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PERC Graduate Fellowship Research Proposal

**Motivation**

As sustainability goals evolve and influential policy decisions are made, it is essential that economists aim to provide high quality, verifiable estimates of the nonmarket benefits from these decisions, typically measured as willingness to pay (WTP). One such method for nonmarket valuation is the contingent valuation method (CVM), which uses survey instruments to effectively ask whether individuals are willing to pay a certain amount of money for a hypothetical amenity. CVM is frequently used to measure the values of goods or policies that do not yet exist (e.g., climate change measures, water quality programs, and wildlife management policies). Although CVM has become widely accepted, there remain some concerns about its reliability. A primary concern—given CVM does not actually require respondents to interact with the good—is whether an individual’s stated WTP would equal their “true” WTP if it were revealed through the market. Despite these concerns, it is necessary to use CVM because revealed prices are not always available for the good being valued. Thus, improving the reliability of CVM results is a pressing matter if we expect them to guide policy decisions.

There has been a growing body of research on best practices for CVM. A common recommendation involves scope testing to verify CVM results (Arrow et al., 1993; Johnston et al. 2017). The goal of scope testing is to examine whether WTP for an amenity varies with the change in quality or quantity of the good being provided.

Our primary contribution is toward improving the understanding of CVM validity testing in the specific context of rationed goods, i.e., a good whose quantity is fixed and is divided among individuals. Access to outdoor recreational activities is often rationed to conserve natural resources. For example, quotas on angling and hunting limit total harvest of fish and wildlife, and “bag limits” cap the harvest per person so that species can be harvested without populations declining. I focus on the specific example of permits for sandhill crane hunting in Indiana. Harvest of sandhill cranes is currently illegal in Indiana, but the Indiana Department of Natural Resources (IDNR) is considering establishing a hunting season. The IDNR would set a quota that limits the total harvest for the season and a bag limit which limits harvest per individual. I expect that hunters get utility from harvesting more cranes, so that the hunter will choose to buy a permit if the utility they receive from the expected harvest given the quota and bag limit outweighs the utility without the permit.

A scope test should show that WTP increases with expected harvest. However, hunters buy a permit, and hence the *chance* to harvest sandhill cranes, rather than purchasing sandhill cranes directly. Further, the expected harvest depends on the permit attributes. Credibly testing for scope effects therefore requires demonstrating a systematic relationship between changes in these attributes and changes in WTP for the permit. Yet testing for these relationships is not straightforward. As the quota increases, each hunter can expect a greater harvest all else equal. But this may induce more hunters to purchase a license, increasing competition for limited harvests. Likewise, increasing the bag limit may decrease the likelihood that an individual fills their own bag limit before other hunters’ harvests trigger the quota. This may induce fewer hunters to purchase a license, reducing competition and offsetting the effect of increasing the bag limit. Hence, changing bag limits and quotas may have countervailing impacts on expected harvest, and thus on WTP, which could make respondents appear insensitive to scope (Lancaster et al., 2024). This makes it challenging to know whether to use bag limit or harvest quota as the relevant parameter in our scope test.

I design a theoretical model that decomposes the effects of changing bag limit and harvest quota on WTP. I show that there are countervailing impacts of changing the permit on expected harvest that can mask scope effects: (i) a “direct effect” from changes in the bag limit or quota and (ii) a “congestion effect” from changes in the number of hunters caused by changes in the bag limit or quota. I find that congestion effects may attenuate WTP if the quota is binding, which could make respondents appear insensitive to changes in the permit. I also find that changing the bag limit has a more significant effect on surplus values than the quota, suggesting that it is a more appropriate parameter for scope testing.

Our secondary contribution is estimating WTP for sandhill crane hunting in Indiana. Legalizing hunting may generate economic value in the state. Prior research has highlighted the value of sandhill cranes from birdwatching (Huber & Sexton, 2019; Stoll et al., 2006) and conservation (Boyle et al.,1994). Understanding the value of recreational hunting is important because sustainable management of fish and wildlife relies on money generated from permit sales. Twenty-nine percent of funding of the Indiana Division of Fish & Wildlife (DFW) comes from license sales, making angling and hunting permit sales significant source of funding of conservation efforts in Indiana (IDNR). To our knowledge, no prior research estimates use values for this species.

**Approach**

I begin by deriving a model of hunter behavior under different sandhill crane hunting permit designs. Assume a hunter gets utility from harvesting sandhill cranes. The expected harvest of cranes depends on the characteristics of the permit, which include bag limit, *b*, harvest quota, *Q*, the number of licensed hunters pursuing cranes, *N*, the permit price, *l*, and other unobservable attributes. Assume that permit price is fixed at l such that N > Q is the number of people in the market for a crane permit. Permits are assigned via a random lottery, so probability a respondent receives a permit is p=Q/N.

Let the utility of a hunter who does not purchase a permit be

1. ,

where *W* is a vector of personal attributes, *y* is income, and *ϵ*0 is a mean-zero i.i.d. shock with a symmetric density function. A respondent who attempts to purchase a license receives expected utility,

1. ,

where *Z* is a vector of personal characteristics that only affect expected harvest. A hunter will attempt to purchase a permit if the utility from having it exceeds that of not having it. The probability this occurs is

where and .

If the total number of registered hunters is . Then and . I substitute this into (3) and integrate over the joint distribution of *W* and *Z* to get,

where a hat (^) denotes an estimate. Following the contraction mapping approach in Timmins and Murdock (), I conduct a counterfactual analysis to solve for the equilibrium in equation (3’) for any given changes to *b*, *Q*, and *l*.

With observable values of *l*, *q*, , and *b,* I can estimate WTP under different bag limits and harvest quotas. The WTP for a license satisfies . Totally differentiating WTP with respect to the bag limit and quota yields,

Next, I derive the signs of ∂p⁄∂b and ∂p⁄∂Q, which appear in equations (4) and (5) respectively. and using the fact that, *,* and , this is equivalent to .

I expect that elasticity would be positive (all else equal, a greater bag limit should be more appealing to people, inducing greater participation), and hence . This implies that greater responsiveness to changes in the bag limit (i.e., a bigger ) should drive smaller scope effects since will be closer to zero in that case.

Secondly, we can evaluate ∂p⁄∂Q as follows, using the fact that, *,* and .

where is an elasticity of demand (captured by *π*\*) with respect to the quota. The sign of ∂*p*/∂*Q* and, hence, , depends on how responsive participation/demand is to changes in the quota. If , then we would expect small (and perhaps insignificant) scope effects from changing the quota. Intuitively, if increasing the quota proportionally raises demand, then the effect on *p* from changing the quota should be small. Since the quota only affects utility via changes to *p*, if the probability of getting a permit does not change with the quota, then willingness to pay for the permit should not change either. If participation is highly inelastic (i.e., ), then I expect and, hence, there should be significant scope effects. Increasing the quota would increase *p* in this case, without the attenuating effect on participation *π*\*. Finally, if , then ; increasing the quota significantly increases the attenuating effect of participation, swamping the increase in the success probability from raising *Q*.

This equation says the effects of changes in bag limit and harvest quota on WTP can be decomposed into two effects, which I call direct and congestion effects. Direct effects, , are the effect of changing bag limit or quota on the expected harvest. Congestion effects, , explain how increasing the number of hunters changes expected harvest.

As a preliminary step, I use data from nearby states where it is legal to hunt sandhill cranes to calibrate a numerical simulation based on our theoretical model. I find that expected harvest is increasing in the quota*,* . However, the sign of depends on whether the quota is binding. When the permit quota is binding, the negative congestion effects of changing the bag limit may attenuate the overall WTP for the permit. This is important because a scope test does not disentangle these effects so it may appear that hunters are insensitive to scope, bringing into question the validity of the CVM results. A sensitivity analysis finds that changing the bag limit has a much larger effect on surplus values, which indicates that varying the bag limit is more likely to generate statistically significant scope effects than varying the quota, particularly given anecdotal evidence that the Indiana quota will likely not be binding.

**Application**

I estimate WTP for a sandhill crane permit using survey data collected from a sample of waterfowl hunters in Indiana. The survey will be administered in Febuary 2025 to a sample of 3,274 Indiana residents who hunted geese during the 2023-2024 season. The questionnaire is divided into four sections. The first section gathers information about respondents' experience with hunting waterfowl and other migratory game birds in Indiana. The second section provides information about sandhill cranes and presents two hypothetical permits, from which we elicit their willingness to pay. Section 3 collects data on their expenditures related to waterfowl hunting, and Section 4 asks for demographic information.

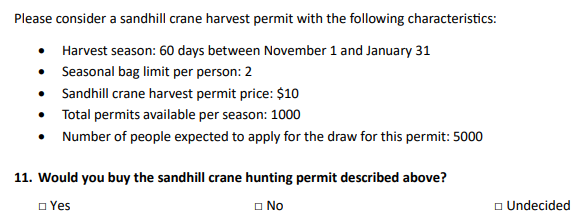
An example of the contingent valuation questions is shown in Figures 1. Before presenting the permit, I ask respondents to imagine that sandhill crane hunting is legal in Indiana and provide some details about how the permit would work. I then present a permit and ask them to consider its characteristics, responding as if it were a real permit. Afterward, I ask whether they would purchase the permit and, if not, ask about the reasons for their decision. Figure 1 demonstrates an example of the permit, though respondents may be shown different permit attributes, as I vary them as part of my identification strategy. Next, respondents are shown a second permit with different attributes, and again asked whether they would purchase it and, if they answer ‘No,’ to explain why.

Figure 1

**Next Steps**

I will have the data from the surveys by the time I begin the fellowship, so my next steps consist of the analysis and write up of my results. This paper will be part of my second year Prospectus and fourth year Dissertation.

**References**

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