Demand for fall annual and perennial plants: pansies and mums in independent garden

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Abstract

Analysis of demand for pansies and mums sold in independent garden centers indicates that price and age are important factors influencing demand. In the fall of 1996, data were collected from a survey of independent garden centers in North Carolina. Statistical analysis was conducted by estimating the relationship between consumer expenditure shares of pansies and mums and prices paid per plants, household income, and various demographic and product characteristic variables. The models were estimated by the least-squares method with correction for selectivity bias, resulting from zero purchases. Own-price elasticities of demand for pansies and mums of –0.80 and –0.76, respectively, were estimated. The results also indicate that older customers who live in attached housing (for pansies) and who are renters (for mums) are important determinants of demand.

Key words: *consumption, demand, garden center products, mums, pansies, Tobit estimates.*

Introduction

Garden center managers face many challenges, including identifying their market and determining the factors affecting customers' demand for their products. Among the many products sold in garden centers, annual and perennial plants comprise a significant proportion of their total sales. In North Carolina, as well as other states in the eastern and southeastern United States, pansies and mums are two of the most significant plants within the categories of annual and perennial plants, respectively. Therefore, an analysis of factors affecting consumer purchases of these important products should yield valuable insight into demand for annual and perennial plants used for home landscaping. The purpose of this paper is to estimate and evaluate the socioeconomic factors affecting demand for pansies and mums sold in North Carolina independent garden centers using survey data collected in the fall of 1996.

Published information on demand for plants sold in garden centers is quite limited. Earlier studies by Johnson and Jensen ; Gineo and Omamo; Rhodus; Turner and Dorfman; and Safley and Wohlgenant (1994, 1995) help identify important factors affecting demand for household expenditures. However, aside

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from a recent paper by Abdelmagid, Wohlgenant, and Safley, no one has estimated demand relationships for individual plants that evaluate the joint effects of prices, income, other socioeconomic factors, and product characteristics.

This paper extends the literature on demand for garden center products in two ways. First, we examine demand for two new commodities (pansies and mums), which are purchased in the fall for home landscaping. Because one of the products (mums) is a perennial, the analysis will provide additional information concerning any differential effect purchases of perennials has on consumers' demand for plants. Second, estimation of demand relationships with survey data collected in the fall will enable a comparison with the results obtained with survey data collected in the springtime (Abdelmagid, Wohlgenant, and Safley).

The following section describes the nature of the data collected from the survey. The third section presents the demand models to be estimated. The fourth section presents econometric results and elasticity estimates for pansies and mums. The final section offers concluding remarks.

Description of the Data

A consumer survey was conducted at eight separate independent garden centers in two different market areas in North Carolina during a four-week period in September and October of 1996. The survey was conducted in four separate independent garden centers in the Raleigh marketing area and in four garden centers in the Triad marketing area (The Triad consists of Greensboro, Winston-Salem, and High Point, North Carolina). A total of 1,789 customers were interviewed, but only 1,469 or 82.7 % of the surveys were usable.

The questionnaire was divided into two parts. The first part was administered before the customers entered the store to determine what they intended to purchase. The second part of the survey was undertaken as the customers left the store in order to determine plant material purchased, the amount of money spent, and to obtain information on a variety of socioeconomic characteristics.

With respect to frequency of purchases, the data collected reflect individual/household purchases on just one day. A total of 14.8% of the customers did not buy any plants while visiting a garden center. Thirty-one and nine-tenths percent of the customers purchased annuals, 31.6% purchased perennials, 15.6% bought shrubs, 7.38% bought trees, and 4.1% bought bulbs. The analysis here is conducted on one annual plant (pansies) and on one perennial plant (mums) because data on these two plants are the most complete of all the data collected. In addition, 90% of the customers who purchased annuals bought pansies, and 83% of the customers who bought perennials purchased mums. Therefore, analysis of demand for pansies and mums should provide valuable insight into demand for annuals and perennials as a whole.[1]

The information collected includes socioeconomic and other demographic variables, including age, income, value of residence (owned by the homeowner), type of residence, number of years lived in residence, housing tenure, and employment status. Purchase information collected includes plant prices, plant types, and plant sizes.

The survey reported income and value of residence variables in intervals (i.e., discrete) form rather than in continuous form. These variables are observed to fall in a certain interval on a continuous scale, with actual values remaining unobserved and with both end intervals being open-ended. Following Abdelmagid, Wohlgenant, and Safley, Stewart's least-squares two-step estimation procedure was used to transform the income and value of residence data from discrete form into continuous form. This procedure has the advantage of producing consistent estimates of the mid-point values of the discrete intervals, assuming that the continuous values are distributed normal. Tables 1 and 2 show the resulting transformations of income and value of residence for this survey data.
Consistent with an earlier survey spring survey by Safley and Wohlgenant (1994), the "typical" customer was between 25 and 44 years old, worked 40 or more hours per week, had an annual household income of $75,000 or more, and owned a home valued at between $150,000 and $199,999.

Table 1. Transformation of Household Income from Discrete to Continuous Values

Income Range	Discrete Values	Continuous Approximations
Less than $15,000	1	$10,336.37
$15,000 - $30,000	2	$24,472.26
$30,000 - $45,000	3	$38,696.30
$45,000 - $60,000	4	$52,868.95
$60,000 - $75,000	5	$67,024.79
Greater than $75,000	6	$83,492.50

Table 2. Transformation of Household Residential Values from Discrete to Continuous Values

Value of Residence	Discrete Values	Continuous Approximations
Less than $100,000	1	$77,899.48
$100,000 - $150,000	2	$127,580.39
$150,000 - $200,000	3	$172,944.16
Greater than $200,000	4	$225,768.09

Model Specification

Because of the presence of a significant number of zero customer purchases, the survey data on pansies and mums is censored. Therefore, the relevant empirical model to analyze the survey data is the Tobit model, which can be written as follows (Amemyia, p.33):

$$y_i^* = \boldsymbol{\beta}' \mathbf{x}_i + u_i, \quad i = 1, 2, \ldots, n, \tag{1}$$

$$y_i = y_i^* \quad \text{if } y_i^* > 0$$
$$= 0 \quad \text{if } y_i^* \leq 0,$$

where y_i^* is the censored purchase variable for the ith customer(assumed to be normally distributed), $\mathbf{x_i}$ is the vector of explanatory variables for the ith individual, $\boldsymbol{\beta}$ is the vector of parameters, and u_i is the normally distributed random error term with mean zero and constant variance. For this application, the dependent variable is specified as expenditure share of the commodity purchased (i.e., expenditure shares of pansies or mums). In addition to price paid per plant and household income, the explanatory variables of the model include: location of the household, value of the residence, age of the respondent, number of years residing in the current home, employment status, housing tenure (i.e., owner or renter), advertising, and plant size purchased.

Expenditure share was chosen as the dependent variable because of the broad consistency of this functional form with household consumer behavior (Deaton and Muellbauer, chapter 1). In addition to logarithms of price, logarithm of income, and demographic and product characteristic variables, we also include the logarithm of income squared to permit more flexibility in consumer response (Abdelmagid, Wohlgenant, and Safley).

Mums, because they are perennials, are durable goods, so prices paid for mums should be converted to user costs or service flow prices. The formula used to convert reported mum prices to annualized values (P_a) is as follows (see Hausman; Davis and Wohlgenant):

$$P_a = \omega r(1 + r)^{-1}[1 - (1 + r)^{-q}]^{-1}$$

where ω is the price paid for the perennial plant (i.e., mum), r is the individual discount rate (assumed to equal 0.07), and q is the expected life of mums purchased (assumed to equal 2.5 years).

Because both pansies and mums are sold in different size containers, dummy variables for each size class (other than the reference class) were included in the demand models. For pansies, plants were classified into three sizes: (1) pots; (2) 12, 18, 24, and 36 flats[2]; and (3) 48 and 50 flats. Mums were grouped into the three classes: (1) gallons; (2) large pots of 38, 39, 40, or 42 inches; and (3) small pots of 32, 33, 34, 35, or 36 inches. In addition to accounting for differences in consumer tastes for different size plants, this specification allows us to control for price differences across different size categories.

Missing prices occur whenever a plant purchase is not made. The model, however, assumes that all customers, whether they buy or not, face the same prices at the same location. When missing prices were encountered, reported prices for the most frequently purchased size were used as proxies for missing prices at the garden center where the customer shopped.

Because there were such few observations available on substitute plants for pansies and mums, prices of other plants were not included in the demand specifications. Moreover, both pansies and mums were estimated as single-equation demand models with only own-price effects included in the specifications.[3]

A location dummy variable was included to account for differences in demand between the Raleigh area and the Triad area. In addition to accounting for any differences in tastes between customers in the two areas, this dummy variable also controls for any cost of living differences between the two areas (Abdelmagid, Wohlgenant, and Safley).

Empirical Results

Table 3 gives the definitions of the variables used in the econometric analysis. Single-demand equations for pansies and mums were estimated using the Tobit model. We first discuss the econometric results with respect to all socioeconomic factors and then present price and income elasticities.

Table 3. Definitions of Variables Used in the Empirical Analysis

Variable	Definition
LP	Log price of pansies (mums)
LOCAT1	Dummy = 1 if location is Raleigh and zero if Triad
LINC	Log household income ($1,000)
LINC2	Log household income squared
LVALHSE	Log market value of household residence ($1,000)
LAGE	Log of customers age
LYRHSE	Log of number years household has resided in home
RET	Dummy = 1 if at least one adult in the household is retired; zero otherwise
DF48	Dummy = 1 if pansies are sold in 48 and 50 flats; zero otherwise
DGALL	Dummy = 1 if mums are sold in gallons; zero otherwise
DLPOT	Dummy = 1 if mums are sold in large pots (i.e., pots of size 28", 34", 40", or 42"); zero otherwise
CONDO	Dummy = 1 if residence is condo/apartment/triplex; zero otherwise
RENTED	Dummy = 1 if residence is rented; zero otherwise
INVMILL	Inverse Mills' ratio

Econometric Results

Econometric results for pansies and mums are shown in tables 4 and 5. These equations were estimated using Heckman's two-step estimator. In the first stage, the Probit model is used to obtain a consistent estimate of the inverse Mills' ratio (INVMILL). In the second stage, OLS estimates are obtained with the INVMILL variable included as an additional explanatory variable.[4] Intuitively, the inverse Mills' ratio is included to correct statistically for the fact that the error term in the truncated model (i.e., the model estimated with only positive values for ex-

penditures) has a nonzero mean. Inclusion of the inverse Mills' ratio in the regression equations produces consistent estimates of the β's in equation (1). Because the value for the inverse Mills' ratio is estimated rather than known with certainty, least-squares estimates of the standard errors of the parameters are inconsistent so asymptotically consistent estimates of the variance-covariance matrix of the parameter estimates were obtained using the formula provided by Amemiya (p.370).

For pansies (table 4), the intercept defines an individual who works at least part time, lives in the Triad area, resides in a detached home, and purchased pansies

Table 4. Econometric Estimates of Demand for Pansies (Dependent Variable is Expenditure Share of Pansies as Percentage of Total Income)

Variable	Coefficient
Constant	2.0775* (2.5420)
LP	0.0066 (1.2208)
LOCAT1	-0.0049 (-1.3307)
LINC	-0.3656* (-2.4412)
LINC2	0.0160* (2.2572)
LVALHSE	-0.0007 (-0.0984)
LAGE	0.0148* (1.9244)
LYRSE	-0.0005 (-0.2774)
RET	-0.0044 (-1.0138)
DF48	-0.0093* (-2.3559)
CONDO	0.0172* (1.5145)
INVMILL	0.0112* (2.6026)
R^2	0.19
Sample Size	1261
Proportion of Customers Purchasing	0.251
Mean of Dependent Variable	0.0348
Root MSE	0.0306

Note: Values in parentheses are approximate t-values (i.e., ratios of coefficient to standard error); asterisk denotes significance at 0.15 level.

in plant size of group 2 (i.e., 12, 18, 24, and 36 flats).[5] The results indicate that income, age of the customer, plant size (DF48), and residence (CONDO) are significant determinants of expenditures on pansies. The fact that price is insignificant does not mean price is not important, rather it means that the price elasticity of demand is close to unity since expenditure share is the dependent variable. While one might believe income is important in purchase decisions, the income elasticities (reported in table 6) indicate that income is not an important determinant of demand for pansies. Aside from price and income, the results indicate that older customers and those living in attached housing are more likely to purchase pansies. Age was also found to be important in purchases of geraniums, marigolds, and petuinias while residence type was not found to be a significant determinant of springtime annual plant purchases (Abdelmagid, Wohlgenant, and Safley). Note that, consistent with economies of scale in purchasing, customers receive a discount for pansies purchased in large flats. Also, note that the inverse Mills' ratio is significant, indicating that it is important to account for censored data in the statistical analysis.

In the case of mums (table 5), the intercept reflects an individual who works at least part time, lives in the Triad area, resides in a detached home, and purchased mums in small pots (i.e., 32", 33", 34", 35", or 36"). Although all the variables included in the model are significant as a group (the F-value of the model was 6.569, implying a p-value less than 0.0001), only the income variables are individually significant determinants of the expenditure share of mums. As in the case of pansies, the fact that price is insignificant does not mean that it is not important, but it means that the elasticity of mums is close to unity. What is somewhat surprising, though, is that none of the socioeconomic variables or size category variables was found to be that important in decisions by consumers to purchase mums. Moreover, statistical analysis accounting for variation among individual stores did not indicate any store effects were present, so that the results appear to be quite robust to the importance of price and income.[6]

Price and Income Elasticities

Price and income elasticities at the sample means were calculated using the formulas:

(2) Price elasticity = (estimated coefficient of LP/mean of expenditure share) – 1
(3) Income elasticity = [(estimated coefficient of LINC + estimated coefficient of LINC2·(mean of log income)] /(mean of expenditure share) + 1

The elasticities (table 6) indicate that both commodities are price inelastic and that the price effects are quite significant with large t-values in each case. The similarity in the two price elasticities is quite striking. A comparison with price elasticities for the springtime annual plants estimated by Abdelmagid, Wohlgenant, and Safely indicates close correspondence to elasticity estimates for begonia of –0.80, dianthus of –0.93, geranium of –0.71, and vinca of –0.77. However, the other springtime annual plants (impatiens, marigolds, and petunias) were estimated to be price elastic. In a controlled pricing experiment of rural and

urban supermarkets (which did not control for individual consumer characteristics), Rhodus found demand for bouquets (daisy, mixed, and garden) to be price elastic.

Table 5. Econometric Estimates of Demand for Mums (Dependent Variable is Expenditure Share of Mums as Percentage of Total Income)

Variable	Coefficient
Constant	0.4538 (1.3446)
LP	0.0022 (0.7893)
LOCAT1	0.0025 (0.1630)
LINC	-0.0886* (-1.8966)
LINC2	0.0038* (1.6811)
LVALHSE	0.0050 (0.3623)
LAGE	0.0000 (0.0081)
LYRSE	-0.0010 (-0.8631)
RET	-0.0001 (-0.0253)
DGALL	0.0016 (0.2271)
DLPOT	-0.0038 (-0.1511)
RENTED	0.0056 (1.3911)
CONDO	0.0009 (0.1383)
INVMILL	0.0118 (0.1967)
R^2	0.23
Sample Size	1261
Proportion of Customers Purchasing	0.234
Mean of Dependent Variable	0.0093
Root MSE	0.0069

Note: Values in parentheses are approximate t-values (i.e., ratios of coefficient to standard error); asterisk denotes significance at 0.15 level.

Table 6. Price and Income Elasticities of Demand for Pansies and Mums

Elasticity	Pansies	Mums
Price Elasticity	-0.80 (-5.00)	-0.76 (-3.21)
Income Elasticity	0.65 (1.33)	0.53 (0.90)

Note: Elasticities are evaluated at sample means; values in parentheses are approximate t-values (i.e., ratios of elasticities to estimated standard errors).

In contrast to the price elasticites, both income elasticities (while positive as expected) are statistically insignificant. This is consistent with Abdelmagid, Wohlgenant, and Safely's analysis of springtime annual plants where few income elasticities were found to be significant.

Concluding Remarks

In this study, cross-sectional data from a fall survey of independent garden centers in North Carolina were used to estimate expenditure functions for pansies and mums. By far, pansies and mums are the largest purchased annual and perennial fall plants, so statistical analysis of these two plants should provide insights into demand for annual and perennial plants used for home landscaping. Statistical analysis was conducted using Heckman's two-stage estimator to account for selectivity bias, resulting from zero purchases of pansies and mums.

Overall, the statistical results indicate that prices are an important factor affecting demand for pansies and mums. In both cases, highly significant price effects were found with inelastic demand response indicated for each commodity. Consumers appear to view pansies and mums as fall plants for which there are few close substitutes. On the other hand, income elasticities were found to be insignificant, suggesting that demand is not responsive to changes in income.

The fact that demand for pansies and mums are price inelastic suggests that nurseries have an incentive to promote these products as unique. However, because the estimated demand elasticities are not significantly different from unity, this suggests that changes in prices will not have a significant effect on total sales revenue[7]. In addition, there is some evidence to indicate that older customers who live in attached housing (for pansies) and who are renters (for mums) are important factors to consider in targeting customers. Overall, the results found here for fall plants are in strong agreement with the findings for a similar survey conducted in the springtime in North Carolina (Abdelmagid, Wohlgenant, and Safley). Both prices and particular demographic factors are important determinants of demand for annual and perennial plants. Therefore, nurseries can benefit from targeting particular customers and taking advantage of specific product characteristics in their marketing programs.

Notes

1. The analysis is best viewed as demand for mums and pansies sold in North Carolina independent garden centers. While a significant proportion of these plants are sold by mass merchants, sales in independent garden centers are significant and compete favorably with mass merchants. A survey of independent garden centers (ICG) and mass merchants (MM) in southern states indicated that about one-third of the plants were sold in ICG and two-thirds were sold by MM (McCormick).
2. The number indicates number of plants per flat (e.g., "12" means 12 plants per flat).
3. The sensitivity of the results to exclusion of cross-price effects indicated that the specification is quite reasonable in this case. When the price of pansies was included in the demand model for mums the estimated coefficient was –0.00001 with a standard error of 0.02. When the mum price was included in the pansies demand model, the estimated coefficient was 0.0006 with a standard error of 0.003.
4. The Probit model results are not presented here, but the likelihood ratio and score tests for both commodities indicate rejection of the null hypothesis that the coefficients of the Probit model are jointly equal to zero. The p-values in both cases were smaller than 0.0001.
5. Because there were only 19 observations in the group "a" category (i.e., pots), estimation problems were encountered with the Probit model. Therefore, these observations were deleted from the model. The alternative approach of combining this category with the next lowest category indicated little or no difference in the quality of the results.
6. Specifications for pansies and mums were estimated that included seven dummy variables to allow for possible differences among the eight stores that participated in the survey. In neither case were the dummy variables found to be statistically significant. While two of the variables, LYRHSE and RENTED became significant in the mums equation, the estimated coefficients were virtually the same at –0.0009 and 0.0070, respectively.
7. From table 6, it can be inferred that the t-statistics of the null hypothesis that the elasticities be equal to a minus one are –1.25 and –1.01, respectively.

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