A Hedonic Analysis on the Implicit Values of Fresh Tomatoes

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Introduction

The food habits and dietary patterns of American consumers are changing and they are increasingly demanding food products that possess certain attributes relating to how the food was produced or processed. For example, concerns over health and environmental degradation may have motivated U.S. consumers to purchase organic produce. Organic foods once considered as a niche product sold primarily in specialty shops are becoming increasingly popular among the conventional consumers. The market for organic foods has grown rapidly in the past decade as organic foods have become more available and affordable for consumers in mainstream grocery stores. Forty four percent of total organic food sales are now handled by supermarkets and grocery stores. Growth in the organic industry has averaged about 20% in the United Sales over the last several years, and the retail sales of organic foods have increased from $3.6 billion in 1997 to $10.4 billion in 2003 (Oberholtzer et al., 2005).

The new U.S. Department of Agriculture (USDA) standards for organic foods, implemented in October 2002, have also facilitated further growth in the organic industry. Who consume organic food and why? Understanding consumers' choices between organic and conventional produce can provide valuable insights into how to promote the sales of organic food. In general, consumers buy organic products because they perceive them as having many positive attributes, such as grown without pesticides, more environmental benefits, better taste, and more nutritional value (Goldman and Clancy 1992; Huang 1991; Jolly and Norris 1991). Yet empirical analysis of demand of organic produce has been limited. Most previous studies of organic produce have measured attitudes regarding the purchase of organic produce rather than actual purchase choices or behavior (Byrne et al., 1991; Huang 1996). The recent addition of organic food sales to scanner data, by ACNielsen and Information Resources, Inc., has afforded the possibility of quantifying consumer demand for organic foods in response to changes in price, income and other socioeconomic characteristics of the consumers.

Previous studies have confirmed that organic food products command a price premium (Boland and Schroeder 2002; Estes and Smith 1996; Maguire et al., 2004; Oberholtzer et al., 2005; Thompson and Kidwell 1998), but there is no systematic study of variations in price premium across produce type, season, market area, and consumer characteristics, using national data. This study takes the advantages of the availability of actual food purchase data reported by a nationally representative panel of U.S. households from the ACNielsen's Homescan panel. More specifically, the objectives of the study are to analyze household purchase of fresh tomatoes and to determine the magnitudes of the price premium paid for the organic tomatoes by estimating a hedonic price model. It is expected that buyers of organic tomatoes may differ among market areas or regions in the United States. Thus, a separate hedonic price model is estimated for each region to examine to what extent the price premium may vary by consumers' socio-demographic characteristics within each region.

Theoretical Framework and Model Specification

Recognizing some of the shortcomings and limitations of the neoclassical demand model, Lancaster (1966) developed an alternative theory of consumer demand suggesting that it is the properties or characteristics of goods from which utility is derived. According to Lancaster, consumption is an activity in which goods and services, singly or in combination, are inputs and in which the output is a collection of characteristics. Lancaster's theory of the demand for characteristic plays a crucial role and lays the necessary conceptual framework in the development of modern hedonic demand analysis.

Expanding on the idea that consumers purchase goods because of the utilities derived from the characteristics or attributes that the goods possess, economists have applied the Lancastern theory to agricultural products and developed the hedonic approaches for exploring price-quality relationships to estimate the implicit values of product characteristics (Ladd and Martin 1976; Ladd and Suvannunt 1976; Rosen 1974; Wilson 1984). Hedonic modeling efforts rely on the fact that consumers and producers recognize these product attributes in approximately the same ways and that choices each group makes lead to an equilibrium condition that neither the consumers nor the suppliers have any incentive to change.

The underlying assumption in the development of a hedonic model is that products can be distinguished simply and uniquely by their characteristics. Thus, demands for various desired characteristics can be derived from consumer willingness to pay for a product. As a result, marginal or implicit values can be estimated for each attribute at the observed purchase price which is linked with the amount of characteristic contained in goods purchased. In essence, the hedonic approach is the disaggregation of commodities into characteristics and the estimation of implicit prices for units of the characteristics. Statistical measurement of the relationship between prices paid by consumers for a product and the quality mixes contained in that product can be used to interpret these marginal values in monetary terms.

As shown elsewhere in the literature (Ladd and Martin 1976; Ladd and Suvannunt 1976; Rosen 1974), the theoretical development supposes a bundle of m products where each of the first n product characteristics is provided by several products. In addition, each product provides a unique characteristic provided by no other product. Total consumption of each quality characteristic is then expressed as a function of the quantities of the quantities of products consumed and of consumption input-output coefficients:

(1) $Q_{sj} = f_j(q_1, q_2, \ldots, q_m, Q_{1j}, Q_{2j}, \ldots, Q_{mj})$, for $j = 1, 2, \ldots, n$,

and

$Q_{sn+1} = f_{n+i}(q_i, Q_{in+1})$, for $i = 1, 2, \ldots, m$.

Where Q_{sj} is the total amount of the j^{th} product characteristic provided by all products; Q_{ij} is the quantity of the j^{th} characteristic provided by one unit of product i; and q_i is the quantity of the i^{th} product consumed. The Q_{ij}s are parameters to buyers whose magnitudes are determined by the sellers or producers. The utility function is expressed as:

(2) $U = U(Q_{s1}, Q_{s2}, \ldots, Q_{sn}, Q_{sn+1}, \ldots, Q_{sn+m})$.

Maximizing the utility function subject to a budget constraint, $\sum p_i q_i = y$, yields the first order conditions:

(3) $$\sum_j (\partial U / \partial Q_{sj})(\partial Q_{sj} / \partial q_i) + (\partial U / \partial Q_{sn+1})(\partial Q_{sn+1} / \partial q_i) - (\partial U / \partial y) p_i = 0.$$

Solving for p_i in equation (3) produces the hedonic price function where one unit of each product supplies one unit of its unique characteristic:

(4) $$p_i = \sum_j (\partial Q_{sj} / \partial q_i)(\partial E / \partial Q_{sj}) + \partial E / \partial Q_{sn+1},$$

where $\partial Q_{sj} / \partial q_i$ is the marginal yield of the j^{th} product characteristic by the i^{th} product, E is the total expenditure on all products, and $\partial E / \partial Q_{sj}$ is the marginal rate of substitution between expenditure and the j^{th} product characteristic or the marginal implicit price paid for the j^{th} product characteristic.

Equation (4) shows that the price paid by the consumer for each product consumed equals the sum of the marginal monetary values of the product's characteristics, and the marginal monetary value of each characteristic equals the quantity of the characteristics obtained from the marginal unit of the product consumed multiplied by the marginal implicit price of characteristic

(Ladd and Suvannunt 1976). It describes a competitive equilibrium price reached by both sides of the market simultaneously in terms of the amount of product characteristics that the producers supplied and consumers demanded (Rosen 1974). In other words, the hedonic price equation is determined by the bids that consumers are willing to make for different bundles of characteristics and the offers of those bundles by suppliers (Palmquist 1984).

For empirical analysis, Rosen (1974) suggested that it is necessary to estimate the marginal bid and offer functions simultaneously to avoid simultaneous equations bias. However, many economists have contended that the supply of characteristics may be considered perfectly inelastic and used the single equation approach to estimate the hedonic price equation (Estes and Smith 1996; Maguire et al., 2004; Steiner 2004; Wilson 1984). In this case, the analysts obtain only equilibrium conditions that existed at a specific point in time rather than the preferred general demand or supply schedules (Palmquist 1984). The primary focus of this study was to determine the effects of organic feature and other market factors on fresh tomatoes prices at different market locations. Therefore, the use of ordinary least squares procedure to obtain the "first-stage" estimation of the hedonic price relationships is of most interest and appropriate to the study objectives.

The general empirical model for the price of fresh tomatoes, p_i, was specified as:

$$(5) \qquad p_{it} = \alpha_0 + \alpha_1 ORG_{it} + \alpha_2 PKG_{it} + \sum_{n=1}^{4} \beta_n BND_{nit} + \sum_{r=1}^{5} \gamma_r MKT_{rit} + \sum_{s=1}^{12} \delta_s SOC_{sit} + e_{it}.$$

Where p_{it} is the price of tomatoes paid by the i^{th} household in time t; ORG_{it} represents the organic attribute of the tomatoes purchased; PKG_{it} is the product form attribute of the tomatoes purchased; BND_{it} represents a number of major brands under which tomatoes are marketed; MKT_{it} represents a set of market factors and characteristics such as type of store outlets, sales, and seasonality; SOC_{it} is set of socio-demographic characteristics that characterize the household making the purchase; and e_{it} is the error term.

Data Source and Estimation

This study uses the 2003 ACNielsen Homescan panel data. The data set represents a nationally representative panel of U.S. households, which provide food purchase data for at-home consumption. A panel household scanned in either the Uniform Product Code (UPC) or a designated code (for random weight) for all of their purchases at all retail outlets. The data include detailed product characteristics, quantity, expenditures, and promotion information as well as detailed household income and demographic data. For 2003, there are more than 8,800 households reported their purchases of both UPC-coded and random-weight foods. For packaged or UPC-coded food products, organic produce can be identified from the 2003 data with codes for organic claim or the presence of the USDA organic seal. For random weight items, the designated codes and their descriptions were used to identify organic produce.

For the purpose of this study, household purchase records of fresh tomatoes from the ACNielsen Homescan panel data for the 11 scantrack major markets were aggregated into monthly data identified with various characteristics related to the purchased produce. The price information was computed as a weighted unit price paid by dividing total expenditure net of any promotional and sale discounts over the total quantity purchased. In cases where quantities were reported as count numbers, a conversion was performed to convert the count numbers into pounds. Detailed descriptions of relevant variables specified for empirical estimation of equation (5) are provided in Table 1. Assuming consumers' purchasing decision on fresh tomatoes may be different among geographic locations, the 11 scantrack major markets were grouped into 4 census regional markets and separate hedonic equations were estimated. Descriptive statistics for each regional market are presented in Table 2. As shown in Table 2, the average prices that consumers paid for fresh tomatoes varied from \$1.69/lb in the North Central markets to \$1.80/lb in the Northeast markets. About 6.1% of the fresh tomatoes purchased in the Western markets were organic while only 2.4% purchased in the North Central markets were of organic type. A vast majority of fresh tomatoes were purchased as random weight products. Based on the supplier information provided in the Homescan data, four binary variables were created to represent the major brands. The distribution pattern of fresh tomatoes purchased among the major brands appears quite different among the regional markets.

The hedonic price model of equation (5) represents essentially a reduced-form reflecting both supply and demand influences. There is little theoretical guidance with respect to the appropriate functional form that can be applied *a priori* in the regression analysis. Consequently, the choice of the functional form for the hedonic price equation, by and large, remains an empirical issue. Although the semi-log function (Estes and Smith 1996; Palmquist 1984; Steiner 2004) and the linear function (Boland and Schroeder 2002; Maguire et al., 2004; Palmquist 1984; Wilson 1984) are among the most popular choice of functional forms, this study employs the Box-Cox (1964) transformation technique to determine the functional form of the hedonic model to be estimated. The Box-Cox technique provides the advantage of estimating a generalized flexible functional form that best fits the data. Specifically, the Box-Cox transformation for a variable, *z*, is defined as:

$$z = \begin{matrix} z^{\lambda-1}/\lambda & \lambda \neq 0 \\ \ln z & \lambda = 0 \end{matrix},$$

where λ is the transformation parameter to be determined. In this study, the same transformation parameter, λ, is applied to all continuous variables in both sides of the hedonic equation. All the binary variables included in the model are not subjected to the transformation. For the Box-Cox model, the marginal implicit prices are calculated as $c(\bar{x}/\bar{p})^{\lambda-1}$, where c is the estimated coefficient, $\bar{x}$ and $\bar{p}$ are the mean values of the independent and dependent variables, respectively.

Empirical Results

Estimation results for equation (5) for each of the regional markets are presented in Table 3. The estimated coefficient of the Box-Cox transformation parameter, λ, is highly significant in each market and the likelihood-ratio tests strongly and consistently reject the three standard alternative functional forms, i.e., the linear, log and multiplicative inverse specifications, at less than the 0.0001 significance level.

The parameter estimates for the hedonic model by regional market are mostly highly significant and consist in signs across markets. For organic attribute, the results show that organic tomatoes command a premium above conventional tomatoes. However, the organic premium varies from $0.26 per pound in the Southeastern and Western regional markets to about $0.41 in the Northeastern market. Consumers in the Southeastern and Western regions paid about the same amount of premiums for organic tomatoes. In a 1994 survey of two retail outlets in Tucson, Arizona, Thompson and Kidwell (1998) reported that price premium for organic tomatoes averaged about 62 cents per pound, or 45%, above the conventional tomatoes. Estes and Smith (1996) also estimated that per unit prices for organically grown produce ranged between 30% and 90% higher than conventionally grown produce. Based on the 2003 data, the average premium paid for fresh organic tomatoes among the regional markets are 9% (Southeast), 21% (West), 25% (North Central) and 29% (Northeast) above conventional prices. Given the increasing availability and popularity of organic foods developed over the past decade, the smaller and lower price premium paid on organic produce is to be expected.

Tomatoes packaged in a container are usually in better quality than random-weight tomatoes, and hence are expected to be priced higher. Consumers in the Southeast and West are paying a higher price for fresh tomatoes sold in packages than those resided in the Northeast. The parameter estimate for packaged tomatoes was not significant for the North Central. The estimated marginal implicit prices for packaged fresh tomatoes were the highest in the Southeastern market followed by the Western market. Among the major brands of fresh tomatoes, the brand identified as "Brand-D" was sold consistently at a lower price than no brand or other brands across regional markets except in the Southeast. This result may reflect the fact that most consumers purchase Brand-D fresh tomatoes because they are cheaper than other brands.

With respect to market factors, the results indicated that consumers consistently paid a lower price for fresh tomatoes purchased at the discount stores such as supercenters and warehouse clubs than traditional supermarkets or specialty food stores. The estimated coefficients for store characteristic had the *a priori* signs and were significant at less than the 0.0001 significance level. The estimated store discounts were fairly consistent, varying from about 32 cents/lb in the Northeast to 64 cents/lb in the West. Similarly, when on sale, fresh tomatoes were discounted by 21 to 35 cents per pound.

Consumers in the West would receive a deeper discount on price than their counterparts, if they purchased fresh tomatoes from discount stores or on sale occasions. Except for the Northeast, the estimated marginal implicit prices on discount store were about twice as large as the marginal implicit prices on sale. This result suggests that consumers, regardless of location, value discount stores higher than sales occasions. Seasonal variations on prices paid for fresh tomatoes are evident across regional markets. The results indicated that prices paid for fresh tomatoes are lowest in the summer than in other seasons, except for the Western market in which the estimated coefficient was not statistically significant. This result is consistent with *a priori* expectation that fresh tomatoes prices would be lower in the summer when supply is plentiful.

The effect of household income on prices paid for fresh tomatoes were positive and highly significant among all regional markets. The results showed that the Southeastern market had the highest income effect. However, the estimated marginal implicit prices for the income variable are smaller than 1 cent/lb for each 10% increase in household income (measured as percent of the poverty level). Similarly, the effects of the age variable for household head less than 40 years old are positive and significant across all regional markets. The result suggests that younger households would pay a higher price for fresh tomatoes than households with household head aged 65 years and older. White households and households with a male or female head aged between 40 and 64 years old also had marginal implicit prices for fresh tomatoes higher than their counterparts, except for those resided in the North Central.

Households with unemployed female head, household head without a college degree, and black and Hispanic households were generally found to associate with lower marginal implicit prices than their counterparts. The estimated coefficients are mostly negative and statistically significant for each regional market. The effects of household size and marital status were less consistent across markets. For the North Central and West, the estimated coefficients on household size were positive and significant while it was negative and significant in the Southeastern market. The effects of marital status were found to be significant only in the Southeastern and Western markets. The estimated marginal implicit prices were about the same magnitudes but with opposite signs. The results suggest that married households in the West would be willing to pay a higher price for fresh tomatoes than single-headed household, while the opposite is true for the Southeast market.

Summary and Conclusions

The study estimated a hedonic price model based on the 2003 ACNielsen Homescan panel data to assess consumers' valuation of organic and other product attributes related to fresh tomatoes. Given the unique feature of household purchase information provided in the data set, the effects of household characteristics on tomatoes prices paid by panel members were estimated as well. For empirical implementation, parameters of the hedonic model were estimated using the Box-Cox transformation procedure. Based on the likelihood-ratio tests, the Box-Cox procedure strongly rejected the three commonly specified functional forms, i.e., linear, log-linear and inverse demand functions.

The hedonic methodology proved useful as a tool for analyzing price variation for fresh tomatoes and as a mechanism for examining consumer preferences of product attributes. Marginal implicit prices for selected product and market attributes that affected the retail price of fresh tomatoes were estimated as well as household economic and demographic characteristics. The results indicated that consumers value the organic and packaging attributes positively and consistently among the major markets. For example, the study suggests that the organic feature contributes $0.41/lb to the price of fresh tomatoes that consumers paid in the Northeast market. For other markets, the organic premiums were estimated to be $0.38/lb in the North Central and $0.26/lb in the Southeast and West.

Overall, the signs and magnitudes of the marginal implicit prices obtained in this study appear to be reasonable and plausible. The effects of household characteristics on prices paid for fresh tomatoes are in general consistent with previous studies. The study suggests that higher household income, household head with younger age and higher education, and white household all contribute positively and significantly to the prices paid for fresh tomatoes.

References

Boland M. and T. Schroeder. “Marginal Value of Quality Attributes for Natural and Organic Beef.” *J. Agr. & Appl. Econ.* 34(2002):39-49.

Box, G.E.P. and D.R. Cox. “Analysis of Transformations.” *J. Royal Stat. Soc., Series B* 26(1964):211-243.

Byrne, P.J., U.C. Toensmeyer, Cl.L. German, and H.R. Muller. “Analysis of Consumer Attitudes toward Organic Produce and Purchase Likelihood.” *J. Food Distr. Res.* 22(1991):49-62.

Estes, E.A. and V.K. Smith. “Price, Quality, and Pesticide Related Health Risk Considerations in Fruit and Vegetable Purchase: An Hedonic Analysis of Tucson, Arizona Supermarkets.” *J. Food Distr. Res.* 27(1996):59-76.

Goldman, B.J. and K.L. Clancy. “A Survey of Organic Produce Purchases and Related Attitudes of Food Cooperative Shoppers.” *Amer. J. Alternative Agr.* 6(1992):89-96.

Huang, C. L. “Organic Foods Attract Consumers for the Wrong Reasons.” *CHOICES*, Third Quarter (1991):18-21.

Huang, C. L. “Consumer Preferences and Attitudes Toward Organically Grown Produce.” *Eur. Rev. Agr. Econ.* 23(1996):331-342.

Jolly, D. and K. Norris. “Marketing Prospects for Organic and Pesticide-Free Produce.” *Amer. J. Alternative Agr.* 6(1991):174-179.

Ladd, G.W. and M.B. Martin. “Prices and Demands for Input Characteristics.” *Amer. J. Agr. Econ.* 58(1976):21-30.

Ladd, G.W. and V. Suvannunt. “A Model of Consumer Goods Characteristics.” *Amer. J. Agr. Econ.* 58(1976):504-510.

Lancaster, K. “A New Approach to Consumer Demand Theory.” *J. Polit. Econ.* 74(1966:132-157.

Maguire, K.B., N. Owens, and N.B. Simon. “The Price Premium for Organic Babyfood: A Hedonic Analysis” *J. Agr. and Resour. Econ.* 29(2004):132-149.

Oberholtzer, L., C. Dimitri, and C. Greene, C. *Price Premiums Hold on as U.S. Organic Produce Market Expands*. VGS-308-01. U.S. Department of Agriculture, Economic Research Service, May 2005.

Palmquist, R.B. “Estimating the Demand for the Characteristics of Housing.” *Rev. Econ. and Stat.* 56(1984):394-404.

Rosen, S. “Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition.” *J. Polit. Econ.* 82(1974):34-55.

Steiner, B.E. “Australian Wines in the British Wine Market: A Hedonic Price Analysis.” *Agribusiness* 20(2004):287-307.

Thompson, G. D. and J. Kidwell. “Explaining the Choice of Organic Produce: Cosmetic Defects, Prices, and Consumer Preferences.” *Amer. J. Agr.l Econ.* 80(1998):277-287.

Wilson, W.W. “Hedonic Prices in the Malting Barley Market.” *West. J. Agr. Econ.* 9(1984):29-40.

Table1. Definition of Variables Used in the Hedonic Model

Variable	Definition	Mean
Dependent Variable		
P	Unit price of fresh tomatoes purchased, dollar per pound	1.767
Product Attributes		
Organic	= 1 if an organic produce, = 0 otherwise	0.043
Packaged	= 1 if the produce purchased is contained in a package with UPC code, = 0 otherwise	0.282
Brand-A	= 1 if the produce is sold under brand name A, = 0 otherwise	0.118
Brand-B	= 1 if the produce is sold under brand name B, = 0 otherwise	0.040
Brand-C	= 1 if the produce is sold under brand name C, = 0 otherwise	0.135
Brand-D	= 1 if the produce is sold under brand name D, = 0 otherwise	0.555
Market Factors		
Discount store	= 1 if the produce is purchased from supercenters or club warehouses, = 0 otherwise	0.071
Sale	= 1 if the produce is on sale, = 0 otherwise	0.253
Spring	= 1 if the produce is purchased in spring quarter, = 0 otherwise	0.253
Summer	= 1 if the produce is purchased in summer quarter, = 0 otherwise	0.296
Fall	= 1 if the produce is purchased in fall quarter, = 0 otherwise	0.248
Household Characteristics		
Income	Percent of household income over the federal poverty level; where household income is the midpoint of the income class	435.0
Household size	Number of persons in the household	2.558
Married	= 1 if the marital status is married, = 0 otherwise	0.647
Female head unemployed	= 1 if the female head of the household is not employed for pay, = 0 otherwise	0.374
Age < 40	= 1 if the age of the older male or female head is less than 40 years, = 0 otherwise	0.129
Age 40-64	= 1 if the age of the older male or female head is between 40 and 64 years, = 0 otherwise	0.611
Grade school	= 1 if the highest education level of the male or female head is grade school or some high school, = 0 otherwise	0.017
High school	= 1 if the highest education level of the male or female head is high school, = 0 otherwise	0.141
Some college	= 1 if the highest education level of the male or female head is some college, = 0 otherwise	0.317
White	= 1 if the ethnicity of the household is white, = 0 otherwise	0.719
Black	= 1 if the ethnicity of the household is black, = 0 otherwise	0.118
Hispanic	= 1 if the ethnicity of the household is Hispanic, = 0 otherwise	0.112
	Total number of observations	38,174

Table 2. Summary Statistics by Regional Market, 2003

	Northeast[a]		North Central[b]		Southeast[c]		West[d]	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Dependent Variable								
P ($/lb)	1.804	0.809	1.694	0.982	1.775	0.876	1.748	0.921
Product Attributes								
Organic	0.038	0.190	0.024	0.152	0.041	0.198	0.061	0.240
Packaged	0.375	0.484	0.311	0.463	0.272	0.445	0.190	0.393
Brand-A	0.138	0.345	0.102	0.303	0.144	0.351	0.057	0.233
Brand-B	0.038	0.191	0.085	0.279	0.036	0.187	0.025	0.157
Brand-C	0.109	0.312	0.105	0.307	0.148	0.355	0.152	0.359
Brand-D	0.499	0.500	0.571	0.495	0.553	0.497	0.608	0.488
Market Factors								
Discount store	0.032	0.176	0.035	0.184	0.119	0.324	0.041	0.199
Sale	0.256	0.437	0.360	0.480	0.205	0.403	0.284	0.451
Spring	0.248	0.432	0.269	0.444	0.249	0.432	0.256	0.437
Summer	0.305	0.460	0.302	0.459	0.293	0.455	0.289	0.453
Fall	0.247	0.431	0.238	0.426	0.249	0.432	0.252	0.434
Household Characteristics								
Income	435.9	221.7	427.9	228.8	431.0	214.0	445.0	222.3
Household size	2.591	1.421	2.503	1.458	2.579	1.364	2.514	1.357
Married	0.640	0.480	0.586	0.493	0.681	0.466	0.622	0.485
Female head unemployed	0.370	0.483	0.345	0.475	0.384	0.486	0.373	0.484
Age < 40	0.142	0.349	0.110	0.313	0.118	0.322	0.144	0.351
Age 40-64	0.596	0.491	0.602	0.490	0.650	0.477	0.562	0.496
Grade school	0.016	0.127	0.013	0.113	0.018	0.132	0.018	0.133
High school	0.174	0.379	0.205	0.404	0.140	0.347	0.075	0.264
Some college	0.291	0.454	0.360	0.480	0.300	0.458	0.354	0.478
White	0.791	0.407	0.763	0.426	0.721	0.449	0.619	0.486
Black	0.096	0.294	0.118	0.323	0.135	0.341	0.110	0.312
Hispanic	0.077	0.267	0.096	0.294	0.112	0.315	0.157	0.364
No. of observations	9,102		4,403		15,944		8,725	

[a] The Northeast market includes scantrack major markets identified as Suburban NY, Urban NY, Exurban NY and Philadelphia.

[b] Includes scantrack major markets identified as Chicago.

[c] Includes scantrack major markets identified as Atlanta, Baltimore, Washington, DC and San Antonio.

[d] Includes scantrack major markets identified as Los Angeles and San Francisco.

Table 3. Estimation Results of the Hedonic Model by Regional Market, 2003

	Northeast		North Central		Southeast		West	
Variable	Coef.[a]	MIP[b]	Coef.	MIP	Coef.	MIP	Coef.	MIP
Constant	0.407		0.437		-0.141		0.364	
Product Attributes								
Organic	**0.272**	0.411	**0.251**	0.386	**0.154**	0.258	**0.180**	0.256
Packaged	**0.067**	0.101	0.044		**0.537**	0.900	**0.546**	0.778
Brand-A	**0.175**	0.265	**-0.132**	-0.202	0.001		**-0.507**	-0.723
Brand-B	**0.178**	0.269	**0.267**	0.410	**-0.189**	-0.316	**-0.246**	-0.350
Brand-C	**-0.200**	-0.302	**-0.230**	-0.354	-0.010		**-0.202**	-0.288
Brand-D	**-0.347**	-0.524	**-0.509**	-0.781	**-0.111**	-0.186	**-0.355**	-0.506
Market Factors								
Discount store	**-0.210**	-0.317	**-0.332**	-0.510	**-0.283**	-0.474	**-0.451**	-0.642
Sale	**-0.188**	-0.284	**-0.165**	-0.254	**-0.127**	-0.213	**-0.244**	-0.348
Spring	**0.046**	0.069	**-0.089**	-0.137	**0.035**	0.059	**0.052**	0.074
Summer	**-0.038**	-0.058	**-0.123**	-0.189	**-0.043**	-0.072	0.000	
Fall	**0.030**	0.045	**-0.043**	-0.066	-0.008		-0.012	
Household Characteristics								
Income	**0.017**	0.000	**0.049**	0.000	**0.061**	0.000	**0.012**	0.000
Household size	0.012		**-0.039**	-0.028	**0.023**	0.016	**-0.025**	-0.020
Married	-0.009		0.013		**-0.026**	-0.044	**0.027**	0.039
Female head unemployed	**-0.040**	-0.060	0.025		**-0.017**	-0.029	**-0.030**	-0.042
Age < 40	**0.059**	0.089	**0.066**	0.101	**0.094**	0.157	**0.137**	0.196
Age 40-64	**0.032**	0.048	0.024		**0.068**	0.114	**0.076**	0.108
Grade school	0.015		**-0.221**	-0.340	-0.029		**-0.090**	-0.128
High school	**-0.040**	-0.061	**-0.047**	-0.072	0.014		**-0.048**	-0.068
Some college	-0.008		**-0.041**	-0.063	**-0.023**	-0.039	**-0.068**	-0.097
White	**0.068**	0.103	-0.085		**0.100**	0.167	**0.172**	0.244
Black	**-0.109**	-0.164	**-0.241**	-0.371	0.020		0.030	
Hispanic	**-0.102**	-0.155	**-0.213**	-0.327	**-0.068**	-0.114	-0.031	
Box-Cox transformation, λ	**0.2997**		**0.1867**		**0.1020**		**0.3664**	
Log likelihood function	-8,906.189		-4,909.434		-14,275.431		-9,356.788	
Likelihood ratio $\chi^2_{(23)}$	2,862.69		1,350.39		7,736.87		2,875.63	

[a] Bold-faced numbers indicate the estimated coefficients are significantly different from zero at least at the 10% significance level.

[b] The marginal implicit price (MIP) is computed only for the estimated coefficients that are statistically significant at least at less than the 10% significance level. The significance level of MIP, however, is not derived here.

Outline of Poster Layout

A Hedonic Analysis on the Implicit Values of Fresh Tomatoes

- Abstract
- Introduction

  . . . Describe the research problems and the objectives of the study

- Background Information

  . . . Market share and consumption trend related to fresh tomatoes
  . . . Comparisons between organically grown and conventionally grown tomatoes

- Data

  . . . Description of the ACNielsen Homescan panel data in general
  . . . Charts and graphs will be used extensively to show the unique characteristics of each regional market in details

- Model Specification

  . . . Specify the formulation of the hedonic price model
  . . . Discuss the Box-Cox procedure used in the study for the estimation of hedonic model

- Results and Discussion

  . . . Present the major empirical results in table format
  . . . Highlight regional comparisons with the estimation results on the marginal implicit prices attributed to product characteristics and market factors
  . . . Highlight the effects of household characteristics on prices paid for fresh tomatoes using bullet text format

- Conclusions and Implications

  . . . Highlight major conclusions and implications drawn from the study using bullet text format