Demand Drivers for Fresh-cut Flowers and Their Substitutes: An Application of Household Expenditure Allocation Models

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Flowers are purchased for a variety of reasons ranging from expressions of love or sympathy to satisfying environmental and beautification goals. Unlike many foods where some of the attributes can be quantitatively measured such as grams of fat in meats and milligrams of cholesterol in fluid milk, these aesthetically pleasing products present an array of attributes that are closely tied to the buyer's reasons for making the purchase. Clearly the attributes are fundamentally different since the goal associated with the purchase depends on the buyer's objectives. This also implies that the demand for such products should be much more closely tied to the characteristics for the buyers and the reasons for buying. Flowers are not absolutely essential for survival and; hence, one may find a given share of the population as non-buyers or infrequent buyers. That is, there is considerable latitude with the decision to purchase or not, and again, this wider range of choices is closely tied to the demographics and occasions or periods. Knowing the latitude with the decision to purchase and the perceptions of the characteristics for products are essential to understanding the demand for flowers.

Expenditure shares for fresh-cut flowers have increased by 9 percent from 1993 to 2000, while the expenditure shares for dry/artificial flowers declined 6 percent between 1993-2000. Expenditure shares for potted flowering plants have been stable or decreased somewhat for the same period (AFE and Ipsos-NPD group). Purchasing of fresh-cut flowers, potted plants, and dry/artificial flowers should be substitutable to some degree even though physically they are fundamentally different products. Yet these products have many similar attributes when considering the purpose for use. They can be used to express thanks, reflect emotions, project beauty, and show environmental concerns. Hence, even with the physical differences,

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consumers may easily change their buying behaviors among these types of flower products. Expenditure patterns are tied to many things, including incomes, purposes, occasions, information and perceptions, and product availability (i.e., outlets). These levels of expenditures depend on market penetration (number of buyers), frequency of transaction among buyers, and prevailing prices. Hence, anything that influences consumer entry into the marketing via more (or fewer) buyers and/or increased frequency of transactions must be measured to have a fuller grasp of the demand for flowers. Understanding demand for flowers is useful to help the flower industry to be proactive in addressing demand issues. Actionable variables such as generic and brand promotion programs, and innovative selling methods are important factors likely to influence the future direction of the industry. Hence, it is important to have a complete definitive understanding of demand drivers for fresh-cut flowers and their substitutes including the relative importance of entry and transactions.

Many studies analyzing the demand for different U.S. agricultural products have used demand systems such as the Rotterdam Model or the Almost Ideal Demand System (AIDS) (see Capps and Schmitz, 1991; Song et al, 1997; Glaser K. Lewrene and Thompson Gary D., 1998; Moon and Ward, 1999; and Verbeke and Ward, 2001). However, there are a few studies on demand analyses of consumer expenditure pattern for U.S. flower products. Rimal (1998) analyzed the effect of generic and brand promotions of fresh-cut flowers on the use of retail flower outlets but did not focus on the total demand for flower products. Hence, the main focus of this paper is to empirically measure the demand for different types of U.S. flower products in total, cross flower types and outlets applying both demand system techniques. Drawing from the model estimates, simulations were applied to illustrate empirical relationships among the flower products, thus extending the analysis beyond just estimating elasticities (Verbeke and Ward, 2001).

Fresh-Cut Flower and their Substitute Data

Data collected by the American Floral Endowment (AFE) and the Ipsos-National Panel Diary Group

(Ipsos-NPD) provide statistics about the purchasing behavior of consumers, including transactions on flowers both as a gift and for self-use. Ipsos-NPD data were available from consumer questionnaires completed by households from a large demographically representive sample of U.S. households. These questionnaires include details on who did and did not purchase flowers, the types of flowers bought (i.e., arrangements, bunches, and others), and when and where flower products were purchased.

Monthly purchasing data from 1992:7 through 2001:12 provide details on the number of households buying flowers, the number of purchasing transactions, and total expenditures on flowers both as gifts and for self-uses. Flower data used in this analysis are categorized into the four income groups: under $25,000; $25,000 to $49,999; $50,000 to $74,999; and $75,000 and over. Monthly expenditures, transactions, quantities, number of buyers, purpose, and a range of other variables are recorded for each income group. Flower purchases include three subcategories: fresh-cut flowers; potted flowering plants; and dry/artificial flowers. Different types of retail outlets for buying flowers include florists and supermarkets. Over the data period, fresh-cut flowers accounted for 62.6 percent of total household expenditures; potted flowering plants accounted for 20.2 percent; and 17.2 percent for dry/artificial flowers. Within the fresh-cut sales type, arrangements accounted for 56 percent of the total; bunches contributed 41.1 percent; and the remaining 2.9 percent was for others (Figure 1). Figure 2 shows the distribution of total household expenditures on the different types of flower products for self-uses and as gift purchases during the 1992:7 to 2001:11 period. U.S. households spent the smallest amount on fresh-cut flowers for self-uses with 28.7 percent of total household expenditures while spending the highest amount on fresh-cut flowers as gifts with 74.4 percent. Alternatively, dry/artificial flowers accounted for the highest percentage (38.3%) or self-uses and the smallest percent (10%) of total expenditures as gifts. Dry/artificial flowers were

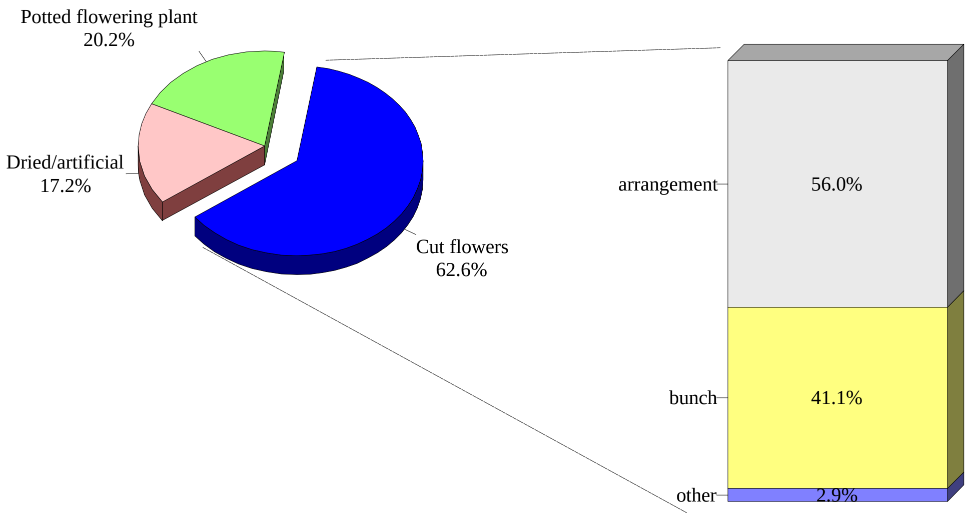


Figure 1. Percent of household expenditures on flowers across the different types of flower products over the 1992:7 to 2001:11 period. Source: AFE and Ipsos-NPD group.

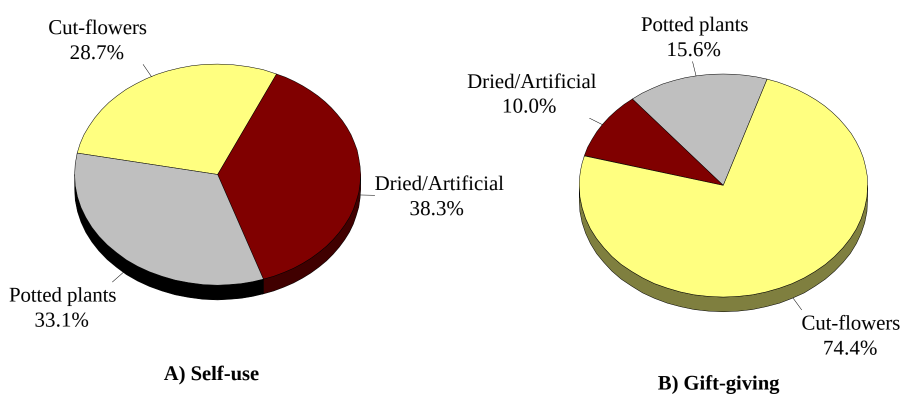
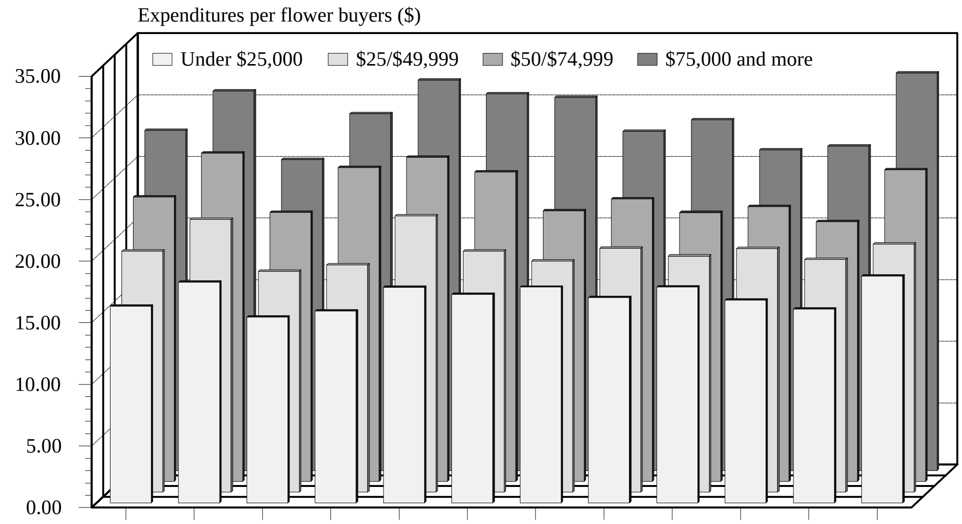


Figure 2. Percent of household expenditures on flowers for self-use and as gift purchase across the different types of flowers between 1992 and 2001. Source: AFE and Ipsos-NPD group.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Under $25,000	15.96	17.91	15.07	15.57	17.51	16.94	17.51	16.65	17.53	16.44	15.74	18.41
$25/$49,999	19.57	22.12	17.91	18.45	22.42	19.57	18.75	19.80	19.16	19.77	18.88	20.12
$50/$74,999	23.07	26.65	21.84	25.47	26.30	25.11	21.95	22.93	21.82	22.29	21.09	25.28
$75,000 and more	27.62	30.82	25.26	28.97	31.68	30.58	30.29	27.54	28.46	26.02	26.34	32.26

Figure 3. Seasonal expenditures among flower buyers across the four income groups over the 1992 to 2000 period. Source: AFE and Ipsos-NPD group.

Table 1. Flower products shares including fresh-cut flowers, potted flowering plants, and dry/artificial flowers for the 1992 - 2000 period across income groups.

Income groups ($1,000)	# of households (Millions)	Share of households (Percent)	# of buying (Percent)	Share of transactions (Percent)	Share of expenditures (Percent)
Under $25	38.01	38.54	27.75	28.82	22.43
$25 to $49	32.89	33.34	30.24	31.14	29.51
$50 to $74	15.37	15.58	19.26	18.41	21.03
$75 or more	12.37	12.54	22.74	21.63	27.03
Total	98.64	100.00	100.00	100.00	100.00

Source: AFE and Ipsos-NPD, Inc.

the alternative selection consumers made for self-uses when they were dissatisfied with the keeping quality of fresh-cut flowers (Miller, 1983).

Household expenditures on flower products across the four income groups over the months are presented in Figure 3. All income groups spent the smallest amount per buyer in March with around $15 to $25 for flowers. The highest amount per buyer for the highest income group accounted for $32 and $18 for the lowest income group in December. In May the income group between $25,000 and $49,999 spent the $22 and the income group between $50,000 and $74,999 spent $26 per buyer.

Table 1 demonstrates the distributions of total flower products with each column showing the market shares across the four income groups, according to households, transactions, and expenditures. The highest income group accounted for 27.03 percent of total household expenditures on flower products and represented 12.54 percent of total households. Alternatively, the lowest income group with 38.54 percent of total household accounted for 22.43 percent of total flower expenditures. Furthermore, the lower income groups showed proportionally more transactions on total flower products than the higher income groups as indicated with the share of transactions column.

Flower Demand Estimates

Consumer demand theory examines consumer preference orderings among different bundles of goods using a utility function. The measurement of the level of the consumer's satisfaction can be described by a result of consuming a bundle of good and services. In general, consumers purchase the optimal quantities of goods by maximizing the utility function subject to a budget constraint.

$$\text{Max} \quad u = u(q_1,...,q_n) \tag{1}$$

$$\sum_{j=1}^{n} p_j q_j = m$$

where p_j and q_j are the price and the quantity of the j^{th} good, respectively, and m is the total expenditures or income on all n goods. Accepted demand theory is based in the consumption of q, the quantity consumed. Unlike most commodities, the units for flowers are quite ambiguous since a wide array of units can make up the actual purchase. For example, one may buy one arrangement or a dozen roses. Both may provide similar levels of utility but the units are clearly different. A useful approach to get around this problem is to express demand in terms of the transaction event within a defined period. If the numbers of buyers and their monthly frequency of transactions are known, then the units in the demand model can be expressed as the total frequency of purchasing or buyer times transactions per buyer. Let b reflect the buyers and f the frequency, then the income constraint is specified as:

$$\sum_{j=1}^{n} p_j f_j b_j = \sum_{j=1}^{n} m_j = m \tag{2}$$

where p_j is now the price per transaction. Using the Lagrangian procedure under plausible conditions on the utility function, the consumer's demand function becomes:

$$f_i b_i = f\left(m, p_i, p_j\right) \tag{3}$$

The demand function describes the consumption of goods in terms of a particular income and the prices of the i^{th} good in transaction units.

Given the total expenditures and the prices of the i^{th} good, the dollar amount to be allocated to (i.e., the budget shares) the i^{th} good can be written as:

$$w_{i(lt)} = p_{i(lt)} f_{i(lt)} b_{i(lt)} / m_{(lt)} \tag{4}$$

where l denotes the l^{th} cross section and t is the specific time period. For editorial convenience, the l and t notations are dropped without any loss in the equation meaning.

$$w_i = \frac{p_i f_i b_i}{m} = \frac{m_i}{m} \qquad (5)$$

To measure factors influencing demand for flowers such as prices, seasonality, demographic variables, etc., the demand for flowers in the different forms can be estimated using a demand system approach. While there are several approaches for estimating the demand for consumption goods, this research will specify an Almost Ideal Demand System (AIDS) to examine household behavior in the U.S. flower industry (Stone, 1954; Theil, 1965; Christensen, Jorgenson, and Lau, 1975; Deaton and Muellbauer, 1980; Keller and Van Driel, 1985; Bewley and Young, 1986). The AIDS model, introduced by Deaton and Muellbauer (1980), imposing the symmetry and homogeneity restrictions of demand theory, aggregates over consumers, and satisfies the axioms of choice (Medina, 2000). The AIDS model was not difficult to estimate because given the $ parameter, the first order conditions for likelihood maximization were almost linear in the ″ and (parameters as shown in equations 6-7 (Deaton and Muellbauer, 1980).

AIDS Model Components

The AIDS model explicitly shows the price and income effects (McGuirk et.al., 1995; and Richards et.al, 1997). Yet, the demand for flower products may have shown considerable change in direct responses to seasonal factors, promotions, and demographics in demand systems. This paper will use the demographic translating to estimate the AIDS model (Richards et.al, 1997). Then, many factors can be used to show the influence on shares in the AIDS model through changes in the "$_i$ and the weighted price P. The AIDS model with demographic translation is rewritten as:

$$w_i = a_i + \sum_{j=1}^{4} \Omega_{ij} + \sum_{k=1}^{4} g_{ki}\, ln\, p_k + b_i (ln\, m - ln\, P) \qquad (6)$$

$$ln\,\mathrm{P} = a_0 + \sum_{k=1}^{4}\left(a_k + \Omega_{kj}\right) ln\,\mathrm{p}_k + \frac{1}{2}\sum_{k=1}^{4}\sum_{j=1}^{4} g_{kj}\, ln\,\mathrm{p}_k\, ln\,\mathrm{p}_j \qquad (7)$$

Again the cross section (l) and time (t) subscripts are dropped, while noting that t indicates the monthly data from 1992:7 to 2001:11; i=1,2,3,4 is defined for fresh-cut flowers, potted flowering plants, dry/artificial flowers and other non-flower items. Given these flowers, in general, are nonessential and other non-flower goods could in some circumstances provide the same set of characteristics (e.g., thanks, love, etc.), it is desirable theoretically that the fourth variable (other non-flower items) be included in the expenditure or income constraint in the expenditure allocation models. Hence, in the summations noted that n=4 with the 4th variable being monies available for other discretionary expenditures. w_i indicates the budget share of the ith commodity; p_k is the price of the kth commodity; m is the total expenditure; P is the price index; and S_{ij} includes all the demographic variables discussed below. Also, when estimating the models the appropriated parameter restrictions (the adding-up; $\sum_i b_i = 0, \sum_k g_{ki} = 0, \sum_i a_i = 1$, homogeneity; $\sum_k g_{ki} = 0$, and symmetry; $g_{ki} = g_{ik}$) consistent with the demand theory are be imposed in equation (6).

With the use of the translating procedure, incorporating all the demographic variables into the AIDS model allow the intercept ($''_i$) in equation (6) to be a function of household characteristic variables expressed as dummy variables as set forth in equation (8).

$$\begin{aligned}\Omega_{ij} = {} & t_{i2}(\mathrm{S}_2 - \mathrm{S}_1) + t_{i3}(\mathrm{S}_3 - \mathrm{S}_1) + t_{i4}(\mathrm{S}_4 - \mathrm{S}_1) \\ & + t_{i5}(\mathrm{S}_5 - \mathrm{S}_1) + t_{i6}(\mathrm{S}_6 - \mathrm{S}_1) + t_{i7}(\mathrm{S}_7 - \mathrm{S}_1) + t_{i8}(\mathrm{S}_8 - \mathrm{S}_1) \\ & + t_{i9}(\mathrm{S}_9 - \mathrm{S}_1) + t_{i10}(\mathrm{S}_{10} - \mathrm{S}_1) + t_{i11}(\mathrm{S}_{11} - \mathrm{S}_1) + t_{i12}(\mathrm{S}_{12} - \mathrm{S}_1) \qquad (8) \\ & + h_{i2}\left(\mathrm{IN}_2 - \mathrm{IN}_1\right) + h_{i3}\left(\mathrm{IN}_3 - \mathrm{IN}_1\right) + h_{i4}\left(\mathrm{IN}_4 - \mathrm{IN}_1\right) \\ & + d_i(\mathrm{PMFL}) + l_i(\mathrm{TT}) + z_i(\mathrm{PUR}) + w_i(\mathrm{OUT})\end{aligned}$$

In equation (8) PMFL is a monthly expenditure on PromoFlor occurring in the period 1996:6 to 1997:6; PUR represents purpose variables for each purchase decision on flowers (self-use and gift-giving); OUT are dummy variables for the retail outlet type (florists and supermarkets); and TT is a time trend variable from 1992:7 to 2001:11. In the AIDS model, including a time trend attempts to capture underlying structure change (Deaton and Muellbauer, 1980; Richards et.al, 1997). IN_1-IN_4 represents dummy variables for incomes under \$25,000; \$25/\$49,999; \$50/\$74,999; and \$75,000 or more, respectively. Seasonality is captured with monthly dummies S_1-S_{12}. The adding-up restriction holds in the extended model by imposing; $\sum h_{i2} = 0$, $\sum h_{i3} = 0$, and $\sum h_{i4} = 0$ for income dummy variables; $\sum t_{ik} = 0$, k=2,...,12 for seasonal dummy variables; $\sum l_i = 0$ for trends; $\sum w_i = 0$ for outlet variables; $\sum z_i = 0$ for purpose variables; $\sum d_i = 0$ for PromoFlor. Note that one convenience way to deal with these discrete (0,1) variables is to restrict the sum of the coefficients to zero for each category. Let $\sum_{k=1}^{12} t_{ik} = 0$, then $t_{i1} = -\sum_{k=2}^{12} t_{ik}$ and SS_k = S_k-S_1 where the SNs are dummy seasonal variables for the months. Since t_{i1} is expressed in terms of the other Jrs, it immediately follows that SS_k = S_k-S_1 where k...1. For the four incomes, let $\sum_{j=1}^{4} h_{ij} = 0$,then $h_{i1} = -\sum_{j=2}^{4} h_{ij}$ and INC_j = IN_j-IN_1 where j...1 and INNs are the dummies for the income groups. For the outlet variables, let $\sum_{j=1}^{2} w_j = 0$, j=1,2 for overall outlets, supermarkets and florists, respectively, then $w_2 = -w_1$ and OUT = $OUTT_1$! $OUTT_2$ and OUTT is the dummy for each outlet type. Similar for the purpose variables, let $\sum_{j=1}^{2} z_j = 0$, j=1,2 for purchasing as total, self-use, and gift-giving and $z_2 = -z_1$ and PUR = $PPUR_1 - PPUR_2$

and PPUR is the dummy variable for the purpose of buying flowers. Using these restrictions for both discrete categories, α_0 in equation 7 represents the average over the four income groups, seasons, outlets, and purposes as shown with equation 9 where I_{kjih} equals the intercept for month k, income j, the outlet i, and purpose h as long as k, j, i, and h are not equal to one.

$$I_{kjih} = a_0 + t_k + h_j + w_i + z_h \qquad (9)$$

When k=j=i=h=1, then $I_{1111} = a_0 - \sum_{k=2}^{12} t_k - \sum_{j=2}^{4} h_j - w_2 - z_2$ Hence, α_0 represents some average value over

the years, across incomes, outlet types and purposes and all adjustments are relative to this average. In additional, the α_0 parameter in equation 7 can be interpreted as expenditures required for a minimal standard of living when prices are unity (Deaton and Muellbauer, 1980). The α_0 parameter is identified in the Σ term in the price index (see equation 7). Edgerton et.al (1996) suggested that the likelihood function for the nonlinear AIDS model was normally very flat around α_0, creating problems with empirical identification. However, this problem can be solved if the value of α_0 is chosen a priori.

As mentioned earlier, the total transaction of flowers can be expressed as the total buyers time transactions per buyer (F = f·b). One possible problem using the total transaction (F) is with seasonal patterns, relating to the fact that buyers are attracted to the markets particularly during special occasions such as Valentine's Day and the Christmas holidays. Hence, seasonality in the total transaction of flowers should be accounted for when estimating the household consumption behavior in the AIDS model. Expenditures for each flower types (m_i) are expressed in terms of units per household in different income groups. This is because the number of households in each income group who actually purchased flowers differs.

Expenditures within each income group depend on both the buyer behavior and the number of buyers. Since the numbers of households differ across incomes, it is useful to express the expenditures on a household basis in order to remove empirical problems associated with having such differences in the household distribution across incomes and seasonality. Hence, expressing expenditure on a per household basis should remove that potential problem.

Rather than separating income categories into four income equations, the AIDS model includes income categories as demographic variables. The model for all income groups can be estimated together, showing shifts across the four income groups. Income variables most likely encompass more than just the income constraints from m. Income groups likely reflect broad categories of behavior. Hence, including the income categories in addition to m in the model should be viewed as a way to capture these broaders, not so well defined behavior categories. Then, the household budget shares of three flower types (fresh-cut flowers, potted flowering plants, and dry/artificial flowers) and other non-flower items can be expressed as a function of price, expenditures and dummy variables representing household characteristics.

AIDS Flower Model Estimates

Three flower products and other non-flower items were already identified. In some circumstances expenditures on other non-flower items can provide similar sets of characteristics generated with the purchases of flowers. If feasible, it is desirable that the fourth variable be included in the expenditure allocation models. Unfortunately, expenditures on other discretionary goods are not explicitly reported in the household data set. One can approximate the total discretionary income available to spend on nonessential goods. These data depend on other variables where a type of income category is based on the discretionary goods and that category can be extremely large. This potentially dominate variable can also create multicollinearity problems. Hence, the presence of expenditures on other non-flowers items could not be included in the AIDS model since that variable dominated the estimation.

Expenditure allocation models based on the AIDS specifications were finally estimated for three flower types (i.e., fresh-cut flowers, potted flowers, and dry/artificial flowers) and a system of equations for all four income groups was estimated while imposing homogeneity and symmetry restrictions. With three flower products, one equation was dropped from the AIDS model since by definition if two shares are known the third share is set. After dropping the third equation (i.e., dry/artificial flowers), the system included only two equations. For each equation, flower budget shares are expressed as a function of flower prices, flower expenditures, and dummy variables representing household characteristics, purpose, outlets, and periods.

The AIDS model from equations 6 and 7 was estimated by applying maximum likelihood procedures including the residual covariance structure. Note that results from the maximum likelihood procedure show that the α_0 parameter from equation 7 is nearly equal to zero. The parameter estimates for three flower types with the seasonally adjusted transaction model are reported in Table 2, including the estimated coefficients of the dropped equation. Each column of Table 2 presents the corresponding estimates of fresh-cut flowers, potted flowers, and dry/artificial flowers. Convergence was achieved with five iterations and, for convenience, t-values instead of the standard errors are reported. The resulting parameters have been corrected for heteroscedasticity. The weighted R-squares show that approximately 68 percent of the variation has been explained for all flower types and that level is generally acceptable for pooled data models.

All direct price effect coefficients (γ_{ij}) with the seasonally adjusted transaction model (Table 2) were significantly different from zero at a 95 percent confidence level. Clearly, changes in the relative prices have a significant impact on flower market shares among fresh-cut flowers, potted flowering plants, and dry/artificial flowers. The coefficient estimates for expenditure effects (β_i) were significant for the model with the seasonally adjusted transaction, indicating that a change in total household expenditures on flowers has a significant effect on the budget shares. Fresh-cut flowers showed a positive response to expenditures,

Table 2. Estimated parameters of the AIDS model using a pooled data with the seasonally adjusted transaction model.

Parameters Dependent (W_i)...Share for ith product	Cut Flowers (i=1)	Potted Flowering Plants (i=2)	Dry/Artificial Flowers (i=3)
"$_i$................Intercept	1.1241	0.0391	-0.1632
	(32.8394)	(1.5152)	(-5.2835)
$\$_i$................Expenditure Effect	0.1037	-0.0410	-0.0627
	(12.1934)	(-6.4093)	(-8.0522)
<u>Price Effects</u>			
($_{ii}$................Own Price Effect	0.2031	0.1322	0.0917
	(18.8679)	(14.7351)	(14.1380)
($_{i1}$=($_{1i}$..........i / Cut Flowers		-0.1218	-0.0812
		(-13.7246)	(-11.7586)
($_{i2}$=($_{2i}$..........i / Potted Flowering Plants			-0.0104
			(-2.6772)
<u>Income Effects</u>			
0$_{i2}$.............Income \$25/\$49,999	0.0280	-0.0125	-0.0155
	(4.2967)	(-2.3873)	(-2.5968)
0$_{i3}$.............Income \$50/\$74,999	0.0063	-0.0016	-0.0047
	(0.7882)	(-0.2468)	(-0.6703)
0$_{i4}$.............Income \$75,000 and more	-0.0513	0.0111	0.0402
	(-5.0057)	(1.4323)	(4.2548)
*$_i$.................Promotion Effect	-0.0359	0.0219	0.0140
	(-2.6848)	(2.1240)	(1.0943)
8$_i$................Trend	-0.2883	0.1545	0.1337
	(-4.9734)	(3.1498)	(3.1767)
.$_i$.................Purpose Effect	-0.0532	0.0279	0.0253
	(-8.8774)	(5.6031)	(4.6622)
T$_i$................Outlet Effect	-0.0317	0.0653	-0.0337
	(-7.2502)	(17.8044)	(-8.3598)

Note: ( ) indicates t-value at five percent level=1.96

Table 2. Continued.

Parameters Dependent (W_i)...Share for i[th] product	Cut Flowers	Potted Flowering Plants	Dry/Artificial Flowers
Seasonal Effects			
J_{i2}.............February	-0.0009	-0.0145	0.0154
	(-0.0730)	(-1.5283)	(1.1301)
J_{i3}.............March	-0.0239	-0.0093	0.0332
	(-1.4451)	(-0.8468)	(1.9755)
J_{i4}.............April	-0.0707	0.0719	-0.0012
	(-4.8177)	(6.1323)	(-0.1075)
J_{i5}.............May	-0.0257	0.0088	0.0168
	(-1.9300)	(0.9452)	(1.5325)
J_{i6}.............June	0.0566	-0.0405	-0.0160
	(3.8680)	(-4.2906)	(-1.1707)
J_{i7}.............July	0.0879	-0.0700	-0.0179
	(6.2571)	(-6.1314)	(-1.4409)
J_{i8}.............August	0.0781	-0.0564	-0.0217
	(5.3665)	(-5.3152)	(-1.7435)
J_{i9}.............September	0.0566	-0.0396	-0.0170
	(4.2227)	(-4.0703)	(-1.5521)
J_{i10}............October	0.0477	-0.0460	-0.0017
	(4.0533)	(-5.3212)	(-0.1482)
J_{i11}............November	-0.0045	-0.0090	0.0135
	(-0.3381)	(-0.8983)	(0.9741)
J_{i12}............December	-0.2241	0.2208	0.0034
	(-19.6330)	(16.1260)	(0.3852)

Period: 1992:7-2001:11	Log Likelihood Ratio = -694.8026
Number of Observations =887	t-value at 95% = 1.96
R-squared for W1 =0.6763	R-squared for W2 = 0.6811
LM het. test for W1=75.8102	LM het. test for W2 =127.877

Notes: W1-W2 denote share of fresh-cut flowers, and potted flowering plants, respectively.
( ) indicates t-value at five percent level=1.96

while potted flowering plants and dry/artificial flowers presented negative expenditure effects in terms of market shares. Hence, the demand for fresh-cut flowers is more elastic with respect to total household expenditures on flowers than that for other flower types. For seasonality effects (J_{ik}), each month is compared to an average over the twelve month cycle. As shown in Table 2, few coefficients for seasonality effects were significant at the 0.05 percent level for dry/artificial flowers. In contrast, many of the seasonal coefficients with the seasonally adjusted transaction model for fresh-cut flowers and potted flowering plants were statistically different from the overall average period and seasonal behavior was apparent. This indicated those household decisions to purchase flowers were highly impacted by special occasions and customs. Note also that to the extent that m has some seasonality, the m may be capturing at least part of the overall seasonality. Outlet (T_i), purpose ($._i$), and trend (8_i) effects played an important role in the purchases of flowers since the coefficient estimates for outlet, purpose, and trend effects were significant for each flower type as shown in Table 2.

The impact of income effects (O_{ij}) on the budget shares was categorized into four groups (i.e., under \$25,000; \$25/\$49,999; \$50/\$74,999; and \$75,000 and more) with each group compared to an average demand across incomes for an average household. From Table 2, all coefficient estimates with the seasonally adjusted transaction model for the income \$25/\$49,999 group were significantly different from the average for three flower types, whereas all income effects for the income \$50/\$74,999 group were insignificantly different from the average at the 0.05 percent level. The estimated O_{ij} parameters for the highest income group except for potted flowering plants were all significantly different from the average at five percent levels.

Flower Demand Elasticities

Using the empirical estimates from the AIDS model (Table 2), estimated demand elasticities for the own prices, cross prices, and expenditures are presented in Tables 3 through 6. All elasticities were calculated at the appropriate sample means and over a range of prices. In each table, standard errors of the elasticities were computed using a bootstrap resampling procedure (Fox, 1997; Mittlehammer et. al, 2000). Most of the uncompensated own-price elasticities were statistically significant at a five percent level except for dry/artificial flowers and demonstrated all expected negative signs. The estimated own-price elasticity for fresh-cut flowers is close to unity in absolute value (-0.8783). For potted flowering plants and dry/artificial flowers, uncompensated own-price elasticities are smaller with -0.3076 and -0.0328, respectively. Demand for fresh-cut flowers has the largest price response relative to the other flower products. Many of the uncompensated cross-price elasticities had negative signs and were statistically significant except for that of dry/artificial flowers. The compensated elasticities have been calculated but a very strong word of caution is emphasized. Since fresh-cut flowers make up a reasonably large share of total expenditures, any change in the fresh-cut prices is by definition going to have an expected large impact on overall purchasing power.

Compensation is the increase in income after the price change that would be needed for the consumer to stay on the same indifference curve. If one product such as fresh-cut flowers has a large share of the total expenditures, then a price increase reduces the income by a substantial amount. That is, precisely the case in Table 3 where fresh-cut flowers account for an average of 73 percent. Hence, one would expect the compensated elasticity to be substantially less than the non-compensated in absolute value. That is, exactly what happens in Tables 3 and 4 with the fresh-cut flowers direct elasticity. Given these results the compensated elasticity is of little use for policy purposes. Clearly, fresh-cut flowers dominate in terms of market shares and any price change would have a substantial impact on the real purchasing power since income is based on just these three products instead of the 4^{th} product. This is a major limitation of the analysis and, hence, the use of compensated elasticities is of limited use.

Expenditure elasticities and expenditure share elasticities for flower products are presented in Table 5. All expenditure elasticities have positive signs as expected for normal goods. In comparing across three

Table 3. Budget shares and estimated uncompensated price elasticities for flowers.

		Uncompensated Price and Cross Price Elasticities		
Flower Types	Mean Budget Share	Cut flowers	Potted flowers	Dry/Artificial flowers
Cut flowers	0.7296	-0.8783* (0.0103)	-0.1695* (0.0070)	-0.0930* (0.0065)
Potted flowers	0.1859	-0.4136* (0.0306)	-0.3076* (0.0388)	-0.0749* (0.0205)
Dry/Artificial flowers	0.0845	-0.1406 (0.0913)	-0.0602 (0.0503)	-0.0328 (0.108)

Note: Standard errors of elasticities using bootstrap method are in parentheses
* denotes statistically significant at 5 percent level.

flower products, fresh-cut flowers have the highest expenditure elasticity with 1.1407, while dry/artificial flowers had the lowest value with 0.2336. Clearly, the demand for fresh-cut flowers increases proportionally more than that of other flower products as total flower expenditures increase. For the expenditure share

Table 4. Estimated compensated price elasticities for flowers.

	Compensated Price and Cross Price Elasticities		
Flower Types	Cut flowers	Potted flowers	Dry/Artificial flowers
Cut flowers	-0.0461* (0.0094)	0.0426* (0.0079)	0.0035 (0.0090)
Potted flowers	0.1672* (0.0316)	-0.1596* (0.0334)	-0.0076 (0.0202)
Dry/Artificial flowers	0.0298 (0.0827)	-0.0168 (0.0444)	-0.0130 (0.0983)

Note: Standard errors of elasticities using bootstrap method are in parentheses
* denotes statistically significant at 5 percent level.

elasticity, fresh-cut flowers show positive effects on the expenditure share elasticity, and potted flowering plants and dry/artificial flowers have negative effects. Hence, shares of potted flowers and dry/artificial flowers will decrease (increase) as total flower expenditures increase (decrease), while fresh-cut shares will increase (decline) as total flower expenditures increase (decline).

Table 5. Estimated expenditure and expenditure share elasticities for flowers.

Flower Types	Cut flowers	Potted flowers	Dry/Artificial flowers
Expenditure Elasticity	1.1407*	0.7961*	0.2336
	(0.0090)	(0.0370)	(0.2000)
Expenditure Share Elasticity	0.1407*	-0.2039*	-0.7664*
	(0.0093)	(0.0339)	(0.1640)

Note: Standard errors of elasticities using bootstrap method are in parentheses
* denotes statistically significant at 5 percent level.

Simulating Household Behavior

Drawing from the model estimates, simulations were applied to illustrate empirical relationships among the flower products, thus extending the analysis beyond just estimating elasticities (Verbeke and Ward, 2001). Simulation techniques can be applied to demonstrate how additional expenditures on flower products would change the allocation and shares among different types of outlets across income groups. What is the impact from both short and long terms changes in total incomes (m) or to price levels and the seasonality on the demand of flowers? Each simulation procedure can be measured by adjusting one or more variables relative to the mean value of all other variables in the demand model. For illustration purposes, each continuous variable is adjusted from 50 percent of the mean level to 150 percent of the mean using increments of 10 percent. Each discrete variable is changed using the binary value.

In Figures 4a-4c each flower transaction was simulated with respect to changes in each flower price, letting the flower price range from 50 percent to 150 percent of the mean value. Demand curves for fresh-cut flowers, potted flowering plants, and dry/artificial flowers show the expected downward slope. As prices

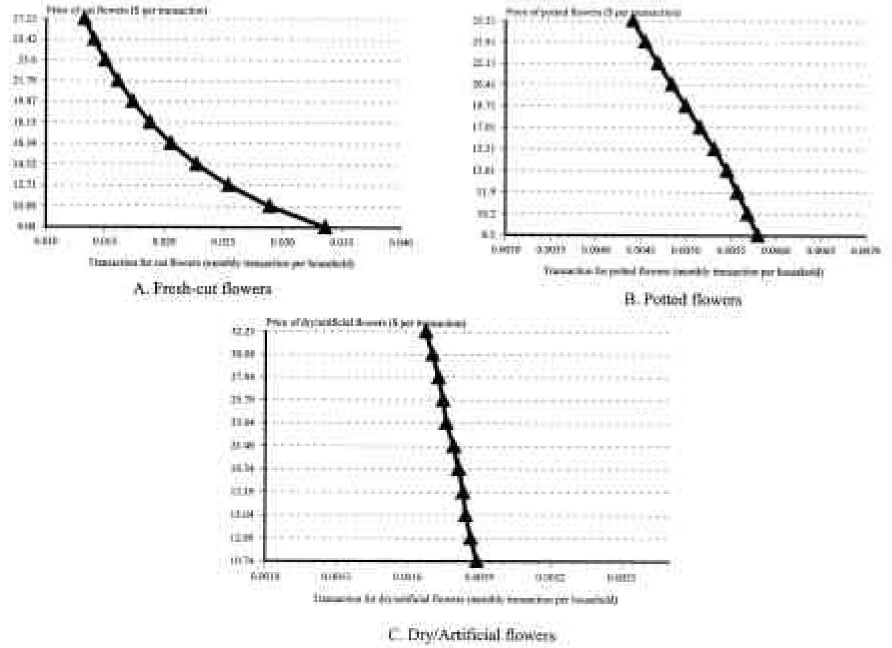


Figure 4. Demand curves for flower products.

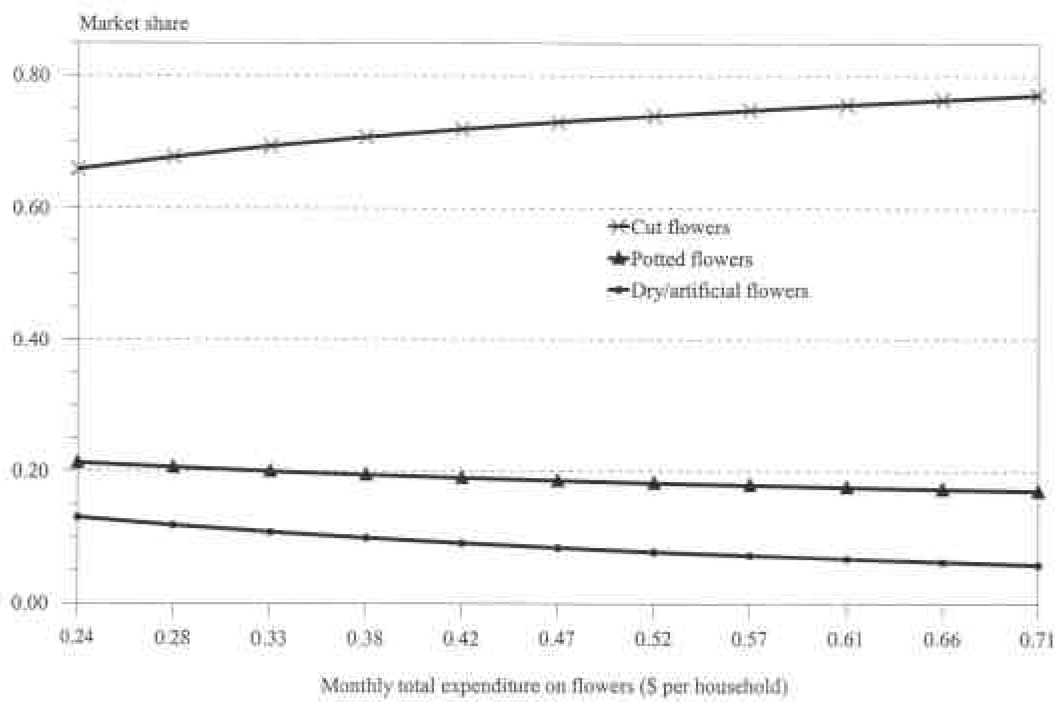


Figure 5. Changes in total expenditures on flowers relative to market shares for each flower types.

of each flower type increase (decrease), monthly transactions per household for each flower type decrease (increase). Fresh-cut flowers accounted for the highest amount of monthly transaction per household followed by potted flowering plants, and dry/artificial flowers. For each simulation the transactions are expressed relative to the number of households in that income category and that is why in all cases the transaction levels are always quite small.

Changes in total expenditures on flowers (i.e., fresh-cut flowers, potted flowering plants and dry/artificial flowers) along with changes in the amount of flower shares are simulated in Figure 5. This simulation can be used to address how additional expenditures on flowers will be allocated among three flower products. Simulations were performed by changing the total expenditures on flowers in the range of 50 to 150 percent of the mean expenditure on all flowers. As total flower expenditures increase from 50 percent to 150 percent of the mean level, fresh-cut shares increase 11 percent while potted shares and

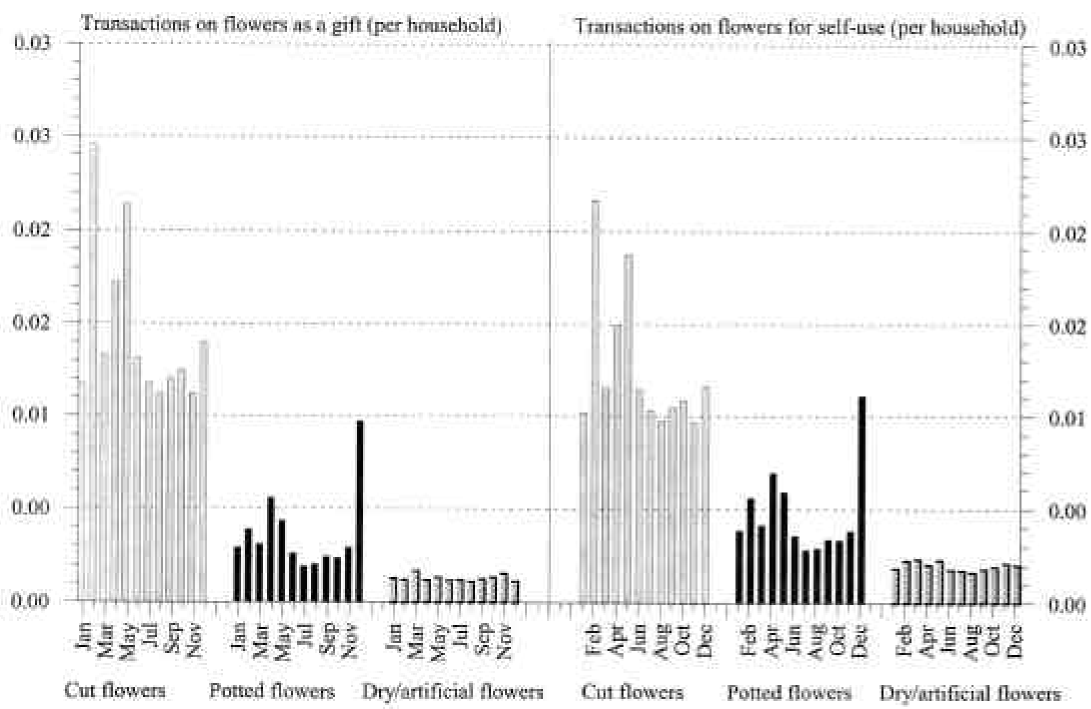


Figure 6. Estimated seasonal transactions of different flower types over the purposes.

dry/artificial shares decline 5 percent and 7 percent as shown in Figure 5. Obviously, the fresh-cut flower industry would benefit from an overall growth in consumer spending on all flowers, while potted flowering plants and dry/artificial flowers lose market shares as total flower expenditures increase. Note that even with

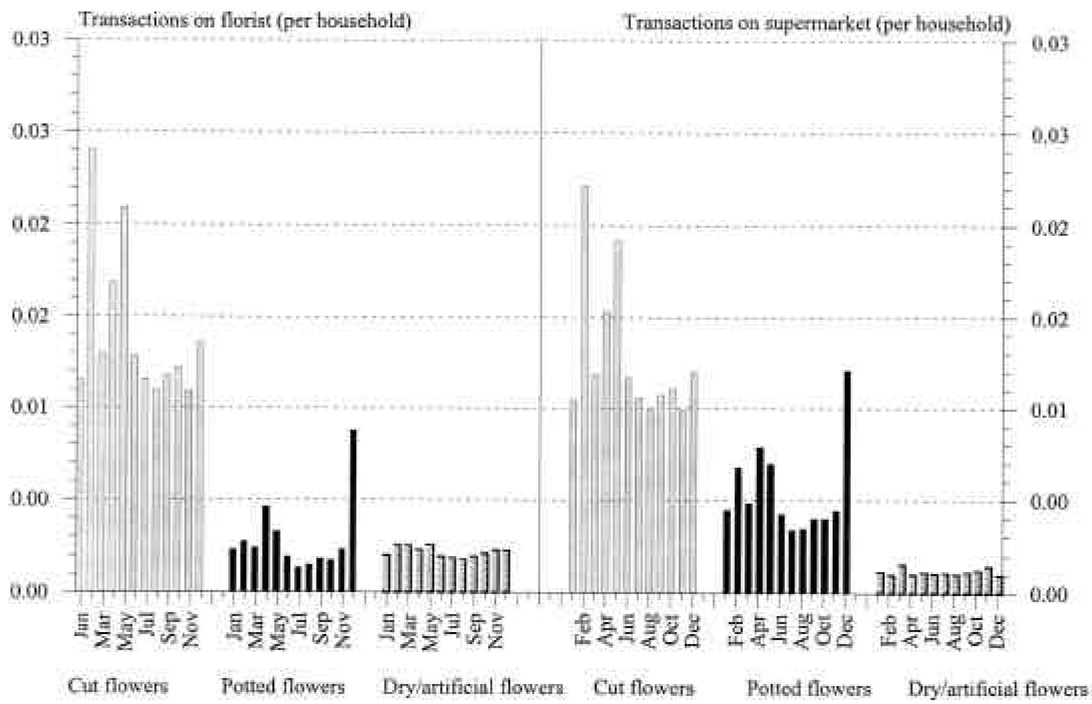


Figure 7. Estimated seasonal transactions fo different flower types over the outlets.

a declining share for these two flower products, their total revenues could still also increase but not at the rate of fresh-cut flowers.

Among purposes of purchasing flowers, monthly transactions on fresh-cut flowers for gifts are higher than those for self-uses. In contrast, potted flowering plants and dry/artificial transactions are slightly higher for self-uses compared to gifts (Figure 6). The highest proportion of monthly transactions per household is in February for fresh-cut flower; in December for potted flowering plants; and in March for dry/artificial flowers and this is generally true for both self and gift purposes. These patterns are in line with expectations.

In July, the households demand is at the highest level for a fixed m level. The highest demand of potted flowering plants (i.e., poinsettias[2] and other holiday plants) were spent in December during the Christmas holidays. For dry/artificial flowers, there are higher transactions in March possibly related to traditional spring home renovations and cleaning. Also, dry/artificial flowers have a long shelf life that is appropriated for home decorations. These results are similar to the allocation of transactions per household across retail outlets as shown in Figure 7. Fresh-cut flowers and dry/artificial transactions are slightly higher through florists while transactions for potted flowering plants are considerably higher through supermarkets.

Monthly transactions on fresh-cut flowers are further illustrated relative to total flower expenditures and fresh-cut prices in Figure 8. Simulations were performed by again adjusting total flower expenditures and fresh-cut prices by 50 percent to 150 percent of the mean level. The three-dimensional plane in Figure 8 corresponds to the results in Figures 4a and 5 and is calculated over a weighted average of the four income

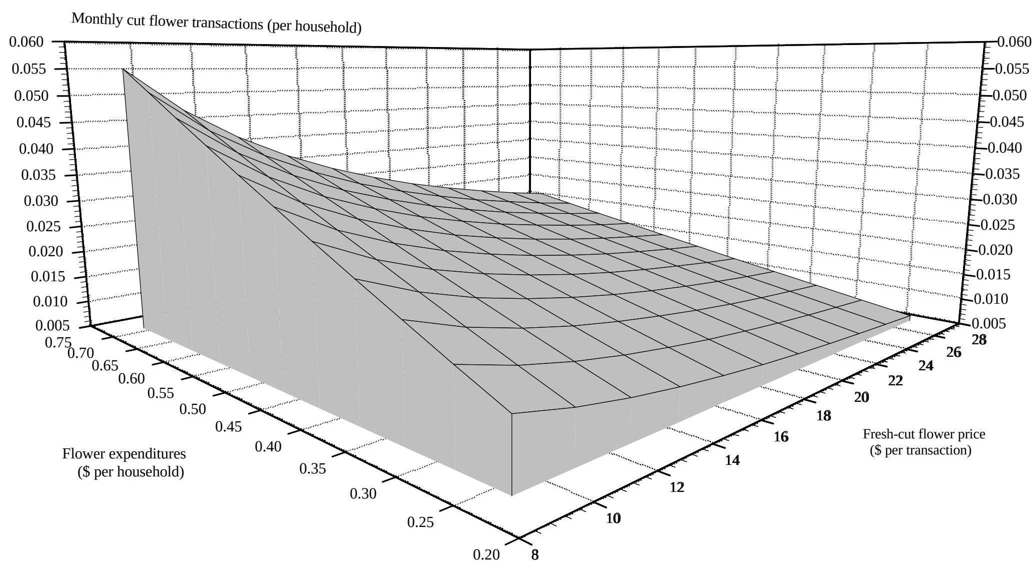


Figure 8. Changes in total flower transactions relative to monthly expenditures on fresh-cut flowers and fresh-cut prices for all income groups.

[2]Poinsettias make up 86 percent of the flowering plants purchased for Christmas/Chanukah (Ipsos-NPD for the American Floral Endowment (AFE) Tracking Study, January-December, 2001).

groups. The horizontal axis on the left-hand side represents monthly total flower expenditures per household, and the horizontal axis on the right-hand side is the prices of fresh-cut flowers per transaction. Monthly transactions on fresh-cut flowers per household are on the vertical axis. As a result, monthly transactions on fresh-cut flowers increased by 71 percent at the mean fresh-cut expenditures of $0.47 per household as total flower expenditures are increased from 50 percent to 150 percent of the mean level. Similarly, as fresh-cut prices increase in the same range as total flower expenditures, monthly transactions on fresh-cut flowers drop by 61 percent at the mean fresh-cut price of $18.15 per transaction.

Figure 8 represents a general overview of the demand response for fresh-cut flowers letting expenditures and prices change over a wide range, possibly wider than normally would be expected. These responses provide good evidence of the performance of the AIDS model in capturing the demand structure where transactions are being measured instead of quantities. Clearly, the sensitivity of both prices and purchasing power are illustrated with the purchasing power (i.e., total expenditures) having the larger impact using the same percentage adjustments. As suggested earlier, this surface would simply shift up or down as the other demand factors are considered such as seasonality, purpose, and outlet.

Flower Implications and Conclusions

Demand system models provided a picture of the consumer side of the market and attempted to provide the empirical insight into what drive changes in the purchasing behavior. Demand can be assumed completely exogenous to an industry and the industry just accepts the pattern of change. The AIDS model as suggested in this paper provides insight into where changes could occur and what the relative category position would appear to be in the absence of any stimulations or adjustment within the flower industry. Yet the same pattern may point to areas needing attention by various sectors within the flower industry. For example, how much gain could be realized by changing the fall drop in seasonal patterns? Who should be targeted? What is the potential gain from price competitiveness versus specific demand enhancement programs? Surprising there is few if any definitive analyses of the broad demand for flowers and this analysis should give the industry a better perspective on the demand for fresh-cut flowers relative to the other goods.

Obviously, the fresh-cut flower industry would benefit from an overall growth in consumer spending on all flowers, while potted flowering plants and dry/artificial flowers lost market shares as total flower expenditures increased. Note that even with a declining share for these two flower products, their revenues could still also increase but not at the rate of fresh-cut flowers. Then, the potted flowering plants and dry/artificial flower industry should have some proactive policy (e.g., advertising program) to increase their sales and change undesirable trend of consumers on their flower types. In cases of retail outlets, fresh-cut flower supermarket shares clearly gained as total flower expenditures increase, whereas potted flowering plants and dry/artificial flowers lost shares with 4 and 7 percent decreases, respectively. As shown for florists, most of the additional flower expenditures through florists went to fresh-cut flowers with an 11 percent increase. However, fresh-cut shares and dry/artificial shares of florists were more diverse than for supermarkets, while shares of potted flowering plants from florists were less than for supermarkets.

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