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ECONOMIC INCENTIVES VERSUS ATTITUDE FOR PROMOTING WATERFOWL HABITAT

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The North American Waterfowl Management Plan (NAWMP) was formally initiated in 1988 with the goal of restoring North American waterfowl numbers to their mid-1970s level. One objective of NAWMP is to encourage farmers to maintain potholes and native upland nest cover as opposed to putting them into production. The Prairie Pothole Project (PPP) is a pilot project of NAWMP and it's goal is to "evaluate financial and program incentives designed to preserve and enhance waterfowl habitat on private land". Since Saskatchewan accounts for 34% of the mallards and 25% of the total number of ducks in North America (Russell and Howland), farmers in the RM of Antler were encouraged to enter into agreements with the Saskatchewan government to change their farming practices.

There are two types of agreements--license (noncultivated) and lease (cultivated). License agreements require farmers to set aside 15 acres of wetlands (the area covered by water in the spring) plus an equivalent or greater amount of uplands. The amount paid to the farmer depends upon the ratio of uplands to wetlands, the contract period and the level of use that is permitted. The highest payment is $10/ac/year on idled land, with a 3:1 ratio of uplands to wetlands and under a 10-year contract; the lowest payment is $2.00/ac/year for a 1:1 ratio, full use and 5-year contract. (All license agreements have a 90-day cancellation clause.) License agreements were used to successfully secure 13,550 acres of native habitat at an average cost of $4.20/ac. This represents approximately 30% of the total unimproved habitat in the RM, 79% of the native privately-owned uplands and 13% of the native noncultivated wetlands (Russell and Howland).

The Prairie Pothole Project has not faired as well in securing lease agreements--40-acre dense nesting cover (DNC) plots located on prime agricultural land, seeded to nest cover by PPP staff and enclosed with a predator fence. Farmers enter into a 10-year agreement that is renegotiated every three years, are paid $30/ac/yr and there is a caveat placed on the land title. Farmers were initially offered $25/ac per annum for a 10-year lease agreement, but this fee was later raised to $30/ac as the Project had trouble securing DNC sites at the lower fee. Two sites were voluntarily secured at the lower rate, with an additional two secured at the higher rate. As this was not considered adequate, five marginal sites were subsequently identified and four of these were secured at $30/ac/year, although two of these were 160 acres in size but they were not fenced. There are currently also two fenced 80-acre DNC plots in the Pothole Program.

The current research was initiated to determine the success of the pilot project. The results of this research indicate that, because inadequate attention has been paid to economic factors, the current Pothole Project needs to be substantially modified if it is to achieve the aims of the NAWMP. In this paper, we present the results of a survey of farmers in the region and suggest what this implies for the Prairie Pothole Project.

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General Description

During June and July, 1988, personal interviews were conducted in the RM of Antler. The questionnaire and a summary of the variables collected are found in Van Kooten and Schmitz. Of the 67 completed interviews, 38 respondents indicated that they had at least one PPP agreement. Only 5 respondents had a lease agreement and of these 4 also had other agreements.

Cattle operations and the number of beef cattle have generally declined in the region partly due to government programs and expectations that grain prices would remain high starting in the 1970s. This has clearly added to the problem of duck habitat in the area. However, respondents did indicate that they drained or cleared a total of 1,535 acres since January 1, 1986; this represents about 58% of all the land that respondents indicated as feasible for draining or clearing. However, fully 50% of all land that was cleared or drained since 1985 had recently been purchased. Finally, on average respondents indicated that 5.9% of their cultivated land had been in potholes within the previous 10 years.

Attitudes and an Economic Scaled Score

One purpose of the current research is to try to understand the impact of attitudes in decisions regarding agronomic practices that either are or are not conserving of waterfowl habitat. The reason for the emphasis upon attitude is that the PPP relies upon cultivating a positive attitude toward the preservation of waterfowl habitat. Thus, there is a believe that educational programs are an important factor in changing agronomic practices and getting farmers to enroll in the Project, thereby saving duck habitat at minimum cost. In the questionnaire,respondents were asked to provide reasons for participating or not participating in various agreements, and these were rated on a Likert-type scale (Kerlinger). Subsequently, the responses were used to constuct two multi-item, scaled scores, one consisting of economic factors and the other of attitudinal factors (see Van Kooten and Schmitz). Multi-item scores were obtained by summing across reasons, dividing by the number of reasons in the category and then normalizing so that the individual scores take on values between 0 and 1.

In order to assess the measurement reliability of the multi-item scores, Cronbach's alpha (Nunnally) is calculated as follows: $\alpha=K/(K-1)\ [(VS-\Sigma V)/VS]$, where K is the number of items in the score, VS is the variance of the sum of the items in the scale (variance of the score) and ΣV is the sum of the variances of the items. An alpha value greater than 0.5 is often suggested, but 15% of empirical research reported in recognized journals does not meet this criterion (Anderson and Coughlan). The α values are a modest 0.461 for the economic score and 0.530 for the attitude score.

Twenty-two respondents did not participate in the Pothole Project; their average economic and attitude scores for not participating are 0.433 and 0.452, respectively. Thirty-eight respondents participated in the Pothole Project; their respective average economic and attitude scores for participating are 0.477 and 0.591. There appears to be no significant difference between the average economic scaled scores of the two groups, but a significant difference between the attitude scores. This suggests that

the decision about participating in the PPP does not occur for economic reasons, but rather for noneconomic ones. However, since there are a variety of different agreement types, it is not clear that simply making a comparison between those who have an agreement and those who do not is sufficient. Therefore, we use the multi-item scores as an explanatory variable in the statistical analyses and test the hypothesis that attitudinal factors are statistically important in determining participation.

Participating in Pothole Agreements: WTP and WTA

To determine the opportunity cost of establishing a DNC plot, or of not draining a non-permanent slough, it is necessary to compare the return that a producer can obtain by draining a pothole (no DNC plot) with the return that same field provides if a part of it remains in wetlands (has DNC plot). Included in this comparison are the returns from government programs and payments from the Pothole Project, as well as grain prices and farming costs. It is not only necessary to take into account the extra cost of driving around the "obstructions" (costs of extra turns include labor time, fuel, etc.), but also the negative utility associated with the aggravation of avoiding field obstructions. In order to capture these costs, and thereby obtain a better estimate of the payment required to induce farmers into participating in the Pothole Project, respondents were asked about their willingness-to-pay (WTP) and willingness-to-accept (WTA) compensation for certain types of land use restrictions.

Using contingent valuation procedures, respondents were directly asked about their WTP and WTA compensation. In particular, they were asked to respond to the following questions:

> "(i) Currently, the law prevents the draining of sloughs or other waterways unless the body of water is entirely on one's own property and the water is not drained off one's own land. Effectively, consolidation of sloughs is the only form of drainage permitted. Suppose the government now has in place heavy annual fines of $10,000/wetland area upon farmers who drain wetlands that do not lie entirely within their own property or drain water onto neighboring lands or into creeks without permission. Suppose also that the government would be willing to sell you the right to drain your slough. In that case, how much would you be willing to pay the government for permission to drain a 15-20 acre slough?
> (ii) The government is unlikely to charge you for the right to drain a slough on your own land. However, it may be willing to pay you to prevent you from draining and farming a slough and surrounding area totalling 30-40 acres. How much would the government have to pay you to prevent you from farming the slough and surrounding area?"

The first question is an attempt to elicit WTP, while the second attempts to elicit WTA. Fifty-seven respondents provided an answer to the first question, while 44 provided a response to the second. The average WTP for the 57 respondents was $3.90/ac per annum, while the average WTA compensation for draining a small slough and surrounding uplands for the 44 respondents was $26.80/ac per annum. Given that the maximum payment for keeping a slough and surrounding uplands idle is $10/ac per year, it would appear that the compensation provided under the PPP might not be sufficient

to prevent farmers from draining sloughs and burning the surrounding growth. Thus, one would expect farmers to enter into Project agreements only for permanent potholes and for wetlands and their associated uplands when they can earn income on that land in addition to payments from the Pothole Project. This is precisely what Russell and Howland suggest is happening.

We attempt to explain WTP and WTA by regressing each on available socioeconomic variables using a simple linear model and OLS regression. Explanatory variables were eliminated from the model when the t-statistic on the estimated coefficient was less than 1.0. The results are provided in the first two columns of Table 1. WTP for draining a slough is positively and significantly related to income as expected. However, WTP is negatively related to the number of acres of summerfallow and pasture, although the latter variable is not statistically significant as a determinant of WTP. The negative coefficient on summerfallow acres may indicate a negative relationship between water availability and the need to summerfallow. That is, greater summerfallow acres indicate a need for moisture and, hence, less sloughs to be drained; then the WTP to drain a slough would also be reduced.

WTA compensation for not draining a slough and not cutting or burning an associated uplands is postively related to the farmer's measure of risk averseness, debt ratio, income and age, and the number of acres in pasture, but negatively related to the number of acres in summerfallow. While the relationship between summerfallow and WTA is likely similar to that indicated for WTP, it is surprising that both age and risk averseness are positively related to WTA. As age and risk averseness increase, the amount the farmer is willing to accept as compensation from the Project must be increased. That is, older farmers appear to require greater compensation for participating in license agreements than young farmers, and participation in such agreements is not seen as a method for reducing risk.

Fifty individuals responded to the question regarding their WTA compensation for establishing a hypothetical 40-acre DNC plot on prime agricultural land. The question that was posed is as follows:

> "Suppose the government is willing to pay you to place 40 acres of prime agricultural land in the middle of a larger field at their disposal for a period of 15 years. A fence will be built around this land and you cannot farm it; rather, you will be required to drive around the fenced off area. How much would the government have to pay you to place such a large parcel of land at their disposal? In other words, what is your bottom line?"

The average WTA compensation for establishing such a plot was $61.80/ac/year.

The results of the OLS regression for WTA compensation for a hypothetical DNC plot are provided in the last column of Table 1. It is clear that WTA compensation rises inversely with the debt ratio suggesting that one would have to pay farmers with a higher debt ratio less to take prime land out of production than farmers with a lower debt ratio. However, more risk averse farmers need to be compensated more to keep land in waterfowl habitat. The higher the economic score of the respondents, the greater is the amount of compensation that is required. While those with a more positive attitude toward the Program are willing to accept a lower level of compensation, this

variable is not statistically significant. Education levels are inversely related to WTA compensation indicating that, if more educated individuals better understand the need to preserve waterfowl habitat, there is evidence to support attempts to educate farmers about the Program.

Participating in Pothole Agreements: Logit Analysis of Factors

While economic factors are hypothesized to be the most important determinant of participation, there is some evidence provided above to indicate that, while this may be true for lease agreements, it may not be true for license agreements. Indeed, attitude may be more important in determining participation than economic factors in the latter case. Hence, in addition to economic parameters, we examine ethnic origin, age, education, attitude and other factors that may help to explain decisions. The purpose is to determine those factors that are statistically significant.

A logit model for distinguishing between those who did and those who did not participate in any of the PPP agreements was initially estimated. The regression results are presented in the first column of Table 2. The results indicate that the availablility of pasture land, the degree of livstock income, the attitude score and ethnic origin are important in determining whether an agricultural producer participated in the Pothole Project. Variables such as income, the debt ratio, age, number of dependents and risk attitude, and education could not explain farmer participation in a statistical sense. The expected probability of taking part in the program increases as the proportion of total farm income derived from livestock increases and as the number of acres of available pasture increases.

The economic score does not explain participation, while attitude is a statistically significant variable explaining farmer participation in the Project. Indeed, the more positive a farmer's attitude toward the program, the greater is the likelihood that he takes part. PPP staff indicated that farmers of French descent tended to be less concerned about waterfowl habitat and, thus, less likely to support the Project. The regression results provide some support for this view.

Since the majority of those signed up for the PPP tend to have a license agreement, the regression results go further in explaining participation in noncultivated land agreements than would otherwise be the case. In order to get a better feel for the factors that explain participation, we conduct similar analyses for (i) DNC plots (license agreements), (ii) idled, noncultivated land, and (iii) noncultivated land in full or modified use. The respective results of these analyses are found in the last three columns of Table 2.

The Pothole Project has experienced some difficulty in securing DNC agreements (Russell and Howland). A reason suggested for this problem is the inadequate compensation paid to producers. Although the dependent variable in the regression has only 5 observations, the regression turns out to have fairly good explanatory power. Sociological factors such as age and education were included in the initial regressions, but such variables turned out to be statistically insignificant and, therefore, dropped from the final regression. Ethnic origin also turned out to be an insignificant explanatory variable. The results indicate that differences between those who have and those who do not have a DNC plot can be explained only by economic

factors, namely, gross income and the economic score. Even attitude turned out to be statistically insignificant. Although the probability of having a DNC plot increases with 1987 gross farm income, the estimated coefficient is only weakly significant from a statistical viewpoint. More importantly, the chance of having a DNC plot increases with the view that the farmer has about the economic consequences of a DNC plot. This indicates one of two things: (i) those who have a DNC plot felt they earned a reasonable return on the set-aside land, or (ii) only those in a more favorable economic position (one where earnings or losses from having a DNC plot are small relative to overall net farm income) are willing to accept a DNC agreement.

A binary dependent variable for participation in noncultivated, idle agreements was constructed by taking all those with such an agreement, regardless of any other agreements they might have, and assigning a one to the variable in that case and a zero otherwise. The final results of the logit regression appear in the third column of Table 1. It appears that three variables explain participation in this type of an agreement, namely, the debt ratio, the number of acres of pasture land and the economic score, and each of these variables is significant at the 0.05 level. The likelihood that a producer participates in such an agreement increases with the number of acres of pasture on the farm and the economic benefit that the farmer believes he or she receives from the agreement. Surprisingly, participation also increases with the farmer's debt ratio; those with a higher ratio tend to favor this agreement.

Finally, we examine participation in noncultivated, full or modified use agreements (last column of Table 2). The estimated model does not predict as well as the model for idled noncultivated land. Both the economic and attitude scores are statistically significant at the 0.075 level, but these are the only statistically significant variables in the model. The sign of the coefficient on economic score suggests that participation declines as economic factors (primarily project payments) rises, suggesting that the value of the land in pasture has also increased. However, the chance that a producer takes part in such an agreement increases as the farmer's concern about noneconomic factors (concern for wildlife, security offered under the program, etc.) or attitude rises. The debt ratio has an impact opposite to that in the case of participation in noncultivated, idle agreements, perhaps because those with a higher debt ratio prefer not to be bothered with agreements that require them to somehow use the land. Finally, some support is provided for the a priori notion that farmers who rely more on income from livestock prefer full or modified, noncultivated agreements.

Conclusion

The results of this analysis confirm what many agricultural economists already know from experience; namely, adequate economic incentives are the most important factor for encouraging preservation of waterfowl habitat. The remaining tasks are to convince non-economists of the importance of economic factors and to get them to work with economists from the beginning when designing natural resource programs.

Table 1: OLS Regression Results for WTP and WTA Models[a]

Variable	Model: Draining of Sloughs WTP	Draining of Sloughs WTA[b]	DNC Plot WTA[b]
CONSTANT	-3.659	-55.963	78.878
	(-0.67)	(-1.54)	(4.04)
Risk Averseness	-	21.828	36.370
	-	(1.20)	(2.21)
Debt Ratio	-	17.250	-32.820
	-	(1.07)	(-2.52)
Log of Estimated 1987	1.011	3.381	-
Gross Income	(1.97)	(1.63)	-
Acres of Summerfallow	-0.016	-0.095	-
	(-2.37)	(-2.93)	-
Acres of Pasture	-0.012	0.054	-
	(-1.33)	(1.29)	-
Economic Score	-	-	76.872
	-	-	(3.32)
Attitude Score	-	-	-41.848
	-	-	(-1.46)
Age	-	1.159	-
	-	(2.60)	-
Education	-	-	-3.437
	-	-	(-2.46)
Number of Observations	56	38	30
R^2	0.157	0.377	0.516
SSR	2,064.05	17,668.96	9,790.30
SEE	6.300	23.874	20.197

[a] t-statistics in parentheses

[b] All observations on WTA are used, but the maximum WTA is $75/ac/yr for noncultivated land and $100/ac/yr for DNC plots. See footnote 12.

Table 2: Logit Analysis of Participation in Various Pothole Project Ageements

Explanatory Variable	Model			
	Overall Participation	DNC Plot	Noncultivated Idle	Noncultivated Mod./Full Use
CONSTANT	-10.283	-5.769	-23.913	-1.095
	(-2.82)[a]	(-3.21)	(-2.25)	(-0.74)
Estimated 1987 Gross	-	6.146	-	-
Farm Income ($mil)	-	(1.49)	-	-
Debt Ratio	-	-	9.533	-1.782
	-	-	(2.26)	(-1.27)
Proportion of Income	4.674	-	-	3.124
from Livestock	(1.65)	-	-	(1.30)
Acres of Pasture	0.025	-	0.057	-
	(3.07)	-	(2.14)	-
Economic Score	-	4.850	20.795	-4.237
	-	(2.05)	(2.10)	(-2.03)
Attitude Score	11.399	-	-	5.416
	(3.07)	-	-	(1.93)
Operator's Education	0.266	-	-	-
	(1.30)	-	-	-
Ethnic Origin	-1.664	-	-	-
	(-1.62)	-	-	-
Number of Observations	60	60	41	41
Number of Participates	38	5	8	18
$-2\ln\lambda$	42.915	6.281	28.751	12.324
Critical Value of Chi-Square at $\alpha=0.05$[b]	11.071	5.991	7.815	9.488
Psudo-R^2	0.537	0.177	0.710	0.219

[a] t-statistics provided in parentheses

[b] Degrees of freedom equal k-1, with k the number of estimated parameters.

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Confidence Intervals for Welfare Estimates From Recreation Demand Models

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This paper investigates the use of bootstrapping procedures to estimate the statistical precision of point estimates of consumer welfare obtained from traditional recreation demand models. In a prototype recreation demand study, a functional form for demand is chosen and parameters of the model are estimated. The estimates are then used to calculate Marshallian consumer surplus or the more exact Hicksian measures of compensating or equivalent variation. Typically, no measure of the precision of the welfare estimator accompanies these point estimates. Finally, recommendations for policy or project decisions are based on the value of these point estimates.

Basing recommendations on welfare estimates about which confidence intervals are unknown does not seem to be a desirable state of affairs. This paper suggests improvements in this basic methodology using bootstrapping techniques. Bootstrapping is a technique for assessing the variability in an estimate using only the data at hand by "resampling" the original observations. A variation of the bootstrapping methodology has recently been introduced to applied welfare analysis by Graham-Tomasi, Adamowicz and Fletcher (G-TAF) and Adamowicz, Fletcher and Graham-Tomasi (AFG-T).

In this paper, we illustrate and analyze use of the bootstrap to construct a confidence interval around a point estimate of welfare. Unlike G-TAF and AFG-T, we analyze a variety of welfare estimators and use a Monte Carlo framework wherein we can evaluate the performance of the bootstrap in a variety of empirical settings. We also propose and evaluate an adaptation of the basic bootstrap methodology using inequality constraints that appears to address and reconcile some significant problems raised in the G-TAF and AFG-T analyses.

Consumer Welfare Estimators

To make the scope of this study manageable, we focus specifically upon the linear and semilog demand functions. These are the most commonly used functional forms in recreation analysis (McConnell and Bockstael and Strand (BS)), and both are compatible with utility maximization (Hanneman). The specific functions we work with are as follows:

$$(1) \qquad X_i = a + bP_i + cY_i + u_i,$$

$$(2) \qquad X_i = \exp(a + bP_i + cY_i + u_i),$$

where X_i is the quantity consumed of the relevant good by the i^{th} individual, P_i and Y_i are, respectively, his nonstochastic normalized price and income. The total Marshallian consumer surplus, $cs(P_i)$, measuring the entire area under the demand curve for a given price can be written $cs(P_i) = -X_i^2/(2\beta)$ and $cs(P_i) = -X_i/\beta$ for the linear and semilog demand functions respectively. Expressions for the consumer surplus associated with a small price change or deadweight loss can also be explicitly expressed as can the associated Hicksian measures (Bockstael, Hanemann and Strand (BHS)). In empirical work, the parameters and the disturbance vector must be replaced by statistical estimates to be denoted by $\hat{\theta}=\{\alpha, \beta, \gamma\}$, and $\epsilon = \{\epsilon_1,\ldots,\epsilon_n\}$, respectively.

Because α, β, and γ, are random variables, the various welfare estimators are also random variables and generally involve some form of ratio of random variables. As is well known (e.g., see Mood, Graybill, and Boes), no simple exact formulae exist for the mean and variance of ratios of random variables. Approximation formulae can be derived based on Taylor's series expansions. For example, for the estimated total Marshallian surplus, $\hat{cs}$, for the linear demand, a Taylor's series approximation to the variance can be written:

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