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ABSTRACT

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JEL Classification: H41, Q24, Q51

Keywords: Willingness-to-pay premium; local public goods; curbside recycling.

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1. Introduction

It is not uncommon for firms to offer free samples of new products to induce a change in the tastes and preferences of their (and their rival's) customers. Indeed, we have all likely encountered this marketing tactic when entering a grocery store or an upper-scale fast food restaurant.[1] Similarly, at some point during the past few years we have all likely received a trial offer from AOL for temporary free internet access without any pre-commitment to signing up for future service. The objective of this type of marketing strategy is to shift the consumer's demand outward for an existing or new product and thereby increase willingness to pay (WTP), or induce what we henceforth call a 'WTP premium effect'.[2] For certain firms, such as AOL, provision of free samples has been a mainstay of its overall marketing strategy.

This paper investigates whether a similar WTP premium effect exists for public goods. Like private firms, a public agency may decide to offer free samples of a public good in order to enhance the agency's future revenue stream and thereby meet a stand-alone budget-balance constraint. In this case, the agency's goal is to increase the public good's perceived societal value so that the general public, in turn, will be willing to pay more for the good's provision in the future. Alternatively, the objective may simply be to raise public acceptance of a particular public good prior to setting the good's user fee,

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[1] And we often wish that the toothpick sized portions on display were larger. Note that free samples are different than pre-commitment enticements, where if you agree to sign up for a good or service for a specific period of time you get the initial units of the good for free.

[2] Bremmer and Mazur (1993) show that the provision of recyclable free samples can actually have negative effects on a firm's profitability. They find that professor re-sale of examination textbooks in the used market has had a negative effect on the prices of new textbooks.

which may or may not be tied to a particular revenue goal. In both cases, the agency is attempting to induce a WTP premium effect; an effect that could be a determining factor for whether the good is ever offered to the public in the first place.

Recently, a unique field experiment was conducted in a moderately sized northern Utah community with the goal of estimating the extent and duration of a WTP premium effect for a particular type of local public good – curbside recycling.[3] As described in more detail below, a random split-sample of households were interviewed over the course of one year. One sub-sample of households (henceforth the S_1 sub-sample) was interviewed about their preferences for a hypothetical curbside recycling program (CRP). A second sub-sample of households (henceforth S_2) was given the opportunity to actually participate for three months free-of-charge in the exact same CRP described to the S_1 households, at the conclusion of which their WTP was elicited. The S_1 households were surveyed six months after the S_2 households. By comparing results from the two sub-samples we are therefore able to estimate whether an *enduring* WTP premium exists for the CRP.

We find that households who had the opportunity to participate in the city's CRP for three months free-of-charge before being queried about its value (i.e., the S_2 households) were willing to pay a $0.13 per-month premium over similar households who were not extended the free three-month opportunity (i.e., the S_1 households). The premium, while not statistically significant at conventional levels, is statistically different than zero at the

[3] Curbside recycling fits the description of an Andreoni (1990) impure public good due to its private (or "egoistic") and public ("altruistic") components. The private component is comprised of the non-pecuniary (e.g., "warm glow") benefit a household derives from helping to divert municipal waste from the landfill, as well as the pecuniary benefit associated with being able to exploit any cost savings associated quantity-based pricing of non-recyclable garbage disposal. The public component is comprised of the benefit associated with the community's aggregate level of recycling.

15% level of significance, suggesting that an enduring premium effect does not appear to exist six months later. Even if the premium was statistically significant immediately after the trial period, say after one month, the fact it is no longer significant after six months suggests that providing free samples of this type of public good is unlikely to be worthwhile from a strict fiscal standpoint.

The next section provides a brief background on the history of recycling in the study area, and discusses how this history helped motivate local officials to conduct the field experiment reported on in this study. Section 3 presents a simple theory of WTP and the premium effect. Section 4 discusses the experimental design and the empirical model used to estimate a WTP premium effect. Section 5 presents a description of the data, summary statistics, and our empirical results. Section 6 concludes.

2. Background on Logan's History with Recycling

Cache County is Utah's northern-most county, abutting Idaho's southern border. Total population in the county is currently 91,400, representing a growth of approximately 28 percent since 1990. Slightly under half of the county's population resides in Logan, the county's largest city (U.S Census Bureau, 2002). In 1996, the residents of Cache County generated approximately 4.91 pounds of solid waste per capita per day. This figure rose to 5.22 pounds in 1998 and was 5.04 pounds in 2001 (personal communication with Issa Hamud, Director, Logan City Environmental Services Division). By comparison, the national averages for 1990 and 2000 were both 4.5 pounds (USEPA, 2004).

Cache County is similar to many regions across the country. It has grown rapidly and is bumping up against its physical constraints for solid waste disposal; the county's 85-acre landfill is projected to reach capacity within the next 15 years. Lying behind its

dwindling landfill capacity are the 'usual suspects'—a high population growth rate and a high level of per-capita solid waste generated.

In an effort to divert waste from the county landfill, Logan city has implemented several programs over the years to reduce its solid waste stream, resulting in what it estimates to be a 30-percent diversion rate.[4] For example, at the time of this study the city maintained 18 drop-off recycling sites that collect a variety of materials (including green waste at some sites). The city currently provides a modest volume-based pricing scheme for residential garbage collection, where households can choose between 60-gallon and 90-gallon container sizes. Average monthly household costs for the 60- and 90-gallon containers at the time of the study were $6.55 and $11.65, respectively. Households are charged an extra $1.85 and $3.60 per month, respectively, for each additional waste disposal container.[5]

The city had also experimented with curbside recycling prior to this particular study. In 2002 a CRP was piloted in two neighborhoods with the twofold objective of assessing the program's potential impact on waste diversion rates and to obtain information on household WTP.[6] Participating households were each provided with one 90-gallon container to hold both fibrous material (mixed paper and cardboard) and non-fibrous material (aluminum, tin, and plastic). According to a pre-arranged monthly schedule,

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[4] This rate includes green waste and construction debris diverted from the landfill (personal communication with Issa Hamud, Director, Logan City Environmental Services Division). The city does not report a separate diversion rate for recyclable materials at the household level.

[5] Thus, by free sampling the CRP S_2 households were able to objectively assess their demand for garbage collection services (i.e. container size) in conjunction with curbside recycling. The literature is mixed with respect to whether quantity-based, or "pay-as-you-throw" pricing induces households to increase their recycling rates. For example, Bohara, et al. (in press), Van Houtven and Morris (1999) and Miranda et al. (1996) find evidence in support of a positive relationship between quantity-based pricing and recycling rates, while Jenkins et al. (2003), Aadland and Caplan (2006a), Fullerton and Kinnaman (1996), Reschovsky and Stone (1994), and Hong and Adams (1999) find little or no evidence of a positive relationship.

[6] See Bohara, et al. (in press) for the results of this pilot program.

households set out their fibrous material one week and their non-fibrous material the next. Each household was therefore required to figure out for themselves how to store the material that was not scheduled to be collected at the end of that week.[7] The collection process was structured in this way in order to reduce the city's sorting costs. It was no surprise that several participants found the fibrous/non-fibrous schedule to be complicated and for the most part inconvenient (Bohara, et al., in press).

As a result of carrying out the pilot program, local officials subsequently decided to pursue a co-mingled recycling option instead, where both fibrous and non-fibrous materials are combined in a single recycling container. To estimate household preferences for this type of program, and in particular to determine whether a WTP premium exists for free provision of the service, city officials initiated the random split-sample survey of households (described in Section 1) in the fall of 2004. At the time of this study, the co-mingled recycling program was already available to Logan city residents on a strictly voluntary basis for $6.00 per month, i.e., only households that had voluntarily signed up for the program through the Logan Environmental Department paid the $6.00 monthly fee and received the curbside service.[8] City officials were also considering whether to mandate the program for $3.00 per month, i.e., mandate that all households pay the $3.00 monthly fee regardless of whether they used the service.

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[7] For example, if fibrous material was scheduled to be collected at the end of the week, the household filled the city-provided 90-gallon container with fibrous material during the week and stored its non-fibrous material in a self-provided container. Once the fibrous material was collected, the household then transferred the non-fibrous material stored during that week into the 90-gallon container and used its own container to store the fibrous material that would accumulate during the coming week.

[8] It is possible that some households included in the 2004 study also participated in the 2002 pilot study. Although we did not control for this possibility, we believe that very few households participated in both studies. Households that were signed up for the voluntary CRP at the time of the 2004 study were explicitly excluded from the study. At the time of the study approximately 1000 households had signed up for the service.

Since the CRP would be mandatory, city officials were not concerned about inducing a WTP premium to balance its recycling budget (the $3.00 monthly household fee was already calculated to do so). Rather, they were curious whether an enduring WTP premium could be induced prior to implementing the mandatory program among those households that had not already revealed their preferences for recycling (by having chosen not to sign up for the voluntary program beforehand). In other words, the city's objective was to raise public acceptance of the CRP prior to setting the monthly fee.

3. Household WTP for Curbside Recycling

We assume that household *i* chooses levels of recycling effort and the numeraire good (i.e., cash on hand for all other goods) to maximize its welfare subject to a budget constraint and classical curvature conditions on its utility function.[9] The solution to this problem can be used to derive the household's indirect utility function, $v_i = v_i\left(Y_i, G_{-i}, S_i, \boldsymbol{\theta}_i\right)$, where Y_i represents household income, $G_{-i} = \sum_{j \neq i} g_j$ represents the total amount of waste produced by the rest of the community (g_j is waste produced by household $j \neq i$), S_i indicates the specific sub-sample in which the household is included, $i = 1,2$ (as discussed in Section 1), and $\boldsymbol{\theta}_i$ represents a vector of household characteristics, such as gender, education level, age, and response certainty of household head, household size and home ownership status.[10]

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[9] For a more complete model of the household's decision problem see Aadland and Caplan (2006a), Technical Appendix, available at www.uwyo.edu/aadland/research/recycle/. Bruvoll and Nyborg (2004) provide a similar model that disaggregates the household's recycling activity into sorting/storage and transportation in order to identify exactly from where the private value of curbside recycling eminates. Eom and Larson (2006) develop a utility-theoretic model that can be used to distinguish use from non-use value for joint estimation using combined stated- and revealed-preference data. Fullerton and Wu [1998] and Kinnaman and Fullerton [2000] provide alternative general equilibrium models of recycling and other "green policies" at the household level.

[10] In keeping with Andreoni (1990), G_{-i} rather than $G = \sum_i g_i$ exogenously enters household *i*'s indirect utility function as a result of household *i* treating g_i as an endogeneous variable.

The indicator, or 'treatment-effect' variable S_i effectively classifies households according to their level of experience with recycling and their information sets at the time they were surveyed. For example, the S_1 households were interviewed six months after the S_2 households. Therefore, although the S_1 households did not participate in the free three-month CRP trial, their WTP was elicited after six additional months of information and debate within the community concerning the efficacy of curbside recycling.[11] As a result, while the S_1 households could be considered to have had less personal experience with curbside recycling when they were surveyed, they nevertheless may have had more information regarding the perceived merits of the CRP from a community perspective.

Assuming it is strictly increasing in Y_i, v_i can be inverted with respect to Y_i to produce the household's expenditure function $m_i = m_i(G_{-i}, S_i, \boldsymbol{\theta}_i, v_i)$. In this case, the reference utility level, v_i^0, is set equal to the maximum utility given that the household does not participate in the CRP. WTP_i for curbside recycling is then derived by subtracting from Y_i the household's minimum expenditure given that it participates in the CRP,[12]

$$WTP_i = Y_i - m_i\left(G_{-i}, S_i, \boldsymbol{\theta}_i, v_i^0\right) \tag{1}$$

WTP for household *i* is therefore defined by the amount of income the household would willingly forego so as to participate in a CRP and maintain its original utility level v_i^0. The household's WTP for curbside recycling will be negative if v_i is such that $m_i\left(G_{-i}, S_i, \boldsymbol{\theta}_i, v_i^0\right) > Y_i$, e.g. if the disutility of foregone leisure is sufficiently large

[11] The local newspaper, *Logan Herald Journal*, printed several articles and opinion pieces on curbside recycling during this three-month period. Further, as mentioned previously, a voluntary CRP was operating during the time of the study.

[12] Note that WTP_i is calculated under the assumption that Y_i is not reduced by the household's actual recycling fee.

relative to the utility gained from recycling (see Aadland and Caplan (2006a) for further details). Evidence of an enduring WTP premium exists if $E(WTP_i|S_2) > E(WTP_i|S_1)$, where E is the (conditional) expectation operator (over all households satisfying the conditions S_2 or S_1, respectively).

4. Survey Design and Empirical Model of WTP

The surveys were conducted face-to-face in two "waves" by a group of Sociology masters students under the direction of the authors.[13] The first wave of surveying (henceforth the baseline survey) was completed in the fall of 2004 based on a random sample of approximately 250 Logan metropolitan households. The purpose of the baseline survey was to obtain demographic information from the households, e.g., age, education, income levels, etc., as well as general attitudes about recycling, including recycling behavior and policy views. In the process of administering this survey, roughly half of the households were given the opportunity of participating in the free three-month trial period. These households, which subsequently comprised the S_2 sub-sample, began the free trial period immediately and were interviewed about their preferences for the CRP three months later in January of 2005. Ultimately, 73 usable surveys were obtained from this sub-sample, representing a 73% response rate.

The S_1 sub-sample was drawn from two groups of households. One group was randomly selected from the half of the baseline-survey households that were not given the opportunity of participating in the free three-month trial period. These households were interviewed about their WTP for the (hypothetical) CRP in July 2005, resulting in 83 usable surveys (representing a 77.6% response rate). The other group was a new

[13] The survey instruments are available from the authors upon request.

sample of households randomly selected from the Logan metropolitan area who had not participated in the baseline survey. This group, which was also interviewed in July 2005 about their preferences for the (hypothetical) CRP, resulted in 109 usable surveys (representing a 73.5% response rate). Thus, the S_1 sub-sample consists of 192 households, representing a weighted-average response rate of 75.3%.

Our econometric approach for estimating WTP follows Cameron and James (1987). The WTP question is set in the single-bounded dichotomous-choice (SBDC) format to elicit a household's WTP through a single dichotomous-choice question. The WTP question is,

"Would you be willing to pay $\$\tau_i$ per month, in addition to your current monthly garbage collection fee, to receive a blue recycling can and curbside pickup of recyclables every other week?"

The bid τ_i is chosen randomly from a set of predetermined values.[14] Based on the responses to the bid, the respondent's latent WTP may be placed in one of two regions: $(-\infty,\tau_i)$ in the event of answering "no" to the WTP question and $[\tau_i, \infty)$ in the event of answering "yes."

Prior to the WTP question, respondents were provided with the following "cheap talk" reminder statement,[15]

"As you prepare to answer the following question, please remember the following three things:

- *First, keep in mind your household budget. In a typical month, at what price would your household be able to afford curbside recycling?*
- *Second, recall that there are alternatives to curbside recycling, such as drop-off centers and landfills, and*

[14] The bids were chosen with equal probabilities from the set of integers 2, 4, and 6. This set encompassed the range of feasible household fees that the Logan Environmental Department originally considered charging for the voluntary CRP (personal communication with Issa Hamud, Director of the department).
[15] See Aadland and Caplan (2006b), List (2001), and Cummings and Taylor (1999) for a more formal treatment of the use of cheap talk in stated-preference surveys.

- *Third, in previous surveys we have found that the amounts that people said they were willing to pay for curbside recycling were often higher than the amounts that they actually were willing to pay when the service became available in their community. As you read the following questions, please imagine your household is actually paying the proposed fee."*

In addition to these three reminders, a sub-group of the S_1 households were provided a fourth reminder in order to control for the possible offsetting effect of an explicit statement about the savings associated with reducing the household's garbage container size as a result of participating in curbside recycling.[16] The bullet point read,

- *"Finally, consider the fact that if your household currently uses a 90-gallon garbage container it may be able to switch to a 60-gallon container due to recycling, resulting in a $3.65 savings in your monthly garbage expenses."*

Turning to our econometric model, we specify a reduced-form version of WTP_i, where the vector of explanatory variables $\mathbf{X}_i$ includes the treatment-effect (S_i) and household characteristic ($\boldsymbol{\theta}_i$) variables mentioned above. A normally distributed random error term ε_i is added to capture the portion of WTP_i unexplained by $\mathbf{X}_i$, implying

$$WTP_i = \mathbf{X}_i\beta + \varepsilon_i, \qquad (2)$$

where β is a vector of coefficients. The variance of the error terms is corrected for (multiplicative) heteroscedasticity following Harvey's (1976) model. Using (2), we then define the binary variable $ACCEPT_i$, which equals one if the respondent accepts τ_i, and zero otherwise. As is standard in the literature, we assume that $ACCEPT_i = 1$ responses imply $WTP_i > \tau_i$ and $ACCEPT_i = 0$ responses imply $WTP_i \leq \tau_i$.

Next, we define the necessary probabilities for maximum-likelihood estimation. Using (2), the probability that household *i* accepts bid τ_i is

$$P_i = Pr[ACCEPT_i = 1]$$

[16] We found this fourth bullet point to be statistically insignificant in explaining a typical household's WTP. The output for this result is available from the authors upon request.

$$= \Pr[WTP_i > \tau_i]$$

$$= \Pr[\varepsilon_i > \tau_i - \mathbf{X}_i\boldsymbol{\beta}]$$

$$= \Phi(\mathbf{X}_i\boldsymbol{\beta} - \tau_i)$$

for i = 1,…,N households, where Φ is the standard normal density function and the last equality follows from Φ's symmetry. The associated log likelihood function is

$$\text{Log L} = \sum_{i=1}^{N} \{\text{ACCEPT}_i \ln(P_i) + (1 - \text{ACCEPT}_i) \ln(1 - P_i)\} \qquad (3)$$

where Log L is estimated as an interval regression model (Woolridge, 2002).[17]

5. Empirical Results

The definitions of the explanatory variables contained in $\mathbf{X}_i$ and used in equations (2) and (3), along with their sample means, are provided in Table 1.[18] In Table 2, we report our empirical results for estimating the typical (i.e., average) household's WTP for the Logan CRP. The marginal effects and associated standard errors (in parentheses and corrected for multiplicative heteroscedasticity) are reported for each explanatory variable. The Chi-Square statistic of 53.93 is significant at the 1 percent level, indicating that the included explanatory variables are together statistically significant in explaining variation in WTP across households. Ben-Akiva and Lerman's (1985) goodness-of-fit measure indicates that the average probability of correct predictions by the model is approximately 62 percent. Prediction successes (reported in Table 3) are generally in the 70 percent

[17] NLOGIT version 3.0.10 is used to estimate equation (3).

[18] A host of additional explanatory variables were included in earlier estimations of equation (3), such as attitudes toward recycling and the environment, monthly household waste generation, and past recycling behavior, but were found to be insignificant in explaining variation in WTP. For information concerning these additional variables, refer to our survey instrument, which is available from the author upon request. Both the input and output NLOGIT files for these earlier estimations are also available from the author upon request.

range, which is consistent with previous studies of household WTP for curbside recycling (Aadland and Caplan, 2006a).

[INSERT TABLES 1, 2, AND 3 HERE]

Both the directions and sizes of the marginal effects reported in Table 2 are for the most part consistent with earlier WTP studies (Aadland and Caplan, 2006a; Kinnaman, 2006). For instance, more highly educated, higher-income, and younger heads-of-household are, all else equal, willing to pay more for curbside recycling. Likewise, household heads who are more certain of their WTP responses have a higher estimated WTP, and the larger the bid τ_i the less likely the respondent is to accept it. However, unlike in previous studies we find that male respondents are not necessarily willing to pay less than their female counterparts. Surprisingly, the larger its size the *less* a household is willing to pay for the CRP.[19]

Most importantly for this study, we find that having been in the S_2 sub-sample increases a household's WTP by approximately \$0.13 per month over an S_1 household's WTP ($D_1 = 0.128$ is statistically different than zero at the 15% level of significance). This suggests that an enduring WTP premium effect for the CRP does not appear to exist six months after introducing the program. Following Cameron and James (1987) we find that the typical household's WTP for the CRP equals approximately \$3.30 per month. The corresponding standard error of 0.784 is calculated using the Delta Method (Greene, 2003, page 70), resulting in a 95% confidence interval of \$1.76 – \$4.84. These results are consistent with the previous literature (Aadland and Caplan, 2006a).

[19] In some respects, however, this result may not be so surprising. A larger household's financial resources might already be too thinly spread over other consumption goods, leaving less of its budget to devote to environmental goods such as recycling, irrespective of the household's environmental views.

6. Summary and Conclusions

This study has investigated whether a 'free sampling' strategy induces an enduring WTP premium effect for public goods. Using data from a unique field experiment involving curbside recycling, we have found that the premium effect associated with providing non-participating households a brief opportunity to participate in a curbside recycling program for free is relatively small and not enduring. It may therefore not be cost effective to offer a free-sampling participation incentive for this type (or similar types) of local public good(s). Only in situations where households' information sets are incomplete (e.g., they are unable to incorporate in their WTP responses the full costs of choosing not to recycling), would an investment in this type of an incentive scheme make fiscal sense.

As an epilogue to this study, Cache County officials decided to make the CRP mandatory (i.e., universal) in mid 2006. The monthly fee for the program was reduced from $6.00 (which was the existing fee for the voluntary program) to $3.00. As anticipated, the participation rate soared to approximately 100% of all households in the community. To encourage active participation in the program, the Logan Environmental Department began an add campaign encouraging households to reduce their garbage container size from 90 to 60 gallons, which results in a savings of $2.15 per month.[20]

[20] In concert with the co-mingled CRP, monthly garbage fees were increased from $6.55 and $11.65 to $10.50 and $12.65 for the 60 and 90 gallon containers, respectively. The reason for this asymmetric increase in fees was (i) an overdue need to account for past inflation in input costs and (ii) a preemptory decision to maintain revenue in the event that a significant number of households switched from the 90 to the 60 gallon container. Bohara, et al (in press) had estimated the number of households that would request 60 gallon containers to be slightly below 60% of all households in Logan city.

The 50% reduction in the recycling fee partially reflected anticipated savings from scale economies. Assuming mean household WTP for the co-mingled CRP is no less than the $3.30 per month estimate from this study and the household fee charged by the city reflects actual cost of service, the co-mingled CRP therefore appears to pass a simple social net benefit test (Aadland and Caplan, 2006b).

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Table 1. Variable Definitions and Means.

Variable	Mean (SD)	Description
Educ1	0.37 (0.48)	1 = some college or trade school, 0 = otherwise.
Educ2	0.29 (0.45)	1 = bachelors degree, 0 = otherwise.
Educ3	0.18 (0.38)	1 = graduate school or professional degree, 0 = otherwise.
D1	0.27 (0.45)	1 = S_1 sub-sample, 0 = otherwise.
Gender	0.41 (0.49)	1 = male, 0 = female.
Age	44.94 (17.57)	Age of respondent (in years).
HHsize	1.68 (0.65)	1 = 1 – 2 household members, 2 = 3 – 5 household members, 3 = 6 – 9 household members.
Inc1	0.36 (0.48)	1 = household income is $25,000 - $49,999, 0 = otherwise.
Inc2	0.41 (0.49)	1 = household income is $50,000 and up, 0 = otherwise.
Own	0.78 (0.41)	1 = household owns home, 0 = household rents home.
Cert	2.22 (1.00)	0 = 0 – 40 percent certain of WTP response, 1 = 41 – 70 percent certain of WTP response, 2 = 71 – 85 percent certain of WTP response, 3 = 86 – 100 percent certain of WTP response.
Tau	3.97 (1.65)	Bid value τ_i.

Notes: Sample sizes range between 237 and 264 observations due to missing values. SD = Standard Deviation.

Table 2. Empirical Results.

Variable	Marginal Effect
Constant	-0.12 (0.271)
Educ1	0.254* (0.146)
Educ2	0.158 (0.151)
Educ3	0.305* (0.169)
D1	0.128 (0.089)
Gender	0.030 (0.083)
Age	-0.007** (0.003)
HHsize	-0.161** (0.067)
Inc1	0.191 (0.119)
Inc2	0.335** (0.133)
Own	0.057 (0.125)
Cert	0.200*** (0.048)
Tau	-0.079*** (0.025)
Mean WTP	3.304*** (0.784)
Sample Size	197
Chi Square Statistic	53.931***
Ben-Akiva & Lerman	0.622
Log L	-109.277

*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level. Standard errors are in parentheses.

Table 3. Prediction Successes and Failures.

	Predicted		
Actual	0	1	Total
0	70	34	104
1	26	67	93
Total	96	101	197

Note: The predicted and actual values of 0 and 1 correspond to values of $ACCEPT_i = 0$ and $ACCEPT_i = 1$, respectively, in equation (2).