourage Mexico to adopt the U.S. tolerance on stems and leaves in fresh tomato cartons. If this policy is adopted it will benefit U.S. exporters to Mexico by eliminating this nontariff trade barrier (Cook and Calvin 2005).

In 2012, Florida's tomato industry filed a request with the United States Department of Commerce to withdraw the 1996 antidumping petition and terminate the 2008 suspension agreement. The purpose of the 1996 antidumping petition was to enforce antidumping laws in the country and serve against unfair trade practices of fresh tomatoes from Mexico. The petition set a minimum price that applied to most of the fresh market tomatoes imported from Mexico. As for the 2008 Suspension Agreement, the goal was to prevent trading partners from undercutting US prices and outcompeting domestic production. However, this agreement did little in terms of promoting fair trade forcing Florida's tomato growers to face unprecedented imports from Mexico at a price well below their production costs. This in turn resulted in losses amounting to millions of dollars in Florida's tomato industry. In 2013, the United States Department of Commerce agreed to suspend the antidumping petition and issue a new agreement that ensures fair trade to the exchange of fresh tomatoes between the two countries (Florida Department of Agriculture and Consumer Services 2013).

### ***Import Trends***

Tomatoes are the highest valued fresh vegetable to be imported by the NAFTA countries. Although the NAFTA agreement has benefited trade ties between the United States, Mexico, and Canada, it presented Mexico with the biggest advantage as their

tomato sales to the US increased considerably during the last years (Figure 2) (Padilla-Bernal and Thilmany 2000); for example, Mexico sales to the US increased by 14% from 2001 to 2002. The main advantages Mexico has over the other two countries are favorable weather and cheap labor conditions (Lucier and Plummer 2003).



**Figure 2. U.S. Imports of Tomatoes from Mexico, 2000-2011 (USDA 2012)**

Mexico is the leading tomato supplier to the United States, generating about 69% of total import value or \$552 million in 2002 (Fonsah 2010). Canada ranked second, with an increase of 20% in the US tomato import value in 2001. Under NAFTA, the United States began to phase out the U.S. tariff on imported tomatoes from Mexico and established a reference price in 1996, which covered most fresh Mexican tomatoes exported to the United States (Padilla-Bernal and Thilmany 2000). Due to the difference in summer and winter market conditions, two different prices were settled. From

October 23 to June 30, the minimum price for Mexican fresh market tomatoes was \$5.27 per 25-pound box, and from July 1 to October 22 the minimum price was \$4.30 per box (Cook and Calvin 2005).

Trade flows vary by type of tomato and season. In the case of the greenhouse industry, its rapid increase has changed trade flows between the NAFTA countries (Figure 3) (Padilla-Bernal and Thilmany 2000). Canada is considered the largest market for U.S. fresh tomato exports, accounting for 88% of total export volume in 2003. However, the country is also marked as the principal exporter of greenhouse tomatoes to the United States (Figure 4), with 30% of the total U.S. greenhouse tomato imports. Canadian exports to the U.S. market compete with field-grown tomatoes from Florida and Mexico during the spring season, and with field-grown tomatoes from California, the U.S. Eastern seaboard, and Mexico during the summer and early fall (Cook and Calvin 2005).

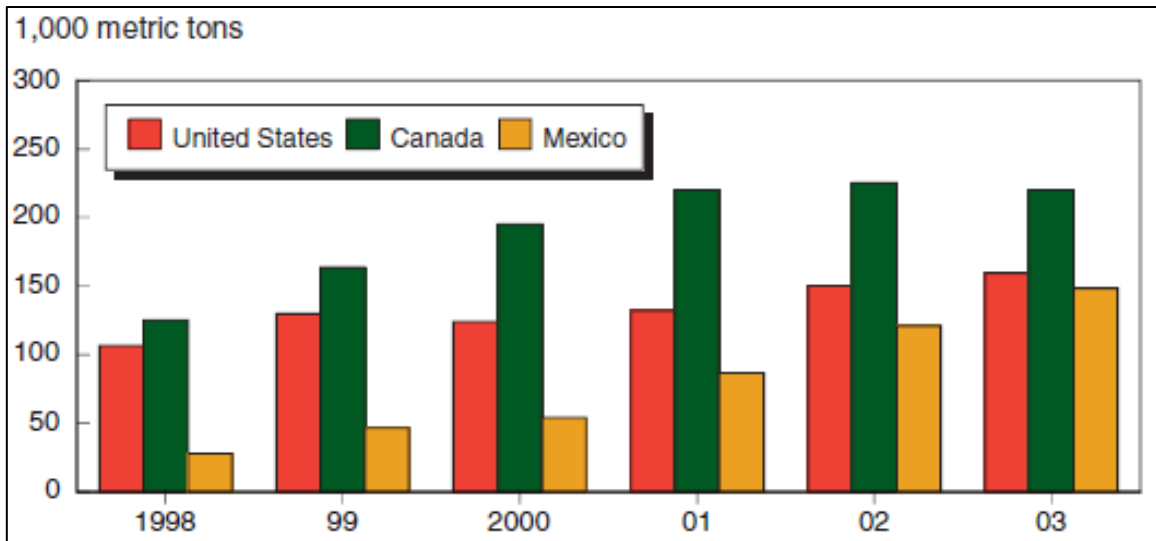


Figure 3. North American Greenhouse Tomato Production Growth (USDA 2005)

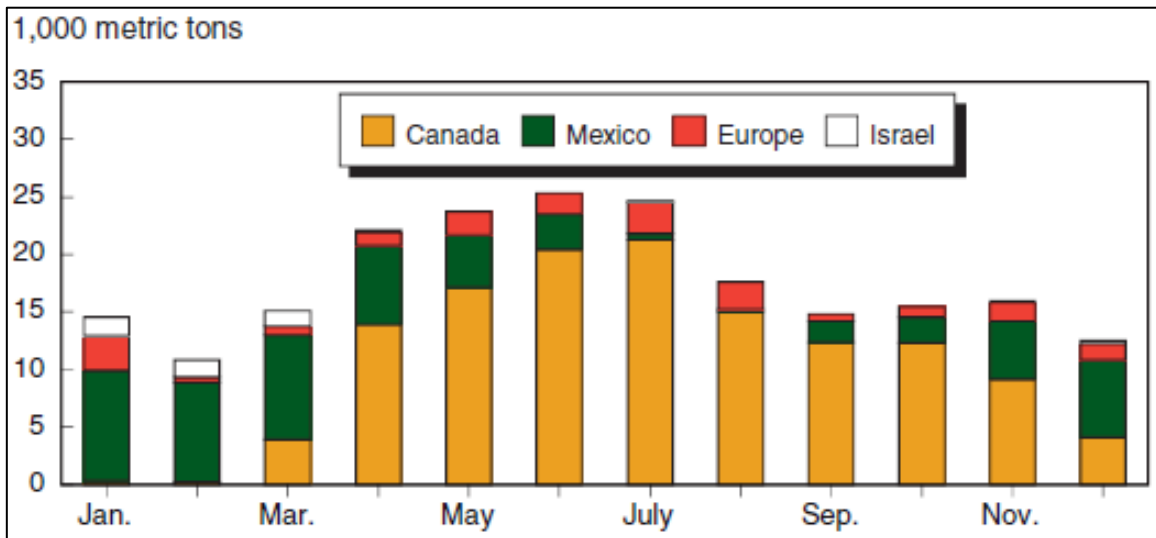
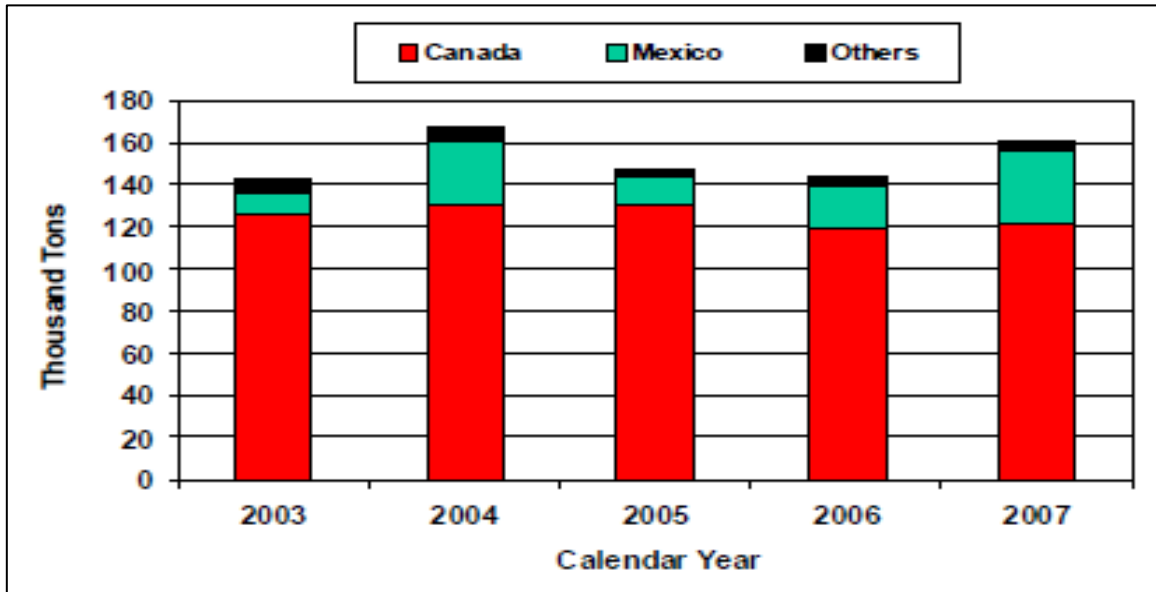


Figure 4. Monthly U.S. Greenhouse Tomato Imports from Major Suppliers, 2003 (USDA 2005)

### Export Trends

Due to the North American Free Trade Agreement (NAFTA), trade among the United States, Canada, and Mexico improved significantly, with Canada as the leading

trading partner for fruits and vegetables (Figure 5) (Padilla-Bernal and Thilmany 2000). In 2002, tomato exports to Canada were \$111.7 million, accounting for 83% of total U.S. tomato exports.



**Figure 5. U.S. Tomato Exports Fluctuate (USDA 2008)**

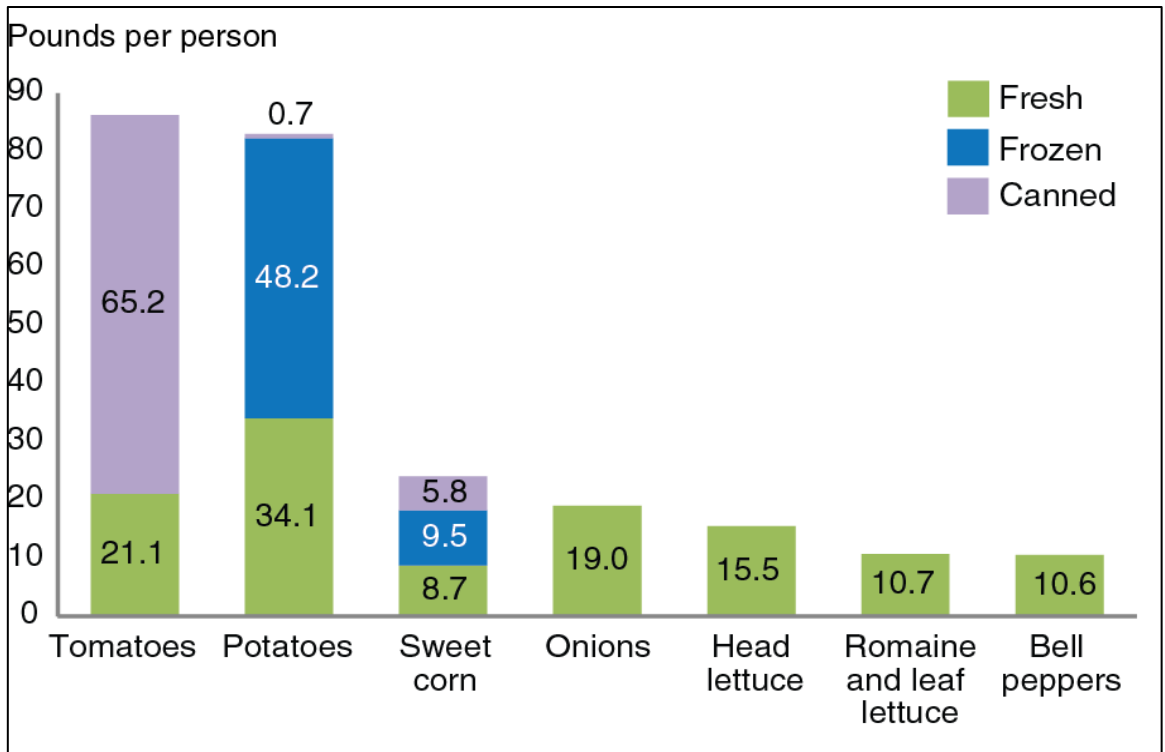
The tomato market in Canada has become saturated recently due to consistent increases in production. This has forced the greenhouse tomato industry in the U.S. to depend on imports, which accounted for 60% of production in 2003 compared to just 23% in 1994. At the same time, the growth of the Mexican greenhouse tomato industry may be having an impact on U.S. field tomato exports to Mexico; especially for California growers, who are concerned that summer greenhouse production in Mexico may be able to fill part of that demand.

Exchange rates became an important factor in trading between Canada and Mexico with the United States. Between 1990 and 2002, the Canadian dollar depreciated

34% against the U.S. dollar, making the U.S. market increasingly attractive. The Canadian dollar continued declining until 2004 (Cook and Calvin 2005). Simultaneously, the Mexican peso started depreciating against the U.S. dollar, making Mexican tomatoes more competitive relative to Canadian product in the U.S. market (Padilla-Bernal and Thilmony 2000). The market competition between the three NAFTA countries has got larger and more complicated as growers appeared to be in the market simultaneously. However, growers started to coordinate and develop better strategies in order to satisfy the demand in a year-round basis.

### **Consumption Trends**

Tomato is the second most consumed vegetable in the United States (Figure 6). In 2012, the per capita consumption of fresh-market tomatoes was 20.6 (USDA 2013c). The increase in the consumption of tomato and tomato products is likely the result of the continued expansion in food-service demand, the increased consumer awareness of the health benefits of tomatoes and the linkage scientific studies have made between diets rich in tomatoes and the risk reduction of several diseases. Tomato consumption can also be influenced by demographic characteristics. For example, Lucier et al. (2000) reported that Hispanics, households with high income, and people over the age of 39 represent the strongest consumers of fresh-market tomatoes.



**Figure 6. Most Commonly Consumed Vegetables (USDA 2013)**

The higher demand for tomatoes has forced the fresh tomato industry to develop more differentiated products (Plunket 1996). Tomatoes can be produced in different varieties with respect to shape, size, degree of ripeness and color. Greenhouse production allows for more efficient development of varieties, which gives it an edge over field tomato production in appealing to the consumers' interest in varieties. This has caused field tomato growers to work in improving characteristics like flavor, appearance and color in their products as consumers perceive greenhouse tomatoes to be superior in this regard.



## **Tomato Prices**

The general price level is determined by supply and demand. Seasonal average prices per cwt are volatile and may vary among years. Most of price variation is due to transportation problems and adverse weather conditions (Fonsah 2010). For example, weather can shift the start or end date for any production region, causing either excess supplies or shortages, and sizable fluctuations in tomato prices (Cook and Calvin 2005). The peak price was recorded in 1998 at \$35.20 per cwt. However, in 1999, the US fresh market industry became concerned as Canadian greenhouse tomatoes started to appear in California markets at lower prices (The Produce News 1999). Thereafter, prices started increasing again, reaching the highest average price per pound of tomatoes in 2003 (Fonsah 2010).

The price variation caused by demand changes is considerably small. Consumers control the demand side by making consumption decisions. Some of them often switch between product types as prices change while others may not even recognize all the distinctions between types of tomatoes. This causes a big difference in price trends between different tomato types. Consumers at retail stores may be more flexible than buyers for foodservice firms, as the food service industry does not substitute types of tomatoes regardless of prices, making demand quite inelastic (Cook and Calvin 2005).

Greenhouse tomatoes generally enjoyed a price premium over other types of tomatoes, but the premium varies throughout the year. In 2004, significant increases in the supply of greenhouse tomatoes cause a reduction in their prices, becoming a more attractive market for consumers, retailers, and foodservice firms.

## **Value Trends**

Retail trends in fresh tomato sales vary significantly when comparing the quantity (physical volume) sold versus dollar value. Recently, consumers have shown a preference for higher value tomatoes, increasing their willingness to pay for greenhouse and specialty tomatoes. For example, the value of tomatoes sold increased 47% from 1999 to 2003, with a 429% increase in cherry and grape varieties. In 2001, the US farmgate values for fresh tomatoes and processed tomatoes were 1.12 and 0.54 billion dollars, respectively. California and Florida dominates the US market, with Florida accounting for 40.3% of the fresh US market, and California accounting for 24.1% of the fresh market and 90.7% of the processed market (Calvin and Cook 2005). This shows that the fresh tomato industry is maturing, and highlights the need for continuing product innovation to maintain consumer excitement and retail support.

## **Quantity Trends**

Total tomato quantity increased 6% between 1999 and 2003. During the same period, the field category (including round, roma, cherry, and grape tomatoes) quantity declined by 2%, while the greenhouse quantity increased by 24%. Even though the greenhouse industry represents a negligible share of retail fresh tomatoes sales, greenhouse tomatoes made up 37% of the weekly quantity of tomatoes sold in U.S. markets in 2003.

Despite the decline in field tomato volume, it still represented the majority of fresh tomatoes sold at retail in 2003, with round and roma field tomatoes comprising 50% of the quantity sold that year. During the same year, field tomato growers

introduced new varieties such as cherry and grapes, which helped preserve the market share of field tomatoes in the industry. This also proved that the industry is not limited to greenhouse production.

### **Marketing Challenges**

On a worldwide scale, the use of tomato products in cooked meals, as a fresh crop and even in scientific research is increasing. Due to their economic and nutritional importance, and because they are well congruent with molecular biology and genetic engineering techniques, tomato products have been studied extensively during the last decade (Hobson and Grierson 1993).

Field tomatoes can withstand a wide range of environmental conditions. Furthermore, they are amenable to mechanical harvesting which facilitates mass production and supply economically.

Tomato products have been incorporated in the market into a wide range of canned, frozen, preserved or dried foods. Its consumption is only increasing with time for many reasons. Salads, salad bars and sandwiches continue to be popular on a world scale and as a result of consumers' attention towards health and nutritious diets, the tomato industry is expanding with the introduction of improved tomato varieties including greenhouse and hydroponic varieties (Lucier et al. 2000).

In spite of this, the tomato market still faces several challenges. For instance, further research needs to be conducted to validate the health benefit-related claims on tomatoes. Also, more attention should be placed on improving and enhancing the most efficient production practices.

## **CHAPTER IV**

### **METHODOLOGY**

#### **Auction Description**

##### *Subjects*

For the study, a total of 157 participants were recruited from the Bryan-College Station area of Texas. To qualify for the study, participants had to be the primary grocery shopper of their household, be at least 18 years, and have no food allergies. The assignment of participants to different sessions was done in a way that mimicked the overall grocery-shopper demographics in Texas. This approach was preferred to the commonly used participant base, which consisted solely of university students because it produces more realistic results. Younger participants, university students, may be less concerned with long-term health benefits when making purchasing decision. Also, the younger generation exhibits different grocery shopping behavior compared to the overall Texas grocery shopping demographic and so to base a study solely on them can create bias in the results.

The participants were recruited using advertisements in the local newspaper and other local online and printed media. Please refer to Appendix A for the advertisement used for recruiting. During the recruitment, subjects were informed that they would be participating in a study on vegetable purchasing decisions that included a tomato tasting section; therefore, if they had a known tomato allergy they couldn't participate. They were also told that the study would last approximately one hour and that they would receive a \$30 compensation for their participation. (The recruited sample was not

intended to be representative of all possible buyers, as it was expected that only individuals who expressed an interest in participating in sensory tests would respond to the advertisement). Individuals that agreed to participate in the study were assigned a time and date to attend to one of the eight sessions conducted over the course of three days at the Texas A&M University Horticultural Gardens Classroom. They received emails with directions to the facility as well as an email reminder one day prior to the study. Individuals who did not have email addresses were provided with directions over the phone.

The target was to recruit twenty-two subjects in each of the eight sessions, for a total of 176 participants. Due to last minute cancellations, the number of participants who attended each session ranged from 15 to 24 making the total number of participants for this study 157.

### *Products*

The five tomato products chosen for this study differed by location of origin (U.S., Mexico, and Texas A&M), method of production (conventional and organic), and quality characteristics (added health benefits and improved taste). The tomato products were: 1) tomato conventionally produced in the U.S., 2) tomato conventionally produced in Mexico, 3) tomato organically produced in the U.S., 4) tomato organically produced in Mexico, and 5) locally grown-specialty tomato. The last tomato product had an improved taste, held added health benefits, and was developed by the Department of Horticultural Sciences at Texas A&M University. A sixth vegetable product was

included as a control product. The reference product chosen was a yellow squash, as it presented a similar reference price (per pound) as the tomato products.

*Tasting Auction:* Each subject received small (approximately 2oz.), equally sized samples from each of the five tomato varieties. Samples were served in plastic cups labeled with a numeric code (from 1 to 6). The yellow squash product was not included in the tasting portion.

*Information Auction:* One unit from each of the six vegetable products was placed in a table centered in the classroom. Below each variety, a card with their numeric code, name, growing condition, and location of origin was placed. Participants were instructed that bids would correspond to one pound of each vegetable product.

#### *Auction Procedures*

Upon arriving at the assigned session, participants were asked to sign a consent form as required by the Texas A&M University Institutional Review Board (IRB). They were then provided with an instructional packet and a packet of bid sheets (Appendix B). Subjects were randomly assigned an identification number to be used throughout the entire session to maintain anonymity. Participants were instructed to review the procedures for the first two stages of the auction, which described in general how bids were submitted and how buyers were selected for the auctions. A session monitor read these instructions aloud from a script to ensure consistency between panel groups. It was made explicitly clear that the auction was non-hypothetical in nature and that any participant who purchased any good during the session would have to pay real money.

To better clarify the specific details of the 2<sup>nd</sup> price auction, subjects were taken through two verbal and numerical examples. The participants then engaged in two practice rounds. During the first practice round, they submitted bids for three common pen products: Paper Mate, Pilot B2P, and Bic. Subjects were told that both practice rounds would be hypothetical (no money would be exchanged). While the market price (2<sup>nd</sup>-highest price) for this round was posted, participants completed a four-question quiz to ensure they understood the auction procedure. Answers to the quiz were discussed and reviewed as a group.

Subjects then participated in the second practice round, submitting bids for four different types of glue products: Instant Krazy, Elmer's Glue, Scotch, Elmer's Clear. Following the completion of the practice rounds of the auction, participants were given instructions on the procedures for the vegetable product portion of the session.

Four vegetable auction rounds were conducted. The first round was the "baseline round", where no information was provided to the participants and it was used to determine a starting point for WTP based on the information that participants already had before they began the study. Following the "baseline round", subjects were provided with three randomized within subject information treatments. These treatments were as follows: 1) Tasting, 2) Health Information, and 3) Information on the location of origin and the production system of each vegetable product. By the end of each session all participants received the three additional information treatments. The order of these treatments was randomized for each session to account for ordering effects. The number

of participants per session and the assigned order of treatments for each session are described in Table 3.

**Table 3. Sessions and Information Treatments**

	N (Total N=157)	1st Information Treatment	2nd Information Treatment	3rd Information Treatment
Session 1	19	Tasting	Health	Information
Session 2	17	Tasting	Information	Health
Session 3	17	Health	Tasting	Information
Session 4	19	Health	Information	Tasting
Session 5	23	Information	Tasting	Health
Session 6	20	Information	Health	Tasting
Session 7	23	Tasting	Health	Information
Session 8	19	Health	Information	Tasting

### **Tasting Treatment**

Small (approximately 2oz), equally sized samples for each of the five tomato varieties (not including the control product) were placed in front of the participants. Firstly, subjects were given verbal and written instructions for the tasting portion of the session. Panelists then tasted the samples while they completed a tasting report regarding the sensory properties of the tomato products. In the tasting report, participants were asked to rate from 1 (Extremely Dislike) to 9 (Extremely Like) six different attributes of the tomato varieties, including appearance, color, smell, freshness, taste, and overall acceptance. After the completion of the tasting report, participants were asked to submit their bidding prices for one pound of each tomato variety in the bid sheet. They had the



opportunity to examine the products before they submitted their bids. After that, the bid sheets from this auction round were collected and subjects continued with the following treatments.

### **Health Information Treatment**

Participants were given an information sheet about the health benefits of consuming tomatoes. The information that subjects received for this treatment was verifiable based on published scientific studies and it can be found in Appendix C. After participants read the health information, they were asked to submit their maximum WTP for one pound of each vegetable product. They had the opportunity to examine the products before they submitted their bids. A session monitor then collected the bid sheets from this round and subjects continued with the last auction round.

### **Location of Origin and Product Information**

The seven vegetable products were labeled with the vegetable name, growing condition (conventional or organic), the location of origin (Mexico, U.S.A, and Texas A&M), and the numeric code used throughout the session. The vegetable products were displayed in the same location and sequence as the samples in the other auction rounds. Participants received the product information verbally before they rotated again through the displays. They then wrote down their bidding price for one pound of each vegetable variety and the bid sheets were collected.

After the bids were collected for all the auction rounds, one round and one product were randomly chosen by a session subject to be binding.

To determine the buyers of the auction, all bids and panelist identification numbers for the randomly selected product were entered into a template in Microsoft Office Excel that was developed to sort the bids for each product. The bids were sorted in descending order and the buyers were assigned according to the 2<sup>nd</sup> price Vickrey auction procedure. Participants with the highest bid on each session were the buyers, but the market price they paid for the selected tomato variety was set equal to the second-highest bid. While the buyers and the market price of the auction were determined, subjects were asked to fill out a consumer survey over their purchasing habits and demographic characteristics.

The participants received a cash compensation of \$30 at the end of the study, less any purchases they made based on the auction procedures. They all signed a receipt of payment form for the compensation received. All items purchased during the study were received by the participants after the results were tabulated.

### **Theoretical Framework for Experimental Auction Mechanism**

In order to understand the theoretical framework of the experimental auction mechanism, first, the characterization of individual preferences and the utility function are described. Second, utility maximization, individual choices, and random utility theory are discussed as well.

#### *Preferences and Utility*

When an individual chooses between two or more options, he/she will choose the option that gives him/her the highest level of satisfaction. The theory of consumer behavior begins with three basic postulates about individuals' preferences:

completeness, transitivity, and continuity. The completeness postulate assumes an individual is not paralyzed by indecision as he/she can always compare between any two alternatives. For example, in comparing any two situations, A and B, the individual can always specify one of the three possibilities: 1) A is preferred to B, 2) B is preferred to A, or 3) A and B are equally attractive. The transitivity assumption states that an individual's choices are internally consistent, that is, if an individual reports that A is preferred to B and B is preferred to C, then he/she must also report that A is preferred to C. Finally, continuity rules out certain discontinuous preferences that pose problems for a mathematical development of the theory of choice. For example, if A is reported to be preferred over B, then situations that are similar to A must also be reported to be preferred over B (Snyder and Nicholson 2008). These assumptions do not explain consumer preferences, but they do impose a degree of rationality and reasonableness on them.

Given these assumptions, an individual is able to choose among a set of available alternatives. If a person prefers option A over option B, then the utility assigned to option A, denoted by  $U(A)$ , exceeds the utility assigned to option B,  $U(B)$ .

In Utility Theory, individuals achieve satisfaction by purchasing a particular combination of goods and services. Individual preferences among these goods can be represented by a utility function of the form

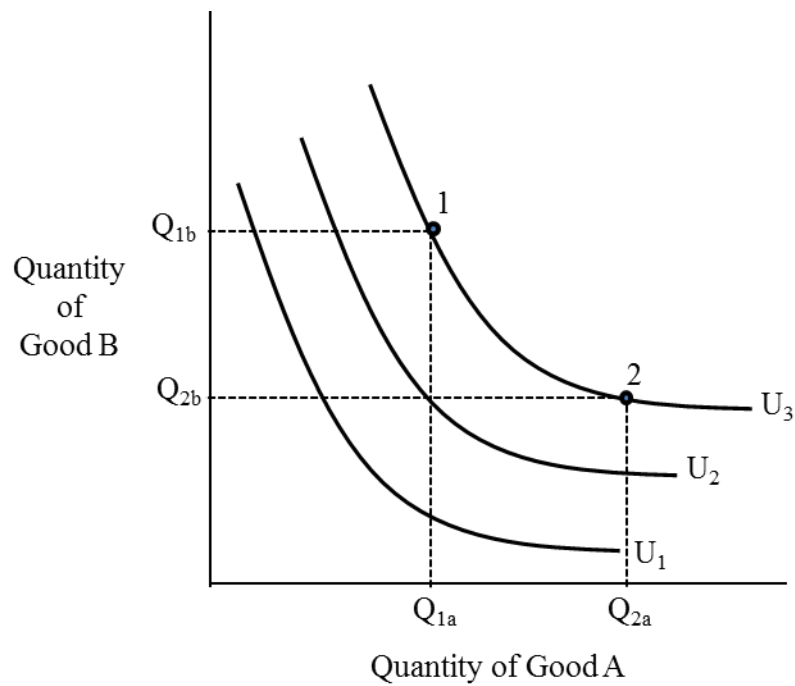
$$(2) \quad \text{utility} = U(x_1, x_2, \dots, x_n; \text{others}),$$

where the  $x$ 's refer to the quantities of the goods that might be consumed and “*others*” is used as a reminder that many aspects of individual welfare are being held constant in the analysis (known as the *ceteris paribus* assumption). For simplification, if only two goods, A and B, are considered, an individual utility function can be specified as

$$(3) \quad \text{utility} = U(A, B).$$

A curve representing all the possible combinations of A and B from which the individual derives the same utility can be developed if all other factors of the utility function are held constant. This curve is known as an *indifference curve* and it shows a set of consumption bundles about which the individual is indifferent. That is, all bundles provide the individual with the same level of satisfaction.

As an example, Figure 7 shows an indifference map which consists on a set of indifference curves that describes individual preferences among goods A and B. This consumer is indifferent between bundles 1 and 2 as they perceive the same level of satisfaction ( $U_3$ ) with any of these bundles.



**Figure 7. Indifference Map**

In a map of indifference curves, movements in a northeast direction represent movements to higher levels of utility, that is, the utility of  $U_1$  is less than that of  $U_2$ , which in turn is less than that of  $U_3$ . This follows directly from the assumption that more of a good is better than less.

The slope of the indifference curve is negative, showing that if the consumer is forced to give up some amount of good A, he or she must be compensated by an additional amount of good B in order to remain indifferent between the two bundles of goods (Pindyck and Rubinfeld 2005). This slope is known as the *marginal rate of substitution (MRS)* and is defined as

$$(4) \quad \text{MRS} = - \frac{\delta_y}{\delta_x} \Big|_{U=U_1}$$

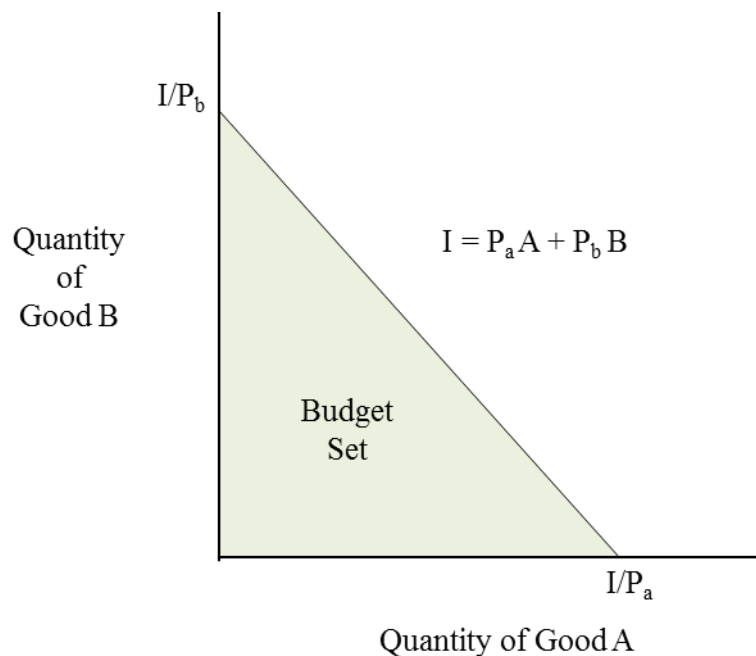
where  $\delta_y$  is the partial derivative of the utility function with respect to good  $y$ ,  $\delta_x$  is the partial derivative of the utility function with respect to  $x$ , and  $U_1$  corresponds to the slope calculated along the  $U_1$  indifference curve.

#### *Utility Maximization and Consumer Choice*

In order to explain individuals' behavior, it must be assumed that individuals are often constrained by limited incomes and they behave in such a way as to maximize utility subject to a budget constraint. The budget set (Figure 8) shows the combinations of A and B that the individual can afford. If it is assumed that the individual is rational and that he/she prefers more rather than less of every good, the outer boundary of the triangle is the relevant constraint where all the income is spent either on A or on B. The slope of this straight-line boundary is given by

$$(5) \quad \text{Slope}_{BC} = - \frac{p_A}{p_B}$$

where  $p_A$  refers to the price of good A located on the x axis  $p_B$  and refers to the price of good B located in the y axis.

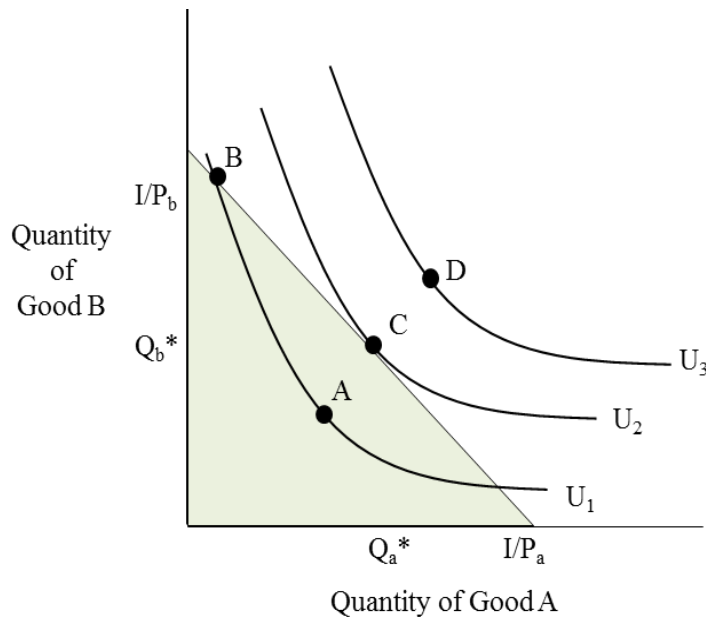


**Figure 8. Budget Constraint**

In an attempt to maximize utility, given a fixed amount of income to spend, an individual will buy those quantities of goods that exhaust his or her total income and for which the rate of trade-off between any two goods (the MRS) is equal to the rate at which the goods can be traded in the market place ( $p_A/p_B$ ). That is, the optimal choice is a point of tangency between the budget constraint and the indifference curve (Snyder and Nicholson 2008). Mathematically, a consumer maximizes satisfaction at the point where

$$(6) \quad \frac{P_a}{P_b} = \frac{\delta_a}{\delta_b} |_{U=U_k}$$

Figure 9 shows three indifference curves describing an individual's preferences for goods A and B. The individual maximizes utility by choosing bundle C ( $Q_a^*$  and  $Q_b^*$ ). At this point, the budget line and the indifference curve  $U_2$  are tangent, and no higher level of satisfaction (e.g. bundle D) can be attained. The individual would behave irrational if he or she chooses bundle A as a higher utility  $U_2$  can be obtained by spending more. Notice that bundles located to the right and above indifference curve  $U_2$ , like bundle D on indifference curve  $U_3$ , achieve a higher utility but cannot be purchased with the available income. Therefore, point C maximizes the consumer's utility.



**Figure 9. Maximizing Consumer Utility**

*Choice Modeling and Random Utility Theory*

In developing choice models, several assumptions regarding the decision-maker, the alternatives and attributes considered to perform the choice, and the decision rules



should be addressed. In general, the decision-maker is assumed to be an individual; however, depending on the context of the application, the concept of individual can be extended to a group of persons (e.g. household or a government). In doing so, all internal decisions within the group are ignored and only the decision of the group as a whole is taken into account. Moreover, all alternatives considered by the individual when performing the choice must be contained in a choice set and for all the alternatives in the set, the analyst has to identify the attributes that are likely to affect the choice. Finally, uncertainty in the rules used by the decision-maker should be considered (Bierlaire 1998).

Decision rules describe the process used by the individual to reach his/her actual choice and are linked to the concept of utility associated with the alternatives. The utility theory, derived from the Neoclassical Economic Theory, assumes that the decision rules are intrinsically deterministic and do not account for uncertainty (Bierlaire 1998). These assumptions strongly limit the neoclassical economic theory for practical applications. Hence, the Random Utility Theory, proposed by Daniel McFadden and Charles F. Manski in the 1970s, has been used as the theoretical basis for discrete choice modeling.

The Random Utility Theory (RUT) assumes, as the Neoclassical Economic Theory, that the decision-maker behaves rationally and has a perfect discrimination capability. In this context, the analyst is supposed to have incomplete information and, therefore, uncertainty must be taken into consideration. In order to reflect this uncertainty, the utility is modeled as a random variable. More specifically, the utility ( $U$ ) that individual  $i$  associates with alternative  $j$  is given by

$$(7) \quad U_{ij} = V(x_{ij}) + \varepsilon_{ij}$$

where  $V(x_{ij})$  is the deterministic part of the utility, and  $\varepsilon_{ij}$  is the stochastic unobserved part that captures the uncertainty (McFadden 1974). Similarly to the Neoclassical Economic Theory, the alternative with the highest utility would be the one chosen by the decision-maker. The models described below were modeled within a Random Utility Theory framework.

### **Econometric Models**

#### *Econometric Models for Experimental Auction Bids*

The nature of this experimental design required the consideration of many factors in the econometric model. A wide span of models has been used in studying WTP behavior and many of those were applied in this paper. The models used here were selected based on their benefits and drawbacks regarding this specific dataset. The initial models were estimated for pedagogical purposes; drawbacks are explained and progression is made towards more appropriate methods of estimation.

In the study, WTP bids are modeled as a function of an individual's demographic characteristics, behavioral characteristics, product characteristics, and treatment indicators.

Thus, each individual has a WTP that is described as the following equation:

$$(8) \quad WTP = f(\text{socioeconomic factors, behavioral characteristics, product characteristics, information treatments}).$$

The included factors are as follows: product characteristics including the tomato variety (Conventional, Organic, Domestic, or Local-Specialty), and the type of vegetable (tomato or yellow squash), and treatment variables including dummy indicators identifying tasting, health, and product information treatments. Table 4 shows a description of the demographic and behavioral variables included in all econometric models.

**Table 4. Demographic and Behavioral Variables**

Type	Abbreviation	Meaning
Dummy	<i>DAGE1</i> <sup>a</sup>	Dummy for ages 18 to 34 years of age
Dummy	<i>DAGE2</i>	Dummy for ages 35 to 54 years of age
Dummy	<i>DAGE3</i>	Dummy for ages more than 55 years of age
Dummy	<i>DEDU1</i> <sup>a</sup>	Dummy for education of high school degree or less
Dummy	<i>DEDU2</i>	Dummy for education $x$ , where: some college $\leq x \leq$ 4-year college degree
Dummy	<i>DEDU3</i>	Dummy for education of some graduate school or more
Continuos	<i>HHSIZE</i>	Household size (number of individuals)
Dummy	<i>FEMALE</i>	Dummy for female variable
Dummy	<i>DMAR</i>	Dummy for married individuals
Dummy	<i>DINC1</i> <sup>a</sup>	Dummy for household income less than \$50,000
Dummy	<i>DINC2</i>	Dummy for household income $x$ , where: \$50,000 $\leq x \leq$ \$99,999
Dummy	<i>DINC3</i>	Dummy for household income greater than \$100,000
Dummy	<i>DRACE1</i> <sup>a</sup>	Dummy for White or Native American individuals
Dummy	<i>DRACE2</i>	Dummy for Hispanic individuals
Dummy	<i>DRACE3</i>	Dummy for Asian, African American, or other races
Continuos	<i>SPENDFV</i>	Weekly household spending on fruits and vegetables
Dummy	<i>ILLNESS</i>	Dummy for having a health issue considered serious by the subject
Dummy	<i>SMOKE</i>	Dummy for individuals who currently smoke cigarretes
Continuos	<i>EXERCISE</i>	Percentage of days per year that the individual exercises for 20 minutes or more

<sup>a</sup> Used as dummy variables base levels.

The dummy variables were coded in a way that the levels of the variables can be compared to some base level of that variable by excluding the base level from the estimation. For example, for three possible age categories, the results would be coded such that there were three age variables (*DAGE1*, *DAGE2*, and *DAGE3*). Each variable will take the value of one if the individual is in that category and a value of zero otherwise. Then one of the dummy variables (*DAGE1*) was removed for each characteristic in order to avoid the dummy variable trap. As an example of a continuous variable, exercise (*EXERCISE*) was the percentage of days per year that the individual exercises for a period of 20 minutes or more. All variables listed in table 4 were coded using the same procedure as these examples.

The experimental auctions resulted in a total of 20 observations (bids) for each individual as they submitted bids for five products for four treatments (baseline, health, tasting and information). Several models were developed and other variables were needed to identify the information treatments and product characteristics. The treatment indicators included are: Baseline (*Base*), Tasting (*Tasting*), Health information (*Health*), and product information (*Info*). The product characteristics variables that were included are: Organic (*Org*) took a a value of 1 for Organically grown tomato products and 0 otherwise; Domestic (U.S) took a value of 1 for varieties produced in the United States and 0 otherwise; Local-Specialty (*Local*) took a value of 1 for locally-grown specialty tomato products and 0 otherwise, and Yellow Squash (*Ysq*) took a value of 1 for the yellow squash product and 0 otherwise.

Several models were applied to the auction data. The benefits and drawbacks of each model pertaining to the specific results of this study are presented.

### **Ordinary Least Squares Model**

There are a number of different approaches to estimation of the parameters of the model. A basic ordinary least squares model was the first model used to analyze the WTP based on the subject's bids. This model was estimated only for comparison purposes because censored observations were anticipated due to the nature of the auction bidding. Therefore, in order to account for bid censoring in the parameters estimation, other estimation methods are preferred.

### **Constant Parameters Tobit Model**

To account for censoring of zero bids, a tobit model was considered to estimate consumer WTP for the tomato products.

For a more convenient normalization, it is assumed that the censoring point is zero.

When data are censored, the distribution that applies to the sample data is a mixture of discrete and continuous distributions. In order to analyze this distribution, a new random variable  $y$  is defined by

$$(9) \quad \begin{aligned} y &= 0 \text{ if } y^* \leq 0, \\ y &= y^* \text{ if } y^* > 0. \end{aligned}$$

If it is assumed that  $y^*$  is normally distributed with mean  $\mu$  and variance  $\sigma^2$ , the distribution that applies is

$$(10) \quad \text{Prob}(y = 0) = \text{Prob}(y^* \leq 0) = \Phi\left(-\frac{\mu}{\sigma}\right) = 1 - \Phi\left(\frac{\mu}{\sigma}\right),$$

and if  $y^* > 0$ , then  $y$  has the density of  $y^*$ . In this distribution, the total probability is one, but instead of a full continuous distribution, the full probability in the censored region is assigned to the censoring point, which in this case is zero.

The censored regression model, also known as the tobit model, was first proposed by Tobin (1958). The mean in the following distribution can be defined for distributions which are censored at zero as

$$(11) \quad E[y|a = 0] = \Phi\left(\frac{\mu}{\sigma}\right) (\mu + \sigma\lambda),$$

where

$$(12) \quad \lambda = \frac{\phi(\mu/\sigma)}{\Phi(\mu/\sigma)}.$$

If the mean is allowed to correspond with the mean in a classical regression model, the following equations are obtained:

$$(13) \quad \begin{aligned} y_i^* &= x_i\beta + \varepsilon_i, \\ y_i &= 0 \text{ if } y_i^* \leq 0, \\ y_i &= y_i^* \text{ if } y_i^* > 0 \end{aligned}$$

where  $x_i$  represents a set of explanatory variables for each individual that are hypothesized to influence bids,  $\beta$  is a vector of coefficients, and  $\varepsilon_i$  is an error term that is randomly distributed with mean zero and variance  $\sigma^2$  (Greene 2003). For the index variable, also known as the *latent variable*, the

$$(14) \quad E[y_i^* | x_i] \text{ is } x_i \beta$$

Then, for any observation randomly drawn from the population, which may or may not be censored, the expected value of  $y$  is given by

$$(15) \quad E[y_i | x_i'] = \Phi\left(\frac{x_i' \beta}{\sigma}\right) (x_i' \beta + \sigma \lambda_i)$$

where

$$(16) \quad \lambda_i = \frac{\phi\left[\frac{(0 - x_i' \beta)}{\sigma}\right]}{1 - \Phi\left[\frac{(0 - x_i' \beta)}{\sigma}\right]} = \frac{\phi\left(\frac{x_i' \beta}{\sigma}\right)}{\Phi\left(\frac{x_i' \beta}{\sigma}\right)}$$

(Greene 2003). At the same time, the marginal effects can be calculated. For the index variable, the marginal effects are given as

$$(17) \quad \frac{\partial E[y_i^* | x_i]}{\partial x_i} = \beta.$$

However, this equation may not be useful since  $y^*$  is unobserved. For the observed data,  $y_i$ , the general result takes the form:

$$(18) \quad \frac{\partial E[y_i|x_i]}{\partial x_i} = \beta x_i \Phi\left(\frac{\beta x_i}{\sigma}\right)$$

for censoring at zero and normally distributed disturbances (Greene 2003). McDonald and Moffitt (1980) suggested a decomposition of the previous result by separating the equation into two different parts such that

$$(19) \quad \frac{\partial E[y_i|x_i]}{\partial x_i} = \text{Prob}[y_i > 0] \left( \frac{\partial E[y_i|x_i, y_i > 0]}{\partial x_i} \right) + \\ E[y_i|x_i, y_i > 0] \left( \frac{\partial \text{Prob}[y_i > 0]}{\partial x_i} \right)$$

where the first component affects the conditional mean of  $y_i$  in the positive part of the distribution and the second component affects the probability that the observation will fall in the part of the distribution. Then, to estimate the model, the likelihood function can be given as

$$(20) \quad LF = \prod_{i=1}^N \left( \frac{1}{\sigma} \phi\left(\frac{y_i - \beta' x_i}{\sigma}\right) \right)^{Uncensored_i} \left( \Phi\left(\frac{-\beta' x_i}{\sigma}\right) \right)^{Left\ Censored_i}$$



The marginal effects of the Tobit model can be incorporated in the mean variable or spread out across all variables. Researchers usually use the marginal effects averaged across all levels of the variables (Greene 2003).

Based on this discussion for tobit models, several equations were estimated separately for each targeted product in the baseline round, the three information treatments, and the full information. Models were estimated based on actual WTP bids made by subjects. The results of these models will be described in Chapter V.

### **Random Effects Tobit Model**

Random effects tobit models were estimated in order to account for bid-censoring and individual heterogeneity. Previous experimental auction studies have used different approaches to take into account the panel structure of the data while analyzing individual's WTP. These models include linear and nonlinear fixed effects (Shogren, List and Hayes 2000; List and Shogren 1999), random effects (Corrigan and Rousu 2006; Lusk, Feldkamp and Schroeder 2004), and random parameters models (Collart and Palma 2013a). While a fixed effects model allows unobserved individual effects to be correlated with the explanatory variables, a random effects model assumes there is zero correlation between regressors and the unobserved effects (Wooldridge 2010), as it has a specific random element for each group such that the differences between units are strictly parametric shifts of the function being estimated. Greene (2003) specifies a random effects model as

$$(21) \quad y_{isj} = x'_{isj}\beta + \alpha + \eta_i + \varepsilon_{isj}$$

where  $\alpha$  is a constant term and  $\eta_i$  is a group-specific random element that is similar to the random error term except that there is only one draw from the distribution for each member of the group.

If individual heterogeneity is considered as the random effects in the model estimation, then the random effects model given in equation 12 can be combined with the tobit model previously specified in equation 7 to obtain

$$(22) \quad y_{isj}^* = x'_{isj}\beta + \alpha + \eta_i + \varepsilon_{isj}$$

where  $y_{isj}^*$  corresponds to a latent variable of individual  $i$ 's bid in round  $s$  for product  $j$ .

Even though the random effects tobit model take into account the panel structure of the data, its assumption of constant regression coefficients represents a key limitation. As noted by (Woolridge 2011) treatment effects may be very different between individuals due to unobserved factors. For example, if we use a coefficient to estimate participants' mean WTP for a given treatment, a constant coefficient model assumes that all treatments have the same effect across individuals; however, it is possible that treatment effects differ based on unobserved heterogeneity in preferences (Collart and Palma 2013a). As a consequence, Random Parameters models were modeled to account for unobserved individual heterogeneity in the coefficients.

### **Mixed Linear Model**

Random Parameters (RP) models, also referred to as Random Coefficients or Mixed models, have become increasingly attractive due to its potential to accommodate

unobserved individual heterogeneity in consumers' valuation. These models facilitate analysis of within-cluster correlation, and so are suitable for auction sessions with repeated rounds in which bids associated with a given participant are likely to be correlated (Lusk, Feldkamp and Schroeder 2004). Random Parameters models account for unobserved individual heterogeneity in the data by allowing the parameters to vary following a specified distribution (Mc Adams et al. 2013). A normal distribution for the random parameters is used, and individuals' bids can be modeled as

$$(23) \quad y_{isj} = x_{isj}\theta + \alpha + \eta_i + \beta x_{isj} + \varepsilon_{isj}$$

where  $\theta$  is a set of constant coefficients for all bids,  $\alpha$  is the intercept for all bidders,  $\eta_i$  captures variation in the intercept for each individual,  $\beta_i x_{isj}$  allows for variation in the values of the specified regressors for each individual, and  $\varepsilon_{isj}$  is a set of overall normally distributed error terms with mean zero and variance  $\sigma^2$  (Mc Adams et al. 2013).

Although this model is similar to the random effects model, it also accounts for unobserved individual heterogeneity in the coefficients through the  $\beta_i x_{isj}$  term. However, the model failed to account for the censoring structure of the data as bids below zero would be possible. Consequently, a Random Parameters Tobit model was developed to measure unobserved individual heterogeneity in the coefficients while modeling the censoring nature of the data.

## Random Parameters Tobit Model

Many of the received applications of random parameters models have used linear regression framework, though there is a growing literature on nonlinear models with random parameters. A random parameters and censored model was applied to the auction data since there exists unobserved consumer heterogeneity and a proportion of zero responses within and across individuals. First, the censoring aspect is modeled following a tobit specification:

$$(24) \quad \begin{aligned} y_{isj}^* &= f(x_{isj}, \eta, \beta, \theta, \varepsilon_{isj}) \\ y_{isj} &= \max(0, y_{isj}^*), \end{aligned}$$

Where  $y_{isj}^*$  is the latent value of individual  $i$ 's bid in round  $s$  for product  $j$ ,  $y_{isj}$  is the observed value,  $x_{isj}$  is a set of socio-economic characteristics, product characteristics, and treatment indicators,  $\eta$  is a vector of random intercepts,  $\beta$  is a vector of random coefficients,  $\theta$  is a vector of constant coefficients, and  $\varepsilon_{isj}$  is a random error term.

The Random Parameters Tobit model allows individual-specific parameter set  $\beta$  to vary around a common mean-coefficient vector, which translate into the assumption that treatments or product features have different effects on individuals. A Random Parameters Tobit model for a given individual  $i$  can be specified following Collart and Palma (2013a) as

$$(25) \quad y_{isj}^* = \alpha \eta_i + x_{1,i} \beta_i + x_{2,i} \theta + \varepsilon_i$$

$$\eta_i = \bar{\eta} + \mu_i \text{ and } \beta_i = \bar{\beta} + \alpha_i$$

$$E(\varepsilon_i) = 0, \quad E(\varepsilon_i \varepsilon_i') = \sigma_e^2 I_{SXJ} \text{ if } i = j \quad \text{or} \quad E(\varepsilon_i \varepsilon_i') = 0 \text{ if } i \neq j$$

$$E(\alpha_i) = 0, \quad E(\alpha_i \alpha_i') = \Delta = \begin{bmatrix} \sigma_{1,1}^2 & \cdots & \sigma_{1,k} \\ \vdots & \ddots & \vdots \\ \sigma_{k,1} & \cdots & \sigma_{k,k}^2 \end{bmatrix} \text{ if } i = j \text{ or } E(\alpha_i \alpha_i') = 0 \text{ if } i \neq j$$

$$E(\mu_i) = 0, \quad E(\mu_i) = \sigma_\mu^2 \text{ if } i = j \quad \text{or} \quad E(\mu_i) = 0 \text{ if } i \neq j$$

where  $y_{isj}^*$  is a  $(S \times J) \times 1$  column vector of latent variable values associated with each observation,  $\alpha$  is a  $(S \times J) \times 1$  column vector of 1s,  $\eta_i$  represents the mean intercept for the group of observations submitted by individual  $i$ ,  $\bar{\eta}$  is a scalar that represents the grand mean, and  $\mu_i$  denotes the deviation of the mean intercept from the grand mean, that is, it captures the variation in intercepts between individuals. It is assumed that the random intercepts are distributed with a zero mean and variance  $\sigma_\mu^2$ . The coefficients vector  $\beta_i$  is the sum of the grand mean coefficient vector,  $\bar{\beta}$ , and the respondent deviation,  $\alpha_i$ , which captures variation in coefficients between individuals, and the  $x_{l,i}$  is a  $(S \times J) \times K$  matrix of  $K$  random covariates. Within the same individual, these deviations are distributed with a zero mean vector and a variance-covariance matrix  $\Delta$ .

Consequently, the random coefficients follow a multivariate normal distribution, so that  $\beta_i \sim mvn(\bar{\beta}, \Delta)$  and  $\mu_i \sim N(0, \sigma_\mu^2)$  if  $i = j$ . In addition,  $x_{2,i}$  represents a  $(S \times J) \times L$  matrix of  $L$  fixed covariates,  $\theta$  is a vector of constant coefficients across individuals, and the term  $\varepsilon_i$  is a normally distributed random vector with mean zero and common variance matrix  $\sigma_\varepsilon^2$ . Finally, it is assumed that  $\alpha$ ,  $\mu$ ,  $e$ , and  $x$  are uncorrelated within and across individuals (Moeltner and Layton 2002; Swamy 1970).

### *Models for Bid Differences Across Treatments*

Recent studies have been more focused on determining the differences in paired bids (multiple bids by an individual) between pre and post information treatments and for close substitutes (i.e., Kanter, Messer and Kaiser 2009). Lusk, Feldkamp, and Schroeder (2004) refer to these differences as “implied differences” and calculated them as

$$(26) \quad \text{DeltaWTP}_{isj} = \text{WTP}_{isj} - \text{WTP}_{i(\text{Base})j}$$

where  $s \neq \text{Base}$ . However, in estimating any model based on the implied differences, the interpretation of the parameter estimates must be undertaken cautiously. The equation for the implied difference in WTP can also be defined as

$$(27) \quad \text{DeltaWTP}_{isj} = (C_s - C_{\text{Base}}) + [\beta_s(X) - \beta_{\text{Base}}(X)]$$

where  $C$  is a constant and  $X$  is a vector of product characteristics, demographic and behavioral features, and information treatments (Mc Adams et al. 2013).

The implied differences in WTP are not censored at \$0.00 as in the case of the full bids. In this case, the participants had the choice to vary their bids either positively or negatively from the baseline round following the information treatments received. For example, it was expected that the WTP for some participants would significantly change after the tasting round depending on whether they liked or disliked the taste of the tomato products. Those who enjoyed the taste are expected to increase their bids and vice versa. Consequently the model for the implied differences was estimated using a mixed linear model that was previously described.

Regarding the health information treatment, it was hypothesized that the individuals will increase their willingness to pay for the vegetable products after they received the health information treatment, as it would be irrational to place a negative value for potential positive benefits. Thus, the model for the implied differences for the health treatment was analyzed using a random parameters tobit model.

#### *Accounting for Endogeneity using Instrumental Variables*

So far the assumption that the explanatory variables and the unobserved factors are uncorrelated has been hold in the development of all models. However, there are some applications in which the explanatory variables are endogeneous, that is, are not independent of the unobserved factors. In those applications, estimation without the assumption of correlation between observed and unobserved factors is inconsistent. The direction of bias can often be determined logically. In the case where the unobserved

factors are positively correlated with the observed variable, the estimation without regard to this correlation will result in an estimated dependent variable coefficient that is biased downward in magnitude. A similar bias, but in an opposite direction occurred if the unobserved factors are negatively correlated with the observed variable (Train 2009).

Several methods to correct for endogeneity in econometric models have been developed. A common approach is the method of Instrumental Variables (IV) which is developed as an extension of the classical regression model and has been used to obtain consistent estimators in the presence of omitted variables. Suppose that in the classical model  $y_i = x_i'\beta + \varepsilon_i$ , the variables  $x_i$  may be correlated with  $\varepsilon_i$ . Suppose as well that there exist another set of variables  $z_i$  such that: 1)  $z_i$  does not have a direct effect on  $y_i$  and thus does not belong on the right-hand-side of the model, 2)  $\text{cov}(z_i, \varepsilon_i) = 0$ , hence exogenous, 3)  $z_i$  is strongly correlated with  $x_i$ . A variable  $z_i$  with these properties is called an Instrumental Variable as it is considered a tool or instrument used to construct a consistent estimator of  $\beta$  by using the assumed relationships among  $z_i$ ,  $x_i$ , and  $\varepsilon_i$  (Greene 2003). Different methods can be used to estimate the IV. In this application, a Two-Stage Least Squares Estimation (2SLS) is used as an IV estimator.

The 2SLS estimation procedure can be used to estimate the parameters of any identified equation within a simultaneous system. An equation is said to be identified if in a system of  $M$  simultaneous equations, which jointly determines the value of  $M$  endogenous variables, at least  $M-1$  variables are absent from the equation in order to estimate its parameters. Consider a system of  $M$  simultaneous equations where  $y_1, y_2, \dots,$



$y_n$  are endogenous variables and  $x_1, x_2, x_3, \dots, x_i$  are exogenous variables. Consider the following structural equation:

$$(28) \quad y_1 = \alpha_2 y_2 + \alpha_3 y_3 + \beta_1 x_1 + \beta_2 x_2 + \varepsilon_1$$

If this equation is identified then its parameters can be estimated in two stages. The first stage consists in estimating the parameters of the reduced form equations:

$$(29) \quad y_2 = \pi_{12} x_1 + \pi_{22} x_2 + \pi_{32} x_3 + v_2$$

$$(30) \quad y_3 = \pi_{13} x_1 + \pi_{23} x_2 + \pi_{33} x_3 + v_3$$

where the parameters  $\pi_j$  and  $\pi_j$  are known as the reduced form parameters and the error terms  $v_j$  are known as reduced form errors. Then, by using OLS the predicted values  $\hat{y}_2$  and  $\hat{y}_3$  can be estimated:

$$(31) \quad \hat{y}_2 = \hat{\pi}_{12} x_1 + \hat{\pi}_{22} x_2 + \hat{\pi}_{32} x_3$$

$$(32) \quad \hat{y}_3 = \hat{\pi}_{13} x_1 + \hat{\pi}_{23} x_2 + \hat{\pi}_{33} x_3$$

The second stage consists in the replacement of the endogenous variables  $y_2$  and  $y_3$  by their predicted values,  $\hat{y}_2$  and  $\hat{y}_3$  in the structural equation:

$$(33) \quad y_1 = \alpha_2 \hat{y}_2 + \alpha_3 \hat{y}_3 + \beta_1 x_1 + \beta_2 x_2 + \varepsilon$$

The parameters of equation (33) are estimated by least squares. Notice that the parameters  $\hat{y}_2$  and  $\hat{y}_3$  are used as the IVs for  $y_2$  and  $y_3$ . Because the parameters  $\hat{y}_2$  and  $\hat{y}_3$  are placed on  $y_1$ , the 2SLS estimates can differ substantially from the OLS estimates (Wooldridge 2010).

In a 2SLS model, the number of instrumental variables required for the estimation is equal to the number of right-hand-side endogenous variables. Suppose several  $x_i$ 's are correlated with  $\varepsilon_i$ . Then, in order to conduct an IV estimation, there must be at least as many instrumental variables as there are endogenous variables. If the number of IV equals the number of endogenous variables, the model parameters are said to be just identified or exact identified. In this case, the term “identified” is used to indicate that the model parameters can be consistently estimated. On the other hand, if the number of IV is greater than the number of endogenous variables, that is, there are more instruments than are necessary for the IV estimation, the model is said to be overidentified (Wooldridge 2010).

In this application, an explanatory variable in the implied differences model for the health treatment was treated as an endogenous variable. Therefore, a 2SLS was developed to account for endogeneity. This model together with the variables used as instruments will be further discussed in the Endogeneity section in Chapter V.

### *A Latent Class Analysis with Individual Heterogeneity*

Besides consumers' preferences for the category of products being investigated, it is also likely that other interrelated factors might influence their bidding behavior. For example, health-related behaviors including exercising, tobacco use, and weight status, among other potential factors might be affecting consumers' valuations for selected food products and/or treatments. All of these factors could result in unobserved individual heterogeneity, which in turn may affect individuals' WTP.

The objectives of estimating a LCA are as follows: First to identify potential latent classes of consumers based on health-related behaviors; and second, to investigate the differences among latent classes in willingness to pay for tomato products, tasting, health information and product information treatments.

Latent class analysis (LCA), also known as finite mixture modeling, has become a statistical tool that social and behavioral researchers turn to with increasing frequency. LCA posits that the population is composed of multiple classes of a categorical latent variable, which are measured by observed categorical indicators that are interrelated. In particular, it estimates the proportion of individuals expected to be in each latent class based on motivational profile (Lanza, Tan, and Bray 2013).

The latent class model, which is described in detail by Collins and Lanza (2010), can be summarized as follows. Suppose there are  $c = 1, \dots, k, \dots, C$  latent classes that must be inferred from a set of  $j = 1, \dots, J$  observed categorical indicators, and that variable  $j$  contains  $R_j$  possible outcomes, for individuals  $i = 1, \dots, n$ . Let  $X_i = (X_{i1}, \dots, X_{ij})$  represent the vector of a particular individual  $i$ 's observed responses to the  $J$  variables,

where the  $r$  possible outcomes of  $X_{ij}$  are  $r = 1, \dots, R_j$ . Let  $I(x_{ij} = r)$  be an indicator function that equals 1 when the response to the variable  $j = r$ , and 0 otherwise. The probability density function of observing a particular response pattern is

$$(34) \quad \begin{aligned} X_i \sim f_i(x_i; \varphi) &= \sum_{c=1}^C \pi_c f_{i|c}(x_i; \theta_c) \\ &= \sum_{c=1}^C \pi_c \prod_{j=1}^J \prod_{r=1}^{R_j} (\theta_{jr|c})^{I(x_{ij}=r)} \end{aligned}$$

where  $\pi = (\pi_1, \dots, \pi_K)$  represents the probability of membership in the latent class  $c$  and the conditional probability density functions  $f_{i|k}(\cdot)$  represents the probability of response  $r_j$  to item  $j$  given the membership in latent class  $c$ . The parameters of the component densities,  $\theta = (\theta_1, \dots, \theta_c)$ , correspond to vectors of indicator-response probabilities for each class. The objective of the LCA is to estimate the parameters  $\varphi = (\pi, \theta)$  given realized values of  $X$  and a value of  $C$  provided by the analyst. The likelihood function for  $\varphi$  is defined as

$$(35) \quad \mathcal{L}(\varphi|X) = \prod_{i=1}^n f_i(x_i; \varphi).$$

When the corresponding parameters  $\varphi$  that maximized the log-likelihood function have been estimated, the  $n$  individuals are classified into the  $C$  classes by assigning each individual to the class with the highest probability (Collart and Palma 2013b).

After the latent class model is defined and characterize, a random parameters tobit model for each class will be estimated in order to measure the differences in willingness to pay among latent classes.

## **CHAPTER V**

### **RESULTS AND DISCUSSION**

The following chapter contains the results for the WTP models developed previously. First, a discussion of the demographic and behavioral characteristics of the subjects included in the sample and relevant statistics of the vegetables' consumer are provided. Then, the results of the various models used to estimate WTP based on the experimental auction are presented and discussed. Finally, a comparison will of the results is done addressing specific characteristics of this data set.

#### **Demographics and Behavioral Characteristics**

The experiment consisted of a total of 157 usable responses. These responses correspond to consumers (nonstudents) who represent the socio-demographic characteristics of U.S. grocery shoppers. The socioeconomic and behavioral characteristics of experimental auction participants are described in Table 5. To ensure participants were regular buyers of vegetables, it was specified in the advertisement that the study would be associated with consumer decision-making for vegetable purchases. About 86% of recruited subjects were the primary grocery shopper of their household.

**Table 5. Demographic and Behavioral Characteristics of Experiment Participants**

Variable	Category	Sample		U.S. Population <sup>a</sup>		Texas Population <sup>a</sup>	
		Mean	Percent	Mean	Percent	Mean	Percent
Age (years)		36.79		37.40		33.9	
	Under 25		25.48		33.50		37.10
	26-34		31.84		13.40		14.40
	35-44		12.74		12.90		13.70
	45-54		14.02		14.10		13.20
	55-64		10.19		12.30		10.70
	65 and over		5.73		13.80		10.90
Household Size (Individuals)		2.57		2.63		2.83	
Education	High School Diploma or Less		7.01		41.60		43.80
	Bachelor's Degree or at least some College		47.77		47.50		47.20
	Graduate Courses or more		45.22		10.90		9.00
Gender	Female		61.51		50.81		50.30
	Male		39.49		49.19		49.70
Marital Status	Married		48.08		48.45		49.70
	Not Married		51.92		51.55		50.30
Yearly Household Income (\$)		47,908		71,317		71,651	
Race	Asian/Pacific Islander		10.26		5.20		4.10
	African American		5.77		12.60		11.60
	Caucasian/Native American		50		62.80		44.50
	Hispanic		31.41		16.90		38.20
	Other		2.56		2.50		1.60
Primary Shopper	Primary Shopper		85.99				
	Secondary Shopper		14.01				
Household Spending on Food (\$/week)		113.35					
Household Spending on Fruits and Vegetables (\$/weeks)		27.61					
Vegetables on Hand (% of full stock)		34.31					
Have a Serious Health Issues	Yes		21.28				
	No		78.72				
Tobacco Use	Yes		8.51				
	No		91.49				
Exercise (% of days per year exercised)		39.52					

<sup>a</sup> Source: U.S. Census Bureau, 2012 American Community Survey.

Over 62% of participants were females and around 48% were married. The sample was composed mostly of Caucasians (50%) followed by Hispanic individuals (31%). The average age of the sample was 36.79 years old, and average annual income was \$47,908. The mean reported household spending on all food purchases was \$113 per week, of which \$28 was spent on fruits and vegetables. Additionally, participants

reported that, on average, fruits and vegetables comprise 34% of their full stock of food at home.

The subjects were also required to answer a series of health-related questions during the study. From all participants, about 21% reported having a serious health issue and 9% reported to be smokers. The average percentage days exercised per year was 40%. These health characteristics were measured for the purpose of testing for any relationship between the effects of such attributes and the information treatments introduced in the study, with a particular interest in the health treatment. Additionally, participants were asked to state as to which of the following weight categories they perceived they belong to: severely obese, moderately obese, overweight, normal, underweight, and severely underweight. This information was used to make further comparisons with weight categories defined on actual measured BMI. In doing so, individuals' weight and height were measured in each session to calculate their actual BMI. To minimize ordering effects, half of the BMI measures were taken at the beginning of the session, and half at the end of the session. These two different classifications are useful for several reasons. First, it can be used to determine how close individual's weight perceptions are to their actual state. Second, having classified subjects into the different weight categories, the effect of obesity on the information treatments, specifically on the health treatment, can be determined. Table 6 shows a comparison of the percentage of individuals that correspond to each weight category either based on actual BMI estimates or on the perceived state by subjects. For the female group, the obese category resulted in an underreported estimate where only 12%



of female were classified as obese based on their weight perception while 17% actually belonged to the obese category. In other words, many more individuals are obese than are classified as such by their own weight perception. The same pattern was found in the male group. These results support those of Burkhauser and Cawley (2008) who concluded that there exist a negative correlation between the direction of reporting bias and the actual weight; that is, underweight individuals tend to over-report their weight, while overweight individuals tend to underreport their weight. While this reporting error can result in severe underestimates of the number of individuals in high weight classifications such as obesity, it may also bias coefficient estimates (Bound, Brown and Mathiowetz 2002).

Equality between the two weight classifications was tested using a paired t-test, which tests the null hypothesis that the two weight classifications are equal. The null hypothesis could not be rejected ( $P=0.886$ ), indicating that the weight classification based on actual BMI estimates and the classification based on individuals' weight perception are statistically equal.

The role obesity plays on consumer decision-making in regard to vegetable purchases and its effect on the health information treatment will be discussed in the Latent Class Analysis (LCA) section.

**Table 6. Comparison of Actual Weight versus Stated Weight Perceptions**

<b>Weight Category</b>	<b>Female</b>		<b>Male</b>	
	<b>N = 95</b>		<b>N = 60</b>	
	<b>Actual Status (%)</b>	<b>Perceived Status (%)</b>	<b>Actual Status (%)</b>	<b>Perceived Status (%)</b>
Underweight	3.16	2.11	0.00	1.67
Normal	57.89	48.42	56.67	63.33
Overweight	22.11	37.89	35.00	28.33
Obese	16.84	11.58	8.33	6.67

Subjects were asked to choose the most important factors when making purchasing decision for tomatoes. The list included observable product characteristics (i.e. visual appearance, size, freshness), information that can be obtained at the point-of-sale (i.e. growing location, nutrition, and certified production practices), and experience attributes (i.e. taste). These factors were elicited in order to determine the elements that play an important role in the consumer decision-making process regarding tomatoes. For the measurement of these factors, subjects were asked to rate each factor on a rating scale from 1 to 4, where 1 = Not important at all and 4 = Very important. Base on this rating scale, freshness (3.8), taste (3.7), and visual appearance (3.5) were cited as the top three factors in purchase decision making for tomatoes; these were followed by price (3.2), nutrition (3.2), convenience (2.8), and size (2.7) as the next highest in importance. These results support those of Pollard, Kirk, and Cade (2002) who reported taste, texture, smell, price, and nutrition as the main factors influencing the food choice of adults in relation to fruit and vegetable consumption. The least important attributes were

certified production (2.4) and growing location (2.1). Importance ratings of all attributes are reported in Table 7.

**Table 7. Relative Importance of Factors in Tomato Purchase Decisions Based on a Rating Scale**

Factor	Mean <sup>(a)</sup>	Std. Dev.	Interpretation of Importance <sup>(a)</sup>
Price	3.282	0.717	Somewhat Important
Taste	3.777	0.475	Very Important
Nutrition	3.268	0.819	Somewhat Important
Convenience	2.847	0.893	Somewhat Important
Visual Appearance	3.513	0.649	Very Important
Size	2.723	0.786	Somewhat Important
Freshness	3.839	0.369	Very Important
Growing Location	2.103	0.877	Not Very Important
Certified Production	2.471	0.931	Not Very Important

<sup>(a)</sup> Subjects were asked to rank all the factors on a scale of 1 to 4; 1 = Not Important at all, 2 = Not Very Important, 3 = Somewhat Important, and 4 = Very Important.

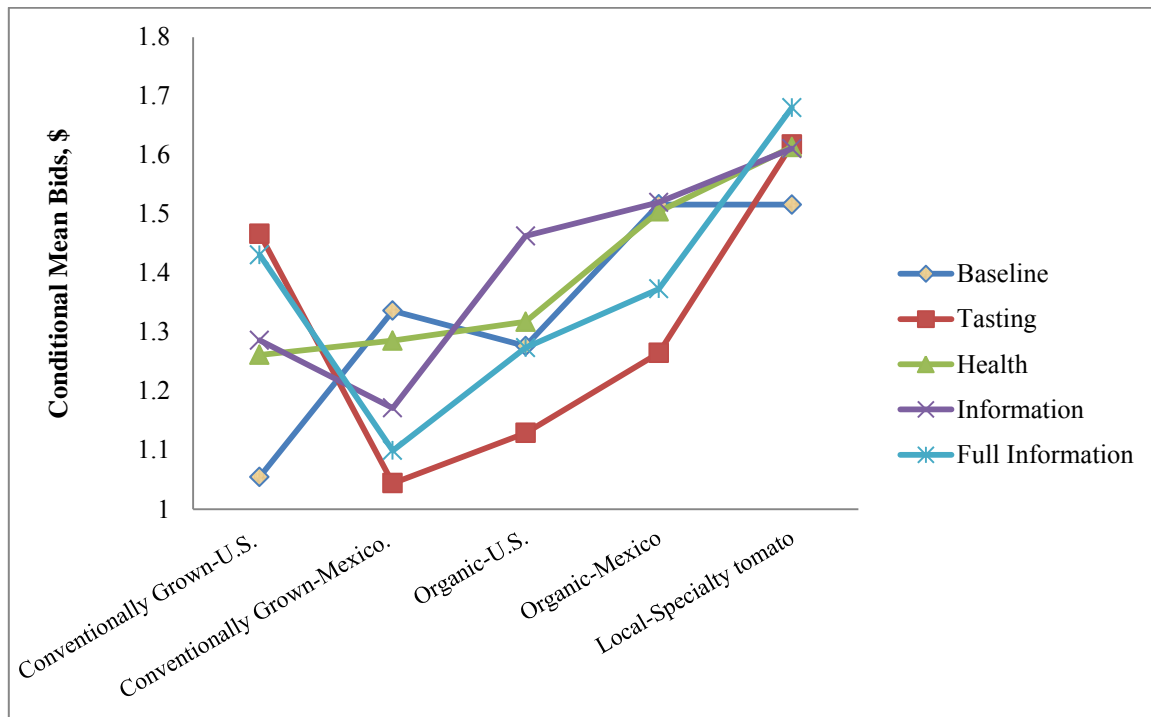
### **WTP Models for Experimental Auction Bids**

The experimental auction bids were pooled for all treatments, which resulted in 3140 observations (5 products x 4 rounds x 157 participants). Recall the five products used in the experiment were conventional tomatoes produced in the U.S. and Mexico, organic varieties produced in the U.S. and Mexico, and a local-specialty tomato product. The domestic varieties were produced in an off-season period. Moreover, the four treatments were: 1) Baseline round, 2) Tasting, 3) Health Information treatment, and 4) Product Information Treatment. Table 8 provides descriptive statistics for the bids by treatment and product. With prices ranging from \$0.00 to \$6.00 for one pound of tomatoes, the average price that consumers were willing to pay for all tomato varieties across all rounds was \$1.37 per pound. This price was significantly higher than the retail price (\$0.79 per pound) and the terminal market price (\$0.75 per pound) for tomatoes in the U.S. (USDA 2014). Based on the mean bids, it's clearly noticeable that individuals had a higher WTP for local-specialty tomatoes for every round. Note that the degree of variance in the submitted bids was large and there were zero bids for all products in all rounds.

**Table 8. Descriptive Statistics for the Bids**

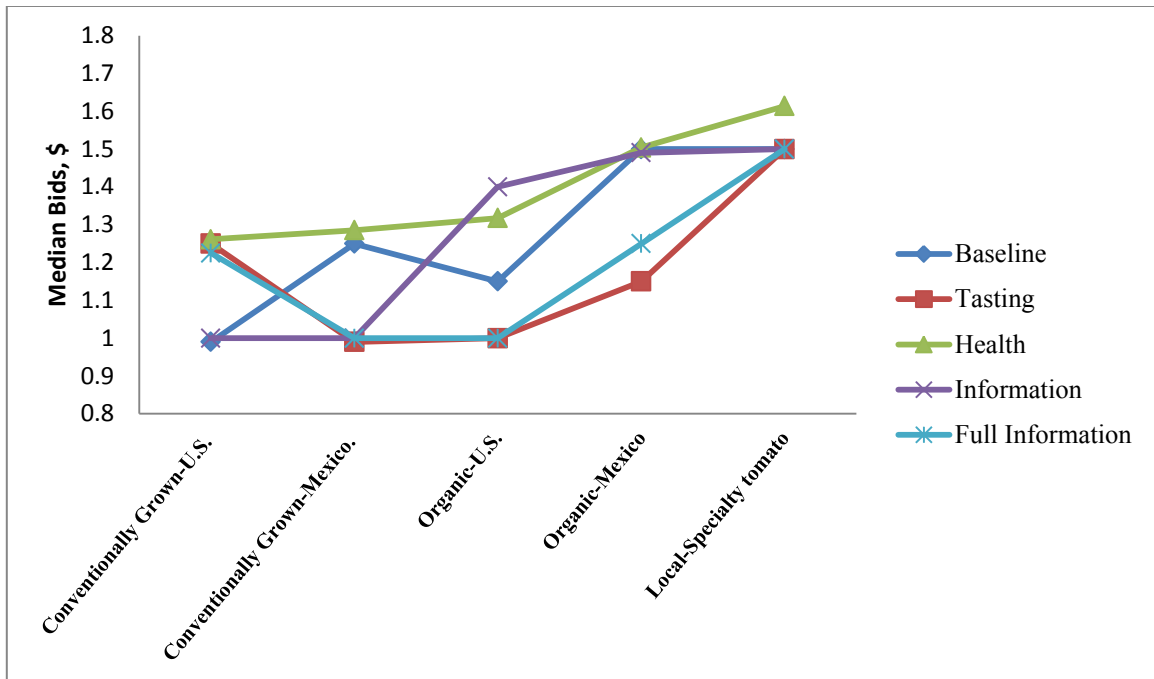
Product Type	Mean Bid	Std. Dev.	Minimum	Median	Maximum
<b>A. Bids - Baseline Round</b>					
Conventionally Grown Tomato - U.S.	1.05	0.74	0.00	0.99	5.00
Conventionally Grown Tomato - Mexico	1.34	0.76	0.00	1.25	4.50
Organic Tomato - U.S.	1.28	0.80	0.00	1.15	6.00
Organic Tomato - Mexico	1.52	0.81	0.00	1.50	5.00
Locally Grown Tomato - Specialty tomato	1.52	0.81	0.00	1.50	4.50
Yellow Squash	1.30	0.81	0.00	1.20	4.00
<b>B. Bids - Tasting Round</b>					
Conventionally Grown Tomato - U.S.	1.47	0.95	0.00	1.25	4.75
Conventionally Grown Tomato - Mexico	1.04	0.69	0.00	0.99	3.10
Organic Tomato - U.S.	1.13	0.77	0.00	1.00	3.00
Organic Tomato - Mexico	1.26	0.83	0.00	1.15	4.75
Locally Grown Tomato - Specialty tomato	1.62	1.06	0.00	1.50	5.50
<b>C. Bids - Health Round</b>					
Conventionally Grown Tomato - U.S.	1.26	0.86	0.00	1.00	5.00
Conventionally Grown Tomato - Mexico	1.29	0.73	0.00	1.20	4.50
Organic Tomato - U.S.	1.32	0.81	0.00	1.25	3.75
Organic Tomato - Mexico	1.50	0.84	0.00	1.40	4.50
Locally Grown Tomato - Specialty tomato	1.61	0.93	0.00	1.50	5.00
Yellow Squash	1.24	0.78	0.00	1.10	4.75
<b>D. Bids - Information Round</b>					
Conventionally Grown Tomato - U.S.	1.29	0.83	0.00	1.00	5.00
Conventionally Grown Tomato - Mexico	1.17	0.70	0.00	1.00	3.75
Organic Tomato - U.S.	1.46	0.84	0.00	1.40	3.90
Organic Tomato - Mexico	1.52	0.89	0.00	1.49	4.50
Locally Grown Tomato - Specialty tomato	1.61	1.00	0.00	1.50	5.00
Yellow Squash	1.22	0.78	0.00	1.00	4.00
<b>E. Bids - Full Information</b>					
Conventionally Grown Tomato - U.S.	1.43	0.92	0.00	1.23	5.00
Conventionally Grown Tomato - Mexico	1.10	0.69	0.00	1.00	3.10
Organic Tomato - U.S.	1.27	0.86	0.00	1.00	3.90
Organic Tomato - Mexico	1.37	0.88	0.00	1.25	4.75
Locally Grown Tomato - Specialty tomato	1.68	1.08	0.00	1.50	5.50
Yellow Squash	1.10	0.74	0.00	1.00	3.00

The information for the conditional mean bids and the median bids can be visualized in Figure 10 and Figure 11, respectively.



**Figure 10. Conditional Mean Bids for Tomato Products By Information Treatment**

The mean bids in the tasting round were in general lower than the mean bids in the other information rounds. This was true for almost all products except the U.S. conventionally-grown tomato and the local-specialty tomato. The full information mean bids closely follow the tasting round for all products even though they were slightly higher than the tasting mean bids for all products except the U.S. conventionally grown variety. The mean bids for the local-specialty tomato were the highest across all products and information treatments. The largest range in mean bids across information treatments was for the U.S. products.

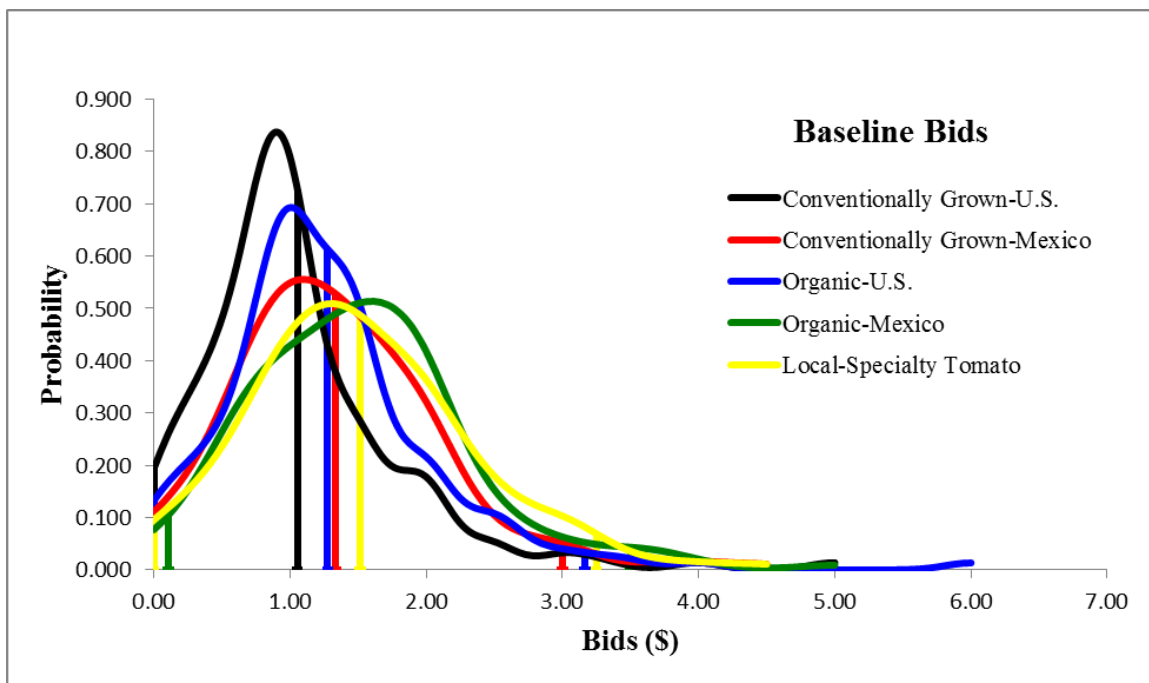


**Figure 11. Median Bids for Tomato Products By Information Treatment**

As seen in Figure 11, the median bids for the full information round closely mirror the median bids for the tasting treatment as in the plot of the means. The smallest range in median bids across information treatments was for the local-specialty variety, which presented similar mean bids for all treatments except the health treatment. In the case of all products, except the U.S. conventionally-grown tomato and local-specialty tomato, there was an initial price premium for the products; however, the premium decreased as participants gained information on the products.

Besides the descriptive statistics for the bids provided in table 8, the distributions of those bids were also compared. Figures 12-16 show the distribution of bids for each tomato product by information treatment. For estimating the probability density functions, a Gaussian kernel density distribution in Simetar© was used. Kernel Density

Estimation is a nonparametric estimation procedure that generates nonparametric probability distributions. It works by estimating a separate probability distribution for each point in the data set and then summing up all the distributions to reflect the overall distribution. By using a Gaussian kernel distribution, if the bids are normally distributed they should appear normally distributed in the probability density function (McAdams 2011).

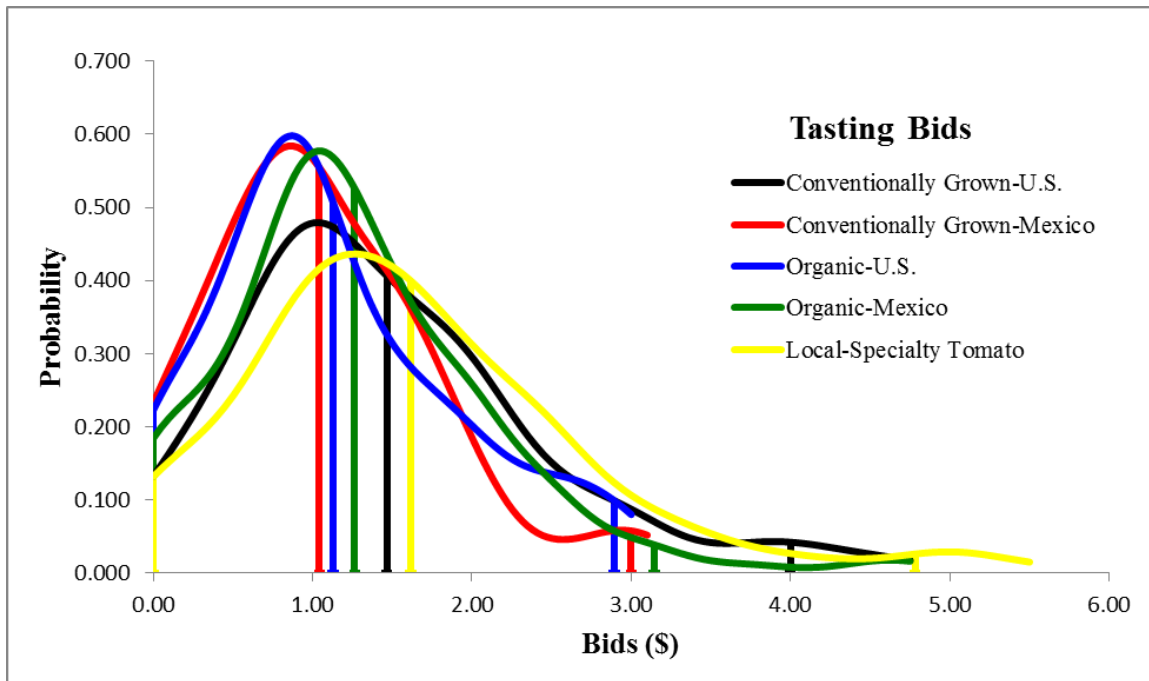


**Figure 12. Distribution of Baseline Round Bids for Tomato Products Estimated with a Gaussian Kernel Density Distribution**

In Figure 12, the U.S. conventionally-grown tomato appears to have the highest degree of censoring at zero, followed by the U.S. organic variety, and then a clustering of the bids for the conventional and organic tomatoes grown in Mexico; the local-specialty tomato had the least amount of censoring. As a result, it is clearly noticeable



from the figure that the conventional tomato produced in the U.S. has the lowest bids mean (consumers liked it the least) while the local-specialty variety presents the highest mean (consumers liked it the most).

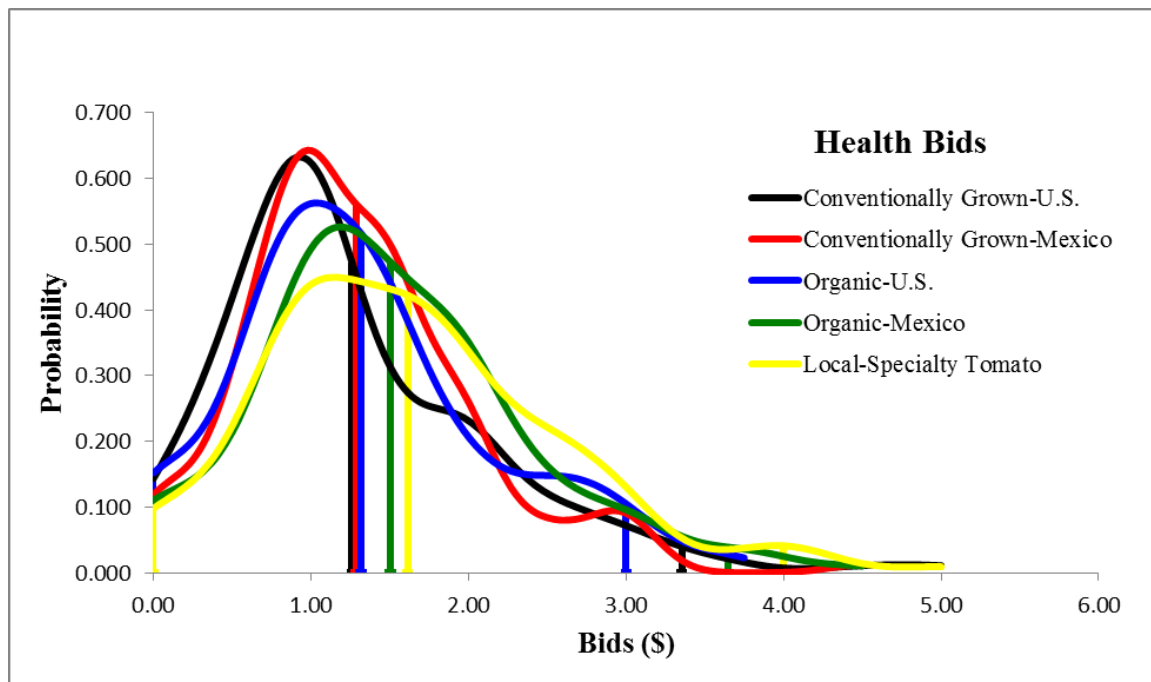


**Figure 13. Distribution of Tasting Round Bids for Tomato Products Estimated with a Gaussian Kernel Density Distribution**

The product distributions for the tasting treatment differed from those of the baseline treatment. Three basic groups of distributions with similar characteristics can be distinguished in Figure 13. The conventionally-grown tomato produced in Mexico and the U.S. organic tomato presented the highest degree of censoring at zero, followed by the organic tomato produced in Mexico with somewhat less censoring at zero, and then the least amount of censoring for the U.S. conventionally grown and local-specialty varieties. As a result, it is the conventional tomato grown in Mexico that has the lowest

bids mean while the local-specialty tomato remains with the highest mean. This implies that more individuals bid negative values for the conventional variety produced in Mexico, after tasting, than any of the other varieties.

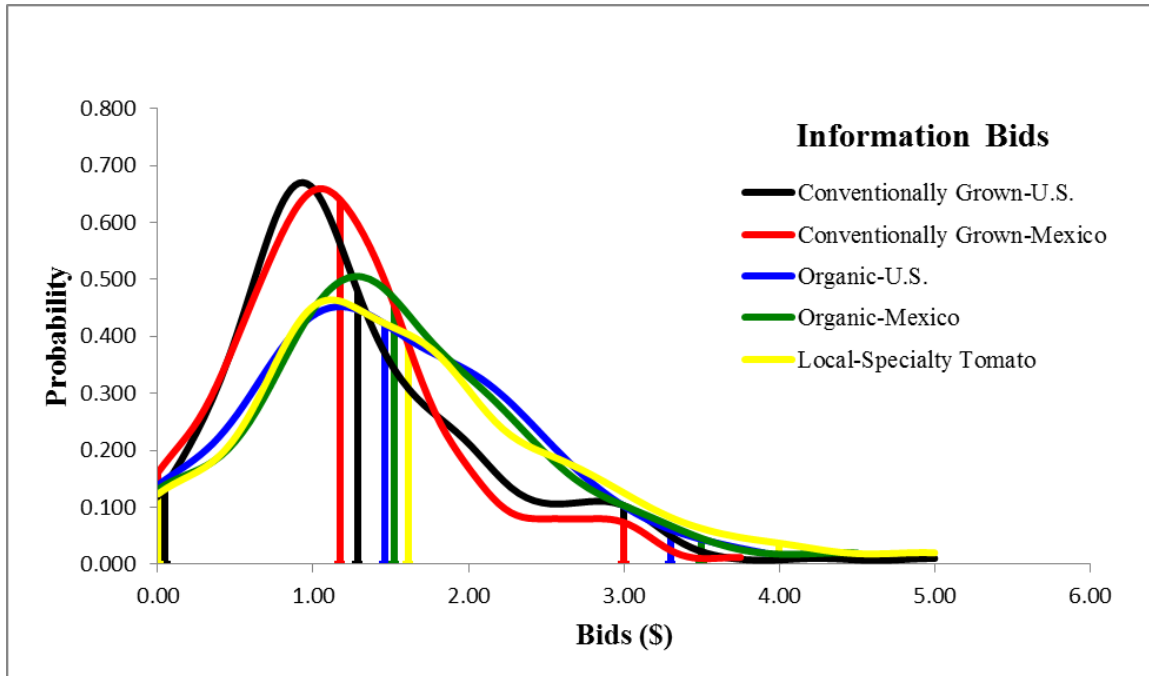
The estimated probability density functions differ across information treatments. Therefore, it was necessary to compare all distributions for each product across information treatments, as it was possible that the information treatment would affect not only the location of the bids, but also their distribution.



**Figure 14. Distribution of Health Information Round Bids for Tomato Products Estimated with a Gaussian Kernel Density Distribution**

When comparing the distribution of the bids across products, the local-specialty tomato and the organic tomato produced in Mexico have less censoring at zero than the rest of the products; the means for these two products are shifted to the right relative to

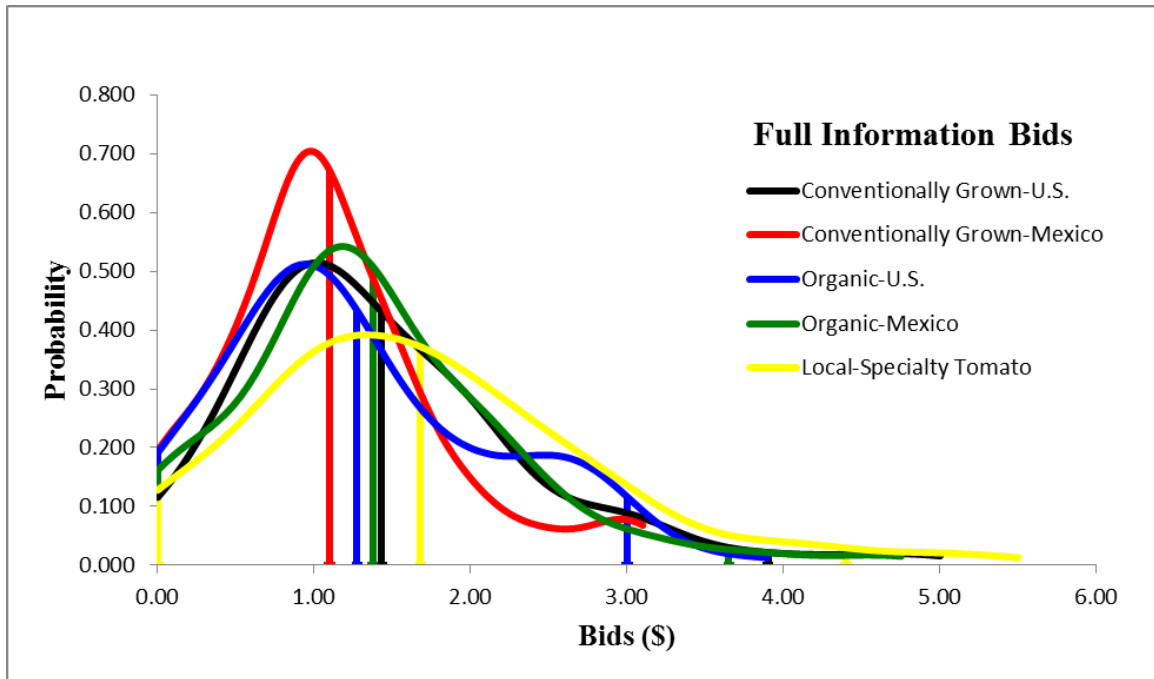
the other products. This implies that those varieties had the least amount of negative bids relative to the others; meaning that, after the health treatment, consumers preferred them the most.



**Figure 15. Distribution of Information Round Bids for Tomato Products Estimated with a Gaussian Kernel Density Distribution**

Different clustering groups of the probability density functions among classes of products appear in the health and information treatments (Figure 14 and Figure 15, respectively). Also, more differences in the distribution shapes are seen when participants had the full information set than in the other individual information treatments (Figure 16). The normality of the bid distributions was tested using a Kolmogorov-Smirnov test, which tests the null hypothesis that the bids are normally

distributed. The null hypothesis was rejected ( $P < 0.05$ ), indicating that the bids are not normally distributed for any of the products or across any of the treatments.



**Figure 16. Distribution of Full Information Round Bids for Tomato Products Estimated with a Gaussian Kernel Density Distribution**

### *Bid Censoring*

The figures shown above help to visualize the censoring that occurred for the bids submitted by the auction participants. Table 9 provides the percentage of bids that are censored by round and by product. The percentage of bid censoring in all information treatments was relatively low across products, ranging from 2.8% to 9.2%. Negative bids would have implied that participants would have to be paid to accept or consume the product in question. This type of behavior would be expected for undesirable characteristics of products for which subjects have different perceptions of quality and

risk, such as genetically modified and irradiated foods (Parkhurst, Shogren and Dickinson 2004). In experimental auctions, the potential for negative values can be handled in two different ways. The easiest approach to account for such values is to allow subjects to bid for any value, either positive or negative. However; if this approach is taken, the researcher should ensure that participants do not bid negative values for strategic reasons (Lusk and Shogren 2007). The second approach is to endowed participants with a product with negative traits and asked them to bid to upgrade (Lusk et al. 2001). In this experiment, the first approach was used. Participants were told during the bidding rounds that they may bid any value for the items, including negative and zero values.

**Table 9. Percentage of Bids Censored at \$0.00 By Round and Product**

Product Type	Treatment			
	Baseline	Tasting	Health	Information
Conventionally Grown Tomato - U.S.	3.55	3.55	4.26	2.84
Conventionally Grown Tomato - Mexico	4.96	8.51	4.26	5.67
Organic Tomato - U.S.	4.26	9.22	8.51	7.80
Organic Tomato - Mexico	2.84	7.80	6.38	7.09
Locally Grown-Specialty Tomato	3.55	6.38	4.26	5.67
All bids	4.46	7.45	5.77	6.08

*Tobit Models for Full Information Treatment*

To analyze the importance of factors that are likely to affect consumers' WTP for tomato products, the WTP functions were estimated using the explanatory variables

describe in Table 4. Results of the full WTP model estimations are presented in Table 10.

Recall that the full information treatment represents the amount consumers are willing to pay for the products after they received all information treatments. The covariates of the model included product characteristics, socio-demographic and behavioral characteristics of the participants.

Income level of \$100,000 or more was positive and significant for all tomato products. Hispanic individuals had a positive coefficient for almost all products; however, the variable is significant ( $P < 0.05$ ) only for conventionally grown tomatoes produced in Mexico.

However, the  $\hat{\beta}$  coefficients estimated in the tobit model should not be interpreted the same way as the  $\hat{\beta}$  coefficients estimated in an ordinary least squares linear regression model. In the tobit model, the sign of the  $\hat{\beta}$  coefficients do tell the direction of the marginal effects; however, its magnitude have no meaning, making the calculation of marginal effects indispensable. In particular, the  $\hat{\beta}$  coefficients in a Tobit model reflect two components: 1) the change in the dependent variable  $y_i$  above a certain threshold called the censored limit, which is weighted by the likelihood of being above the limit; and 2) the change in the probability of being above the limit, which is weighted by the expected value of  $y_i$  for interpretation (McDonald and Moffitt 1980). Therefore, the most relevant results in a tobit model, from an economic perspective, are the marginal effects for each independent variable.

**Table 10. Tobit Models for WTP by Product, Full Information**

	Full Information				
	Conventional U.S.	Conventional Mexico	Organic U.S.	Organic Mexico	Local- Specialty
	Parameter (Std. Error)	Parameter (Std. Error)	Parameter (Std. Error)	Parameter (Std. Error)	Parameter (Std. Error)
Constant	2.055 *** (0.428)	1.528 *** (0.332)	1.133 *** (0.414)	1.997 *** (0.417)	2.427 *** (0.521)
Demographics/Behaviors					
DAGE2	-0.085 (0.204)	-0.021 (0.158)	0.102 (0.190)	0.026 (0.206)	0.088 (0.235)
DAGE3	-0.346 (0.271)	0.090 (0.210)	-0.289 * (0.252)	-0.203 (0.273)	-0.360 (0.312)
DEDU2	-0.448 (0.333)	-0.218 (0.258)	0.388 (0.153)	-0.132 (0.166)	-0.393 (0.190)
DEDU3	-0.508 (0.342)	-0.431 (0.265)	0.307 (0.229)	-0.399 (0.249)	-0.449 (0.283)
HHSIZE	-0.100 (0.072)	-0.009 (0.056)	0.031 (0.064)	0.024 (0.070)	0.021 (0.080)
FEMALE	0.007 (0.159)	-0.113 (0.123)	-0.136 (0.146)	-0.271 * (0.158)	-0.073 (0.180)
DMAR	0.199 (0.184)	-0.065 (0.142)	0.013 (0.170)	0.085 (0.185)	-0.028 (0.210)
DINC2	0.081 (0.216)	-0.087 (0.168)	-0.119 (0.198)	-0.226 (0.215)	0.029 (0.244)
DINC3	0.541 ** (0.259)	0.446 ** (0.200)	0.796 *** (0.237)	0.458 * (0.257)	0.617 ** (0.294)
DRACE2	-0.176 (0.189)	0.420 *** (0.146)	0.257 (0.173)	0.258 (0.188)	0.132 (0.215)
DRACE3	-0.431 ** (0.212)	0.007 (0.164)	-0.226 (0.198)	-0.135 (0.214)	-0.225 (0.243)
SPENDFV	0.000 (0.004)	-0.004 (0.003)	-0.007 (0.004)	-0.005 (0.004)	-0.004 (0.005)
ILLNESS	0.040 (0.192)	0.061 (0.148)	-0.114 (0.177)	-0.340 * (0.192)	-0.202 (0.219)
TOBACCO	-0.474 (0.291)	-0.411 * (0.224)	-0.300 (0.249)	-0.111 (0.269)	-0.298 (0.307)
EXERCISE	0.003 (0.002)	-0.002 (0.002)	-0.002 (0.002)	-0.004 * (0.002)	-0.006 * (0.003)
$\sigma$	0.888 *** (0.052)	0.684 *** (0.041)	0.851 *** (0.052)	0.863 *** (0.053)	1.077 *** (0.064)
Log-Likelihood	-195.763	-158.439	-187.79	-190.866	-222.737

Note: \*, \*\*, \*\*\*, indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

The marginal effects of the coefficients were calculated using the Delta method.

Estimates for the marginal effects are given in Table 11. In particular, the marginal

effects of the continuous variables represent the expected change in the willingness to pay for tomatoes given a one-unit change in the variable of interest. In the case of dummy explanatory variables, the marginal effects are interpreted relative to the base level of the dummy variable.

In looking at the marginal effects of the model for the demographic variables, we conclude that an individual with a yearly income greater than \$100,000 would be willing to pay price premiums of \$0.43 and \$0.35 for domestic and imported conventional tomatoes, respectively. Moreover, respondents are willing to pay premiums of \$0.60 and \$0.48 for organic tomatoes produced in U.S. and local-specialty tomatoes, respectively. Hispanics are willing to pay a price premium of \$0.33 for the conventional tomato produced in Mexico compared to Caucasian individuals. While consumers with 55 years of age or older expressed price discounts of \$0.22 for the organic tomato produced in U.S., females had price discounts of \$0.21 for the Mexican organic tomatoes.

Regarding behavioral characteristics, results show that smokers and individuals who had a serious illness expressed price discounts for the tomato varieties produced in Mexico. Also, a lower WTP for the Mexican organic tomato and local-specialty product is linked to individuals who exercise on a regular basis. To be considered a regular exerciser, an individual must exercise nearly every day for at least 30 minutes per day (Harvard Health Publications 2011).



**Table 11. Marginal Effects for Tobit Models for WTP by Product, Full Information**

	Full Information				
	Conventional U.S.	Conventional Mexico	Organic U.S.	Organic Mexico	Local- Specialty
	$\hat{\partial y/\partial x}$ (Std. Error)	$\hat{\partial y/\partial x}$ (Std. Error)	$\hat{\partial y/\partial x}$ (Std. Error)	$\hat{\partial y/\partial x}$ (Std. Error)	$\hat{\partial y/\partial x}$ (Std. Error)
Demographics/Behaviors					
DAGE2	-0.067 (0.162)	-0.016 (0.130)	0.077 (0.147)	0.020 (0.160)	0.068 (0.186)
DAGE3	-0.274 (0.215)	0.071 (0.172)	-0.218 * (0.195)	-0.159 (0.212)	-0.281 (0.247)
DEDU2	-0.355 (0.264)	-0.171 (0.105)	0.292 (0.119)	-0.103 (0.129)	-0.307 (0.150)
DEDU3	-0.403 (0.271)	-0.337 (0.157)	0.231 (0.178)	-0.312 (0.194)	-0.350 (0.224)
HHSIZE	-0.080 (0.057)	-0.007 (0.044)	0.023 (0.050)	0.019 (0.054)	0.016 (0.063)
FEMALE	0.006 (0.126)	-0.088 (0.100)	-0.102 (0.113)	-0.212 * (0.123)	-0.057 (0.143)
DMAR	0.158 (0.145)	-0.051 (0.116)	0.010 (0.132)	0.067 (0.144)	-0.022 (0.166)
DINC2	0.064 (0.172)	-0.068 (0.135)	-0.089 (0.153)	-0.177 (0.167)	0.022 (0.194)
DINC3	0.430 ** (0.205)	0.349 ** (0.162)	0.599 *** (0.183)	0.358 * (0.200)	0.481 ** (0.232)
DRACE2	-0.139 (0.150)	0.329 *** (0.118)	0.193 (0.134)	0.201 (0.146)	0.103 (0.170)
DRACE3	-0.342 ** (0.168)	0.006 (0.135)	-0.170 (0.153)	-0.105 (0.167)	-0.175 (0.193)
SPENDFV	0.000 (0.004)	-0.003 (0.003)	-0.005 (0.003)	-0.004 (0.003)	-0.003 (0.004)
ILLNESS	0.031 (0.152)	0.048 (0.121)	-0.086 (0.137)	-0.265 * (0.149)	-0.157 (0.174)
TOBACCO	-0.376 (0.230)	-0.322 * (0.170)	-0.225 (0.193)	-0.087 (0.209)	-0.232 (0.243)
EXERCISE	0.002 (0.002)	-0.322 (0.002)	-0.001 (0.002)	-0.003 * (0.002)	-0.004 * (0.002)

Note: \*, \*\*, \*\*\*, indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Even though the tobit model estimations presented above facilitate the comparison of parameters estimates and marginal effects for each product under each information treatment, they limit the generalization of the results to less specific products and the extension of the comparisons to additional information treatments. Therefore, the

experimental auction bids were pooled and further models were estimated to provide additional insight.

#### *Ordinary Least Squares Model*

The pooled bids for the tomato varieties are first modeled using an ordinary least squares (OLS) model. This model was only estimated as a baseline comparison for the other models as it does not account for bid-censoring and unobservable factors that may affect individual's valuation of the vegetable products and information treatments. Therefore, OLS estimates are biased and inconsistent. The nature and reasons of this inconsistency will be elaborated later on when discussing models.

The estimation results of the experimental auction data using OLS model are presented in Table 12. It is obvious that most of the factors influencing bidding behavior were found to be significant in the OLS regression. All the coefficients associated with the product varieties are statistically significant ( $P < 0.05$ ). In general, consumers are willing to pay price premiums for organic and local-specialty tomatoes compared with conventionally grown tomatoes produced in Mexico. Although none of the information treatments are statistically significant, the tasting effect for each product becomes significant when interacting with other products. In particular, mean bids for the domestic tomato and local-specialty tomato increased after participants tasted the products, however, the treatment had a significant negative effect on WTP for the organic varieties.

**Table 12. Ordinary Least Squares Estimates for WTP for Tomato Products**

	Parameter	Standard Error
Constant	1.835 ***	0.096
Product		
Organic	0.168 ***	0.047
U.S.	-0.183 ***	0.047
Local-Specialty tomato	0.244 ***	0.062
Additional Information		
Tasting	-0.118	0.073
Health	0.062	0.042
Product Information	-0.082	0.073
Product/treatment		
Tasting x Organic	-0.225 ***	0.081
Tasting x U.S.	0.334 ***	0.081
Tasting x Local	0.200 *	0.107
Info x Organic	0.096	0.081
Info x U.S.	0.211 ***	0.081
Info x Local	0.162	0.107
Demographics/Behaviors		
DAGE2	0.027	0.041
DAGE3	-0.226 ***	0.055
DEDU2	-0.190 ***	0.066
DEDU3	-0.404 ***	0.068
HHSIZE	-0.048 ***	0.014
FEMALE	-0.077 **	0.032
DMAR	0.045	0.037
DINC2	-0.020	0.044
DINC3	0.513 ***	0.053
DRACE2	0.181 ***	0.038
DRACE3	-0.205 ***	0.043
SPENDFV	-0.002 **	0.001
ILLNESS	-0.093 **	0.039
TOBACCO	-0.281 ***	0.058
EXERCISE	-0.002 ***	0.000

Note: \*, \*\*, \*\*\*, indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Almost all socio-demographic and behavioral covariates included in the model are statistically significant ( $P < 0.05$ ). Regarding the socio-demographic profile, results showed that Hispanic individuals, and those with high yearly household income (greater than \$100,000) are willing to pay price premiums for these tomato products. In contrast, consumers aged 55 years old or more, females, those with some college or graduate education level and with larger household size, expressed price discounts. Regarding the behavioral characteristics, all variables have a negative significant effect on WTP for the tomato products. Possible explanations for the sign of each variable's coefficient will be discussed in further models.

#### *Tobit Model for Pooled Bids*

The constant parameters tobit model is estimated using the same variables included in the OLS estimation; however, the tobit model accounts for the bid censoring that the OLS estimation ignores. Table 13 shows the estimation results for the tobit model including its marginal effects. The estimated standard deviation of the residuals is given by the  $\sigma$  value. The maximized log-likelihood value is also given.

In comparing the two models presented so far, OLS and tobit, few differences between them can be observed. These differences are reflected in the parameter estimations of the models. The demographic effects that are significant from the OLS model are also significant for the pooled tobit model. Further, all the product varieties are shown to be significant in the Tobit model as well, indicating a significant correlation between WTP and each respective product characteristic. Unlike the OLS, there was a significant negative effect of the tasting treatment in the tobit model, which

indicates there was a decrease in mean bids after subjects tasted the tomato products. However, when analyzing the tasting effect for each specific product, only the organic varieties had a negative marginal effect, which suggests that subjects decreased their bids specifically after they tasted the organic tomatoes.

The comparison of the tobit model versus the OLS model shows a high number of observations (158 censored observations of 3030 total bids) at the censoring level of \$0.00, which indicates that an OLS model is inappropriate for the bids. In addition, contrary to OLS, the tobit model provides an estimate of the standard deviation of residuals, which amounted to 0.842 and was statistically significant at the 99% confidence interval.

**Table 13. Constant Parameters Tobit Model Estimates for WTP for Tomato Products**

	Parameter	Standard	
		Error	$\partial y/\partial x$
Constant	1.791 ***	0.100	
Product			
Organic	0.164 ***	0.049	0.130
U.S.	-0.186 ***	0.049	-0.147
Local-Specialty tomato	0.246 ***	0.064	0.195
Additional Information			
Tasting	-0.135 *	0.076	-0.106
Health	0.056	0.044	0.045
Product Information	-0.088	0.076	-0.070
Product/treatment			
Tasting x Organic	-0.230 ***	0.085	-0.182
Tasting x U.S.	0.346 ***	0.085	0.274
Tasting x Local	0.206 *	0.112	0.163
Info x Organic	0.090	0.085	0.071
Info x U.S.	0.219 **	0.085	0.173
Info x Local	0.161	0.112	0.127
Demographics/Behaviors			
DAGE2	0.025	0.043	0.020
DAGE3	-0.236 ***	0.058	-0.187
DEDU2	-0.163 **	0.069	-0.129
DEDU3	-0.381 ***	0.071	-0.302
HHSIZE	-0.038 ***	0.015	-0.030
FEMALE	-0.087 ***	0.034	-0.069
DMAR	0.061	0.039	0.048
DINC2	-0.042	0.046	-0.033
DINC3	0.529 ***	0.055	0.419
DRACE2	0.195 ***	0.040	0.155
DRACE3	-0.208 ***	0.045	-0.165
SPENDFV	-0.002 ***	0.001	-0.002
ILLNESS	-0.091 **	0.041	-0.072
TOBACCO	-0.280 ***	0.061	-0.222
EXERCISE	-0.002 ***	0.001	-0.001
$\sigma$	0.842 ***	0.011	
Log-Likelihood	-3773.261		

Note: \*, \*\*, \*\*\*, indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

### *Random Effects Tobit Model*

The constant parameters tobit model was adjusted to incorporate random effects to account for the panel nature of the data, that is, each subject submitted multiple bids for different vegetable products in multiple bidding rounds. The pooled bids of this study contain 20 bids submitted by each subject: bids for 5 vegetable products across the baseline and three information treatments, meaning the data collected is multidimensional. It is likely that bids submitted by the same subject over repeated products and treatments are strongly correlated (Lusk, Felfkamp, and Schroeder 2004). Therefore, a random effects Tobit model is used to account for random individual effects. Table 14 presents the results of the random effects tobit model including the marginal effects. These results will be compared in particular with those of the constant parameters tobit model.

In order to compare the fit of the two models, random effects and constant parameters tobit, a likelihood ratio test was conducted. The likelihood of a function measures the probability of the data given the parameter estimates. A likelihood ratio (LR) test assumes that one of the models is a restricted form of the other model (“unrestricted” model). Also, the test assumes that the unrestricted model can encompass the restricted model by assuming that the coefficients of the variables omitted in the restricted model follow a smooth constant pattern. The LR test statistic is

$$(34) \quad LRT = -2 \ln \left( \frac{L_R}{L_U} \right) = -2 [\ln(L_R) - \ln(L_U)]$$

where  $L_U$  is the value of the likelihood function of the unconstrained model and  $L_R$  is the value of the likelihood function of the constrained model (Wooldridge 2009). The null hypothesis of the test claims that the coefficients on the omitted variables are statistically insignificant. That is, if the null hypothesis is valid, then imposing the restrictions in estimation of the coefficients should make little difference to the maximized value of the likelihood function (Cameron and Trivedi 2009). The LR test statistic is distributed  $\chi^2$  with degrees of freedom equal to the number of restrictions placed on the model. In this application, the random effects tobit specification ( $H_0: \sigma_u \neq 0$ ) provided a better fit than the constant parameters tobit regression, based on a likelihood ratio test ( $P > 0.01$ ). Thus, if the model is well defined, we can conclude that there are individual specific effects and that the standard tobit model would be inappropriate.

Specification of the random effects tobit model also provides the value labeled  $\rho$ . This value represents the percentage of the total variance resulting from the individual random effects. Hence, it clearly takes on values between zero and one inclusive. A value of zero means that none of the variance came from the individual effects, while a value of one indicates that 100% of the overall variance was contributed by the individual random effects. (McAdams 2011).

Few differences between the two models, random effects model and standard tobit model, are found when comparing the significance of the product and treatment indicators. First, the significance of the product varieties is robust to both model specifications for the regressors. Among the information treatments, the health treatment is significant at 10% level in the random effects model. Moreover, the information



treatment for the local-specialty tomato becomes significant (at 5% level) in the random effects tobit model.

Furthermore, there were differences in the significance of the socio-demographic and behavioral indicators when the tobit model was specified to allow for random effects. Among the demographic variables, the random effects model only suggests an influence income higher than \$100,000 and highly educated respondents. Regarding the behavioral characteristics, none of the variables have a significant impact on the bids that were submitted for the tomato products.

Similar to the tobit model, the marginal effects of the random effects tobit are useful to compare one-unit changes for any regressor. Results indicate an increased in bids based on the health information treatment when compared to the two other treatments, which cause a negative impact on WTP. The marginal effects of the product varieties were similar in direction and magnitude to the ones in the tobit model. In looking at the demographic characteristics, a subject with a household income greater than \$100,000 is willing to pay \$0.41 more than a subject with a household income less than \$50,000. Moreover, an individual with some graduate education level expressed a price discount of \$0.31 for the tomato products compared to individuals with only high school education. Unlike the tobit model, any of the behavioral characteristics did have an impact on subjects' valuation.

**Table 14. Random Effects Tobit Model for WTP for Tomato Products**

	Parameter	Standard	
		Error	$\partial y/\partial x$
Constant	1.781 ***	0.285	
Product			
Organic	0.165 ***	0.036	0.130
U.S.	-0.187 ***	0.036	-0.147
Local-Specialty tomato	0.249 ***	0.047	0.197
Additional Information			
Tasting	-0.132 **	0.056	-0.104
Health	0.060 *	0.032	0.047
Product Information	-0.088	0.056	-0.069
Product/treatment			
Tasting x Organic	-0.231 ***	0.062	-0.183
Tasting x U.S.	0.350 ***	0.062	0.276
Tasting x Local	0.207 **	0.081	0.163
Info x Organic	0.093	0.062	0.073
Info x U.S.	0.219 ***	0.062	0.173
Info x Local	0.163 **	0.081	0.129
Demographics/Behaviors			
DAGE2	0.023	0.136	0.018
DAGE3	-0.226	0.182	-0.178
DEDU2	-0.166	0.216	-0.131
DEDU3	-0.393 *	0.224	-0.310
HHSIZE	-0.037	0.047	-0.030
FEMALE	-0.088	0.107	-0.069
DMAR	0.068	0.123	0.053
DINC2	-0.038	0.144	-0.030
DINC3	0.523 ***	0.173	0.413
DRACE2	0.201	0.126	0.159
DRACE3	-0.213	0.141	-0.168
SPENDFV	-0.002	0.003	-0.002
ILLNESS	-0.091	0.129	-0.072
TOBACCO	-0.268	0.192	-0.212
EXERCISE	-0.002	0.002	-0.001
$\sigma(\mu)$	0.586 *** <sup>a</sup>	0.035	
$\sigma(e)$	0.613 *** <sup>b</sup>	0.008	
$\rho$	0.477 ***	0.031	
Log-Likelihood	-3048.795		
Likelihood ratio test	1448.932 *** <sup>c</sup>		

Note: \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

<sup>a</sup> Standard deviation of individual-specific error.

<sup>b</sup> Standard deviation of overall error.

<sup>c</sup> Likelihood ratio test that  $\sigma(\mu) = 0$

### *Mixed Linear Model*

The mixed linear model, also known as random parameters linear model, was applied to the participant bids to account for possible unobserved individual heterogeneity in the coefficients. The model was estimated using maximum likelihood estimation. Results from the mixed linear model are shown in Table 15.

In examining the results for the mixed linear model, several factors can be pointed out when comparing it with the models reported previously. In general, the product information treatment does not have an impact on WTP as in the previous models. However, when interacting with each product variety, there is a positive effect on the bids for the domestic tomato. That is, respondents' WTP increased by 20.9¢ after they found out the product was U.S. grown. Significant decreases in the bids were observed for the tasting treatment; in particular bid prices for the organic tomato decreased 23.1¢. In contrast, WTP for domestic and local-specialty tomatoes increase by 33.5¢ and 19.9¢ respectively after the tasting round. Again, the product varieties are all significant ( $P < 0.01$ ) and the direction of the coefficients remains the same as in the previous models. Among the demographic indicators, there is a tendency for lower WTP for females with higher education levels and larger household size. However, positive effects for married individuals, those with relatively high yearly household income, and Hispanics are found in the magnitude of 5.6¢ for individuals who are married, 39.4.7¢ for those with a higher yearly income, and 22.2¢ for Hispanics.

**Table 15. Mixed Linear Model Estimates for WTP for Tomato Products**

	Parameter	Standard Error
<b>Means of Random Parameters</b>		
Constant	2.561 ***	0.063
Organic	0.149 ***	0.038
U.S.	-0.112 ***	0.031
Local-Specialty tomato	0.194 ***	0.049
Tasting	-0.119 *	0.064
Health	0.066 ***	0.025
Product Information	-0.077	0.072
Tasting x Organic	-0.231 ***	0.071
Tasting x U.S.	0.335 ***	0.062
Tasting x Local	0.199 **	0.091
Info x Organic	0.089	0.079
Info x U.S.	0.209 ***	0.063
Info x Local	0.160	0.101
<b>Demographics/Behaviors</b>		
DAGE2	0.012	0.027
DAGE3	-0.256 ***	0.036
DEDU2	-0.385 ***	0.042
DEDU3	-0.471 ***	0.042
HHSIZE	-0.107 ***	0.009
FEMALE	-0.205 ***	0.020
DMAR	0.056 **	0.025
DINC2	0.135 ***	0.029
DINC3	0.394 ***	0.034
DRACE2	0.222 ***	0.024
DRACE3	-0.259 ***	0.029
SPENDFV	-0.004 ***	0.001
ILLNESS	-0.251 ***	0.025
TOBACCO	-0.528 ***	0.038
EXERCISE	-0.005 ***	0.000
<b>Standard Deviations of Random Parameters</b>		
Constant	0.516 ***	0.009
Organic	0.274 ***	0.014
U.S.	0.491 ***	0.018
Local-Specialty tomato	0.529 ***	0.019
Tasting	0.150 ***	0.018
Health	0.045 **	0.019
Product Information	0.049 **	0.019
Tasting x Organic	0.136 ***	0.031
Tasting x U.S.	0.014	0.032
Tasting x Local	0.009	0.043
Info x Organic	0.139 ***	0.029
Info x U.S.	0.008	0.035
Info x Local	0.041	0.046
$\hat{\sigma}_u^2$	0.495 ***	0.003
Log-Likelihood	-2638.609	

Note: \*, \*\*, \*\*\*, indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 15 also includes the log-likelihood value and the standard deviations for the random effects specified at the individual level, reported as  $\hat{\sigma}_u^2$ . Standard deviations of the random parameters, which represent the dispersion in intercepts and coefficients between individuals, are construed as unobserved individual heterogeneity (Rickard et al. 2011, McAdams et al. 2013). Results indicate that almost all standard deviations in the mixed linear model were statistically significant, meaning there was variation in the effect that any particular information treatment and product variety might have had on an individual.

The values of the estimated parameters for the random effects tobit model (random intercept only) and the mixed linear model (random intercept and random coefficients) are different for most of the explanatory variables. When the information effect and the product variety effect are allowed to vary in the mixed linear model, the demographic and behavioral characteristics gain additional significance. Here, a college degree, a larger household size, and being female, all decreased the bids for the tomato products. Unlike the random effects model, in the mixed linear model all the behavioral characteristics are negative and significant at the 1% level. For example, individuals who present an illness, those who exercise on a regular basis, and smokers are willing to pay less for the tomato varieties.

#### *Random Parameters Tobit Model*

Even though the mixed linear model accounts for the existing unobserved heterogeneity and the correlation between the random covariates, the model still ignores potential bid-censoring at zero. As a consequence, a random parameters tobit model is

estimated for the bids to account for unobserved individual heterogeneity while also accounting for the censoring nature of the data.

In examining the results for the random parameters tobit model (Table 16), several relevant factors should be pointed out. Results show that knowledge of location of origin of tomatoes does have an impact on consumer valuation. The same holds true for the taste attribute (experience) and the health attribute (credence).

Consumers are willing to pay a price premium of around \$0.14 for organic tomatoes and a price premium of around \$0.20 for locally grown tomatoes, compared to conventionally grown tomatoes produced in Mexico, whose average price is \$1.34. These results can be explained by the increase in consumers' attention towards healthy diets and the rise in consumers' concerns and awareness over the quality of the food they purchase. However, consumers expressed a price discount of \$0.10 for the conventional tomato produced in the United States. This can be explained by the lower quality, especially small size, this variety presented at the moment of the study as it was conducted during an off-season period. This is one of the questions this study aims to answer. How would consumers react to local product with limited availability in terms of quantity and quality. Also, it has been shown that people tend to make quality judgments based on the exterior appearance of the food products, some of which may be inaccurate (Schechter 2010). Yue, Alfnes, and Jensen (2009) conducted a study to analyze consumers' WTP for organic and conventional apples with different levels of cosmetic damages. The authors reported that 75% of subjects were willing to pay more for organic than for conventional apples given identical appearance. However, when the

organic apples presented any imperfection in their appearance, the price premium consumers were willing to pay for those products was significantly reduced.

Consumer's WTP for tomatoes increases \$0.06 after they receive the health information treatment. It is hypothesized that health information will increase consumer WTP because it is unlikely that a consumer will place a negative value on positive health attributes. This result shows that providing health-related information when advertising a product can increase the demand for that product.

However, consumer's WTP decrease \$0.14 after the tasting treatment. That is, although the added information of health did cause a statistically significant increase in valuation, that amount was not enough to offset the amount the consumer discounted the tomato from its initial bid after it was consumed. In other words, the decrease in valuation that the taste attribute caused was larger than the increase in valuation that the health benefits characteristic introduced. In previous studies, significant decreases in WTP were observed when the products did not meet consumer expectations. For example, Chern, Kaneko, and Tarakcioglu (2003) found consumer's WTP for orange juice processed by a novel pulsed electric field technique declined by 17% after the tasting treatment. Similarly, Combris et al. (2009) reported a significant decreased for bid prices for wine with the label indicating "Appellation of Origin". However, this decrease in valuation after tasting should not be viewed as a dislike for the taste of tomatoes, rather simply a decrease from the initial valuation under imperfect information. It must also be noted that the manner in which the tomatoes were prepared (no lime and no salt) may not be the typical preparation method used by consumers.

Thus, they may have discounted the taste due to a preconceived notion of how a tomato is “supposed” to taste. Since all tomato products were tasted in the same manner, comparison among products was still valid.

Consumers’ WTP for domestic and local-specialty tomatoes increased after the tasting treatment; however, their valuation for organic tomatoes decreases after the tasting treatment. This result is robust across all models. In addition, results of the random parameter tobit model suggest that consumers are willing to pay more for domestic tomatoes than imported tomatoes, after they knew the origin of those tomatoes. These results support those of Mabiso et al. (2005), who reported that on average consumers are willing to pay a price premium of \$0.48 for U.S. grown tomatoes if they are labeled as “U.S. grown”.

The constant coefficients of the model included socio-demographic and behavioral characteristics of the participants. Regarding the socio-demographic profile, results show that consumers who are Hispanics, and those with relatively high yearly household income (greater than \$100,000), are willing to pay price premiums for these tomato products. Consumers aged 55 years old or more, those with at least a college education, females, and those with a yearly household income between \$50,000-100,000 had price discounts. Related to the effect of gender, Corrigan and Rousu (2006) found that males have a higher tendency to increase their bids following treatments compared to females. They suggest that an ego factor playing a bigger role for men than for women. Regarding behavioral characteristics, a lower WTP is linked to consumers who present a serious health illness and those who are smokers. Related to



the effect of Tobacco use, several studies concluded that smokers present an unhealthier eating habits comparing with nonsmokers, suggesting that their diet is higher in saturated fat, cholesterol, and less in fiber, vitamins and fruits and vegetables (Dallongeville et al. 1998). On the contrary, consumers with a higher weekly expenditure in fruits and vegetables and those who exercise on a regular basis expressed price premiums for the tomato products.

Additionally, results indicate that most of the standard deviations in the random parameters model were statistically significant, meaning that there exists unobserved individual heterogeneity in consumers' valuations. A likelihood ratio test (Prob > 0.01) rejected the null hypothesis of a constant parameters tobit model in favor of a random parameters tobit specification. The Random Parameters Tobit regression also provided a better fit than a Random Effects Tobit model, based on a likelihood ratio test which exceed the critical value at a 99% confidence level (Prob > 0.01).

**Table 16. Random Parameters Estimates for WTP for Tomato Products**

	Parameter	Standard Error	$\partial y/\partial x$
<b>Means of Random Parameters</b>			
Constant	2.118 ***	0.069	
Organic	0.143 ***	0.042	0.142
U.S.	-0.103 ***	0.030	-0.103
Local-Specialty tomato	0.204 ***	0.053	0.204
Tasting	-0.139 **	0.067	-0.139
Health	0.062 **	0.025	0.062
Product Information	-0.083	0.079	-0.083
Tasting x Organic	-0.239 ***	0.075	-0.239
Tasting x U.S.	0.345 ***	0.059	0.344
Tasting x Local	0.202 **	0.096	0.201
Info x Org	0.090	0.088	0.090
Info x U.S.	0.212 ***	0.068	0.211
Info x Local	0.145	0.108	0.144
<b>Demographics/Behaviors</b>			
DAGE2	-0.089 ***	0.029	-0.088
DAGE3	-0.271 ***	0.038	-0.270
DEDU2	-0.528 ***	0.048	-0.526
DEDU3	-0.896 ***	0.049	-0.893
HHSIZE	0.013	0.009	0.013
FEMALE	-0.284 ***	0.022	-0.283
DMAR	-0.014	0.026	-0.014
DINC2	-0.138 ***	0.031	-0.138
DINC3	0.600 ***	0.037	0.598
DRACE2	0.236 ***	0.026	0.235
DRACE3	-0.532 ***	0.029	-0.529
SPENDFV	0.001 **	0.001	0.001
ILLNESS	-0.089 ***	0.027	-0.089
TOBACCO	-0.301 ***	0.041	-0.299
EXERCISE	0.001 ***	0.000	0.001
<b>Standard Deviations of Random Parameters</b>			
Constant	0.587 ***	0.011	
Organic	0.325 ***	0.014	
U.S.	0.451 ***	0.019	
Local-Specialty tomato	0.581 ***	0.021	
Tasting	0.180 ***	0.020	
Health	0.050 **	0.019	
Product Information	0.023	0.021	
Tasting x Organic	0.141 ***	0.034	
Tasting x U.S.	0.042	0.036	
Tasting x Local	0.038	0.048	
Info x Organic	0.045	0.029	
Info x U.S.	0.085 **	0.036	
Info x Local	0.089 *	0.048	
$\sigma(e)$	0.522 ***	0.003	
Log-Likelihood	-2856.624		
Likelihood ratio test	1833.274 *** <sup>a</sup>		
Likelihood ratio test	384.342 *** <sup>b</sup>		

Note: \*, \*\*, \*\*\*, indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

<sup>a</sup> Likelihood ratio test of Random Parameters Tobit vs. Constant Parameters Tobit Regression.

<sup>b</sup> Likelihood ratio test of Random Parameters Tobit vs. Random Effects Tobit Regression.

### *Comparison of Econometric Models for Full Bids*

Each of the models described previously has helped us to better understand the relative value respondents placed on the tomato products. However, each model presents some drawbacks when predicting WTP and subsequent consumer behavior. The individual tobit models are possibly the most straightforward in their interpretation; however, the ability to generalize them across information treatments and products is limited in comparison to a model that includes all bids. Although the OLS and the mixed linear model include the observations for all products and treatments, both models failed to account for the censoring nature of the data. On the other hand, the random effects tobit model takes into account bid-censoring and capture unobserved heterogeneity in the intercepts, but it overlooks heterogeneity in the coefficients. In this application, a random parameters tobit model would be preferred as it accounts for unobserved individual heterogeneity in the coefficients while modeling the censoring structure of the data.

Despite all those drawbacks there still are results that are robust across models. This is clearly noticed in the product varieties, which were significant predictors ( $P < 0.01$ ) for WTP in all the econometric models. Moreover, the sign of these product variables did not change across models, with the organic and local-specialty tomato having a positive effect on WTP and the domestic variety having a negative impact on bids. Regarding the information treatments, while the tasting and health information variables were generally significant predictors of WTP, the product information treatment was not an important factor in predicting consumers' valuations. The

interactions between the tasting treatment and each tomato variety were robust predictors of WTP. In particular, bid prices for the domestic and local-specialty varieties increased after the tasting round, while a significant decrease in WTP was observed for the organic product after tasting. Related to the demographics and behavioral characteristics, the effect they had on WTP varied depending on the model that was estimated.

### **Implied Differences in WTP for Tomato Products**

All the econometric models described so far were used to analyze WTP based on the full bids for the tomato products. However, it might be relevant for this study to compare differences in WTP across information treatments but within each individual.

#### *Differences in WTP Across Information Treatments*

A question that merits attention in regards to the information treatments is whether there was a change in bids submitted by participants after each information treatment. Wilcoxon's Paired t-tests were used to compare differences in bids for each product from the baseline round to the specified information round. The results for the paired t-tests are given in Table 17.

Mixed results were found for each product and treatment combinations. The conventional tomato produced in the U.S. was the only product for which all treatments showed a significant effect ( $P < 0.001$ ), meaning there were a difference in the bids subjects submitted for U.S. grown tomatoes after each treatment. Even though both conventional products showed similar results, there was not a significant difference in WTP for the conventional tomato produced in Mexico for the health information round. The results for the organic tomato produced in Mexico were not significant except for

the full information set. Surprisingly, there was no significant effect for the health treatment for organic products although consumers tend to associate organic food products with health benefits and nutrition. In the case of the local-specialty variety, there was significant effect for the health information and full information treatments, but there was no significance for the tasting and product information sets. The result related to the product information treatment was expected as subjects indicated in the behavioral/demographic survey that the growing location of a product was not an important factor when making tomato-purchasing decisions.

**Table 17. Paired t-Tests of Information Treatment Effects**

	Conventional Tomato U.S. p-values	Conventional Tomato Mexico p-values	Organic Tomato U.S. p-values	Organic Tomato Mexico p-values	Local- Specialty Tomato p-values
Tasting Information	0.0000	0.0000	0.0214	0.8761	0.1598
Health Information	0.0000	0.3216	0.476	0.8321	0.0719
Product Information	0.0000	0.0004	0.0075	0.6567	0.1529
Full Information	0.0000	0.0000	0.9305	0.0263	0.0202

<sup>a</sup> Tests are paired t-tests of the null hypothesis  $H_0: WTP_{baseline} = WTP_{treatment}$

One surprising result from the comparison of individual bids for a single product across information treatments is that the number of bids decreased for some products when individuals had more information about the item. These results are shown in Table 18. As expected, some individuals disliked the taste of some tomato products and

therefore decreased their valuation after subsequent rounds. However, it was surprising that a large portion of the participants also discounted the amount that they were willing to pay for products following the health information treatment. The proportion of zero changes in bids is lower across treatments compared with the proportion of positive and negative changes in subjects' WTP. This would indicate that the additional information provided to subjects had some effect on WTP.

**Table 18. Proportions of Positive, Negative, and Zero Differences for Changes in WTP from Baseline Round, Summed for All Products**

Type of Bid Difference	Calculation	Percentage of Negative Differences	Percentage of Zero Differences	Percentage of Positive Differences
<i>DeltaBidTaste</i>	$WTP_{Tasting} - WTP_{Baseline}$	45.48	17.20	37.32
<i>DeltaBidHealth</i>	$WTP_{Health\ Information} - WTP_{Baseline}$	34.39	24.59	41.02
<i>DeltaBidProductInformation</i>	$WTP_{Product\ Information} - WTP_{Baseline}$	37.20	18.98	43.82
<i>DeltaFullBid</i>	$WTP_{Full\ Information} - WTP_{Baseline}$	42.55	16.82	40.64

The summary statistics for the implied differences are described in Table 19. Based on the mean values, it can be noticed that the tasting treatment caused a change in WTP for mostly all tomato products, except for the local-specialty variety, whose median was zero. In contrast, all products in the health information treatment presented a median with a value of zero, which implies that for the median subject, the health treatment did not cause a change in WTP. Besides the median, there are other factors that can indicate whether consumers show changes in the levels of their bids. The range between the minimum and the maximum values clearly shows that there were some participants who significantly changed their bids for a product between the baseline

round and one of the additional information rounds. Furthermore, results showed that all differences in mean bids from the baseline product within rounds are positive, meaning there was an increase on participants' mean WTP for all tomato products after they received each information treatment.

**Table 19. Summary Statistics for Implied Differences**

Product Type	Mean Bid					Difference in Mean Bid From Baseline Product within a Round Based on Implied Differences <sup>a</sup>
	Difference	Std. Dev.	Minimum	Median	Maximum	
<b>B. Bids - Tasting Round</b>						
Conventionally Grown Tomato - Mexico	-0.29	0.63	-3.00	-0.20	3.00	Baseline Product
Conventionally Grown Tomato - U.S.	0.41	0.83	-2.50	0.25	3.90	+0.70
Organic Tomato - U.S.	-0.15	0.79	-6.00	-0.05	2.40	+0.15
Organic Tomato - Mexico	-0.25	0.78	-4.25	-0.20	2.00	+0.04
Locally Grown Tomato - Specialty tomat	0.10	0.90	-2.49	0.00	3.74	+0.39
<b>C. Bids - Health Information Round</b>						
Conventionally Grown Tomato - Mexico	-0.06	0.54	-1.78	0.00	3.00	Baseline Product
Conventionally Grown Tomato - U.S.	0.20	0.66	-1.30	0.00	3.00	+0.26
Organic Tomato - U.S.	0.03	0.79	-6.00	0.00	2.40	+0.09
Organic Tomato - Mexico	-0.02	0.68	-3.00	0.00	2.50	+0.04
Locally Grown Tomato - Specialty tomat	0.09	0.74	-2.00	0.00	3.00	+0.15
<b>D. Bids - Product Information Round</b>						
Conventionally Grown Tomato - Mexico	-0.17	0.57	-2.00	-0.10	3.00	Baseline Product
Conventionally Grown Tomato - U.S.	0.22	0.70	-1.30	0.00	3.00	+0.40
Organic Tomato - U.S.	0.18	0.85	-6.00	0.20	2.75	+0.35
Organic Tomato - Mexico	-0.01	0.79	-5.00	0.00	2.00	+0.17
Locally Grown Tomato - Specialty tomat	0.08	0.82	-2.49	0.00	3.00	+0.26
<b>E. Bids - Full Information Round</b>						
Conventionally Grown Tomato - Mexico	-0.24	0.60	-3.00	-0.20	3.00	Baseline Product
Conventionally Grown Tomato - U.S.	0.37	0.75	-1.30	0.20	3.00	+0.61
Organic Tomato - U.S.	-0.01	0.85	-6.00	0.00	2.75	+0.23
Organic Tomato - Mexico	-0.15	0.78	-5.00	0.00	2.00	+0.09
Locally Grown Tomato - Specialty tomat	0.15	0.87	-2.49	0.00	3.00	+0.40

Note: Bids indicate the participant's reservation price, that is, their maximum willingness to pay for one unit of each good.

<sup>a</sup> The baseline product is assigned to the Conventional Tomato produced in Mexico but is specific to each information treatment.

Three different econometric models were estimated to analyze the implied differences in WTP, one for each information treatment. In this application, the

predictors of the implied differences model indicate how an individual's bids change when more information is provided. That is, the model indicates whether the product and demographic factors significantly influenced bids when information treatments are applied. The models estimated for implied differences related to each information treatment and examples of the interpretation of their parameters are described below.

#### *Implied Differences for the Tasting Treatment*

After tasting the products, participants may like or dislike them. Hence theoretically, implied difference may be positive, negative, or zero. Accordingly, and in order to account for individual heterogeneity in preferences, the model for the implied differences was estimated using a mixed linear model. Results of the mixed linear model for the implied differences are shown in Table 20.

The dependent variable is the difference between the tasting round and the baseline round. Therefore, the parameter estimates are also the differences in the parameter values between the tasting round and the baseline round. As an example, the estimated difference in the effect of the product characteristics from the baseline to the tasting treatment is an increase of 41.8¢ in value for the domestic variety and an increase of 25¢ in value for the local-specialty tomato. In contrast, the estimated change in WTP from the baseline round to the tasting round for the organic variety is a decrease of 25.8¢ in value. Regarding the socio-economic characteristics, consumers with at least a college education and those with relatively high yearly household income increased their bids after the tasting treatment. The rest of the indicator variables were not statistically significant, indicating they did not necessarily have an effect on the size of the change in



bids due to the tasting treatment. Moreover, based on the estimated standard deviations of random parameters, results show there was heterogeneity in individual responses.

**Table 20. Mixed Linear Model Estimates for Implied Differences in WTP for Tomato Products, Tasting Information Treatment**

	Parameter	Standard Error
<b>Means of Random Parameters</b>		
Constant	-0.356 ***	0.124
Organic	-0.258 ***	0.070
U.S.	0.418 ***	0.063
Local-Specialty tomato	0.250 ***	0.086
<b>Demographics/Behaviors</b>		
DAGE2	-0.012	0.068
DAGE3	-0.019	0.088
DEDU2	0.316 ***	0.087
DEDU3	0.450 ***	0.091
HHSIZE	-0.035	0.025
FEMALE	-0.062	0.055
DMAR	-0.053	0.064
DINC2	0.128 *	0.073
DINC3	0.148	0.093
DRACE2	-0.094	0.064
DRACE3	-0.027	0.075
<b>Standard Deviations of Random Parameters</b>		
Constant	0.334 ***	0.022
Organic	0.265 ***	0.039
U.S.	0.088 ***	0.038
Local-Specialty tomato	0.437 ***	0.048
$\sigma_u^2$	0.681 ***	0.012
Log-Likelihood	-871.680	

Note: \*, \*\*, \*\*\*, indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

### *Implied Differences for the Product Information Treatment*

Similar to the tasting information treatment, the implied differences model for the product information treatment was estimated using a mixed linear model. There was a theoretical assumption that respondents may prefer or discount products based on information about growing location and production method. Results show that the domestic and local-specialty varieties were the only significant ( $P < 0.01$ ) variables in the model (Table 21). The sign of the effects for both product characteristics was positive, indicating that the change in WTP attributed to those tomato varieties increased from the baseline round to the product information round.

Regarding the socio-demographic characteristics, only individuals with college or graduate education expressed price premiums for the tomato varieties after the information treatment. Married consumers and Hispanics expressed price discounts. The rest of the demographic characteristics did not have an effect on the bids due to the product information treatment.

In addition, results indicate that all standard deviations for the random parameters were statistically significant, meaning the product features exhibit individual heterogeneity in valuations.

**Table 21. Mixed Linear Model Estimates for Implied Differences in WTP for Tomato Products, Product Information Treatment**

	Parameter	Standard Error
<b>Means of Random Parameters</b>		
Constant	-0.398 ***	0.102
Organic	0.069	0.053
U.S.	0.276 ***	0.047
Local-Specialty tomato	0.212 ***	0.067
<b>Demographics/Behaviors</b>		
DAGE2	-0.057	0.055
DAGE3	0.050	0.069
DEDU2	0.300 ***	0.078
DEDU3	0.433 ***	0.079
HHSIZE	0.023	0.019
FEMALE	-0.028	0.045
DMAR	-0.088 *	0.051
DINC2	0.084	0.058
DINC3	0.012	0.072
DRACE2	-0.138 ***	0.052
DRACE3	-0.064	0.061
<b>Standard Deviations of Random Parameters</b>		
Constant	0.308 ***	0.018
Organic	0.427 ***	0.032
U.S.	0.312 ***	0.029
Local-Specialty tomato	0.482 ***	0.039
$\sigma_u^2$	0.551 ***	0.010
Log-Likelihood	-770.799	

Note: \*, \*\*, \*\*\*, indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

### *Implied Differences for the Health Information Treatment*

Unlike the tasting and product information treatments, the implied differences model for the health information treatment was estimated using a random parameters tobit model. As explained in the methodology chapter, a theoretical restriction is imposed to only allow for nonnegative difference for the health treatment compared to the baseline round; it is hypothesized that a rational individual will place a positive or zero difference after receiving information about the potential health benefits of consuming tomatoes. Moreover, it is assumed that certain product features and behavioral characteristics will exhibit individual heterogeneity. For these reasons, a random parameters tobit model was used to analyze the implied differences in bids submitted for the health information treatment. Results for this model, including the marginal effects, are shown in Table 22.

Besides the product features indicators, behavioral characteristics were included in the model as random parameters as it is assumed that those indicators may have an effect on the size of the change in bids due to the health information treatment. For example, the estimated difference in the effect of an individual who presented a serious health illness from the baseline to the health treatment is an increase of 8.2¢ in value. In the case of continuous variables, such as the weekly household spending on fruits and vegetables (*Spendfv*), the estimated change in WTP for a product resulting from any continuous variable would be the value of that variable times the estimated parameter. Thus, the *Spendfv* estimate would indicate a one tenth of a cent decrease in WTP for each additional dollar spent every week on fruits and vegetables.

Among the product characteristics variables, it can be noticed that the effect of the domestic variety on WTP increased by 8.5¢ from the baseline to the health information treatment. In contrast to the implied differences model for the tasting treatment, the organic variety effect was not significant in this model, meaning this indicator did not have an effect on the size of the change in bids due to the health information treatment.

Regarding the socio-demographic profile, results show that variables indicating an individual aged 55 years old or more and household size, were statistically significant ( $P < 0.05$ ) but presented a negative sign. This indicates that for any of these socio-economic characteristics, the change in WTP attributed to that characteristic decreased from the baseline round to the health information round. In contrast, the positive value in the variable describing an individual with a relatively high yearly income (greater than \$100,000), indicates that the effect of that variable on WTP increased from the baseline to the health information treatment. Regarding the effect of household size, the result is not necessarily unexpected. Larger households may be seeking bulk purchases and pursuing less expensive vegetable substitutes. Hence, they might be facing a tradeoff between quantity and quality that was imposed by their income constraint.

In addition, results show that most of the standard deviations of the random parameters were statistically significant, meaning that unobserved heterogeneity should be taken into account when analyzing consumers' valuations for the health information treatment.

**Table 22. Random Parameters Tobit Model Estimates for Implied Differences in WTP for Tomato Products, Health Information Treatment**

	Parameter	Standard Error	$\partial y/\partial x$
<b>Means of Random Parameters</b>			
Constant	0.064	0.190	
Organic	0.008	0.069	0.003
U.S.	0.222 ***	0.065	0.085
Local-Specialty tomato	0.148	0.091	0.057
Spendfv	-0.004 **	0.002	-0.001
Illness	0.214 ***	0.078	0.082
Tobacco	-0.127	0.121	-0.049
Exercise	-0.002 *	0.001	-0.001
<b>Demographics/Behaviors</b>			
DAGE2	-0.094	0.083	-0.036
DAGE3	-0.343 ***	0.121	-0.132
DEDU2	-0.088	0.145	-0.034
DEDU3	-0.068	0.152	-0.026
HHSIZE	-0.080 ***	0.028	-0.031
FEMALE	-0.009	0.064	-0.003
DMAR	0.097	0.075	0.037
DINC2	0.139	0.085	0.054
DINC3	0.209 **	0.106	0.081
DRACE2	0.036	0.072	0.014
DRACE3	0.058	0.081	0.022
<b>Standard Deviations of Random Parameters</b>			
Constant	0.463 ***	0.027	
Organic	0.171 ***	0.046	
U.S.	0.201 ***	0.045	
Local-Specialty tomato	0.488 ***	0.063	
Spendfv	0.002 **	0.000	
Illness	0.122 **	0.059	
Tobacco	0.060	0.105	
Exercise	0.000	0.000	
$\sigma(e)$	0.642 ***	0.019	
Log-Likelihood	-616.929		

Note: \*, \*\*, \*\*\*, indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Although the model was estimated with a theoretical restriction for the bid difference to be nonnegative ( $\Delta \text{bid health} \geq 0$ ), this assumption was relaxed to allow for possible price discounts placed by consumers as they often believe that healthiness and tastiness are negatively correlated (Chandon and Wansink 2007), and are rarely willing to compromise on taste for health benefits. This may cause a decrease in consumers' WTP for health benefits in food products. As a consequence, the model for implied differences for the health treatment was also estimated using a mixed linear model to account for positive, negative, or zero values. Results from the mixed linear model were similar to those of the random parameters tobit model; few differences were found in the sign and magnitude of the coefficients.

Utilizing the implied differences models can be highly beneficial when information treatments are applied with the objective of measuring differences in WTP for a product (i.e. advertisement). In particular, if researchers and marketers are interested in identifying the type of information that induces consumers to increase their willingness to pay for a product, the use of full bids could lead to dramatically different results than those generated using simple paired differences in bids.

### **Accounting for Endogeneity - IV Approach**

Although certain socio-economic and behavioral characteristics (like education, race, and income level) are helpful in explaining WTP, individuals' BMI remains an important predictor of consumers' valuations, especially when analyzing the health-related treatment.

In our application, the problem arises when the BMI variable is omitted from the model as it tends to be strongly correlated with the health information treatment indicator, which introduces an endogeneity problem. As discussed in the methodology chapter, this may cause inconsistency in the parameters estimated obtained by OLS. To deal with the possible endogeneity in the model, a 2SLS model was used as an Instrumental Variable (IV) estimator.

In this case, the BMI indicator was treated as an endogenous variable and it was estimated separately as a function of the instrumental variables. The instruments used were EXERCISE, TOBACCO USE, ASPENDFV, and HEALTHISS. The description of these variables is found in Table 4. Previous studies have used similar instruments to explain individual's BMI as they found a strong influence of those variables on BMI (Abrevaya and Tang 2011). The endogeneity of the BMI indicator was tested for using an endogeneity test, which tests the null hypothesis that the variable is exogenous. The null hypothesis was rejected ( $P > 0.05$ ), indicating that the BMI indicator was not exogenous.

The results for the 2SLS model are reported in Table 23. As in the implied differences models previously described, the dependent variable represents the difference in bids from the baseline round to the health information treatment. For example, results show there is a positive effect from the domestic variety, which indicates that the change in WTP attributed to that variety increased from the baseline round to the health information treatment. The organic and local-specialty varieties



effects were not significant in this model, indicating the variables did not have an effect on the difference in bids due to the health information treatment.

Regarding the socio-economic characteristics, results show that individual's BMI had a significant positive association with the difference in WTP from the baseline round to the health information treatment. That is, an increase in one unit in consumer's BMI is associated with an expected increase of \$0.06 in the change on WTP from the baseline to the health information treatment. Similarly, the positive value of the variables describing an individual with a relatively high yearly income and with some college or graduate education level indicates that the effect of those variables on WTP increased from the baseline to the health information treatment. On the contrary, individuals aged 55 years old or more, and those with larger household size indicated price discounts for the tomato products.

As in the linear regressions previously explained, the 2SLS model also takes into account all bids in the estimation, including positive, negative, and zero values. The 2SLS model was estimated as there is a large portion of differences in bids that were negative (more than 30%). A second model was estimated with a theoretical restriction for the bid difference to be nonnegative; that is  $\Delta \text{bid}_{\text{health}} \geq 0$ . The model was estimated using an IV tobit model, which censors non positive values at zero. As in the 2SLS model, a Wald test of exogeneity was performed, which tests the null hypothesis that BMI is exogenous. The null hypothesis was rejected ( $P > 0.05$ ), meaning the variable is not exogenous.

When comparing the two models used for dealing with possible endogeneity, few differences can be found between them. For example, although the organic variety is not significant in any of the two models, the effect it had on the change in WTP from the baseline to the health treatment round became positive in the tobit model. Also, the local-specialty was positive and significant in the IV tobit model. This means the change in WTP attributed to the local-specialty variety increased from the baseline round to the product information round. Regarding the socio-demographic profile, while the dummy variable indicating a yearly household income between \$50,000 and \$99,999 became statistically significant, the opposite occurred with the dummy variable indicating individuals with a college education level.

Although the IV approach helped to account for possible endogeneity in the model, it was not sufficient in solving the problem, as it was noticed that almost all the socio-demographic and behavioral indicators were also endogenous. As a consequence, a latent class analysis of health status was used in order to explain individuals' BMI effect on WTP.

**Table 23. Two Stage Least Squares Model Estimates for Implied Differences in WTP for Tomato Products, IV Approach**

	Dep. Var. = dwtph <sup>a</sup>	
	Parameter	Standard Error
Constant	-1.826 **	0.818
Product		
Organic	-0.065	0.058
U.S.	0.166 ***	0.058
Local-Specialty tomato	0.109	0.077
Demographics/Behaviorals		
BMI	0.061 **	0.025
DAGE2	-0.202 **	0.104
DAGE3	-0.222 **	0.099
DEDU2	0.444 **	0.223
DEDU3	0.608 **	0.263
HHSIZE	-0.040 *	0.023
FEMALE	-0.039	0.055
DMAR	0.009	0.067
DINC2	0.124	0.084
DINC3	0.146 *	0.088
DRACE2	-0.054	0.072
DRACE3	-0.104	0.083

Instrumented: BMI

Instruments: ASPENDFV, HEALTHISS, SMOKE, EXERCISE

Note: \*, \*\*, \*\*\*, indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

<sup>a</sup> dwtph refers to the difference  $WTP_{\text{health}} - WTP_{\text{baseline}}$

**Table 24. Constant Parameters Tobit Model Estimates for Implied Differences in WTP for Tomato Products, IV Approach**

	Dep. Var. = dwtp <sup>a</sup>		
	Parameter	Standard Error	$\hat{c}y/\hat{c}x$
Constant	-2.549 ***	0.965	
Product			
Organic	0.024	0.087	0.008
U.S.	0.239 ***	0.088	0.079
Local-Specialty tomato	0.244 **	0.116	0.080
Demographics/Behaviorals			
BMI	0.082 ***	0.033	0.027
DAGE2	-0.284 *	0.150	-0.094
DAGE3	-0.434 ***	0.145	-0.143
DEDU2	0.337	0.210	0.111
DEDU3	0.463 *	0.253	0.152
HHSIZE	-0.098 ***	0.036	-0.032
FEMALE	-0.017	0.085	-0.005
DMAR	0.146	0.098	0.048
DINC2	0.203 *	0.115	0.067
DINC3	0.245 *	0.139	0.081
DRACE2	0.038	0.100	0.013
DRACE3	-0.064	0.125	-0.021
$\sigma$	-0.087 **	0.034	
s	0.848 *** <sup>b</sup>	0.037	
v	4.872 *** <sup>c</sup>	0.125	
Log-Likelihood	-2919.563		

Instrumented: BMI

Instruments: ASPENDFV, HEALTHISS, SMOKE, EXERCISE

Note: \*, \*\*, \*\*\*, indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

<sup>a</sup> dwtp<sup>a</sup> refers to the difference  $WTP_{\text{health}} - WTP_{\text{baseline}}$

<sup>b</sup> Standard deviation of exogenous variables.

<sup>c</sup> Standard deviation of instruments.

## **Buying your Way into a Healthy Lifestyle? A Latent Class Analysis with Individual Heterogeneity**

Although the random parameters models described so far account for unobserved individual heterogeneity, they are not well suited to explain the sources of heterogeneity. As an alternative, a latent class approach was used to classify participants into unobserved latent classes based on observed indicators of lifestyle habits and health status. This approach may help researchers understand the discrepancies in consumers' WTP and explain some of the sources of individual heterogeneity. The LCA was set up using the following procedure: 1) select the number of latent classes, 2) characterize the latent classes, and 3) measure consumers' WTP for products and treatments for each latent class.

First, in order to select the correct number of latent classes, a sequence of latent class models with the number of classes ranging from 2 to 9 was estimated. Table 25 shows the statistics for each model including the log-likelihood values, AIC, BIC, and Adjusted BIC estimates. When comparing the models, the minimum BIC statistic favored a two-class model, whereas the minimum AIC and Adjusted BIC statistics favored a three-class model. When the results of the different Information Criteria (ICs) are contradictory, the question often arises as to which is best to use in practice. Dziak et al. (2012) stated that there is a risk in using AIC criteria as it often tends to choose a large model (i.e. overfitting), while BIC and similar criteria often risk choosing too small a model (i.e. underfitting). Nylund et al. (2007) presented simulations on the performance of various ICs and tests for choosing the number of classes in a LCA. The

authors reported that in general the BIC performed much better than the AIC, as the latter had a much smaller accuracy due to its overestimating tendency. Furthermore, although the three-class model was preferred based on two selection criteria, the estimated class-membership probabilities for that model were 3.18%, 51.59%, and 45.22%. As discussed by Lanza et al. (2007) the size difference between classes should be significant in order for them to be easily distinguishable based on their probabilities. Thus, given the estimated values of the Information Criteria and the estimated class-membership probabilities, a two-class model was chosen.

**Table 25. Comparison of Latent Class Models**

Number of latent classes (S)	Log likelihood at convergence	AIC	BIC	Adjusted BIC
<b>2</b>	-423.6	92.4	138.2	90.7
3	-403.5	68.2	138.5	65.7
4	-401.2	79.7	174.4	76.3
5	-399.2	91.6	210.8	87.4
6	-398.7	106.5	250.2	101.4
7	-397.33	119.8	287.9	113.8
8	-396.5	134.2	326.7	127.3
9	-396.3	149.8	366.8	142.1

Note: Boldface type indicates the selected model.

<sup>a</sup> AIC (Akaike Information Criterion).

<sup>b</sup> BIC (Bayesian Information Criterion).

After the appropriate number of classes was chosen, each class was characterized. Table 26 shows the estimated class membership probabilities and

indicator-response probabilities. Based on the class-membership probabilities, 51.59% of individuals were members of Class 1 and 48.41% of individuals were members of Class 2. The indicator response probabilities represent the probability of observing each health indicator variable in the different latent classes. That is, there is a 100% probability that consumers in Class 1 had a BMI between 18.5 kg/m<sup>2</sup> and 24.9 kg/m<sup>2</sup>, which is considered a normal weight. Consumers in this class were not likely to smoke cigarettes or have a serious health issue. Moreover, 37% of the individuals in Class 1 exercised on a regular basis and 14% of them had a weekly fruit and vegetable expenditure of \$50 or more.

On the other hand, individuals in Class 2 had a 7% probability of being underweight and a 93% probability of being obese. They were also more likely to be smokers and to have a serious health issue relative to consumers in Class 1. Similar to Class 1, there was a 13% probability that consumers in Class 2 had a high weekly fruit and vegetable expenditure. However, there was only a 20% probability that individuals in Class 2 exercised on a regular basis, which is almost half the probability in Class 1.

**Table 26. Latent Class Parameter Estimates for Two-Class Model**

		Class 1	Class 2
		Latent class membership probabilities ( $\pi$ )	
		51.59%	48.41%
Variable	Definition	Indicator-response probabilities ( $\theta$ )	
UNDERWEIGHT	Had a BMI < 18.5 kg/m <sup>2</sup>	0.000	0.066
NORMAL	Had a BMI between 18.5 kg/m <sup>2</sup> and 24.9 kg/m <sup>2</sup>	1.000	0.000
OBESE	Had a BMI > 25.0 kg/m <sup>2</sup>	0.000	0.934
SMOKE	Smoked cigarettes	0.062	0.118
HEALTHISS	Had a serious health issue	0.136	0.289
WFV	Had a high weekly fruit and vegetable expenditures (more than \$ 50)	0.136	0.132
EXERCISE	Exercised on a regular basis (4 times per week or more)	0.370	0.197

Table 27 shows a description of demographic and behavioral characteristics of the experimental auction participants by latent class and for the entire sample. Class 1 was composed mainly of young individuals (67% aged 18 to 34 years old), while about 53% of the individuals in Class 2 were older than 34 years old. Regarding gender and marital status, Class 1 had mostly females that were not married while Class 2 included mostly married females.

Household size and income were two variables that differed in a similar manner between the two classes; that is, households in Class 2 were larger on average than households in Class 1, and yearly income in Class 1 and Class 2 were \$44,312 and \$51,849, respectively. Regarding education level, participants in Class 1 were the most educated as this class included the highest percentage of participants with graduate education and the lowest percentage of participants with only a high school education. Classes 1 and 2 were mainly composed by Caucasian individuals (about 47% and 53%, respectively) and certain Hispanic individuals (around 37% and 26%, respectively).



Even though the probability that consumers in Class 1 and Class 2 had a high weekly fruit and vegetable expenditure was similar, participants in Class 1 expressed a higher amount of fresh produce on hand as percentage of their full stock compared to Class 2.

After characterizing the different latent classes, the willingness to pay for each class was calculated for comparison purposes. Table 28 contains parameter estimates from the Random Parameters Tobit models per class and for all participants.

Coefficients from the random parameters model for the entire sample indicate that all consumers place value on the tasting and health information treatments. Recall the magnitude of the marginal effects indicates that consumers increase their WTP by \$0.06 after receiving the health information set; however, their WTP decreased by \$0.13 after the tasting treatment. Coefficients also indicate that consumers are willing to pay price premiums of \$0.14 and \$0.21 for organic and local-specialty tomatoes, respectively. However, their WTP decreased by \$0.24 after tasting the organic product. The opposite occurred with the domestic variety. Even though consumers expressed a price discount of \$0.16 for the domestic tomato compared with an imported variety, their WTP for the domestic product actually increased by \$0.35 after tasting it and by \$0.21 after knowing the origin of the product.

Estimating WTP equations for each class separately provides more detailed information than estimating an overall WTP. Consumers in Class 1 (51.6% of participants) are willing to pay higher price premiums of \$0.11 and \$0.15 for organic and local-specialty tomatoes, respectively. However, they expressed price discounts for the domestic variety. In general, consumers in Class 1 had no statistically significant

price premiums for any of the additional information treatments. However, when analyzing the information treatments for each specific product, consumers expressed significant price premiums for the domestic variety after tasting it and after knowing it was produced in the U.S. The average consumer in Class 1 is willing to pay \$1.42 per tomato product. Recall Class 1 is composed of individuals who had a normal weight and were less likely to have a serious health illness. Moreover, they were more likely to be nonsmokers and frequent exercisers. This leads us to refer to the first latent class of consumers as “Health Conscious”.

In contrast, consumers in Class 2 (48.4% of participants) expressed a positive effect on the health information treatment. In particular, their WTP increased by \$0.08 after receiving information about the potential health benefits of consuming tomatoes. Even though consumers in Class 1 are also willing to pay price premiums for the organic and local-specialty varieties, the price premiums consumers in Class 2 expressed for those products were significantly higher than those of Class 1. Moreover, consumers in this class increased their WTP for the domestic and local-specialty tomatoes after tasting them. The average consumer in Class 2 is willing to pay \$1.33 per tomato product, which is lower than the estimate of Class 1. Recall Class 2 is represented by individuals who were underweight or obese, had a serious health issue, and were more likely to be smokers. Moreover, they were less likely to exercise on a regular basis. Since this class of consumers present unhealthy lifestyles, but are willing to pay a price in order to make up for their unhealthy habits, we refer to them as the “Health Redeemers.”

After the differences in WTP among the latent classes were analyzed, an additional random parameters tobit model was estimated for each class in order to evaluate the effect of a full information treatment on bids. As discussed previously, the full information treatment reveals the final WTP bids after participants received all information treatments; that is, it reflects a state of complete information on the products.

The estimates provided in table 29 suggest that consumers in Class 1 are willing to pay price premiums of \$0.40 for domestic tomatoes and \$0.26 for local-specialty varieties, after receiving all information treatments. However, a price discount of \$0.24 is expressed for the organic variety.

Similar results are found for consumers in Class 2. The magnitude of the marginal effects indicate that individuals in this class are willing to pay price premiums of \$0.38 and \$0.33 for the domestic and local specialty varieties, respectively, after having complete information on the products. Even though they also expressed a price discount for the organic variety, the effect is not statistically significant.

When comparing these results with those from the random parameters model for all treatments, it can be noticed that the negative effect caused by the organic variable can be attributed to the tasting treatment. On the other hand, the price premium consumers placed for the domestic tomato can be attributed to both the tasting and the product information sets, as their bids increased after receiving those treatments.

The classes differed significantly in terms of their preferences, willingness to pay, socio-economic profile, and health-driven motivations. Overlooking these

differences might lead researchers to make erroneous inferences regarding product valuation. This application shed more light on the importance of accounting for unobserved individual heterogeneity, which facilitates the analysis of consumers' valuations of different treatments.

### **Robustness of Indicators Across Models**

Several econometric models were estimated. While there were some small differences, there were results that were robust across models. Regarding the product characteristics, the organic and local-specialty varieties were positive and significant at the 0.01 level across models. Although the domestic variety was also significant at the 0.01 level, its effect on the bids was always negative. With regards to the information treatments, the indicators were often not significant in the models for the full bids; however, consumers often expressed price premiums for the products after receiving the health information treatment and their bids often decreased following the tasting and product information treatments. In particular, significant price premiums were reported for the domestic and local-specialty varieties after the tasting treatment, while significant price discounts were expressed for the organic products after tasting. Also, a significant increase in WTP after the information treatment was often reported for the domestic variety. Indicators related to socio-demographic and behavioral characteristics such as age, education level, gender, income, marital status, race and tobacco use, had a significant effect on WTP across models.

**Table 27. Demographic and Behavioral Characteristics of Experiment Participants by Latent Class**

Variable	Category	All Participants		Class 1		Class 2	
		Mean	Percent	Mean	Percent	Mean	Percent
Age (years)	18-34		57.33		66.67		47.37
	35-44		26.75		22.22		31.58
	55 and over		15.92		11.11		21.05
Household Size (Individuals)		2.57		2.49		2.65	
Education	High School Diploma or Less		7.01		6.17		7.89
	Bachelor's Degree or at least some College		47.77		41.98		53.95
	Graduate Courses or more		45.22		51.85		38.16
Race	Caucasian/Native American		50.30		46.91		52.63
	Hispanic		31.21		37.04		26.32
	Asian/African American		18.49		16.05		21.05
Gender	Female		61.51		62.96		57.89
	Male		39.49		37.04		42.11
Marital Status	Married		48.08		43.21		53.33
	Not Married		51.92		56.79		46.67
Yearly Household Income (\$)		47,908		44,312		51,849	
Primary Shopper	Primary Shopper		85.99		86.41		85.52
	Secondary Shopper		14.01		13.59		14.48
Vegetables on Hand (% of full stock)		34.31		37.88		30.49	

**Table 28. Random Parameters Tobit Estimates for WTP for Tomato Products by Latent Classes**

	Class 1 Health Councious			Class 2 Health Redeemers			All Participants		
E[y]	1.421			1.329			1.377		
	Parameter	S.E.	$\partial y/\partial x$	Parameter	S.E.	$\partial y/\partial x$	Parameter	S.E.	$\partial y/\partial x$
<b>Means of Random Parameters</b>									
Intercept	1.667 ***	0.083		1.022 ***	0.066		1.072 ***	0.045	
Organic	0.112 *	0.067	0.111	0.170 ***	0.048	0.169	0.142 ***	0.041	0.141
U.S.	-0.172 ***	0.048	-0.169	-0.270 ***	0.048	-0.269	-0.163 ***	0.032	-0.162
Local-Specialty tomato	0.155 *	0.083	0.152	0.372 ***	0.073	0.371	0.212 ***	0.054	0.211
Tasting	-0.162	0.111	-0.159	-0.100	0.084	-0.100	-0.135 **	0.068	-0.134
Health	0.043	0.044	0.042	0.079 **	0.031	0.079	0.061 **	0.026	0.060
Product Information	-0.097	0.131	-0.096	-0.072	0.092	-0.072	-0.085	0.077	-0.084
Tasting x Organic	-0.271 **	0.126	-0.267	-0.194 **	0.087	-0.194	-0.240 ***	0.078	-0.238
Tasting x U.S.	0.403 ***	0.103	0.397	0.289 ***	0.081	0.288	0.349 ***	0.063	0.348
Tasting x Local	0.181	0.156	0.179	0.244 **	0.122	0.243	0.206 **	0.103	0.205
Info x Org	0.036	0.149	0.035	0.153	0.095	0.152	0.095	0.085	0.095
Info x U.S.	0.246 **	0.098	0.242	0.178	0.116	0.177	0.215 ***	0.067	0.214
Info x Local	0.123	0.179	0.122	0.184	0.151	0.183	0.160	0.107	0.159
<b>Demographics/Behaviors</b>									
DAGE2	-0.260 ***	0.047	-0.256	-0.145 ***	0.041	-0.145	0.088 ***	0.027	0.087
DAGE3	-0.788 ***	0.079	-0.777	-0.401 ***	0.043	-0.400	-0.262 ***	0.032	-0.260
DEDU2	0.332 ***	0.039	0.328	0.346 ***	0.029	0.345	0.188 ***	0.021	0.187
DEDU3	-0.111 **	0.049	-0.109	-0.102 **	0.052	-0.101	0.199 ***	0.031	0.198
HHSIZE	-0.335 ***	0.022	-0.331	0.052 ***	0.010	0.052	-0.007	0.009	-0.007
FEMALE	-0.336 ***	0.038	-0.331	-0.498 ***	0.032	-0.496	0.048 **	0.021	0.048
DMAR	0.513 ***	0.044	0.505	0.248 ***	0.037	0.248	0.186 ***	0.024	0.185

**Table 28. Continued**

	Class 1 Health Councious			Class 2 Health Redeemers			All Participants		
E[y]	1.421			1.329			1.377		
	Parameter	S.E.	$\hat{\partial}y/\hat{\partial}x$	Parameter	S.E.	$\hat{\partial}y/\hat{\partial}x$	Parameter	S.E.	$\hat{\partial}y/\hat{\partial}x$
<b>Demographics/Behaviors</b>									
DINC2	0.057	0.048	0.057	-0.152 ***	0.041	-0.152	-0.047	0.029	-0.047
DINC3	0.706 ***	0.064	0.695	0.335 ***	0.045	0.334	0.262 ***	0.034	0.261
DRACE2	0.885 ***	0.045	0.872	0.437 ***	0.037	0.436	0.098 ***	0.025	0.097
DRACE3	0.090 *	0.054	0.088	-0.267 ***	0.035	-0.267	-0.132 ***	0.028	-0.132
<b>Standard Deviations for Random Parameters</b>									
Intercept	0.665 ***	0.024		0.567 ***	0.014		0.66 ***	0.011	
Organic	0.527 ***	0.030		0.237 ***	0.024		0.291 ***	0.016	
U.S.	0.552 ***	0.030		0.407 ***	0.028		0.472 ***	0.017	
Local-Specialty tomato	0.651 ***	0.036		0.492 ***	0.032		0.523 ***	0.021	
Tasting	0.148 ***	0.026		0.12 ***	0.026		0.064 ***	0.019	
Health	0.157 ***	0.032		0.006	0.027		0.066 ***	0.019	
Product Information	0.055	0.035		0.047	0.029		0.033	0.022	
Tasting x Organic	0.089	0.056		0.176 ***	0.040		0.165 ***	0.033	
Tasting x U.S.	0.005	0.063		0.072	0.048		0.044	0.036	
Tasting x Local	0.019	0.062		0.128 **	0.054		0.209 ***	0.047	
Info x Organic	0.166 ***	0.052		0.21 ***	0.039		0.048 *	0.029	
Info x U.S.	0.041	0.056		0.076 *	0.045		0.026	0.037	
Info x Local	0.193 ***	0.090		0.145 **	0.058		0.133 ***	0.050	
$\sigma(e)$	0.575 ***	0.005		0.424 ***	0.005		0.522 ***	0.003	
Log-Likelihood	-1684.523			-1106.124			-2854.983		

Note: \*, \*\*, \*\*\*, indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

**Table 29. Random Parameters Tobit Estimates for WTP for Tomato Products by Latent Classes, Full Information**

	Class 1 Health Councious			Class 2 Health Redeemers			All Participants		
E[y]	1.419			1.314			1.369		
	Parameter	S.E.	$\partial y/\partial x$	Parameter	S.E.	$\partial y/\partial x$	Parameter	S.E.	$\partial y/\partial x$
<b>Means of Random Parameters</b>									
Intercept	1.340 ***	0.104		1.034 ***	0.080		1.240 ***	0.066	
Organic	0.211 **	0.102	0.210	0.186 ***	0.067	0.186	0.202 ***	0.065	0.202
U.S.	-0.147 *	0.077	-0.146	-0.288 ***	0.052	-0.288	-0.250 ***	0.047	-0.249
Local-Specialty tomato	0.216 *	0.111	0.214	0.123	0.080	0.122	0.197 ***	0.069	0.196
Full	-0.149	0.118	-0.148	-0.108	0.083	-0.108	-0.132 *	0.075	-0.131
Full x Organic	-0.242 *	0.142	-0.241	-0.092	0.092	-0.092	-0.182 **	0.091	-0.182
Full x U.S.	0.405 ***	0.122	0.403	0.381 ***	0.089	0.381	0.392 ***	0.077	0.391
Full x Local	0.262 *	0.156	0.261	0.327 ***	0.120	0.326	0.317 ***	0.101	0.316
<b>Demographics/Behaviors</b>									
DAGE2	-0.014	0.059	-0.014	-0.242 ***	0.052	-0.242	-0.013	0.037	-0.013
DAGE3	-0.362 ***	0.086	-0.360	-0.286 ***	0.054	-0.286	-0.17 ***	0.048	-0.170
DEDU2	0.036	0.050	0.035	0.348 ***	0.039	0.348	0.110 ***	0.032	0.110
DEDU3	-0.163 **	0.066	-0.162	0.184 ***	0.071	0.184	-0.008	0.047	-0.008
HHSIZE	-0.047 *	0.027	-0.047	0.019	0.013	0.019	0.021 *	0.012	0.021
FEMALE	-0.118 **	0.048	-0.117	0.083 **	0.040	0.083	0.005	0.030	0.005
DMAR	0.234 ***	0.054	0.232	0.185 ***	0.047	0.185	0.059 *	0.034	0.059
DINC2	-0.019	0.065	-0.019	-0.122 **	0.052	-0.122	-0.092 **	0.040	-0.092
DINC3	0.326 ***	0.080	0.324	0.445 ***	0.058	0.444	0.222 ***	0.048	0.221
DRACE2	0.285 ***	0.059	0.283	0.331 ***	0.048	0.330	0.218 ***	0.035	0.217
DRACE3	0.111	0.069	0.111	-0.665 ***	0.049	-0.664	-0.244 ***	0.040	-0.244



**Table 29. Continued**

	Class 1 Health Councious			Class 2 Health Redeemers			All Participants		
E[y]	1.419			1.314			1.369		
	Parameter	S.E.	$\partial y/\partial x$	Parameter	S.E.	$\partial y/\partial x$	Parameter	S.E.	$\partial y/\partial x$
<b>Standard Deviations for Random Parameters</b>									
Intercept	0.674 ***	0.026		0.564 ***	0.020		0.548 ***	0.014	
Organic	0.145 ***	0.033		0.034	0.027		0.045 *	0.023	
U.S.	0.342 ***	0.033		0.385 ***	0.032		0.431 ***	0.022	
Local-Specialty tomato	0.211 ***	0.048		0.392 ***	0.039		0.088 ***	0.028	
Full	0.366 ***	0.032		0.207 ***	0.025		0.259 ***	0.019	
Full x Organic	0.386 ***	0.050		0.329 ***	0.035		0.392 ***	0.032	
Full x U.S.	0.181 ***	0.047		0.212 ***	0.038		0.002	0.031	
Full x Local	0.610 ***	0.074		0.360 ***	0.048		0.549 ***	0.041	
$\sigma(e)$	0.564 ***	0.009		0.423 ***	0.008		0.524 ***	0.006	
Log-Likelihood	-881.805			-625.956			-1544.26		

Note: \*, \*\*, \*\*\*, indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

## **CHAPTER VI**

### **SUMMARY AND CONCLUSIONS**

This final chapter presents a brief summary and the main conclusions of the study. First, the background of the study is presented. Then, economic and marketing implications of the final results are discussed. Lastly, the limitations of this research study are addressed and recommendations for future research are given.

#### **Summary and Conclusions**

Experimental auctions are common value elicitation methods that help measure consumers' preferences and valuations for goods and services. In this study, an incentive compatible non-hypothetical second-price Vickrey auction was conducted in order to analyze consumer preferences and willingness to pay for vegetable products. Specifically, several econometric models of panel data, and a Latent Class Analysis (LCA), were used for the following purposes:

- Analyzing the impact of location of origin, production method, taste, and health information on consumer valuation for tomato products.
- Examining the correlation between sensory tasting and credence attributes in order to evaluate consumer preferences regarding the taste of organic, local, and specialty products.
- The segmentation of experimental auction participants into different latent classes based on health-related behaviors, and measuring

differences in the valuation of products and information treatments among those classes.

For the study, a total of 157 participants were recruited in central Texas (Bryan/College Station) to participate in one of the eight sessions that were conducted over the course of three days. The assignment of participants to different sessions was done in a way that mimicked the overall grocery-shopper demographics in Texas. In order to participate in the study, subjects had to be the primary grocery shopper of their household, be at least 18 years old, and have no tomato allergies. About 86% of recruited individuals were the primary shopper of groceries in their household.

Upon arriving at the assigned session, participants were asked to sign a consent form and were randomly assigned an identification number to be used throughout the entire session to maintain anonymity. Then, they were provided with an instructional packet and a packet of bid sheets. All instructions were read loudly from a script by a session monitor, who explicitly clarified that the auction was non-hypothetical in nature and that any participant who purchased any good during the session would have to pay real money.

To better clarify the specific details of the sealed-bid second-price Vickrey auction, subjects were taken through two verbal and numerical examples. Then, they participated in two practice rounds. While the market price (2<sup>nd</sup> –highest bid) for the first practice round was posted, participants completed a short knowledge quiz on the auction procedures, and the answers to the quiz were discussed. Next, they participated in the

second practice round. Following the completion of the practice rounds, subjects were given instructions on the procedures for the vegetable product portion of the session. Six vegetable products, which are close substitutes, were chosen for this study:

Conventionally-grown tomatoes produced in the U.S. and Mexico, organic tomatoes produced in the U.S. and Mexico, local-specialty tomato, and a yellow squash as a reference product. The locally-grown specialty variety had an improved taste, held added health benefits, and was developed by the Department of Horticultural Sciences at Texas A&M University. Moreover, the U.S. grown tomatoes were produced in an off-season period; thus, their quality was lower compared to the rest of the products.

Four non-hypothetical vegetable auction rounds were conducted. The first round was the “baseline round”, where no information was provided to the participants. Following the “baseline round”, subjects were provided with three randomized within subject information treatments. These treatments were as follows: 1) Tasting, in which subjects had the opportunity to taste small, equally sized samples for each of the vegetable products, 2) Health Information Treatment, in which subjects were provided with information about the health benefits of consuming tomatoes, and 3) Product Information Treatment, in which participants were provided with information regarding the location of origin and production system of each vegetable variety. At the time of bidding, subjects had the opportunity to closely examine the vegetable products up to auction. After bids were collected for all rounds, one round and one product were randomly chosen by a session monitor to be binding. Then, while the buyers and the market price of the auction were determined, participants were asked to fill out a

consumer survey over their purchasing habits and demographic characteristics. Finally, subjects received a participation fee of \$30 and they all signed a receipt of payment form for the compensation received.

The auction mechanism described above was utilized to obtain information regarding socio-economic and behavioral characteristics of participants as well as determine the factors that influence WTP and preferences for the vegetable products. There are few relevant demographic and behavioral characteristics of interest that were obtained from the consumer survey completed by participants. The mean reported household spending on all food purchases was \$113 per week, of which \$28 went to spending on fruits and vegetables. Participants also reported that, on average, fruits and vegetables comprise 34% of their full stock of food at home; this result was measured to test whether the size of the current stock of similar products has an impact on WTP for the products in the study. Among the factors that affect purchasing decisions for tomatoes, taste, freshness, and visual appearance were at the top of the list.

To test for any relationship between health-related factors and the information treatments included in the study, participants were surveyed on their health-related behaviors. From all participants, about 21% reported having a serious health issue and 9% reported to be smokers. The average percentage days exercised per year was 40%. Additionally, participants were asked to state as to which of the weight categories they perceived they belonged to; this information was used to make comparisons with weight categories defined on actual BMI estimates taken during the experiment. The obese category resulted in an underreported estimate, meaning that more individuals were

obese than were classified as such by their own perception. While this reporting error can result in severe underestimates of the number of individuals in high weight classifications such as obesity, it may also bias coefficient estimates.

Since the participant sample was recruited for the sole purpose of studying vegetable purchasing decisions and the subjects had to meet certain criteria to be eligible for the study, caution should be exercised when generalizing those results to the overall population.

Caution should also be exercised when extending the findings of this study to other vegetable products; although some of the behavioral and demographic characteristics measured in this study may serve as a framework when examining the factors that affect the buying behavior of those other products.

The experimental auction bids were pooled, which resulted in 3140 observations (5 products x 4 rounds x 157 participants). With prices ranging from \$0.00 to \$6.00 for one pound of tomatoes, the average price that consumers were willing to pay for all tomato varieties across all rounds was \$1.37 per pound. Based on the mean bids, it was clearly noticeable that individuals had a higher WTP for local-specialty tomatoes for every round.

Individual WTP for a product was censored at \$0.00 when measured using this experimental auction. The percentage of bid-censoring in all information treatments was relatively low across products. This result was expected as all tomato products are regularly purchased for a positive value in the marketplace. To model these results, several approaches were considered. First, individual models for each product and

information treatment were estimated using a constant parameters tobit model to account for bid-censoring. The separate tobit models limit the generalization of the results to other products and the extension of the comparisons to additional information treatments. Therefore, the experimental auction bids were pooled across individuals, information treatments, and products, and further models were estimated to provide additional insight.

Some of the models used included ordinary least squares, constant parameters tobit, random effects tobit, mixed linear, and random parameters tobit. Each of these models held some benefits and drawbacks. While the results varied depending on the specific model used for estimation and the variables that were included, the product characteristics of organic and local-specialty tomatoes often increased WTP for the products. Even though the information treatments were often not significant in the models for the full bids, consumers often expressed price premiums for the products after receiving the health information treatment and their bids often decreased following the tasting and product information treatments. Also, the random effects tobit, mixed linear, and random parameters tobit, predicted a significant presence of individual heterogeneity. Thus, the ordinary least squares and the constant parameters tobit models were rejected as models for the bids in this study, and they were only estimated as baseline and for pedagogical purposes.

Among all estimation methods considered, particular attention was paid to the random parameters tobit model, as it captured heterogeneity in preferences while accounting for bid censoring. In examining the results for the random parameter tobit,

several relevant factors should be pointed out. First, the model indicated that valuations were heterogeneous across individuals, which implies that unobserved heterogeneity is a vital factor that needs to be considered in the econometric analysis. Second, results showed that consumers are willing to pay price premiums for the organic and local-specialty tomatoes. These results can be explained by the increase in consumers' attention towards healthy eating habits and the rise in consumers' awareness over the quality of the food they purchase. However, consumers expressed a price discount of \$0.14 for the conventional tomato produced in the U.S., which can be explained by the lower quality this product presented at the moment of the study as it was conducted during an off-season period. With regards to the information treatments, estimates show significant price premiums for the domestic and locally grown specialty varieties after the tasting treatment. However, bid prices decreased after consumers tasted the organic tomato. Also, a significant increase in WTP after the health information was reported. Indicators related to socio-demographic and behavioral characteristics such as age, education level, gender, income, marital status, tobacco use, and exercise had a significant effect on WTP.

Although analyzing WTP using full bids is useful, it was also necessary to reanalyze the bids using implied differences in order to measure the size of the change in WTP between different information treatments and the baseline round. Results from these models show that the change in WTP for the domestic and local-specialty varieties was positive over all of the information treatments. Among the socio-economic characteristics, a graduate education level caused an increase in the size of the change in



WTP. Particularly for the case of health information treatment, the variables indicating weekly fruit and vegetable expenditures and exercise decreased the size of the change in WTP.

The socio-economic and behavioral characteristics included in the models so far were helpful in explaining WTP. However, individuals' BMI was also considered an important predictor of consumers' valuations, especially when analyzing the health information treatment. In this application, the BMI indicator was treated as an endogenous variable and implied differences models were estimated using an Instrumental Variable (IV) approach. Results show that individual's BMI caused a positive effect on WTP, which indicates that the change in WTP attributed to that variable increased from the baseline round to the health information treatment. With regards to the product varieties, estimates showed a positive effect from the domestic variety; however, the organic and local-specialty tomatoes effects were not significant in this model, indicating the variables did not have an effect on the size of the change in bids due to the health treatment.

Finally, a LCA was used to segment consumers into potential latent classes and analyze the differences in WTP among those classes. Based on observed indicators of lifestyle habits and health status, demographic and behavioral characteristics, and WTP estimates, two latent classes were selected and characterized as: "Health Conscious" (51.6% of participants), and "Health Redeemers" (48.4% of participants). The random parameters tobit model suggested that more detailed information could be obtained by estimating separate WTP equations for each class rather than pooling both classes. The

classes differed significantly in terms of their preferences, willingness to pay, socio-economic profile, and health-driven motivations. Overlooking these differences might lead researchers to make erroneous inferences regarding product valuation.

### **Economic and Marketing Implications**

The demand for differentiated products is expected to continue to increase as consumers associate the nutritional and health benefits of eating organic, local, and specialty foods. Given that consumers are differentiating products on the basis of higher quality, nutrition, freshness, environmental and economic benefits, this study is important to understand current consumer preferences when it comes to fruit and vegetable products.

This study holds many benefits for producers, distributors and retailers of fruit and vegetable products. It has confirmed that consumers have different perceptions towards differentiated food products and identified which consumers are willing to pay price premiums for those products. This information is vital to suppliers as it helps them improve marketing schemes, enhance consumer targeting and understand product growth opportunities.

When analyzing consumers' reactions to the tasting treatment for each tomato product, it was found that they were willing to pay price premiums after tasting the local-specialty and domestic varieties. Producers can take advantage of this fact, while marketing their products, by giving samples at point of purchase. The tasting treatment, however, generated opposite results for other tomato varieties, where consumers placed price discounts after tasting. This result should not be taken as a dislike for the taste of

tomatoes but rather as a decrease in valuation due to incomplete information. Furthermore, the way tomatoes were prepared for the sensory analysis might differ from the standard way consumers prepare their tomatoes at home. This could result in the consumer discounting the taste due to a prejudiced view of how the tomato should taste. Another information treatment that significantly impacted WTP was the product information set in which consumers revised their bids in favor of locally grown and domestic tomato varieties. This could be viewed as a benefit to producers who can boost their sales by emphasizing product origins to their advantage. Finally, results from the health information treatment indicated that it had a positive impact on the change in WTP.

Policy makers can use the information in this study to increase the welfare of both consumers and producers when developing their policies. To this end, they should promote the consumption of fruits and vegetables by providing a higher awareness about the nutritional benefits of those products. This can be accomplished by including labels that carry specific information about the particular products being marketed.

### **Limitations and Suggestions for Future Research**

The limitations of this study are listed below along with suggestions for further research:

- The experimental auction was conducted during an off-season period where the available tomatoes were mostly imported products from Mexico. This means that the domestic variety presented a lower than usual quality in terms of size and appearance. Subsequently, there was a constant decrease in consumer valuation of this variety compared with the other products.

- The study showed that location of origin did have a significant impact of consumers' valuation for local products; however, this experimental auction was conducted only in the central area of Texas (Bryan/College Station). Therefore, the question remains whether this result can be generalized countrywide. It would be helpful to test this hypothesis in other areas in the country to better understand consumers' demand for local foods.
- The nutritional information provided to the participants in the health information treatment wasn't product specific, rather it included potential benefits of consuming tomatoes in general. Each product has its own nutrient profile and health benefits. Providing product-specific information to the subjects may alter their valuation of the varieties, and enable us to more fully understand the interaction between health benefits and WTP.
- The sensory analysis (Tasting round) could have been made more appropriate if conducted in a sensory analysis laboratory. Contrary to this study, a sensory analysis laboratory eliminates all sorts of communication and interaction between the participants. This ensures the absence of any social influence on panelists while reporting their results.
- Even though the revealed preferences approach, used in this study, helps mitigate the hypothetical bias present in the stated preference approach, it still poses the risk of including some biases in the results due to the effect of commitment fees (participants might actually end up buying a product), bid affiliations, and zero bid values.

## REFERENCES

- Abrevaya, J., and H. Tang. "Body Mass Index in Families: Spousal Correlation, Endogeneity, and Intergenerational Transmission." *Empirical Economics* 41, no. 3 (2011): 841-864.
- Adams, P. "Effect of Salinity on the Distribution of Calcium in Tomato (*Lycopersicon esculentum*) Fruit and Leaves." In *Plant Nutrition-Physiology*, by M.L. van Beusichem, 473-476. Dordrecht: Kluwer Academic Publishers, 1990.
- Adams, P. "Mineral Nutrition." In *The Tomato Crop*, by J.G. Atherton and J. Rudich, 281-334. London: Chapman and Hall, 1986.
- Alfnes, F., and K. Rickertsen. "Non-Market Valuation: Experimental Methods." In *Oxford Handbook on the Economics of Food Consumption and Policy*, by J. Lusk, J. Roosen and J. Shogren, edited by Oxford University Press. Oxford, 2010.
- Ames, BN., MK. Shigenaga, and TM. Hagen. "Oxidants, Antioxidants, and the Degenerative Diseases of Aging." *Proc Natl Acad Sci USA* 90 (1993): 7915-7922.
- Appleman, C.O., and C.M. Conrad. "The Pectic Constituents of Tomatoes and their Relation to the Canned Product." *Maryland Agr. Exp. Sta.*, no. 291 (1927).
- Arab, L., and S. Steck. "Lycopene and Cardiovascular Disease." *American Journal of Clinical Nutrition* 71 (2000): 1691S-1695S.
- Azzurra, A., and P. Paola. "Consumer's Behavior and Attitudes toward Healthy Food Products: The Case of Organic and Functional Foods." Paper prepared for the

113<sup>th</sup> EAAE Seminar 'A Resilient European Food Industry and Food Chain in a Challenging World', Chania Greece, 3-6 September, 2009.

- Baker, B.P., C.M. Benbrook, E. Groth, and L. Benbrook. "Pesticide Residues in Conventional, Integrated Pest Management (IPM)-Grown and Organic Foods: Insights from Three US Data Sets." *Food Additives & Contaminants* 19, no. 5 (2002): 427-446.
- Baker, G.A. "Consumer Preferences for Food Safety Attributes in Fresh Apples: Market Segments, Consumer Characteristics, and Marketing Opportunities." *Journal of Agricultural and Resource Economics* 24 (1999): 80-97.
- Barreiro-Hurlé, J., S. Colombo, and E. Cantos-Villar. "Is There a Market for Functional Wines? Consumer Preferences and Willingness-to-pay for Resveratrol-Enriched Red Wine." *Food Quality and Preference* 19 (2008): 360-371.
- Batte, M.T., N.H. Hooker, T.C. Haab, and J. Beaverson. "Putting their Money Where their Mouths Are: Consumer Willingness to Pay for Multi-Ingredient, Processed Organic Food Products." *Food Policy* 32 (2007): 145-159.
- Bernard, J.C. "Evidence of Affiliation of Values in a Repeated Trial Auction Experiment." *Applied Economics Letters* 12 (2005): 687-691.
- Bernard, J.C., and D.J. Bernard. "Comparing Parts with the Whole: Willingness to Pay for Pesticide-Free, Non-GM, and Organic Potatoes and Sweet Corn." *Journal of Agricultural and Resource Economics* 35, no. 3 (2010): 457-475.

- Bernard, J.C., and D.J. Bernard. "What Is It About Organic Milk? An Experimental Analysis." *American Journal of Agricultural Economics* 91, no. 3 (2009): 826-836.
- Bierlaire, M. "Discrete Choice Models." Vol. 166, in *Operations Research and Decision Aid Methodologies in Traffic and Transportation Management*, by M. Labbé, G. Laporte, K. Tanczos and P. Toint, 203-227. Springer Verlag, 1998.
- Binmore, K. "Why Experiment in Economics?" *The Economic Journal* 109 (1999): F16-F24.
- Blumenschein, K., G.C. Blomquist, M. Johannesson, N. Horn, and P. Freeman. "Eliciting Willingness to Pay Without Bias: Evidence from a Field Experiment." *The Economic Journal* 118 (2008): 117-137.
- Bound, J., C. Brown, and N. Mathiowetz. "Measurement Error in Survey Data." *Handbook of Econometrics* 5 (2002).
- Bourn, D., and J. Prescott. "A Comparison of the Nutritional Value, Sensory Qualities, and Food Safety of Organically and Conventionally Produced Foods." *Critical Reviews in Food Science and Nutrition* 42, no. 1 (2002): 1-34.
- Breidert, C., M. Hahsler, and T. Reutterer. "A Review of Methods for Measuring Willingness-to-Pay." *Innovative Marketing* 2, no. 4 (2006): 8-32.
- Brown, C. "Consumers' Preferences for Locally Produced Food: A Study in Southeast Missouri." *American Journal of Alternative Agriculture* 18 (2003): 213-224.
- Brown, D.J., and L.F. Schrader. "Cholesterol Information and Shell Egg Consumption." *American Journal of Agricultural Economics* 72 (1990): 548-555.

- Bruhn, C.M., P.M. Vossen, E. Chapman, and S. Vaupel. "Consumer Attitudes toward Locally Grown Produce." *California Agriculture* 46 (1992): 13-16.
- Burchardi, H., C. Schröder, and H.D. Thiele. "Willingness-To-Pay for Food of the Own Region: Empirical Estimates from Hypothetical and Incentive Compatible Settings." AAEA Annual Meeting, Providence, RI, 2005.
- Burkhauser, R.V., and J. Cawley. "Beyond BMI: The Value of More Accurate Measures of Fatness and Obesity in Social Science Research." *Journal of Health Economics* 27, no. 2 (2008): 519-529.
- Calle, E.E, C. Rodriguez, K. Walker-Thurmond, and M.J. Thun. "Overweight, Obesity and Mortality from Cancer in a Prospectively Studied Cohort of US Adults." *The New England Journal of Medicine* 348 (2003): 1625-1628.
- Cameron, A.C., and P.K. Trivedi. *Microeconometrics Using Stata*. Texas: Stata Press, 2009.
- Canavari, M., G. Nocella, and R. Scarpa. "Stated Willingness-to-Pay for Organic Fruit and Pesticide Ban." *Journal of Food Products Marketing* 11, no. 3 (2005): 107-134.
- Capps, O.J. "Utilizing Scanner Data to Estimate Retail Demand Functions for Meat Products." *American Journal of Agricultural Economics* 71 (1989): 750-60.
- Carey, V.J., et al. "Body Fat Distribution and Risk of Non-Insulin-Dependent Diabetes Mellitus in Women." *American Journal of Epidemiology* 145, no. 7 (1997): 614-619.



Caris-Veyrat, C., M.J. Amiot, V. Tyssandier, D. Grasselly, M. Buret, and M.

Mikolajczak. "Influence of Organic versus Conventional Agricultural Practice on the Antioxidant Microconstituent Content of Tomatoes and Derived Purees; Consequences on Antioxidant Plasma Status in Humans." *Journal of Agricultural and Food Chemistry* 52 (2004): 6503-9.

Carlsson, F., and P. Martinsson. "Do Hypothetical and Actual Marginal Willingness to Pay Differ in Choice Experiments?" *Journal of Environmental Economics and Management* 41 (2001): 179-192.

Caswell, J.A., and E.M. Mojduszka. "Using Informational Labeling to Influence the Market for Quality in Food Products." *American Journal of Agricultural Economics* 78 (1996): 1248-1253.

Chandon, P., and B. Wansink. "The Biasing Health Halos of Fast-Food Restaurant Health Claims: Lower Calorie Estimates and Higher Side-Dish Consumption Intentions." *Journal of Consumer Research* 34 (2007): 301-314.

Chang, K. "Parsing of Data Led to Mixed Messages on Organic Food's Value." *Science*, The New York Times, October 15, 2012.

[http://www.nytimes.com/2012/10/16/science/stanford-organic-food-study-and-vagaries-of-meta-analyses.html?\\_r=0](http://www.nytimes.com/2012/10/16/science/stanford-organic-food-study-and-vagaries-of-meta-analyses.html?_r=0).

Chern, W.S., N. Kaneko, and G.B. Tarakcioglu. "Willingness-to-Pay for PEF-processed Orange Juice: Evidence from an Auction Experiment." AAEA Annual Meeting, Montreal, Canada, 2003.

- Chern, W.S., E.T. Loehman, and S.T. Yen. "Information, Health Risk Beliefs, and the Demand for Fats and Oils." *Review of Economics and Statistics* 77, no. 3 (1995): 555-564.
- Clinton, S.K. "Lycopene: Chemistry, Biology, and Implications for Human Health and Disease." *Nutrition Reviews* 56 (1998): 35-51.
- Colditz, G.A. "Economic Costs of Obesity and Inactivity." *Medicine & Science in Sports & Exercise* 31 (1999): S663-S667.
- Collart, A.J., and M.A. Palma. "Modeling Unobserved Consumer Heterogeneity in Experimental Auctions: A Censored Random Parameters Approach." AAEA Annual Meeting, Washington, D.C., 2013a.
- Collart, A.J., and M.A. Palma. "Who Participates In Experimental Auctions? A Latent Class Analysis With Individual Heterogeneity." Working Paper, Department of Agricultural Economics, Texas A&M University, 2013b.
- Collins, L.M., and S.T. Lanza. *Latent Class and Latent Transition Analysis: With Applications in the Social, Behavioral and Health Sciences*. Hoboken, NJ: Wiley.
- Combris, P., P. Bazoche, E. Giraud-Héraud, and S. Issanchou. "Food Choices: What do We Learn from Combining Sensory and Economic Experiments?" *Food Quality and Preference* 20 (2009): 550-557.
- Cook, R. "The Evolving Bilateral U.S.-Mexico Horticultural Trade Relationship: Trends and Issues." Dept. of Agricultural Economics, University of California, Davis, California, 1995.

- Cook, R., and L. Calvin. "Greenhouse Tomatoes Change the Dynamics of the North American Fresh Tomato Industry." *Electronic, Economic Research Service/USDA*, (2005):1-81.
- Coppinger, V.M., V.L. Smith, and J.A. Titus. "Incentives and Behavior in English, Dutch, and Sealed-Bid Auctions." *Economic Inquiry* 43 (1980): 1-22.
- Corrigan, J.R., and M.C. Rousu. "Posted Prices and Bid Affiliation: Evidence from Experimental Auctions." *American Journal of Agricultural Economics* 88 (2006): 1078-1090.
- Costa, J.M., and E. Heuvelink. "Introduction: the Tomato Crop and Industry." In *Tomatoes*, by E. Heuvelink, 1-19. CAB International, 2005.
- Cunha, L.M., and A.P. Moura. *Conflicting Demands of Agricultural Production and Environmental Conservation: Consumer's Perception of the Quality and Safety of Food in Ecological Agriculture and Rural Development in Central and Eastern European Countries*, Filho, W.L., Nato Science Series, IOS Press, Amsterdam, 2004.
- Coursey, D.L., J.L. Hovis, and W.D. Schulze. "The Disparity Between Willingness to Accept and Willingness to Pay Measure of Value." *Quarterly Journal of Economics* 102 (1987): 679-690.
- Cummings, R., and L. Taylor. "Unbiased Value Estimates for Environmental Goods: A Cheap Talk Design for the Contingent Valuation Method." *American Economic Review* 89 (1999): 649-665.

- Cummings, R., D. Brookshire, and W. Schulze. *Valuing Environmental Goods: An Assessment of the Contingent Valuation Method*. NJ: Rowman and Allanheld, 1986.
- Cummings, R.G., G.W. Harrison, and E.E. Rutstrom. "Homegrown Values and Hypothetical Surveys: Is the Dichotomous Choice Approach Incentive-Compatible?" *American Economic Review* 85 (1995): 260-266.
- Cummings, R.G., S. Elliott, G.W. Harrison, and J. Murphy. "Are Hypothetical Referenda Incentive Compatible?" *Journal of Political Economy* 105, no. 3 (1997): 609-621.
- Curhan, R.C. "The Effects of Merchadising and Temporary Promotional Activities on the Sales of Fresh Fruits and Vegetables in Supermarkets." *Journal of Marketing Research* 11, no. 3 (1974): 286-294.
- Dalal, K.B., D.K. Salunkhe, A.A. Boe, and L.E. Olson. "Certain Physiological and Biochemical Changes in the Developing Tomato Fruit (*Lycopersicon esculentum* Mill)." *Journal of Food Science* 30 (1965): 504-508.
- Dallongeville, J., N. Marecaux, J.C. Fruchart, P. Amouyel. "Cigarette Smoking Is Associated with Unhealthy Patterns of Nutrient Intake: A Meta-analysis." *Journal of Nutrition* 128, no. 9 (1998): 1450-1457.
- Darby, K., M.T. Batte, S. Ernst, and B. Roe. "Decomposing Local: A Conjoint Analysis of Locally Produced Foods." *American Journal of Agricultural Economics* 90, no. 2 (2008): 476-486.

- Darby, M.R., and E. Karni. "Free Competition and the Optimal Amount of Fraud." *Journal of Law and Economics* 16, no. 1 (1973): 67-88.
- Davies, A., A.J. Titterington, and C. Cochrane. "Who Buys Organic Food? A Profile of the Purchasers of Organic Food in Northern Ireland." *British Food Journal* 97 (1995): 17-23.
- Davis, D.D., and C.A. Holt. "Experimental Economics: Methods, Problems, and Promise." *Experimental Economics* 8, no. 2 (1993): 179-212.
- De-Magistris, T., A. Gracia, and R.M. Nayga. "On the Use of Honesty Priming Tasks to Mitigate Hypothetical Bias in Choice Experiments." *American Journal of Agricultural Economics* 95, no. 5 (2013): 1136-1154.
- Demeritt, L. "All Things Organic 2002: A Look at the Organic Consumer." The Hartman Group, Bellevue, WA, 2002.
- Dhar, T., and J.D. Foltz. "Milk by Any Other Name...Consumer Benefits from Labeled Milk." *American Journal of Agricultural Economics* 87, no. 1 (2005): 214-228.
- Dickie, M., A. Fisher, and S. Gerking. "Market Transactions and Hypothetical Demand Data: A Comparative Study." *Journal of the American Statistical Association* 82, no. 397 (1987): 69-75.
- Dimitri, C., and C. Greene. "Recent Growth Patterns in U.S. Organic Foods Market." Agricultural Information Bulletin No. 777, USDA, Economic Research Service, Septemeber 2002, [www.ers.usda.gov/publications/aib777/](http://www.ers.usda.gov/publications/aib777/).

- Ding, M., R. Grewal, and J. Liechty. "Incentive-Aligned Conjoint Analysis." *Journal of Marketing Research* 42 (2005): 67-83.
- DuBourg, W.R., M. Jones-Lee, and G. Loomes. "Imprecise Preferences and the WTP-WTA Disparity." *Journal of Risk Uncertainty* 9 (1994): 115-133.
- Dziak, J., D.L. Coffman, S.T. Lanza, and R. Li. "Sensitivity and Specificity of Information Criteria." The Methodology Center. Technical Report Series #12-119, Pennsylvania State University, 2012.
- FAO, ITC, and CTA. "World Markets for Organic Fruit and Vegetables Opportunities for Developing Countries in the Production and Export of Organic Horticultural Products." Food and Agriculture Organization of the United Nations, International Trade Centre, and Technical Centre for Agricultural and Rural Cooperation, 2001.
- Ferrari, R.A., and A.A. Benson. "The Path of Carbon on Photosynthesis of the Lipids." *Archives of Biochemistry and Biophysics* 93 (1961): 185-192.
- Festing, H. "Farmers' Markets- Bringing the Countryside to the Town." *Town and Country Planning*, (1996): 269-270.
- Finkelstein, E.A., J.G. Trogon, J.W. Cohen, and W. Dietz. "Annual Medical Spending Attributable To Obesity: Payer-And Service-Specific Estimates." *Health Affairs* 28, no. 5 (2009): w822-w831.
- Flegal, K.M., M.D. Carrol, R.J. Kuczmarski, and C.L. Johnson. "Overweight and Obesity Trends in the United States: Prevalence and Trends, 1960-1994."

*International Journal of Obesity and Related Metabolic Disorders* 22 (1998): 39-47.

Florida Department of Agriculture and Consumer Services. “*United States Department of Commerce and Mexican Tomato Industry Reach Antidumping Suspension Agreement on Imports of Fresh Tomatoes.*” February 2013.

<http://www.freshfromflorida.com/News-Events/Press-Releases/2013-Press-Releases/United-States-Department-of-Commerce-and-Mexican-Tomato-Industry-Reach-Antidumping-Suspension-Agreement-on-Imports-of-Fresh-Tomatoes> (accessed March 2014).

Fonsah, E.G. *Marketing*. Commercial Tomato Production Handbook. Cooperative Extension, the University of Georgia College of Agricultural and Environmental Sciences, February 2010.

Food and Agriculture Organization of the United Nations. *Selected Indicators of Food and Agricultural Development in the Asian-Pacific Region 2001-2011*. Bangkok, 2012.

Food and Agriculture Organization of the United Nations. FAO Water . “*Crop Water Information: Tomato.*” 2013. [http://www.fao.org/nr/water/cropinfo\\_tomato.html](http://www.fao.org/nr/water/cropinfo_tomato.html) (accessed April 2014).

Foster, W., and R.E. Just. "Measuring Welfare Effects of Product Contamination with Consumer Uncertainty." *Journal of Environmental Economics and Management* 17 (1989): 266-283.

- Fox, J.A., D.J. Hayes, and J.F. Shogren. "Consumer Preferences for Food Irradiation: How Favorable and Unfavorable Descriptions Affect Preferences for Irradiated Pork in Experimental Auctions." *Journal of Risk and Uncertainty* 24 (2002): 75-95.
- Fox, J.A., J.F. Shogren, D.J. Hayes, and J.B. Kliebenstein. "CVM-X: Calibrating Contingent Values with Experimental Auction Markets." *American Journal of Agricultural Economics* 80 (1998): 455-465.
- Fox News. "10 Reasons Organic Food Is so Expensive." Food Drink. March 2012. <http://www.foxnews.com/leisure/2012/03/11/10-reasons-organic-food-is-so-expensive/> (accessed April 2014).
- Frahm, D.G., and L.F. Schrader. "An Experimental Comparison of Pricing in Two Auction Systems." *American Journal of Agricultural Economics* 52, no. 4 (1970): 528-534.
- Freedman, D.S., and G. Perry. "Body Composition and Health Status Among Children and Adolescents." *Preventive Medicine* 31, no. 2 (2000): S34-S53.
- Freeman, B.B., and K. Reimers. "Tomato Consumption and Health: Emerging Benefits." *American Journal of Lifestyle Medicine*, (2010): 1-10.
- Friedman, D., and S. Sunder. *Data Analysis in Experimental Methods: A Primer for Economists*. New York: Cambridge University Press, 1994.
- Fryar, C.D., M.D. Carroll, and C.L. Ogden. "Prevalence of Overweight, Obesity, and Extreme Obesity Among Adults: United States, Trends 1960-1962 Through 2009-2010." National Center for Health Statistics. September 2012.



[http://www.cdc.gov/nchs/data/hestat/obesity\\_adult\\_09\\_10/obesity\\_adult\\_09\\_10.htm](http://www.cdc.gov/nchs/data/hestat/obesity_adult_09_10/obesity_adult_09_10.htm) (accessed April 2014).

- Garrouste-Orgeas, M., et al. "Body mass index." *Intensive Care Medicine* 30, no. 3 (2004): 437-443.
- Giovannucci, E. "Tomatoes, Tomato-Based Products, Lycopene, and Cancer: Review of the Epidemiologic Literature." *Journal of the National Cancer Institute* 91, no. 4 (1999): 317-331.
- Govindasamy, R., and J. Italia. "Predicting Willingness-to-pay a Premium for Organically Grown Fresh Produce." *Journal of Food Distribution Research* 30, no. 2 (1999): 44-53.
- Green, P., and V. Srinivasan. "Conjoint Analysis in Marketing: New Developments with Implications for Research and Practice." *Journal of Marketing* 54 (1990): 3-19.
- Greene, W.H. *Econometric Analysis: Fifth Edition*. Upper Saddle River, New Jersey: Prentice Hall, 2003.
- Halberg, N., and I.S Kristensen. "Expected Crop Yield Loss When Converting to Organic Dairy Farming in Denmark." *Biological Agriculture and Horticulture* 14 (1997): 25-41.
- Hanemann, W.M. "Willingness to Accept and Willingness to Pay: How Much Can They Differ?" *American Economic Review* 81 (1991): 635-647.
- Harrison, G.W., R.M. Harstad, and E.E. Rustrom. "Experimental Methods and Elicitation of Value." *Experimental Economics* 7 (2004): 123-140.

- Harvard Health Publications. "*Benefits of Exercise-Reduce Stress, Anxiety, and Helps Fight Depression, from Harvard Men's Health Watch.*" February 2011.  
[http://www.health.harvard.edu/press\\_releases/benefits-of-exercisereduces-stress-anxiety-and-helps-fight-depression](http://www.health.harvard.edu/press_releases/benefits-of-exercisereduces-stress-anxiety-and-helps-fight-depression) (accessed May 2014).
- Hasler, C.M. "Functional Foods: Benefits, Concerns and Challenges- A Position Paper from the American Council on Science and Health." *Journal of Nutrition* 132, no. 12 (2002): 3772-3781.
- Hayes, D.J., J.F. Shogren, S.U. Shin, and J.B. Kliebenstein. "Valuing Food Safety in Experimental Auction Markets." *American Journal of Agricultural Economics* 77 (1995): 40-53.
- Heber, D. "Colorful Cancer Prevention: Carotene, Lycopene, and Lung Cancer." *The American Journal of Clinical Nutrition* 72 (2000): 901-902.
- Hobson, G., and D. Grierson. "Tomato." In *Biochemistry of Fruit Ripening*, by G.B. Seymour, J.E. Taylor and G.A. Tucker, 405-442. London: Chapman & Hall, 1993.
- Hochmuth, G.J., and R.C. Hochmuth. *Production of Greenhouse Tomatoes-Florida Greenhouse Vegetable Production Handbook*. Suwannee Valley, University of Florida Cooperative Extension, (1990):1-18.
- Horowitz, J.K., and K.E. McConnell. "A Review of WTA/WTP Studies." *Journal of Environmental Economics and Management* 44 (2002): 426-447.

- Hu, W., T. Woods, and S. Bastin. "Consumer Acceptance and Willingness to Pay for Blueberry Products with Nonconventional Attributes." *Journal of Agricultural and Applied Economics* 41, no. 1 (2009): 47-60.
- Huang, C.L. "Consumer Preferences and Attitudes towards Organically Grown Produce." *European Review of Agricultural Economics*, 1996: 331-342.
- Hubert, H.B., M. Feinleib, P.M. McNamara, and W.P. Castelli. "Obesity as an Independent Risk Factor for Cardiovascular Disease: a 26-year Follow-Up of Participants in the Framingham Heart Study." *Circulation* 67 (1983): 968-977.
- Hughner, R.S., P. McDonagh, A. Prothero, J. Clifford, II. Shultz, and J. Stanton. "Who are Organic Food Consumers? A Compilation and Review of Why People Purchase Organic Food." *Journal of Consumer Behavior* 6 (2007): 94-110.
- Hwang, Y.J., B. Roe, and M. Teisl. "An Empirical Analysis of United States Consumers' Concerns About Eight Food Production and Processing Technologies." *AgBioForum* 8 (2005): 40-49.
- Ippolito, P.M., and A.D. Mathios. "Information, Advertising and Health Choices: A Study of the Cereal Market." *The RAND Journal of Economics* 21 (1990): 459-480.
- Jaeger, S.R., and R. Harker. "Consumer Evaluation of Novel Kiwifruit: Willingness-to-Pay." *Journal of the Science of Food and Agriculture* 85 (2005): 2519-2526.
- James, J.S., B.J. Rickard, and W.J. Rossman. "Product Differentiation and Market Segmentation in Applesauce: Using a Choice Experiment to Assess the Value of

- Organic, Local, and Nutrition Attributes.” Working Paper, Department of Applied Economics and Management, Cornell University, January 2009.
- Jaynes, T.S., L. Rubey, F. Lupi, D. Tschirley, and M.T. Weber. "Estimating Consumer Response to Food Market Reform Using Stated Preference Data: Evidence from Easter and Southern Africa." *American Journal of Agricultural Economics* 78 (1996): 820-824.
- Jordan, K.H., and J.J. VanSickle. "Integration and Behavior in the U.S. Winter Market for Fresh Tomatoes." *Journal of Agricultural and Applied Economics* 27, no. 1 (1995): 127-137.
- Kahneman, D., J.L. Knetsch, and R.H. Thaler. "Experimental Tests of the Endowment Effect and the Coase Theorem." *The Journal of Political Economy* 98 (1990): 1325-1348.
- Kannel, W.B. "Effect of Weight on Cardiovascular Disease." *Nutrition* 13 (1997): 157-158.
- Kanter, C., K.D. Messer, and H.M. Kaiser. "Does Production Labeling Stigmatize Conventional Milk?" *American Journal of Agricultural Economics* 91, no. 4 (2009): 1097-1109.
- Kelley, W.T., and G. Boyhan. "History, Significance, Classification and Growth." In *Commercial Tomato Production Handbook*, by The University of Georgia Cooperative Extension, 3. 2010.
- Killinger, K.M., C.R. Calkins, W.J. Umberger, D.M. Feuz, and K.M. Eskridge. "A Comparison of Consumer Sensory Acceptance and Value of Domestic Beef

- Steaks and Steaks from a Branded, Argentine Beef Program." *Journal of Animal Science* 82 (2004): 3302-3307.
- Knetsch, J.L. "Biased Valuations, Damage Assessments, and Policy Choices: The Choice of Measure Matters." *Ecological Economics* 63 (2007): 684-689.
- Kohlmeier, J.L., et al. "Lycopene and Miocardial Infarction Risk in the EURAMIC Study." *American Journal of Epidemiology* 146 (1997): 618-626.
- Köszegi, B., and M. Rabin. "A Model of Reference-Dependent Preferences." *Quarterly Journal of Economics* 121, no. 4 (2006): 1133-1165.
- Kumanyika, S.K., et al. "Population-Based Prevention of Obesity. The Need for Comprehensive Promotion of Healthful Eating, Physical Activity, and Energy Balance." *Circulation*, 2008: 428-464.
- Kompaniyets, L. "Effect of Nutrition Merchandising and Consumer Preferences on Willingness to Pay for Local Tomatoes and Strawberries in Kentucky and Ohio." Theses and Dissertations-Agricultural Economics. Paper 5, 2012.  
[http://uknowledge.uky.edu/agecon\\_etds/5](http://uknowledge.uky.edu/agecon_etds/5)
- La Trobe, H. "Farmers' Markets: Consuming Local Rural Produce." *International Journal of Consumer Studies*. 25, no. 3 (2001): 181-192.
- La Trobe, H. *Local Food, Future Directions*. London: Friends of the Earth, 2002.
- Lancaster, K. "A New Approach to Consumer Theory." *Journal of Political Economy* 74, no. 2 (1966): 132-157.

- Lanza, S.T., L.M. Collins, D.R. Lemmon, and J.L. Schafer. "PROC LCA: A SAS Procedure for Latent Class Analysis." *Structural Equation Modeling* 14, no.4 (2007): 671-694.
- Lanza, S.T., X. Tan, and B.C. Bray. "Latent Class Analysis With Distal Outcomes: A Flexible Model-Based Approach." *Structural Equation Modeling* 20, no.1 (2013): 1-26.
- Le Strange, M., W.L. Schrader, and T.K. Hartz. "*Fresh-Market Tomato Production in California.*" Division of Agriculture and Natural Resources, University of California, 2000.
- Lee, L., S. Frederick, and D. Ariely. "Try It, You'll Like It: The Influence of Expectation, Consumption and Revelation on Preferences for Beer." *Psychological Science* 17, no. 12 (2006): 1054-1058.
- Levitt, S.D., and J.A. List. "What Do Laboratory Experiments Measuring Social Preferences Reveal About the Real World?" *Journal of Economic Perspectives* 21, no. 2 (2007): 153-174.
- Lissner, L. "Causes, Diagnosis and Risk of Obesity." *Pharmacoeconomics* 5 (1994): 8-17.
- List, J.A. "Do Explicit Warnings Eliminate the Hypothetical Bias in Elicitation Procedures? Evidence from Field Auctions for Sportscards." *American Economic Review* 91 (2001): 1498-1507.

- List, J.A., and C.A. Gallet. "What Experimental Protocol Influence Disparities Between Actual and Hypothetical Stated Values?" *Environmental and Resource Economics* 20 (2001): 241-254.
- List, J.A., and J.F. Shogren. "Calibration of the Differences Between Actual and Hypothetical Valuations in a Field Experiment." *Journal of Economic Behavior and Organization* 37 (1998): 193-205.
- List, J.A., and J.F. Shogren. "Price Information and Bidding Behavior in Repeated Second-Price Auctions." *American Journal of Agricultural Economics* 81 (1999): 942-949.
- Loomis, J. "What's to Know About Hypothetical Bias in Stated Preference Valuation Studies?" *Journal of Economic Surveys* 25, no. 2 (2011): 363-370.
- Loureiro, M.L., and J.J. McCluskey. "Assesing Consumer Response to Protected Geographical Identification Labeling." *Agribusiness* 16 (2000): 309-20.
- Loureiro, M.L., and S. Hine. "A Comparison of Consumer Willingness to Pay for a Local (Colorado-grown), Organic, and GMO-Free Product." *Journal of Agricultural & Applied Economics* 34, no. 3 (2002): 477-487.
- Louviere, J.J., T.N. Flynn, and R.T. Carson. "Discrete Choice Experiments Are Not Conjoint Analysis." *Journal of Choice Modelling* 3, no. 3 (2010): 57-72.
- Love, J., and G. Lucier. "Florida-Mexico Competition in the U.S. Market for Fresh Vegetables." Washington DC: Economic Research Service/USDA, 1996.
- Lucier, G., and C. Plummer. "Vegetables and Melons Outlook." Electronic Outlook, Economic Research Service, USDA, 2003.

- Lucier, G., B. Lin, J. Allshouse, and Scott Kantor L. "*Vegetables and Specialties Situation and Outlook Report.*" USDA, Economic Research Service. November 2000. <http://usda.mannlib.cornell.edu/usda/ers/VGS//2000s/2000/VGS-11-16-2000.pdf> (accessed March 2014).
- Lusk, J.L, T. Feldkamp, and T.C Schroeder. "Experimental Auction Procedure: Impact on Valuation of Quality Differentiated Goods." *American Journal of Agricultural Economics* 86, no. 2 (2004): 389-405.
- Lusk, J.L. "Consumer Information and Labeling." In *Federal Policies Affecting Food and Agricultural Markets: Challenges and Options*, by W.J. Armbruster and R.D. Knutson. New York, NY: Springer, 2013b.
- Lusk, J.L., and B. Norwood. "The Locavore's Dilemma: Why Pineapples Shouldn't Be Grown in North Dakota." January, 2011.
- Lusk, J.L., and B. Norwood. "Effect of Experimental Design on Choice-Based Conjoint Valuation Estimates." *American Journal of Agricultural Economics* 87 (2005): 771-785.
- Lusk, J.L., and B.C. Briggeman. "Food Values." *American Journal of Agricultural Economics* 91, no. 1 (2009): 184-196.
- Lusk, J.L., and J.F. Shogren. *Experimental Auctions: Methods and Applications in Economic and Marketing Research*. Cambridge: Cambridge University Press, 2007.



- Lusk, J.L., and T.C. Schroeder. "Are Choice Experiments Incentive Compatible? A Test with Quality Differentiated Beef Steaks." *American Journal of Agricultural Economics* 86, no. 2 (2004): 467-482.
- Lusk, J.L., and T.C. Schroeder. "Auction Bids and Shopping Choices." *Advances in Economic Analysis and Policy*, 2006.
- Lusk, J.L., J. Roosen, and J.A. Fox. "Value Elicitation in Laboratory and Retail Environments." *Economics Letters* 79 (2003): 27-34.
- Lusk, J.L., J.A. Fox, T.C. Schroeder, J. Mintert, and M. Koohmaraie. "In-Store Valuation of Steak Tenderness." *American Journal of Agricultural Economics* 83 (2001): 539-550.
- Lusk, J.L., T. Feldkamp, and T.C. Schroeder. "Experimental Auction Procedure: Impact on Valuation of Quality Differentiated Goods." *American Journal of Agricultural Economics* 86 (2004): 389-405.
- Mabiso, A, J. Sterns, L. House, and A. Wysocki. "Estimating Consumers' Willingness-To-Pay for Country-Of-Origin Labels in Fresh Apples and Tomatoes: A Doubled-Hurdle Probit Analysis of American Data Using Factor Scores." AAEA Annual Meeting, Providence, RI, 2005.
- Maga, J.A., F.D. Moore, and N. Oshima. "Yield, Nitrate Levels and Sensory Properties of Spinach as Influenced by Organic and Mineral Nitrogen Fertilizer Levels." *Journal of the Science of Food and Agriculture* 27 (1976): 109-114.
- Malnick, S.D.H, and H. Knobler. "The Medical Complications of Obesity." *Quarterly Journal of Medicine* 99 (2006): 565-579.

- Markosyan, A., T.I. Wahl, and J.J. McCluskey. "Functional Foods in the Marketplace: Willingness-to-pay for Apples Enriched with Antioxidants." AAEA Annual Meeting, Portland OR, 29 July- 1 August, 2007.
- McAdams, C., M.A. Palma, C. Hall, and A. Ishdorj. "A Nonhypothetical Ranking and Auction Mechanism for Novel Products." *Journal of Agricultural and Applied Economics* 45 (2013): 35-52.
- McAdams, C. Willingness-To-Pay for Pomegranates: Impact of Product and Health Features Using Nonhypothetical Procedures. Thesis, August 2011.  
<http://repository.tamu.edu/bitstream/handle/1969.1/150934/McAdams.pdf?sequence=1>
- McClure, S., J. Li, D. Tomlin, K. Cypert, L. Montague, and P. Montague. "Neural Correlates of Behavior Preference for Culturally Familiar Drinks." *Neuron* 44 (2004): 379-387.
- McCluskey, J.J., and M.L. Loureiro. "Consumer Preference and WTP for Food Labeling: A Discussion of Empirical Studies." *Journal of Food Distribution Research* 34, no. 3 (2003): 95-102.
- McCollum, J.P. "Distribution of Carotenoids in the Tomato." *Food Research* 20 (1955): 55-59.
- McDonald, J.F., and R.A. Moffitt. "The Uses of Tobit Analysis." *The Review of Economics and Statistics* 62, no. 2 (1980): 318-321.

- McFadden, D. "Conditional Logit Analysis of Qualitative Choice Behavior." In *Frontiers in Econometrics*, by P. Zarembka, 105-142. New York: Academic Press, 1974.
- McQuillan, B.M., J. Hung, J.P. Beilby, M. Nidorf, and P.L. Thompson. "Antioxidant Vitamins and the Risk of Carotid Atherosclerosis. The Carotid Ultrasound Disease Assessment Study (CUDAS)." *Journal of the American College of Cardiology* 38 (2001): 1788-1794.
- Misra, S.K., C.L. Huang, and S.L. Ott. "Consumer Willingness to Pay for Pesticide-Free Fresh Produce." *Western Journal of Agricultural Economics* 16, no. 2 (1991): 218-227.
- Moeltner, K., and D.F. Layton. "A Censored Random Coefficients Model for Pooled Survey Data with Application to the Estimation of Power Outage Costs." *The Review of Economics and Statistics* 84 (2002): 552-561.
- Mokdad, A.H., M.K. Serdula, W.H. Dietz, B.A. Bowman, J.S. Marks, and J.P. Koplan. "The Spread of the Obesity Epidemic in the United States, 1991-1998." *JAMA* 282 (1999): 1519-1522.
- Mordente, A., et al. "Lycopene and Cardiovascular Diseases: An Update." *Current medicinal Chemistry* 18 (2011): 1146-1163.
- Murphy, J.J., J.A. Geoffrey, T.H. Stevens, and D. Weatherhead. "Meta-Analysis of Hypothetical Bias in Stated Preference Evaluation." *Journal of Environmental and Resource Economics* 30 (2005): 313-325.

- Myerson, R.B. "Incentive Compatibility and the Bargaining Problem." *Econometrica* 47, no. 1 (1979): 61-74.
- Nagle, T.T., and R.K. Holden. *The Strategy and Tactics of Pricing* . Upper Saddle River, NJ: Prentice Hall, 2002.
- Nalley, L.L., D. Hudson, and G. Parkhurst. "Consistency of Consumer Valuation Under Different Information Sets: An Experimental Auction with Sweet Potatoes." *Journal of Food Distribution Research* 37, no. 3 (2006): 56-67.
- Napolitano, F., C. Pacell, A. Girolami, and A. Braghleri. "Effect of Information About Animal Welfare on Consumer Willingness to Pay for Yogurt." *Journal of Dairy Science* 91 (2008): 910-917.
- National Center for Health Statistics. "*Health, United States, 2012: With Special Feature on Emergency Care.*" Hyattsville, MD. 2013.
- Nuegebauer, T., and R. Selten. "Individual Behavior in First-Price Auctions: The Importance of Information Feedback in Computerized Experimental Markets." *Games and Economic Behavior* 54 (2006): 183-204.
- Nylund, K. L., T. Asparouhov, and B.O. Muthen. "Deciding on the Number of Classes in Latent Class Analysis and Growth Mixture Modeling: A Monte Carlo Simulation Study." *Structural Equation Modeling* 14 (2007): 535-569.
- Oberholtzer, L., C. Dimitri, and C. Greene. "*Price Premiums Hold on as U.S. Organic Produce Market Expands.*" Electronic Outlook Report, USDA, Economic Research Service, May 2005.

- Ogden, CL., MD. Carroll, LR. Curtin, MA. McDowell, CJ. Tabak, and Flegal KM.  
"Prevalence of Overweight and Obesity in the United States, 1999-2004." *JAMA*  
295, no. 13 (2006): 1549-1555.
- Onozaka, Y., and D.Thilmany. "Does Local Labeling Complement or Compete with  
Other Sustainable Labels? A Conjoint Analysis of Direct and Joint Values for  
Fresh Produce Claims." *American Journal of Agricultural Economics* 93, no. 3  
(2011): 693-706.
- Ozbay-Filiz, E., and E.Y. Ozbay. "Auctions with Anticipated Regret: Theory and  
Experiment." *The American Economic Review* 97, no. 4 (2007): 1407-1418.
- Padilla-Bernal, L., and D. Thilmany. "Mexican-U.S. Fresh Tomato Trade: An Analysis  
of Volume, Prices and Transaction Costs." *WAEA meetings*. Vancouver, 2000. 1-  
23.
- Palma, M.A., L.A. Rivera, and R.D. Knutson. "The Era of the Functional Consumer."  
Working Paper, Department of Agricultural Economics, Texas A&M University,  
2014.
- Parsons, W. *Organic Fruit and Vegetable Production: Is It for You?* Ottawa: Statistics  
Canada, 2002.
- Patterson, P.M., H. Olofsson, T.J. Richards, and S. Sass. "An Empirical Analysis of  
State Agricultural Product Promotions: A Case Study of Arizona Grown."  
*Agribusiness* 15, no. 2 (1999): 179-196.

- Pearson, D., J. Henryks, and H. Jones. "Organic Food: What We Know (And Do Not Know) About Consumers." *Renewable Agriculture and Food System* 26, no. 2 (2010): 171-177.
- Peralta, I.E., and D.M. Spooner. "History, Origin and Early Cultivation of Tomato (Solanaceae)." In *Genetic Improvement of Solanaceous Crops*, by MK. Razdan and AK. Mattoo, 1-24. Science Publishers, 2007.
- Phillips, K. "Whitefly, Tomato Growers Find Truce in New Texas Variety." *AgriLife Today*, Texas A&M AgriLife. December 2011.  
<http://today.agrilife.org/2011/12/05/whitefly-tomato-growers-find-truce-in-new-texas-variety/> (accessed April 2014).
- Picha, D.H. "Effect of Harvest Maturity on the Final Fruit Composition of Cherry and Large-Fruited Cultivars." *Journal of the American Society of Horticultural Science*, 1986: 723-727.
- Pindyck, R.S., and D.L. Rubinfeld. *Microeconomics*. 6th. Upper Saddke River, NJ: Prentice Hall, 2005.
- Plott, C.R., and K. Zeiler. "The Willingness to Pay - Willingness to Accept Gap, the "Endowment Effect," Subject Misconceptions and Experimental Procedures." *American Economic Review* 95 (2005): 530-545.
- Plunket, D.J. "Mexican Tomatoes. Fruit of New Technology." Economic Research Service, USDA. 1996. <http://www.econ.ag.gov/>. (accessed April 10, 2014).

- Ragland, E., and D. Tropp. "*USDA National Farmers Market Manager Survey, 2006.*" U.S. Department of Agriculture, Agricultural Marketing Service. 2009. <http://dx.doi.org/10.9752/MS037.05-2009> (accessed April 2014).
- Ragland, E., V. Lakins, and C. Coleman. "*Results of Dot Survey: USDA Outdoor Farmers Market, Washington, D.C.*" U.S. Department of Agriculture, Agricultural Marketing Service. September 2011. <http://dx.doi.org/10.9752/MS43.09-2011> (accessed April 2014).
- Rao, A.V., and L.G. Rao. "Carotenoids and Human Health." *Pharmacological Research* 55 (2007): 207-216.
- Rao, A.V., and S. Agarwal. "Bioavailability and In Vivo Antioxidant Properties of Lycopene from Tomato Products and their Possible Role in the Prevention of Cancer." *Nutrition and Cancer* 31 (1998): 199-203.
- Ratcliffe, J. "The Use of Conjoint Analysis to Elicit Willingness-to-Pay Values." *International Journal of Technology Assessment in Health Care* 16, no. 1 (2000): 270-290.
- Razdan, M.K., and A.K. Mattoo. *Genetic Improvement of Solanaceous Crops*. Vol. 2. NY: Science Publishers, 2007.
- Rexrode, K.M., V.J. Carey, C.H. Hennekens, E.E. Walters, and G.A. Colditz. "Abdominal Adiposity and Coronary Heart Disease in Women." *JAMA* 280 (1998): 1843-1848.
- Rickard, B.J., J. Liukonyte, H.M. Kaiser, and R.J. Richards. "Consumer Response to Commodity-Specific and Broad-Based Promotion Programs for Fruits and

- Vegetables." *American Journal of Agricultural Economics* 93 (2011): 1312-1327.
- Ro, E., and D. Frechette. "The Effect of California Weather Conditions on Price Premia for Organically Grown Vegetables in the United States." *Journal of Food Distribution Research*, 2001.
- Rosa, J.T. "Ripening of Tomatoes." *Proceedings of the American Society for Horticultural Science* 22 (1925): 315-322.
- Rousu, M.C., and J.F. Thrasher. "Demand Reduction from Plain and Pictorial Cigarette Warning Labels: Evidence from Experimental Auctions." *Applied Economic Perspectives and Policy* 35, no. 1 (2012): 171-184.
- Rowland, T.W. "Adolescence: A 'Risk Factor' for Physical Inactivity." *President's Council on Physical Fitness and Sports Research Digest* 3, no. 6 (1999): 1-8.
- Sadler, G., J. Davis, and D. Dezman. "Rapid Extraction of Lycopene and B-carotene from Reconstituted Tomato Paste and Pink Grapefruit Homogenates." *Journal of Food Science* 55 (1990): 1460-1461.
- Salunkhe, D.K., S.J. Jadhav, and M.H. Yu. "Quality and Nutritional Composition of Tomato Fruit as Influenced by Certain Biochemical and Physiological Changes." *Qual. Plant.*, (1974): 85-113.
- Sándor, Z., and P.H. Franses. "Consumer Price Evaluations Through Choice Experiments." *Journal of Applied Econometrics* 24 (2009): 517-535.
- Schechter, L. "The apple and your eye: Visual and taste rank-ordered probit analysis with correlated errors." *Food Quality and Preferences* 21 (2010): 112-120.



- Schutz, H.G., and O.A. Lorenz. "Consumer Preferences for Vegetables Grown Under 'Commercial' and 'Organic' Conditions." *Journal of Food Science* 41 (1976): 70-73.
- Seidell, J.C. "Obesity, Insulin Resistance and Diabetes - A Worldwide Epidemic." *British Journal of Nutrition* 83, no. Suppl.1 (2000): S5-S8.
- Seidell, J.C. "The Impact of Obesity on Health Status: Some Implications for Health Care Costs." *International Journal of Obesity* 19 (1995): S13-S16.
- Seidell, J.C., and A. Rissanen. *Time Trends in the Worldwide Prevalence of Obesity*. Edited by New York: Dekker, 1997.
- Seip, K., and J. Strand. "Willingness to Pay for Environmental Goods in Norway: A Contingent Valuation Study with Real Payments." *Environmental Resource Economics* 2 (1992): 91-106.
- Seymour, G.B., J.E. Taylor, and G.A. Tucker. *Biochemistry of Fruit Ripening*. London: Chapman and Hall, 1993.
- Shah, B.M., D.K. Salunkhe, and L.E. Olson. "Effects of Ripening Processes on Chemistry of Tomato Volatiles." *Journal of American Society for Horticultural Science* 94 (1967): 171-176.
- Shepherd, R., M. Magnusson, and P. Sjoden. "Determinants of Consumer Behavior Related to Organic Foods." *AMBIO: A Journal of the Human Environment* 4 (2005): 352-359.
- Shogren, J.F., et al. "Auction Mechanisms and the Measurement of WTP and WTA." *Resource and Energy Economics* 23 (2001): 97-109.

- Shogren, J.F., J.A. Fox, D.J. Hayes, and J.B. Kliebenstein. "Bid Sensitivity and the Structure of the Vickrey Auction." *American Journal of Agricultural Economics* 76 (1994): 1086-1095.
- Shogren, J.F., J.A. List, and D.J. Hayes. "Preference Learning in Consecutive Experimental Auctions." *American Journal of Agricultural Economics* 82 (2000): 1016-1021.
- Shogren, J.F., S.Y. Shin, D.J. Hayes, and J.B. Kliebenstein. "Resolving Differences in Willingness to Pay and Willingness to Accept." *American Economic Review* 84 (1994): 255-270.
- Sjöström, L., et al. "Lifestyle, Diabetes and Cardiovascular Risk Factors 10 Years after Bariatric Surgery." *The New England Journal of Medicine* 351 (2004): 2683-2693.
- Snyder, C., and W. Nicholson. *Microeconomic Theory*. 10th. Mason, OH: Thomson South-Western, 2008.
- Soler, F., J.M. Gil, and M. Sanchez. "Consumer's Acceptability of Organic Food in Spain. Results from an Experimental Auction Market." *British Food Journal* 104, no. 8 (2002): 670-687.
- Stevens, M.A. "Inheritance of Tomato Fruit Quality Components." In *Plant Breeding Reviews*, by J. Janick, 273-311. Westport: Avi Publishing Co., 1986.
- Stommel, J.R. USDA 97L63, 97L66, and 97L97. "Tomato Breeding Lines with High Fruit Beta-carotene Content." *HortScience* 36 (2001): 387-388.

- Suryanata, K. "Products for Paradise: The Social Construction of Hawaii Crops." *Agriculture and Human Values* 17 (1999): 181-189.
- Swamy, P.A. "Efficient Inference in a Random Coefficient Regression Model." *Econometrica* 38 (1970): 311-323.
- Taylor, I.B. "Biosystematics of the Tomato." In *The Tomato Crop*, by J. Atherton and J. Rudich, 1-34. NY: Chapman and Hall, 1986.
- Temple, S. *The Transition from Conventional to Low-Input or Organic Farming Systems: Soil Biology, Soil Chemistry, Soil Physics, Energy Utilization, Economics, and Risk*. Sustainable Agriculture Research and Education Program, University of California, 2000.
- Thaler, R. "Toward a Positive Theory of Consumer Choice." *Journal of Economic Behavior and Organization* 1 (1980): 39-60.
- The Packer. "*Fresh Trends: Profile of the Fresh Produce Consumer.*" 2002.
- The Produce News. *Hothouse Tomato Market has been Anything but Hot this Season*. Englewood Cliffs, NJ, 1999.
- Thilmany, D., C.A. Bond, and J.K. Bond. "Going Local: Exploring Consumer Behavior and Motivations for Direct Food Purchases." *American Journal of Agricultural Economics* 90 (2008): 1303-1309.
- Thompson, G.D. "Consumer Demand for Organic Foods: What We Know and What We Need to Know." *American Journal of Agricultural Economics* 80 (1998): 1113-1118.

- Thompson, G.D., and P.N. Wilson. "The Organizational Structure of the North American Fresh Tomato Market: Implications for Seasonal Trade Disputes." *Agribusiness: An International Journal* 13 (1997): 533-547.
- Thompson, K.A., M.R. Marshall, C.A. Sims, C.I. Wei, S.A. Sargent, and J.W. Scott. "Cultivar, Maturity, and Heat Treatment on Lycopene Content in Tomatoes." *Journal of Food Science* 65, no. 5 (2000): 791-795.
- Thornsbury, S., and A. Jerardo. "Low Prices Continue for Fresh-Market Vegetables." Vegetables and Pulses Outlook. Economic Research Service, USDA. June 2012. <http://www.ers.usda.gov/publications/vgs-vegetables-and-pulses-outlook/vgs-350.aspx> (Accessed April 2014).
- Tobin, J. "Estimation of Relationships for Limited Dependent Variables." *Econometrica* 26, no. 1 (1958): 24-36.
- Tomek, W.G. "Confirmation and Replication in Empirical Econometrics: A Step Toward Improved Scholarship." *American Journal of Agricultural Economics* 75 (1993): 6-14.
- Train, K. *Discrete Choice Methods with Simulation*. 2nd. New York: Cambridge University Press, 2009.
- Truffer, C.J., et al. "Health Spending Projections Through 2019: The Recession's Impact Continues." *Health Affairs* 29, no. 3 (2010): 522-529.
- Tversky, A., and D. Kahneman. "Advances in Prospect Theory: Cumulative Representation of Uncertainty." *Journal of Risk and Uncertainty* 5 (1992): 297-323.

Umberger, W.J., D.M. Feuz, C.R. Calkins, and K. Killinger-Mann. "U.S. Consumer Preference and Willingness-to-Pay for Domestic Corn-Fed Beef versus International Grass-Fed Beef Measured Through an Experimental Auction." *Agribusiness: An International Journal* 18 (2002): 491-504.

Unnevehr, L., J. Eales, H. Jensen, J. Lusk, J. McCluskey, and J Kinsey. "Food and Consumer Economics." *American Journal of Agricultural Economics* 92, no. 2 (2010): 506-521.

U.S. Department of Agriculture. Agricultural Marketing Service. "*Fruit and Vegetable Market News*." Tomato Report. May 2014.

[http://www.marketnews.usda.gov/portal/fv?paf\\_dm=full&paf\\_gear\\_id=1200002&startIndex=1&dr=1&rowDisplayMax=25&displaySort=&repType=retail&portal=fv&class=&commName=TOMATOES&commAbr=TOM&resultSetItems=YES&region=NATIONAL&organic=ALL&repDate=&compareLy=No&x=13&y=12](http://www.marketnews.usda.gov/portal/fv?paf_dm=full&paf_gear_id=1200002&startIndex=1&dr=1&rowDisplayMax=25&displaySort=&repType=retail&portal=fv&class=&commName=TOMATOES&commAbr=TOM&resultSetItems=YES&region=NATIONAL&organic=ALL&repDate=&compareLy=No&x=13&y=12) (accessed May 2014).

U.S. Department of Agriculture. Agricultural Marketing Service. "*National Organic Program*." 2013a. <http://www.ams.usda.gov/AMSV1.0/NOPOrganicStandards> (accessed April 2014).

U.S. Department of Agriculture. Agricultural Marketing Service. "*Farmers Markets and Local Food Marketing*." 2013b.

<http://www.ams.usda.gov/AMSV1.0/ams.fetchTemplateData.do?template=TemplateS&navID=WholesaleandFarmersMarkets&leftNav=WholesaleandFarmersMa>

rkets&page=WFMFarmersMarketGrowth&description=Farmers%20Market%20Growth&acct=frmdirmkt (accessed April 2014).

U.S. Department of Agriculture. Economic Research Service. “*North American Fresh-Tomato Market.*” March 2013c. <http://www.ers.usda.gov/topics/in-the-news/north-american-fresh-tomato-market.aspx#.UycrjT9dV8E> (accessed March 2014).

U.S. Department of Agriculture. Economic Research Service. “*How Much Do Americans Pay for Fruits and Vegetables.*” n.d. [http://www.ers.usda.gov/media/303025/aib790d\\_1\\_.pdf](http://www.ers.usda.gov/media/303025/aib790d_1_.pdf) (accessed April 2014).

U.S. Department of Agriculture. Economic Research Service. Crops, Vegetables & Pulses. “*Tomatoes.*” 2012. <http://www.ers.usda.gov/topics/crops/vegetables-pulses/tomatoes.aspx#.U0W7G6hdV8E> (accessed April 2014).

U.S. Department of Agriculture. “*Tomatoes, Red, Raw, Ripe.*” USDA National Nutrient Database for Standard Reference, Release 26. 2011. <http://ndb.nal.usda.gov/ndb/foods/show/3270> (accessed April 2014).

U.S. Department of Health and Human Services. “*Dietary Guidelines for Americans.*” 2010. <http://www.cnpp.usda.gov/DGAs2010-PolicyDocument.htm> (accessed April 2014).

Vainio, H., and F. Bianchini. “International Agency for Cancer handbook of cancer prevention.” Vol. 6, in *Weight control and physical activity*. Lyon: IARC, 2002.

- Verbeke, W., R.W. Ward, and J. Viaene. "Probit Analysis of Fresh Meat Consumption in Belgium: Exploring BSE and Television Communication Impact." *Agribusiness* 16, no. 2 (2000): 215-234.
- Vickrey, W. "Counterspeculation, Auctions and Competitive Sealed Tenders." *Journal of Finance* 16 (1961): 8-37.
- Visscher, T., and J.C. Seidell. "Public Health Impact of Obesity." *Annual Review of Public Health* 22 (2001): 355-375.
- Vogtmann, H. "From Healthy Soil to Healthy Food: An Analysis of the Quality of Food Produced under Contrasting Agricultural Systems." *Journal of Nutrition and Health* 6 (1988): 21-35.
- Walz, E. "Final Results of the Fourth National Organic Farmers' Survey: Sustaining Organic Farms in a Changing Organic Marketplace." Organic Farming Research Foundation, Santa Cruz, California, 2004.  
[http://ofrf.org/sites/ofrf.org/files/docs/pdf/4thsurvey\\_results.pdf](http://ofrf.org/sites/ofrf.org/files/docs/pdf/4thsurvey_results.pdf) / (accessed April 2014).
- Wang, T.J., et al. "Obesity and the Risk of New-onset Atrial Fibrillation." *JAMA* 292 (2004): 2471-2477.
- Wang, W., and J. Sun. "Consumer Preference and Demand for Organic Food: Evidence from a Vermont Survey." AAFA Annual Meeting, Montreal, Canada, 2013.
- Wang, Y., and M.A. Beydoun. "The Obesity Epidemic in the United States-Gender, Age, Socioeconomic, Racial/Ethnic, and Geographic Characteristics: A

- Systematic Review and Meta-Regression Analysis." *Epidemiologic Review* 29 (2007): 6-28.
- Wang, Y., C. Monteiro, and B.M. Popkin. "Trends of Obesity and Underweight in Older Children and Adolescents in the United States, Brazil, China, and Russia." *The American Journal of Clinical Nutrition* 75 (2002): 971-977.
- Weaver, R.D., D.J. Evans, and A.E. Luloff. "Pesticide Use in Tomato Production: Consumer Concerns and Willingness-to-Pay." *Agribusiness* 8, no. 2 (1992): 131-142.
- Weibel, F.P., R. Bickel, S. Leuthold, T. Alfoldi, and U. Niggli. "Are Organically Grown Apples Tastier and Healthier? A Comparative Field Study using Conventional and Alternative Methods to Measure Fruit Quality." *IFOAM*, 1999: 147-153.
- Wertenbroch, K., and B. Skiera. "Measuring Consumer's Willingness to Pay at the Point of Purchase." *Journal of Marketing Research* 39 (2002): 228-241.
- Whole Foods Market. "Nearly Two-Thirds of Americans have Tried Organic Foods and Beverages." November 2005. <http://media.wholefoodsmarket.com/news/nearly-two-thirds-of-americans-have-tried-organic-foods-and-beverages> (accessed April 2014).
- Williams, P.R., and J.K. Hammit. "A Comparison of Organic and Conventional Fresh Produce Buyers in the Boston area." *Risk Analysis* 20, no. 5 (2000): 735-746.
- Winter, C.K., and S.F. Davis. "Organic Foods." *Journal of Food Science* 71, no. 9 (2006): R117-R124.



- Woese, K., D. Lange, C. Boess, and K. Werner. "A Comparison of Organically and Conventionally Grown Foods-Results of a Review of the Relevant Literature." *Journal of the Science of Food and Agriculture* 74 (1997): 281-293.
- Wooldridge, J.M. *Econometric Analysis of Cross Section and Panel Data*. 2. Vol. 1. London, England: The MIT Press, 2010.
- Wooldridge, J.M. *Introductory Econometrics: A Modern Approach*, 4<sup>th</sup> ed., South Western / Cengage Learning, 2009.
- Wooldridge, J.M. "Thoughts on Heterogeneity in Econometric Models." *Presidential Address at MEA anual meeting*. St. Louis MO, 2011.
- World Health Organization, WHO. "Global Startegy on Diet, Physical Activity and Health." *The Role of the Private Sector*. 2014b.  
[http://www.who.int/dietphysicalactivity/childhood\\_private\\_sector/en/](http://www.who.int/dietphysicalactivity/childhood_private_sector/en/) (accessed April 2014).
- . "Media Centre." *Obesity and Overweight*. 2014a.  
<http://www.who.int/mediacentre/factsheets/fs311/en/> (accessed April 2014).
- World Health Organization, WHO. *"Obesity-Preventing and Managing the Global Epidemic."* Geneva, Switzerland, 1997.
- Worthington, V. "Nutritional Quality of Organic versus Conventional Fruits, Vegetables, and Grains." *Journal of Alternative and Complementary Medicine* 7 (2001): 161-173.

- Yiridoe, E.K., S Bonti-Ankomah, and R.C. Martin. "Organic and Conventionally Food: A Literature Review of the Economics of Consumer Perceptions and Preferences." 2006.
- Young, LR., and M. Nestle. "The Contribution of Expanding Portion Sizes to the US Obesity Epidemic." *American Journal of Public Health* 92 (2002): 246-249.
- Yue, C., F. Alfnes, and H. Jensen. "Discounting Spotted Apples: Investigating Consumers' Willingness to Accept Cosmetic Damage in an Organic Product." *Journal of Agricultural and Applied Economics* 41 (2009): 29-46.
- Zhao, J., and C.L. Kling. "Willingness-to-Pay, Compensating Variation, and the Cost of Commitment." *Economic Inquiry* 42 (2004): 503-571.
- Zhao, X., E. Chambers, Z. Matta, M. Loughin, and E. Carey. "Consumer Sensory Analysis of Organically and Conventionally Grown Vegetables." *Journal of Food Science* 72, no. 2 (2007): 87-91.

## APPENDIX A

### NEWSPAPER ADVERTISEMENT

# ATTENTION GROCERY SHOPPERS!

The Dept. of Agricultural Economics at Texas A&M University is looking for individuals to participate in a study on vegetable purchasing decisions. Participants are needed for either November 30, December 1 and 3, 2012. The study will take place on the campus of Texas A&M University.

---

Besides an opportunity to contribute to a scientific research project, participants will be awarded a payment of **\$30** for their participation. To participate, you must be at least 18 years of age. Participation in the study will take approximately 1 hour.

---

The study includes tomato tasting. If you have a known tomato allergy, you may not participate in this study.

Participation in the study is completely voluntary.

---

If you are interested in participating in this study, please contact **TAMUMarketing@gmail.com** or (979) 402-9324 to sign up for the most convenient session.

## APPENDIX B

### EXPERIMENTAL AUCTION QUESTIONNAIRE

# Decision-Making for Vegetable Purchases



#### INSTRUCTIONS

Please, do not turn the page until directed to do so.

Failure to follow the instructions outlined here may result in a session monitor asking you to leave. If this occurs, any compensation for your participation will be forfeited.

Participant ID Number:



## **Introductory Instructions**

Welcome! Thank you for agreeing to participate in today's session.

When you entered the room you received this **packet of information**. You should have also been assigned a participant **ID number**, located on the front page of this packet of information. You should use this ID number to identify yourself throughout the session today. The use of identification numbers ensures individual confidentiality.

As a reminder before we start today's session, your participation is **completely voluntary**. At any time you may elect to end your participation in the session. However, in order to receive the participation fee you must complete the session. All information collected today will be kept confidential and will not be used for any purpose other than this research.

**The purpose of today's session is to gather some general information on the decision making process for purchasing vegetables.** We will now go through a series of instructions. These instructions will be read from a script to make sure the procedures are accurately described. There will be an opportunity for questions once we go through the instructions.

**For the rest of today's session, it is very important that there be no further talking or other communication between participants.** If you have questions or comments, please inform a session monitor. If you are not able to comply with these requests you may be disqualified from the experiment.

If you have any questions, please direct them to a session monitor who will gladly answer them.

Again, thank you for your participation.

## Overview

\*\*\*Please follow all instructions presented in this booklet carefully. If you have any questions, please ask a session monitor.

The purpose of today's experiment is to help us understand purchasing decisions for vegetables and vegetable products. To accomplish this purpose, you will be asked to complete a survey and submit bids for several items. This is a real experiment; if you are one of the buyers of the auctions, you will pay the auction price and in exchange you will receive the item. You will be given more information on the auction procedures shortly.

The experiment will proceed in several stages as described below.

**STAGE 1:** Learn How Bids Are Submitted

**STAGE 2:** Learn How Prices and Buyers of the Auction Are Determined

**STAGE 3:** First Practice Round

**STAGE 4:** Complete Short Knowledge Quiz

**STAGE 5:** Second Practice Round

**STAGE 6:** Submit Bids for Vegetable Products

**STAGE 7:** Complete Survey

**STAGE 8:** Determine Auction Buyers

**STAGE 9:** Receive Payment

If you have not already done so, please review and sign the Consent Form. Please leave the portion for the "Signature of the Person Obtaining Consent" blank. You will be provided with a copy of this document.

## STAGE 1: Learn How Bids Are Submitted

The Auction: The auction that you will participate in today is called a “sealed bid 2<sup>nd</sup>-price auction”.

1. You will examine the products that will be auctioned.  
You will be given the opportunity to re-evaluate each item if you would like to do so.
2. **Write down** your bid.  
Your bid is the **maximum amount of money** that you would be **willing to pay** for each item on the “Bid Sheet.”
3. Return to your seat and wait for the Bid Sheets to be collected.

## STAGE 2: Learn How the Auction Price and Buyers Are Determined

How The Auction Price is Determined: Today you will be participating in a sealed bid 2<sup>nd</sup>-price auction. Determining the market price:

After all the bids for the items have been collected from all participants, we will sort the bids from highest to lowest. The 2<sup>nd</sup> highest bid will be the **market price**. The highest bidder will pay the market price for the product.

How Buyers are Determined:

### 1. Auction Buyers:

You will participate in more than one round of auctions today. However, we will select at random which one of these rounds will be binding. All rounds have an equal chance of being drawn. Once the binding round is drawn, a single product from that round will be selected. **Therefore, you will only have a chance to purchase one vegetable item from today's session.**

For the round that is binding, the person who bid the highest price will purchase the item at the market price. This buyer will pay the market price for that round, which will be deducted from the participation fee, and will take home the product.

**IMPORTANT REMINDERS: For the auction it is in your best interest to truthful bid your value.**

*\*Remember, in the auction it is in your best interest to submit a bid of EXACTLY your true value for the good.* If you submit a bid for less than your value, you may end up not winning the auction even though you could have bought the item at a price you were actually willing to pay. If you submit a bid for more than you value the item, then you may end up having to buy the item at a price that is more than you really want to pay.

*\* The practice rounds are hypothetical, but the auction rounds for vegetable products are not.* The buyer of the auction will actually pay money and in exchange receive the vegetable item.

*\* When deciding on your bid, consider the alternatives for what you could spend that much money on.* For example, if you did not buy the product up for auction, how many gallons of gas could you purchase with the amount you bid? Consider other options when deciding what your true value is for that good.

*\* You may bid any value for the item.*

*\*You will not buy more than one vegetable item from this market.* We will randomly select one round and one product to be binding.

*\*One session participant will take home ONE vegetable product today.* There will be a session participant who will buy a product based on the auction bids.





Please do not read any further until instructed to do so by the session monitor. Your cooperation is greatly appreciated!

### **STAGE 3: First Practice Round of Auction**

#### **INSTRUCTIONS:**

In this stage you will participate in the first hypothetical practice round. First you will be asked to bid on three types of pens. The practice round will proceed as follows:

1. When instructed by a session monitor, you may go to the tables to examine each product. Please do not talk to other participants during bidding. We will be happy to answer any of your questions.
2. On the practice-bidding sheet, you will write down your bid for each item. Then, return to your seat.
3. Wait until a session monitor collects the practice-bidding sheets.

While you wait for the price and buyers of this practice round to be determined, you will complete a short knowledge about the auction procedures. The knowledge quiz starts on the next page (8).

## STAGE 4: Short Knowledge Quiz

### INSTRUCTIONS:

This is a brief quiz designed for you to check your understanding of how the auctions operate. Please choose the correct answer. Once all participants have completed the quiz, we will go over the answers together.

### About the Auction:

1. In a sealed bid 2<sup>nd</sup>-price auction, the highest bidder is the buyer of the item.
  - a. True
  - b. False
  
2. The buyer of the auction for the binding round and product will pay the amount he/she bid for the item.
  - a. True
  - b. False
  
3. More than one round of bidding on several products will be done today, but only one round and one product will be randomly selected to be binding.
  - a. True
  - b. False
  
4. There will be the opportunity to actually purchase and take home more than one vegetable product today.
  - a. True
  - b. False



Please do not read any further until instructed to do so by the session monitor. Your cooperation is greatly appreciated!

## **STAGE 5: Second Practice Round of Auction**

### **INSTRUCTIONS:**

You have completed half of the practice. Now you will be asked to bid on four types of glue products. The stage will proceed as follows:

1. When instructed by a session monitor, you may go to the tables to examine each product. Please do not talk to other participants during bidding. We will be happy to answer any of your questions.
2. On the practice-bidding sheet, you will write down your bid for each item. Then, return to your seat.
3. Wait until a session monitor collects the practice-bidding sheets.



Please do not read any further until instructed to do so by the session monitor. Your cooperation is greatly appreciated!

## **STAGE 6: VEGETABLE AUCTIONS**

Thank you for participation so far. The next auction rounds will be for several vegetable products, but only one of the rounds will be binding. The binding round will be selected at random after all rounds have been completed.

**INSTRUCTIONS:** The stage will proceed as follows:

1. When instructed to do so, you may go to the tables to examine each product. Please do not talk to other participants during bidding. The monitor will be happy to answer any of your questions.
2. On the bidding sheet, write down your bid for each item. Then, return to your seat.
3. Wait until a session monitor collects your sheets.

Please do not turn the page until directed to do so. We will repeat the auction procedure whenever indicated.

The market price for the binding vegetable auction will not be posted until the end of today's session.



Please do not read any further until instructed to do so by the session monitor. Your cooperation is greatly appreciated!



## **TASTING REPORT**

### **INSTRUCTIONS:**

1. Taste samples from left to right following the order of the sample code.
2. Mark with an “X” the appropriate box according to your evaluation for the attributes of appearance, color, smell, taste, freshness and overall acceptance.  
1= Extremely Dislike  
9= Extremely Like
3. You can find crackers and water in the table to rinse your palate between each sample.

If you have any questions, please direct them to a session monitor who will gladly answer them.

Date: December, 2012

Participant ID:

**Sample: 1**

**Appearance**

1      2      3      4      5      6      7      8      9

Extremely  
Dislike

Neither like /  
Nor dislike

Extremely  
Like

**Color**

1      2      3      4      5      6      7      8      9

Extremely  
Dislike

Neither like /  
Nor dislike

Extremely  
Like

**Smell**

1      2      3      4      5      6      7      8      9

Extremely  
Dislike

Neither like /  
Nor dislike

Extremely  
Like

**Taste**

1      2      3      4      5      6      7      8      9

Extremely  
Dislike

Neither like /  
Nor dislike

Extremely  
Like

**Freshness**

1      2      3      4      5      6      7      8      9

Extremely  
Dislike

Neither like /  
Nor dislike

Extremely  
Like

**Overall Acceptance**

1      2      3      4      5      6      7      8      9

Extremely  
Dislike

Neither like /  
Nor dislike

Extremely  
Like

Date: December, 2012

Participant ID:

**Sample: 2**

**Appearance**

1      2      3      4      5      6      7      8      9

Extremely  
Dislike

Neither like /  
Nor dislike

Extremely  
Like

**Color**

1      2      3      4      5      6      7      8      9

Extremely  
Dislike

Neither like /  
Nor dislike

Extremely  
Like

**Smell**

1      2      3      4      5      6      7      8      9

Extremely  
Dislike

Neither like /  
Nor dislike

Extremely  
Like

**Taste**

1      2      3      4      5      6      7      8      9

Extremely  
Dislike

Neither like /  
Nor dislike

Extremely  
Like

**Freshness**

1      2      3      4      5      6      7      8      9

Extremely  
Dislike

Neither like /  
Nor dislike

Extremely  
Like

**Overall Acceptance**

1      2      3      4      5      6      7      8      9

Extremely  
Dislike

Neither like /  
Nor dislike

Extremely  
Like

Date: December, 2012

Participant ID:

**Sample: 3**

**Appearance**

1	2	3	4	5	6	7	8	9
Extremely Dislike			Neither like / Nor dislike			Extremely Like		

**Color**

1	2	3	4	5	6	7	8	9
Extremely Dislike			Neither like / Nor dislike			Extremely Like		

**Smell**

1	2	3	4	5	6	7	8	9
Extremely Dislike			Neither like / Nor dislike			Extremely Like		

**Taste**

1	2	3	4	5	6	7	8	9
Extremely Dislike			Neither like / Nor dislike			Extremely Like		

**Freshness**

1	2	3	4	5	6	7	8	9
Extremely Dislike			Neither like / Nor dislike			Extremely Like		

**Overall Acceptance**

1	2	3	4	5	6	7	8	9
Extremely Dislike			Neither like / Nor dislike			Extremely Like		

Date: December, 2012

Participant ID:

**Sample: 4**

**Appearance**

1      2      3      4      5      6      7      8      9

Extremely  
Dislike

Neither like /  
Nor dislike

Extremely  
Like

**Color**

1      2      3      4      5      6      7      8      9

Extremely  
Dislike

Neither like /  
Nor dislike

Extremely  
Like

**Smell**

1      2      3      4      5      6      7      8      9

Extremely  
Dislike

Neither like /  
Nor dislike

Extremely  
Like

**Taste**

1      2      3      4      5      6      7      8      9

Extremely  
Dislike

Neither like /  
Nor dislike

Extremely  
Like

**Freshness**

1      2      3      4      5      6      7      8      9

Extremely  
Dislike

Neither like /  
Nor dislike

Extremely  
Like

**Overall Acceptance**

1      2      3      4      5      6      7      8      9

Extremely  
Dislike

Neither like /  
Nor dislike

Extremely  
Like

Date: December, 2012

Participant ID:

**Sample: 5**

**Appearance**

1	2	3	4	5	6	7	8	9
Extremely Dislike			Neither like / Nor dislike			Extremely Like		

**Color**

1	2	3	4	5	6	7	8	9
Extremely Dislike			Neither like / Nor dislike			Extremely Like		

**Smell**

1	2	3	4	5	6	7	8	9
Extremely Dislike			Neither like / Nor dislike			Extremely Like		

**Taste**

1	2	3	4	5	6	7	8	9
Extremely Dislike			Neither like / Nor dislike			Extremely Like		

**Freshness**

1	2	3	4	5	6	7	8	9
Extremely Dislike			Neither like / Nor dislike			Extremely Like		

**Overall Acceptance**

1	2	3	4	5	6	7	8	9
Extremely Dislike			Neither like / Nor dislike			Extremely Like		

Date: December, 2012

Participant ID:

**Sample: 6**

**Appearance**

1	2	3	4	5	6	7	8	9
Extremely Dislike			Neither like / Nor dislike			Extremely Like		

**Color**

1	2	3	4	5	6	7	8	9
Extremely Dislike			Neither like / Nor dislike			Extremely Like		

**Smell**

1	2	3	4	5	6	7	8	9
Extremely Dislike			Neither like / Nor dislike			Extremely Like		

**Taste**

1	2	3	4	5	6	7	8	9
Extremely Dislike			Neither like / Nor dislike			Extremely Like		

**Freshness**

1	2	3	4	5	6	7	8	9
Extremely Dislike			Neither like / Nor dislike			Extremely Like		

**Overall Acceptance**

1	2	3	4	5	6	7	8	9
Extremely Dislike			Neither like / Nor dislike			Extremely Like		



Please do not read any further until instructed to do so by the session monitor. Your cooperation is greatly appreciated!





- c.  Roadside Fruit and Vegetable Stand
- d.  Farmers' Market
- e.  Other (Please \_\_\_\_\_ Indicate  
: \_\_\_\_\_)

**6. LAST PURCHASE OF FRUIT AND VEGETABLES: When was the last time someone in your household purchased fruits and vegetables?**

- a.  Less than 2 days ago
- b.  2-4 days ago
- c.  5-7 days ago
- d.  8- 10 days ago
- e.  11-14 days ago
- f.  More than 2 weeks ago

**7. FREQUENCY OF FRUIT AND VEGETABLE PURCHASES: How often does your household purchase fresh fruits and vegetables?**

- a.  Less than once a month
- b.  Once a month
- c.  Two to three times / month
- d.  Once a week
- e.  More than once a week

**8. FRESH VEGETABLES ON HAND: Please estimate the amount of FRESH VEGETABLES that you currently have on hand in your home as a percentage of your full stock.**

- a.  0%
- b.  1-24%
- c.  25-49%
- e.  50-74%
- f.  75-100%

How important are the following factors to you when making tomato purchasing decision? (Please select only one level of importance per row).				
	Not Important At All	Not Very Important	Somewhat Important	Very Important
9. PRICE				
10. TASTE				
11. NUTRITION				
12. CONVENIENCE				
13. VISUAL APPEARANCE				
14. SIZE				
15. FRESHNESS				
16. GROWING LOCATION				
17. CERTIFIED PRODUCTION PRACTICES				

18. How often do you exercise? (Include only periods of exercise longer than 20 minutes).

- a. \_\_\_ Never
- b. \_\_\_ Once a month
- c. \_\_\_ Once a week
- d. \_\_\_ 2-3 times per week
- d. \_\_\_ 4-6 times per week
- e. \_\_\_ Once a day
- f. \_\_\_ More than once a day

19. How often do you participate in extreme sports?

(Extreme sports include bungee-jumping, para-gliding, parachute jumping, gliding, rafting, diving and other dangerous sports.)

- a. \_\_\_ Never
- b. \_\_\_ A few times
- c. \_\_\_ Occasionally
- d. \_\_\_ Often
- e. \_\_\_ Every chance I get

20. Do you currently smoke cigarettes?

- a. \_\_\_ Yes
- b. \_\_\_ No

**21. Do you currently have any serious health issues (including any conditions which require regular doctor visits and/or prescription medication)?**

- a.  Yes
- b.  No (Skip to question 24)

**22. If you have health issues that you would consider serious, are any of them nutrition related?**

- a.  Yes
- b.  No

**23. If you have health issues that you would consider serious, do any of them require specific diet?**

- a.  Yes
- b.  No

**24. Have you ever experienced food poisoning from consuming fruits and vegetables?**

- a.  Yes
- b.  No
- c.  Don't Know

**25. Do you believe there are benefits of consuming fruits and vegetables that have been certified for appropriate food safety?**

- a.  Yes
- b.  No
- c.  Don't Know/Not Sure

**26. AGE: Please indicate your age in years:**

- a.  18-25
- b.  26-34
- c.  35-44
- d.  45-54
- e.  55-64
- f.  65 or more

**27. WEIGHT: Please indicate your weight in kilograms:**

- a.  Kg

**28. HEIGHT: Please indicate your height in feet:**

- a.  ft.  in

**29. WEIGHT PERCEPTION:** Please mark an “X” below the corresponding category that indicates your nutritional status.

<b>Category</b>	<b>"X"</b>
Severely Obese	
Moderately Obese	
Overweight	
Normal	
Underweight	
Severely Underweight	

**30. EDUCATION:** Please indicate the highest level of education you have completed:

- |                                  |                                  |
|----------------------------------|----------------------------------|
| a. ___ Some High School or less  | e. ___ 4 year/ Bachelor’s Degree |
| b. ___ High School Diploma       | f. ___ Some Graduate School      |
| c. ___ Some College              | g. ___ Graduate Degree           |
| d. ___ 2 year/ Associates Degree |                                  |

**31. HOUSEHOLD SIZE:** Including yourself, how many people live in your household?

- a. \_\_\_ People

**32. CHILDREN:** How many children live in your household, if any?

- a. \_\_\_ Children

**33. GENDER:** Please indicate your gender:

- |               |             |
|---------------|-------------|
| a. ___ Female | b. ___ Male |
|---------------|-------------|

**34. RACE:** Please indicate your race:

- a. \_\_\_ Asian/Pacific Islander
- b. \_\_\_ African American
- c. \_\_\_ Caucasian/White
- d. \_\_\_ Native American/ Indigenous
- e. \_\_\_ Hispanic
- f. \_\_\_ Other (Please List: )

**35. MARITAL STATUS:** What is your current marital status?

- |               |                |
|---------------|----------------|
| a. ___ Single | b. ___ Married |
|---------------|----------------|

**36. INCOME: Please indicate your household yearly income for 2012.** (Include all forms of income, including salary, interest and dividend payments, tips, scholarship support, student loans, parental support, social security, child support, and allowance).

- |  |   |
|--|---|
| a. <input type="checkbox"/> Less than \$30,000 | f. <input type="checkbox"/> \$70,000-\$79,999   |
| b. <input type="checkbox"/> \$30,000-\$39,999  | g. <input type="checkbox"/> \$80,000-\$89,999   |
| c. <input type="checkbox"/> \$40,000-\$49,999  | h. <input type="checkbox"/> \$90,000-\$99,999   |
| d. <input type="checkbox"/> \$50,000-\$59,999  | i. <input type="checkbox"/> \$100,000-\$149,999 |
| e. <input type="checkbox"/> \$60,000-\$69,999  | j. <input type="checkbox"/> More than \$150,000 |

**37. EMPLOYMENT: Which of these best describes your employment status?**

- |   |                                      |
|---|--------------------------------------|
| a. <input type="checkbox"/> Unemployed          | e. <input type="checkbox"/> Retired  |
| b. <input type="checkbox"/> Stay-at-Home Parent | f. <input type="checkbox"/> Disabled |
| c. <input type="checkbox"/> Part-time Employed  | g. <input type="checkbox"/> Student  |
| d. <input type="checkbox"/> Full-time Employed  |                                      |

**38. What do you plan to do with the money you will receive today?**

- a.  Spend 25% or less and save the rest
- b.  Spend 26-50% and save the rest
- c.  Spend 51-75% and save the rest
- d.  Spend more than 75% and save the rest
- e.  Spend 100% when you receive the money

**39. Please consider the two options below. Which one do you find more attractive?**

- a.  Receive \$100
- b.  1% probability of winning \$10000 dollars and a 99% probability of winning \$0
- c.

**40. Please consider the two options below. Which of these two options do you find more attractive?**

- a.  Receive \$250 today
- b.  Receive \$300 in a month

**41. How often do you find yourself short of cash between paychecks?**

- |  |  |
|--|--|
| a. <input type="checkbox"/> Every time       | e. <input type="checkbox"/> Almost never |
| b. <input type="checkbox"/> 3 out of 4 times |  |
| c. <input type="checkbox"/> 2 out of 4 times |  |
| d. <input type="checkbox"/> 1 out of 4 times |  |

**42. Please, provide any additional comments about today's experience:**

## ***Thank you for your participation!***

*Your responses are very important for us. A session monitor will collect your questionnaire.*



*Please do not discuss the procedures of today's study with anyone who will be participating in later rounds of the study until after they have completed their session. This will help ensure the validity of our results.*

*Shortly, you will receive your participation fee minus any purchases. Please wait for further instructions.*

**BIDDING SHEETS**

**STAGE 3: PRACTICE ROUND 1: Pen Bidding**

INSTRUCTIONS: Please indicate the maximum amount that you would be willing to pay for each of these items. Write the amount of your bid (in dollars and cents) in the "Bid" column in the chart below.

<b>A. PAPER MATE PEN</b>	<b>B. PILOT B2P PEN</b>	<b>C. BIC PEN</b>
BID:\$_____	BID:\$_____	BID:\$_____

---

**STAGE 5: PRACTICE ROUND 2: Glue Bidding**

INSTRUCTIONS: Please indicate the maximum amount that you would be willing to pay for each of these items. Write the amount of your bid (in dollars and cents) in the "Bid" column in the chart below.

<b>A. INSTANT KRAZY GLUE</b>	<b>B. ELMER'S GLUE STICK</b>	<b>C. SCOTCH GLUE GEL</b>	<b>D. ELMER'S CLEAR GLUE</b>
BID:\$_____	BID:\$_____	BID:\$_____	BID:\$_____

---



### **STAGE 6: ROUND 3-A Vegetable Product Bidding**

INSTRUCTIONS: Please indicate the maximum amount that you would be willing to pay for one pound of these items. Write the amount of your bid (in dollars and cents) in the "Bid" column in the chart below. **Please be sure to write a bid for ALL products listed.**

<b>A.</b>	<b>B.</b>	<b>C.</b>	<b>D.</b>	<b>E.</b>	<b>F.</b>
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>BID:\$_____</b>	<b>BID:\$_____</b>	<b>BID:\$_____</b>	<b>BID:\$_____</b>	<b>BID:\$_____</b>	<b>BID:\$_____</b>

---

### **STAGE 6: ROUND 3-B Vegetable Product Bidding**

INSTRUCTIONS: Please indicate the maximum amount that you would be willing to pay for one pound of these items. Write the amount of your bid (in dollars and cents) in the "Bid" column in the chart below. **Please be sure to write a bid for ALL products listed.**

<b>A.</b>	<b>B.</b>	<b>C.</b>	<b>D.</b>	<b>E.</b>	<b>F.</b>
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>BID:\$_____</b>	<b>BID:\$_____</b>	<b>BID:\$_____</b>	<b>BID:\$_____</b>	<b>BID:\$_____</b>	<b>BID:\$_____</b>

---

### STAGE 6: ROUND 3-C Vegetable Product Bidding

INSTRUCTIONS: Please indicate the maximum amount that you would be willing to pay for one pound of these items. Write the amount of your bid (in dollars and cents) in the "Bid" column in the chart below. **Please be sure to write a bid for ALL products listed.**

A.	B.	C.	D.	E.	F.
1	2	3	4	5	6
BID:\$_____	BID:\$_____	BID:\$_____	BID:\$_____	BID:\$_____	BID:\$_____

---

### STAGE 6: ROUND 3-D Vegetable Product Bidding

INSTRUCTIONS: Please indicate the maximum amount that you would be willing to pay for one pound of these items. Write the amount of your bid (in dollars and cents) in the "Bid" column in the chart below. **Please be sure to write a bid for ALL products listed.**

A.	B.	C.	D.	E.	F.
1	2	3	4	5	6
BID:\$_____	BID:\$_____	BID:\$_____	BID:\$_____	BID:\$_____	BID:\$_____

---

## **APPENDIX C**

### **Tomato Health Information**

Much scientific research suggests that there may be health benefits to consuming tomatoes. Lycopene, an antioxidant found in tomatoes, is thought to be mainly responsible for the beneficial properties of tomatoes. The ability of lycopene to act as a potent antioxidant is thought to be responsible for protecting cells against oxidative damage and thereby decreasing the risk of chronic diseases. In addition, lycopene has been shown to induce cell to cell communication and modulate hormonal, immune systems and other metabolic pathways.

Harvard School of Medicine recommended a dietary intake of 10 or more servings of tomato products per week. The health benefits suggested include reduction in disease risk for certain cancers, reduction of cardiovascular diseases, and regulation of cholesterol metabolism.

## APPENDIX D

### Stata Code

```
*-----
* DO FILE TO ANALYZE TOMATO AUCTION DATA
* WTP MODELS FOR FULL BIDS
* MICHELLE S. SEGOVIA
*-----

*LEGEND

* rp = round.product

*Rounds
* =1 Baseline
* =2 Tasting
* =3 Health
* =4 Information

* Products
* =1 Conventional USA
* =2 Conventional Mexico
* =3 Organic USA
* =4 Organic Mexico
* =5 Texas A&M Variety 1
* =6 Texas A&M Variety 2
* =7 Yellow Squash

*-----
* START DO FILE
*-----

clear
cap log close
log using data_tomato, replace
cd "H:\My Documents\RESEARCH\RESEARCH\tomato-stata"

use data_tomato
/*CHANGE THIS PATH TO MATCH THE FILE LOCATION ON YOUR MACHINE*/

reshape long wtp, i(id) j(rp)

*-----
* GENERATED VARIABLES
*-----

*Generate Indicators for Tomato Varieties
gen Org:1= rp==13|rp==23|rp==33|rp==43|rp==14|rp==24|rp==34|rp==44
```

```

gen US:1= rp==11|rp==21|rp==31|rp==41|rp==13|rp==23|rp==33|rp==43
gen Mex:1= rp==12|rp==22|rp==32|rp==42|rp==14|rp==24|rp==34|rp==44
gen Loc1:1= rp==15|rp==25|rp==35|rp==45
gen Loc2:1= rp==16|rp==26|rp==36|rp==46
gen Ysq:1= rp==17|rp==27|rp==37|rp==47
drop if Ysq==1
drop if Loc2==1

```

\*Generate Indicators for Treatments, and Interaction TRT\*PRODUCT

```

gen base:1= (10<rp) & (rp<18)
gen tasting:1= (20<rp) & (rp<28)
gen health:1= (30<rp) & (rp<38)
gen info:1= (40<rp) & (rp<48)

```

```

gen tOrg = tasting*Org
gen tUS = tasting*US
gen tLoc1 = tasting*Loc1
gen tLoc2 = tasting*Loc2
gen tYsq = tasting*Ysq

```

```

gen hOrg = health*Org
gen hUS = health*US
gen hLoc1 = health*Loc1
gen hLoc2 = health*Loc2
gen hYsq = health*Ysq

```

```

gen iOrg = info*Org
gen iUS = info*US
gen iLoc1 = info*Loc1
gen iLoc2 = info*Loc2
gen iYsq = info*Ysq

```

\*Generate age: AGE1 is 18-34, AGE2 is 35-54, AGE3 is 55 or over

```

gen dage1=(age==1 | age==2) if!missing(age)
gen dage2=(age==3|age==4) if!missing(age)
gen dage3=(age==5|age==6) if!missing(age)

```

\*Generate race: RACE1 is American, RACE2 is Hispanic, RACE3 is Other

```

gen drace1= (race==3 | race==4)
gen drace2= (race==5)
gen drace3= (race==1 | race==2 | race==6)

```

\*Generate edu: EDU1 is high school diploma or less, EDU2 is some college-bachelor's degree, EDU3 is some grad school or more

```

gen dedu1=(edu==1 | edu==2) if!missing(edu)
gen dedu2=(edu==3|edu==4|edu==5) if!missing(edu)
gen dedu3=(edu==6|edu==7) if!missing(edu)

```

\*Generate income: INC1 is <50k, INC2 is 50K to <100K, INC3 is 100K or more

```

gen dinc1=(income==1 | income==2|income==3) if!missing(income)
gen dinc2=(income==4|income==5|income==6|income==7|income==8) if!missing(income)
gen dinc3=(income==9|income==10) if!missing(income)

```

```

*recode changes the values of numeric variables according to the rules specified.
*Generate average value of weekly expenditures in fruits and vegetables: ASPENDFV
recode wfv (1=12) (2=37) (3=62) (4=87) (5=100), gen (aspendfv)

*Generate average percentage of fresh vegetables on hand: APVOH
recode freshv (1=0) (2=12.5) (3=37) (4=62) (5=87.5), gen (apvoh)

*Generate exercise: Never=0, Once a Month=12, Once a week= 52, 2-3/week = 130, 4-6/week= 260 ,
once a day=365, more than once a day =730
recode exercise (1=0) (2=12) (3=52) (4=130) (5=260) (6=365) (7=730), gen (dexter)
gen exer=dexter/365*100

-----
*Ordinary Least Squares Model*
*-----
regress wtp Org US Loc1 tasting health info tOrg tUS tLoc1 iOrg iUS iLoc1 dage2 dage3 dedu2 dedu3
hhszize female married dinc2 dinc3 drace2 drace3 aspendfv healthiss smoke exer
estat ic

*-----
*Constant Parameter Tobit Model*
*-----
tobit wtp Org US Loc1 tasting health info tOrg tUS tLoc1 iOrg iUS iLoc1 dage2 dage3 dedu2 dedu3
hhszize female married dinc2 dinc3 drace2 drace3 aspendfv healthiss smoke exer, ll(0) log
margins, dydx(*) predict (e(0,.))
estat ic

*-----
*Random Effects Tobit Model*
*-----
global xlist Org US Loc1 tasting health info tOrg tUS tLoc1 iOrg iUS iLoc1 dage2 dage3 dedu2 dedu3
hhszize female married dinc2 dinc3 drace2 drace3 aspendfv healthiss smoke exer //Define regressor list
$xlist
xtset id
xttobit wtp $xlist, ll(0) log tobit
margins, dydx(*) predict (e(0,.))
estat ic
estimates store Random
xtset, clear

*-----
*Kolmogorov-Smirnov Test
*-----
egen wtp_mu = mean(wtp)
egen wtp_s = sd(wtp)
ksmirnov wtp = normprob((wtp-wtp_mu)/wtp_s) if base==1 & Loc1==1
ksmirnov wtp = normprob((wtp-wtp_mu)/wtp_s) if tasting==1 & Loc1==1
ksmirnov wtp = normprob((wtp-wtp_mu)/wtp_s) if health==1 & Loc1==1
ksmirnov wtp = normprob((wtp-wtp_mu)/wtp_s) if info==1 & Loc1==1

log close

```

```
*-----  
* DO FILE TO ANALYZE FULL INFORMATION TREATMENT  
*-----
```

```
*LEGEND
```

```
* rp = round.product
```

```
*Rounds
```

```
* =1 Baseline
```

```
* =2 Tasting
```

```
* =3 Health
```

```
* =4 Information
```

```
* Products
```

```
* =1 Conventional USA
```

```
* =2 Conventional Mexico
```

```
* =3 Organic USA
```

```
* =4 Organic Mexico
```

```
* =5 Texas A&M Variety 1
```

```
* =6 Texas A&M Variety 2
```

```
* =7 Yellow Squash
```

```
*-----  
* START DO FILE  
*-----
```

```
clear  
set more off  
cap log close  
cd "H:\My Documents\RESEARCH\RESEARCH\tomato-stata"  
log using data_tomato, replace
```

```
use data_tomato  
/*CHANGE THIS PATH TO MATCH THE FILE LOCATION ON YOUR MACHINE*/
```

```
*creating a full information round*
```

```
gen wtp51=0  
replace wtp51=wtp21 if ordert==4  
replace wtp51=wtp31 if orderh==4  
replace wtp51=wtp41 if orderi==4
```

```
gen wtp52=0  
replace wtp52=wtp22 if ordert==4  
replace wtp52=wtp32 if orderh==4  
replace wtp52=wtp42 if orderi==4
```

```
gen wtp53=0  
replace wtp53=wtp23 if ordert==4  
replace wtp53=wtp33 if orderh==4  
replace wtp53=wtp43 if orderi==4
```

```

gen wtp54=0
replace wtp54=wtp24 if ordert==4
replace wtp54=wtp34 if orderh==4
replace wtp54=wtp44 if orderi==4

gen wtp55=0
replace wtp55=wtp25 if ordert==4
replace wtp55=wtp35 if orderh==4
replace wtp55=wtp45 if orderi==4

gen wtp56=0
replace wtp56=wtp26 if ordert==4
replace wtp56=wtp36 if orderh==4
replace wtp56=wtp46 if orderi==4

gen wtp57=0
replace wtp57=wtp37 if orderh==4
replace wtp57=wtp47 if orderi==4
drop wtp21-wtp47

reshape long wtp, i(id) j(rp)

*-----
* GENERATED VARIABLES
*-----

*Generate Indicators for Tomato Varieties
gen ConUS:1= rp==51|rp==11
gen ConMex:1= rp==52|rp==12
gen OrgUS:1= rp==53|rp==13
gen OrgMex:1= rp==54|rp==14
gen Loc1:1= rp==55|rp==15
gen Loc2:1= rp==56|rp==16
gen Ysq:1= rp==57|rp==17
drop if Loc2==1
drop if Ysq==1

**Generate Indicators for Treatments
gen base:1= (10<rp) & (rp<18)
gen full:1= (50<rp) & (rp<58)

*Generate age: AGE1 is 18-34, AGE2 is 35-54, AGE3 is 55 or over
gen dage1=(age==1 | age==2) if!missing(age)
gen dage2=(age==3|age==4) if!missing(age)
gen dage3=(age==5|age==6) if!missing(age)
*Generate race: RACE1 is American, RACE2 is Hispanic, RACE3 is Other
gen drace1= (race==3 | race==4)
gen drace2= (race==5)
gen drace3= (race==1 | race==2 | race==6)

*Generate edu: EDU1 is high school diploma or less, EDU2 is some college-bachelor's degree, EDU3 is
some grad school or more
gen dedu1=(edu==1 | edu==2) if!missing(edu)

```



```

gen dedu2=(edu==3|edu==4|edu==5) if!missing(edu)
gen dedu3=(edu==6|edu==7) if!missing(edu)

*Generate income: INC1 is <50k, INC2 is 50K to <100K, INC3 is 100K or more
gen dinc1=(income==1 | income==2|income==3) if!missing(income)
gen dinc2=(income==4|income==5|income==6|income==7|income==8) if!missing(income)
gen dinc3=(income==9|income==10) if!missing(income)

*recode changes the values of numeric variables according to the rules specified.
*Generate average value of weekly expenditures in fruits and vegetables: ASPENDFV
recode wfv (1=12) (2=37) (3=62) (4=87) (5=100), gen (aspendfv)

*Generate average percentage of fresh vegetables on hand: APVOH
recode freshv (1=0) (2=12.5) (3=37) (4=62) (5=87.5), gen (apvoh)

*Generate exercise: Never=0, Once a Month=12, Once a week= 52, 2-3/week = 130, 4-6/week= 260 ,
once a day=365, more than once a day =730
recode exercise (1=0) (2=12) (3=52) (4=130) (5=260) (6=365) (7=730), gen (dexter)
gen exer=dexter/365*100

*-----
*Constant Parameter Tobit Model*
*-----
global xlist dage2 dage3 dedu2 dedu3 hhsz female married dinc2 dinc3 drace2 drace3 aspendfv healthiss
smoke exer //Define regressor $xlist
tobit wtp $xlist if full==1 & ConUS==1, ll(0) log
margins, dydx(*) predict (e(0,))
tobit wtp $xlist if full==1 & ConMex==1, ll(0) log
margins, dydx(*) predict (e(0,))
tobit wtp $xlist if full==1 & OrgUS==1, ll(0) log
margins, dydx(*) predict (e(0,))
tobit wtp $xlist if full==1 & OrgMex==1, ll(0) log
margins, dydx(*) predict (e(0,))
tobit wtp $xlist if full==1 & Loc1==1, ll(0) log
margins, dydx(*) predict (e(0,))

log close

*-----
* DO FILE FOR IMPLIED DIFFERENCES MODELS
*-----

*LEGEND

* rp = round.product
*Rounds
* =1 Baseline
* =2 Tasting
* =3 Health
* =4 Information

* Products
* =1 Conventional USA

```

```

* =2 Conventional Mexico
* =3 Organic USA
* =4 Organic Mexico
* =5 Texas A&M 1
* =6 Texas A&M 2
* =7 Yellow Squash

```

```

*-----
* START DO FILE
*-----

```

```

clear
cap log close
log using data_tomato, replace
cd "H:\My Documents\RESEARCH\RESEARCH\tomato-stata"

```

```

use data_tomato
/*CHANGE THIS PATH TO MATCH THE FILE LOCATION ON YOUR MACHINE*/

```

```

*-----
*IMPLIED DIFFERENCES-HEALTH TRT
*-----

```

```

gen dwtp1= (wtp31-wtp11)
gen dwtp2= (wtp32-wtp12)
gen dwtp3= (wtp33-wtp13)
gen dwtp4= (wtp34-wtp14)
gen dwtp5= (wtp35-wtp15)

```

```

reshape long dwtp, i(id)j(rp)*/

```

```

*-----
*IMPLIED DIFFERENCES-TASTING TRT
*-----

```

```

gen dwtpt1= (wtp21-wtp11)
gen dwtpt2= (wtp22-wtp12)
gen dwtpt3= (wtp23-wtp13)
gen dwtpt4= (wtp24-wtp14)
gen dwtpt5= (wtp25-wtp15)
gen dwtpt6= (wtp26-wtp16)
reshape long dwtpt, i(id)j(rp)

```

```

*-----
*IMPLIED DIFFERENCES-INFO TRT
*-----

```

```

gen dwtpi1= (wtp41-wtp11)
gen dwtpi2= (wtp42-wtp12)
gen dwtpi3= (wtp43-wtp13)
gen dwtpi4= (wtp44-wtp14)
gen dwtpi5= (wtp45-wtp15)
gen dwtpi6= (wtp46-wtp16)
gen dwtpi7= (wtp47-wtp17)

```

```

reshape long dwtpi, i(id)j(rp)

```

```
*-----  
* GENERATED VARIABLES  
*-----
```

```
*Generate Indicators for Tomato Varieties
```

```
gen Org:1= rp==3|rp==4  
gen US:1= rp==1|rp==3  
gen Loc1:1= rp==5  
gen Mex:1= rp==2|rp==4  
gen Loc2:1= rp==6  
gen Ysq:1= rp==7  
drop if Loc2==1  
drop if Ysq==1
```

```
*Generate age: AGE1 is 18-34, AGE2 is 35-54, AGE3 is 55 or over
```

```
gen dage1=(age==1 | age==2) if!missing(age)  
gen dage2=(age==3|age==4) if!missing(age)  
gen dage3=(age==5|age==6) if!missing(age)
```

```
*Generate race: RACE1 is American, RACE2 is Hispanic, RACE3 is Other
```

```
gen drace1= (race==3 | race==4)  
gen drace2= (race==5)  
gen drace3= (race==1 | race==2 | race==6)
```

```
*Generate edu: EDU1 is high school diploma or less, EDU2 is some college-bachelor's degree, EDU3 is  
some grad school or more
```

```
gen dedu1=(edu==1 | edu==2) if!missing(edu)  
gen dedu2=(edu==3|edu==4|edu==5) if!missing(edu)  
gen dedu3=(edu==6|edu==7) if!missing(edu)
```

```
*Generate income: INC1 is <50k, INC2 is 50K to <100K, INC3 is 100K or more
```

```
gen dinc1=(income==1 | income==2|income==3) if!missing(income)  
gen dinc2=(income==4|income==5|income==6|income==7|income==8) if!missing(income)  
gen dinc3=(income==9|income==10) if!missing(income)
```

```
*recode changes the values of numeric variables according to the rules specified.
```

```
*Generate average value of weekly expenditures in fruits and vegetables: ASPENDFV  
recode wfv (1=12) (2=37) (3=62) (4=87) (5=100), generate (aspendfv)
```

```
*Generate average percentage of fresh vegetables on hand: APVOH
```

```
recode freshv (1=0) (2=12.5) (3=37) (4=62) (5=87.5), generate (apvoh)
```

```
*Generate exercise: Never=0, Once a Month=12, Once a week= 52, 2-3/week = 130, 4-6/week= 260 ,  
once a day=365, more than once a day =730
```

```
recode exercise (1=0) (2=12) (3=52) (4=130) (5=260) (6=365) (7=730), generate (dexter)  
generate exer=dexter/365*10
```

```
*-----
```

```
*MIXED LINEAR MODEL-Tasting TRT
```

```
*-----
```

```
xtset id
```

```

xtmixed dwtpt Org US Loc1 dage2 dage3 dedu2 dedu3 hssize female married dinc2 dinc3 drace2 drace3,
|| id: Org US Loc1 , mle

*-----
*MIXED LINEAR MODEL-Information TRT
*-----
xtset id
xtmixed dwtpt Org US Loc1 dage2 dage3 dedu2 dedu3 hssize female married dinc2 dinc3 drace2 drace3,
|| id: Org US Loc1 , mle

log close

*-----
* DO FILE TO ANALYZE ENDOGENEITY PROBLEM -IV APPROACH
*-----

*LEGEND

* rp = round.product
*Rounds
* =1 Baseline
* =2 Tasting
* =3 Health
* =4 Information

* Products
* =1 Conventional USA
* =2 Conventional Mexico
* =3 Organic USA
* =4 Organic Mexico
* =5 Texas A&M 1
* =6 Texas A&M 2
* =7 Yellow Squash

*-----
* START DO FILE
*-----

clear
cap log close
log using data_tomato, replace
cd "H:\My Documents\RESEARCH\RESEARCH\tomato-stata"

use data_tomato
/*CHANGE THIS PATH TO MATCH THE FILE LOCATION ON YOUR MACHINE*/
*-----
*IMPLIED DIFFERENCES-HEALTH TRT
*-----
gen dwtp1= (wtp31-wtp11)
gen dwtp2= (wtp32-wtp12)
gen dwtp3= (wtp33-wtp13)
gen dwtp4= (wtp34-wtp14)
gen dwtp5= (wtp35-wtp15)

```

```

reshape long dwtph, i(id)j(rp)
*-----
* GENERATED VARIABLES
*-----

*Generate Indicators for Tomato Varieties
gen Org:1= rp==3|rp==4
gen US:1= rp==1|rp==3
gen Loc1:1= rp==5

*Generate Indicators for Treatments, and Interaction TRT*PRODUCT
gen base:1= (50<rp) & (rp<18)
gen tasting:1= (20<rp) & (rp<28)
gen health:1= (30<rp) & (rp<38)
gen info:1= (40<rp) & (rp<48)
keep base health
gen hOrg = health*Org
gen hUS = health*US
gen hLoc1 = health*Loc1

*Generate age: AGE1 is 18-34, AGE2 is 35-54, AGE3 is 55 or over
gen dage1=(age==1 | age==2) if!missing(age)
gen dage2=(age==3|age==4) if!missing(age)
gen dage3=(age==5|age==6) if!missing(age)

*Generate race: RACE1 is American, RACE2 is Hispanic, RACE3 is Other
gen drace1= (race==3 | race==4)
gen drace2= (race==5)
gen drace3= (race==1 | race==2 | race==6)

*Generate edu: EDU1 is high school diploma or less, EDU2 is some college-bachelor's degree, EDU3 is
some grad school or more
gen dedu1=(edu==1 | edu==2) if!missing(edu)
gen dedu2=(edu==3|edu==4|edu==5) if!missing(edu)
gen dedu3=(edu==6|edu==7) if!missing(edu)

*Generate income: INC1 is <50k, INC2 is 50K to <100K, INC3 is 100K or more
gen dinc1=(income==1 | income==2|income==3) if!missing(income)
gen dinc2=(income==4|income==5|income==6|income==7|income==8) if!missing(income)
gen dinc3=(income==9|income==10) if!missing(income)

*recode changes the values of numeric variables according to the rules specified.
*Generate average value of weekly expenditures in fruits and vegetables: ASPENDFV
recode wfv (1=12) (2=37) (3=62) (4=87) (5=100), generate (aspendfv)

*Generate average percentage of fresh vegetables on hand: APVOH
recode freshv (1=0) (2=12.5) (3=37) (4=62) (5=87.5), generate (apvoh)

*Generate exercise: Never=0, Once a Month=12, Once a week= 52, 2-3/week = 130, 4-6/week= 260 ,
once a day=365, more than once a day =730
recode exercise (1=0) (2=12) (3=52) (4=130) (5=260) (6=365) (7=730), generate (dexer)
generate exer=dexer/365*100

```

```

*-----
* CONSTANT PARAMETERS TOBIT
*-----
ivtobit dwtpH Org US Loc1 hhszize female married dage2 dage3 dedu2 dedu3 dinc2 dinc3 drace2 drace3 (
bmiact = aspendfv healthiss smoke exer), ll(0) log
margins, dydx(*) predict (e(0,))

*-----
* 2SLS MODEL
*-----
ivregress 2sls dwtpH Org US Loc1 hhszize female married dage2 dage3 dedu2 dedu3 dinc2 dinc3 drace2
drace3 (bmiact = healthiss aspendfv smoke exer) , vce(robust) first
estat endogenous
estat overid
estat firststage

est store ivregress
regress dwtpH Org US Loc1 hhszize female married dage2 dage3 dedu2 dedu3 dinc2 dinc3 drace2 drace3
bmiact
hausman ivregress ., constant sigmamore

log close

*-----
* LATENT CLASS ANALYSES
*-----

version 12
set more off, permanently
clear

discard
//set trace on
drop _all

cd "H:\My Documents\RESEARCH\RESEARCH\tomato-stata\LCA\release1-1\Release" /*CHANGE
THIS PATH TO MATCH THE FILE LOCATION ON YOUR MACHINE!*/
use LCAex.dta

*2 Classes
doLCA smoke healthiss wfv2 under normal obese exer , ///
nclass(2) ///
seed(100000) ///
categories(2 2 2 2 2 2) ///
criterion(0.000001) ///
rhoprior(1.0)

return list
matrix list r(gamma)
matrix list r(gammaSTD)
matrix list r(rho)

```

```

matrix list r(rhoSTD)
matrix list r(post_prob)

*3 Classes
doLCA smoke healthiss wfv2 under normal obese exer , ///
  nclass(3) ///
    seed(100000) ///
    categories(2 2 2 2 2 2) ///
    criterion(0.000001) ///
    rhoprior(1.0)

return list
matrix list r(gamma)
matrix list r(gammaSTD)
matrix list r(rho)
matrix list r(rhoSTD)
matrix list r(post_prob)

*4 Classes
doLCA smoke healthiss wfv2 under normal obese exer , ///
  nclass(4) ///
    seed(100000) ///
    categories(2 2 2 2 2 2) ///
    criterion(0.000001) ///
    rhoprior(1.0)

return list
matrix list r(gamma)
matrix list r(gammaSTD)
matrix list r(rho)
matrix list r(rhoSTD)
matrix list r(post_prob)

*5 Classes
doLCA smoke healthiss wfv2 under normal obese exer , ///
  nclass(5) ///
    seed(100000) ///
    categories(2 2 2 2 2 2) ///
    criterion(0.000001) ///
    rhoprior(1.0)

return list
matrix list r(gamma)
matrix list r(gammaSTD)
matrix list r(rho)
matrix list r(rhoSTD)
matrix list r(post_prob)

*6 Classes
doLCA smoke healthiss wfv2 under normal obese exer , ///
  nclass(6) ///
    seed(100000) ///
    categories(2 2 2 2 2 2) ///

```

```

        criterion(0.000001) ///
        rhoprior(1.0)

return list
matrix list r(gamma)
matrix list r(gammaSTD)
matrix list r(rho)
matrix list r(rhoSTD)
matrix list r(post_prob)

*7 Classes
doLCA smoke healthiss wfv2 under normal obese exer , ///
    nclass(7) ///
        seed(100000) ///
        categories(2 2 2 2 2 2) ///
        criterion(0.000001) ///
        rhoprior(1.0)

return list
matrix list r(gamma)
matrix list r(gammaSTD)
matrix list r(rho)
matrix list r(rhoSTD)
matrix list r(post_prob)

*8 Classes
doLCA smoke healthiss wfv2 under normal obese exer , ///
    nclass(8) ///
        seed(100000) ///
        categories(2 2 2 2 2 2) ///
        criterion(0.000001) ///
        rhoprior(1.0)

return list
matrix list r(gamma)
matrix list r(gammaSTD)
matrix list r(rho)
matrix list r(rhoSTD)
matrix list r(post_prob)

*9 Classes
doLCA smoke healthiss wfv2 under normal obese exer , ///
    nclass(9) ///
        seed(100000) ///
        categories(2 2 2 2 2 2) ///
        criterion(0.000001) ///
        rhoprior(1.0)

return list
matrix list r(gamma)
matrix list r(gammaSTD)
matrix list r(rho)

```



```
matrix list r(rhoSTD)
matrix list r(post_prob)
```

```
**Summary Stat of Variables*
```

```
summarize smoke healthiss wfv2 under normal obese exer if class1==1
```

```
summarize smoke healthiss wfv2 under normal obese exer if class2==1
```

```
log close
```

## **NLOGIT 5 Code**

```
*-----
```

```
*WTP MODELS FOR FULL BIDS
```

```
*-----
```

```
IMPORT;FILE="C:\Users\mapalma\Documents\Dropbox\Projects\Tomatoes\Data\ImpliedDIFF\fullbids.c
sv"$
```

```
NAMELIST ; ALLX = ONE, ORG, US, LOC1, TASTING, HEALTH, INFO, TORG, TUS, TLOC1,
```

```
IORG, IUS, ILOC1, DAGE2, DAGE3, DEDU2, DEDU3, hhsz, female, marri
```

```
NAMELIST ; RPX = org, us, loc1, tasting, health, info, torg, tus, tloc1, iorg, ius, iloc1 $
```

```
SETPANEL ; Group = id ; Pds = groupti $
```

```
?Random Parameters Tobit Model
```

```
TOBIT
```

```
  ; Lhs = wtp
```

```
  ; Rhs = ALLX
```

```
  ; RPM
```

```
  ; Fcn = ONE(n), ORG(n), US(n), LOC1(n), TASTING(n), HEALTH(n), INFO(n), TORG(n), TUS(n),  
TLOC1(n), IORG(n), IUS(n), ILOC1(n)
```

```
  ; Panel
```

```
  ; Pts = 500
```

```
  ; Halton
```

```
  ; Partial Effects
```

```
  $
```

```
?Mixed Linear Model
```

```
REGRESS
```

```
  ; Lhs = wtp
```

```
  ; Rhs = ALLX
```

```
  ; RPM
```

```
  ; Fcn = ONE(n), ORG(n), US(n), LOC1(n), TASTING(n), HEALTH(n), INFO(n), TORG(n), TUS(n),  
TLOC1(n), IORG(n), IUS(n), ILOC1(n)
```

```
  ; Panel
```

```
  ; Pts = 500
```

```
  ; Halton
```

```
  ; Partial Effects
```

```
  $
```

```
*-----  
*IMPLIED DIFFERENCES-TASTING TRT  
*-----
```

```
IMPORT;  
FILE="C:\Users\mapalma\Documents\Dropbox\Projects\Tomatoes\Data\ImpliedDIFF\Impliedtaste.csv"$  
NAMELIST ; ALLX = ONE, Org, US, LOC1, DAGE2, DAGE3, DEDU2, DEDU3, hhsiz, female,  
married, dinc2, dinc3, drace2, drace3 $  
NAMELIST ; RPX = org, us, loc1, smoke, healthis, exer, aspendfv $  
SETPANEL ; Group = id ; Pds = groupti $
```

```
? Random Coefficients Linear  
REGRESS  
; Lhs = dwtpt  
; Rhs = ALLX  
; RPM  
; Fcn = ONE(n), ORG(n), US(n), LOC1(n)  
; Panel  
; Pts = 500  
; Halton  
; Partial Effects
```

```
*-----  
*IMPLIED DIFFERENCES-INFORMATION TRT  
*-----
```

```
IMPORT;  
FILE="C:\Users\mapalma\Documents\Dropbox\Projects\Tomatoes\Data\ImpliedDIFF\Impliedinfo.csv"$  
NAMELIST ; ALLX = ONE, Org, US, LOC1, DAGE2, DAGE3, DEDU2, DEDU3, hhsiz, female,  
married, dinc2, dinc3, drace2, drace3 $  
NAMELIST ; RPX = org, us, loc1, smoke, healthis, exer, aspendfv $  
SETPANEL ; Group = id ; Pds = groupti $
```

```
? Random Coefficients Linear  
REGRESS  
; Lhs = dwtpt  
; Rhs = ALLX  
; RPM  
; Fcn = ONE(n), ORG(n), US(n), LOC1(n)  
; Panel  
; Pts = 500  
; Halton  
; Partial Effects
```

```
*-----  
*IMPLIED DIFFERENCES-HEALTH TRT  
*-----
```

```
IMPORT;  
FILE="C:\Users\mapalma\Documents\Dropbox\Projects\Tomatoes\Data\ImpliedDIFF\Implichealth.csv"$  
NAMELIST ; ALLX = ONE, ORG, US, LOC1, DAGE2, DAGE3, DEDU2, DEDU3, hhsiz, female,  
married, dinc2, dinc3, drace2, drace3, smoke, healthis, exer, as  
NAMELIST ; RPX = org, us, loc1, smoke, healthis, exer, aspendfv $
```

SETPANEL ; Group = id ; Pds = groupti \$

? Random Coefficients Tobit

TOBIT

; Lhs = dwtp

; Rhs = ALLX

; RPM

; Fcn = ONE(n), ORG(n), US(n), LOC1(n), smoke(n), healthis(n), exer(n), aspendfv (n)

; Panel

; Pts = 500

; Halton

; Partial Effects

? Random Coefficients Linear

REGRESS

; Lhs = dwtp

; Rhs = ALLX

; RPM

; Fcn = ONE(n), ORG(n), US(n), LOC1(n), smoke(n), healthis(n), exer(n), aspendfv (n)

; Panel

; Pts = 500

; Halton

; Partial Effects

\*-----  
\* LATENT CLASS ANALYSES  
\*-----

? Random Parameters Tobit for All

IMPORT;

FILE="C:\Users\mapalma\Documents\Dropbox\Projects\Tomatoes\Data\LCA\LCA-RP.csv"\$

NAMELIST ; ALLX = ONE, ORG, US, LOC1, TASTING, HEALTH, INFO, TORG, TUS, TLOC1,

IORG, IUS, ILOC1, DAGE2, DAGE3, DEDU2, DEDU3, hhsz, female, marri

NAMELIST ; RPX = org, us, loc1, tasting, health, info, torg, tus, tloc1, iorg, ius, iloc1 \$

SETPANEL ; Group = id ; Pds = groupti \$

TOBIT

; Lhs = wtp

; Rhs = ALLX

; RPM

; Fcn = ONE(n), ORG(n), US(n), LOC1(n), TASTING(n), HEALTH(n), INFO(n), TORG(n), TUS(n),  
TLOC1(n), IORG(n), IUS(n), ILOC1(n)

; Panel

; Pts = 500

; Halton

; Partial Effects

? Random Parameters Tobit for Class 1

Sample; All \$

Reject ; class2=0 \$

TOBIT

```

; Lhs = wtp
; Rhs = ALLX
; RPM
; Fcn = ONE(n), ORG(n), US(n), LOC1(n), TASTING(n), HEALTH(n), INFO(n), TORG(n), TUS(n),
TLOC1(n), IORG(n), IUS(n), ILOC1(n)
; Panel
; Pts = 500
; Halton
; Partial Effects

```

? Random Parameters Tobit for Class 2

```

Sample; All $
Reject ; class1=0 $
TOBIT
; Lhs = wtp
; Rhs = ALLX
; RPM
; Fcn = ONE(n), ORG(n), US(n), LOC1(n), TASTING(n), HEALTH(n), INFO(n), TORG(n), TUS(n),
TLOC1(n), IORG(n), IUS(n), ILOC1(n)
; Panel
; Pts = 500
; Halton
; Partial Effects

```

? Random Parameters Tobit for Full Information, All

```

IMPORT;
FILE="C:\Users\mapalma\Documents\Dropbox\Projects\Tomatoes\Data\LCA\LCA-full.csv"$
NAMELIST ; ALLX = ONE, ORG, US, LOC1, FULL, FORG, FUS, FLOC1, DAGE2, DAGE3, DEDU2,
DEDU3, hhszize, female, married, dinc2, dinc3, drace2, drace3 $
NAMELIST ; RPX = org, us, loc1, tasting, health, info, forg, fus, flocl $
SETPANEL ; Group = id ; Pds = groupti $

```

```

TOBIT
; Lhs = wtp
; Rhs = ALLX
; RPM
; Fcn = ONE(n), ORG(n), US(n), LOC1(n), FULL(n), FORG(n), FUS(n), FLOC1(n)
; Panel
; Pts = 500
; Halton
; Partial Effects

```

? Random Parameters Tobit for Full Information, Class 1

```

Sample; All $
Reject ; class2=0 $
TOBIT
; Lhs = wtp
; Rhs = ALLX
; RPM
; Fcn = ONE(n), ORG(n), US(n), LOC1(n), FULL(n), FORG(n), FUS(n), FLOC1(n)
; Panel
; Pts = 500

```

```
; Halton  
; Partial Effects
```

```
? Random Parameters Tobit for Full Information, Class 2
```

```
Sample; All $
```

```
Reject ; class1=0 $
```

```
TOBIT
```

```
; Lhs = wtp
```

```
; Rhs = ALLX
```

```
; RPM
```

```
; Fcn = ONE(n), ORG(n), US(n), LOC1(n), FULL(n), FORG(n), FUS(n), FLOC1(n)
```

```
; Panel
```

```
; Pts = 500
```

```
; Halton
```

```
; Partial Effects
```