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Impact of Income and Different Generation Cohorts on Nursery Products and Landscaping Project Spending

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Socioeconomic factors influencing consumer demand for nursery products and landscape projects were investigated using consumer survey data collected from North Carolina in 2008. Tobit models were estimated for censored dependent variables, budget expenditure shares on nursery products, and landscape spending. The most significant factors influencing the share of income spent on nursery products were age and household income. The elderly and baby boomers tend to spend less on bedding plants, perennials, and outdoor hardscapes than Generations X and Y. The income elasticities suggest that the amount spent on outdoor living projects is sensitive to changes in household income, whereas spending in vegetable plants and chemicals is less responsive to income.

Key Words: nursery products, expenditures, demand, Tobit

JEL Classifications: R51, R58, O21, O23, R11, R38

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Gardening and landscape needs are determined by a myriad of factors. Before a landscaping project starts, the garden's design and existing landscape need to be evaluated. A plan to use for adding plants and/or landscaping aids in selecting nursery products and/or deciding what landscape project to choose. Purchases of nursery products depend on the season of the year, availability of plants in that season, and the customer's tastes for plants. Income is likely to be an important factor affecting consumer's choices. Unlike food, which is a necessity, nursery products and landscape services can be characterized as nonessentials. Geary pointed out that most consumers may consider buying nursery products a luxury in American Nurseryman Magazine–Horticulture Magazine and Horticulture Books (2012). Gardening and landscaping combine art design, functionality, and gardening science. Demand for these products and services would be expected to be very responsive to changes in consumers' income. In this article, we use survey data of nursery and landscaping customers

to estimate the responsiveness of purchases of different products and services to changes in income and how income responsiveness is affected by consumer demographic characteristics.

One of the most significant demographic characteristics is the age or generation cohort of those who purchase nursery products and landscape projects. As shown in Hall's image analysis of retail garden centers (Hall, 2002; Washington State University–Garden Center Nursery Management, 2004), the baby boomer generation and those older than 60 years of age have different shopping habits for nursery products. Recently there is concern that the aging baby boomers are spending less on nursery products, and the Generation X successors are now in prime buying years (American Nurseryman Magazine–Horticulture Magazine and Horticulture Books, 2012). If this is true, the demand for nursery products and landscaping projects will be affected. There will be new challenges, for example, whether Generations X and Y will make up for the decline in purchases of their parents and grandparents, whether Generations X and Y will demand more landscape projects but less nursery products, etc. Hence, a study of buying characteristics of different age groups becomes particularly important for making marketing and business strategy decisions. The goal of this article is to examine if the determinants of demand for nursery products and landscape projects are affected by income and demographic characteristics, particularly the effect of generation cohorts.

Data

The study of demand for nursery products and landscaping services is based on a survey of potential customers conducted in October 2008.[1] The survey was jointly developed by the North Carolina Department of Agriculture and Consumer Services (NCDA&CS), the North Carolina Nursery and Landscape Association, and the Department of Agricultural and Resource Economics at North Carolina State University. Data from the survey were collected through telephone calls to 2543 random selected households in North Carolina by enumerators under the direction of the NCDA&CS. A total of 29 different questions was asked of each customer. A high rate of response was obtained with 2349 usable surveys collected. However, some surveys contain some missing information, which restricted the regression analysis to a slightly smaller number of observations.

Information collected from the survey includes: 1) estimated amount spent on bedding plants, vegetable plants, perennials, shrubs and trees, chemicals, and statuary and plant pots; 2) major shopping locations; 3) opinions on large-scale chain stores and local garden centers; 4) plans and budgets on hardscape and landscaping projects; and 5) demographic information, including age of the customer. Amounts spent on products and services and the demographic information are particularly useful to our study.

Literature Review

The nursery industry was one of the fastest growing industries in the United States during the 1970s and 1980s with a recorded 12% and 8.6% growth rate, respectively (Johnson and Jensen, 1992). Although the size of the nursery market is relatively small compared with markets of commodity agricultural crops, its remarkable rapid growth in the 1970s and 1980s spurred a wave of research on nursery marketing and consumer demand for nursery products and services.

Gineo (1988) took the lead in sketching a blueprint for qualitative and quantitative research on consumer demand for landscape plants and services. Gineo enumerated a variety of potential socioeconomic factors for detailed quantitative investigations, including age, education levels, consumer income, housing and construction starts, and consumer preference in attributes of nursery plants and services such as quality and size of plants, price, color, etc. It is

[1] Although 2008 was a recession in the overall U.S. economy, total expenditures did not decline and, in fact, increased slightly from the previous year to $36.1 billion from $35.1 billion according to statistics compiled from the National Gardening Surveys for the National Gardening Association. Expenditures subsequently fell in 2009 and 2010. In consequence, there is no reason to believe 2008 was an unusual year for the garden center industry.

notable that the increasing middle-aged group, which was the baby boomer cohort in the 1980s, was commonly believed to be one of the most important reasons for the fast growth rate. The development of a refined wholesale distribution network and the incorporation of the universal product bar coding system into the marketing of nursery industry were found to help fuel the rapid growth of the nursery industry in the 1980s.

Johnson and Jensen (1992) studied the fast growth rate in the nursery industry from a macroeconomic perspective. They examined the dependence of nursery plant sales on general economic conditions using the sample data spanning from 1966–1988. Their results suggested that nursery stock sales in the United States were strongly positive correlated with Gross National Product but moderately negative related with inflation. Moreover, they found a high positive correlation between value of home additions and renovations and nursery stock sales, indicating that homeowners tend to spend more on landscaping when they improve or renovate their homes.

As the nursery and landscaping market has matured, the growth rate in the 21st century has slowed considerably (Creel, 2006). In addition, as a result of the aging baby boomer generation, and fewer gardening hobbyists in the younger generations, the nursery market is projected to decline. According to the findings in the 2006 Grapevine survey report (Creel, 2006), market demand has moved from do-it-yourself gardening toward professional service-focused purchases. Traditional locally owned garden centers, increasingly facing competition from large chain stores, are no longer the first place to shop for nursery products and landscaping services. The extant business strategy, which was developed in the 20th century to suit do-it-yourself type gardeners, should be adjusted to accommodate new trends in consumer demand and shopping patterns.

A number of qualitative studies has been conducted to identify consumer preferences for products and services related to landscape retailing in different regions of the United States, including Arizona (Niemiera, Innis-Smith, and Leda, 1992), Kansas (Khatamian and Stevens, 1994), Georgia (Day, 1994), North Carolina (Safley and Wohlgenant, 1994, 1995), and the New England region (Brand and Leonard, 2001). Khatamian and Stevens (1994), Niemiera, Innis-Smith, and Leda (1992), and Safley and Wohlgenant (1994, 1995) surveyed only consumers in independent garden centers. The most important factors influencing consumers' selection of garden centers identified in these studies were plant quality, wider variety plant selection, and knowledgeable sales staff. Prices were also found to be important but to a lesser degree. Similar results were obtained by Brand and Leonard (2001) and Day (1994).

The North Carolina consumer survey (Safley and Wohlgenant, 1995) interviewed customers as they entered the garden center and as they left the store to determine how much they spent as they left the store in relationship to how much they expected to spend. Safley and Wohlgenant found that customers who anticipated spending less than $11 tended to spend more than they had planned, and those who thought they would spend more than $25 tended to spend less. Time spent in the garden center was another factor determining the actual amount spent. Furthermore, based on the responses to what they purchased, customers shopped at garden centers mainly to buy plants. Gardening supplies and hardware were usually purchased from mass merchandisers as a result of lower prices compared with garden centers.

To date, Abdelmagid, Wohlgenant, and Safley (1996) have taken the most comprehensive and rigorous approaches to quantitative analysis of expenditures on nursery products using data obtained from the North Carolina consumer survey (Safley and Wohlgenant, 1994, 1995). A modified Almost Ideal Demand System model was used to investigate the impact of price, income, age, location, etc., on the amount spent on seven selected plants. A correction for selectivity bias was made by incorporating the inverse Mills' ratio in the regression model following Heien and Wessells (1990). Adbelmagid, Wohlgenant, and Safley found that age has a positive impact on the amount spent on plants, partly because retired and older people have more time available for gardening. Impacts of income and prices were

measured by income elasticities and price elasticities. A number of other articles has also quantified factors affecting household demand for nursery products. For example, Gineo and Omamo (1990) used household data in different states to measure the influence of income, age, construction starts, and education on expenditures for a bundle of nursery products and related goods. Rhodus (1989) and Stegelin (1994) evaluated the influence of prices on demand for nursery products.

Competition between local garden centers and mass merchandisers has become more intense recently. A series of studies have concentrated on the attributes of different stores and evaluated consumers' choice and preference of different stores. Day (1994) provided an exploratory study in retail selection for landscape plants based on "round-able" discussions and one-on-one individual interviews. Day (1994) suggested that retail selection was driven by the type of purchase. For example, inexpensive and low-risk plants were mainly purchased from mass merchandisers, whereas independent garden centers are preferred for expensive and high-risk purchases such as shrubs and trees. Brand and Leonard (2001) further studied the choice of independent garden centers and mass merchandisers, including gardening habits in detail through surveys conducted through mailers in New England. As opposed to the 2006 Grapevine survey (Creel, 2006), in which property value was found to be the main motivation for gardening in 2006, Brand and Leonard (2001) found relaxation and enjoyment to be the most important reasons for gardening, whereas increases in property values were not found to be important. Yue and Behe (2008) evaluated the probability of shopping in multiple outlets using multinomial logit estimation. Yue and Behe (2008) suggested quarter and year, region, products purchased, uses of products, sociodemographics, and factors influencing choices of different outlets all influence selections of stores for nursery products.

Hinson, Paudel, and Vela'stegui (2012) indicate that garden centers, landscapers, mass merchandisers, and rewholesalers have contributed to the growth of ornamental crop sales in the United States. Data on trade flows, marketing methods, and characteristics of firms were collected using a mail survey covering 44 states in 2003. Using a two-limit Tobit model, Hinson, Paudel, and Vela'stegui (2012) found a larger than expected role through rewholesaler channels for ornamental sales.

This article differs from previous studies because we quantify the detailed expenditure shares of six nursery products and three gardening services. Moreover, we evaluate the impact of different generations on purchases: pre-World War I, baby boomers, Generation X, and Generation Y. Furthermore, we consider how changes in household income would alter the amount spent in nursery products and gardening services.

Model Specification

There are three major features of the data that need to be considered in modeling demand for nursery products and landscaping services. First, the annual estimated amount spent on products and services was collected rather than quantity demanded. Because the amount spent is the product of price and quantity purchased, we cannot use this variable directly as a proxy for quantity demanded. Instead we converted the estimated expenditures to expenditure shares by dividing each expenditure amount by total household income. The expenditure share is then taken as the dependent variable in the ensuing regressions. Second, many of the household demographic variables are categorical variables rather than continuous variables. The respondent was given multiple choices and data were recorded in discrete form. Variables with multiple categories include residential classification, length of time in current type of dwelling, gender, highest education level, race, and income. All but income are used directly as categorical variables in the regression analysis. A procedure developed by Stewart (1983) was used to convert discrete income intervals to continuous values. Third, the expenditure data are either positive values or zero when respondents say they have not purchased any of the product or service. The fact that the dependent variable has a lower bound of zero causes the error distribution to be truncated

so it no longer can be modeled as a normal distribution.[2] This means ordinary least squares will produce biased and inconsistent estimates so we used the Tobit model to address this problem.

The model is specified as follows:

$$w_{ih}^* = \rho_{i0} + \sum_{k=1}^{s} \rho_{ik} d_{kh} + \beta_i \ln m_h + \delta_i (\ln m_h)^2 + u_{ih} \tag{1a}$$

$$w_{ih} = \max\left(w_{ih}^*, 0\right) \tag{1b}$$

where $u_{ih} \sim N(0, \sigma_i^2)$. The latent variable w_{ih}^* is the hth household's share of amount spent on product i in total income and satisfies the assumption on the error term u_{ih} that follows the normal distribution with zero mean and homoscedasticity. The observed response is the expenditure share w_{ih}, which is always nonnegative. The parameters to be estimated are ρ_{i0}, ρ_{ik} s, β_i, and δ_i. The variable m_h is the hth's household income and d_{kh} is the hth household's kth demographic variable.

The demographic variables include 1) age generation: pre-World War II, baby boomer cohort 1, baby boomer cohort 2, Generation X, and Generation Y; 2) number of family members employed full-time; 3) number of years lived in current dwelling: less than 5 years, 5–8 years, and more than 8 years; 4) highest education level attained: less than high school, high school, 2-year junior college degree, some college but no degree, bachelor's degree, and postgraduate education; 5) gender; and 6) race. Of particular interest to the nursery and landscape industry is the effect of age generation. The demographic variables are incorporated in Equation 1a in the same way as Abdelmagid, Wohlgenant, and Safley (1996) and Heien and Wessells (1990).[3]

The conditional expected value of the expenditure share of product i given demographic variables and household income is

$$E\left(w_{ih} \mid w_{ih}^* > 0, d_{kh}, m_h\right) = \rho_{i0} + \sum_{k=1}^{s} \rho_{ik} d_{kh} + \beta_i \ln m_h + \delta_i (\ln m_h)^2 + \sigma_i \lambda_{ih}(c_{ih}) \tag{2a}$$

where

$$\lambda_{ih}(c_{ih}) = \phi(c_{ih}) / \Phi(c_{ih}), \tag{2b}$$

and

$$c_{ih} = \left(\rho_{i0} + \sum_{k=1}^{s} \rho_{ik} d_{kh} + \beta_i \ln m_h + \delta_i (\ln m_h)^2\right) \Big/ \sigma_i. \tag{2c}$$

$\phi(\cdot)$ and $\Phi(\cdot)$ are, respectively, the standard normal density function and the standard normal cumulative density function. The function $\lambda_{ih}(c_{ih})$ is called the inverse Mills' ratio, which guarantees that the predicted value of the expenditure share of product i is always positive (Greene, 2008).[4]

The unconditional expected value of the expenditure share of product i is

$$E(w_{ih} \mid d_{kh}, m_h) = E\left(w_{ih} \mid w_{ih}^* > 0, d_{kh}, m_h\right) \cdot \Phi(c_{ih}), \tag{3}$$

where c_{ih} is defined as Equation 2c.

The conditional and unconditional partial effects of explanatory variables on the expenditure share are given as

$$\frac{\partial E\left(w_{ih} \mid w_{ih}^* > 0, d_{kh}, m_h\right)}{\partial d_{kh}} = \rho_{ik}[1 - \lambda_{ih}(c_{ih}) \cdot (c_{ih} + \lambda_{ih}(c_{ih}))], \tag{4a}$$

$$\frac{\partial E\left(w_{ih} \mid w_{ih}^* > 0, d_{kh}, m_h\right)}{\partial \ln m_h} = (\beta_i + 2\delta_i \ln m_h) \times [1 - \lambda_{ih}(c_{ih}) \cdot (c_{ih} + \lambda_{ih}(c_{ih}))], \tag{4b}$$

$$\frac{\partial E(w_{ih} \mid d_{kh}, m_h)}{\partial d_{kh}} = \rho_{ik} \cdot \Phi(c_{ih}), \tag{4c}$$

[2] A referee raised the question whether we should use two-limit Tobit because expenditure shares are constrained to be between 0 and 1. In our data set, only one observation exceeds 1 (equal to 1.4). Therefore, we still apply the standard Tobit model.

[3] Prices also may have an effect on demand but are unobserved. Like in most cross-section data, we expect that these prices are highly correlated with demographic variables so the demographic variables in the model may reflect the combination of direct and price induced effects. See, for example, Cox and Wohlgenant (1986).

[4] A referee expressed concern that it was appropriate to model the expenditure shares as independent. On further analysis, we found evidence of correlation across three commodities: bedding plants, perennials, and chemicals. However, the results were very similar to the results reported here with no change in levels of significance. Therefore, by Occam's razor, we only report the results for the standard Tobit model.

$$\text{(4d)} \qquad \frac{\partial E(w_{ih} \mid d_{kh}, m_h)}{\partial \ln m_h} = (\beta_i + 2\delta_i \ln m_h) \cdot \Phi(c_{ih}).$$

The conditional partial effects evaluate the changes in expenditure share in response to changes in household income and demographic status for consumers who currently purchase nursery products and landscaping services. The unconditional partial effects measure the response of expenditure share for all the consumers, including those who decide to buy or not to buy. Those who do not consume nursery products and landscaping services are potential new customers. The unconditional partial effects are particularly useful for nurserymen if they want to expand the market and attract new consumers. The partial effects of demographic variables reflect the demographic difference in expenditure share. The partial effect of $\ln m_h$ indicates the changes in the expenditure share as income rises or falls.

Income elasticities, the ratio of the percentage change in the spending to the percentage change in the household income, measure the responsiveness of quantity demanded for different products to the changes in household income. The hth household's income elasticity of the ith product e_{ih} is written as

$$\text{(5)} \qquad e_{ih} = \frac{\tilde{\beta}_i + 2\tilde{\delta}_i \ln m_h}{w_{ih}} + 1,$$

where $\tilde{\beta}_i$ and $\tilde{\delta}_i$ are the adjusted partial effects of $\ln m_h$.

Two types of income elasticities are calculated. The first type is based on the conditional adjusted coefficients. When the conditional adjusted partial effect in Equation 4b is used, $\tilde{\beta}_i + 2\tilde{\delta}_i \ln m_h$ is defined as

$$\text{(6a)} \qquad \tilde{\beta}_i + 2\tilde{\delta}_i \ln m_h = (\beta_i + 2\delta_i \ln m_h) \times [1 - \lambda_{ih}(c_{ih}) \cdot (c_{ih} + \lambda_{ih}(c_{ih}))].$$

The prediction of changes in expenditure share in response to changes in household income is conditional on the expenditure share being positive only, which focuses on households who choose to buy nursery products and landscaping services. The conditional income elasticity is useful in evaluating change in spending patterns of existing customers. It explains how many existing customers will choose to buy or not to buy and changes in purchases made by existing customers. The second type uses the unconditional adjusted coefficient defined in Equation 4d. $\tilde{\beta}_i + 2\tilde{\delta}_i \ln m_h$ is written as

$$\text{(6b)} \qquad \tilde{\beta}_i + 2\tilde{\delta}_i \ln m_h = (\beta_i + 2\delta_i \ln m_h) \cdot \Phi(c_{ih})$$

The unconditional adjusted partial effect considers all households, including existing customers and those who do not buy nursery products and services. The unconditional income elasticity measures the overall responsiveness of household to an income change. It is important to explain how many new customers can be attracted to buy nursery products and services as income rises, which will help store managers set marketing strategies if they tend to expand the existing market and attract new customers to enter the market.

The values of household income m_h and c_{ih}s are specific to each household; thus, the income elasticities in Equation 5 will vary for different households. The average income elasticity for product i can be obtained by taking the average over all the households:

$$\text{(7)} \qquad e_i = mean[e_{ih}] = \frac{mean[(\beta_i + 2\delta_i \ln m_h) \cdot \Phi(c_{ih})]}{mean[w_{ih}]} + 1$$

The mean value of the expenditure share spent on product i over all the households is listed in Table 1.

Special Data Treatments

Household income was reported in intervals in the survey rather than in continuous form. Respondents were asked to select from given household income ranges but not give exact household income. A transformation from discrete intervals to continuous values would save degrees of freedom in estimation. One simple method is to assign the midpoint of the interval to all observations that fall in a given interval with open-ended intervals being assigned values on an ad hoc basis (Abdelmagid, Wohlgenant, and Safley, 1996; Stewart, 1983). Because such a method does not generally result in consistent estimates, a least squares two-step estimator procedure discussed by Abdelmagid, Wohlgenant,

Table 1. Average Budget Shares and Positive Purchases

Products and Services	Average Budget Share (%)	Average of Positive Budget Share (%)	Number of Observations with Positive Spending
Bedding plants	0.173	0.226	1033
Vegetable plants	0.036	0.087	597
Perennials	0.076	0.139	762
Shrubs and trees	0.080	0.237	494
Chemicals (such as fertilizer, insecticides, fungicides, or herbicides)	0.128	0.167	1036
Statuary and plant pots	0.044	0.113	567
Outdoor living hardscapes (such as outdoor patio, deck, etc.)	0.661	4.544	198
Landscape or gardening project	0.143	0.683	284
Landscape services (such as mowing, edging, and pruning)	0.319	1.708	278

and Safley (1996) and Stewart (1983) was used to transform the discrete interval income into continuous income.

All observations of household income were reassigned the conditional expectation q_k in the interval, in which q_k satisfies $A_{k-1} < q_k < A_k$ and A_{k-1} and A_k are the lower and upper bound for each interval. q_k is obtained by

$$(8) \qquad q_k = \mu + \sigma \cdot \frac{[f(Z_{k-1}) - f(Z_k)]}{F(Z_k) - F(Z_{k-1})}$$

where $Z_k = (A_k - \mu)/\sigma$, and f and F are the probability density function and cumulative density function of standard normal distribution. Consistent estimates of μ and σ are obtained by fitting a normal distribution to the sample distribution of the partially observed variable. One simple and convenient way is a least square variant of the graphical method of Aitchison and Brown (1957). First let C_k be the sample cumulative frequency, then regress $F^{-1}(C_k)$ on A_k. The cumulative frequency C_k with a normal distribution can be expressed as

$$(9) \qquad C_k = F\left(\frac{A_k - \mu}{\sigma}\right) = \int_{-\infty}^{(A_k-\mu)/\sigma} f(t)dt$$

The inverse cdf of the cumulative frequency can be written as

$$(10) \qquad F^{-1}(C_k) = \frac{A_k}{\sigma} - \frac{\mu}{\sigma} = Z_k,$$

where Z_k is the distance from the mean of a normal distribution expressed in units of standard deviation. Therefore, the regression of $F^{-1}(C_k)$ on A_k provides consistent estimates of μ and σ. Then q_k is obtained by substituting the consistent estimates of μ and σ back into the equation of q_k. The transformation results are shown in Table 2.

Estimation and Results

The consumer survey studied six nursery products and three types of landscaping services: bedding plants, vegetable plants, perennials, shrubs and trees, chemicals, statuary and plant pots, outdoor living hardscapes (such as outdoor patio, deck, etc.), landscape or gardening project, and landscape services (such as mowing, edging, and pruning). The Tobit model is estimated for each product separately as a function of the explanatory variables shown in Table 3.

The explanatory variables incorporated in the model are defined in Table 3. The dependent variable, the share of spending in household income with nonnegative value, is left-censored (see Table 1). Among 2349 usable surveys, approximately half of respondents purchased or planned to purchase bedding plants or chemicals in 2008, partly because purchases of bedding plants and chemicals are low risk, inexpensive, and do not require expertise in gardening. Among 2349 respondents, only 198 would spend on outdoor living hardscapes such as an outdoor patio and deck. The

Table 2. Transformation of Household Income from Discrete Interval to Continuous Value

Household Income Range	Frequency	Cumulative Percent	q_k
Under $25,000	137	8.978	$6,623.56
$25,000 to $34,999	105	15.858	$30,244.96
$35,000 to $49,999	197	28.768	$42,894.78
$50,000 to $74,999	354	51.966	$62,903.68
$75,000 to $99,999	324	73.198	$87,047.18
$100,000 and over	409	100	$123,188.87

Note: q_k is the continuous income for each discrete income interval. q_k is computed through

$$q_k = \mu + \sigma \cdot \frac{[f(Z_{k-1}) - f(Z_k)]}{F(Z_k) - F(Z_{k-1})}$$

where $Z_k = (A_k - \mu)/\sigma$, A_{k-1} and A_k are the lower and upper bound for each interval, and f and F are the probability density function and cumulative density function of standard normal distribution.

average budget share in 2008 for those who have a plan on outdoor living hardscapes accounts for 4.5% of total household income. Outdoor living hardscapes are more costly than other plants and services, which may explain the small number of consumers with positive estimated spending. Moreover, consumers usually make a detailed project plan and hire a professional service company to complete the project, which explains the large budget share.

Because the budget share of spending as a share of household income is very small, the variable used in the regression is rescaled. The definition of the transformed budget share w'_{ih} is

$$w'_{ih} = \frac{p_{ih} \cdot q_{ih}}{m_h/1{,}000}$$

where p_{ih} and q_{ih} are price and quantity of product i paid by the hth household, respectively. The household income used in the model is redefined in 1000 U.S. dollars. The income elasticity based on the rescaled budget and household income is

Table 3. Definitions of Explanatory Variables

Variable	Definition
preww2	Dummy = 1 if seniors (born before 1945)
bb1	Dummy = 1 if baby boomer cohort 1 (born between 1946 and 1954)
bb2	Dummy = 1 if baby boomer cohort 2 (born between 1955 and 1964)
Employed	Number of family members full-time employed
Loginc	Natural logarithm of household income (in 1000 U.S. dollars)
loginc_sq	The square of the natural logarithm of household income (in 1000 U.S. dollars)
lt5	Dummy = 1 if length of living in the current dwelling is less than 5 years
gt5lt8	Dummy = 1 if length of living in the current dwelling is between 5 and 8 years
male	Dummy = 1 if male respondent
lthigh	Dummy = 1 if the highest education level achieved is less than high school
high	Dummy = 1 if the highest education level achieved is high school
associate	Dummy = 1 if the highest education level achieved is associates, 2-year junior college degree
somecollege	Dummy = 1 if the highest education level achieved is some college, but no degree
bachelor	Dummy = 1 if the highest education level achieved is bachelor's degree
spanish	Dummy = 1 if Spanish
white	Dummy = 1 if white

Note: The intercept of the model reflects a respondent who is Generation X or Y (born after 1965), lives in the current house for more than 8 years, black female, postgraduate, and non-Spanish.

$$(11) \qquad e_{ih} = \frac{\tilde{\beta}'_i + 2\tilde{\delta}'_i \ln m'_h}{w'_{ih}} + 1$$

where $m'_h = m_h/1{,}000$. w'_{ih} and m'_h are used in Equation 2a to obtain rescaled coefficients $\tilde{\rho}'_{i0}$, $\tilde{\rho}'_{ik}$, $\tilde{\beta}'_i$, and $\tilde{\delta}'_i$.

The sample distribution of different generations is shown in Table 4. We combined Generation X and Generation Y to be the baseline level because the number of observations for Generations X and Y is relatively small. Generations X and Y are of interest because they are expected to be the largest customer group in the next decade.

The model was estimated in SAS 9.2 using maximum likelihood estimation. Likelihood ratio tests were implemented to select the best set of explanatory variables. The Tobit estimates of $\tilde{\rho}'_{i0}$, $\tilde{\rho}'_{ik}$, $\tilde{\beta}'_i$, and $\tilde{\delta}'_i$ for each product are shown in Tables 5 and 6. Household income, generation, length of living in current dwelling, gender, and race (white/black) are significant factors to the buying decision.

Suppose two respondents, A and B, both have bachelor's degrees, earn $75,000, live in the current dwelling more than 8 years, and have two family members full-time employed. They are both non-Spanish and white females. The only difference is that respondent A either belongs to Generation X or Generation Y and respondent B is in the pre-World War II cohort. If both A and B choose to purchase bedding plants, we can obtain the adjusted partial difference between A and B using Equation 4a. The conditional adjusted partial effect of dummy variable preww2 on w'_{ih} is –0.5094, which means that respondent B's budget share of bedding plants is 0.05% lower than respondent A. Following Equation 4c, the unconditional adjusted partial effect of dummy variable preww2 on w'_{ih} is –0.7184. It means that regardless of whether both A and B choose to purchase bedding plants or not, respondent B's budget share of bedding plants is 0.07% lower than respondent A. Interpretations of other variables can be obtained in a similar way using Equations 4a and 4c for different demographic combinations.

The adjustments of estimates using Equations 4a and 4c would not affect the direction of changes in budget share in response to changes in explanatory variables, because signs of adjusted partial effects are the same as the estimates in Tables 5 and 6. Equations 4a and 4c only adjust the magnitude of the partial effect of each explanatory variables and dummy variables. The results in Table 5 suggest that customers who are pre-World War II generation spend less on bedding plants, perennials, and chemicals than Generations X and Y. Baby boomer cohort 1 spends less on bedding plants, perennials, and statuary and plant pots than Generations X and Y. The estimates in Table 6 indicate that all pre-World War II respondents and baby boomers would spend less on outdoor hardscapes than Generations X and Y. In addition, pre-World War II and baby boomer cohort 1 respondents would spend less on landscapes and gardening projects than Generations X and Y. Our findings suggest that the elderly and aging baby boomers tend to spend less on nursery products and landscaping services, which are in line with the 2006 Grapevine survey. The baby boomer cohort used to have strong purchasing power in gardening and nursery products in the 1970s, 1980s, and 1990s and is commonly

Table 4. Respondents' Generation Information

Generation	Year of Birth	Number of Respondents	Respondents (%)
Missing		133	5.66
Pre-World War II	Before 1945	503	21.41
Baby boomers: cohort 1	1946–1954	440	18.73
Baby boomers: cohort 2	1955–1964	686	29.20
Generation X	1965–1976	496	21.12
Generation Y	After 1977	91	3.87

Note: The total sample size in this table is 2349.

Table 5. Estimates (standard error) of the Tobit Model for Nursery Products

	Expenditure Share					
Variable	Bedding Plants	Vegetable Plants	Perennials	Shrubs and Trees	Chemicals	Statuary and Plant Pots
Intercept	21.597*** (1.970)	6.283*** (1.018)	5.912*** (1.222)	6.907** (3.000)	11.209*** (1.440)	3.690*** (1.371)
preww2	–1.272** (0.507)	–0.297 (0.268)	–0.909*** (0.321)	–0.430 (0.800)	–0.899** (0.387)	–0.392 (0.379)
bb1	–0.401* (0.236)	–0.101 (0.132)	–0.275** (0.150)	–0.215 (0.378)	–0.135 (0.178)	–0.380** (0.169)
bb2	–0.123 (0.205)	–0.102 (0.113)	0.026 (0.128)	0.344 (0.322)	0.198 (0.154)	0.128 (0.142)
employed	–0.176 (0.137)	–0.003 (0.075)	0.080 (0.083)	0.233 (0.214)	0.243*** (0.097)	–0.106 (0.095)
loginc	–9.471*** (1.032)	–2.926*** (0.544)	–2.687*** (0.643)	–4.653*** (1.597)	–4.650*** (0.762)	–1.693** (0.721)
loginc_sq	1.068*** (0.138)	0.299*** (0.074)	0.297*** (0.086)	0.536*** (0.215)	0.460*** (0.102)	0.176** (0.097)
lt5	0.238 (0.215)	–0.239** (0.122)	0.356*** (0.136)	1.713*** (0.338)	0.205 (0.163)	0.167 (0.153)
gt5lt8	0.338* (0.220)	–0.071 (0.122)	0.152 (0.137)	0.810*** (0.347)	0.060 (0.166)	0.290** (0.153)
male	–0.081 (0.169)	0.021 (0.093)	–0.216** (0.106)	–0.236 (0.268)	0.116 (0.126)	–0.390*** (0.120)
lthigh	0.172 (0.667)	–0.574* (0.389)	–0.143 (0.429)	–0.056 (1.010)	0.375 (0.489)	0.034 (0.489)
high	0.465* (0.300)	0.134 (0.168)	–0.138 (0.190)	–0.052 (0.478)	0.277 (0.221)	–0.007 (0.213)
associate	–0.193 (0.334)	0.101 (0.183)	0.004 (0.208)	–0.105 (0.532)	–0.316 (0.254)	0.283 (0.234)
somecollege	–0.043 (0.282)	0.137 (0.158)	–0.011 (0.178)	0.152 (0.458)	0.205 (0.211)	–0.068 (0.205)
bachelor	–0.025 (0.246)	0.086 (0.139)	0.110 (0.155)	–0.003 (0.395)	0.155 (0.182)	0.157 (0.175)
spanish	0.333 (0.591)	0.247 (0.310)	–0.318 (0.372)	0.413 (0.838)	0.533 (0.426)	0.061 (0.394)
white	0.713** (0.320)	0.364** (0.189)	0.292* (0.198)	0.698 (0.505)	0.442** (0.228)	0.082 (0.226)
invmill	2.588*** (0.066)	1.315*** (0.047)	1.574*** (0.048)	3.672*** (0.144)	1.939*** (0.050)	1.693*** (0.061)

Note: Significance levels of 0.01, 0.05, and 0.15 are indicated by ***, **, and *, respectively.
Detailed results of significance tests and prediction are available on request.

Table 6. Estimates (standard error) of the Tobit Model for Landscaping Projects

	Expenditure Share		
Variable	Outdoor Hardscapes	Landscapes and Gardening Project	Landscape Services
Intercept	93.494 (71.003)	10.188 (13.986)	151.642*** (28.107)
preww2	–69.101*** (23.811)	–14.464*** (5.136)	1.053 (7.794)
bb1	–46.635*** (9.771)	–5.154*** (1.895)	–1.946 (3.759)
bb2	–32.326*** (7.819)	–0.071 (1.482)	1.171 (3.178)
employed	1.903 (5.066)	–0.743 (0.987)	–6.489*** (2.184)
loginc	–85.220** (38.069)	–8.852 (7.435)	–89.397*** (15.348)
loginc_sq	11.183** (5.173)	0.889 (1.005)	12.292*** (2.123)
lt5	–2.943 (8.287)	2.623* (1.580)	1.536 (3.374)
gt5lt8	–2.229 (8.540)	2.021 (1.670)	2.931 (3.420)
male	19.794*** (6.631)	1.597 (1.266)	–7.326*** (2.700)
lthigh	–2.459 (28.572)	1.587 (5.006)	–16.431 (11.986)
high	3.557 (11.505)	–2.822 (2.315)	–17.323*** (5.308)
associate	4.957 (12.369)	–2.078 (2.525)	–7.345 (5.196)
somecollege	–8.963 (11.295)	–1.536 (2.130)	–6.561* (4.400)
bachelor	–4.510 (9.572)	–0.028 (1.841)	–2.847 (3.569)
spanish	18.913 (21.326)	2.480 (3.927)	–0.025 (9.108)
white	8.773 (12.698)	1.334 (2.346)	–12.614*** (4.490)
invmill	70.176*** (4.415)	14.866*** (0.756)	29.182*** (1.666)

Note: Significance levels of 0.01, 0.05, and 0.15 are indicated by ***, **, and *, respectively. Detailed results of significance tests and prediction are available on request.

believed to be one of the most important reasons for the fast growth rate during that time (Gineo, 1988). However, as the baby boomers retire, they no longer purchase as much as before. Combining our results with those of Creel (2006) suggests that Generations X and Y would spend significantly more than pre-World War II and baby boomers on outdoor hardscapes, landscapes, and gardening projects, partly because Generations X and Y tend to hire professional service companies to complete the projects, which usually cost more than do-it-yourself projects. Managers of nursery stores or garden centers have an incentive to introduce

Table 7. Conditional and Unconditional Income Elasticities

Product	Income Elasticity for Consumers (whose spending is positive)	Income Elasticity for All the Consumers (whose spending is either positive or zero)
1. Bedding plants	0.921	0.845
2. Vegetable plants	0.839	0.531
3. Perennials	0.963	0.881
4. Shrubs and trees	0.996	0.956
5. Chemicals (such as fertilizer, insecticides, fungicides, or herbicides)	0.782	0.606
6. Statuary and plant pots	0.949	0.810
7. Outdoor living hardscapes (such as outdoor patio, deck, etc.)	1.054	1.270
8. Landscape or gardening project	0.959	0.803
9. Landscape services (such as mowing, edging, and pruning)	1.289	2.698

more project designs and services to attract more young customers.

Income elasticities were computed using Equation 11. The unconditional and conditional market income elasticities are reported in Table 7. All products are normal goods. For bedding plants, perennials, shrubs and trees, statuary and plant pots, and landscape or gardening projects, the conditional income elasticity estimates are all near 1. If household income increases by 1%, the existing customers tend to increase their spending in the products by approximately 1%. For vegetable plants and chemicals, the conditional income elasticity is inelastic, which means that existing customers will not change their spending in proportion to the changes in household income. The income elasticities of outdoor living hardscapes and landscape services are elastic, implying existing customers will spend more as a share of income as incomes increase.

The unconditional income elasticities measure general changes in expenditure share in response to income changes regardless of whether respondents choose to buy or not buy the product. In particular, as opposed to the six nursery products and landscape or gardening projects, the unconditional income elasticities of outdoor hardscapes and landscape services are larger than their conditional income elasticities. It means as household income increases, those who currently do not plan on purchasing outdoor hardscapes and landscape services will buy the products. Managers of nursery stores should pay more attention to marketing outdoor hardscapes and landscape services as general economic conditions improve.

Conclusion

In this study, we quantified the determinants of consumer spending on nursery products and landscaping services based on consumer survey data collected in North Carolina in 2008. The Tobit model is applied to estimate the model because budget shares are left-censored with nonnegative values. Adjusted partial effects of explanatory demographic variables are derived for existing customers and potential customers. Our findings suggest that aging baby boomers spend less money on nursery products and landscaping services, although most of the baby boomers are gardening hobbyists. Generations X and Y are found to spend significantly more money on outdoor hardscapes and landscape services, which suggests managers of nursery stores would benefit from targeting marketing professional services to Generations X and Y.

Estimates of income elasticities suggest that all products and services considered in this study are normal goods. Income elasticities vary across the different products and services. Bedding plants, perennials, shrubs and trees, statuary and plant pots, and landscape or gardening projects are approximately unit income elastic. Inelastic products are vegetables plants and chemicals. Income elasticities of outdoor living hardscapes and landscape services are elastic. The unconditional income elasticities of outdoor hardscapes and landscape services are larger than their conditional income elasticities. As household income increases, those who currently do not plan on purchasing outdoor hardscapes and landscape services are more likely to invest in outdoor hardscapes and landscape services.

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