Appendix C: Description of the Recreation Models

This report uses two methods to compute the CRP's impact on outdoor recreational expenditures. The "trips-based" method uses data on outdoor recreational trips taken by individuals. The "receipts-based" method uses information on money paid to farmers for recreational uses of their land. Both methods also use information on trip-related expenditures, such as expenditures on food, lodging, and transport.

The Trips-Based Method

The trips-based method uses survey data on the American public's participation in outdoor recreation. This data comes from the 2000 National Survey of Recreation and the Environment (NSRE2000) and the 1996 Fishing, Hunting, and Wildlife Associated Recreation Survey (FHWAR96). In addition, land-use data from the 1992 Natural Resources Inventory (NRI) is used to describe the sites visited by individuals.

Ideally, the actual sites visited by survey respondents, and the physical attributes of these sites, would be used in an econometric model. However, for a number of reasons (survey restrictions, difficulty of matching reported site names with actual sites, and limited biophysical data) we use an indirect measure of site location. In particular, individuals reported the distance and direction to visited sites.[84] When combined with the respondent's zip code, this distance and direction information identifies the subcounty region visited. In addition, the NSRE2000 and FHWAR96 data provided respondent attributes, such as income and age.

These subcounty regions were the "choices" available to each respondent. Formed from the intersection of county boundaries, major land resource area boundaries, and eight-digit hydrological unit code boundaries, these regions are likely to be relatively homogeneous.

The NRI points falling within each of the subcounty regions are used to describe the attributes of each of these recreational site choices. Since the research focused on the impacts of the Conservation Reserve Program, a reduced-form set of variables was used. That is, instead of attempting to identify the various attributes that outdoor recreationists actually care about (such as the number of birds spotted, or the clarity of the stream water), measures of land use within each region were used as proxies for these attributes.

To explicitly account for site attributes, a discrete-continuous model was used to estimate trip-taking behavior.[85] The first stage of the model (the discrete component) is used to predict the probability of visiting different sites (given that a trip is taken). A multinomial logit model is used, with the probability of an individual visiting the j^{th} site (out of J total sites):

$$P(j)= \exp\{V_j)\}\Big/\Sigma_m \exp\{V_m\},$$

[84] Respondents reported one of the eight cardinal directions: North, Northeast, East, Southeast, South, Southwest, West and Northwest.

[85] This discrete/continuous model is similar to the version used in Feather et al., 1999.

$$V_j=\beta_1*TC_j + \beta_2*\ln(M_j) + \beta_3*X_{1j} .. + \beta_k*X_{kj}$$

The individual specific set of j=1..J available sites are the subcounties within 100 miles of a zip code's centroid. β are parameters to be estimated, and $X_1 \ldots X_k$ are site attributes. M is an aggregation correction that controls for the size of the counties.

The second stage estimates total trips taken by the respondent. A Poisson count model is used that includes an "inclusive value," computed using data and coefficients from the first stage. The probability of an individual making q total trips:

$$\text{Prob}(Q=q) = \exp(-\lambda) * \lambda^q / q!$$

$$\lambda = I*\mu + Z\theta$$

$$I= \ln(\Sigma_j \exp\{V_j\})$$

I is the inclusive value, computed using β and site attributes from the first stage of the model. Z are individual socioeconomic characteristics, and θ and μ are parameters to be estimated.

The discrete/continuous models were estimated for several different types of activity (hunting, fishing, swimming, boating, and other water-based recreation). Tables C.1 and C.2 illustrate the results obtained for wildlife viewing (using data from the FHWAR96 survey).

These results indicate that increasing the percent of CRP (in a subcounty area) increases the probability of that subcounty being visited. Furthermore,

Table C.1—First stage (multinomial logit) results for wildlife viewing

Variable	Coefficient	t-statistic
Distance to site	-0.041	-213.5
CRP (percent)	0.527	2.3
Cultivated cropland (percent)	-1.02	-16.8
Non-cultivated cropland (percent)	-0.311	-1.91
Pasture (percent)	-0.10	-1.18
Range (percent)	-1.55	-24.8
Forest (percent)	-0.28	-5.7
Urban (percent)	0.99	17.55
Urbanization index (0=urban to 9=totally rural)	-0.011	-3.3

Number of observations=3,345. Log-likelihood = -93458.7.
Source: Economic Research Service, USDA, using NSRE data.

Table C.2—Second stage (Poisson) results for wildlife viewing

Variable	Coefficient	t-statistic
Constant	0.12	0.65
Inclusive value	0.195	9.3
Income	-0.0063	-2.1
Male dummy (1 if male)	-0.120	-7.0
Years of schooling	-0.020	-7.03
Age	0.0093	20.0
Race dummy (1 if white)	0.094	2.6

Number of observations=3,029. Log likelihood=-21252.7.
Source: Economic Research Service, USDA, using NSRE data.

an increase in CRP will increase the inclusive value, which will have a positive impact on total number of wildlife viewing trips taken.

To compute the CRP's impact on recreational expenditures, the CRP percent variable is set to zero, and other land-use variables are adjusted (using the land-use prediction model described in Appendix B). Then, using the coefficients from both steps, the predicted number of recreational trips is computed. The difference between the observed number of trips and the predicted number of trips is then multiplied by per trip expenditure data (that was gathered as part of the FHWAR96 and NSRE2000 surveys).[86] This product, after suitable weighting (using sample-to-population weights included in both surveys) is the "trips-based" estimate of the CRP's impact on recreational expenditures. As noted in the text, the net result was quite small, with a national value of about $7 million.

Although this methodology is grounded in actual observations on recreational trip-taking, along with data on actual land uses, this methodology suffers from a number of problems. In particular, the use of "subcounties" as destinations will introduce aggregation bias. Hence, our predicted impacts are not likely to be robust, and may be highly biased.

The Receipts-Based Method

As an alternative to the empirically based, but possibly biased, trips-based method, a receipts-based estimate is also constructed. This uses information on money received by farmers as payment for recreational access to their land.

The following question from the 2000 ARMS survey is used:

> "In 2000, what was the total income received by you for recreation, such as hunting, fishing, petting zoos, horseback riding, on-farm rodeos, etc."

Of 10,309 ARMS respondents in 2000, 1,139 had some CRP land. After applying population weights, this subsample of 1,139 represents:

- About 100 million acres of land, including approximately 33 million acres of CRP land.
- Recreational receipts of about $39 million (out of about $750 million received by all farmers)

Dividing recreational receipts by CRP acres yields approximately $1.20 per acre.

The next step is to account for expenditures other than for access fees. One measure can be derived by assuming that the average hunter will spend money on access fees in fixed proportion to expenditures on all other hunting-related goods and services. Using the FHWAR96 data, average expenditures by small game and migratory waterfowl hunters were computed for several sectors: food and lodging, transportation (public and private), trade goods (cooking fuel and ammo), and services (lease payments, guide payments, equipment rentals, boating costs). Sector-specific expansion factors are computed as the ratio of sector expenditures

[86] More precisely, several categories of per trip expenditures are used, including food, transportation, lodging, special equipment, and guide services. Some classes of expenditures, such as purchases of guns and other equipment, are not included on the assumption that hunters would purchase these things even if CRP did not exist.

over access fees. For example, if total access fee expenditures for a region were $2 million, and expenditures on food and lodging were $5 million, then the regional "food and lodging expansion factor" would be 2.5. These data are used to compute sector expenditures on a per county basis, using:[87]

Sector-expenditures = crp-acres * access_fee_receipts_per_acre * sector_specific_expansion_factor

Summing sector expenditures for the entire nation and all sectors yields a value of about $146 million. However, this only accounts for hunting and does not consider wildlife viewing. To more fully capture the impacts of CRP, we double this amount, yielding a "wildlife-related" impact of approximately $290 million.

This doubling is based on the following:

- FHWAR96 data indicate that about 75 percent of hunting trips occur on private lands. Therefore, fees for access to private lands should capture a component of most hunting trips—or, more precisely, average fees will capture a component of a representative hunting trip.
- Conversely, about 80 percent of wildlife watching occurs on public lands. Thus, access fees paid to private landowners are less likely to be an important component of wildlife-watching trips.
- This does not mean that CRP is unimportant for wildlife watching, since wildlife viewed on public lands may depend on nearby CRP lands.
- From FHWAR data, about one-quarter of all small-game hunting trips are for pheasant hunting.[88]
- According to Feather et al. (1999), the positive impact of the CRP on pheasant hunting was about one-quarter of CRP's impact on wildlife viewing ($80 million versus $347 million).
- Thus, if CRP's impact on all small-game hunting trips is similar to CRP's impact on pheasant hunting, then the expenditures on wildlife viewing due to the CRP will equal the expenditures on small-game hunting.

There are a number of factors that may bias the receipts-based method. These include factors that may lead to underestimates or overestimates. Since water-based recreation impacts are not accounted for, the receipts-based method underestimates CRP's impact on recreational spending. Furthermore, hunters who are given free access to CRP land are not explicitly accounted for (even though they, too, will be spending money on food, lodging, etc). On the other hand, the receipts-based method attributes all recreation expenditures to farmers who have any CRP land to their CRP acres, even though CPR accounts for less than half of their land. This may overestimate CRP's importance. Furthermore, all recreational receipts are assumed to be a function of CRP enrollment even though some activities, such as corn mazes, may not depend on having land retired from production.[89] Finally, activity substitution is not accounted for—it is assumed that if the CRP were terminated, then all related recreational expenditures (such as for gas and transportation) would cease. Since a substantial percentage of the recreational fees collected by farmers are probably from local hunters and recreationists, this assumption probably leads to overstated CRP impacts.

[87] The (average) per acre access fees and the sector-specific expansion factors are computed for each of the 10 census regions.

[88] Earlier work also suggests that one-quarter of CRP's small-game benefits are from pheasant hunting (Ribaudo et al., 1990).

[89] Evidence from a North Dakota survey of farmers suggests that about three-fourths of farmer receipts from recreationists are from hunters (Hodur et al., 2002).