Valuing Access to U.S. Public Lands: A Unique Pricing Experiment

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Abstract. We report the findings of a unique nation-wide experiment to price access to U.S. public lands. In 2004, the U.S. Federal Lands Recreation Enhancement Act mandated the creation of a new annual pass to cover all federal recreation sites that charge an entrance or access fee. Our task was to assist federal policymakers in determining an appropriate price for this new pass. Toward that end, we administered a national telephone survey to over 3,700 households and used contingent valuation to estimate households' willingness to pay (WTP) for the new pass at different prices. Our innovative experimental design allows us to estimate three distinct components of hypothetical bias in order to calibrate our WTP estimates against actual purchasing decisions. In a sample of the general U.S. population – most of whom have little experience with similar federal passes – respondents tend to greatly exaggerate their WTP for the pass when contrasted with previous pass sales. A sample of recent pass purchasers, however, exhibits little bias, confirming other recent research showing that market experience can mitigate hypothetical bias. Calibrated for bias, our results indicate that the $80 pass price ultimately adopted by policymakers implies an increase of nearly 2.5% in total revenue relative to the former pass, priced at $65, but a 4.5% loss in potential revenue absent any such pass.

1. Introduction

This paper reports the findings of a unique nation-wide experiment to price access to U.S. federal lands. The Federal Lands Recreation Enhancement Act of 2004 mandated a new recreation pass (hereafter, the NRP) to replace the Golden Eagle Passport (GEP) and the National Parks Pass. (For a list of acronyms used in this paper, see Table 1.) The NRP, similar to the GEP, covers all federal lands that charge an entrance or access fee for recreational use. This includes units administered by the National Park Service, many sites administered by the U.S. Forest Service, and some locations administered by other federal agencies.

Our economic and survey research team undertook an economic analysis of the new pass program and submitted a price recommendation to federal land management agencies in the fall of 2006. The project was completed under the constraint that the NRP should "provide convenient access, at a fair price, to federal recreation sites that charge fees….and should at least allow the government to break even in the sense that, *on average*, the sale of the [NRP] does not result in a revenue loss relative to the revenue that would be received absent the ability to purchase an annual pass."[1] After receiving our analysis and price recommendation, the U.S. Departments of Agriculture and the Interior announced that the price for the annual NRP would be set at $80; the new pass went on sale in January 2007.

Here we describe the methodological and economic issues associated with assisting federal land management agencies to determine an appropriate price for the new pass. We used contingent valuation (CV) methods to help determine an appropriate price for the NRP. CV and

[1] This should be recognized as a political constraint on the price-setting exercise; as stipulated by the sponsoring agencies, "revenue neutrality" was defined in relation to revenues absent any pass, not in relation to revenues from existing passes. There are other possible policy issues associated with pass pricing (e.g., public education, congestion, pollution, deterioration of infrastructure, etc.) that were outside the scope of our current study. Our goal was to provide information to help set the price of the new pass given the objective of revenue neutrality. We explored neither the *optimal* price of the pass based on the full social costs, nor the distribution of total revenues across federal sites and federal land management agencies.

other stated preference valuation methods have made significant in-roads into public decision-making over the past two decades. Federal policymakers use the value estimates to help guide their decisions for a range of topics like water quality protection, air quality improvements, watershed and ecosystem protection, and reduced human health risk (see for example Brown, Champ, and Boyle, 2004).

In the present application, an innovative experimental design allows us to contrast the hypothetical purchasing decisions of survey respondents with the actual purchasing decisions of households. As a result, we are less open to a major criticism of contingent valuation analysis—hypothetical bias. Hypothetical bias exists when people misstate their actual willingness to pay (WTP) in a survey. In our analysis, we account for hypothetical decision-making because we are able to calibrate our new price estimates to the actual purchasing decisions of households.[2]

Unlike most other non-market valuation exercises, we have a real benchmark – the GEP. The GEP entitled households to basically identical access to public lands as the NRP and had been offered at $65 since 2000. Using past GEP sales figures and the reported purchasing decisions of households within our sample, we are able to estimate three distinct components of hypothetical bias. The total degree of hypothetical bias in our sampling of the U.S. general population (a Random Digit Dialing sample) implies that NRP revenues estimated directly from the uncalibrated household survey responses would be higher than actual revenues by a factor of 16. The total bias using our sampling of recent pass purchasers (a sample obtained from the

[2] The topic of hypothetical bias has triggered a large literature in non-market valuation research (see Murphy *et al*., 2005). Research can be grouped into two broad categories: *ex ante* or *ex post*. Ex ante methods frame the valuation question so as to make it more "real" to the person asked the valuation question, or they provide additional information to get people to realize that they might be overstating their actual preferences (i.e., cheap talk, see Cummings and Taylor, 1999; Aadland and Caplan, 2003). Ex post techniques attempt to reduce the hypothetical bias by calibrating stated values to price data from real market proxies (see Champ *et al*., 1997; Fox *et al*., 1998). We take the ex post approach and calibrate households' bids against actual purchasing behavior of the now-defunct GEP.

National Parks Foundation) is much lower and even slightly negative. This finding supports previous research in the area of non-market valuation[3], which shows that market experience is an important indicator of people's ability to accurately identify and state their true valuation for public and environmental goods (e.g., List and Shogren, 1998; List and Gallet, 2001; Cherry *et al*., 2003; Murphy *et al*., 2005; and Cherry and Shogren, 2007).

2. Background

The Federal Lands Recreation Enhancement Act (Public Law 108-447, the FLREA), which was signed into law on December 8, 2004, established a new recreation pass to replace the existing GEP and National Parks Pass (NPP). The FLREA called for a pass to provide convenient and fairly priced access to federal recreation sites that charge fees; to provide opportunities for education on federal lands; to provide support for public lands; and to develop partnerships with organizations that support recreation and stewardship on public lands.

This new pass (the NRP) covers the entrance fees for units administered by the National Park Service and the U.S. Fish and Wildlife Service, as well as standard amenity fees for developed areas administered by the U.S. Forest Service, the Bureau of Land Management, and the Bureau of Reclamation. Fee areas generally include visitor centers or other developments with certain basic facilities (e.g., designated parking, restrooms, etc.). Like the passes it replaces, the new pass does not cover any expanded amenity fees for such things as reservation services or developed campgrounds and boat launches. When appropriate, pass holders will also continue to

[3] While the NRP is not a "non-market good," our results indicate that CV analyses – even those associated with goods and services purchased in the market – need to be interpreted with caution, especially if hypothetical bias is not taken into account.

pay special recreation permit fees such as those for motorized recreational vehicle use, recreational events, and group activities.

The NRP is similar to the earlier GEP. The GEP was introduced in 1965, at a price of $7 per year. By 1997 its price had risen to $50; by 2000 the price was $65. Like the NRP, the GEP provides entrance for the passholder (and other occupants of a private vehicle) to virtually all federal lands that charge a fee.[4] The year 2000 saw the introduction of the NPP, sold for $50 and providing entrance only to those federal lands administered by the National Park Service. For an additional $15, a sticker could be purchased and affixed to the NPP to make it equivalent in all respects to the GEP (and therefore, essentially equivalent to the NRP). Throughout this paper, "GEP" refers to either the Golden Eagle Passport or the National Parks Pass with sticker, while "NPP" refers to the National Parks Pass without the sticker. Sales of the GEP and the NPP were discontinued in January of 2007 when the NRP was introduced.

3. Economic Analysis

Our economic analysis begins with the assumption that by stating their WTP for the NRP, households are revealing their optimal choice for expected number of visits to federal recreation sites. This assumption provides a convenient method for calculating expected pass and gate revenues. All households with a maximum WTP above the price of the NRP will purchase the pass and contribute exclusively to pass revenues; all households with a maximum WTP that is below the price of the NRP will instead pay at the gate and contribute exclusively to gate

[4] One minor difference is that the NRP card can be signed by two adult passholders, either of whom may show the card to secure entrance, whereas the GEP card had space for only one signature. As a practical matter, however, this difference is inconsequential, because typically the individual showing the GEP on behalf of a carload of entrants was not required to verify that the signature was his or hers.

revenues. We can then evaluate how various NRP prices will impact total pass and gate revenues, and whether the prices satisfy the "revenue neutrality" constraint mentioned in Section 1.

The value of the NRP is derived from both use and non-use sources. The NRP provides access to recreation at federal sites, without paying daily entrance or usage fees. We refer to this as *use value*, which can in turn be separated into *convenience* and *economic value*. Convenience refers to the reduced transaction costs associated with using the NRP rather than having to make separate payments for each entrance fee.[5] Economic value is derived from the expected cost in entrance fees, given the number of planned visits to recreation sites and the current entrance fee structure.[6] The NRP may also provide households with a sense of satisfaction in helping to fund the creation and maintenance of federal recreation sites that may be used by others. We refer to this non-use value as *stewardship value*.

In deciding whether to purchase the NRP, households weigh all the benefits and costs. The benefits include convenience, economic value, and possible stewardship motives. The relevant cost is the price of the pass. The household's decision is straightforward – if the total benefits outweigh the private costs, purchase the pass; otherwise, pay the gate fees. To better understand this decision, we undertook a CV experiment designed to simulate the actual market environment and NRP purchasing decisions.

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[5] We note that some may find an offsetting inconvenience in having to remember to bring the pass for each visit. In concept, some of the values associated with "convenience" also accrue to the federal government if having a pass reduces wait times at entrance stations, allowing fee collectors to work more efficiently.

[6] Our discussion of the economic value of the pass assumes households base their purchasing decision on the expected number of recreation trips and the current gate fees, not the amount of uncertainty associated with future trips. We recognize, however, that households might incorporate the option value of the pass into their decision-making. Similar to a *real option*, the NRP can be thought of as an irreversible investment under uncertainty (Dixit and Pindyck, 1994). Once the NRP is purchased, the decision is final and irreversible because of legal restrictions on the resale of purchased passes. Now suppose a household, having purchased the pass, receives an adverse shock (e.g., sudden loss in income, rising gasoline prices, family illness, etc.) and decides it must forgo a previously planned family vacation to a national park. The household may *ex post* regret the decision to purchase the NRP, as the purchase no longer satisfies the internal cost-benefit test. But it also seems reasonable that the household will, at least to some degree, anticipate this possibility *ex ante* and place a value on the option to delay the purchase. While we do not formally model the option value for the NRP, we recognize the household will likely incorporate the value of delaying purchase into its stated WTP for the pass.

3.1 Hypothetical Bias

A fundamental concern of any CV study is *hypothetical bias*. Respondents have a well-established tendency to state willingness to pay values that are significantly greater than those revealed in real-market interactions (e.g., Diamond and Hausman, 1994; Harrison and Rutström, 2006). While different methods have been proposed to obtain more accurate WTP values from non-market valuation surveys (Boyle, 2003), our study has a built-in mechanism to calibrate hypothetical WTP values with real choices. We take advantage of the fact that the NRP is nearly identical to the existing GEP, which was previously sold in the marketplace. Our survey design (described in more detail below) uses revealed-preference data from the GEP market to generate calibration factors for three components of hypothetical bias within our survey sample. We use these estimated calibration factors to adjust WTP values from the survey so they are consistent with the actual purchasing decisions of households. The details of this calibration exercise are described in Sections 5.2 through 6.1.

3.2 Calculating NRP and Gate Revenues

Initially, we assume households are motivated to purchase the NRP based solely on its economic value. That is, people purchase the pass if it reduces the total planned entrance expenses for visitation to federal recreation sites and do not place any value on convenience or stewardship. With this assumption (which we relax later), it is straightforward to use our estimated WTP values to project the NRP revenue and gate revenue associated with various NRP fee levels. *NRP revenue* is defined as the revenue generated directly from sales of the NRP. *Gate revenue* is the revenue generated from on-site entrance fees at federal recreation sites.

To further clarify, consider the case in which a household's maximum WTP for the NRP is greater than the price of the NRP. In this case, the household purchases the pass and contributes nothing to gate revenues.[7] Conversely, if the household's maximum WTP is less than the cost of the NRP, the household will not purchase the pass and instead pay at the gate. If the household's WTP for the NRP is driven by economics, the most they would be willing to pay for the pass would be the exact amount they expect to spend at the gate. This produces a straightforward method for calculating NRP and gate revenues:

$$\text{NRP Revenue} = \sum_{\text{WTP} \geq \text{NRP Price}} \text{NRP Price} \tag{1.1}$$

$$\text{Gate Revenues} = \sum_{\text{WTP} < \text{NRP Price}} \text{WTP} \tag{1.2}$$

Total NRP revenues are calculated by multiplying NRP price by the total number of households with a maximum WTP greater than the price (i.e., all households that would purchase the pass). Total gate revenues are calculated by summing up maximum WTP for all households with WTP less than the NRP price (i.e., all households that would not purchase the pass and instead pay at the gate). This method for estimating total gate revenues assumes that (i) households do not systematically over- (or under-) estimate the number of trips to federal recreation sites, and (ii) they do not purchase the pass for convenience or stewardship purposes. The effect of relaxing these assumptions is considered at the end of Section 6.2.3.

4. Survey Design

Our goal with the survey was to link the NRP valuation exercise to real choices and real outside options; respondents answered the new valuation question after thinking about the *status*

[7] Of course, the initial purchase of the pass may occur "at the gate" of a federal recreation site, but its price is not included in "gate revenue" as defined here.

quo and their familiarity with the NPP and GEP. Our intent was to keep the survey realistic, simple, and quick while still generating reasonable value estimates. Given time constraints and the scale of the project a face-to-face survey was infeasible. Instead, we conducted a nationwide telephone survey between February and April of 2006.

The survey sample consisted of two independent strata. The first stratum was sampled using a national Random Digit Dialing (RDD) draw of households with landline telephones. To enhance the precision of estimates from this part of the sample, it was pre-stratified by the 9 major geographic divisions defined by the U.S. Bureau of the Census, and post-stratified to reflect Census Bureau distributions by geographic division, household income, Hispanic origin, and racial identification. By design, this sample of 1,799 responding RDD households represents the roughly 110 million households in the U.S. with landline phones, except for about 30,000 that fall into the second stratum. The second stratum was randomly sampled from a population list of telephone numbers for households known to the National Parks Foundation (NPF) to have purchased a National Parks Pass (with or without a sticker) between April 2004 and March 2005 (i.e., from one to two years prior to the survey). This sample was also pre-stratified by geographic division, and the 1,974 responding NPF households were weighted to match the geographic distribution of the NPF population list.

The total sample size across both strata was 3,773 households. Within-household sampling was not undertaken, because the relevant unit of analysis is the household. The NRP (like the GEP and NPP) is not an individual pass; rather, it entitles the members of a household traveling together to access federal lands for recreation. Therefore, any willing adult respondent in each household included in the survey was asked to provide information on behalf of the household.

With total sales of approximately half a million passes per year, the NPF population list of only 30,629 households covers just a small subset of NPP and GEP purchasers one to two years earlier; obviously, it covers an even smaller fraction of all U.S. households. The NPF sampling frame mainly represents households that purchased the pass on-line. It omits most of the roughly 50,000 annual purchasers of the GEP, except to the (unknown) extent that those on the NPF list may have purchased the $15 sticker that upgrades the NPP to the GEP. Fortunately, our interest in the NPF sample is not predicated on claiming it represents all pass purchasers. Rather, the NPF sample reflects a small but noteworthy group of supporters of the national parks (who tend to be familiar with the passes), while the RDD sample is designed to represent the full spectrum of the population of U.S. households (the majority of whom are unfamiliar with the passes).

Both samples were screened, through questions asked early in the survey, to eliminate from our analysis those households in which anyone qualified for a Golden Age or Golden Access Passport. These lifetime passes, available only to senior citizens and the disabled, effectively remove a household from the market for an annual GEP, NPP, or NRP. As stipulated by the sponsoring agencies, households that had not visited any federal recreation lands in the past two years were also screened out of the analysis, on the assumption they would not be part of the relevant market either. Protest households (those that said they would not accept the NRP for free) were excluded as well, for the same reason. After all screening, the RDD sample provided 462 cases for analysis and the NPF sample provided 1,461 cases.[8]

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[8] While larger final samples would have been desirable, the extensive screening just described was essential for analytic purposes. As will be evident in the results below, both of the screened sample sizes provide adequate statistical power to identify as "significant" the effects central to our analysis. The final response rates were good (65% for RDD and 55% for NPF, using the RR3 formula of the American Association for Public Opinion Research (2006)). Differences between weighted and unweighted descriptive results (not shown here, but available on request) were small, suggesting that non-response bias was low. The weighting itself introduced little loss in statistical power (inflating standard errors only 7.5% in the RDD sample and less than 1% in the NPF); these power losses have been appropriately taken into account in our tests of statistical significance (using the method described

The survey questionnaire began with an introduction, screening questions, and a short series of items about the household's recent recreational experiences on federal lands. (The complete questionnaire is available from the authors on request [and is provided as an attachment here for use by the reviewers].) The interviewer then asked whether the respondent was aware of the NPP or GEP. If the answer was "YES", the respondent was asked whether the household had purchased the NPP or GEP in the past 12 months.

The next section of the questionnaire provided a short description of the NRP followed by the valuation question, which asked whether the household would be willing to buy the NRP at a randomly selected bid value. For some respondents, the random bid value was the current GEP price, which allows us to compare hypothetical purchasing decisions to real purchasing decisions. To more precisely pinpoint the valuation distribution, the interviewer then asked a follow-up question. If the respondent was willing to purchase the NRP at the first bid price, we increased the price by a randomly set amount and asked again; if not, we lowered the price and asked again.

The final section of the questionnaire asked a series of socio-demographic questions including age, education, race, and household income. Table 2 presents the full set of variables used here, with definitions and descriptive statistics.[9] We turn now to the econometric analysis of the survey data.

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by Dorofeev and Grant, 2007, p. 105). Further details regarding survey design, sampling, and weighting can be found in (*reference deleted for anonymity in the review process*).

[9] Although not explicitly modeled here, a potential source of explanatory power is the distance to nearby federal recreation sites. Measurement of this variable is difficult for various reasons: (i) it would have been extremely difficult to identify the "nearby" federal sites relevant for each potential respondent; (ii) many federal recreation sites have multiple points of entry (e.g., national forests); (iii) the definition of "nearby" is arbitrary; (iv) not all recreation sites are equally attractive recreation areas; etc. For these reasons, we do not include this spatial variable in our empirical analysis but leave it as a possible avenue for future research.

5. Econometric Analysis

We break the econometric analysis into three sections. In Section 5.1, we present the model to estimate overall WTP for the NRP. Section 5.2 defines the model used to estimate the degree of hypothetical bias in terms of increased probability that a stated-preference household will purchase the pass at $65. Finally, in Section 5.3, we describe how to use the two models to translate the probability measure into a dollar-denominated measure of hypothetical bias. This scaling factor, which we term "internal" hypothetical bias, is one of three components that we use to calibrate the WTP estimates to the actual purchasing decisions of households. The other two ("awareness" bias and "external" hypothetical bias)[10] are examined in Section 6.

5.1 Overall WTP Model

Our first econometric model estimates WTP for the NRP, which in turn can be used to forecast pass and gate revenue at various NRP prices. We use an interval regression model that follows directly from the double-bounded dichotomous-choice (DBDC) survey design described above (Hanemann *et al.*, 1991). An interval regression is an ordered probit model with variable and known cut points (Woolridge, 2002).

We start by writing the empirical model in terms of a household's maximum WTP for the NRP, which is indirectly derived from the utility of visiting federal recreation sites:

$$WTP_i = \exp(X_i'\beta + \varepsilon_i)\,, \qquad (3)$$

[10] Awareness bias refers to the fact that all survey respondents were made aware of the NRP and its features before being asked about their willingness to purchase it, whereas a substantial fraction of households in the general population would likely remain unaware of the NRP's existence (as is true of the GEP and NPP, according to our survey) and therefore would not have the opportunity to purchase it. External hypothetical bias refers to the remaining difference between hypothetical and actual WTP once internal and awareness bias are taken into account.

where WTP_i is the latent willingness to pay for the NRP; X_i is a vector of explanatory variables; β is a vector of coefficients; ε_i is a mean-zero Gaussian error term with variance σ^2; and $i = 1,..,N$ indexes households in a sample of size N. The exponential functional form guarantees the predicted WTP will be non-negative. Given expression (3), the probability of purchasing the pass is represented as

$$P_i = \Pr(y_i = 1) = \Pr(WTP_i \geq b_i) = \Phi(\frac{1}{\sigma}(X_i'\beta - \ln(b_i))), \quad (4)$$

where Φ is the standard normal cumulative density function, $y_i = 1$ if the household purchased the pass, $y_i = 0$ if the household did not purchase the pass, and b_i is the proposed price of the NRP. The initial bids are chosen at random from the following bid vector (which we developed using focus groups):

$$b = (\$25, 45, 65, 85, 105, 125, 145, 165). \quad (5)$$

Table 3 shows the percent of the RDD and NPF samples that respond "YES" to the initial bids. As expected, the percent responding "YES" generally declines as the bids increase in value, and the NPF respondents are more likely to say "YES" at every bid price. As described in Section 4, we follow the initial bid with a second one, randomly selected from either b^H = (b+\$20, 2b-\$5) if the respondent accepts the first bid or b^L = (b-\$20, 0.5(b+\$5)) if the respondent declines.[11] If a respondent answers "NO" to both bids, we ask another follow-up

[11] In other words, if the initial bid price is accepted, the second price is (randomly) either \$20 higher, or else (with equal probability) it is approximately double the initial bid amount. If the initial price is declined, the second price is either \$20 lower, or else it is approximately half the initial amount. Adjustments of \$5 (when doubling or halving

question with a bid equal to *zero*, in order to identify protest bidders. Given (3), the probabilities of purchasing a pass within each possible range of prices are

$$P_{i1} = \Pr(-\infty < WTP_i < 0) = 0 \qquad (6.1)$$

$$P_{i2} = \Pr(0 \le WTP_i \le b_i^L) = \Phi(\frac{1}{\sigma}(\ln(b_i^L) - X_i'\beta)) - P_{1i} \qquad (6.2)$$

$$P_{i3} = \Pr(b_i^L < WTP_i \le b_i) = \Phi(\frac{1}{\sigma}(\ln(b_i) - X_i'\beta)) - \Phi(\frac{1}{\sigma}(\ln(b_i^L) - X_i'\beta)) \qquad (6.3)$$

$$P_{i4} = \Pr(b_i < WTP_i \le b_i^H) = \Phi(\frac{1}{\sigma}(\ln(b_i^H) - X_i'\beta)) - \Phi(\frac{1}{\sigma}(\ln(b_i) - X_i'\beta)) \qquad (6.4)$$

$$P_{i5} = 1 - (P_{i1} + P_{i2} + P_{i3} + P_{i4}). \qquad (6.5)$$

The log likelihood function is then given by

$$\ln L(\beta, \sigma) = \sum_{i=1}^{N} \sum_{j=1}^{5} \omega_{ij} \ln P_{ij}(\beta, \sigma), \qquad (7)$$

where ω_{ij} is a binary variable equal to one if household *i* chooses category *j*. We choose β and σ to maximize the likelihood function. With estimates of β and σ in hand, we form WTP estimates for every household in the sample, and in turn the NRP and gate revenue functions.

Table 4 presents the results from the DBDC model. We analyze the RDD and NPF samples separately throughout, because the two populations are substantially different in their demographic characteristics (e.g., NPF respondents tend to be older, with more education and higher income), in their visitation to federal recreation sites, and of course, in their recent purchases of federal recreation passes. Protest households (i.e., those who refuse the pass for

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the initial amount) ensure that all bids are multiples of 5, to avoid any confounding that might arise if multiples of 10 have a different psychological resonance with respondents.

free) are excluded from all analyses, based on the original screening decision to exclude households that are unlikely to participate in the market for the NRP. As compared to the rest of the sample, protest households (N=67 for RDD; N=30 for NPF) tend to be older, less educated, lower income, less likely to be white, and more likely to reside in states in the northeast (NJ, NY and PA) or great plains (IA, KS, MN, MO, ND, NE and SD).

We incorporate heteroscedasticity into the econometric model because the WTP bid intervals vary across households. Recall that half of our follow-up bids are either half or twice the initial bid, so higher initial bids tend to be associated with larger WTP intervals. We use the initial bid to proxy for interval width and model the heteroscedasticity as

$$\sigma_i^2 = \exp(\alpha_0 + \alpha_1 b_i) . \tag{8}$$

As shown in Table 4, the test statistic for heteroscedasticity is large in the NPF sample, leading us to reject the null of homoscedastic errors there, but not in the RDD sample.

Mean and median WTP figures are presented at the bottom of Table 4. The mean and median WTP values for the RDD sample are approximately \$42 and \$35, indicating a WTP distribution that is slightly skewed toward higher WTP values. The mean and median WTP values for the NPF sample are both approximately \$95, an average substantially higher than in the RDD sample, which is expected given that the NPF sample is comprised of recent pass purchasers.[12] Next, we consider hypothetical bias.

[12] Given the debate regarding the DBDC model (Herriges and Shogren, 1996; Whitehead, 2002), we also estimated a single-bounded dichotomous-choice (SBDC) WTP model (results available on request from the authors). In the NPF sample, the predicted WTP distributions and coefficient estimates from the SBDC model are similar to the results from the DBDC model. For the RDD sample, the calibrated mean and median WTP from the SBDC model are approximately \$7 lower than from the DBDC model, and the coefficient estimates are qualitatively similar.

5.2 Modeling Internal Hypothetical Bias[13]

We now describe the econometric procedure to calibrate estimated WTP to be consistent with stated rates of GEP purchases from within our two survey samples. We designed our valuation experiment to account for hypothetical bias by comparing hypothetical decisions to buy the NRP (at a bid equal to $65) with actual decisions to purchase the existing GEP, which has been sold for $65 in the marketplace since 2000. Assuming households are accurately stating whether or not they purchased the GEP within the immediately preceding 12 months, this internal calibration should result in WTP and revenue estimates that more nearly reflect the actual purchasing decisions of households in the general U.S. population.

To estimate the degree of internal hypothetical bias in the survey data, we specify a probit model with a dummy variable to capture the difference between hypothetical and actual purchasing decisions. Within the RDD and NPF samples taken separately, we pool data from two distinct subsamples—the *stated preference* and the *revealed preference* subsamples. The revealed preference subsample includes every household who knew of the $65 GEP, whether or not they had purchased one. The stated preference subsample includes every household that was unaware of the GEP and received an initial bid of $65 for the NRP, whether or not they said "YES" to that bid. Protest households (who refused the pass for free) are excluded from the analysis.[14]

The underlying economic model is similar to (3) but modified to incorporate hypothetical bias

[13] The estimation of what we call "internal" hypothetical bias in this section follows Aadland and Caplan (2003). Because our estimation of internal hypothetical bias captures *any* difference between stated and revealed preferences, it will include other differences such as strategic bias. Strategic bias occurs when households intentionally say 'NO' to an acceptable bid in order to encourage policymakers to set a lower price.

[14] We also excluded 61 and 336 revealed-preference households in the RDD and NPF samples who were aware of the policy that allowed receipts from recent entrance fees to federal recreation sites to be applied toward the cost of the NPP or GEP. This was done to level the playing field because this unpublicized "receipt policy" may alter the value of a pass and was not described to survey respondents.

$$\text{WTP}_i = \exp(X_i'\beta + \delta \cdot \text{SP}_i + \varepsilon_i) = \exp(\delta \cdot \text{SP}_i)\exp(X_i'\beta + \varepsilon_i)\,, \tag{9}$$

where WTP_i is unobserved willingness to pay for either the GEP or the NRP, SP_i is a dummy variable equal to one for the stated-preference subsample and zero for the revealed-preference subsample, and δ is the hypothetical bias coefficient. Analyzing the RDD and NPF samples separately, we form the probability (P_i) that the i^{th} household purchases the pass at a price of $65:

$$P_i = \Pr(\text{WTP}_i \geq \$65) = \Phi(\frac{1}{\sigma}(X_i'\beta + \delta \cdot \text{SP}_i - \ln(\$65)))\,. \tag{10}$$

Let $y_i = 1$ indicate the household purchased the pass (either hypothetical or real), and let $y_i = 0$ indicate they did not purchase the pass. This is a probit model with (log) likelihood function

$$\ln L(\beta, \delta \mid y, X) = \sum_{i=1}^{N} \left[y_i \ln(P_i) + (1 - y_i)\ln(1 - P_i) \right]. \tag{11}$$

The coefficients β and δ are only identifiable up to the scale factor ($1/\sigma$). Because β and δ only show up in the likelihood function as a ratio with σ (i.e., (β/σ) and (δ/σ)) and the price is fixed at $65, it is impossible to disentangle the ratios and obtain individual estimates of β, δ and σ. However, the *marginal effects*, which measure the change in probability for a one unit change in the explanatory variables (*X* or *SP*), only depend on the identifiable ratios. For the average household, the marginal effect for hypothetical bias is

$$\begin{aligned} \Delta &= \Pr(y=1 \mid \overline{X}, SP=1) - \Pr(y=1 \mid \overline{X}, SP=0) \\ &= \Phi\left(\overline{X}'(\beta/\sigma) + (\delta/\sigma)\right) - \Phi\left(\overline{X}'(\beta/\sigma)\right) \end{aligned} \tag{12}$$

where a *bar* over the variable represents its average value. This coefficient is defined in terms of increased (or decreased) probability of pass purchase. In the next section, we describe how to translate Δ into a WTP scale factor using the baseline DBDC model.

5.3 Translating Internal Hypothetical Bias from a Probability into Dollars

The coefficient of hypothetical bias Δ in expression (12) is measured in terms of probability the pass is purchased. Although this provides evidence of hypothetical bias, it does not allow household WTP and welfare measures to be directly adjusted to reflect revealed preferences. Furthermore, the probit model shown in expression (10) does not identify a dollar amount of hypothetical bias because the bids are not varied (i.e., the bid is fixed at $65). Fortunately, the DBDC model described in Section 5.1 uses the entire bid vector and allows us to identify household WTP.

We use the normal distribution along with estimates of β and $\hat{\sigma} = \sqrt{exp(\alpha_0 + \alpha_1 \$65)}$ to back out the WTP hypothetical bias scale factor consistent with Δ for the average household.[15] This is accomplished by solving for δ (given estimates of β, $\hat{\sigma}$, and Δ) from the following equation:

[15] Estimates for σ are formed using $\hat{\sigma} = \sqrt{exp(\alpha_0 + \alpha_1 \$65)}$ for both the RDD and NPF samples even though we do not find evidence of heteroscedasticity in the RDD sample (see Table 4). The RDD results that follow are qualitatively similar if the errors are instead assumed to be homoscedastic.

$$\Delta = \Pr(\overline{\text{WTP}}_{SP} > \$65) - \Pr(\overline{\text{WTP}}_{RP} > \$65)$$
$$= \Phi(\frac{1}{\hat{\sigma}}(\overline{X}'\beta + \delta - \ln(\$65))) - \Phi(\frac{1}{\hat{\sigma}}(\overline{X}'\beta - \ln(\$65))), \qquad (13)$$

Figure 1a illustrates the procedure for identifying exp(δ), the WTP scale factor for hypothetical bias for the RDD sample, while Figure 1b illustrates the procedure using the NPF sample. The procedure is the same for each sample, but the figures are drawn separately to reflect the position and shape of the empirical WTP distributions for each sample.

We start with our estimate of hypothetical bias, Δ, which is measured in terms of the increased probability the NRP is purchased. This value is estimated using the method outlined in Section 5.2 and is represented by the etched area in Figure 1a. (In Figure 1b it is the difference between areas H and A.) The area under the hypothetical WTP distribution to the right of ln($65) is the probability that a household will *hypothetically* accept a $65 bid for the NRP; the area under the actual WTP distribution to the right of ln($65) is the probability that a household will *actually* purchase the NRP at a $65 price. The difference between the two probabilities is Δ. Assuming a normal distribution, we then back out the unique value of δ that positions the hypothetical WTP distribution to be consistent with Δ and the standard deviation $\hat{\sigma}$. Finally, we use the corresponding WTP scale factor, exp(δ), to form the *internally calibrated* WTP estimates [WTP_i / exp(δ)] that more accurately reflect actual purchasing decisions of households.

We now turn our attention to the results from the hypothetical bias model outlined above, estimated separately for the RDD and NPF samples. The first row of Table 5 presents the coefficient and marginal effect (ME) estimates for hypothetical bias. In both samples, the hypothetical bias coefficients are positive and statistically significant. The ME estimates indicate that, all else equal, the average RDD and NPF stated-preference households are 13.6 and

12.6 percentage points more likely to purchase a hypothetical \$65 NRP than similar revealed-preference households are to have purchased the actual \$65 GEP. The control variables include demographics such as age, gender, education, race and region.

As discussed above, the estimates of Δ need to be translated from a probability into a WTP scale factor (i.e., we need to map our estimates of Δ into estimates of $\exp(\delta)$ for the purpose of calibrating the WTP estimates for hypothetical bias). To accomplish this, we use the baseline DBDC estimates reported in Table 4. The estimated value for the hypothetical bias calibration factor, $\exp(\delta)$, is approximately 1.4 and 1.3 for the RDD and NPF samples. Table 6 reports the details for this calculation. Put differently, the dollar values for WTP in the RDD and NPF samples need to be reduced by 40% and 30% to be consistent with the observation that stated-preference households are 13.6 and 12.6 percentage points more likely than revealed-preference households to purchase a pass at \$65. The revenue functions reported below are therefore scaled by $\exp(\delta)$ to more accurately reflect actual purchasing decisions.

However, these estimates of hypothetical bias are likely to be lower bounds on the true total bias in the population. To estimate internal hypothetical bias, the sample was partitioned according to whether respondents were aware of the GEP (revealed-preference households) or not aware of the GEP (stated-preference households, if they received a \$65 bid for the NRP). If lack of awareness of the GEP is associated with a lower propensity to visit federal recreation sites (and therefore a lower WTP for the NRP), then our stated-preference households are, all else equal, less likely to hypothetically purchase a pass at any given price. This will lead to an underestimate of internal hypothetical bias by the method just described. Accordingly, we next augment our calibration to include an explicit adjustment for awareness bias and a final "external" adjustment using data on aggregate actual sales of the GEP.

6. Estimated Revenue Functions

In this section, we describe the calibration process and present the resulting NRP and gate revenue functions. We calculate both parametric and non-parametric estimates of the revenue functions. The *parametric* estimates of the revenue functions are based on the DBDC model and methods outlined in Section 5.1. The *non-parametric* estimates of the revenue functions are a direct reflection of households' "YES" or "NO" responses to the various bids presented in the CV analysis. For simplicity, we focus on the non-parametric estimates and make the parametric estimates available upon request.[16]

6.1 Calibration for Awareness, Internal, and External Hypothetical Bias

All the revenue functions are first calibrated for awareness bias. Approximately 50% of the RDD sample and 4% of the NPF sample were unaware of both the NPP and GEP.[17] Assuming the NRP is marketed in a similar manner, we expect similar fractions of the respective populations would not purchase the NRP at any price, simply because they would not learn of its existence. To account for this in our population revenue projections, we calculate NRP revenues in the sample by summing NRP revenues only for those who were aware of either the NPP or the GEP and have a maximum WTP that is higher than the proposed NRP price. We then scale that amount up to the appropriate population size. Estimated gate revenues do include households

[16] The primary difference between the estimates is that the non-parametric model has more success predicting the small number of households that place themselves at the tails of the WTP distributions (see Greene (2003), page 685). Although the revenue functions tend to have a similar shape, the peak revenue occurs at a substantially lower price for the parametric estimates.

[17] The NPF sample consists of telephone numbers that had belonged to households purchasing the National Parks Pass from one to two years before the survey was conducted. Some of those telephone numbers may no longer belong to the households that bought the pass, and respondents reached at those numbers might be unaware of both the NPP and the GEP.

who were unaware of both the NPP and the GEP, under the assumption such households would continue to visit federal recreation sites and pay gate fees.

After adjusting for awareness bias, we calibrate sequentially for what we term internal and external hypothetical bias. The internal calibration procedure uses the sample RDD and NPF survey data and is outlined in Sections 5.2 and 5.3. Unlike other valuation studies, however, our research design permits a further important adjustment: using external information to calibrate our WTP estimates against actual purchasing decisions in the aggregate. Our external calibration uses outside information on recent pass revenues to project future pass revenues and then matches them to projected NRP revenues. As a consequence, the external calibration adjusts for any remaining hypothetical bias not addressed by the awareness or internal hypothetical bias adjustments.

Based on recent pass sales, we project that at a price of $65, NRP revenues should be approximately $30 million and $1 million for the RDD and NPF populations.[18] After adjustments to WTP for awareness bias and internal hypothetical bias, we then scale the corresponding NRP revenues to match these figures. Because gate revenues are calculated from NRP revenues, they are automatically calibrated in a similar fashion.

Table 7 presents the magnitudes of all three types of calibration factors. Panel A shows the projected NRP revenues based on various assumptions about awareness and hypothetical bias in the relevant populations. Panel B presents total scaling factors and their decomposition into

[18] In 2005, there were approximately 460,000 National Parks Passes sold (at $50), plus 54,000 Golden Eagle Passports ($65), together generating revenue of $26.5 million, a total that had increased by an average of 15% per year since 2001 *(reference deleted for anonymity)*. Extrapolating the increase even one year would yield pass revenue in excess of $30 million for the general population. Partial data on actual NRP sales during the first nine months of 2007 have now confirmed $30 million as an appropriate benchmark figure (U.S. Department of the Interior, 2008). The $1 million figure for the NPF population takes into account our survey results showing that just over half of NPF pass purchasers in 2004 bought the GEP in 2005 ($0.5 \times 30629 \times \$65 = \$1$ million). For purposes of calibrating NRP revenue, these figures are conservative, in the sense that they seem more likely too low than too high; if so, NRP revenue will be underestimated in our analysis (and external hypothetical bias will be overstated).

awareness bias, internal hypothetical bias and external hypothetical bias. In calculating the total bias, the decomposed terms are multiplied together, rather than added, to be consistent with the multiplicative hypothetical bias term in equation (9). By decomposing the total bias in a multiplicative fashion, each individual bias term retains the interpretation of a 'scaling factor'.

The scaling factors in Panel B are calculated using the revenue projections in Panel A. First, the scaling factors for awareness bias are calculated by taking the ratio of predicted NRP revenues at \$65 (assuming all households in the population will be made aware of the NRP) to the predicted NRP revenues at \$65 (assuming that households in the population will be aware of the NRP at the same rate as our sample was aware of the GEP or NPP). Second, maintaining the correction for awareness bias, the internal hypothetical bias scaling factor is calculated by taking the ratio of predicted NRP revenues at \$65 (without a correction for internal hypothetical bias) to predicted NRP revenues at \$65 (after scaling WTP by $\exp(\delta)$). Finally, the external bias factor is calculated by taking the ratio of projected revenues at \$65 (with adjustments for awareness and internal hypothetical bias) to the benchmark revenues mentioned above (\$30 million and \$1 million for the RDD and NPF populations).

Panel B of Table 7 shows the total degree of awareness and hypothetical bias. Using the RDD sample and the non-parametric forecasts, the uncalibrated NRP revenues are approximately 16 times higher than the calibrated data would suggest. Using the parametric forecasts, the bias in the uncalibrated RDD results is only half as large, and it is completely eliminated by just the awareness and internal calibrations.

The total bias using the NPF sample is much lower (perhaps negligible for some purposes), and even slightly negative in the non-parametric case. This suggests the overall hypothetical bias for the general public RDD sample is greater than the bias for the more pass-experienced

NPF sample. The result also confirms previous empirical and meta-analysis research that market experience helps mitigate valuation biases (e.g., List and Shogren, 1998; List and Gallet, 2001; Cherry *et al*., 2003; Murphy *et al*., 2005; Cherry and Shogren, 2007).

6.2 Projected Revenue Functions

Next we present non-parametric, calibrated estimates for NRP and gate revenues.[19]

6.2.1 NRP Revenue

As shown in Table 8, the NRP revenue functions reach maximums at approximately $25 and $45 for the RDD and NPF samples. For the RDD sample, NRP revenues drop sharply at $45 and then level off up to $105, after which pass revenues again begin to fall more rapidly. In the NPF sample, the decline in pass revenues after the peak is steady out to $265. The degree of sensitivity of NRP revenues to price reflects the elasticity of the underlying demand curve for the NRP. Recall, all these revenue functions are calibrated for awareness, hypothetical and external bias as described in Section 6.1.

6.2.2 Gate Revenue

Table 8 also shows gate revenues. We project the level of gate revenues based on households' maximum WTP for the NRP (i.e., the most households should be willing to pay for the NRP is the amount they expect to spend at the gate). At low NRP prices, gate revenues are

[19] We calculate the non-parametric revenue functions by assuming the household's true WTP is at the midpoint of the chosen bid interval. Households that answer "YES" to both bids are assigned a WTP equal to $10 plus the high bid. Households that answer "NO" to both bids, but "YES" when asked if they would accept the new pass for free, are assigned a WTP equal to half the lower bid. Those that reject both bids, and also say they would not accept the pass for free (67 households in the RDD sample and 30 in the NPF sample), are treated as protest bidders and are omitted from the analysis.

relatively low and consist primarily of households that are unaware of the pass program and thus pay at the gate.[20] As the NRP price goes up, gate revenues increase as households with a maximum WTP less than the pass price choose instead to pay at the gate. Gate revenues flatten out at their maximum level once the NRP price reaches about $150 for the RDD sample and about $200 for the NPF sample. At these higher-end prices, there are few predicted NRP purchasers remaining.

6.2.3 Revenue Neutrality

Recall from Section 1 that one goal established for the NRP was that the selected price must be "revenue neutral". As defined by the sponsoring agencies, revenue neutrality implies that the price of the NRP should not result in substantial revenue losses relative to the revenue that would be received absent the ability to purchase an annual pass. The revenue losses from pricing the NRP are straightforward to calculate. The revenues absent the pass are given by the gate revenues at the bottom of the table (i.e., at a sufficiently high price that no households purchase the pass). The $254 million and $2.9 million in gate revenues for the RDD and NPF samples, absent a pass, can then be compared to the total NRP plus gate revenues at lower NRP prices. The results in Table 8 suggest that the price would need to be set well above the recent GEP price of $65 to avoid sacrificing substantial revenues. As the NRP price increases, we approach "revenue neutrality" near a price of about $150 for the RDD sample and $200 for the NPF sample. Interestingly, the cost of an annual pass for California's state parks in 2006 was $125;

[20] Projected gate revenues are based on the assumption that the fraction of unaware households in the population does not vary with the NRP price. We recognize that this assumption is questionable at low NRP prices (i.e., word is likely to spread fast if the NRP price is set at or near zero). These low prices, however, are also likely to be outside the practical range for public policy, and little or no attention need be given to the extremes of any of the revenue functions.

the cost of an annual pass in 2006 for Parks Canada was $US140. However, at NRP prices of $150 or higher, few U.S. households would purchase the pass.

In all of our results so far, we assume that households are motivated to purchase the NRP based on its *economic value*. That is, people purchase the NRP pass because doing so results in a savings in expected at-the-gate expenses for visiting federal recreation sites. This assumption has some empirical support: in our survey, 83% of the RDD sample (and more than 90% of the NPF sample) say that "the number of times the household expects to visit federal lands" and "the price of the pass compared to the cost of entrance fees" are important reasons to purchase the pass. But there are other reasons a household may purchase the pass. First, the household may receive *convenience value*, which refers to the reduced transaction costs associated with using the NRP rather than having to make separate payments for each entrance fee. A substantial fraction of the RDD sample (76%) states that "the convenience of one annual pass" is important. That figure is even higher in the NPF sample (94%). There may also be *stewardship value*, if the household views the NRP as a method for contributing to the maintenance and improvement of federal lands and facilities. And households may systematically *over-estimate* the number of expected trips to federal recreation sites (or the associated entry fees). Any of these factors, and perhaps others, might encourage households to purchase the NRP at a greater rate than the basic "economic" assumption would imply. Consequently, our estimates to this point represent a lower bound on the demand for the NRP pass based on economic considerations.

We believe the economic rationale for purchasing the pass is reasonable. However, the open-ended survey questions reveal a few households do express stewardship concerns. Furthermore, in the parametric model the coefficient for ALL REVENUE, which could be considered a weak proxy for stewardship, is a positive and statistically significant predictor of WTP. In addition, the survey results show that average “expected” numbers of trips within the next year (3.52 and 4.77 for RDD and NPF) are slightly higher than average numbers of “typical” trips (3.42 and 4.65). The direction of these small differences is consistent with some over-estimation of trips.[21]

To explore these possibilities, we allow a portion of the WTP for the NRP to be derived from convenience, stewardship concerns, trip over-estimation, and/or other “non-economic” factors. For example, if 40% or more of WTP is derived from these non-economic factors then rather than being a *revenue loser*, the NRP program is predicted to become a *revenue generator* for NRP prices greater than $60.[22] However, it seems unlikely that anything close to 40% of the value of the NRP is due to stewardship or other non-economic factors, especially given our survey results showing limited evidence of stewardship purchasers and little systematic over-estimation of visitation.

7. Concluding Remarks

Stated preference valuation methods have made significant in-roads into public decision-making over the past two decades. Federal policymakers use the value estimates to help guide their decisions for a range of topics like water quality protection, air quality improvements, watershed and ecosystem protection, and reduced human health risk (see for example Brown, Champ, and Boyle, 2004). Here we have described our use of contingent valuation to assist U.S. federal land management agencies to determine an appropriate price for a new pass providing access to all federal recreational lands. This unique project was spurred by the U.S. Federal Lands Recreation Enhancement Act of 2004, which authorized a new pass to replace the existing Golden Eagle Passport and the National Parks Pass. The question we addressed was evaluating

[21] Using a paired *t* test, the differences are statistically significant for the NPF sample but only at the 10% significance level.
[22] The estimation results are omitted to conserve space but are available from the authors upon request.

how much to charge for the new recreation pass given the preferences of the general public and the revenue-neutrality constraint of the federal agencies. We designed and administered a contingent valuation survey to over 3,700 households in two samples to estimate willingness to pay for the new pass at a variety of prices.

Our experimental design allows us to estimate the degree of hypothetical bias in the sample and to calibrate our WTP estimates to reflect actual purchasing decisions. We find the general U.S. population – most of whom have little experience with similar federal passes – tend to greatly exaggerate their WTP for the pass when contrasted with previous pass sales. A sample of recent pass purchasers, however, exhibits little hypothetical bias, supporting the idea that market experience can substantially mitigate bias in WTP estimates. Accounting for the hypothetical bias, our results suggest that to maintain the "revenue neutrality" target desired by the federal agencies, the NRP price would have to be nearly $150 for the general population sample.

After receiving our results and conclusions, the federal government officially announced the new recreation pass in December 2006. The price of the new pass, named the *America the Beautiful Pass*, was set at $80. According to our estimates, this price implies an approximate $11 million loss in revenue annually, or 4.5% of total pass and gate revenues at that price. However, it does come almost $6 million (nearly 2.5% of total revenue) closer to revenue neutrality than the $65 price of the Golden Eagle Passport. Federal policymakers ultimately decided that $11 million in forgone revenue was preferable to the adverse public reaction that would likely have greeted a new pass priced at more than double the National Parks Pass or Golden Eagle Passport.

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Table 1. Acronyms Used in the Text

Acronym	Full Expression
CV	Contingent Valuation
DBDC	Double-Bounded Dichotomous Choice
FLREA	Federal Lands Recreation Enhancement Act
GEP	Golden Eagle Passport (and/or National Parks Pass with sticker)
ME	Marginal Effect
NPF	National Parks Foundation
NPP	National Parks Pass
NRP	New Recreation Pass
RDD	Random Digit Dialing
SBDC	Single-Bounded Dichotomous Choice
WTP	Willingness to Pay

Table 2. Variable Definitions and Sample Means

Variables	Definitions	Means	
		RDD Sample (N = 462)	NPF Sample (N = 1461)
Initial Bid	First bid chosen randomly from {$25,$45,$65,$85,$105,$125,$145,$165}	93.615	96.691
All Revenue	1 if household is more likely to purchase pass if all money was used for services and facilities on federal recreation sites; 0 otherwise	0.628	0.636
Low Visits	1 if number of visits last year to Federal recreation sites ≤ 3, 0 otherwise	0.803	0.453
Young	1 if 17 < Age < 30; 0 otherwise	0.149	0.138
Old	1 if 50 < Age < 60; 0 otherwise	0.242	0.300
Male	1 if Male; 0 otherwise	0.433	0.477
BS degree	1 if BS degree or some graduate school; 0 otherwise	0.357	0.394
Professional degree	1 if Graduate or professional degree; 0 otherwise	0.236	0.353
Low Income	1 if Household income is less than $50K; 0 otherwise	0.321	0.255
Hispanic	1 if Hispanic; 0 otherwise	0.056	0.027
White	1 if White; 0 otherwise	0.846	0.876
Asian	1 if Asian; 0 otherwise	0.011	0.026
African American	1 if African American; 0 otherwise	0.024	0.003
NE	1 if states (CT, MA, ME, NH, RI, VT); NE = 0 otherwise	0.048	0.079
ENC	1 if states (NJ, NY, PA); ENC = 0 otherwise	0.113	0.117
WNC	1 if states (IL, IN, MI, OH, WI); WNC = 0 otherwise	0.160	0.155
GP	1 if states (IA, KS, MN, MO, ND, NE, SD); GP = 0 otherwise	0.071	0.082
SE	1 if states (DC, DE, FL, GA, MD, NC, SC, VA, WV); SE = 0 otherwise	0.165	0.177
WSC	1 if states (AL, KY, MS, TN); WSC = 0 otherwise	0.065	0.025
SW	1 if states (AR, LA, OK, TX); SW = 0 otherwise	0.067	0.071
RM	1 if states (AZ, CO, ID, MT, NM, NV, UT, WY); RM = 0 otherwise	0.097	0.109
PC	1 if states (AK, CA, HI, OR, WA); PC = 0 otherwise	0.214	0.185

Table 3. Percent Responding “YES” to Initial Referendum

RDD Sample (N = 462)		NPF Sample (N = 1461)	
Price	Percent Responding “YES”	Price	Percent Responding “YES”
25	55.5%	25	89.4%
45	38.3%	45	79.0%
65	22.4%	65	60.2%
85	22.0%	85	45.4%
105	19.4%	105	33.9%
125	10.5%	125	22.8%
145	12.7%	145	22.3%
165	13.5%	165	13.6%

Notes. Protest households (67 in RDD sample and 30 in NPF sample) have been omitted.

Table 4. DBDC WTP Estimates for the NRP

Explanatory Variables[†]	RDD Sample		NPF Sample	
	Coefficient	P-Value	Coefficient	P –Value
All Revenue	0.52***	0.00	0.12***	0.00
Low Visits	-0.40***	0.01	-0.11***	0.00
Young	0.12	0.28	-0.09*	0.07
Old	-0.01	0.47	-0.04**	0.04
Male	-0.09	0.26	-0.08**	0.02
BS degree	0.17	0.17	0.05	0.15
Professional degree	0.08	0.34	0.09**	0.05
Low Income	-0.10	0.29	-0.19***	0.00
White	0.06	0.43	-0.02	0.39
Hispanic	0.77**	0.03	0.07	0.31
Asian	0.62	0.14	-0.16	0.12
African American	-0.66	0.10	0.32	0.14
NE	-0.24	0.24	0.02	0.38
ENC	-0.23	0.19	-0.03	0.34
WNC	-0.40**	0.05	-0.04	0.27
GP	-0.18	0.28	-0.12*	0.09
SE	-0.07	0.39	-0.02	0.34
WSC	-0.40	0.12	-0.06	0.31
SW	0.02	0.47	0.04	0.30
RM	0.21	0.21	0.05	0.21
Heteroscedasticity (H^d) Results				
Constant	-0.22	0.24	-0.57***	0.00
Initial Bid	0.003	0.21	-0.01***	0.00
H^d Likelihood Ratio	0.76	0.38	14.34***	0.00
Summary Statistics				
Sample Size	462		1461	
Likelihood Ratio Statistic	45.97***		65.07***	
Mean WTP	$42.28		$94.52	
Median WTP	$34.93		$95.63	

Notes. (***), (**), and (*) refer to statistical significance at the 1, 5 and 10 percent levels. The estimation was carried out using the Constrained Maximum Likelihood (CML 2.0) package in Gauss version 3.5. The nonlinear optimization routine was Newton-Raphson with a convergence criterion of 1×10^{-5} for the gradient of the coefficients. The estimates for "don't know" and "missing" dummy variables are not shown. [†]Although not explicitly listed as an explanatory variable, the bids are incorporated through the probabilities (see equation 6) and the likelihood function (see equation 7). See Cameron and James [1987] for further details. Protest households are defined as those who refused the NRP for free and are excluded from the analysis.

Table 5. Hypothetical Bias Probit Model

Explanatory Variables	RDD Sample (N = 180)				NPF Sample (N = 830)			
	Mean	Coefficient	P –Value	ME	Mean	Coefficient	P –Value	ME
Hypothetical	0.082	1.362***	0.001	0.136	0.039	0.348**	0.034	0.126
All Revenue	0.628	-0.177	0.338	-0.007	0.636	0.030	0.376	0.012
Low Visits	0.803	-1.329***	0.006	-0.131	0.453	-0.409***	0.000	-0.157
Young	0.149	0.580	0.181	0.038	0.138	-0.055	0.346	-0.021
Old	0.242	-0.400	0.223	-0.014	0.300	0.177**	0.044	0.067
Male	0.433	-0.517	0.124	-0.022	0.477	0.062	0.252	0.024
BS degree	0.357	0.537	0.158	0.026	0.394	0.093	0.210	0.036
Professional degree	0.236	0.068	0.455	0.003	0.353	0.129	0.144	0.049
Low Income	0.312	-0.400	0.221	-0.019	0.255	0.054	0.361	0.020
White	0.846	-0.577	0.174	-0.038	0.877	0.224*	0.080	0.087
NE	0.048	0.168	0.443	0.008	0.079	-0.475***	0.008	-0.187
ENC	0.113	0.178	0.391	0.008	0.117	-0.297**	0.038	-0.117
WNC	0.160	0.117	0.432	0.005	0.155	-0.375**	0.012	-0.147
GP	0.071	0.122	0.438	0.005	0.082	-0.730***	0.000	-0.285
SE	0.165	-0.187	0.391	-0.007	0.177	-0.307**	0.018	-0.120
WSC	0.065	-3.832	0.494	-0.032	0.025	-0.471**	0.046	-0.186
SW	0.067	-1.256	0.100	-0.020	0.071	-0.353**	0.039	-0.139
RM	0.097	-1.114	0.151	-0.022	0.109	-0.171	0.147	-0.067
Constant	1.000	3.535***	0.000	--	1.000	0.435**	0.037	--

Notes. (***), (**), and (*) refer to statistical significance at the 1, 5 and 10 percent levels. The estimation was carried out using the Constrained Maximum Likelihood (CML 2.0) package in Gauss version 3.5. The nonlinear optimization routine was Newton-Raphson with a convergence criterion of 1×10^{-5} for the gradient of the coefficients. The estimates for "don't know" and "missing" dummy variables are not shown. ME = Marginal Effect. 26 and 17 protest households (those that would not be interested in the NRP even if it were offered free of charge) were removed from the RDD and NPF samples.

Table 6. Information Used in Solving for the Internal Hypothetical Bias Factor from Equation (13)

Estimate	RDD Sample	NPF Sample
Δ	0.136	0.126
$\hat{\sigma} = \sqrt{\exp{(\alpha_0 + \alpha_1 \$65)}}$	0.985	0.628
$\bar{X}'\beta$	3.748	4.536
Equation (13): $\Delta = \Phi(\frac{1}{\hat{\sigma}}(\bar{X}'\beta + \delta - \ln(\$65))) - \Phi(\frac{1}{\hat{\sigma}}(\bar{X}'\beta - \ln(\$65)))$		
δ	0.348	0.272
$\exp(\delta)$	1.416	1.313

Notes. $\Phi \equiv$ standard normal cumulative distribution function.

Table 7. Awareness, Internal Hypothetical Bias and External Hypothetical Bias Calibration Factors

Panel A. NRP Revenue Predictions

Type of Calibration	Predicted NRP Revenue ($65 × Millions of Households Purchasing NRP)			
	RDD Sample		NPF Sample	
	Non-Parametric	Parametric	Non-Parametric	Parametric
Uncalibrated	491.14	254.63	0.88	1.40
Awareness Calibration Only	187.63	102.75	0.85	1.35
Awareness & Internal Calibrations	143.48	26.80	0.53	1.02
All Calibrations	30.00	30.00	1.00	1.00

Panel B. Scaling Factors

Type of Bias	Scaling Factor: "NRP Revenues are Divided by a Factor of __"			
	RDD Sample		NPF Sample	
	Non-Parametric	Parametric	Non-Parametric	Parametric
Awareness Bias	2.62	2.48	1.04	1.04
Internal Hypothetical Bias	1.31	3.83	1.57	1.31
External Hypothetical Bias	4.78	0.89	0.53	1.02
Total Bias	16.41	8.44	0.88	1.40

Table 8. Predicted Revenue and Number of Pass Holders (Non-Parametric Estimates)

	RDD Sample			NPF Sample		
Price	Predicted Number of Pass Holders (in thousands)	NRP Revenue (millions of $)	Gate Revenue (millions of $)	Predicted Number of Pass Holders	NRP Revenue (millions of $)	Gate Revenue (millions of $)
15	2,698.2	40.5	139.2	42,404	0.64	0.11
25	1,863.9	46.6	155.8	40,356	1.01	0.16
35	1,224.9	42.9	174.8	35,601	1.25	0.30
45	621.3	27.2	199.1	28,295	1.27	0.60
55	514.8	27.3	204.7	21,299	1.17	0.95
65	461.5	30.0	207.8	15,385	1.00	1.30
75	372.8	28.0	214.1	12,795	0.96	1.48
85	284.0	24.1	220.9	8,736	0.74	1.81
95	266.3	25.3	222.4	7,112	0.68	1.96
105	213.0	22.4	227.8	5,102	0.54	2.16
115	124.3	14.3	237.7	4,097	0.47	2.27
125	88.8	11.1	241.8	2,938	0.37	2.41
135	53.3	7.2	246.4	2,590	0.35	2.46
145	35.5	5.1	249.0	1,778	0.26	2.57
155	17.8	2.8	251.6	1,198	0.19	2.66
165	0	0	254.4	1,005	0.17	2.69
175	0	0	254.4	812	0.14	2.72
185	0	0	254.4	734	0.14	2.73
195	0	0	254.4	387	0.08	2.80
205	0	0	254.4	232	0.05	2.83
215	0	0	254.4	232	0.05	2.83
225	0	0	254.4	116	0.03	2.86
235	0	0	254.4	116	0.03	2.86
245	0	0	254.4	77	0.02	2.87
255	0	0	254.4	77	0.02	2.87
265	0	0	254.4	0	0	2.89

Notes. For simplicity, price points at the extremes of the bid range are excluded. RDD survey data have been calibrated to reflect $30 million in NRP revenue at $65, based on current annual pass sales. NPF survey data have been calibrated to reflect $1 million in NRP revenue at $65, based on estimated NPP and GEP sales to former purchasers through NPF. Revenue and pass holder figures are calculated using the midpoint of the WTP interval. Households that state “YES” to both bids are assigned a WTP equal to $10 plus the highest bid. For the RDD sample, 67 protest households have been omitted, leaving a sample size of N = 462. For the NPF sample, 30 protest households have been omitted, leaving a sample size of N = 1461.

Figure 1a. Illustration of the Procedure to Identify Dollar-Valued Hypothetical Bias (RDD Sample)

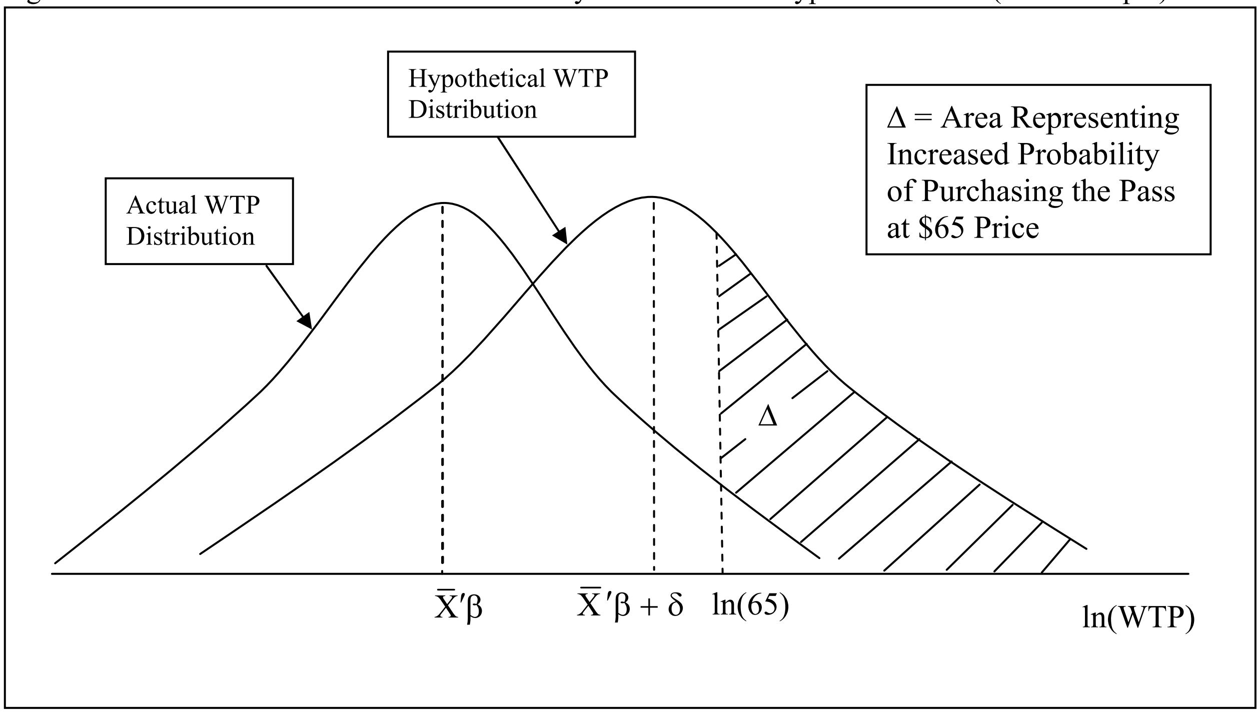

Figure 1b. Illustration of the Procedure to Identify Dollar-Valued Hypothetical Bias (NPF Sample)