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An Analysis of Factors Associated with Consumers' Use of Grocery Coupons

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A conceptual model of grocery coupon usage is developed and maximum likelihood estimates of a Tobit model are used to assess the influence of several economic and demographic variables on consumers' use of grocery coupons. Specific factors considered include income, age, household size, race, education, shopping practices, and size and composition of grocery transactions. The analysis includes a combination of scanner and survey data collected from 1,047 consumers. Results confirm strong effects for household size, race, shopping practices, and size and composition of grocery transactions.

Key words: consumer characteristics, grocery coupons, Tobit model.

Grocery coupons are an important marketing tool used by food firms to promote their products. In 1984 expenditures on coupon-related promotional activities for foods were over $1.2 billion, accounting for over 14% of total food promotion expenditures. By 1987 coupon-related promotional expenditures had risen to over $1.9 billion, representing over 17% of total food promotion expenditures [U.S. Department of Agriculture (USDA)]. In 1990 over 277.1 billion coupons were issued and 7.2 billion coupons were redeemed, representing a $3.89 billion credit to total food expenditures by consumers (Hume). Grocery coupons come in various forms, including discounts off the purchase price, two-for-one offers, and mail-in rebates. Coupons are distributed through various channels including newspapers, magazines, direct mailings, and product packaging. In 1989, 86.1% of coupons were distributed through newspapers, 4.3% through direct mailings, 3.9% through package attachments, 3.3% through magazines, and 2.4% through other distribution means (Newspaper Advertising Bureau).

Coupons perform a variety of promotional functions for the food supplier. Coupons may be used to exercise price discrimination (Narasimhan), to introduce new products (Blattberg, Eppen, and Lieberman), to promote brand switching (Haugh), and to maintain brand loyalty (Dodson, Tybout, and Sternhal). The selective offering of coupons in various geographic or demographic sectors may also allow grocery suppliers to gather specialized market data (Narasimhan). In particular, insights into advertising effectiveness often are generated through carefully monitored coupon promotions.

In spite of the large amount of resources devoted to sales promotion through the use of coupons, relatively little research has addressed the factors which are related to consumers' use of grocery coupons. Although it is estimated that over 75% of U.S. households use coupons to some degree (Aycrigg), grocery coupon usage patterns may vary systematically across individual households and may differ substantially according to the nature of individual transactions. A 1981 Nielsen study evaluated consumer characteristics associated with coupon use and determined that the most common user is a consumer between the ages of 31 and 60, from a household of three to six members, with an annual household income of more than $25,000, and a weekly grocery bill in excess of $71. However, this study failed to reveal large differences in coupon use across household sizes, incomes, ages, and grocery expenditures.

The objective of this article is to investigate the economic and demographic factors which influence a consumer's use of grocery coupons. Specific objectives are to isolate and quantify the effects of such factors on a consumer's willingness to use grocery coupons and to identify target groups inclined to use grocery coupons. Data collected from a survey of 1,047 consumers are used in conjunction with scanner data associated with individual consumers' purchases.

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A Model of Grocery Coupon Usage

Coupon redemption is a price-reducing activity that consumers undertake at a cost which results from the time and organization required by the redemption activities. In addition to the price-reducing benefit, consumers may realize nonpecuniary returns from the savings generated by redemption activities. For example, satisfaction may be realized from the perception of obtaining a "bargain" through coupon usage. In this light, consumers act to maximize utility by trading off the perceived benefits and savings with the costs associated with coupon redemption. Given the importance of the opportunity cost of time to the coupon redemption decision, the theory of consumer behavior that incorporates this consideration (Becker; Becker and Michael; Pollak and Wachter) offers an appropriate framework for a conceptual model of grocery coupon usage.

Because the available data represent coupon usage for individual shopping trips, a few simplifying assumptions are necessary to consistently incorporate the value of time into the conceptual model of coupon redemption. The model is constructed to represent optimizing behavior, including the optimal allocation of household time, over a single period of time. The relevant time period is assumed to be a week and each household is assumed to make one shopping trip per week.[1] It is also assumed that, although coupons may come in different forms, they are all analogous price-reducing instruments. For a household of n individuals, the optimal level of coupon usage is determined within the following constrained utility maximization framework:

$$\max U\{X, L, (S'K), g\} \tag{1}$$

$$\text{s.t. } I = \sum_{j=1}^{n} w_j T_j + A + W \geq P'X - S'K + \sum_{j=1}^{n} w_j L_j + \sum_{j=1}^{n} w_j \left(\sum_{i=1}^{m} t_{ij} X_{ij} + \sum_{i=1}^{m} \tau K_{ij} \right)$$

$$T = \sum_{j=1}^{n} \left(\sum_{i=1}^{m} t_{ij} X_{ij} + \sum_{i=1}^{m} \tau K_{ij} + L_j + H_j \right),$$

$$K \leq K^*,$$

$$K^* \leq X,$$

$$X, K, K^* \geq 0,$$

where X is the vector of consumption goods; K is the subset of consumption goods purchased using coupons ($K \subset X$); K^* is the subset of consumption goods for which coupons are available ($K^* \subset X$); I represents full household income; W is the service flow from wealth, including unspent income from previous periods; L_j is the quantity of leisure consumed by household member j; H_j denotes the quantity of market labor supplied by household member j; P is a vector of per-unit prices for X; S is the vector of per-unit savings from the goods purchased using coupons; t_{ij} is time input into the consumption of X_i by household member j; τ is the per-unit time input for using coupons; A is household nonwage income; w_j is household member j's market wage rate; T is total household time available; and g denotes consumer characteristics affecting the utility function. Consumers choose an optimal level of coupon usage, represented by their choice of K, subject to time and full-income constraints. Note that the total savings generated by coupon usage, $S'K$, appears as a direct argument in the utility function. This allows for nonpecuniary returns in the form of direct satisfaction from coupon savings. The first constraint represents the household's distribution of income and the second constraint represents the distribution of the household's time. The per-unit time cost associated with coupon redemption for a single commodity is given by τ and is assumed to be identical for all commodities and all household members. The third constraint recognizes the fact that coupons may not be available for all consumption goods. The final constraint recognizes that consumption quantities and coupon redemption levels must be nonnegative.[2]

A consumer's shopping practices may influence his or her costs of using coupons. For example, use of a shopping list could provide organizational advantages that reduce the per-unit time costs associated with coupon redemption. In addition, if significant fixed time costs are associated with redemption activities, per-unit redemption costs may be lower for larger transactions. To incorporate these effects, the per-unit time cost of using coupons is allowed to vary for alternative shopping practices (SP) and for alternative sized transactions:

$$\tau = f(SP, P'X). \tag{2}$$

Utility maximization, subject to the constraints, yields a function representing the optimal use of grocery coupons:

$$S'K = f(P, X, K^*, W, w, H, A, t, SP, P'X, g). \tag{3}$$

In equation (3), the optimal level of coupon usage is determined by prices, the availability of coupons for the consumption bundle, the opportunity costs of time (represented by the implicit wage rate), wealth, labor and nonlabor income, shopping practices, the size and composition of the transaction, and other consumer characteristics which influence the household's utility function. In the empirical analysis which follows, specific data for wealth, implicit wages, hours worked, time inputs, and nonlabor income were not available. In lieu of such data, total household income, household size, employment status of the husband and wife, and education are used as proxy measures of wealth, income, and the opportunity costs of a household's time. In addition, explicit information about the availability of coupons for products contained in the consumption bundle was not available. To represent K^*, variables reflecting the composition of the transaction (expenditures on nonbranded meats and fresh fruits and vegetables) are included. Finally, because the data were collected over a short period of time, prices are assumed to be constant. In light of these constraints, the following empirical representation of equation (3) is adopted:[3]

(4) $S'K = f($Income, Household Size, Shopping Practices, Size of Transaction, Education, Employment Status, Age, Composition of Transaction, Other Demographic Variables$)$.

Income may influence the use of coupons through wealth effects and through the opportunity cost of a consumer's time spent in coupon-redemption activities. A series of categorical income variables are included in the empirical model of grocery coupon usage. Narasimhan found that coupon usage rose with income to a point, and then declined as income rose further. However, these effects were not revealed to be statistically significant. A 1981 Nielsen study revealed that coupon usage was quite similar across alternative income classes, though usage tended to rise slightly as income rose. Teel, Williams, and Bearden, Lee and Brown, and Levedahl found that consumers who use coupons tended to have significantly higher household incomes than nonusers. Finally, Cotton and Babb found that consumer responses to coupon promotions did not differ significantly across alternative household incomes.

A possible explanation for the uncertain nature of the income effect is that consumers may realize a psychological satisfaction from participating in coupon-redemption activities. McCann, and Cotton and Babb have concluded that coupons provoke a much greater sales response than an equivalent price reduction. Schindler explained this effect by identifying three nonpecuniary, psychological mechanisms which may motivate consumers to use coupons.[4] In particular, Schindler noted that the perception of achieving a "bargain" may provide direct satisfaction from coupon usage. In this light, coupon usage may be a direct utility-producing activity that is undertaken at a cost which arises from the opportunity cost of the time used in the collection and redemption process. In this way, higher income may be associated with greater use of grocery coupons.

In addition to the direct income effects, a household's opportunity cost of time may be influenced by household size, by whether the household contains a married couple, and if so, by whether the household's husband and/or wife are employed. Teel, Williams, and Bearden found that coupon users are likely to come from significantly larger households. Cotton and Babb found a much greater response to coupon promotions from households in which the wife is employed.

In this study, a series of categorical dummy variables are included to represent household size effects on coupon usage. Smaller households are expected to be less likely to use coupons. A discrete variable equal to one if the consumer is married is also included in the model. Likewise, discrete variables equal to one if a married household's wife works outside of the home and if the husband is unemployed are included in the model.

Coupon usage is an activity that requires substantial planning and organization on the part of a consumer. Coupon promotion schemes are numerous and complex and purchases must coincide with the availability of coupons for particular goods. As is noted above, the costs of coupon usage may be influenced by shopping practices. A common and fundamental form of consumer organization involves the use of a grocery list. An indicator variable equal to one if the consumer used a grocery list in the observed transaction is included in the model of grocery coupon usage. This variable is expected to exhibit a positive effect on coupon usage.

Consumer preferences for coupon usage also may be influenced by demographic characteristics such as age, education, and race. Teel, Williams, and Bearden concluded that coupon users were an average 3.9 years younger than nonusers. Ward and Davis found that coupon usage was most likely to be observed for middle-aged consumers. A series of age category variables are included in the model to account for differences in coupon usage which are related to age. Levedahl found that coupon redeemers tended to be better educated than nonredeemers. An indicator variable representing education beyond high school is included in the model to account for differences in coupon usage which are related to educational levels. Lee and Brown found that coupon redemption for frozen concentrated orange juice was more likely to occur for white households than nonwhite households. A variable equal to one if the consumer is from a minority (nonwhite) population and zero otherwise is also included in the model.

The size and composition of a particular grocery transaction may have an important influence on the use of grocery coupons. As is noted above, the use of grocery coupons may require a significant investment of time and considerable organization. Thus, larger purchases may be more likely to involve grocery coupon usage than small purchases. The total dollar amount of the grocery transaction is included as a variable in the model of coupon usage and is expected to have a positive effect on coupon use. However, because large grocery transactions may be associated with greater shopping time costs, an alternative negative effect is also possible. The coupon-redemption choice is also constrained by the availability of coupons for the consumption bundle. Promotion generally is undertaken only for branded products. In this light, coupon usage is less likely to be observed for transactions that include a large proportion of unbranded, generic products. Meat products and fresh fruits and vegetables represent high-value product classes which usually comprise a large proportion of any given grocery transaction and typically are not marketed under a brand name. Thus, larger purchases of meats and fresh fruits and vegetables are expected to have a negative effect on coupon usage. The total values of meat and fresh fruit and vegetable purchases are included to represent the composition of the transaction.

Econometric Procedures

The empirical analysis evaluates both the discrete decision of whether to use grocery coupons and, for those consumers who do use coupons, the level of coupon usage. Specifically, the analysis models the effects of explanatory factors on the level of coupon usage for a sample of individual grocery transactions. Given the censored nature of the distribution of coupon usage, the Tobit model (Tobin) is used.

Variables used in the statistical model of equation (4) are defined in table 1. Because several of the explanatory variables are of a qualitative nature, default categories were chosen to define a reference individual and the variables representing these categories were deleted from the statistical model in order to avoid singularity problems. The base individual is single, white, between 35 and 44 years of age, did not attend college, from a household which had an annual income between \$10,000 and \$19,999 in 1983 and contained three or four individuals, and who did not use a grocery list.

McDonald and Moffitt showed that the Tobit model can be used to determine both changes in the probability of being above the limit (i.e., the discrete decision of whether to use coupons) and changes in the values of the dependent variable for the entire sample and for those observations which are above the limit. As they showed, the effect of a change in the kth explanatory variable (X_k) on the expected value of the dependent variable is given by:

$$\partial E(y)/\partial X_k = F(z)(\partial E(y^*)/\partial X_k) + E(y^*)(\partial F(z)/\partial X_k), \tag{5}$$

where $z = X\beta/\sigma$, $E(y^*)$ is the expected value of y conditional on y being above the limit, and $F(z)$ is the cumulative normal distribution function. The change in the probability of being above the limit is given by:

$$\partial F(z)/\partial X_k = f(z)\beta_k/\sigma, \tag{6}$$

where $f(z)$ is the unit normal density. The change to the expected value of y conditional on y being above the limit is given by:

$$\partial E(y^*)/\partial X_k = [1 - zf(z)/F(z) - f(z)^2/F(z)^2]\beta_k. \tag{7}$$

These derivatives can be used to construct elasticity estimates using some specified level for the independent variables, such as the sample means. Because several of the explanatory variables utilized in this analysis are of a discrete, categorical nature, continuous derivatives do not exist and $F(z)$, $E(y)$, and $E(y^*)$ must be evaluated at alternative discrete values of the categorical independent variables, holding other variables at their mean values.

Estimates of the standard errors associated with the Tobit decompositions are obtained using the Wald result (Gallant and Holly, p. 712). If $h(\beta)$ is a function of the estimated parameter set β, a first-order approximation of the covariance matrix for $h(\beta)$ is given by:

$$V(h(\beta)) = (\partial h/\partial \beta)' V(\beta)(\partial h/\partial \beta), \tag{8}$$

where $V(\beta)$ is the covariance matrix associated with the parameter estimates β. Because the decompositions involve complex derivatives of probability distribution functions, the derivatives are estimated using numerical differentiation.[5]

Data Description

The data used in this analysis consist of survey and scanner data for 1,047 individual transactions at a retail grocery store in Kansas. Scanner data which recorded individual item purchases and coupon usage

Table 1. Variable Definitions

Variable	Description
COUPON	1 if the consumer used grocery coupons, 0 otherwise
COUPONAMT	Total dollar amount of grocery coupons used
*INCOME*1	1 if household income is less than $10,000, 0 otherwise
*INCOME*2	1 if household income is between $10,000 and $19,999, 0 otherwise
*INCOME*3	1 if household income is between $20,000 and $39,999, 0 otherwise
*INCOME*4	1 if household income is $40,000 or more, 0 otherwise
COLLEGE	1 if the consumer had attended college or vocational school, 0 otherwise
LIST	1 if the consumer used a shopping list, 0 otherwise
*AGE*1	1 if the consumer is less than 24 years of age, 0 otherwise
*AGE*2	1 if the consumer is between 25 and 34 years of age, 0 otherwise
*AGE*3	1 if the consumer is between 35 and 44 years of age, 0 otherwise
*AGE*4	1 if the consumer is between 45 and 54 years of age, 0 otherwise
*AGE*5	1 if the consumer is between 55 and 64 years of age, 0 otherwise
*AGE*6	1 if the consumer is over 64 years of age, 0 otherwise
*NUMBER*1	1 if the household contains one individual, 0 otherwise
*NUMBER*2	1 if the household contains two individuals, 0 otherwise
*NUMBER*3	1 if the household contains three or four individuals, 0 otherwise
*NUMBER*4	1 if the household contains five or more individuals, 0 otherwise
MARRIED	1 if the consumer is married, 0 otherwise
WIFEEMP	1 if the wife is employed full or part time outside of the household, 0 otherwise
HNEMP	1 if the husband is not employed, 0 otherwise
NONWHITE	1 if the consumer is from a minority (nonwhite) population, 0 otherwise
TOTALSALE	Dollar amount of total grocery bill
TOTALMEAT	Dollar amount of total meat purchases
TOTALFFV	Dollar amount of total fresh fruit, vegetable, and potato purchases

for each transaction were matched with economic and demographic data elicited from each consumer through the administration of a survey.[6] The survey produced 909 usable observations. Responses not included in the survey were omitted due to consumers' unwillingness to respond to certain demographic questions. The data were collected between 12 June and 18 June 1983. Summary statistics of the variables used in this analysis are presented in table 2. Over 25% of the consumers' transactions involved the use of grocery coupons. Of those consumers using coupons, the average coupon credit was $1.32.

Empirical Application and Results

Estimation of the Tobit model of grocery coupon usage was accomplished using maximum likelihood techniques. Parameter estimates and relevant statistics are presented in table 3. Several of the parameter estimates are highly significant. The likelihood ratio test statistic has a value of 107.67, which exceeds the chi-square critical value with 20 degrees of freedom at the $\alpha = .001$ level of significance. This rejects the null hypothesis that all slope and intercept shifting variables are zero. McFadden's R^2 has a value of .0651.

Table 2. Summary Statistics of Variables Relevant to Grocery Coupon Usage

	Total Sample		Noncoupon Users		Coupon Users	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
COUPON	.2552	.4362	—	—	—	—
COUPONAMT	.3380	.9242	—	—	1.3242	1.4303
*INCOME*1	.2310	.4217	.2541	.4357	.1638	.3709
*INCOME*2	.2728	.4457	.2895	.4539	.2241	.4179
*INCOME*3	.3982	.4898	.3604	.4805	.5086	.5010
*INCOME*4	.0979	.2974	.0960	.2948	.1034	.3052
COLLEGE	.5512	.4977	.5421	.4986	.5776	.4950
LIST	.5402	.4987	.4948	.5003	.6724	.4703
*AGE*1	.1694	.3753	.1891	.3919	.1121	.3161
*AGE*2	.3058	.4610	.3043	.4604	.3103	.4636
*AGE*3	.2299	.4210	.2127	.4095	.2802	.4501
*AGE*4	.1441	.3514	.1448	.3521	.1422	.3501
*AGE*5	.0979	.2974	.0960	.2948	.1034	.3052
*AGE*6	.0528	.2238	.0532	.2245	.0517	.2219
*NUMBER*1	.0660	.2484	.0857	.2801	.0086	.0926
*NUMBER*2	.2871	.4527	.2969	.4572	.2586	.4388
*NUMBER*3	.4466	.4974	.4195	.4938	.5259	.5004
*NUMBER*4	.2002	.4004	.1979	.3987	.2069	.4060
MARRIED	.8284	.3773	.7947	.4042	.9267	.2612
WIFEEMP	.4275	.4947	.3944	.4891	.5172	.5008
HNEMP	.3025	.4596	.3279	.4698	.2284	.4207
NONWHITE	.0616	.2406	.0753	.2641	.0216	.1455
TOTALSALE	51.0249	34.3233	48.3290	33.4480	58.8920	35.6836
TOTALMEAT	6.9753	8.9398	6.9558	9.1569	7.0322	8.2924
TOTALFFV	2.3892	2.6979	2.3847	2.7300	2.4024	2.6077

The parameter estimates in table 3 correspond to a probability of coupon use for the base individual[7] of .1092 and to a probability of coupon use at the mean data values of .2210. Though the values of the regression parameters do not directly correspond to probability changes or changes in the expected level of usage, their signs do indicate the direction of such effects. Implied probability changes [calculated from equation (6)], change derivatives [calculated from equations (5) and (7)], and elasticities[8] (represented by ϵ) for each variable are presented in table 4.

Significant differences in coupon usage patterns across alternative consumer and transaction types are indicated in the results presented in tables 3 and 4. Coupon usage appears to be the greatest for consumers with household incomes between \$20,000 and \$39,999. Consumers in this income category have a probability of coupon use of .2102, which is .0589 higher than the probability of use for the excluded category comprised of consumers with incomes between \$10,000 and \$19,999. This difference is statistically significant at the $\alpha = .10$ level. The lowest and highest income categories do not appear to differ significantly from the excluded category. A likelihood ratio test that coupon redemption patterns do not vary with income was considered by testing that all income variables were jointly zero. This test statistic had a value of 3.2838, which does not exceed the chi-square critical value at the $\alpha = .05$ level with three degrees of freedom. Thus, although consumers in the third income category are significantly more likely to use coupons than those in the second category, a joint test that all income effects are zero is not rejected. These results confirm the findings of earlier research (Nielsen 1988; Narasimhan) which concluded that grocery coupon usage was most likely to be observed for middle-income households but that income effects are difficult to distinguish statistically.

As was anticipated, transactions in which the consumer used a shopping list were far more likely to involve the use of grocery coupons. Holding all other variables at their mean values, the probability of coupon use for consumers using a shopping list is .2607, which is .0819 higher than the probability of use for transactions not involving a shopping list. Use of a list raises the expected amount of coupon use by 13¢ for all consumers and by 14¢ for those consumers using coupons. This confirms the importance of consumer planning and organization in coupon redemption activities.

The variable representing a single-person household is highly significant and exhibits a strong negative effect on coupon usage. This variable corresponds to a probability change of −.1876, from .2608 to .0733, when going from a household of three or four members to a single-person household. Households consisting of a single person have an expected coupon use that is 28¢ lower for the entire sample and 35¢ lower for

Table 3. Maximum Likelihood Estimates for Tobit Model of Grocery Coupon Usage

Variable	Parameter Estimate	Asymptotic Standard Error	Asymptotic t-ratio[a]
Intercept	−3.2411	.6047	5.36***
*INCOME*1	0.1321	.3205	0.41
*INCOME*3	0.4359	.2633	1.66*
*INCOME*4	0.0938	.4023	0.23
COLLEGE	0.1164	.2128	0.55
LIST	0.6124	.2119	2.89***
*AGE*1	−0.4517	.3916	1.15
*AGE*2	−0.3032	.2691	1.13
*AGE*4	−0.5664	.3320	1.71*
*AGE*5	−0.4611	.4059	1.14
*AGE*6	−0.2973	.5431	0.55
*NUMBER*1	−1.7880	.8011	2.23**
*NUMBER*2	−0.2960	.2588	1.14
*NUMBER*4	−0.3975	.2671	1.49
MARRIED	1.0603	.4506	2.35**
WIFEEMP	0.1779	.2177	0.82
HNEMP	0.4430	.3217	1.38
NONWHITE	−1.3714	.5574	2.46**
TOTALSALE	0.0199	.0038	5.29***
TOTALMEAT	−0.0414	.0136	3.04***
TOTALFFV	−0.0830	.0419	1.98**
Censored Observations	677		
Noncensored Observations	232		
Likelihood Ratio Statistic	107.67[b]		
McFadden's R^2	.0651		

[a] Single, double, and triple asterisks indicate statistical significance at the .1, .05, and .01 levels, respectively.
[b] Test that $\beta_1 = \ldots = \beta_{20} = 0$.

those transactions involving coupon use. The variables which represent household sizes of two and five or more individuals are not statistically significant. This indicates that significant differences in coupon usage patterns do not exist between households with three or four members and households with two or five or more members, but that households comprised of a single individual are much less likely to use grocery coupons than are households with three or four members. A likelihood ratio test that all household size variables are zero produced a test statistic of 7.9977, which exceeds the chi-square critical value with three degrees of freedom at the $\alpha = .05$ level. Thus, a joint test that household size has no effect on coupon usage is rejected at the $\alpha = .05$ level.

Grocery coupon usage does not appear to differ strongly between the excluded category, comprised of consumers between the ages of 35 and 44, and the other age categories. However, the *AGE*4 variable, representing consumers between the ages of 45 and 54, is significant at the $\alpha = .10$ level. Because all of the age category coefficients are negative, coupon redemption appears to be most likely to occur for consumers in the excluded category with ages between 35 and 44 years. However, a test of the joint significance of the age variables produces a likelihood ratio test statistic of 3.4928, which is less than the chi-square critical value with five degrees of freedom at the $\alpha = .05$ level. Thus, the null hypothesis that coupon usage does not vary across alternative age classes cannot be rejected at the $\alpha = .05$ level.

An important result is that differences in income and age do not appear to strongly influence the propensity to use grocery coupons. This result is indicated by the results of joint hypothesis testing of the income and age variables. Middle-income, middle-aged consumers appear to be the most likely to use grocery coupons, though this effect is difficult to verify statistically.

Married consumers are much more likely to participate in grocery coupon promotions. Holding all other variables at their mean values, married households have a probability of coupon usage of .2462, which is .1247 larger than the probability of coupon use for single consumers. The expected level of use

Table 4. Implied Probability Changes, Change Derivatives, and Elasticities (ϵ) for Tobit Model of Grocery Coupon Usage

Variable	Change in Probability[a]	Total Change[a] Derivative	Total Change[a] ϵ	Change Above the Limit[a] Derivative	Change Above the Limit[a] ϵ
*INCOME*1	.0169	.0266	.0220	.0290	.0053
	(.0411)[b]	(.0653)	(.0540)	(.0706)	(.0129)
*INCOME*3	.0589	.0968	.1377	.0997	.0314
	(.0349)*	(.0576)*	(.0824)*	(.0600)*	(.0188)*
*INCOME*4	.0119	.0187	.0065	.0205	.0016
	(.0514)	(.0813)	(.0284)	(.0883)	(.0068)
COLLEGE	.0156	.0256	.0505	.0265	.0116
	(.0285)	(.0467)	(.0921)	(.0484)	(.0211)
LIST	.0819	.1337	.2582	.1391	.0593
	(.0276)***	(.0457)***	(.0900)***	(.0474)***	(.0203)***
*AGE*1	−.0626	−.1053	−.0638	−.1056	−.0141
	(.0531)	(.0887)	(.0539)	(.0902)	(.0121)
*AGE*2	−.0431	−.0738	−.0806	−.0723	−.0174
	(.0385)	(.0668)	(.0731)	(.0647)	(.0156)
*AGE*4	−.0769	−.1277	−.0658	−.1305	−.0149
	(.0442)*	(.0739)*	(.0379)*	(.0756)*	(.0086)*
*AGE*5	−.0639	−.1072	−.0375	−.1077	−.0083
	(.0544)	(.0902)	(.0315)	(.0926)	(.0072)
*AGE*6	−.0422	−.0724	−.0137	−.0710	−.0030
	(.0750)	(.1259)	(.0237)	(.1266)	(.0053)
*NUMBER*1	−.1876	−.2757	−.0651	−.3502	−.0183
	(.0553)***	(.0728)***	(.0178)***	(.1271)***	(.0067)***
*NUMBER*2	−.0417	−.0709	−.0728	−.0701	−.0159
	(.0359)	(.0606)	(.0626)	(.0606)	(.0138)
*NUMBER*4	−.0550	−.0925	−.0662	−.0929	−.0147
	(.0358)	(.0591)	(.0425)	(.0609)	(.0096)
MARRIED	.1247	.1901	.5629	.2212	.1447
	(.0449)***	(.0648)***	(.1926)***	(.0852)***	(.0560)***
WIFEEMP	.0241	.0396	.0603	.0408	.0137
	(.0296)	(.0490)	(.0745)	(.0501)	(.0168)
HNEMP	.0614	.1033	.1118	.1036	.0248
	(.0457)	(.0791)	(.0860)	(.0770)	(.0184)
NONWHITE	−.1444	−.2093	−.0461	−.2682	−.0130
	(.0422)***	(.0551)***	(.0120)***	(.0918)***	(.0045)***
TOTALSALE	.0027	.0044	.8022	.0045	.1832
	(.0005)***	(.0009)***	(.1569)***	(.0009)***	(.0343)***
TOTALMEAT	−.0056	−.0091	−.2280	−.0095	−.0521
	(.0018)***	(.0031)***	(.0757)***	(.0031)***	(.0171)***
TOTALFFV	−.0112	−.0183	−.1567	−.0190	−.0358
	(.0056)**	(.0093)**	(.0795)**	(.0095)**	(.0180)**
$\hat{\sigma}$		2.2041			
		(.1160)***			
z		−.7690			
		(.0714)***			
$f(z)$		.2968			
		(.0163)***			
$F(z)$		.2210			
		(.0219)***			
$E(y)$		.2797			
		(.0348)***			
$E(y^*)$		1.2661			
		(.0359)***			

[a] Evaluated at mean data values.
[b] Numbers in parentheses are approximate standard errors. Single, double, and triple asterisks indicate significance at the .1, .05, and .01 levels, respectively.

for married consumers is 19¢ higher for the entire sample and 22¢ higher for the subsample of transactions involving coupon use.

The employment status of the husband and wife and the education variable are not statistically significant in the Tobit model. This implies that coupon usage does not differ across households with unemployed husbands, working wives, and for those consumers having college education.

The variable representing minority consumers has a highly significant negative value. The probability of coupon usage by nonwhite consumers is .0880, which is .1444 lower than the probability of usage by white consumers. The expected value of usage by minority consumers is 21¢ lower for the entire sample and 27¢ lower for coupon users. This result is in agreement with the findings of Lee and Brown and may suggest that cultural differences in shopping and consumption practices make minority consumers less likely to use grocery coupons. Specifically, differing lifestyles may influence preferences for coupon use. Minority consumers also may purchase a different product mix with fewer coupon redemption opportunities.

Finally, the variables representing the size and composition of the grocery transaction are highly significant. The parameter estimates imply that the probability of coupon usage rises .27% for each dollar of the total grocery bill. In addition, the results indicate that each additional dollar of total grocery expenditures raises the expected amount of coupon use by .44¢ ($\epsilon = .8022$) for the entire sample and by .45¢ ($\epsilon = .1832$) for those transactions involving coupons. This result suggests that coupon redemption is more likely for larger purchases and thus may suggest the existence of large fixed costs in coupon usage.[9] The parameter estimates for total meat purchases and total purchases of fresh fruits and vegetables confirm strong negative effects from increased non-branded purchases. The results indicate that the probability of coupon usage falls .56% for each additional dollar of meat purchases and 1.12% for each additional dollar of fresh fruit and vegetable purchases. Furthermore, the results indicate that each additional dollar of expenditures on meats, other things constant, reduces the expected value of coupon usage by .91¢ ($\epsilon = -.2280$) for the entire sample and by .95¢ ($\epsilon = -.0521$) for those transactions involving coupon usage.[10] Each additional dollar of expenditures on fresh fruits and vegetables, other things constant, reduces the expected level of coupon usage by 1.80¢ ($\epsilon = -.1567$) for the entire sample and by 1.90¢ ($\epsilon = -.0358$) for those transactions involving coupon usage. These results confirm expectations that larger grocery transactions are more likely to involve grocery coupon redemptions but that larger purchases of meats and fresh fruits and vegetables reduce consumer participation in coupon promotions.

Concluding Remarks

This analysis identifies factors which influence a consumer's use of grocery coupons. Maximum likelihood parameter estimates from a Tobit regression model are used to quantify both the consumer's discrete decision of whether to use coupons and, if so, the continuous level of coupon usage. Inferences regarding the probabilities of coupon usage across alternative socioeconomic consumer classifications are drawn from the estimates. The Tobit parameters also are decomposed to quantify the effects of explanatory variables on the expected value of coupon usage for the entire sample and for the subsample of coupon users.

The results may be useful in identifying socioeconomic groups inclined to participate in coupon promotions. Parameter estimates suggest that the most likely coupon user is a white, married consumer, from a household of three or four individuals, who uses a shopping list and has a relatively large grocery bill and low meat and fresh fruit and vegetable purchases. Thus, grocery coupon promotions may be more effective if they are directed toward these consumer groups.

Finally, it should again be acknowledged that these results are derived from a survey which was collected from a limited sample of consumers in a single midwestern metropolitan area. Care should be exercised when extending these results to draw inferences on a national level. However, it also can be noted that these results are quite similar to those obtained in earlier considerations of grocery coupon usage and thus serve to further clarify and quantify these relationships. A logical extension of this work would give further consideration to alternative demographic and socioeconomic factors which may be relevant to the use of grocery coupons but are not included in this analysis.

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Notes

[1] These assumptions are made solely to conform to the available data and to simplify the conceptual framework underlying the empirical model of coupon usage. The assumption of a single shopping trip per week is supported by the survey data used in the empirical analysis in that the surveyed consumers averaged one shopping trip per week.

In particular, 50.2% of the sample indicated that they usually made one shopping trip per week, while 26.4% reported that they made more than one trip per week, and 23.4% indicated that they made less than one trip per week. The expected influences of variables representing the value of a consumer's time and the expected effects of other conceptually relevant variables are not affected by these simplifying assumptions. A similar analysis of demand behavior for individual trips is contained in Lee, Brown, and Schwartz.

[2] Hanemann discusses the discrete/continuous dichotomy apparent in optimization problems with nonnegativity constraints. He notes (p. 541) that, from a formal point of view, such discrete/continuous choices can be regarded as switching regression models and thus can be estimated using standard methods developed by Amemiya; Heckman; and Lee and Trost.

[3] A linear version of equation (4) is used in the empirical analysis. Pollak and Wales discuss fundamental approaches to consistently incorporating demographic variables into demand systems. Because of the categorical nature of much of the data and because this analysis does not explicitly fall within a demand systems framework, simple intercept shifting dummy variables were used to incorporate demographic factors into the model of coupon usage. A similar approach recently has been applied by many authors, including Capps, Tedford, and Havlicek; Heien and Wessells; and Heien and Pompelli (1988, 1989).

[4] Schindler's psychological mechansims affecting coupon use are: (*a*) the attention/awareness mechanism whereby a consumer's attention is drawn to a particular good by the promise of a lower price, (*b*) the discount information mechanism whereby a coupon conveys information regarding a discounted price, and (*c*) the price choice mechanism whereby a consumer perceives a sense of accomplishment at having obtained a "bargain" through the use of a coupon.

[5] Derivatives are obtained through numerical approximation using a symmetric, two-sided change of .00001.

[6] Consumers provided register receipts from a scanning check-out system and completed a detailed survey.

[7] The probability of coupon use for the base individual is evaluated at the mean values of the total sales, total meat purchases, and total fresh fruit and vegetable purchases.

[8] Elasticities for qualitative variables should be interpreted with care.

[9] Caution must be exercised with regard to the total sales variable in that any interpretation is conditional on the representation of household size and income. Larger households and households with greater incomes may be expected to make larger total purchases, regardless of coupon usage patterns. In addition, higher purchases of meats and fresh fruits and vegetables will raise total sales but will lower the likelihood of coupon use.

[10] The proportions of total sales accounted for by meat purchases and fresh fruit and vegetable purchases also were considered as representative measures of the composition of the transaction in the Tobit regression. These variables gave results very similar to those presented here. Caution should be noted in the interpretation of these variables as determinants of preferences for coupon use since their effects represent the supply (availability) of coupons rather than demand influences.

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