# ANALYSIS OF BRAND RECOGNITION ASSOCIATED WITH THE TEXAS SUPERSTAR ™ AND EARTH-KIND ™ PROGRAMS IN TEXAS

A Thesis

by

ALBA JEANETTE COLLART DINARTE

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

MASTER OF SCIENCE

August 2009

Major Subject: Agricultural Economics

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Approved by:

| | |
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| Co-Chairs of Committee, | David A. Bessler |
| | Charles R. Hall |
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# ABSTRACT


Analysis of Brand Recognition Associated with the Texas Superstar™ and Earth-Kind™ Programs in Texas. (August 2009)




Alba Jeanette Collart Dinarte, B.S., Pan-American School of Agriculture

Co-Chairs of Advisory Committee: Dr. David A. Bessler
Dr. Charles R. Hall



The environmental horticulture industry, also known as the “Green Industry”, is the second most important sector in the United States’ agricultural economy in terms of economic output and one of the fastest growing segments of agriculture; however, it has experienced a steady slowdown in growth in the past years. Floriculture and nursery crops average annual growth rate decreased from 13.64% in the 1970s to approximately 2.87% in the 2000s, and the industry is currently considered to be facing a mature market. The Texas A&M Agricultural Program, in an attempt to help Texas’ green industry producers compete effectively in an evolving marketplace, developed the Texas Superstar ™ and Earth-Kind ™ programs. Both of these programs intend to raise awareness among consumers of Texas-grown plant material while promoting environmental responsibility, and to increase producers’ profitability by providing them with products that can be sold at a price premium.

In spite of the considerable investments on research and marketing that have been done in order to assure the release of every new plant, no research has investigated the effectiveness of these branding efforts in terms of consumer's behavior. This research seeks to evaluate brand awareness and willingness-to-pay on the part of lawn and garden consumers. The discrete choice models used were the logit and probit model on brand awareness and the tobit model on the conditional willingness-to-pay. Results from this study conclude that consumers' awareness of Texas Superstar ™ and Earth-Kind ™ in the Texas area is low, but the satisfaction level among aware consumers is high. The presence of awareness was found to increase willingness-to-pay for Texas Superstar ™ and Earth-Kind ™ by about 10%. Furthermore, profiles of the consumers' behavioral and demographic characteristics that are more likely to influence brand awareness and willingness-to-pay were identified.

# DEDICATION

This thesis and all of the efforts put forth to obtaining this graduate degree are dedicated to my beautiful family. My family, each in their individual way, has so selflessly provided encouragement and support during my educational accomplishments. It is through my actions rather than words that I hope to express my gratitude and appreciation to each of you.

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# CHAPTER I

# INTRODUCTION

The study of consumer behavior has always been a major research topic in economic theory. It studies characteristics of consumers such as demographic and behavioral variables in an attempt to understand the buyer's decision making process. Although demographic characteristics cannot be changed, the identification of different demographic groups allows researchers to understand how the consumers think, feel, reason, and select between different alternatives (i.e. brands). In this manner, the theory of consumer behavior helps marketers adapt and improve their marketing strategies to more effectively influence purchase decisions. Moreover, it forms the basis for the analysis of demand for agricultural products (Young 1995).

In agricultural markets, consumers are constantly changing lifestyles, eating and shopping habits, perceptions on natural foods, and insights on the use of resources, and major changes in consumers' behavior are constantly affecting the demand side. The demand of non-traditional agricultural goods (i.e. ornamental products) is further influenced by other factors like discretionary income and seasonality. Consumption of ornamentals varies a great deal throughout the year and, compared to traditional agricultural goods, these products are not considered a strict necessity for the average consumer. However, gardening is considered one of the most favorite leisure-time

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This thesis follows the style of the *American Journal of Agricultural Economics*.

activities and, therefore, ornamental products compete well for consumer discretionary spending.

**Current Market Trends of the U.S. Environmental Industry**

The environmental horticulture industry, also known as the “Green Industry”, consists of ornamental and landscape horticulture, floriculture, greenhouse and nursery management, and urban forestry. Businesses involved in the production and distribution of this industry’s products and services include nursery and greenhouse growers, retail garden centers, mass merchandisers, landscape designers, contractors and maintenance firms, and marketing intermediaries such as brokers and re-wholesalers.

The green industry is one of the fastest growing segments of the U.S. agricultural economy and the second most important sector in the nation’s agriculture in terms of economic output; however, it has experienced a gradual slowdown in growth in the past years. Floriculture and nursery crops average annual growth rate decreased from 13.64% in the 1970s to approximately 2.87% in the 2000s, and the industry is maturing with an annual growth of less than 5% annually (Hall 2008). According to Brumfield (2003), following an average growth of 10% per year in the 1980s and of 5% during the 1990s, the industry has shifted from rapid growth to considerably slower growth and is now considered a mature market.

The four stages in a product life cycle are shown in Figure 1.1. In this cycle, every new product advances through a sequence that goes from introduction to growth, maturity, and decline. The sequence is associated with changes in the marketing circumstances since each stage is defined by the behavior of sales over time. At maturity, market demand consists mainly of replacement sales to current users and almost all prospective buyers are already users of the industry's products. Other signs of maturity include an increase in competition from international markets, acquisitions of struggling rivals that reduce the number of companies in the industry, and tighter margins that affect the profitability of the industry (Hall 2008).

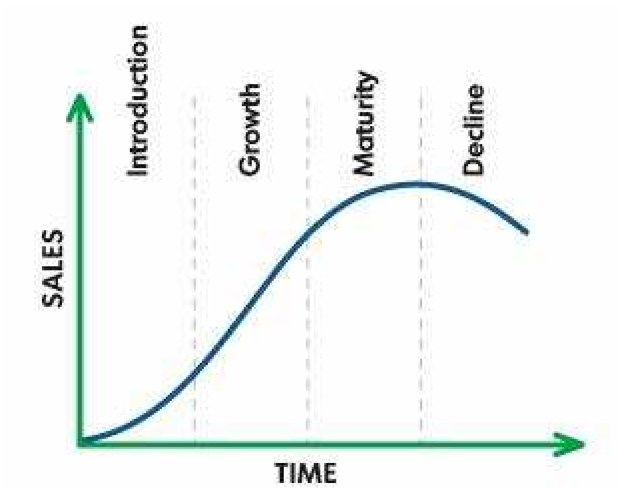



**Figure 1.1 Product life cycle**

In the U.S. green industry, besides a slower growth rate, an increase in international competition and a decrease in the number of producers have been also noticeable. In 1993, half of the U.S. consumption of cut flowers was covered by imports, while in 2006, imports accounted for nearly two-thirds of total consumption. Furthermore, a survey completed by the United States Department of Agriculture (USDA) among fifteen of the U.S. major floriculture producers states revealed that the number of producers dropped 8.8% from 2005 to 2006 (Jerardo 2007).

In order to slow down industry maturity, Hall (2008) suggests three alternative market strategies to be adopted by producers in the green industry. First, to become a low-cost operator and play the volume-commodity game, that is, to produce high volumes of goods with little or no value added. Second, to apply differentiation by product, service, customer type, or geographic area; this strategy comprises new plant introductions, innovative packaging, branding efforts, and value added services. Third, to develop partnerships through horizontal and/or vertical coordination to increase the value or service provided to customers.

New plant introductions to the horticulture industry have been possible through plant breeding and genetic engineering but, thus far, branding of ornamental products is not considered a common marketing strategy. As seen in retail stores and garden centers, most products are still traded using their generic botanical names. Nevertheless, in the light of these mature market conditions and as a strategic response, many brands have been established in recent years in the ornamental industry (i.e. Sygenta flowers, Proven Winners ™, Novalis™ Plants that Work ™, Garden Splendor ™), and several states have developed state-sponsored brands (i.e. Oklahoma Proven, Louisiana Select, Oregon Grown, Florida Plants of the Year) aiming to stimulate demand and increase the industry's sales and profitability.

Once a brand is established, it provides a differentiated product for the consumer, and increases the added value for the producer (Bagnara 1996). Brands usually meet consumers' desire for variety, quality, and service, and allow farmers to retain higher profit margins (Hayes and Lence 2002).

**Texas Superstar ™ and Earth-Kind ™ Programs**

The Texas A&M University Agricultural Program in conjunction with other state and private collaborators of the ornamental industry in Texas, developed over a decade ago the Texas Superstar ™ and Earth-Kind ™ programs as an effort to help Texas' producers compete effectively in an evolving marketplace. Texas Superstar ™ is an initiative carried out by the Coordinated Educational and Marketing Assistance Program (CEMAP), a group of horticultural scientists and extension specialists that have been selecting (for over 18 years) plants specifically adapted to the Texas environment. The potential plant material is identified by research and extension faculty and it goes through an extensive evaluation process that assesses heat, drought, disease and insect tolerance.

Texas' size and its location with relation to the North American continent, the Gulf of Mexico and the Pacific Ocean, guarantee a constant exchange of unstable weather (Bomar 1985). Rainfall distribution ranges from 8 inches (20.3 cm) in Far West Texas to 56 inches (142.2 cm) in Far East Texas. Hence, multi-year testing of potential plants is currently being done at multiple locations representative of the diverse weather conditions. CEMAP trial sites and Texas' diverse climatic areas are illustrated in Figure 1.2.

Statewide testing usually takes three years for an annual flower and up to eight years for a new woody plant. During the field trials across the state, plants receive minimal soil preparation, minimal water and no pesticides applications. Once testing has been completed, plants that demonstrated superior performance in most test locations are designated as Texas Superstars (Mackay et al. 2001). Moreover, if production problems arise, additional research is undertaken before marketing the product. An example of this is “Texas Gold” columbine (*Aquilegia chrysantha hinckleyana*), a plant with admirable heat tolerance and considerable potential as a landscape plant, but with an irregular germination pattern that complicated transplant production. Research prior to the marketing campaign improved seed germination to nearly 90% by using temperature manipulation (a day/night cycle of 25/20 °C was simulated), allowing “Texas Gold” columbine to be commercially produced (Davis et al. 1993).

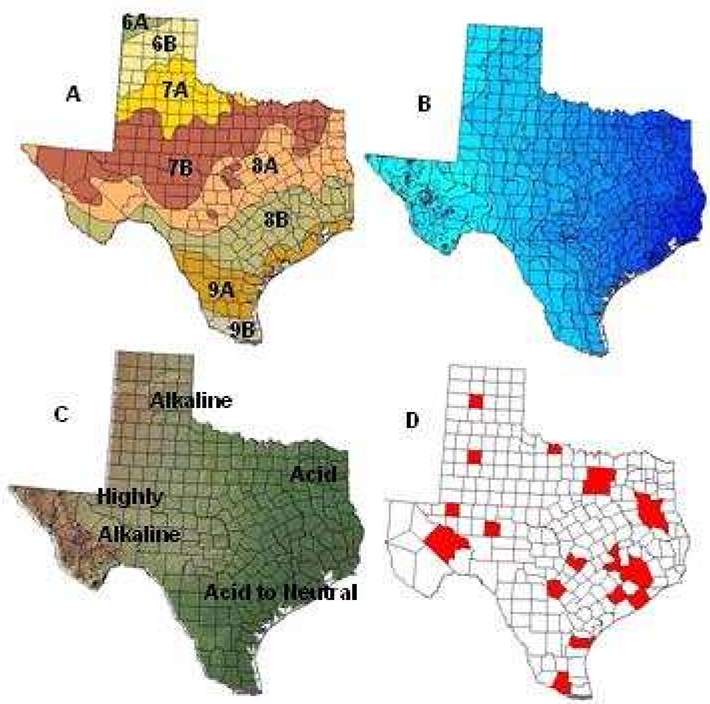



**Figure 1.2 (A) USDA hardiness zone map of Texas (B) Rainfall distribution in Texas where isolines represent 4-inch increments in yearly rainfall (C) General soil pH map of Texas (D) CEMAP trial sites by county, indicated in red**

As described by Mackay et al. (2001), after propagation problems are solved and with a minimum of one year in advance, growers are advised on production practices. Retailers are notified of the participating growers six to nine months before the following year's promotion. Texas' retailers that choose to take part in the program, work closely with participating growers, attending training seminars and making sure that when the product is released, it displays the trademark "Texas Superstar ™" label at the point of purchase (POP). As a final task, a media campaign that includes newspapers, magazines, radio and television, is started a week before and continued throughout the campaign period. If an individual firm was to embark on this type of marketing campaign, the typical budget could reach up to $120,530 (Table 1.1).

**Table 1.1 Typical Media Budget for Texas Superstar ™**

| | | **Texas Superstar ™** | | |
|---|---|---|---|---|
| Item | Cost (US$) | Insertions | Times | Total (US$) |
| Neil Sperry Radio | 200 | 3 spots | 8 shows | 4,800 |
| Gardens Magazine | 3,060 | 1 insertion | 2 issues | 6,120 |
| Texas Monthly | 17,305 | 1 insertion | 2 issues | 34,610 |
| Outdoor | 3,000 | 5 posters | 2 months | 30,000 |
| Neil Sperry Trade Show | 15,000 | | | 15,000 |
| Trade Shows | 10,000 | | 3 shows | 30,000 |
| | | | | **120,530** |

Source: Pocheptsova et al. (2008)

Texas Superstars are also cross-promoted with the "Go Texan" logo, a marketing effort launched by the Texas Department of Agriculture (TDA) that seeks to promote agricultural products from Texas, including food, fiber, wine, flowers, plants and trees.

The logo intends to make it easier for Texas' consumers to find Texas-grown agricultural products.

Examples of Texas Superstars that have been promoted in the CEMAP program are new color ranges of Texas Bluebonnets (*Lupinus texensis*), roses that can be grown in acidic, neutral, or alkaline soils such as Belinda's Dream Rose, a number of vegetables as the hybrid Tomato 444 (*Lycopersicon esculentum*) which is resistant to the spotted wilt virus, and woody plants including Mexican Firebush (*Hamelia patens*) and Satsuma Orange (*Citrus reticulata*). The only tree promoted has been the Chinese Pistache (*Pistacia chinensis*) which according to Arnold et al. (1998) has become one of the most widely recommended trees in the state.

Rodriguez (2006) investigated the economic impact of Texas Superstar ™ on the green industry, and found that four plants (Satsuma's, Gold Star Esperanza, Perennial Hibiscus and Belinda's Dream Rose) were million-dollar sellers for the Texas' nursery industry within four years of their introduction. In addition, The CEMAP group estimated that approximately $10 million in new plant sales have been generated as a result of the first ten years of the program (Mackay et al. 2001).

On the other hand, Earth-Kind ™ is an environmental stewardship program promoted by Texas AgriLife Extension Service that encourages the use of efficient, traditional and organic gardening techniques, aiming to create a horticultural system based on environmental protection. The program seeks to ensure that gardeners and landscapers across Texas have access and actively use environmentally friendly practices.

The key objectives of Earth-Kind™ are water and energy conservation, reduction of fertilizers and pesticides use, and decrease of yard wastes entering landfills. Sustainable landscaping practices that it promotes in order to achieve these objectives include rain water harvesting, the use of low volume irrigation systems, Integrated Pest Management (IPM), windbreaks, mulching, composting, proper pre-design of the landscape, and suitable plant selection.

Information is mostly disseminated trough the program's website. Sections featured on the site include an online evaluation for the gardener about the cultural practices used and its contribution to a sustainable environment (the Earth-Kind™ Challenge), an online training which offers informational modules about Earth-Kind™ principles (the Earth-Kind™ On-Line Master Gardener) along with an interactive version for kids (the Junior Master Gardener), a plant selector, and several publications and videos regarding landscaping practices.

The Earth-Kind™ plant selector allows gardeners to make a search by zip code for plants with higher propensity to adapt to the specified region. The Earth-Kind™ Index value, which ranges from 1 to 10, is a measurement on five resource efficiency categories. Plants are rated for heat tolerance, drought tolerance, pest tolerance, soil requirement and fertility requirement. Those plants with an Earth-Kind™ Index value of 8 or higher are considered as extremely resource efficient.

Additionally, the Earth-Kind™ specialists created in 1996, the Earth-Kind™ Rose Program. Since roses are considered in horticulture one of the most difficult to grow garden flowers, the program was defined by a number of experts as probably the most significant development in rose horticulture (Hammond 2005). In this program, research is conducted to identify cultivars of landscape roses which are attractive, heat and drought tolerant, tolerant of poorly aerated, highly alkaline clay soils, and so tolerant/resistant to disease and insect problems that pesticide applications are seldom required (Arnold et al. 2002).

The first research study was initiated in 1996; it included 468 bushes, and lasted five years. During the study, the roses received very little irrigation, they were never fertilized, pruned, sprayed with fungicides or insecticides, and the test beds contained unimproved soil. In 2002, the results of the initial phase of the research program showed that from all the cultivars studied, only 11 demonstrated impressive performances despite the adverse growing conditions (Hammond 2005).

According to Rodda (2008), a total of seventeen roses have been designated as Earth-Kind ™ roses to date. Earth-Kind ™ cultivars vary from dwarf shrubs such as the “Marie Daly” roses, to medium, to large shrubs as “Mutabilis” roses and are being sold at the wholesaler and retailer level in Texas. An example marketing budget for Belinda’s Dream, an Earth-Kind Rose ™, is provided in Table 1.2.

The Texas-born program has also caught the attention of universities in other states. Testing of Earth-Kind ™ roses is being done at The University of Minnesota, Kansas State, Iowa State, University of Nebraska-Lincoln and Colorado State. Moreover, through a joint effort the Dallas suburb, Farmers Branch, and the Houston Rose Society, research to produce a national collection has being started.

**Table 1.2 Typical Media Budget for an Earth-Kind Rose ™**

| Belinda's Dream | | | | |
|---|---|---|---|---|
| Item | Cost (US$) | Insertions | Times | Total (US$) |
| Neil Sperry Radio | 200 | 3 spots | 2 shows | 1,200 |
| Gardens Magazine | 3,262 | 1 insertion | 2 issues | 6,524 |
| Texas Monthly | 17,305 | 1 insertion | 2 issues | 34,610 |
| Outdoor | 3,000 | 5 posters | 2 months | 30,000 |
| Online Advertising | 30 | 2 websites | 2 months | 6,000 |
| Co-op Advertising | 3,500 | 2 insertations | 2 weeks | 7,000 |
| | | | | **85,334** |

Source: Pocheptsova et al. (2008)

**Problem Statement**

Both of these promotional/educational programs were developed in an attempt to raise awareness among consumers of Texas-grown plant materials while supporting environmental responsibility. In addition, the programs were intended to provide Texas' green industry producers with products that have differentiating features and that can be sold at a price premium, in an effort to increase green industry margins. Since these brands aim to increase the chances of gardening success, the market price is indeed higher than that of a regular plant. To maintain program credibility in the marketplace, a considerable investment in research, expertise involvement and marketing needs to be done in order to assure a new plant release.

While many promotional campaigns have been undertaken over time and an extensive coordination among scientists, producers, sellers, and other partners is necessary, no research has focused on analyzing in great detail Texas' consumers behavior with respect to these programs. In spite of the fact that selected indicators of consumer awareness (i.e. sales statistics) have been recorded, no emphasis has been given to consumers' brand awareness and furthermore the consumers' willingness-to-pay (WTP) for Texas Superstar ™ and Earth-Kind ™ plant materials. Assessing and understanding the factors that influence the depth of brand awareness and WTP for a brand is crucial information for a maturing industry (Macdonald and Sharp 2003).

**Objectives**

The overall objective of this research is to gain a better understanding of the determinants of brand awareness and WTP for the Texas Superstar ™ and the Earth-Kind ™ programs, to measure their extent, and to evaluate the overall effectiveness of these branding efforts in the Texas area.

In order to accomplish the overall objective, this research has several secondary objectives. First, to construct a profile of the consumer's behavioral and demographic characteristics that is more likely to influence brand awareness and WTP. This will be achieved by estimating two econometric models for each brand and identifying the individual implications of each model. Second, to assist decision makers in the Texas' green industry in improving their marketing strategies for current and future plant material releases (i.e. to target particular consumers and/or to assign a greater proportion of marketing spending in certain geographical areas). Third, to evaluate the brands' level of recognition in the marketplace among other plant promotion programs. Lastly, to develop greater sensitivity in measures of brand awareness and WTP, and to provide researchers with a methodology that might be transferable to similar studies in other states with state-sponsored or non state-sponsored marketing programs.

**Organization of the Study**

This thesis is organized in six chapters. Chapter II is a review of literature on preferences and utility, utility maximization, choice modeling and random utility theory, brand awareness, and willingness-to-pay. Chapter III presents an overview of the U.S. green industry, and the economic impacts of the industry in the U.S. and Texas. Chapter IV is a description of the conceptual framework used to measure brand awareness and willingness-to-pay. In this chapter a detailed description of the models specifications and assumptions is presented. Chapter V includes the estimation and discussion of the econometric models. In Chapter VI, a summary of this thesis study is given and major conclusions are drawn.

# CHAPTER II

# REVIEW OF LITERATURE

This chapter consists of three sections. First, the characterization of individual preferences and the utility function are described. Indifference curves, the marginal rate of substitution, and utility maximization are also discussed. Second, choice models and the random utility theory are explained, and three probabilistic choice models are briefly discussed. Third, relevant brand awareness and willingness-to-pay literature is summarized, along with previous studies involving the use of probabilistic choice models.

## Preferences and Utility

When an individual chooses between two or more options, he/she will choose the option under which he/she feels better off. In consumer behavior theory, this preference relation is assumed to have three basic properties: completeness, transitivity and continuity. According to the completeness property, an individual can always compare and is never paralyzed by indecision. For example, in comparing A and B, the individual can always specify exactly whether A is preferred to B, B is preferred to A, or A and B are equally attractive. Transitivity implies that the individual's choices are internally consistent, which means that if A is reported to be preferred over B, and B is preferred over C, then A has to be preferred over C. Finally, the continuity assumption rules out discontinuous preferences that pose problems for the mathematical development of the theory of choice. Basically, it entails that if A is preferred to B, then situations suitably close to A must also be preferred to B (Snyder and Nicholson 2008).

Given these assumptions it is possible to show that people are able to rank all possible situations from the least desirable to the most. This ranking is called utility. If a person prefers situation A to situation B, then the utility assigned to option A, denoted by U (A), exceeds the utility assigned to B, denoted by U (B). Moreover, subjective values, sometimes expressed in units called “utils”, are assigned to every choice.

In Utility Theory, consumers gain utility from the consumption of goods and services. This theory is concerned with structures of preference on a choice set, and individual preferences are represented by a utility function of the form:

(2.1) $$utility = U(X_1, X_2, ...X_n; other)$$

where the *X*s refer to the quantities of the goods that might be consumed and “other” is a reminder that many aspects of individual welfare are being held constant in the analysis (often referred to as the *ceteris paribus* assumption). For simplification, the utility function for any two goods can be written as:

(2.2) $$utility = U(A, B)$$

where $A$ and $B$ are the two goods under consideration.

A curve representing all the alternative combinations of A and B for which an individual has the same level of utility can be developed if the other arguments of the utility function are held constant. That curve is called an indifference curve, and it represents a set of consumption bundles about which the individual is indifferent. That is, all the bundles provide the same utility.

As an example, Figure 2.1 which shows a map of indifference curves with goods A and B. This consumer is indifferent between points 1 and 2 because the same utility ($U_3$) is perceived with any of these bundles.

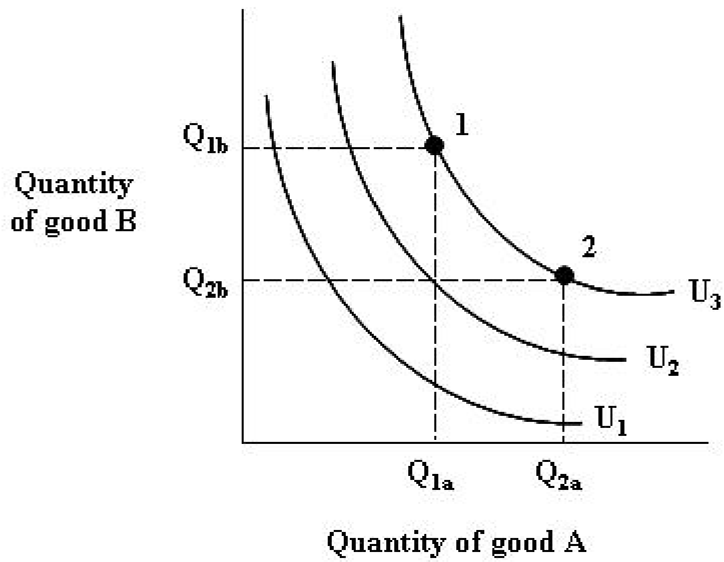



**Figure 2.1 Map of indifference curves**

For instance, if A refers to clothes and B to food, at point 1 this person has a lot of food compared to clothes, and at point 2, he/she has a lot of clothes compared to food. Still, this consumer is indifferent between bundles 1 and 2 since the same utility is expected from the consumption of any of them. If this person chooses to switch from one bundle to the other, he/she will remain in the same indifference curve.

In a map of indifference curves, movements in a northeast direction represent movements to higher levels of satisfaction (i.e. from $U_2$ to $U_3$). Assuming a rational behavior, an individual will always choose a bundle that belongs to the indifference curve that is the farthest away from the origin. However, this individual will encounter an income constraint that limits the indifference curve and the bundles that he/she can reach.

The slope at a given point of an indifference curve indicates the trades that an individual will voluntary make. It represents how much of product A an individual is willing to give up for additional units of product B. The slope is known as the marginal rate of substitution (MRS) at that point and is indicated by:

(2.3) $$MRS = -\partial y / \partial x \,\Big|_{U=U_1}$$

where $\partial y$ is the partial derivative of the utility function with respect to y (or the good in the y axis), $\partial x$ is the partial derivative of the utility function with respect to x (or the good in the x axis), and $U_1$ indicates that the slope is to be calculated along the $U_1$ indifference curve. The sign of the MRS is expected to be negative, because in order to obtain more of one product, one would have to trade it off and reduce consumption of the other.

**Utility Maximization and Choice**

To truthfully explain individuals' behavior and model choice, constraints in their incomes must be addressed. The budget set (Figure 2.2) represents those combinations of A and B that an individual can afford. If it is assumed that the individual is rational, and that will always prefer more rather than less of every good (i.e. normal goods), the outer boundary of the triangle is the relevant constraint where all income is spent in either A or B, and no savings are left.

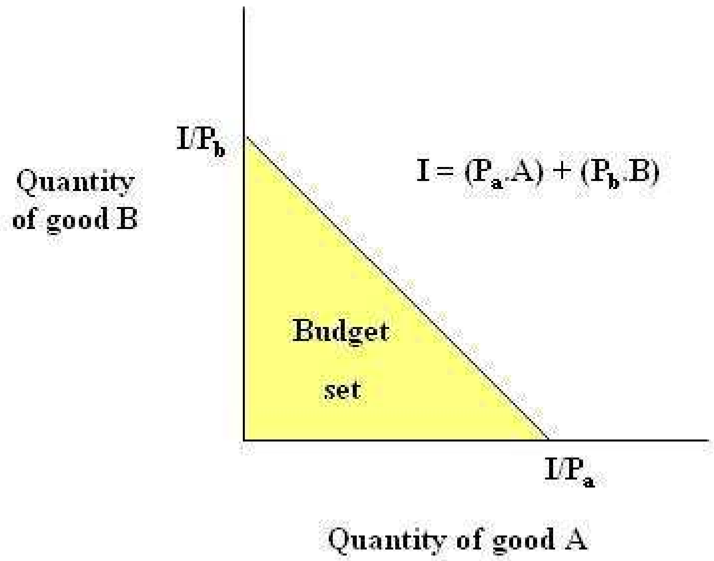



**Figure 2.2 Budget constraint**

The slope of this straight-line boundary is given by the ratio of the price of A ($P_a$) to the price of B ($P_b$), that is:

(2.4) $$Slope_{BC} = -(Pa/Pb)$$

where $Pa$ refers to the price of the good in the x axis and $Pb$ to the price of the good in the y axis.

In order to maximize utility, given a fixed amount of income to spend, an individual will ultimately buy those quantities of goods that exhaust his or her total income and for which the rate of trade-off between any two goods (MRS) is equal to the rate at which the goods can be traded one for the other in the marketplace ($P_a/P_b$). That is to say, that the optimal choice is a point of tangency between the budget constraint and the farthest out affordable indifference curve. Mathematically this occurs at the point where equality 2.5 holds (Snyder and Nicholson 2008).

(2.5) $$Pa / Pb = \partial a / \partial b \;\Big|_{U=U_k}$$

The individual graphically represented in Figure 2.3 will eventually spend all his/her money to buy $Q_a$* and $Q_b$* (recall: no savings assumption), and will receive for that budget, the maximum level of utility associated with indifference curve $U_2$.

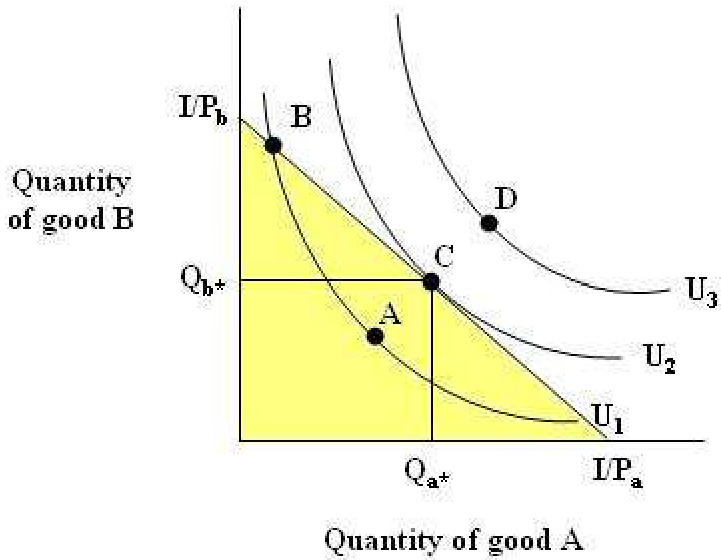



**Figure 2.3 Graphical demonstration of utility maximization**

Figure 2.3 illustrates that if the tangency condition is not met, this consumer could be made better off by reallocating expenditures. The individual would be irrational to choose point A since a higher utility ($U_2$) can be obtained simply by spending more. Similarly, by reallocating expenditures, the individual can do better than point B (i.e. point C), and this individual's income is not enough to purchase D. Therefore, the location of maximum utility for this consumer is at point C, where combination ($Q_a$*,$Q_b$*) is chosen.

**Choice Modeling and Random Utility Theory**

The specification of models that capture the decision making process of individuals dealing with many choices, require particular assumptions to be made about the decision maker, the alternatives, the attributes of each potential alternative, and the decision rules. In general, the decision maker is assumed to be an individual, this implies that if the decision maker is a group of persons (i.e. the government or a household), all internal decisions within the group are ignored and the decision of the group is considered as a whole. Moreover, every alternative readily available to the individual must belong to the choice set and, for all the alternatives in the set, the analyst has to identify the attributes that are most likely to affect the choice. Lastly, the consideration of uncertainty by the decision rules must also be addressed.

Decision rules describe the process used by the individual to reach his/her actual choice and are closely linked to the concept of utility associated with the alternatives (Bierlaire 1998). The utility theory explained before is derived from the Neoclassical Economic Theory. In this work, a subject's preferences or indifferences do not account for uncertainty and are considered to be non-probabilistic (Strauss 1996).

According to Bierlaire (1998), the complexity of human behavior suggests that a choice model should explicitly capture some level of uncertainty, and the assumption of deterministic decision rules of neoclassical economic theory presents strong limitations for practical applications. Thus, the Random Utility Theory, proposed by Daniel

McFadden and Charles F. Manski in the 1970s, has played a major role as the theoretical basis for discrete choice modeling.

Random Utility Theory (RUT) assumes, as neoclassical economic theory, that the decision-maker is rational and has a perfect discrimination capability. However, in this context the decision maker is supposed to have incomplete information and, therefore, uncertainty is taken into account. More specifically, McFadden (1974) describes the utility that individual *i* associates with alternative *a* as given by:

(2.6) $$U_a^i = V_a^i + \varepsilon_a^i$$

where $V_a^i$ is the deterministic component of the utility that reflects the representative tastes of the population, and $\varepsilon_a^i$ is the stochastic component that captures the uncertainty.

Different assumptions about the distribution of the stochastic portion of utility produce different choice models. Gujarati (1995) acknowledges that the four most commonly used discrete choice models derived from RUT are the Linear Probability Model (LPM), the Logit model, the Probit model and the Tobit (or censored regression) model. These models are also known as Qualitative Response (QR) models because the values taken by the dependent variables correspond to some qualitative outcome (i.e. qualitative choices, rankings, counts). The first three models are known as binary choice models whenever the outcome refers to a “yes or no” decision, and the tobit model is in essence an extension of the probit model.

While the LPM is the simplest of the binary choice models, it has several limitations: the random component is not normally distributed, there is a possibility for the estimated probabilities to lie outside the 0-1 bounds and the variances of the random terms are heteroscedastic (the error variance is not constant through out the sample). More suitable probabilistic models are the logit and the probit models; both of them are nonlinearly related to the explanatory variables and guarantee the estimated probabilities to lie in the 0-1 range. The main difference between the probit and the logit models is that the random term of the logit model is associated with a logistic cumulative distribution function (CDF), while in the probit model the disturbance term is normally distributed. In contrast, the tobit model was developed to describe the relationship between a non-negative dependent variable (not necessarily binary), and an independent variable or vector. Various researchers have made extensions of the binary choice models including bivariate probit, ordered probit, among others.

These types of binary choice models examine choice situations in which the potential outcomes are discrete; explicitly, problems that involve choices between two or more discrete alternatives, such as entering or not entering the labor market, being aware or not of a product, and consuming or not a certain good. These models have been extensively used in psychology (Strauss 2006), marketing research (Baltas and Doyle 2000; Swait and Erdem 2007), and are regarded as the most used choice models for transportation applications (Bierlaire 1998, Ben-Akiva and Bierlaire 1999; Ben-Akiva and Lerman 1985).

In marketing research, brand choice models based on RUT, assume that the consumer's utility for a brand depends on the consumer's underlying preference for the brand and observable marketing variables such as price, advertising, packaging etc., and on utility that is unobserved by the marketing researcher. In other words, a consumer's utility for a brand is parameterized as a deterministic function of observed marketing variables plus a random error term. A rational individual is modeled as choosing the brand with the highest utility among those available on the purchase occasion and, any difference between the consumer's actual choice and the choice predicted by the maximum utility rule, can only be attributed to the random error which captures the researcher's uncertainty about the consumer's utility function (Pazgal, Seetharaman and Batsell 2005).

**Brand Awareness**

A brand has been defined as a name, term, sign, symbol, design, or a combination of these, which is intended to identify the goods and services of a seller and to differentiate them from those of the competitors (Kotler 1991). While in general, branding as a marketing strategy has become rather common, measuring its effectiveness has been regarded by marketing managers as a challenge, mainly because of the lack of investment in measurement systems and the seldom institution of brand metrics to business performance.

Munoz and Kumar (2004) studied the link between brands and business performance and their results emphasized that the measurement of the strength and success of an organization's brand is in its infancy. Although intangible assets are certainly the largest part of corporate value, and brand is often the largest component of intangible assets, few businesses seem able to actively measure their brands' impact. Davis (2004) confirms that in fact, few companies worldwide measure the performance of their brands. *Prophet*, a global consultancy firm specializing in branding and marketing, showed that only one-third of 90 companies surveyed during 2001 made use of brand metrics of some sort.

The rationale behind few investments in brand effectiveness measurement systems may be attributed to its cost. A measurement system is most powerful when viewed as a tool for continuous improvement rather than as a static snapshot in time of the brand's performance but the implementation of a continuous brand measurement system could be a highly costly activity.

Munoz and Kumar (2004) argued that in today's environment there exists a gap in priorities between marketers' and chief executive officers' objectives (CEO). Executives' primary focus is to increase shareholder's value and not to invest in developing capabilities. Moreover, according to a survey by the Marketing Forum, about marketing leadership among United Kingdom companies, marketing professionals remain short of representation at "top tables". The survey found that only five FT-SE 100[1] businesses had a marketer at the board level.

Even though brand performance measurement can be perceived as an expensive task often considered secondary by corporate decision makers, its benefits are broad. As suggested by Munoz and Kumar (2004), the most important benefit is that it links brand management and business performance. It helps businesses to understand how the brand performs against customer expectations and the competitive set, to identify brand

[1] The FT-SE 100 consists of the largest 100 companies in the United Kingdom, by full market value.

weaknesses before they become business problems, and to establish areas to focus brand building efforts to create business value.

Brand awareness is a crucial concept for marketing practitioners, yet it is frequently not evaluated in a constant basis or often times wrongly measured. Macdonald and Sharp (2003) investigated the use of brand awareness as measures of marketing effectiveness among marketing managers in South Australia and found that less than 50% could provide a reasonable definition of the concept and about 44% measured awareness only during the initial commercialization period of a new product or during advertising campaigns. While determining the breadth of a brand's awareness is quite easy, measuring depth of brand awareness is extremely difficult. The depth of brand awareness refers to the level of accessibility of the brand in the consumer's mind and is the factor of most interest to mature markets. The authors concluded that the managers' lack of interest could be partially justified by the insensitivity of existing metrics of brand awareness.

In general, Davis (2004) categorizes appropriate brand metrics into two categories: performance metrics and perception metrics. Performance metrics range from price premium to loyalty whereas perception metrics monitor the more intangible aspects of brand such as consideration and awareness. Financial metrics, like market share and operating cash flow are also widely employed (Rajagopal 2007).

Market share is a financial metric frequently used to evaluate a brand’s overall performance and the efficiency of a company’s marketing communications. It is calculated as the number or value of units sold in a given period of time as a percentage of the total market size. However, as exposed by Brown (1986), when using sales as a performance metric it should be considered that sales are influenced by several other factors such as changes in pricing, special offers, prominence in the retail stores space and variations in all of these for other competitive brands.

Market penetration is a metric that considers the number of customers a brand has as a percentage of the total customers in the marketplace. An indicator of market penetration is brand awareness, that is, the percentage of consumers in a market able to name a certain brand. Brand awareness is considered a partial indicator of market penetration given the fact that a customer being aware of a brand does not imply an actual purchase, but a consumer of a product is expected to be conscious of the brand.

As a result, it is important to not only consider the measurement of brand performance an essential task, but also to visualize the study of brand metrics as an integrated analysis. For instance, a company with a large market penetration but a low market share may be experiencing many low-value sales and, if raising market share is among its objectives, it should increase sales rather than chasing more consumers. In the same way, brand awareness can be crossed-analyzed with market penetration to assess the depth of brand coverage and brand reach, namely, the brand awareness among actual consumers and the potential to win new consumers respectively (Rajagopal 2007).

Brand awareness has been defined as a rudimentary level of brand knowledge involving, at the least, recognition of the brand name (Hoyer and Brown 1990). It relates to brand recognition, but also to brand recall performance by consumers, explicitly to the likelihood that a brand name will come to mind and to consumers' ease of recall. While brand recognition requires consumers to have seen or heard the brand previously, brand recall refers to consumers’ ability to retrieve the brand from memory. In addition, brand awareness in conjunction with brand image, form what is known as brand knowledge (Keller 1993).

Since it is typically expected that a higher rate of product awareness in the market generates higher sales, the creation and enhancement of brand awareness has been considered a primary job for the manager (Pitts and Katsanis 1995). For the consumer, brand awareness plays an important role in decision making for three major reasons. First, it raises the likelihood of the product to be in the consideration set and to be purchase; second, it is seen as a major choice rule even if there are no other brand associations (i.e. a minimum level of awareness may be sufficient for the product to be chosen, regardless of the other brands availability in the set); and third, it influences the formation and strength of brand associations in the brand image (Keller 1993).

Research regarding the effects of brand awareness on consumer choice, has shown that when brand awareness is present subjects will be significantly more likely to base their decisions on brand awareness as choice rule despite price and quality differentials; however, when no awareness is present, other criteria like packing and price are estimated to be employed (Hoyer and Brown 1990; Macdonald and Sharp 2000). Additionally, brand awareness needs to pre-exist in order to develop concepts such as brand preference (Alreck and Settle 1999), brand equity (Aaker 1996) and brand attitude (Rossiter and Percy 1987).

The majority of research about estimating consumer awareness in the literature has focused in descriptive statistics such as frequencies and percentages, and inferential statistics like cross tabulation (Tzimitra-Kalogianni et al. 2002; McLean-Meyinsse and Larks 2006). A lesser amount of studies involving discrete choice models and appropriate econometric analysis is found (Obubuafo et al. 2008; Lin, Jensen and Yen 2004; Govindasamy, Italia and Thatch 1998).

A discrete choice model (logit) was used by Govindasamy, Italia and Thatch (1998) to measure the success of the Jersey Fresh Program (JFP), a state-sponsored marketing program in New Jersey, in terms of the program's awareness. The JFP was initiated in an effort to boost the net returns of New Jersey's Farmers, and to increase the share of New Jersey's produce in their retail markets. The purpose of this program was to promote locally grown fruits and vegetables by highlighting the freshness of New Jersey produce over others shipped from out of state. Although the awareness of the program was surveyed previously, as a result of the study the authors were able to provide a comprehensive analysis of the consumers' behavioral attitudes and demographic profiles. Behavioral variables that indicated a higher propensity of awareness included consumers who shopped at direct marketing facilities, such as farmer's markets and roadside stands, those who frequently read food advertisement in newspapers and grocery stores. and those who were willing to change their usual shopping place in order to buy specially advertised produce. Major demographic characteristics included age and education variables. Awareness was found to be high among consumers (77 %), and contrary to the expectations, the results indicated that the program was popular among young consumers, with less than a high school degree, and those who were employed by others instead of retired or self-employed.

Obubuafo et al. (2008) used a probabilistic approach to determine the extent of awareness of the Environmental Quality Incentives Program (EQIP) among Lousiana Cow-Calf producers. The types of cattle producers who were most likely to have the greatest awareness of and to be the most extensive applicants to government programs, specifically the EQIP were identified. Results indicated that awareness depended on income derived from off-farm sources, farmed land, producers' age, and contact with the Natural Resource Conservation Service and extension service personnel. Likewise, the determinants of U.S. consumer's awareness of food borne pathogens were investigated using a probit model (Lin, Jensen and Yen 2004).

**Willingness-to-Pay**

Consumer recognition of a brand is closely linked with the consumer's response and willingness-to-Pay (WTP) for the product. In India for example, organic produce awareness was studied among Kerala's consumers, one of the major markets of organic vegetables, fruits, spices and milk products in this country. As expected, consumers who were aware of the products had a higher WTP for organic produce (Dana et al. 2009). Furthermore, since brands have been less commonly used in horticultural goods, an emphasis in studying consumers' WTP for brands has gained popularity in agricultural marketing.

WTP is a measure of value used by an individual when buying an object (Shogren et al. 1994); it denotes the maximum price a buyer is willing to pay for a given quantity, that is, a ratio-scaled measure of the subjective value the buyer assigns to that quantity. In neoclassical theory of consumption, the marginal WTP in terms of any two goods X and Y is given by the slope of the indifference curve, which equals to the marginal rate of substitution (MRS) between the goods.

For instance, a MRS of Y in terms of X ($MRS_{y\ x)}$ equal to -3 indicates that this consumer is willing to pay 3 units of Y to obtain an additional unit of X. It also specifies the seller's Willingness to Accept (WTA), which indicates that the seller is willing to accept 3 units of Y to give up one unit of X. A map of indifference curves was illustrated previously in Figure 2.1, and the equation to compute the MRS at any given point of an indifference curve was shown in Equation 2.3.

WTP can also be expressed in terms of prices. The reservation price for a good denotes the buyer's maximum WTP or conversely, the seller's minimum WTA. The differences between reservation prices and the current market price bring into being consumer and producer surplus. Consumer surplus is the amount that consumers benefit by being able to purchase a product for a price that is less than the price they would be willing to pay, and producer surplus is the amount that producers benefit by selling at a market price that is higher than the price they would be willing to sell for. Therefore, both of these measures suggest a monetary measure of the benefits that consumers and producers receive from market participation.

As illustrated in Figure 2.4, at equilibrium price, WTP equates WTA, producer and consumer surplus are zero, and equilibrium is reached. These conditions hold under the assumption of a competitive market where companies are price takers, opposed to a monopoly or a duopoly, where companies are price setters or operate under little competition.

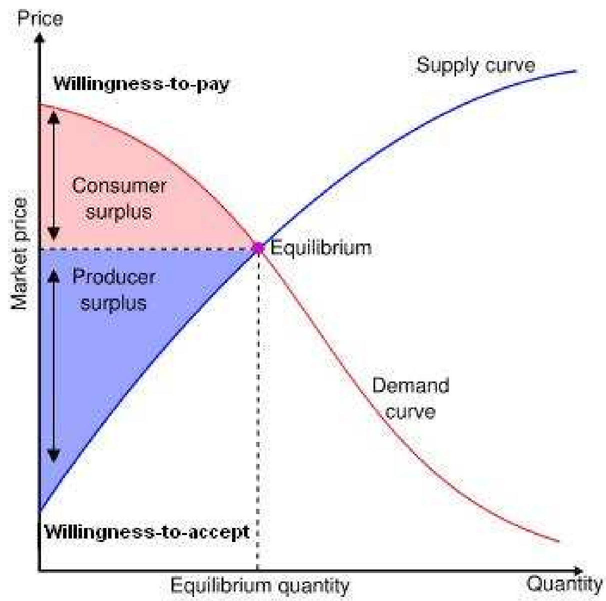



**Figure 2.4 Graphical representation of willingness-to-pay (WTP) and willingness-to-accept (WTA)**

Economists, psychologists and marketing researchers rely on measures of consumers' WTP in estimating demand for private and public goods and in designing optimal price schedules (Wertenbroch and Skiera 2002), given that this measure is the best indicator of individual preferences available to specialists (Golan and Kuchler 1999).

Since WTP is an extensively used technique to assess preferences, there are many approaches to its appropriate measurement. Breidert, Hahsler and Reutterer (2006) illustrate several methods that have been presented in the literature thus far to calculate WTP under different conceptual foundations and methodological implications. A graphical framework of these approaches is shown in Figure 2.5.

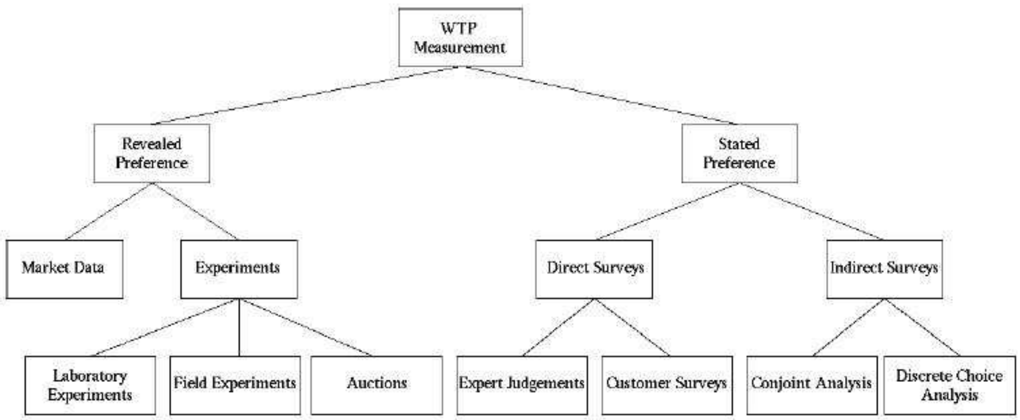



**Figure 2.5 Classification frameworks for methods to measure willingness-to-pay**

Market researchers can estimate WTP either from revealed preferences (RP), which comprises actual market transactions and simulated markets, or from stated preferences (SP), that consists of direct and indirect survey data.

Revealed preferences (RP) are known to have high external validity since actual purchases are observed under realistic marketing-mix conditions. Some limitations include that in the real world when a good is purchased, it is impossible to identify what goods had to be discarded for that given preference. Transactions data are also unavailable for products not yet been offered in the market and what is more, the data reveals only that a buyer’s WTP is at least as high as the posted price and that a non-buyer’s WTP is lower than that price.

Stated preferences (SP) in contrast, can be used in new product developments and in public goods (Wertenbroch and Skiera 2002). The majority of analysis of consumers’ WTP for non-market resources (public goods), are applications concerning environmental goods (Azevedo, Herriges and Kling 2003), outdoor recreation (Fried et al. 1995; Walsh, Miller and Gilliam 1983) and health economics (Nocera, Bonato and Telser 2002; Asgari et al. 2004). Criticism to survey-based economic techniques includes response bias given that respondents may not take notice of their budget constraints.

Even though there are reservations about the use of SP to determine WTP for a good, there is also considerable evidence in the literature that answers to carefully designed surveys contain valuable information (Azevedo, Herriges and Kling 2003). Haener et al. (2001) studied the use of SP and concluded that as long as the questions are correctly formulated and prior exposure to the subject minimized there is merit in pursuing the use of these methods in economic analysis. Often, SP models are used to determine which attributes consumers are most sensitive to when RP methods are incapable of determining an accurate forecast of behavior (Bower and Baxter 2000).

A direct approach to measure WTP using SP is to openly ask customers an specific WTP or to survey marketing specialists. Consumers’ WTP for private price-based goods has been measured as the average premium that consumers are willing to pay above the regular price assuming a fixed price per unit for an existing product

(Loureiro 2002) or simply as the total price willing to pay for a hypothetical product (Lenert et al. 1999).

Indirect approaches available for marketing analysts to estimate WTP with survey data include conjoint analysis and discrete choice analysis. Conjoint analysis is a technique for measuring individuals' preference structures via variations of product attributes in an experimental design. Basically, the respondents are presented several product profiles with textual and/or graphical descriptions and are given the task to assign a preference ranking to each of these profiles. In discrete choice modeling, WTP and the choice's probabilities are estimated trough regression analysis.

Asselin (2005) estimated the WTP for omega-3 and vitamin enhanced eggs using a discrete choice model (logit) and the levels of the explanatory variable. WTP was calculated for different groups from the survey sample and it was found that even though WTP increased as health consciousness and health behavior indicators increased, the price premium for functional eggs exceeded what consumers were willing to pay for their attributes. For example, very health conscious respondents indicated the greatest WTP of $0.72 per unit, while the existing premium for omega-3 eggs was $0.93, suggesting that consumer's willingness-to-pay was 23% less than the actual market price.

Yahong, Zilberman and Heiman (2008) compared the point value of WTP and ranges of WTP for brands across four product categories including electronics, clothing, packaged food and fresh produce. Similar results were found using the stated point of WTP by means of tobit, random effect tobit, and OLS models controlling for brand preference. The study found that WTP for fresh produce is least among the four product categories. If a variable to account for brand preference was included, consumers were willing to pay 5-6% more for brands in electronics, clothing, and packaged food than for brands in fresh produce. The results also suggested that females were willing to pay 5% more for brand products than males, African Americans had the highest stated WTP for brands at 19% more than white respondents, and consumers with strong brand preferences were willing to pay approximately 16% more for brand products. An ordered probit model for the ranges of WTP was used and the study showed that more educated consumers had a lower WTP range, and that white respondents were likely less willing to pay more for brands than other ethnic groups.

# CHAPTER III

# DESCRIPTION OF THE U.S. AND TEXAS GREEN INDUSTRY

This chapter consists of an overview of the environmental horticulture industry, commonly referred to as the green industry, in the United States and Texas. First, an introduction with a description of the green industry's productive chain and the role of each segment are outlined. Second, an overview of the U.S. green industry's sales trends is given. Third, the economic impacts of the industry in the U.S. are summarized and discussed. Finally, the economic impacts of the industry specifically to the state of Texas are discussed.

## Introduction

Environmental horticulture is defined as the science and art of cultivating, processing, and marketing ornamental plants for human and environmental benefit. This industry, also known as the "Green Industry" encompasses all the people, products and firms involved in horticultural services, which design, install, construct, plant, and maintain outdoor environments. The industry is also linked to urban forestry by providing plant material and personnel expertise for managing cities' and other public landscapes. Moreover, the green industry refers to input suppliers, wholesale distributors, retail operations, and production firms such as nurseries, floriculturists, and turf growers.

Input suppliers, also known as allied trade firms, provide the industry with seeds, agrichemicals, fertilizers, containers, machinery, propagative materials, consulting, and any other inputs necessary for the production process. Then, production firms such as nursery, greenhouse and turf growers transform these inputs into the green industry’s products.

Nursery crops are defined as woody perennial plants that are typically grown in containers or in-ground and include ornamental trees (together with Christmas trees), shrubs, vines, and fruit and tree nuts for ornamental use. Since the demand of these products is seasonal throughout the year many nurseries may also sell other related products like soil. Each plant species that is grown in-ground has a hardiness zone that sets the northern geographic latitude, therefore the location of nursery production units depends largely upon soil and climate conditions, availability of water, accessibility to markets, and the cost of land. On the other hand, greenhouse growers specialize in the production of cut flowers, foliage, potted flowering plants for indoor use, bedding plants which consist of young flowering plants (annual and perennials), and vegetable plants. Turf growers, are specialized nurseries that usually only produce a subset of turf grass varieties that are hardy for their particular region.

The final products are then sold to end users (i.e. homeowners, horticultural services firms) or distributed by wholesale or retail operations. Wholesalers typically use a lot of intermediaries such as importers, brokers, and transporters, and sell large quantities of products to either retailers or re-wholesalers (also called horticultural distribution centers). Retail operations range from independent garden centers, florists, and home improvement centers, to mass merchandisers and chain stores. These businesses sell inputs and final products, including their own grown products.

In the U.S. there has been evident consolidation among large growers, mostly in response to retailer consolidation. The increase in the number of large home centers and mass merchandisers has created an opportunity for growers who can meet their product requirements (i.e. large volumes, custom labeling, bar codes, etc.). Nursery firms have grown rapidly through acquisition during the past decade in order to supply these large retailers, while independent garden centers, retail nurseries, and smaller landscape firms may be supplied by both large and small growers (Hall, Hodges, and Haydu 2005).

In 2007, the Economic Research Service (ERS) reported that the number of large floriculture farms in the United States was indeed decreasing. According to a fifteen-state survey conducted in 2006, the number of floriculture producers dropped around 9%, from 7,178 producers in 2005 to a total of 6,546 that year. Moreover, the estimated number of hired workers in the U.S. floriculture sector was 63% fewer than the number of workers in 1998 (Jerardo 2007).

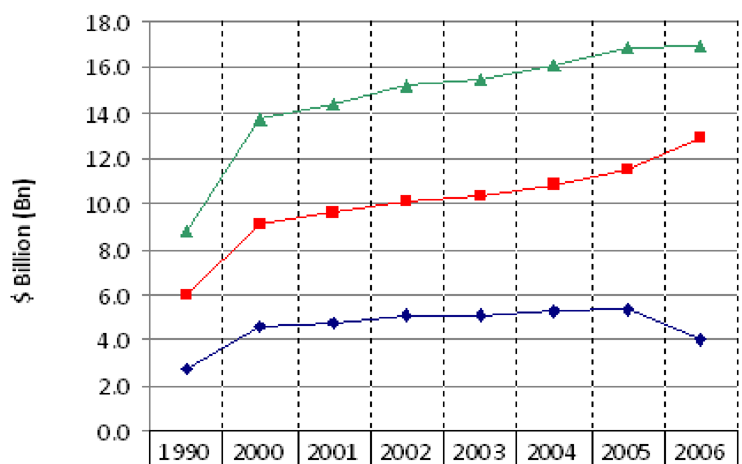
Other industries that interact with the green industry include marketing companies, paper mills which provide paper for catalogs or packaging; oil wells that generate petroleum products, fisheries that provide inputs for fertilizers' production, among many others.

**Overview of the U.S. Green Industry**

The green industry plays a major role in U.S. agriculture and trade as reflected in its contributions to the economy. In addition, it is considered one of the fastest growing segments of the United States' agricultural sector (Hall 2007).

Production and sales in this industry have depended largely upon growth in economic indicators such as new housing units completed, homeownership, disposable income, increases in population and following increases in construction. For instance, the green industry grew at a phenomenal rate during the real estate boom of the 1980s, which represented an affluent period in the U.S. economy history.

The floriculture and nursery crops sector sales have experienced an uninterrupted growth over time in spite of an U.S. economy facing recessionary periods on many occasions. Figure 3.1 illustrates growers' sales receipts of floriculture crops, including commercial growers with at least $10,000 in annual crop sales, and receipts of nursery crops along with records of Christmas trees sales. Source: USDA-NASS, Floriculture Crops; USDA-ERS.




| | 1990 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|
| Floriculture crops | 2.7 | 4.6 | 4.8 | 5.1 | 5.1 | 5.3 | 5.4 | 4.0 |
| Nursery crops | 6.0 | 9.1 | 9.6 | 10.1 | 10.4 | 10.8 | 11.5 | 12.9 |
| Total floriculture and nursery crops | 8.8 | 13.7 | 14.4 | 15.2 | 15.4 | 16.1 | 16.8 | 16.9 |

**Figure 3.1 U.S. floriculture and nursery crop grower sales receipts for 1990 and the 2000-2006 period**

During the early 1990s U.S. consumers faced a recession caused by the burst of the 1980s real estate boom, the savings and loans financial crisis (institutions that provide mortgage loans), and higher oil prices resulting from the First Gulf War. After the economy recovered, a significant period of economic prosperity followed, but the economic downturn in the late 1990s resulted in thousands of Americans losing their jobs. Whereas the trend of the U.S. economic environment throughout the 1990s was marked by sharp fluctuations, total sales of floriculture and nursery crops increased, reflecting the overall expansion of the economy between 1992 and 2000. Over this period, total floriculture and nursery grower sales increased an exceptional 56%, from $8.8 billion (Bn) to $13.7 Bn (Figure 3.1).

The current decade, with an opening weaker U.S. economy, led to a slower growth in total sales of around 5% yearly from 2000 to 2002, and around 4.4% per year from 2003-2005. This percentage of growth represented a much slower growth compared to the previous years, but yet another period of continuous annual sales increases. Since 2005, the economy has been experiencing higher oil and energy prices. The costs of fertilizer, storage, processing, transport, and overall greenhouses operation costs have been rising. In addition, the consumers' cost of living has also increased, resulting in reduced consumer spending on discretionary goods such as ornamental crops.

A slower rate of growth in total output is one of the major indicators of a maturing industry. Under this evidenced market conditions, growers have to cope with diminishing expected gains, increasing costs of production, and tighter margins. In 2006, the gain in total sales was projected by the USDA to be really modest and to reach $16.9 Bn.

In terms of household expenditure, demand for ornamental crops is also increasing at a lower rate each year. According to the USDA Floriculture and Nursery Crops Outlook of 2007, every U.S. household spent, on average, $132 in floriculture and nursery crops in 2003, which is $30 more than the average spending over a decade ago and an increase of 2.3% from the previous year. In 2006 the percentage increase with respect to 2005 was 0.6%, that is, a $1 increment in per household expenditure (Figure 3.2).

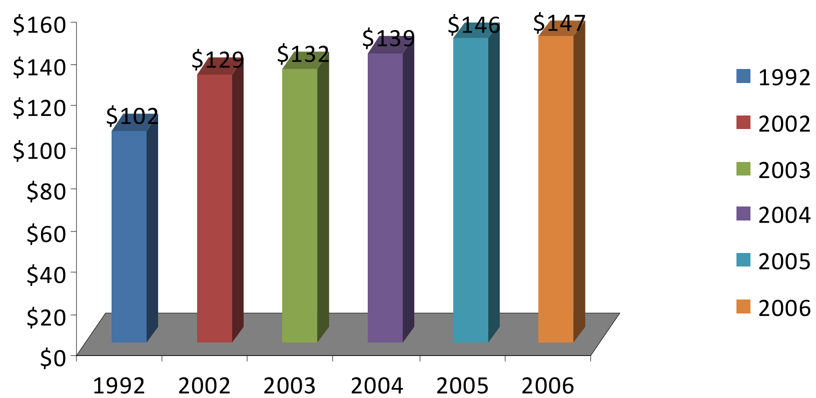



**Figure 3.2 U.S. household expenditure on floriculture and nursery crops ($/HH)**

Floriculture and nursery sales had an overall increasing trend in the past years; however, if floriculture and nursery crops are analyzed separately, it is evident that floriculture sales have actually decreased. According to Jerardo (2007) competition from imported cut flowers from South America has reduced domestic growers' market share. For instance, roses, mums, and carnations face strong competition from imports, largely from Colombia and Ecuador. The share of U.S. cut-flower's consumption coming from imports was around 50% in 1993, by 2006, it increased to 66%.

Trade influences domestic production mainly for cut flowers. Even though nursery stock is also shipped from Canada and the Netherlands, the volume is not comparable to that of cut flowers, and furthermore, the currencies of these countries have appreciated against the U.S. dollar in the past years, turning exports of nursery crops less profitable than before.

With respect to other sectors of the green industry, such as horticultural services firms, retailers and garden stores, and equipment providers, output data has shown an increasing trend in the long term (Figure 3.3).

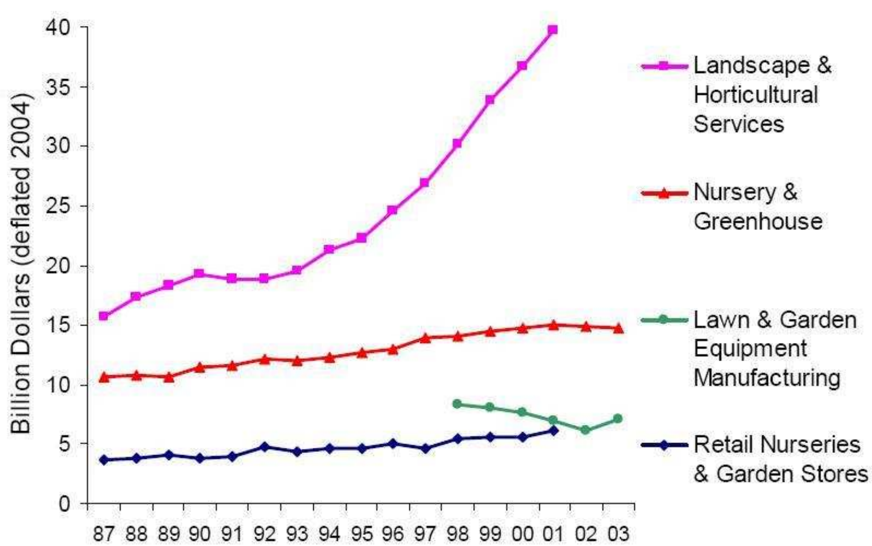



**Figure 3.3 Growth in output of U.S. green industry sectors, 1987-2003 (Values expressed in constant 2004 dollars using GDP implicit price deflator (USDOC))**

According to Hall, Hodges, and Haydu (2005), horticultural services firms have experienced a substantial increase in output since the mid 1990s. This sector grew from around $15 Bn in 1987 to nearly $40 Bn in 2001, representing an average annual growth rate of 11.0 %. These companies provide two primary services: mowing and lawn maintenance where the latter represents the greatest total revenue for landscape businesses. Nevertheless, almost 50% of horticultural services firms have become more diverse since 2002, offering a greater number of services. For instance, in 2004, 59 % of the companies who primarily mowed also offered construction services, 24 % also offered chemical lawn care, and 53 % also offered arborist services. In the same year, horticultural services firms' revenue and producer's confidence improved; while in 2002 and 2003 around 58% of producers expected an increase in revenues, this percentage increased to 84% in 2004.

The retail nursery and garden stores sector has also grown significantly in terms of sales while the lawn and garden equipment manufacturing sector has actually declined. Between 1998 and 2003, the retail sector grew in output from $3.7 to $6.2 Bn, averaging a 5% annual growth, and the garden equipment declined from $8.3 to $7.1, a 2.7 % decrease annual rate. Although the output of equipment manufacturers was decreasing and it recovered partially in 2003, the demand for power lawn and garden equipment was projected to rise over 3% per year throughout 2009, reaching $10.7 billion. Reasons to forecast this increase include product innovations such as cordless equipment and an expansion of customers within target demographic groups. Customers in the age group of 55-64 years old are frequent users of garden equipment and professional lawn care services, and female customers account for a growing portion of equipment sales and use.

From the two markets that the lawn and garden equipment sector supplies, the residential market is accountable for most of the sales in this sector; in 2004, 67% of the sector's sales were generated by this market. However, technological advances in the commercial market, increasing popularity of golf in the U.S., and a higher demand of professional landscapers are enlarging sales in this market as well.

**Economic Impacts of the Green Industry in the United States**

A model that represents an industry's flow of economic activity demonstrates what each sector is required to purchase from every other sector in order to produce its output. Measures of economic activity include output or sales, income, jobs, and value added. The concept of value added refers essentially to the contribution of the factors of production (i.e. labor and capital) to raising the value of a product and corresponds to the incomes received by the owners of these factors. The factors of production provide services which raise the unit price of a product relative to the cost per unit of intermediate goods used up in the production of that product. This measure is the most commonly used indicator of the contribution of a region to the nation's economy as it avoids double counting of intermediate sales and captures only the value added by the region to final products.

In 2002, economic impacts of commercial activity for the U.S. Green Industry were estimated at $148 billion (Bn) in output, 1,964,339 jobs, $95.1 Bn in value added, $64.3 Bn in labor income, and $6.9 Bn in indirect business taxes; these values are detailed in Table 3.1, where the values for output, value added, labor income and indirect business taxes are expressed in 2004 dollars products (Hall, Hodges, and Haydu 2005).

**Table 3.1 Economic Impacts of the Green Industry in the U.S., by Sector, 2002**

| Industry Group/Sector (NAICS*) | Output ($Mn) | Employ-ment (jobs) | Value Added ($Mn) | Labor Income ($Mn) | Indirect Business Taxes ($Mn) |
|---|---|---|---|---|---|
| **Production and Manufacturing** | **34,578** | **300,677** | **20,796** | **11,037** | **784** |
| Nursery and Greenhouse (1114) | 26,053 | 261,408 | 18,076 | 9,612 | 647 |
| Lawn and Garden Equipment (333112) | 8,281 | 37,343 | 2,610 | 1,346 | 129 |
| Greenhouse Mfg. (332311) | 244 | 1,927 | 110 | 78 | 7 |
| **Horticultural Services** | **57,774** | **753,557** | **39,013** | **30,269** | **1,387** |
| Landscape Services (561730) | 52,971 | 704,875 | 35,564 | 27,719 | 1,312 |
| Landscape Architecture (541320) | 4,803 | 48,683 | 3,449 | 2,549 | 74 |
| **Wholesale and Retail Trade** | **55,475** | **910,104** | **35,275** | **23,044** | **4,701** |
| Wholesale Flowers, Nursery Stock and Florists Supplies (424930) | 2,879 | 68,969 | 1,907 | 1,130 | 440 |
| Garden Equipment Wholesale (423820) | 4,146 | 40,617 | 2,737 | 1,601 | 657 |
| Lawn and Garden Stores (4442) | 22,859 | 347,916 | 14,806 | 9,747 | 1,810 |
| Building Material and Supply Stores (4441) | 9,982 | 123,591 | 6,491 | 4,258 | 789 |
| Florists (4531) | 7,195 | 200,451 | 3,977 | 2,725 | 401 |
| Food and beverage stores (445) | 2,263 | 35,117 | 1,385 | 944 | 156 |
| General merchandise stores (452) | 6,150 | 93,443 | 3,973 | 2,639 | 448 |
| **Total All Sectors** | **147,828** | **1,964,339** | **95,084** | **64,349** | **6,872** |

*North American Industry Classification System

For the production and manufacturing sectors, total output impacts were $34.6 Bn, and value added impacts were $20.8 Bn. Most of these impacts came from the nursery and greenhouse production which accounted for $26 Bn in output, and $18 Bn in value added. For the horticultural services sectors of landscape services and landscape architects, total output impacts were $57.8 Bn, and value added impacts were $39.0 Bn.

Wholesale and retail trade sectors' impacts were greater than the production and manufacturing sectors' impacts across all measures. Impacts for the wholesale and retail sectors were measured at $55.5 Bn in output and $35.3 Bn in value added.

If economic impacts are analyzed by aggregated sectors, the horticultural services and the wholesale and retail trade sectors contributed almost equally to total output with 39% and 38% respectively. However the contribution of the horticultural services to value added was greater at 41 % (Figure 3.4).

In 2002, the production and manufacturing sectors generated approximately 300,677 jobs. Within this group, the nursery and greenhouse sector generated the greatest quantity with 261,408 jobs. The horticultural services sector generated 753,557 jobs, and the landscape wholesale and retail trade sector 910,104 jobs.

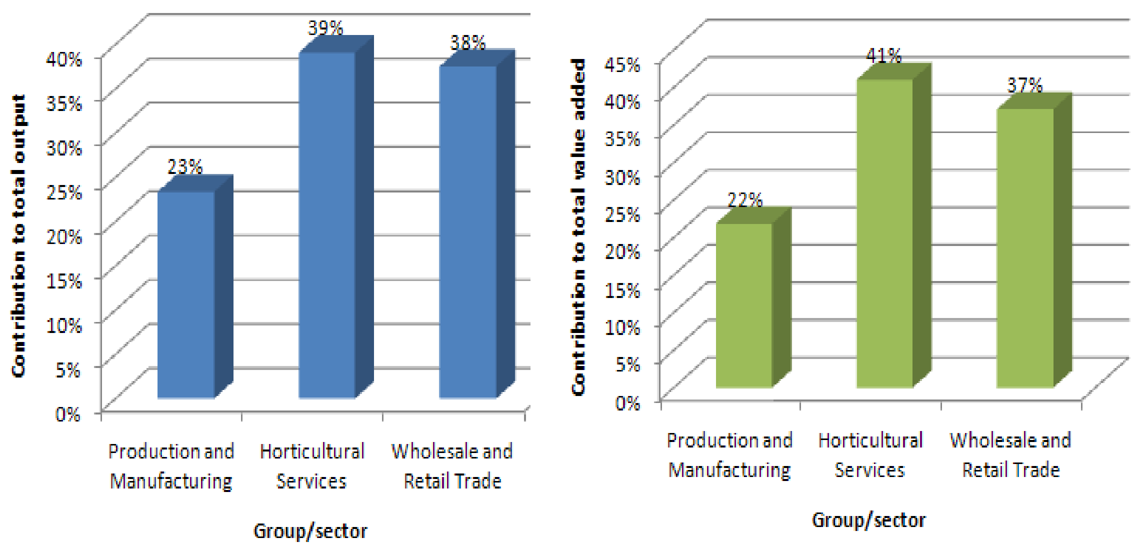



**Figure 3.4 Contribution of aggregated sectors to total output and value added impacts**

Analysis of aggregated sectors shows that the wholesale and retail trade is the group of sectors that contributed the most to job generation with 46% of total employment (Figure 3.5). However, the individual sector of landscape services, inside the horticultural services group, represented the largest impacts for all the U.S. green industry in terms of the three indicators of economic activity measured. This sector contributed with 34% of total employment impacts, 34% of total output impacts, and 37% of total value added for all the green industry.

State and regional results suggested that in 2002 the largest producing states in terms of output impacts and value added impacts (Figure 3.6), were California ($20.4 Bn in output, $13.7 Bn in value added), Florida ($9.9 Bn in output, $7.1 Bn in value added), Texas ($9.7 Bn in output, $6.1 Bn in value added), and Illinois ($6.9 Bn in output, $4.3 Bn in value added). Other states with significant green industry production include Oregon, North Carolina, Michigan, Ohio, Pennsylvania, New York, and Georgia. Similarly, the states that generated most of the employment in the green industry, all exceeding 60,000 employees were California, Florida, Texas, and Illinois (Figure 3.7).

Many green industry associations (California Green Industry Council, Florida Nursery Growers and Landscape Association, Texas Nursery and Landscape Association) in these states work closely to address industry-wide issues such as legislation, regulations and ordinances, and to increase public and industry awareness of the green industry.


**Figure 3.5 Contribution of aggregated sectors to total employment impacts**

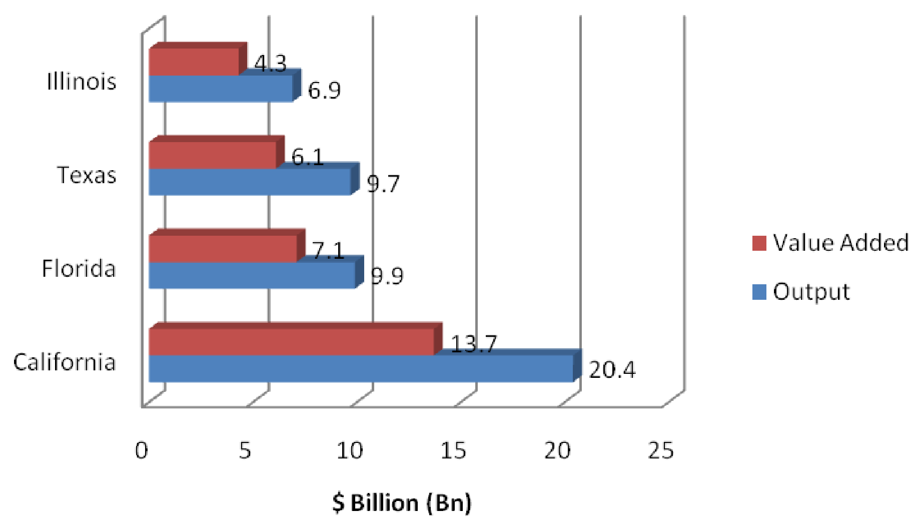



**Figure 3.6 Output and value added impacts of the U.S. green industry in leading states, 2002**

According to the California Green Industry Council, the green industry in the leading state comprises about 1 % of California's gross state product and, with its population projected to increase to about 58 million by 2050, the environmental horticulture industry should continue to grow even more. Florida, ranked second in terms of overall industry value and employment generation, reported an increase of 54% in total sales by Florida nursery, landscape service firms, and horticulture retailers from 2000 to 2005 (Hodges and Haydu 2005).

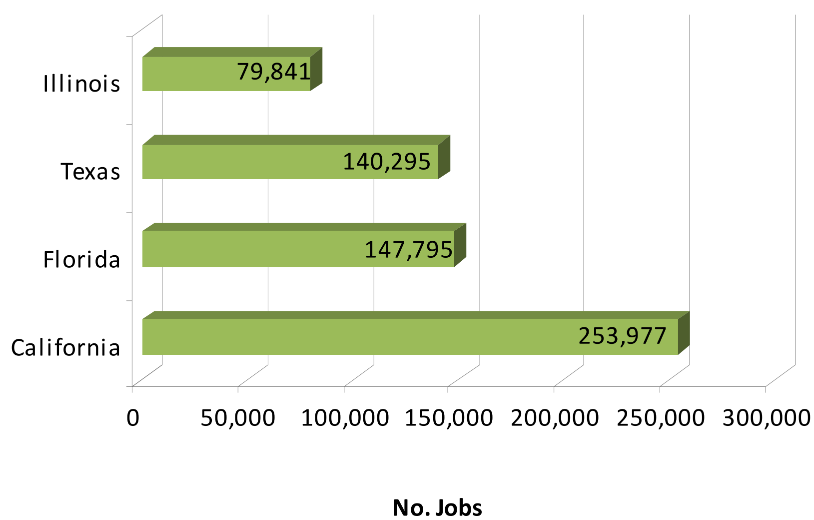



**Figure 3.7 Employment impacts of the U.S. green industry in leading states, 2002**

Other monetary benefits of the green industry include significant increases in a home's perceived value due to landscaping improvements in complexity and color. Research has shown that landscape expenditures result in higher home selling prices than homes with a minimal landscape. In 1999, the results of a seven-state survey conducted by Niemiera (2007), which included the states of Delaware, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, and Texas, suggested that the change in value from homes with no landscape to well-landscaped, ranged from 5.5 % (Louisiana) to 11.4 % (South Carolina). Thus, a home with only lawn and valued at $150,000 could be worth $8,250 to $17,100 more with a sophisticated landscape that incorporates color and large plants.

Urban forests also have other non-market economic and environmental impacts. Valuable environmental benefits can be measured in terms of ecosystem services including energy savings for building heating and cooling, reduction of atmospheric carbon dioxide, improved air quality, reduction of storm water runoff, and other aesthetic benefits.

**Economic Impacts of the Green Industry in Texas**

Texas' environmental horticulture industry ranks third in terms of output, value added and employment impacts. Palma and Hall (2009) estimated the economic impacts of the green industry in Texas at $13.5 Bn in output, 157,990 jobs, and $7.6 Bn in value added in 2007(Table 3.2). In Texas, the Metropolitan Statistical Areas (MSA) with the greatest economic impact contributions to the state's economy were Houston and Dallas, generating 23% and 17% respectively of output, value added and employment.

Analysis of economic impacts by groups shows that the production and manufacturing sectors have the lowest economic impacts. Total impacts for these sectors were $2.3 Bn in output, 23,929 job posts in employment, and $1.3 Bn in value added, while the wholesale and retail trade sectors total output impacts were $4.2 Bn, 49,740 job posts, and $2.7 Bn in value added.

**Table 3.2 Economic Impacts of the Green Industry in Texas, by Sector, 2007**

| Industry Group/Sector (NAICS*) | Output ($Mn) | Employment (jobs) | Value Added ($Mn) |
|---|---|---|---|
| **Production and Manufacturing** | **2,370** | **23,929** | **1,366** |
| Nursery and Greenhouse | 2,064 | 22,734 | 1,260 |
| Lawn and Garden Equipment Mfg. | 207 | 745 | 65 |
| Greenhouse Mfg. | 98 | 450 | 41 |
| **Horticultural Services** | **6,806** | **84,322** | **3,417** |
| Landscape Services | 6,487 | 81,814 | 3,220 |
| Landscape Architecture | 318 | 2,507 | 197 |
| **Wholesale and Retail Trade**** | **4,277** | **49,740** | **2,780** |
| Wholesale Flowers, Nursery Stock and Florists Supplies | 140 | 827 | 87 |
| Lawn and Garden Equipment and Supplies Stores | 1,608 | 16,023 | 1,054 |
| Florists | 735 | 12,852 | 480 |
| Building Material and Supplies Stores | 697 | 6,944 | 457 |
| Food and beverage stores | 150 | 1,979 | 96 |
| General merchandise stores | 724 | 9,789 | 467 |
| Garden Equipment Wholesale | 224 | 1,325 | 139 |
| **Total All Sectors** | **13,452** | **157,990** | **7,564** |

*North American Industry Classification System
**The direct impact is gross sales except for retail sectors

The largest economic impacts came from the horticultural services sector with a total output of $6.8 Bn, employment impacts around 84,322 jobs and value added impacts of $3.4 billion. At the individual level, the sectors with the higher contribution to the Texas' green industry economic impacts were the landscape services, nursery and greenhouse production, and lawn and garden stores.

In 2002, Texas was the No. 1 state in greenhouse manufacturing (prefabricated metal buildings) which translated into an industry of $729 million (Mn) that year. The nursery and greenhouse production was ranked third place with 8.8% of total production, while no lawn and garden equipment manufacturing was being done. It was also considered second in lawn and garden equipment and supplies stores, third in landscape services and florists' wholesale and retail trade, fourth in landscape architecture with 5.8% of total U.S. sales, and fifth in flower, nursery stock and florist supplies at the wholesaler level with $559 Mn in sales.

According to a survey realized by Texas A&M University AgriLife Extension Service, in 2007 more than half of the growers in Texas were in the nursery crops business. The main products grown were container-grown trees (27%), Christmas trees (14%), and container-grown shrubs (8%) in an average area of production of 554 sq. ft acres of nursery bed space in the open and 356,756 sq. ft. of greenhouse or shaded house.

Most of landscapers were affiliated to the Texas Nursery and Landscape Association (51.5%) and approximately 72% of landscape firms expected sales to increase an average of 37% over the next five years, that is, a 7.4% expected increase per year. Independent gardens represented by far the main type of garden centers in Texas. As regards to the business structure, sole proprietorship was the predominant business structure for growers, representing almost 69 %. Landscapers used both, sole proprietorship and partnership, and only a high percentage of retailers (42%) were organized as a corporation.

The contribution of Texas' green industry to the national economy is apparent and considerable. While the sectors within the industry may be experiencing different growth rates and market trends, they are all facing a maturing market. Furthermore, the effects of tighter margins in the environmental horticulture industry impact not only the members of its productive chain, but also other industries that interact with it.

# CHAPTER IV

# METHODOLOGY

This chapter develops the conceptual framework used to explain brand awareness and willingness-to-pay. First, a discussion about the nature of the survey data and the statistical software used in this research is given. Second, the theoretical foundations of the Logit and Probit models are derived, and an explanation of the appropriateness of these models to measure brand awareness is presented. Third, the brand awareness model is set up and the variables used are discussed. Fourth, the validation and theoretical foundations of the Tobit model are presented. Finally, the willingness-to-pay model is established and the corresponding variables are discussed.

## Survey Data

An electronic mail survey was conducted in July of 2008 to collect data regarding consumers' perceptions of branding efforts and WTP in the green industry. The survey sample consisted of 880 individuals provided by MarketTools Corporation; a company specialized in market research and online survey services.  The respondents mailing list used by MarketTools included a representative sample of the Texas population. From the total sample, approximately 31% were actual consumers of the ornamental industry's products, lowering the final number of usable responses to 274.

The survey was divided in four major categories in order to measure consumers' behavioral and demographic variables. The first category included general consumer habits toward ornamental products, the second and third categories contained specific questions about the Texas Superstar ™ and Earth-Kind ™ programs respectively, and the fourth category collected demographic information.

The questions about consumer habits toward ornamentals measured frequency, purpose and place of purchase, number of monthly transactions if any, and the significance of several aspects that were assumed to influence the purchase decision. The frequency of purchase options were weekly, monthly, yearly or special occasions only, where weekly and monthly were considered as a high frequency. The selection of places of purchase covered garden centers, supermarkets, chain stores, and nurseries and the purpose of the purchase was either for self-consumption or for gifts.

For each program, questions about brand awareness, level of satisfaction, intention of re-purchase, WTP, and a rating of relevant features of the brand were included. The ranges of WTP for a branded plant versus a regular plant used in this study were: 0%, 1-10%, 11-20%, 21-30%, 31-40%, and 41% or more. Awareness of other similar brands such as Wave ™, Proven Winners ™, and Plants that Work ™ was also examined.

The category of demographic characteristics incorporated variables to determine ethnicity, age, income, and the regional location of the respondent among twelve Texas' districts.

**Discrete Choice Models**

Discrete choice models, also known as qualitative response models, are used to model settings in which the economic outcome is a discrete choice among a set of alternatives, rather than a continuous measure of some activity. In general, conventional regression methods are inappropriate in these cases but qualitative models allow linking this type of outcome with a set of causal factors (Greene 2003).

Even thought there are different types of models that apply in different situations, the common factor to all of these regression models is that the dependent or response variable itself is a categorical variable, which means that it is a variable with two or more categories. For convenience during the estimation process, a code could be assigned to the value taken by the dependent variable. For example, a value of 1 or 0 can be assigned to the dependent variable to indicate some qualitative outcome such as a "yes or no" decision, or values that indicate a ranking such as 0 to represent "strongly disagree", 1 "disagree", 2 "neutral", 3 "agree", and 4 "strongly agree". Similarly, values can be assigned to designate categories that are not necessarily a ranking or a count.

According to Greene (2003), the general framework of probability models can be represented by:

(4.1) $$P_i(Y=1 \mid x) = F(x, \beta)$$

where $P$ is the probability of the event *i* occurring, *Y* is a discrete choice variable, *x* is a vector of explanatory variables, $\beta$ is a vector of parameter estimates, and *F* is an assumed cumulative distribution function (CDF).

A linear model that represents this framework can be denoted by:

(4.2) $$P_i(Y=1 \mid x_i) = \beta_1 + \beta_2 X_i$$

where now, the probability $P$ of the event *i* is linearly related to the set of explanatory variables $X_i$ and the parameter estimates. If this model is estimated by the standard

Ordinary Linear Squares (OLS) regression, the main problem is that as the values of the *X* variables increase or decrease indefinitely, the probabilities could lie outside the 0-1 bounds.

In order to guarantee that the estimated probabilities of discrete choice models lie in the 0-1 range, probability models with an S-shaped cumulative distribution function (CDF) are used. In practice, the logistic and normal CDFs are chosen, the former giving rise to the logit and the latter to the probit model (Gujarati 1995).

**The Logit Model**

Gujarati (1995) shows the logistic CDF associated with the logit model as:

(4.3) $$P_i(Y=1 \mid x_i) = \frac{1}{1+\ell^{-(\beta_1+\beta_2 x_i)}}$$

simplifying:

(4.4) $$P_i(Y=1 \mid x_i) = \frac{1}{1+\ell^{-Z_i}}$$

whenever:

(4.5) $$Z_i = \beta_1 + \beta_2 X_i$$

From Equation 4.3 it can be inferred that the logistic CDF is nonlinearly related to the vector of explanatory variables, which solves the problem described earlier with the linear model. Yet, the model is still linear with respect to the set of $\beta$ parameters; a necessary assumption to explain the relationship between the parameter and the probabilities. This can be clearly seen if the natural log of the odds ratio is computed.

Explicitly, if the event occurs, then:

(4.6) $$P_i(.) = \frac{1}{1+\ell^{-Z_i}}$$

and if the event does not occur:

(4.7) $$1 - P_i(.) = \frac{\ell^{-Z_i}}{1+\ell^{-Z_i}} = \frac{\ell^{Z_i}}{\ell^{Z_i}(\ell^{Z_i}+1)} = \frac{1}{1+\ell^{Z_i}}$$

therefore the ratio of the odds is given by:

(4.8) $$\frac{P_i(.)}{1-P_i(.)} = \frac{1+\ell^{Z_i}}{1+\ell^{-Z_i}} = \frac{\ell^{z}(1+\ell^{z})}{(1+\ell^{z})} = \ell^{Z_i}$$

If the natural log is computed on both sides of Equation 4.8, the result is:

(4.9) $$\ln\left(\frac{P_i(.)}{1-P_i(.)}\right) = \ln \ell^{Z_i}$$

(4.10) $$L_i = Z_i \text{, or } L_i = \beta_1 + \beta_2 X_i$$

where $L_i$ is the log of the odds ratio in favor of the event occurring and $Z_i$ is a linear model. The final result of Equation 4.10 is called the Logit model, and we have shown from this equation, that even though this model is not linearly related to *X*, it has a linear relationship with the parameters $\beta$.

The slopes $\beta_2$ measure the change in $L_i$ for a unit change in $X_i$, that is, the change in the log-odds ratio in favor of the event occurring, as one of the independent variables change by one unit. Since the relationship of the model with the parameters is linear, a positive slope measures an increase (decrease) in the log-odds ratio as the *X* associated with that slope increases (decreases) by a unit. The intercept $\beta_1$ is the value of the log-odds in favor of the event occurring if all independent variables are zero.

It might be that the interpretation of the log-odds does not give very intuitive results but there are many approaches to interpret this model. For the case of continuous independent variables more sensitive conclusions can be drawn by looking at the marginal effects, or to be precise, at the effects of a change in an independent variable on the probability of the event occurring. Recall Equation 4.1 which described the general framework of probability models. The expected probability from a discrete choice model is given by:

(4.11) $$E[Y|x] = F(x, \beta)$$

Then, as illustrated by Anderson and Newell (2003), a change in the probability derived from a change in an independent variable *x* would be equal to:

(4.12) $$\frac{\partial E[Y|x]}{\partial x} = f(x, \beta).\beta$$

where $f(x, \beta)$ is the density function, equivalent to the logistic density function for the logit model, and $\beta$ is the estimated parameter associated with that variable *x*. As a result, in continuous independent variables the density function is a scale factor that translates raw estimates into marginal effects. A positive marginal effect measures an increase in the probability of the event occurring, as variable *x* increases one unit.

In the case of dummy independent variables, more insightful inferences can be obtained trough an interpretation of the odds ratio. If initially we had:

$$L_i = \ln\left(\frac{P_i(.)}{1-P_i(.)}\right) = \beta_1 + \beta_2 X_i \tag{4.13}$$

and the antilog of both sides is calculated, then the antilog of $\beta_2$ (or $10^{\wedge\beta_2}$) equals the odds ratio.

It was assumed that $\beta_2$ was a vector of parameters, each one associated to an explanatory variable. If the vector is denoted by $\beta_j$, then the interpretation of a change of one unit in the *jth* variable is a change in the odds ratio by $10^{\wedge\beta_j}$.

Finally, given a certain level to all of the independent variables in the $X_i$ set, not a change in the probability but the probability itself of the event occurring can be calculated. Once the intercept $\beta_1$ and the slopes $\beta_2$ are known, $L_i$ will equal a constant *k*:

$$L_i = \ln\left(\frac{P_i(.)}{1-P_i(.)}\right) = k \tag{4.14}$$

Taking the antilog of the constant and of the log of the odds ratio, the following result is obtained:

$$\left(\frac{P_i(.)}{1-P_i(.)}\right) = 10^k \tag{4.15}$$

where $10^k$ yields another constant, and equals an expression from which the probability $P_i$ can be found.

**The Probit Model**

Another suitable CDF to explain the behavior of a dichotomous dependent variable is the normal CDF. This distribution function is associated with the probit or normit model and is represented by:

$$(4.16) \qquad P_i(Y = 1 \mid x_i) = \frac{1}{\sqrt{2\Pi}} \int_{-\infty}^{\beta_1 + \beta_2 X} \ell^{-t^2/2} \partial t$$

where the probability $P_i$ of the event occurring is measured by the area of the standard normal curve from –α to $\beta_1 + \beta_2 X_i$ (Figure 4.1).

The underlying principles behind the probit model can be obtained based on utility theory or rational choice perspective on behavior, as developed by McFadden (1974). In this context, the individual's decision of choosing an option or not, depends on an unobservable utility index $I_i$. This index is determined by a set of explanatory variables $X_i$ in such a way that the larger value of the index, the greater the probability of the individual choosing that option. The expression for the index is:

$$(4.17) \qquad I_i = \beta_1 + \beta_2 X_i$$

where for each individual, there is a critical or threshold level of the index, namely $I_i^*$. If $I_i$ exceeds $I_i^*$ then the individual chooses the option that is being considered.

Given the assumption of normality, the probability of the event occurring or that $I_i^*$ is less than or equal to $I_i$, can be computed from the standardized normal CDF as:

(4.18) $$P_i(Y=1 \mid x_i) = P_i(I_i^* \le I_i) = F(I_i) = \frac{1}{\sqrt{2\Pi}}\int_{-\infty}^{I_i} \ell^{-t^2/2}\partial t$$

It is apparent from the previous equation that the independent variables $X_i$ are non linear, and so are the $\beta$ parameters. In the same way that taking the log of the odds ratio enabled the logistic model to be linear, in the probit model, the inverse of the normal CDF is used to linearize the estimated model, specifically:

(4.19) $$I_i = F^{-1}(I_i) = F^{-1}(P_i) = \beta_1 + \beta_2 X_i$$

where $F^{-1}$ is the inverse of the normal CDF.

Figure 4.1 is shows that in the probit model, given $X^i$ and the parameters $\beta_i$ and $\beta_2$, the probability $P_i$ can be read from the ordinate.

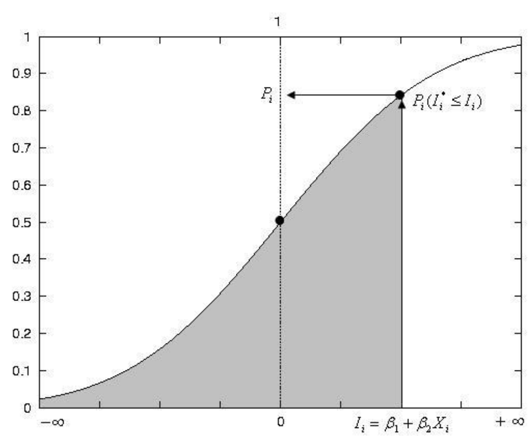



**Figure 4.1 Standard normal CDF and probit model read from the ordinate**

Similarly, the value of the utility index can be obtained given the value of $P_i$, which is simply the reverse of the previous figure and is shown in Figure 4.2.

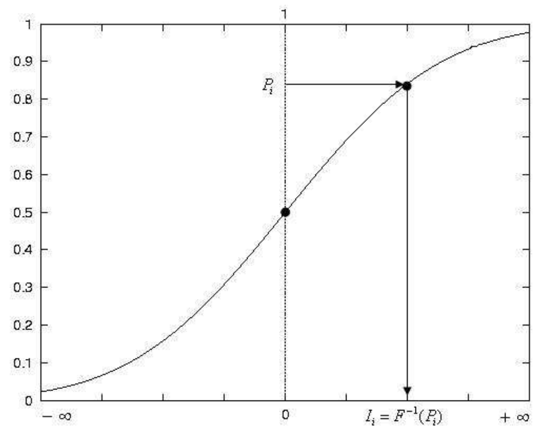



**Figure 4.2 Standard normal CDF and probit model read from the abscissa**

The marginal effects in the probit model, explicitly representing the changes in the probability of the event occurring from a change in an independent variable *x*, can be calculated from Equation 4.12 by letting $f(x, \beta)$ equal the standard normal density function.

**Evaluation of Logit and Probit Estimates**

Several research studies have shown that the parameter estimates values of the probit and logit models are not quite comparable; nonetheless the results are directly comparable in terms of significance (Gujarati 1995; Greene 2003; Amemiya 1981).

The interpretation of the results for both models is based on the significant variables that the models yield; therefore these models are expected to produce similar results. The parameter estimates themselves can also be matched; Amemiya (1981) suggested that a logit estimate of a parameter multiplied by a 0.625 factor provides a fairly good approximation of the probit estimate of the same parameter, this is illustrated by:

(4.20) $$\beta_{probit} \cong 0.625\beta_{\log it}$$

The main difference between these two models is the underlying CDF and its variance. It can be seen in Figure 4.3 that the logistic distribution has slightly flatter tails, and that the normal distribution that generates the probit model, moves toward the axes more quickly.

Since the results from these models are proven to be alike, the choice of which model to use is one of mathematical convenience or ready availability of computer software. Bessler (2008) recommends the modeling of discrete zero-one data with both, logit and probit models, in view of the fact that the true underlying probability distribution is not usually known and the cost of estimation using statistical software is typically low.

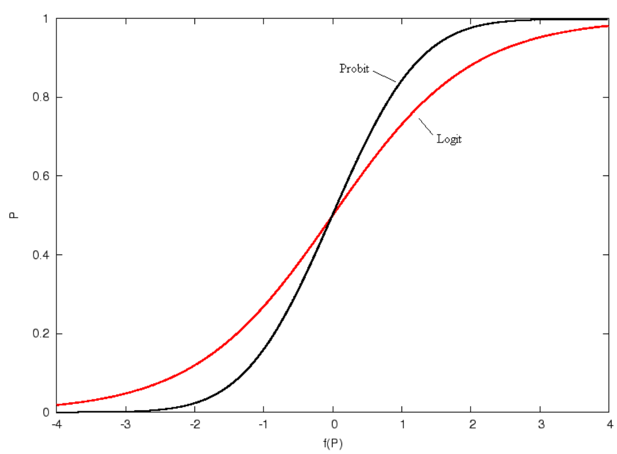



**Figure 4.3 Logit and probit CDF**

**Brand Awareness Models**

In this research, the estimation of brand awareness has a probabilistic approach given that one of the main purposes of this thesis is to investigate how likely are Texas' consumers to be aware of the Texas Superstar $^{TM}$ and Earth-Kind $^{TM}$ programs. For each brand, a logit and a probit model are built.

The general model specification for estimating the brand awareness of Texas Superstar $^{TM}$ labeled products and Earth-Kind $^{TM}$ program as a function of its causal effects is given by:

(4.21) $$P_i\left(Y_{(1,0)}\right) = \beta_1 + \sum \beta_i X_i + \varepsilon_i$$

where $X_i$ is the vector of causal effects and $\varepsilon_i$ is the error associated to the *ith* measure of the $X$ value.

In the models to determine awareness the vector $X_i$ is composed of socio-demographic characteristics, consumer habits and geographic location, as in:

(4.22) *P(Brand awareness) = f (Socio-demographic characteristics, Consumer habits, Regions, Parameters* $\beta$ *)*

The independent variables used in the models are described in detail in Table 4.1. The variables are dummy variables created for age, gender, marital status, income, regularity and purpose of purchase, and region. The dependent variable is brand awareness and it takes the value of one to indicate the presence of brand awareness and zero otherwise. These models can be represented by Equation 4.23 and Equation 4.24.

(4.23) $$P(TS^{TM}\ awareness) = \beta_1 + \beta_2\ (DAGE_2) + \beta_3 (DAGE_3) + \beta_4 (DAGE_4) + \beta_5 (GEN) + \beta_6 (MAR) + \beta_7 (DINC2) + \beta_8 (REGU) + \beta_9 (PUR) + \beta_{10} (DREG_2) + \beta_{11} (DREG_3) + \varepsilon_i$$

(4.24) $$P(EK^{TM}\ awareness) = \beta_1 + \beta_2\ (DAGE_2) + \beta_3 (DAGE_3) + \beta_4 (DAGE_4) + \beta_5 (GEN) + \beta_6 (MAR) + \beta_7 (DINC2) + \beta_8 (REGU) + \beta_9 (PUR) + \beta_{10} (DREG_2) + \beta_{11} (DREG_3) + \varepsilon_i$$

where P(.) is the probability of brand awareness evaluated at the inverse of the normal distribution for the probit model, and the log of the odds ratio for the logit model.

**Table 4.1 Definition of Independent Variables for Brand Awareness Models**

| **Variable** | **Description** |
|---|---|
| **Socio-demographic characteristics** | |
| DAGE2 | Age between 25-39 years old (= 1 if true and 0 otherwise) |
| DAGE3 | Age between 40-55 years old (= 1 if true and 0 otherwise) |
| DAGE4 | More than 55 years old (= 1 if true and 0 otherwise) |
| GEN | Gender (= 1 if female and 0 otherwise) |
| MAR | Marital Status (= 1 if married and 0 otherwise) |
| DINC2 | Income level (= 1 if income above $50,000 and 0 otherwise) |
| **Consumer habits** | |
| REGU | Regularity of purchase (= 1 if weekly or monthly and 0 otherwise) |
| PUR | Purpose of the purchase (= 1 if self consumption and 0 otherwise) |
| **Region** | |
| DREG2 | Region: Central Texas (= 1 if true and 0 otherwise) |
| DREG3 | Region: South Texas (= 1 if true and 0 otherwise) |

According to Greene (2003), when there are several categories or groupings (i.e. quarterly data or ranges of age), a set of binary variables is really useful, but the dummy variables for one of the categories must be dropped in the analysis. If all the categories were included, then all the categories would sum to one at every observation, which would reproduce the constant term and would be a case of perfect multicollinearity. This is known as the dummy variable trap. The dropped category becomes the base category against which the other categories are compared. It is also plausible to drop the overall constant and keep all of the categories. A third approach to avoid the dummy variable trap consists of restricting the sum of the coefficient of the dummy variables to zero. In this case, the base of the dummies would be the mean of all the categories.

For example, let $\beta_{ik}$ be the parameter estimate for the *ith* causal effect age, where this variable has *k* categories with dummy variables associated with each of them. The categories are: individuals less than 25 years old, 25-39 years old, 40-55 years old, and individuals with more than 55 years old.

Then, the dummy variables actually used in the model are created following the operation:

(4.25) $$Dummy_k = category_k - category_1, \text{ where } k \neq 1.$$

For the age variable and if the first category is dropped:

(4.26) $$Dummy_2 = category_2 - category_1$$

$$Dummy_3 = category_3 - category_1$$

$$Dummy_4 = category_4 - category_1$$

where *Dummy* 2-4 are the three variables used in the regression.

With this procedure, the sum of the coefficients of all the categories is restricted to zero as in:

(4.27) $$\sum_{k=1}^{K} \beta_{ik} = 0 \text{, to obtain } -\sum_{k=2}^{K} \beta_{ik} = \beta_{i1}$$

and the dummy variable trap is effectively evaded.

In the specification of the brand awareness models, the category dropped in the age group was the variable for 25 or fewer years old; in the income group it was the variable for an income of $50,000 or less. A low frequency of purchase was denoted by consumers who shopped yearly or in special occasions only, and the purpose of the purchase was either for self consumption or gifts. Out of the twelve Texas' district among which the respondents could classify themselves in the survey, the variable Central Texas included the districts of Far West, West Central, Central, Southwest, East and Southeast Texas. The districts in the variable South Texas were Coastal Bend and the South district. The categorical variable dropped was the North area which included Panhandle, South Plains, Rolling Plains, and the North district.

**The Tobit Model**

A functional limitation of the previously discussed probit model arises from its reliance on the entire normal distribution. In some situations, the unobserved factor is by necessity positive (Train 2003) and a model that describes the relationship between a non-negative dependent variable $Y_i$ and an independent variable (or vector) needs to be used.

The tobit model introduced by the Nobel laureate economist James Tobin in 1958, can be used when the dependent variable in a regression model equation has a lower or upper limit. In general, tobit is specified like OLS, with a dependent variable and a list of independent variables as in Equation 4.28.

(4.28) $$Y_i^* = \beta_1 + \beta_2 X_i + \varepsilon_i$$

In this equation, $X_i$ is the vector of causal variables, and $\varepsilon_i$ is a normally distributed error term. Additionally, a truncation in the normal distribution is made at some threshold value that is often set at zero. In such a case, the model specification is given by:

(4.29) $$Y_i = \begin{cases} y_i * \rightarrow if \;\; y_i * > 0 \\ 0 \rightarrow if \;\; y_i * \leq 0 \end{cases}$$

where $Y_i$ is the dependent variable that is only observed or only exists when the latent or unobservable variable $y_i *$ is greater than zero.

Tobit can be also used to model dependent variables where the cutoff value is different from zero, or where observations with large values are those not observed.

**Willingness-to-Pay Models**

The second part of the analysis consists of determining the WTP for Texas Superstar $^{TM}$ and Earth-Kind $^{TM}$ programs. Since a customer’s willingness-to-pay for a desirable attribute of a product is expected to be always positive (i.e. greater than zero), the use of a censored model like the tobit model is appropriate.

The model specification for estimating the WTP for Texas Superstar ™ labeled produce and Earth-Kind ™ program as a function of socio-demographic characteristics, consumer habits and region is given by:

(4.30) $$TS^{TM}\ WTP = \beta_1 + \beta_2\ (DAGE_2) + \beta_3 (DAGE_3) + \beta_4 (DAGE_4) + \beta_5 (GEN) + \beta_6 (MAR) + \beta_7 (DINC2) + \beta_8 (REGU) + \beta_9 (PUR) + \beta_{10} (TSAWARE) + \beta_{11} (DREG_2) + \beta_{12} (DREG_3) + \varepsilon_i$$

(4.31) $$EK^{TM}\ WTP = \beta_1 + \beta_2\ (DAGE_2) + \beta_3 (DAGE_3) + \beta_4 (DAGE_4) + \beta_5 (GEN) + \beta_6 (MAR) + \beta_7 (DINC2) + \beta_8 (REGU) + \beta_9 (PUR) + \beta_{10} (EKAWARE) + \beta_{11} (DREG_2) + \beta_{12} (DREG_3) + \varepsilon_i$$

where the vector of independent variables is described in Table 4.2.

The value of the dependent variable in these models was the corresponding conditional mean WTP. For instance, if the consumer's WTP was between 1-10%, the WTP used for that particular observation was 5%. If the WTP was indicated above 41%, the WTP used for that observation was 41%. The additional variables TSAWARE in the Texas Superstar ™ WTP model, and EKAWARE in the Earth-Kind ™ WTP model, indicate the presence of awareness of the program being analyzed. These are dummy variables where the value one corresponds to the consumer being aware of the brand.

**Table 4.2 Definition of Independent Variables for Willingness-to-pay Models**

| Variable | Description |
|---|---|
| **Socio-demographic characteristics** | |
| DAGE2 | Age between 25-39 years old (= 1 if true and 0 otherwise) |
| DAGE3 | Age between 40-55 years old (= 1 if true and 0 otherwise) |
| DAGE4 | More than 55 years old (= 1 if true and 0 otherwise) |
| GEN | Gender (= 1 if female and 0 otherwise) |
| MAR | Marital Status (= 1 if married and 0 otherwise) |
| DINC2 | Income level (= 1 if income above $50,000 and 0 otherwise) |
| **Consumer habits** | |
| REGU | Regularity of purchase (= 1 if weekly or monthly and 0 otherwise) |
| PUR | Purpose of the purchase (= 1 if self consumption and 0 otherwise) |
| TSAWARE | Texas Superstar ™ awareness (= 1 if true and 0 otherwise) |
| EKAWARE | Earth-Kind ™ awareness (= 1 if true and 0 otherwise) |
| **Region** | |
| DREG2 | Region: Central Texas (= 1 if true and 0 otherwise) |
| DREG3 | Region: South Texas (= 1 if true and 0 otherwise) |

The purpose of including these variables in the WTP analysis was to assess the impact if any, of brand awareness on willingness-to-pay for these particular programs, that is, to identify if there is any relationship between a consumer's awareness of the brand and a consumer's willingness-to-pay for it, and further to measure the extent of this relationship.

# CHAPTER V

# RESULTS AND DISCUSSION

The following chapter contains the results for the brand awareness and WTP models developed previously. First, an introduction to the survey administration, a discussion about the representativeness of the sample, and relevant statistics of the ornamentals' consumer are provided. Then, the results for the brand awareness models are presented and discussed. Finally, the results for the willingness-to-pay models are presented and discussed.

## Survey Administration

The survey provided a total of 274 usable responses. These responses correspond to consumers of the green industry's products, defined as those survey respondents who bought any type of ornamental plants from July 2007 to July 2008. Selected variables were used to estimate the econometric models (Table 4.1 and 4.2). The estimates were all obtained using TSP 4.5 and significance of the variables was considered at the 0.1, 0.05 and 0.01 levels. A copy of the TSP programs used can be found in Appendix A.

The survey sample fairly represented Texas' population based on socio-demographic characteristics, including marital status, gender, income, and age. Of the sample, 60% of respondents were married compared with 54% of the population in Texas. The percentage of females in the sample was 53% versus 50% for Texas. From the total number of respondents 53% had an income of more than $50,000 in contrast with 47% of the actual population, and 55% of respondents were 25 to 55 years old, compared with 44% of Texas' population (Table 5.1).

**Table 5.1 Sample Representativeness**

| Demographic variables | | Survey Data Frequency | Survey Data Percentage | Census Data Percentage |
|---|---|---|---|---|
| **Marital status** | Married | 163 | 59.9 | 53.5 |
| | Single | 109 | 40.1 | 46.5 |
| **Gender** | Male | 129 | 47.3 | 49.8 |
| | Female | 144 | 52.7 | 50.2 |
| **Age** | Less than 25 | 35 | 12.9 | 38.7 |
| | 25-39 | 69 | 25.5 | 15.2 |
| | 40-55 | 81 | 29.9 | 28.4 |
| | More than 55 | 86 | 31.7 | 17.6 |
| **Income** | Under $25,000 | 45 | 16.4 | 26.7 |
| | $25,000-$50,000 | 85 | 31.0 | 26.6 |
| | $50,001-$75,000 | 57 | 20.8 | 17.9 |
| | $75,001-$99,999 | 36 | 13.1 | 11.3 |
| | $100,000-& above | 51 | 18.6 | 17.5 |

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

**Purchasing Habits of the Ornamentals' Consumer**

Respondents stated an overall low frequency of purchase of ornamental products with 78% of respondents buying yearly or in special occasions while only 20% of the sample affirmed to buy monthly (Figure 5.1). Approximately 75% of respondents had 0 to 2 transactions during the previous month of the survey (Figure 5.2) and, provided that the survey was done in July of 2008, the average number of transactions for June was 1.8 transactions.

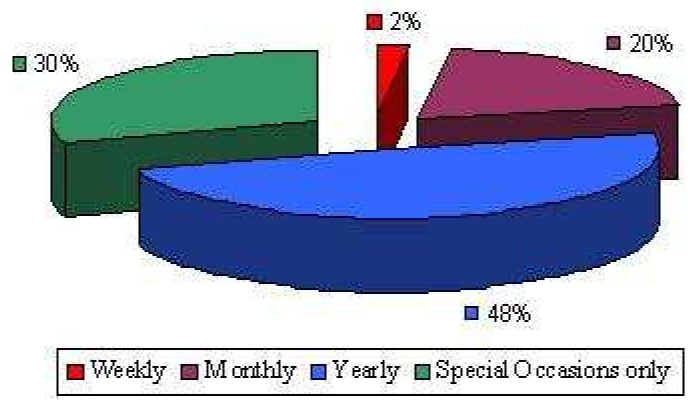



**Figure 5.1 Respondents' frequency of purchase**

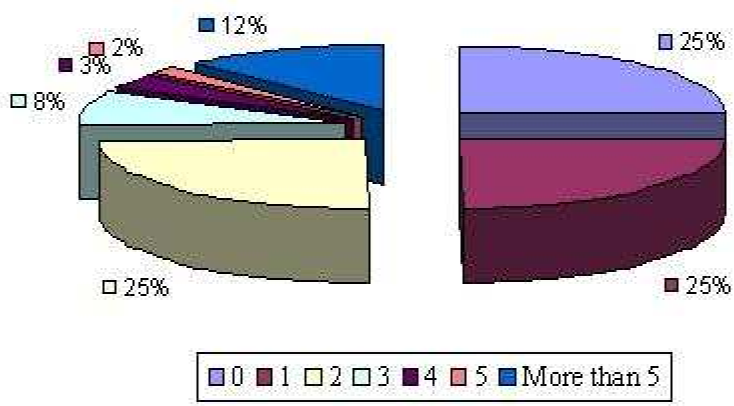



**Figure 5.2 Respondents' number of transactions, June of 2008**

Most ornamental products in Texas were purchased for self-consumption purposes, with 84% of respondents declaring the reason of the purchase was self-consumption. Palma (2005) studied a representative sample of all U.S. households, and concluded that this relationship was around one half of the purchases for self-use purposes and one half for gifts at the national level during the 1993 to 2003 period. The preferred outlets to purchase ornamental products were garden centers (72%), followed by nurseries (40%), chain stores (32%), and supermarkets (30%), as shown in Figure 5.3.


**Figure 5.3 Respondents' preferred outlets**

Respondents were also asked to rate from 1 to 5, where 5 was the highest score, how important several aspects in the purchase decision were, including price, low-care demand, organic growth, light demand, guaranteed growth, drought tolerance, vibrant colors, and season. The weighted average rating of these aspects suggests that price is the most important feature, probably because the survey was conducted during an economic downturn. Other important features included vibrant colors and low-care demand (Table 5.2).

**Table 5.2 Average Rating of Significant Aspects in Purchase Decision**

| | |
|---|---|
| Price | 3.89 |
| Vibrant colors | 3.85 |
| Low-care demanding | 3.83 |
| Drought tolerant | 3.64 |
| Season | 3.57 |
| Guaranteed growth | 3.51 |
| Light demand | 3.34 |
| Organically-grown | 2.58 |

Table 5.3 summarizes the rating results for each series and category where the indicator is the percentage of total respondents selecting the option. For example, out of the total sample, 31% of respondents rated price at the highest score, and 23% rated organically-grown at the lowest score.

**Table 5.3 Summary of Rating Results of Significant Aspects in Purchase Decision**

| | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| Price | 1% | 5% | 29% | 34% | 31% |
| Low-care demanding | 1% | 8% | 25% | 38% | 28% |
| Organically-grown | 23% | 22% | 28% | 18% | 7% |
| Light demand | 4% | 11% | 36% | 36% | 12% |
| Guaranteed growth | 4% | 10% | 30% | 35% | 19% |
| Drought tolerant | 3% | 8% | 28% | 31% | 27% |
| Vibrant colors | 3% | 5% | 19% | 39% | 32% |
| Season | 1% | 7% | 32% | 41% | 16% |

The features of ornamental products that received high scores of 4 or 5 and appear to have a major influence in the respondents' purchase decision include the presence of vibrant colors, a low demand for care, the plant's response to seasonal changes, price, and drought tolerance. From the total sample of ornamentals' consumers, 71% assigned high ratings to the feature vibrant colors and 66% to low-care demanding.

Features such as price (65%) and drought tolerance (58%) also received the maximum scores.

The characteristics of seasonality and guaranteed growth showed a similar pattern. More than 50% of the respondents rated both of these characteristics at the higher scores, but around 30% was by some means neutral. The rating of other factors such as organically-grown and light care showed an inclination toward low scores. For instance, 45% of the respondents assigned low ratings of 1 or 2 to organically-grown product and 36% confirmed that light demand was not a feature they carefully seek for when buying an ornamental plant.

Awareness among respondents of other plant promotional programs, such as Novalis ™ Plants that Work ™ was slightly higher than Earth-Kind ™ awareness. While 15% of respondents were aware of Novalis ™ about 14% were aware of Earth-Kind ™. The awareness of Texas Superstar ™ (12%) was identical to the awareness of Wave ™, but lower than that for the former programs. The brand that exhibited the lowest level of awareness in the state of Texas was Proven Winners ™, with 8% of respondents stating awareness of this brand.

**Texas Superstar ™ Awareness**

The first of the main sections of this study consists in the analysis of the factors influencing brand awareness. The majority of respondents surveyed indicated that they were unaware of Texas Superstar ™ (Figure 5.4). Of the respondents who were aware, 84% were satisfied or very satisfied with Texas Superstar ™ plants and 75% stated a strong re-purchase intention. In this study, a strong re-purchase intention was assigned to individuals who would probably or definitely purchase the brand again.

In regards to the sources of awareness, the brand was most often recalled from in-store displays and from recommendations of friends or relatives whereas other sources included articles from the newspaper (Figure 5.5).

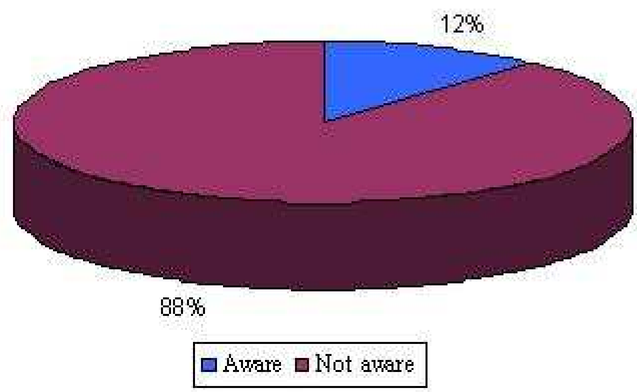



**Figure 5.4 Texas Superstar ™ awareness**

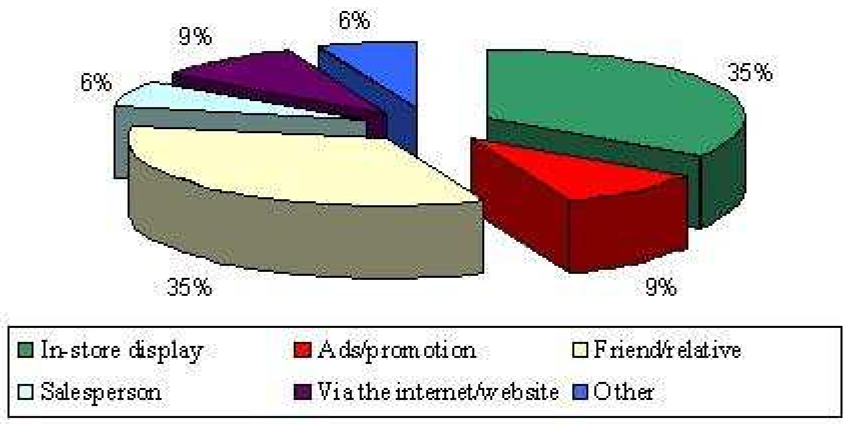



**Figure 5.5 Texas Superstar ™ sources of awareness**

A rating of the Texas Superstar ™ features was done by every respondent that reported to be aware of the brand. The weighted average rating of these features suggests that no pesticides use and minimal soil preparation are the most important features of Texas Superstar ™ (Table 5.4).

**Table 5.4 Average Rating of Texas Superstar ™ Features**

| | |
|---|---|
| No pesticides usage | 4.09 |
| Minimal soil preparation | 4.09 |
| High temperatures resistance | 4.06 |
| Guaranteed growth | 4.06 |
| Minimal water usage | 3.97 |

According to the results, 85% of respondents assigned high ratings of 4 or 5 to the features temperatures resistance and no pesticides usage, around 78% rated guaranteed growth and minimal soil preparation at the same levels, and about 72% of total respondents considered minimal water usage as an important feature in Texas Superstar plants ™ (Table 5.5).

**Table 5.5 Summary of Rating Results of Texas Superstar ™ Features**

| | **1** | **2** | **3** | **4** | **5*** |
|---|---|---|---|---|---|
| Minimal water usage | 6% | 3% | 19% | 31% | 41% |
| No pesticides usage | 3% | 6% | 6% | 47% | 38% |
| Minimal soil preparation | - | 3% | 19% | 44% | 34% |
| High temperatures resistance | - | 6% | 6% | 47% | 38% |
| Guaranteed growth | 3% | 6% | 13% | 38% | 41% |

*Highest score

**Texas Superstar ™ Awareness Model Results**

The parameter estimates of the brand awareness model using logit and probit were identical in terms of significance, therefore only the results for the logit model are discussed. An indicator of similar results for the logit and probit models is a comparison of the coefficients. Table 5.6 shows the proportionality of the value of the parameter estimates for each of the independent variables using Amemiya (1981) identity presented in Equation 4.17. Thus, the slope coefficient of 0.09 for the variable MAR estimated in the logit model and the corresponding estimate of the slope coefficient in the probit model of 0.05 are not directly comparable. However, the logit estimate multiplied by a 0.625 factor gives a reasonable approximation of the probit estimate.

**Table 5.6 Logit and Probit Proportionality of Parameter Estimates for Texas Superstar ™ Brand Awareness Model**

| | Estimated β logit | 0.625*β logit | Estimated β probit |
|---|---|---|---|
| Intercept | -1.88 | -1.18 | -1.11 |
| **Socio-demographic characteristics** | | | |
| DAGE2 | -0.01 | -0.01 | -0.03 |
| DAGE3 | -1.22 | -0.76 | -0.68 |
| DAGE4 | -0.29 | -0.18 | -0.11 |
| GEN | -1.12 | -0.70 | -0.59 |
| MAR | 0.09 | 0.06 | 0.05 |
| DINC2 | 0.13 | 0.08 | 0.08 |
| **Consumer habits** | | | |
| REGU | 1.64 | 1.02 | 0.87 |
| PUR | -0.36 | -0.23 | -0.18 |
| **Region** | | | |
| DREG2 | 0.10 | 0.06 | 0.09 |
| DREG3 | 0.06 | 0.04 | -0.02 |

Note: Refer to Table 4.1 for a definition of each independent variable

Alternatively, Greene (2003) proposed that the probit estimates can be multiplied by $\Pi / \sqrt{3} \approx 1.8$ to obtain a quite good approximation of the logit estimate of the same variable.

The goodness of fit of the model is indicated by the McFadden's $R^2$ of 0.19. Additionally, the value of the likelihood ratio test was 36.5, and the null hypothesis that all slope coefficients in the logit model are zero (i.e. the independent variables non significant) is rejected (p-value<0.0001). Regarding the extent of predictive accuracy, this model compared to a naïve model with a 0.5 cutoff, predicts 238 of 268, or 88.8% of the observations correctly, that is, approximately 238 of the survey participants were correctly classified as either aware or unaware of Texas Superstar ™. This percentage was obtained by adding up the diagonal elements (236+2) and diving by the number of observations (268) in Table 5.7.

**Table 5.7 Frequencies of Actual and Predicted Outcomes for Texas Superstar ™ Brand Awareness Model Using Logit**

| | **Predicted** | | |
|---|---|---|---|
| **Actual** | 0 | 1 | **Total** |
| 0 | 236 | 1 | **237** |
| 1 | 29 | 2 | **31** |
| **Total** | **265** | **3** | **268** |

The logit analysis results for the Texas Superstar ™ brand are given in Table 5.8 and the comparable probit results can be found in Appendix B. The dependent variable for this model was awareness of Texas Superstar ™. This variable was one for those respondents who were aware of the brand and zero for those who were not. A negative sign in the estimated parameter of an independent variable means that there exists an inverse relationship between that variable and the dependent variable, while a positive sign implies a direct relationship. The independent variables were defined in Table 4.1.

**Table 5.8 Brand Awareness Parameter Estimates from Logit Model for Texas Superstar ™ Program**

| | Logit | | | |
|---|---|---|---|---|
| | **Coefficient** | **Standard Error** | **t-value** | **Odds ratio** |
| Intercept | -1.8817*** | (0.6182) | -3.0435 | |
| **Socio-demographic characteristics** | | | | |
| DAGE2 | -0.0149 | (0.3615) | -0.0414 | 0.9662 |
| DAGE3 | -1.2202** | (0.4912) | -2.4840 | 0.0602 |
| DAGE4 | -0.2857 | (0.3937) | -0.7257 | 0.5180 |
| GEN | -1.1228** | (0.4648) | -2.4159 | 0.0754 |
| MAR | 0.0917 | (0.4919) | 0.1864 | 1.2351 |
| DINC2 | 0.1318 | (0.2334) | 0.5645 | 1.3545 |
| **Consumer habits** | | | | |
| REGU | 1.6371*** | (0.4716) | 3.4712 | 43.3651 |
| PUR | -0.3622 | (0.5344) | -0.6779 | 0.4343 |
| **Region** | | | | |
| DREG2 | 0.0952 | (0.2986) | 0.3190 | 1.2452 |
| DREG3 | 0.0639 | (0.4194) | 0.1524 | 1.1585 |
| Number of usable observations | 268 | | | |
| Log-likelihood ($L_1$) | -77.74 | | | |
| Likelihood ratio [a] | 36.52 | | | |
| LR p-value | 0.0001 | | | |
| McFadden's $R^2$ [b] | 0.19 | | | |
| Fraction of correct predictions | 0.89 | | | |

Note: Refer to Table 4.1 for a definition of each independent variable

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

a Defined as $2(L_1-L_0)$

b Defined as $1-(L_1/L_0)$

The variable that measured regularity of purchase was significant at the 0.01 level and had a positive relationship with brand awareness. Consumers who shop frequently might be more likely to be aware of Texas Superstar ™. The odds ratio indicated that the presence of a high regularity of purchase makes awareness of Texas Superstar ™ considerable more likely to occur as long as the other explanatory variables in the model are held constant. Even though this might be an expected result, the substantial magnitude of the increase in the likelihood caused by awareness should be noticed.

The variables DAGE3 and GEN had negative signs and were significant at the 5 % level (i.e. a 95% confidence interval), which indicates that consumers between 40-55 years old and females might be less likely to be aware of Texas Superstar ™. Since negative coefficients lead to odds ratios less than one, a one unit change in the variables DAGE3 and GEN lead to awareness being less likely to occur by 6% (0.06/0.94) and 7% (0.07/0.93) correspondingly.

Therefore, the model implies that the odds in favor of Texas Superstar ™ awareness might increase for consumers that exhibit a regular consumption of ornamental products, and might decrease for those consumers between 40-55 years old and females. According to Hall, Hodges and Haydu (2005), in the U.S. elder consumers are increasingly engaging in professional lawn care services and females' use of garden equipment is increasing due to comparatively recent product innovations (i.e. battery-powered or cordless equipment), therefore the awareness of ornamentals products currently available in the market might be lower for these particular socio-demographic groups.

**Earth-Kind ™ Awareness**

A greater part of respondents surveyed indicated that they were unaware of the Earth-Kind ™ program (Figure 5.6). Nevertheless, 78% of the aware respondents were satisfied or very satisfied with Earth-Kind ™, and more than 80% affirmed two things: that they would probably or definitely re-purchase the plants, and recommend Earth-Kind ™ plants or Earth-Kind ™ landscaping techniques to others. Approximately one half of the aware respondents had used at least one of the advised Earth-Kind ™ landscaping techniques and almost every respondent considered that Earth-Kind ™ plants must be clearly identified with a tag at the point of purchase (92%).

The program was most often remembered from suggestions of friends or relatives, and from advertisement including in-store displays. Other sources of awareness were articles from the newspaper and the Dallas Arboretum (Figure 5.7).

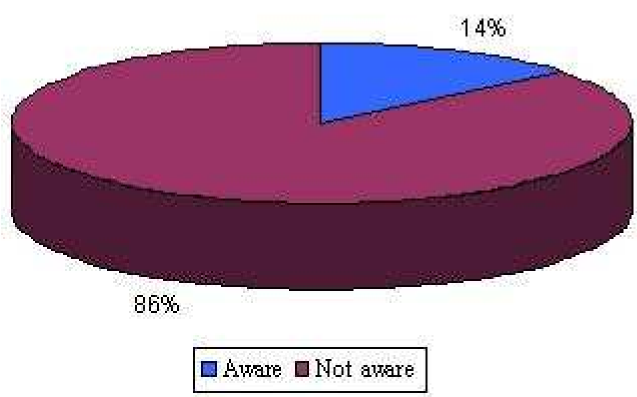



**Figure 5.6 Earth-Kind ™ awareness**

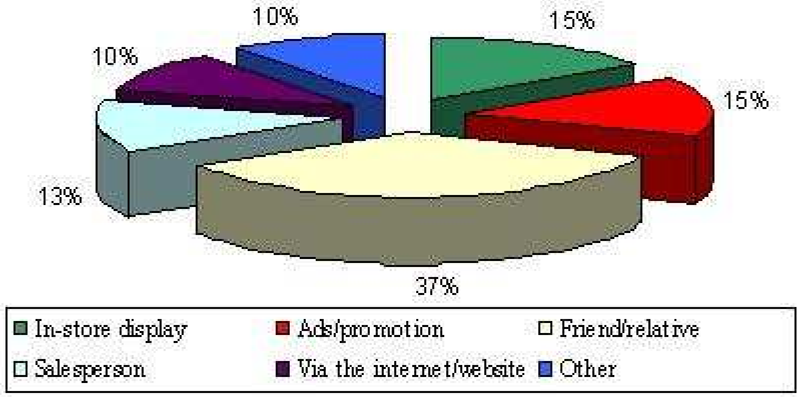



**Figure 5.7 Earth-Kind ™ sources of awareness**

Respondents' average rating of several features of Earth-Kind ™ plants indicated that the adaptability to local conditions and the non-use of fertilizers are among the best attributes of this program (Table 5.9). This rating was done by all of the respondents who reported being aware of Earth-Kind ™.

**Table 5.9 Average Rating of Earth-Kind ™ Features**

| | |
|---|---|
| Adapted to local conditions | 4.05 |
| No fertilizers usage | 4.03 |
| Minimal water usage | 3.97 |
| Minimal pesticides usage | 3.92 |
| Minimal yard wastes | 3.92 |

From the sample of aware respondents, 74% rated as high, at the 4 or 5 levels, the non-use of fertilizers, while 72% assigned the same ratings to the minimal use of pesticides. The characteristic of minimal water usage received high scores by almost 80% of respondents but at the same time 13% of total respondents rated this feature at the 1 or 2 levels. The rating of adaptability to local conditions showed the same distribution, receiving high ratings from 77% of the respondents and low ratings from 11%. Lastly, about 30% of aware respondents were neutral concerning minimal yard wastes (Table 5.10).

**Table 5.10 Summary of Rating Results of Earth-Kind ™ Features**

| | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| Minimal water usage | 3% | 10% | 8% | 46% | 33% |
| No fertilizers usage | 3% | - | 23% | 41% | 33% |
| Adapted to local conditions | 3% | 8% | 13% | 36% | 41% |
| Minimal pesticides usage | 3% | 3% | 21% | 36% | 36% |
| Minimal yard wastes | 3% | 3% | 28% | 21% | 44% |

Regarding the landscaping advised techniques, approximately 48% of the aware respondents had used at least one of them. Among the most popular used practices were the selection of locally adapted plants, the use of organic matter in soil preparation, and the use of mulches. For instance, of the aware respondents that had previously used Earth-Kind ™ techniques, 68% had used the Earth-Kind ™ plant selector (Table 5.11).

Also, respondents showed a higher inclination to follow fertilization recommendations in the spring, perhaps because the spring is commonly seen as a time of plant growth, and is in effect the season when annuals bloom. Of the aware respondents, 63% had applied a one-time fertilization in the spring while only 37% had done the same in the fall.

The use of organic matter and mulches were frequently used techniques that more than 50% of aware respondents had used. Some of the less used advices include more complex design of the landscape which demands more involvement in the industry from the gardener. For example, respondents affirmed to pre-plan and design the landscape (47%) but few respondents hired landscape architectural services for this planning stage (11%).

**Table 5.11 Use of Earth-Kind ™ Landscaping Techniques**

| | |
|---|---|
| Selection of locally adapted plants | 68% |
| Fertilization in the spring (once) | 63% |
| Use of organic matter when preparing the soil | 58% |
| Use of mulches wherever possible | 53% |
| Pre-planning and design of the landscape | 47% |
| Efficient irrigation: watering only when needed | 47% |
| Fertilization in the fall (once) | 37% |
| Elimination of water demanding weeds | 32% |
| More square and less narrow turf areas | 26% |
| Use of professional help for the planning stage | 11% |

**Earth-Kind ™ Awareness Model Results**

Similar to the Texas Superstar ™ awareness evaluation, the parameter estimates of the Earth-Kind ™ awareness model by means of logit and probit analyses were identical in terms of significance and proportionally comparable in terms of value.

Table 5.12 indicates the comparative relation between all of the logit and probit estimated coefficients of the variables defined in Table 4.1. As shown in Table 5.12 the logit parameter estimates multiplied by a 0.625 factor yield a fair approximation of the slope coefficient estimated using probit. Given this evidence, only the logistic results are discussed.

The goodness of fit of the Earth-Kind ™ brand awareness model is indicated by the McFadden's $R^2$ of 0.16 and the likelihood ratio test of 24.6. For large likelihood ratio statistics such as this, the null hypothesis that all slope coefficients in the model are zero and that the independent variables are non significant, is rejected (p-value<0.0001).

**Table 5.12 Logit and Probit Proportionality of Parameter Estimates for Earth-Kind ™ Brand Awareness Model**

| | Estimated β logit | 0.625*β logit | Estimated β probit |
|---|---|---|---|
| Intercept | -1.47 | -0.92 | -0.86 |
| **Socio-demographic characteristics** | | | |
| DAGE2 | -0.27 | -0.17 | -0.15 |
| DAGE3 | -0.70 | -0.44 | -0.39 |
| DAGE4 | -0.19 | -0.12 | -0.11 |
| GEN | -0.47 | -0.29 | -0.27 |
| MAR | 0.22 | 0.14 | 0.10 |
| DINC2 | -0.35 | -0.22 | -0.20 |
| **Consumer habits** | | | |
| REGU | 1.12 | 0.70 | 0.60 |
| PUR | -0.49 | -0.31 | -0.26 |
| **Region** | | | |
| DREG2 | -0.25 | -0.16 | -0.13 |
| DREG3 | 0.74 | 0.46 | 0.42 |

Note: Refer to Table 4.1 for a definition of each independent variable

As regards to the models' prediction of actual choice outcomes, this model compared to a naïve model with a 0.5 cutoff, predicts 232 of 268, or 86.5%, of the observations correctly, and about 232 of the survey participants were correctly classified as either aware or unaware of Earth-Kind ™. This percentage was obtained by adding up the diagonal elements (230+2) and diving by the number of observations (268) in Table 5.13.

**Table 5.13 Frequencies of Actual and Predicted Outcomes for Earth-Kind ™ Brand Awareness Model Using Logit**

| | Predicted | | |
|---|---|---|---|
| **Actual** | 0 | 1 | **Total** |
| 0 | 230 | 1 | **231** |
| 1 | 35 | 2 | **37** |
| **Total** | **265** | **3** | **268** |

The logistic results for the Earth-Kind ™ program are summarized in Table 5.14 which includes the number of usable observations, the estimated coefficients, standard errors, t-values, and odds ratios. The corresponding probit results can be found in Appendix B. The dummy dependent variable for this model was awareness of Earth-Kind ™. This variable was one for those respondents that were aware of this program and zero for those who were not. The independent variables were defined in Table 4.1.

The coefficient for the independent variable REGU was positive and highly significant at the 0.01 level, meaning that consumers who shop weekly or monthly might be more likely to be aware of Earth-Kind ™. Once again, the effect of the variable REGU on the probability ratio is considerable, and a one unit increase in this variable makes the respondent about thirteen times more likely to be aware of the Earth-Kind ™ program.

The significance of the variable DREG3 indicated that consumers living in South Texas (Coastal Bend and South District) might have higher probabilities of being aware than consumers living in any other districts. The odds ratio of DREG3 suggested that a one unit change in this variable might make awareness five times more likely to be present.

**Table 5.14 Brand Awareness Parameter Estimates from Logit Model for Earth-Kind ™ Program**

| | Logit | | | |
|---|---|---|---|---|
| | **Coefficient** | **Standard Error** | **t-value** | **Odds ratio** |
| Intercept | -1.4721*** | (0.5403) | -2.7246 | |
| **Socio-demographic characteristics** | | | | |
| DAGE2 | -0.2709 | (0.3380) | -0.8014 | 0.5359 |
| DAGE3 | -0.6993* | (0.3719) | -1.8801 | 0.1998 |
| DAGE4 | -0.1885 | (0.3221) | -0.5853 | 0.6478 |
| GEN | -0.4682 | (0.3930) | -1.1913 | 0.3402 |
| MAR | 0.2199 | (0.4242) | 0.5184 | 1.6593 |
| DINC2 | -0.3549* | (0.2085) | -1.7019 | 0.4417 |
| **Consumer habits** | | | | |
| REGU | 1.1226** | (0.4403) | 2.5499 | 13.2633 |
| PUR | -0.4899 | (0.4752) | -1.0311 | 0.3236 |
| **Region** | | | | |
| DREG2 | -0.2524 | (0.2591) | -0.9741 | 0.5592 |
| DREG3 | 0.7382** | (0.3174) | 2.3255 | 5.4723 |
| Number of usable observations | 268 | | | |
| Log-likelihood ($L_1$) | -95.25 | | | |
| Likelihood ratio [a] | 24.67 | | | |
| LR p-value | 0.006 | | | |
| McFadden's $R^{2}$ [b] | 0.11 | | | |
| Fraction of correct predictions | 0.86 | | | |

Note: Refer to Table 4.1 for a definition of each independent variable
* P-value < 0.1, ** P-value < 0.05, *** P-value < 0.01
a Defined as $2(L_1-L_0)$
b Defined as $1-(L_1/L_0)$

An unexpected result was a negative relationship between the variables DAGE3 and DINC2, and awareness. The results imply that respondents between 40-55 years old and with high income levels (defined above $50,000) are less likely to be aware of Earth-Kind ™. The preceding might be explained by the increasing participation of senior citizens in professional landscaping services. Also, it might be attributed to the fact that Earth-Kind ™ is not only a brand of ornamental plants but also an educational effort focused on environmental practices that is organized through county extension offices. Active participation in these campaigns might be less likely for consumers with relatively high income and consumers in that particular age group. The estimated impact of one unit change in DAGE3 and DINC2 is to make awareness less likely to happen by 0.19 and 0.44, respectively.

The results of the Earth-Kind ™ brand awareness model indicate that the odds of awareness of this program among ornamentals' consumers might increase substantially for those consumers who shop weekly or monthly. This relationship is similar to the relationship between brand awareness and regularity of purchase in the Texas Superstar ™ brand awareness model; although the effects of a unit change in the variable that measures regularity on the odds of awareness, is lower for the Earth-Kind ™ model than that for the Texas Superstar ™ model. Furthermore, the likelihood of awareness is expected to be higher for consumers who live in the districts of Coastal Bend and the South District which were defined as the South Texas area. Finally, awareness is predicted to decrease for consumers with an income above $50,000 and within 40 to 55 years old provided that these consumers might be less willing or able to follow environmental campaigns organized through county extension offices.

**Texas Superstar ™ Willingness-to-Pay**

The majority of respondents who had previously bought Texas Superstar ™ plants were willing to pay a price premium for them. Around 22% of respondents were willing to pay a premium of 1-10% for Texas Superstar ™ compared to a regular plant, while 28% of respondents were willing to pay 11-20% more. Further, the distribution of the sample in the ranges of WTP indicates that 19% of surveyed respondents were willing to pay at least 31% more for the same brand while 16% were not willing to pay anything extra. These ranges of WTP are represented graphically in Figure 5.8.

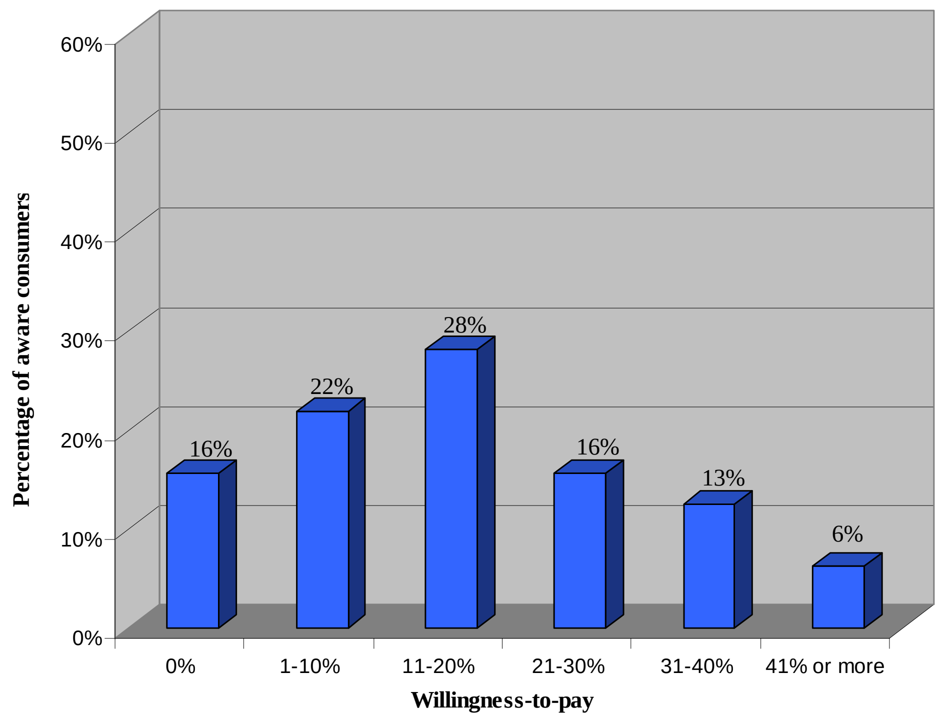



**Figure 5.8 Willingness-to-pay for Texas Superstar ™ of aware respondents**

WTP was also collected among non-aware respondents (88%) that were briefly informed about the program prior to measuring their WTP. The majority of unaware respondents were willing to pay 1-10% more for a Texas Superstar ™ plant weighted against a regular plant (51%), around 5% were willing to pay 31% or more and 12%

affirmed not to be willing to pay any additional premium. The distribution of WTP for non aware respondents is shown in Figure 5.9.

The distributions of the ranges of willingness-to-pay among aware and non-aware respondents suggest a positive relationship between the respondents' willingness-to-pay for a price premium and his/her awareness of the brand either from the marketplace or from informational statements.

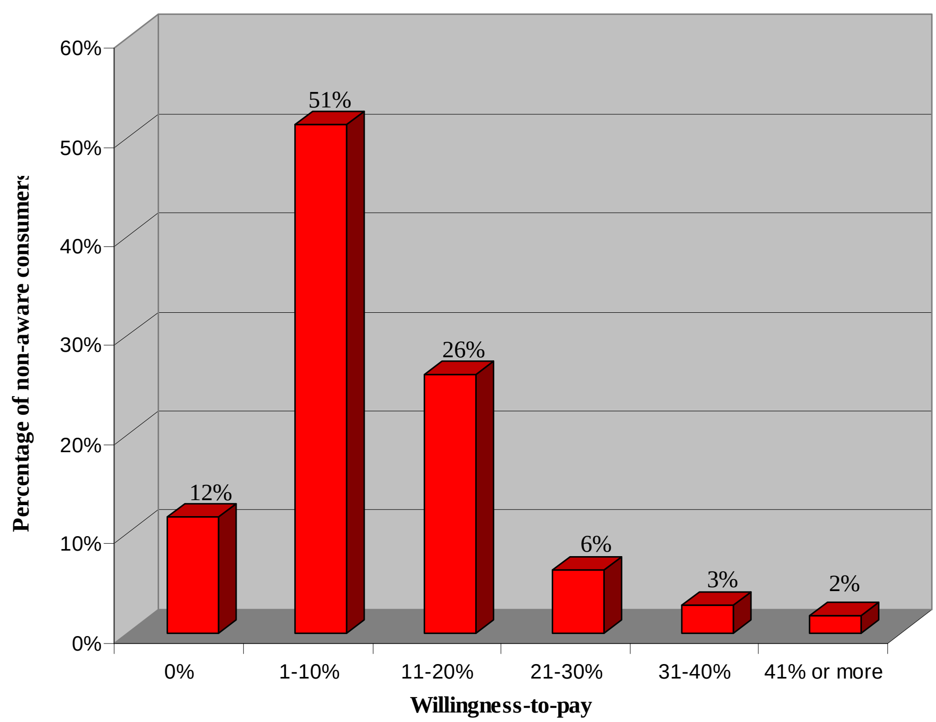



**Figure 5.9 Willingness-to-pay for Texas Superstar ™ of non-aware respondents**

The statistics show that more than 50% of aware respondents were willing to pay a premium between 1-20%, and 57% of unaware respondents were willing to pay 1-10% more. Also, that 16% of previously aware respondents and 13% of informed respondents were not willing to pay any premium. This relationship is more precisely investigated in the following econometric results.

**Texas Superstar ™ Willingness-to-Pay Model Results**

The estimated coefficients, standard errors, t-values and marginal effects for the tobit analysis of Texas Superstar ™ WTP are presented in Table 5.15. The dependent variable for the model was the conditional mean WTP for Texas Superstar ™ which was calculated from each of the ranges of percent WTP described previously. The independent variables were previously defined in Table 4.2.

The extreme significance of the SIGMA parameter suggests that for the data truncation, the lower limit level of zero can not be ignored and the estimation method must deal with the asymptotic distribution of the data (i.e. Tobit model). This parameter refers to the estimated standard deviation of the residual. In this model, 130 of 141, or 87.2% of the usable observations were positive.

The coefficient of the variable PUR was found to have an inverse relationship with WTP and was significant at the 0.05 level. The described relationship and significance of this variable imply that if the purpose of the purchase of a Texas Superstar ™ plant is defined as self-consumption, the price premium that consumers might be willing to pay for a Texas Superstar ™ plant in relation to a regular plant decreases. In reference to the marginal effect, the presence of self-consumption purposes decreases the average price premium for Texas Superstar ™ by 16%.

**Table 5.15 Willingness-to-pay Parameter Estimates from Tobit Model for Texas Superstar $^{TM}$ Program**

| | Tobit | | | |
|---|---|---|---|---|
| | **Coefficient** | **Standard Error** | **t-value** | **Marginal Effects** |
| Intercept | 0.1516*** | (0.0315) | 4.8147 | |
| **Socio-demographic characteristics** | | | | |
| DAGE2 | -0.0252 | (0.0175) | -1.4339 | -0.0593 |
| DAGE3 | -0.0032 | (0.0167) | -0.1907 | -0.0075 |
| DAGE4 | -0.0136 | (0.0156) | -0.8699 | -0.0320 |
| GEN | 0.0188 | (0.0201) | 0.9361 | 0.0444 |
| MAR | -0.0085 | (0.0204) | -0.4166 | -0.0201 |
| DINC2 | 0.0029 | (0.0103) | 0.2868 | 0.0070 |
| **Consumer habits** | | | | |
| REGU | 0.0166 | (0.0237) | 0.6995 | 0.0391 |
| PUR | -0.0687** | (0.0274) | -2.5108 | -0.1622 |
| TSAWARE | 0.0448* | (0.0255) | 1.7574 | 0.1059 |
| **Region** | | | | |
| DREG2 | -0.0023 | (0.0129) | -0.1813 | -0.0055 |
| DREG3 | -0.0006 | (0.0179) | -0.0360 | -0.0015 |
| SIGMA | 0.1058*** | (0.0069) | 15.2602 | |
| Number of usable observations | 141 | | | |

Note: Refer to Table 4.2 for a definition of each independent variable
* P-value < 0.1, ** P-value < 0.05, *** P-value < 0.01

The model estimation validates the positive effect of brand awareness on willingness-to-pay. The coefficient of the variable TSAWARE was positive and significant at a 90% confidence interval. The results suggest that, after controlling for socio-demographic and area variations, ornamentals' consumers aware of Texas Superstar $^{TM}$ plants might willing to pay more for them. Respondents with awareness of this brand are willing to pay a price premium that is 11% higher than the average price premium for Texas Superstar $^{TM}$.

Results of the Texas Superstar ™ willingness-to-pay model show that self consumption purposes decrease the average consumers' willingness-to-pay for Texas Superstar ™ plants compared to regular plants around 16%, while awareness of Texas Superstar ™ increases willingness-to-pay for Texas Superstar ™ by 11%. Moreover, the WTP for Texas Superstar ™ of the average consumer was calculated at 10%.

**Earth-Kind ™ Willingness-to-Pay**

The greater part of respondents who were aware of Earth-Kind ™ were willing to pay 1-10% more for an Earth-Kind ™ plant relative to a regular plant (44%). As shown in Figure 5.10, 18% of surveyed respondents were willing to pay at least 31% more for Earth-Kind ™ while 3% were not willing to pay any premium.

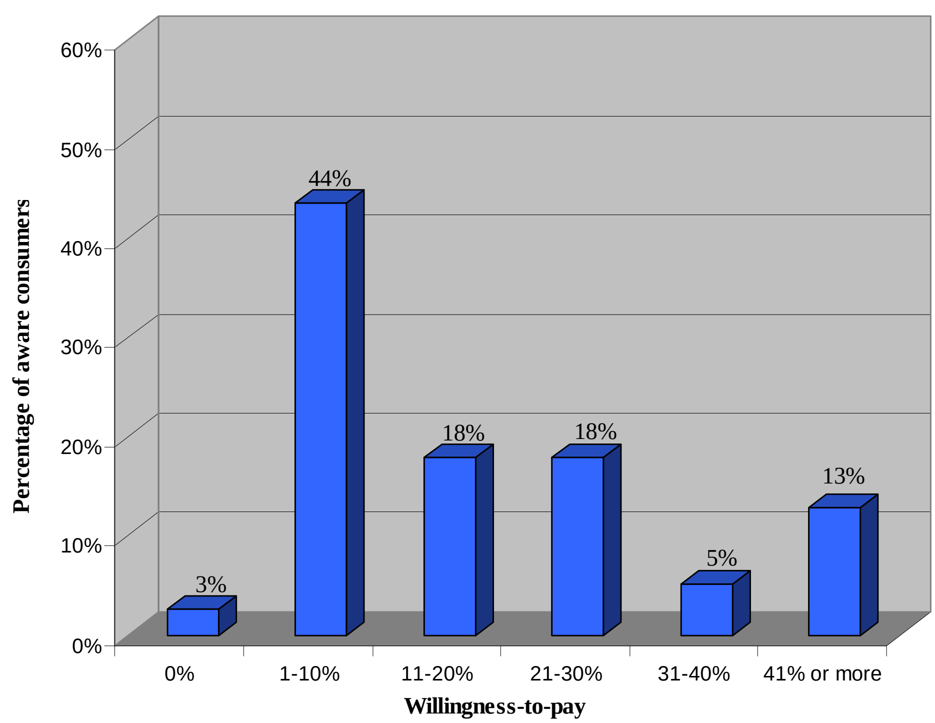



**Figure 5.10 Willingness-to-pay for Earth-Kind ™ of aware respondents**

The WTP of respondents that were unaware of the program (86%), but that received the information prior to the WTP question stayed around 1-10% as well. The ranges of WTP for unaware respondents are shown in Figure 5.11. In the distribution, 43% of respondents stated a WTP of 1-10%, around 4% were willing to pay 31% or more, and for 18% the willingness-to-pay was zero.

Similar to the Texas Superstar ™ program, the distributions of the ranges of willingness-to-pay among aware and non-aware respondents for the Earth-Kind ™ program suggest a positive relationship between the respondents' willingness-to-pay and respondents' brand awareness.

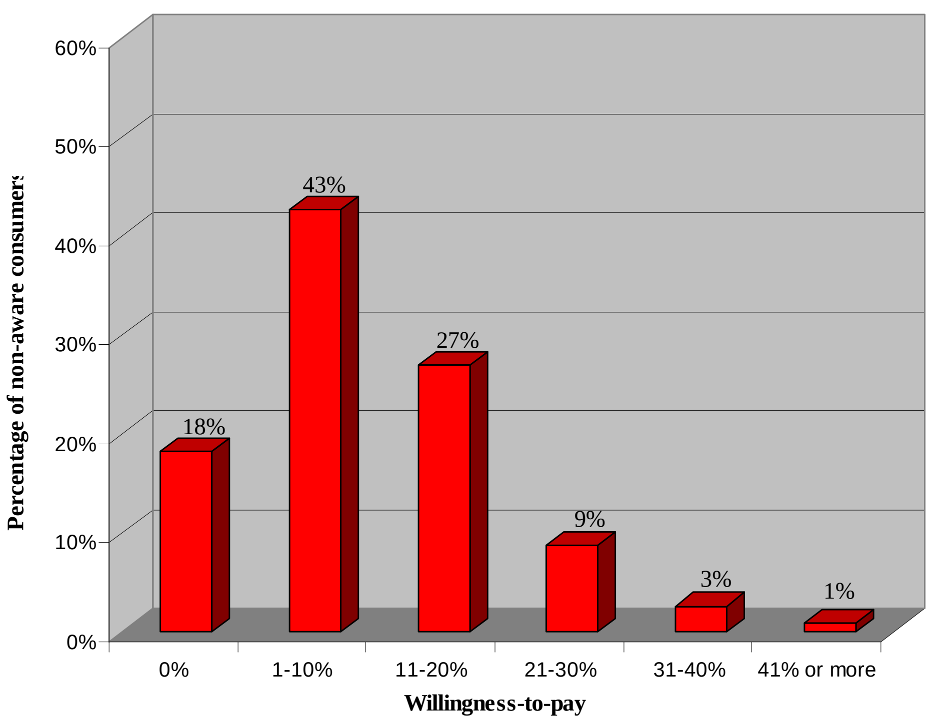



**Figure 5.11 Willingness-to-pay for Earth-Kind ™ of non-aware respondents**

According to the survey data, more than 40% of each group was willing to pay an additional 1-10%, while 3% of previously aware respondents and 18% of non aware respondents had a willingness-to-pay of zero.

**Earth-Kind TM Willingness-to-Pay Model Results**

The results for the tobit estimation of the Earth-Kind TM Willingness-to-pay model are described in Table 5.16. The dependent variable for the model was the conditional mean WTP for Earth-Kind TM. The definition of each independent variable can be found in Table 4.2.

The tobit model appears to fit the data considerable well as indicated by the high significance of the parameter SIGMA. In this model, 129 of 151, or 85.4% of the observations were positive, and the significance of the estimated coefficients, along with the standard errors and t-values are detailed in Table 5.16.

The coefficient of the variable DAGE4 was greatly significant and had a negative effect on the program's WTP, indicating that the price premium that consumers might be willing to pay for an Earth-Kind TM plant compared to a regular plant declines for consumers of more than 55 years of age. This age group might be willing to pay a price premium that is 12% lower than the average price premium for Earth-Kind TM products.

Comparable to the results of the Texas Superstar TM WTP model, the variables that measured purpose of purchase and brand awareness in the Earth-Kind TM model had an influence on willingness-to-pay. In the Earth-Kind TM WTP model, the coefficients associated to the variables PUR and EKAWARE were significant at the 0.1 level; the first implying that the price premium that respondents are willing to pay for a branded plant, particularly Earth-Kind ™, is lower if the purpose of the purchase is self-consumption and the second corroborating that previously aware respondents are willing to pay more for these products. The decrease in WTP from self-consumption purposes in Earth-Kind ™ (6%) is less than the same effect in Texas Superstar ™ (16%). However, the increase in WTP as consequence of brand awareness is a close estimate for the two programs, with an increase of 10% on the average WTP as a result of Earth-Kind ™ awareness.

**Table 5.16 Willingness-to-pay Parameter Estimates from Tobit Model for Earth-Kind ™ Program**

| | **Tobit** | | | |
|---|---|---|---|---|
| | **Coefficient** | **Standard Error** | **t-value** | **Marginal Effects** |
| Intercept | 0.1373*** | (0.0314) | 4.3742 | |
| **Socio-demographic characteristics** | | | | |
| DAGE2 | -0.0098 | (0.0165) | -0.5951 | -0.0238 |
| DAGE3 | -0.0173 | (0.0152) | -1.1446 | -0.0420 |
| DAGE4 | -0.0476*** | (0.0148) | -3.2026 | -0.1151 |
| GEN | 0.0144 | (0.0187) | 0.7728 | 0.0349 |
| MAR | -0.0139 | (0.0194) | -0.7204 | -0.0337 |
| DINC2 | 0.0009 | (0.0098) | 0.0961 | 0.0023 |
| **Consumer habits** | | | | |
| REGU | 0.0258 | (0.0221) | 1.1667 | 0.0624 |
| PUR | -0.0439* | (0.0262) | -1.6770 | 0.0624 |
| EKAWARE | 0.0429* | (0.0221) | 1.9401 | 0.1037 |
| **Region** | | | | |
| DREG2 | 0.0026 | (0.0123) | 0.2130 | 0.0063 |
| DREG3 | -0.0032 | (0.0168) | -0.1897 | -0.0077 |
| SIGMA | 0.1039*** | (0.0067) | 15.6130 | |
| Number of usable observations | 151 | | | |

Note: Refer to Table 4.2 for a definition of each independent variable
* P-value < 0.1, ** P-value < 0.05, *** P-value < 0.01

The results of the Earth-Kind TM WTP model suggest that consumers of more than 55 years of age might be willing to pay a price premium for an Earth-Kind TM plant compared to regular plant, that is 12% lower than the average premium. Furthermore, consumers whose purpose of purchase is self consumption might be willing to pay a price premium that is 6% lower, and those aware of Earth-Kind TM before the purchase might be willing to pay a premium that is 10% higher. The WTP for Texas Superstar TM of the average consumer was calculated at 9.9%.

# CHAPTER VI

# SUMMARY AND CONCLUSIONS

This final chapter presents a brief summary and the main conclusions of this thesis research. First, the background of the study is presented. Then, the implications of the final results for the brand awareness and willingness-to-pay sections are discussed. Lastly, the limitations of this study are acknowledged and recommendations for further research are given.

## Summary and Conclusions

The study of consumer behavior has always been a major research topic in economic theory. In agricultural markets, constant changes in consumers' behavior are continuously affecting the demand side. The demand of non-traditional agricultural goods such as ornamental products is further influenced by other factors like discretionary income and seasonality. Nevertheless, the ornamental industry, also known as the "Green Industry", is one of the fastest growing segments of the U.S. agricultural economy and the second most important sector in the nation's agriculture in terms of economic output.

This industry has experienced a gradual slowdown in growth in the past years, an increase in international competition and a decrease in the number of producers, all of these signs indicating that the green industry faces now a mature market. Differentiation by product, service, or geographic location is among the alternative market strategies that have been proposed to producers to slow down industry maturity. This strategy comprises new plant introductions and branding efforts.

In an attempt to support Texas' green industry producers, the Texas A&M University Agricultural Program in conjunction with other state and private collaborators of the ornamental industry in Texas, developed the Texas Superstar ™ and Earth-Kind ™ programs. One of the objectives of these programs was to raise awareness among consumers of Texas-grown plant materials while supporting environmental responsibility. In addition, the programs were intended to increase producers' profitability by providing them products with outstanding features that are to be sold at a price premium. While a considerable investment in research and marketing, expertise involvement, and an extensive coordination process have been done by the Texas A&M Agricultural Program to assure new plant releases, no research has focused on investigating consumer's behavior for these particular branding efforts.

In order to evaluate the overall effectiveness of Texas Superstar ™ and Earth-Kind ™ in the Texas area, the present research made two types of analyses for each program. First brand awareness, and second WTP. Brand awareness was defined as the level of accessibility of the brand in the consumer's mind and WTP referred to a measure of value used by an individual when buying an object.

An electronic mail survey was used to collect data regarding consumers' perceptions and WTP for branded products in the green industry. The survey sample of 880 individuals was provided by MarketTools Corporation and it was done in July of

2008. From the total sample, 31% of individuals were actual consumers of the ornamental industry's products; lowering the final number of usable responses to 274.

Because in this research the estimation of brand awareness had a probabilistic approach, a type of model that takes into account probabilities and uncertainty was chosen. Models that deal with these sorts of forecasts are the logit and probit model, and provided that the results were identical in terms of significance, only the results of the logit model were presented.

The results implied that the awareness of the Texas Superstar ™ and Earth-Kind ™ programs in the Texas area is low, but the level of satisfaction among aware consumers is high. Respondents who shopped weekly or monthly for ornamental plants were considerable more likely to be aware of programs such as Texas Superstar ™ and Earth-Kind ™. This effect on the odds of awareness was higher for Texas Superstar ™ than that for Earth-Kind ™. Also, a demographic characteristic of respondents who were up to five times more likely to be aware of Earth-Kind ™ included those who lived in South Texas (Coastal Bend and South District). The preceding should be an indicator for decision makers of consumers' awareness of these particular products in the South Texas area.

The results suggested that marketing programs might not be effectively reaching some demographic groups. These groups would include female consumers and those between 40 to 55 years old for the Texas Superstar ™ brand, and consumers between the same 40 to 55 years old group and those with an income of $50,000 or more for the Earth-Kind ™ program. This might indicate that consumers with relatively high income, females and senior citizens are relying more and more everyday in professional landscaping services, and are less aware of the products available in the ornamentals' market. Furthermore, in the case of Earth-Kind ™ this might be explained by the fact that Earth-Kind ™ is not only a brand of ornamental plants but also an educational effort focused on environmental practices that is organized by county extension offices, and active participation in these campaigns might be less likely for consumers with relatively high income and those in that particular age group.

The awareness among Texas' consumers of Texas Superstar ™ and Earth-Kind ™ was found to be similar to that of other plant promotion programs such as Plants that Work ™ and Wave ™. Awareness of these programs was found to be higher than awareness of Proven Winners ™.

The WTP analysis was made by means of the Tobit model, under the assumption that a consumer's observable willingness-to-pay for a desirable attribute of a product is always positive. Interestingly, the findings suggest that consumers who shop for self consumption purposes might be willing to pay a lower price premium for Texas Superstar ™ and Earth-Kind ™ plants compared to regular plants, although this reduction on WTP was higher for Texas Superstar ™ than that for Earth-Kind ™. An additional socio-demographic characteristic of consumers willing to pay a lower price premium for Earth-Kind ™ products included consumers more than 55 years old.

Since consumer recognition of a brand is closely linked with the consumer's response and WTP for the product, the effect of the brand's awareness was added to the WTP model developed for each of these programs. It was found that consumers who were previously aware of the brands were willing to pay more for the additional benefits they offer compared to a regular plant. Earth-Kind ™ awareness increased WTP for Earth-Kind ™ products by 10%, and Texas Superstar ™ awareness increased WTP for Texas Superstar ™ products by 11%. The WTP for Earth-Kind ™ and Texas Superstar ™ of the average respondent was 10%. Therefore, this research suggests a price premium of around 10% for Earth-Kind ™ and Texas Superstar ™ products.

The outcomes of this study should be helpful to existing and upcoming promotional programs. Marketing efforts should target those groups of consumers with higher WTP, that is, consumers with a profile of behavioral and demographic characteristics that might be more likely to influence awareness of Texas Superstar ™ and Earth-Kind ™. The groups with higher odds of awareness include consumers who shop weekly or monthly and, for the Earth-Kind ™ program, those who live in South Texas. The increase in the consumers' regularity of purchase could be achieved trough promotional tactics. Successful marketing campaigns have been done in other states of the U.S. that have proven to increase the frequency of purchase among ornamentals' consumers. For example, in 2000 the Flower Promotion Organization (FPO) launched a promotional effort to increase the buying frequency among existing female flower buyers in non-traditional holidays. Ward (2004) estimated the impact of this campaign and concluded that the promotions positively impacted the demand for flowers and effectively increased buyer frequency.

Clearly, another option is targeting those groups that might not have being efficiently reached thus far. These groups include consumers between 40-55 years old, females, and consumers with an income above $50,000. However, the likelihood of awareness for these groups might be lower either because they have not been reached by past marketing efforts or because they are simply not a target group for this type of products. Hence, there might be considerable more potential for increasing brand awareness and subsequently increasing market penetration in targeting those groups with the behavioral and demographic profile described earlier, which are more prone to be aware.

**Recommendations and Directions for Future Research**

This research analyzed two aspects of consumer's behavior: brand awareness and willingness-to-pay; however, other dimensions of consumer's behavior such as post-purchase evaluation, and product use could be investigated. The present research evaluated the Earth-Kind ™ and Texas Superstar ™ programs at the aggregate level, but further empirical work could also analyze consumer's behavior toward individual products. For instance, demand analyses could be done for Earth-Kind ™ and Texas Superstar ™ best sellers (i.e. Belinda's Dream rose). Additionally, research with revealed preferences and actual purchasing behavior could be useful to obtain additional insights regarding WTP for brands in ornamental products.

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# APPENDIX A

## TSP PROGRAMS

```
OPTIONS MEMORY=500;
TITLE 'ALBA COLLART MASTER THESIS';

? PROGRAM 1 FOR BRAND AWARENESS SUPERSTAR LOGIT MODEL;

?================================================;
? CREATING A TLB FILE FROM THE EXCEL;
?================================================;
OUT 'F:\THESIS\TSP\AWL\TSAWD';
READ(FORMAT=EXCEL,FILE='F:\THESIS\TSP\AWL\TSAWD');
OUT;

?================================================;
? READ THE DATA FROM A TLB FILE CREATED EARLIER;
?================================================;
IN 'F:\THESIS\TSP\AWL\TSAWD';
DBLIST 'F:\THESIS\TSP\AWL\TSAWD';

?=================================================;
? CREATING DUMMY VARIABLES;
?=================================================;

?-----------------------------;
? AGE  1=UNDER 25, 2=25/39, 3=40/55, 4=55+;
?-----------------------------;
DOT 2-4;
DAGE.=AGE.-AGE1;
ENDDOT;

?-----------------------------;
? INCOME  1=LOW INCOME OF UNDER 50KI, 2=HIGH INCOME 50K+;
?-----------------------------;
DOT 2;
DINC.=INC.-INC1;
ENDDOT;

?-----------------------------;
? ETHNICITY  1=CAUCASIAN, 2=HISPANIC, 3=OTHER;
?-----------------------------;
DOT 2-3;
DET.=ET.-ET1;
ENDDOT;

?-----------------------------;
? EDUCATION  1=HIGH SCHOOL, 2=COLLEGE, 3=GRAD SCHOOL;
?-----------------------------;
DOT 2-3;
DEDU.=EDU.-EDU1;
```

```
ENDDOT;

?----------------------------;
? REGION  1=NORTH, 2=CENTRAL, 3=SOUTH;
?----------------------------;
DOT 2-3;
DREG.=REG.-REG1;
ENDDOT;

LIST X C DAGE2-DAGE4 GEN MAR DINC2 REGU PUR DREG2-DREG3;
LOGIT TSAW X;
PRINT @DPDX;
PRINT @VCOV;
?PRINT @FIT;

EXECUTION
```

```
OPTIONS MEMORY=500;
TITLE 'ALBA COLLART MASTER THESIS';

? PROGRAM 1 FOR BRAND AWARENESS EARTHKIND LOGIT MODEL;

?=================================================;
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?=================================================;
OUT 'F:\THESIS\TSP\AWL\EKAWD';
READ(FORMAT=EXCEL,FILE='F:\THESIS\TSP\AWP\EKAWD');
OUT;

?=================================================;
? READ THE DATA FROM A TLB FILE CREATED EARLIER;
?=================================================;
IN 'F:\THESIS\TSP\AWL\EKAWD';
DBLIST 'F:\THESIS\TSP\AWL\EKAWD';

?==================================================;
? CREATING DUMMY VARIABLES;
?==================================================;

?----------------------------;
? AGE  1=UNDER 25, 2=25/39, 3=40/55, 4=55+;
?----------------------------;
DOT 2-4;
DAGE.=AGE.-AGE1;
ENDDOT;

?----------------------------;
? INCOME  1=LOW INCOME OF LESS THAN 50K; 2=HIGH INCOME 50+;
?----------------------------;
DOT 2;
DINC.=INC.-INC1;
ENDDOT;
```

```
?-----------------------------;
? ETHNICITY  1=CAUCASIAN, 2=HISPANIC, 3=OTHER;
?-----------------------------;
DOT 2-3;
DET.=ET.-ET1;
ENDDOT;

?-----------------------------;
? EDUCATION  1=HIGH SCHOOL, 2=COLLEGE, 3=GRAD SCHOOL;
?-----------------------------;
DOT 2-3;
DEDU.=EDU.-EDU1;
ENDDOT;

?-----------------------------;
? REGION  1=NORTH, 2=CENTRAL, 3=SOUTH;
?-----------------------------;
DOT 2-3;
DREG.=REG.-REG1;
ENDDOT;

LIST X C DAGE2-DAGE4 GEN MAR DINC2 REGU PUR DREG2-DREG3;
LOGIT EKAW X;
PRINT @DPDX;
PRINT @VCOV;
?PRINT @FIT;

EXECUTION


OPTIONS MEMORY=500;
TITLE 'ALBA COLLART MASTER THESIS';

? PROGRAM 1 FOR BRAND AWARENESS SUPERSTAR PROBIT MODEL;

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OUT;

?=================================================;
? READ THE DATA FROM A TLB FILE CREATED EARLIER;
?=================================================;
IN 'C:\TSPPRG\ALBA\TSAWD';
DBLIST 'C:\TSPPRG\ALBA\TSAWD';

?==================================================;
? CREATING DUMMY VARIABLES;
?==================================================;
```

```
?----------------------------;
? AGE  1=UNDER 25, 2=25/39, 3=40/55, 4=55+;
?----------------------------;
DOT 2-4;
DAGE.=AGE.-AGE1;
ENDDOT;

?----------------------------;
? INCOME  1=LOW INCOME OF UNDER 50KI, 2=HIGH INCOME 50K+;
?----------------------------;
DOT 2;
DINC.=INC.-INC1;
ENDDOT;

?----------------------------;
? ETHNICITY  1=CAUCASIAN, 2=HISPANIC, 3=OTHER;
?----------------------------;
DOT 2-3;
DET.=ET.-ET1;
ENDDOT;

?----------------------------;
? EDUCATION  1=HIGH SCHOOL, 2=COLLEGE, 3=GRAD SCHOOL;
?----------------------------;
DOT 2-3;
DEDU.=EDU.-EDU1;
ENDDOT;

?----------------------------;
? REGION  1=NORTH, 2=CENTRAL, 3=SOUTH;
?----------------------------;
DOT 2-3;
DREG.=REG.-REG1;
ENDDOT;

LIST X C DAGE2-DAGE4 GEN MAR DINC2 REGU PUR DREG2-DREG3;
PROBIT TSAW X;
PRINT @DPDX;
PRINT @VCOV;
?PRINT @FIT;

EXECUTION
```

**OPTIONS MEMORY=500;**
**TITLE 'ALBA COLLART MASTER THESIS';**

**? PROGRAM 1 FOR BRAND AWARENESS EARTHKIND PROBIT MODEL;**

```
?==================================================;
? CREATING A TLB FILE FROM THE EXCEL;
?==================================================;
OUT 'C:\TSPPRG\ALBA\EKAWD';
READ(FORMAT=EXCEL,FILE='C:\TSPPRG\ALBA\EKAWD');
```

```
OUT;

?================================================;
? READ THE DATA FROM A TLB FILE CREATED EARLIER;
?================================================;
IN 'C:\TSPPRG\ALBA\EKAWD';
DBLIST 'C:\TSPPRG\ALBA\EKAWD';

?=================================================;
? CREATING DUMMY VARIABLES;
?=================================================;

?-----------------------------;
? AGE  1=UNDER 25, 2=25/39, 3=40/55, 4=55+;
?-----------------------------;
DOT 2-4;
DAGE.=AGE.-AGE1;
ENDDOT;

?-----------------------------;
? INCOME  1=LOW INCOME OF LESS THAN 50K; 2=HIGH INCOME 50+;
?-----------------------------;
DOT 2;
DINC.=INC.-INC1;
ENDDOT;

?-----------------------------;
? ETHNICITY  1=CAUCASIAN, 2=HISPANIC, 3=OTHER;
?-----------------------------;
DOT 2-3;
DET.=ET.-ET1;
ENDDOT;

?-----------------------------;
? EDUCATION  1=HIGH SCHOOL, 2=COLLEGE, 3=GRAD SCHOOL;
?-----------------------------;
DOT 2-3;
DEDU.=EDU.-EDU1;
ENDDOT;

?-----------------------------;
? REGION  1=NORTH, 2=CENTRAL, 3=SOUTH;
?-----------------------------;
DOT 2-3;
DREG.=REG.-REG1;
ENDDOT;

LIST X C DAGE2-DAGE4 GEN MAR DINC2 REGU PUR DREG2-DREG3;
PROBIT EKAW X;
PRINT @DPDX;
PRINT @VCOV;
?PRINT @FIT;

EXECUTION
```

```
OPTIONS MEMORY=500;
TITLE 'ALBA COLLART MASTER THESIS';

? PROGRAM 2 FOR WILLINGNESS-TO-PAY SUPERSTAR;

?==================================================;
? CREATING A TLB FILE FROM THE EXCEL;
?==================================================;
OUT 'C:\TSPPRG\ALBA\WTP\TSWTP';
READ(FORMAT=EXCEL,FILE='C:\TSPPRG\ALBA\WTP\TSWTP');
OUT;

?==================================================;
? READ THE DATA FROM A TLB FILE CREATED EARLIER;
?==================================================;
IN 'C:\TSPPRG\ALBA\WTP\TSWTP';
DBLIST 'C:\TSPPRG\ALBA\WTP\TSWTP';

?===================================================;
? CREATING DUMMY VARIABLES;
?===================================================;

?-----------------------------;
? AGE  1=UNDER 25, 2=25/39, 3=40/55, 4=55+;
?-----------------------------;
DOT 2-4;
DAGE.=AGE.-AGE1;
ENDDOT;

?-----------------------------;
? INCOME  1=UNDER $25K, 2=25K-50K, 3=50K-75K, 4=75K-99K,  5=100K+;
?-----------------------------;
DOT 2;
DINC.=INC.-INC1;
ENDDOT;

?-----------------------------;
? ETHNICITY  1=CAUCASIAN, 2=HISPANIC, 3=OTHER;
?-----------------------------;
DOT 2-3;
DET.=ET.-ET1;
ENDDOT;

?-----------------------------;
? EDUCATION  1=HIGH SCHOOL, 2=COLLEGE, 3=GRAD SCHOOL;
?-----------------------------;
DOT 2-3;
DEDU.=EDU.-EDU1;
ENDDOT;

?-----------------------------;
? REGION  1=NORTH, 2=CENTRAL, 3=SOUTH;
?-----------------------------;
```

```
DOT 2-3;
DREG.=REG.-REG1;
ENDDOT;

LIST X C DAGE2-DAGE4 GEN MAR DINC2 PUR REGU TSAWARE DREG2-DREG3;

?============================================================;
?MODEL WITH ALL VARIABLES;
?============================================================;

GENR TSWTP1 = TSWTP - 1;
TOBIT TSWTP1 X;
SET @COEF(1) = @COEF(1)+1;
PRINT @COEF;
PRINT @DPDX;

EXECUTION
```

```
OPTIONS MEMORY=500;
TITLE 'ALBA COLLART MASTER THESIS';

? PROGRAM 2 FOR WILLINGNESS-TO-PAY EARTHKIND;

?==================================================;
? CREATING A TLB FILE FROM THE EXCEL;
?==================================================;
OUT 'C:\TSPPRG\ALBA\WTP\EKWTP';
READ(FORMAT=EXCEL,FILE='C:\TSPPRG\ALBA\WTP\EKWTP');
OUT;

?==================================================;
? READ THE DATA FROM A TLB FILE CREATED EARLIER;
?==================================================;
IN 'C:\TSPPRG\ALBA\WTP\EKWTP';
DBLIST 'C:\TSPPRG\ALBA\WTP\EKWTP';

?===================================================;
? CREATING DUMMY VARIABLES;
?===================================================;

?----------------------------;
? AGE  1=UNDER 25, 2=25/39, 3=40/55, 4=55+;
?----------------------------;
DOT 2-4;
DAGE.=AGE.-AGE1;
ENDDOT;

?----------------------------;
? INCOME  1=UNDER $25K, 2=25K-50K, 3=50K-75K, 4=75K-99K,  5=100K+;
?----------------------------;
DOT 2;
DINC.=INC.-INC1;
ENDDOT;
```

```
?----------------------------;
? ETHNICITY  1=CAUCASIAN, 2=HISPANIC, 3=OTHER;
?----------------------------;
DOT 2-3;
DET.=ET.-ET1;
ENDDOT;

?----------------------------;
? EDUCATION  1=HIGH SCHOOL, 2=COLLEGE, 3=GRAD SCHOOL;
?----------------------------;
DOT 2-3;
DEDU.=EDU.-EDU1;
ENDDOT;

?----------------------------;
? REGION  1=NORTH, 2=CENTRAL, 3=SOUTH;
?----------------------------;
DOT 2-3;
DREG.=REG.-REG1;
ENDDOT;

LIST X C DAGE2-DAGE4 GEN MAR DINC2 PUR REGU EKAWARE DREG2-DREG3;

?========================================================;
?RUNNING THE MODEL WITH ALL VARIABLES;
?========================================================;

GENR EKWTP1 = EKWTP - 1;
TOBIT EKWTP1 X;
SET @COEF(1) = @COEF(1)+1;
PRINT @COEF;
PRINT @DPDX;
PRINT @VCOV;

EXECUTION
```

# APPENDIX B

## PROBIT ANALYSIS RESULTS FOR BRAND AWARENESS MODEL

**Table B-1 Brand Awareness Parameter Estimates from Probit model for Texas Superstar ™ Program**

| | Probit | | |
|---|---|---|---|
| | **Coefficient** | **Standard Error** | **t-value** |
| Intercept | -1.1093*** | (0.3421) | -3.2425 |
| **Socio-demographic characteristics** | | | |
| DAGE2 | -0.0257 | (0.1957) | -0.1315 |
| DAGE3 | -0.6776*** | (0.2476) | -2.7363 |
| DAGE4 | -0.1074 | (0.1992) | -0.5392 |
| GEN | -0.5896** | (0.2423) | -2.4329 |
| MAR | 0.0476 | (0.2636) | 0.1806 |
| DINC2 | 0.0782 | (0.1238) | 0.6320 |
| **Consumer habits** | | | |
| REGU | 0.8683*** | (0.2559) | 3.3923 |
| PUR | -0.1822 | (0.3029) | -0.6016 |
| **Region** | | | |
| DREG2 | 0.0947 | (0.1636) | 0.5788 |
| DREG3 | -0.0221 | (0.2318) | -0.0952 |
| Number of usable observations | 268 | | |
| Log-likelihood ($L_1$) | -77.80 | | |
| Likelihood ratio [a] | 36.41 | | |
| LR p-value | 0.0001 | | |
| McFadden's $R^2$ [b] | 0.19 | | |
| Fraction of correct predictions | 0.89 | | |

Note: Refer to Table 4.1 for a definition of each independent variable
* P-value < 0.1, ** P-value < 0.05, *** P-value < 0.01

a Defined as $2(L_1-L_0)$

b Defined as $1-(L_1/L_0)$

**Table B-2 Frequencies of Actual and Predicted Outcomes for Texas Superstar ™ Brand Awareness Model Using Probit**

| | Predicted | | |
|---|---|---|---|
| **Actual** | 0 | 1 | **Total** |
| 0 | 237 | 0 | **237** |
| 1 | 30 | 1 | **31** |
| **Total** | **267** | **1** | **268** |

**Table B-3 Brand Awareness Parameter Estimates from Probit Model for Earth-Kind ™ Program**

| | Probit | | |
|---|---|---|---|
| | **Coefficient** | **Standard Error** | **t-value** |
| Intercept | -0.8593*** | (0.3048) | -2.8192 |
| **Socio-demographic characteristics** | | | |
| DAGE2 | -0.1537 | (0.1834) | -0.8378 |
| DAGE3 | -0.3883** | (0.1923) | -2.0191 |
| DAGE4 | -0.1068 | (0.1745) | -0.6120 |
| GEN | -0.2687 | (0.2119) | -1.2684 |
| MAR | 0.1041 | (0.2287) | 0.4552 |
| DINC2 | -0.1988* | (0.1117) | -1.7792 |
| **Consumer habits** | | | |
| REGU | 0.6008** | (0.2462) | 2.4408 |
| PUR | -0.2625 | (0.2684) | -0.9780 |
| **Region** | | | |
| DREG2 | -0.1253 | (0.1428) | -0.8773 |
| DREG3 | 0.4205** | (0.1784) | 2.3565 |
| Number of usable observations | 268 | | |
| Log-likelihood ($L_1$) | -95.11 | | |
| Likelihood ratio [a] | 24.94 | | |
| LR p-value | 0.005 | | |
| McFadden's $R^2$ [b] | 0.12 | | |
| Fraction of correct predictions | 0.87 | | |

Note: Refer to Table 4.1 for a definition of each independent variable

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

a Defined as $2(L_1-L_0)$

b Defined as $1-(L_1/L_0)$

**Table B-4 Frequencies of Actual and Predicted Outcomes for Earth-Kind ™ Brand Awareness Model Using Probit**

| | Predicted | | |
|---|---|---|---|
| **Actual** | 0 | 1 | **Total** |
| 0 | 231 | 0 | **231** |
| 1 | 35 | 2 | **37** |
| **Total** | **266** | **2** | **268** |

# VITA

Alba Jeanette Collart Dinarte received her Bachelor of Agribusiness degree from the Pan-American Agricultural School at Zamorano, Honduras in 2007. She entered the Agricultural Economics Program at Texas A&M University in January of 2008 and received her Master of Science degree in August of 2009. Her research interests include econometric models applied to agricultural topics. She plans to work in research, consulting and subsequently in academia.

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