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Analysis

Using an intervention framework to value salient ecosystem services in a stated preference experiment

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ABSTRACT

To estimate the value of an improvement in the provision of an ecosystem service, analysts often use an intervention framework in a stated preference experiment. An intervention framework is defined by (i) an intervention, such as a publicly-funded program, and (ii) the intervention effect — the difference in the provision of the ecosystem service with and without the intervention. The contention of this paper is that if the purpose of an experiment is to estimate the value of the intervention *effect*, rather than the intervention itself, consideration needs to be given to the saliency of the service to the respondent population, because for salient services respondents often have prior beliefs about the intervention effect, and if these prior beliefs are different on average than implicitly assumed or explicitly presented in the choice experiment, the estimate of the value of the improvement will be biased. We emphasize that in some cases a structural model can be used to identify the value of the intervention effect, whereas for others, only the value of the intervention can be identified. We illustrate the issue using two case studies concerning ecosystem service provision on freshwater lakes, prevention of aquatic species invasions, and fish habitat enhancement.

1. Introduction

Ecosystem services vary in their saliency to the people who benefit from them. Consider, for instance, biological diversity on the one hand, and a lake's fish population on the other. Biological diversity promotes the resiliency of natural ecosystems to external shocks in a manner that clearly benefits people (Tilman, 1996; Worm et al., 2006), but this benefit is lost on most non-scientists. In contrast, a lake's fish population is a prominent and easily understood ecosystem service, where recreational anglers often have strong if not always correct beliefs about its current and future state. To estimate the value of an improvement in the provision of an ecosystem service, analysts often use an intervention framework in a stated preference experiment. An intervention framework is defined by (i) an intervention — usually a public program to improve the provision of the ecosystem service, such as a program to conserve open space, to protect an endangered species, etc.; and (ii) the intervention effect — the difference in the provision of the ecosystem service with and without the intervention. Intervention frameworks are often favored in stated preference experiments because they create a decision environment that is sensible, if not completely familiar, to the respondent. The contention of this paper is that if the purpose of an experiment is to estimate the value of the intervention *effect*, rather than the intervention itself, the analyst needs to give consideration to the saliency of the service to the respondent population, because for salient services respondents often have prior beliefs about the intervention effect, and if these prior beliefs are different on average than implicitly assumed or explicitly presented in the valuation exercise, the estimate of the value of the improvement will be biased.

Failure to properly identify a respondent's beliefs about the intervention effect implies that the analyst can only identify the average WTP for the intervention itself and *not* for the differential provision of the ecosystem service embedded in the intervention effect. So, for instance, the analyst might ascertain the average WTP for a particular climate change mitigation *program* (the intervention), but without insight to the respondents' understanding of how climate will change in the absence of the program, the analyst is unable to make a claim about the value of the climate change mitigation attached to the program. In some circumstances this can be quite sufficient. For instance, in program benefit–cost analysis the analyst's objective is to determine how much a respondent is willing to pay for a program; the underlying intervention effect used by respondents to arrive at their valuations might be a matter of interest, but it's not critical to the objective. But often the analyst is interested in the intervention *effect* — the value of the differential provision of the ecosystem service: the expected loss from an aquatic species invasion, the value of a particular amount of biodiversity enhancement, the benefit of mitigating a particular aspect

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of climate change, and so forth. In these cases the intervention is primarily a vehicle to understand the value respondents place on ecosystem improvement, and so the analyst must accurately gauge the respondents' understanding of the improvement provided by the intervention. This paper develops this point and presents two case studies to demonstrate that as a practical matter it can be very difficult to identify the intervention effect, either because the ecosystem improvement in question is difficult to precisely define, or because respondents have beliefs about the baseline state of the ecosystem that are at odds with the researcher.

There are four basic reasons that identifying the intervention effect is important. First, it is useful for benefit transfer. For instance, an estimate of the average welfare cost of an aquatic species invasion at the lake level in Wisconsin is likely to be useful in evaluating the cost of invasions in similar lake districts from Maine to Minnesota. Second, it provides the basis for assessing convergent validity. Staying with our aquatic invasive species example, if both a hedonic analysis and a contingent valuation analysis indicate similar welfare losses from an aquatic species invasion, managers and policymakers have greater confidence that these values accurately reflect the true cost of an invasion. Third, when combined with models describing ecosystem changes, intervention effects provide the opportunity for sound resource management and policy analysis. For example, a resource agency with a limited budget and tasked with controlling several different aquatic invasive species is likely faced with several management options that differentially prioritize the species. Having information about the value lake users place on controlling the different species is useful information in choosing among the options. Finally, there is value in basic scientific research to identify the benefits of improving and preserving ecosystem goods and services. For instance, a variety of studies in Maryland, Wisconsin, and Maine have examined the value of improving water quality (Leggett and Bockstael, 2000; Poor et al., 2001; Moore et al., 2011). Such efforts contribute to a general broadening and deepening of understanding of the cost of letting aquatic ecosystems deteriorate.

In an intervention framework for ecosystem services that are not salient to survey respondents, researcher-provided statements about the degree of provision of the ecosystem service with and without the intervention (that is, statements asserting the intervention effect) are a reasonable way – often the only way – to establish the intervention effect for the experiment. For example, the famous Exxon Valdez valuation study (Carson et al., 2003) presented survey respondents with a program to prevent future oil spills. Respondents were told that scientists believe that another oil spill in Prince William Sound of Alaska "can be expected to occur" over the next ten years. Respondents also were told that with the oil spill prevention program in place it is "virtually certain there will be no large oil spill that will affect this area".[1] It is reasonable to believe that respondents do not have strong prior beliefs about the likelihood of an oil spill in the absence of the prevention program, and that they do not have strong prior beliefs about the likelihood of a spill after the prevention program is put in place, and so their expectations about future oil spills with and without the prevention program are based solely on what they're told in the survey instrument. The survey instrument, in other words, is the sole source of respondents' understanding of the intervention effect. Loureiro and Loomis (2013) provide a more recent stated preference analysis of preventing oil spills in Europe that follows a similar pattern to the Valdez study of stating damages with and without a prevention program.

On the other hand, for the provision of salient ecosystem services the intervention effect presented in a survey instrument can be in contradiction, or at least not fully consistent, with a respondent's prior beliefs. For example, because climate change has become politicized, statements about the effect of mitigation measures might often contradict a respondent's prior beliefs. Lee and Cameron's (2008) contingent valuation study of U.S. citizens' willingness to pay (WTP) to mitigate climate change examined this issue. The authors observe, "popular support for climate change mitigation policy is noticeably greater when people perceive that climate change is likely to cause greater levels of harm" (p. 246). Cai et al. (2010), Carson et al. (2010) and Viscusi and Zeckhauser (2006) also find heterogeneous expectations of climate change damages.

The intervention framework is used often in stated preference surveys valuing ecosystem services, in particular interventions that involve the conservation of undeveloped land (Mogas et al., 2009; Boyle and Ozdemir, 2009; Cunha-e-Sa et al., 2012; Scheufele and Bennett, 2012), the conservation of specific species or groups of species (e.g., Czajkowski and Hanley, 2009; Carlsson et al., 2010; Lew and Wallmo, 2011; Atkinson et al., 2012; Kragt and Bennett, 2012), outdoor recreation (Jeon and Herriges, 2010; Hess and Beharry-Borg, 2012), and water access (Brouwer et al., 2010; Akram and Olmstead, 2011). Whether respondent expectations are relevant to the valuation of the intervention effect is a research judgment call. Consider recent studies that ask respondents about their WTP for programs that conserve land. It is reasonable to assume that residents of the UK do not have well-formed expectations over the intervention effect of programs to conserve land in Brazil (Atkinson et al., 2012). On the other hand, it is also reasonable to assume that respondents do have prior beliefs about the intervention effect — about the counterfactual if not the alternative condition imposed by the intervention — for local land conservation programs (e.g., Boyle and Ozdemir, 2009; Mogas et al., 2009; Czajkowski and Hanley, 2009; Cunha-e-Sa et al., 2012; Scheufele and Bennett, 2012).

Fig. 1 draws on recent surveys to illustrate the heterogeneity of survey respondent beliefs about how they expect a local ecosystem service/good to change over the ensuing ten years in the absence of an intervention. The data are from surveys conducted by the authors between 2005 and 2011, and apply to lake users in northern Wisconsin. Clearly these lake users do not have uniform beliefs of baseline future ecosystem service provision on their lakes. For example, about 12% of recreational boaters think that an invasion of their favorite lake by the highly undesirable plant Eurasian Milfoil is imminent (Fig. 1.a), while 22% of lakeshore property owners think there is almost no chance that their lake will be invaded by the Milfoil (Fig. 1.b). About 60% of lakeshore property owners expect no future changes in their lake's fishing prospects while just under 30% are more pessimistic and expect a modest decrease (Fig. 1.c). Lakeshore property owners in particular are quite divided over the prospects for future neighboring development on their lakes (Fig. 1.d). If scope matters at all – and it should in a well-designed study – then respondents more pessimistic about future ecosystem service provision will be willing to pay more for programs that conserve those services than respondents who are more optimistic. Thus, in addition to the usual explanation of heterogeneous preferences and income conditioning WTP estimates, heterogeneous expectations of baseline conditions will also systematically condition WTP. For example, results presented in Section 3 of this paper show that the mean WTP for a 25% increase in a lake's fish population is $183 for respondents who expect a modest decrease in their lake's fish population and only $14 for respondents who expect no change. Further, in their responses in a choice experiment, respondents with heterogeneous expectations are likely to ignore or at best deviate from researcher-stated baseline conditions (as a good Bayesian would). We suspect that the problem of disentangling expectations and preferences in stated preference analyses is likely to be most acute for goods at the center of political debate (climate change mitigation, clean groundwater in areas of high concentration of natural gas and oil drilling), or local goods with high use value (lake fisheries, prevention of species invasions).

This paper expands on a recent paper by Provencher et al. (2012) – hereafter PLA – about identifying the value of a change in salient ecosystem services when the intervention effect is heterogeneous across respondents. PLA examined lakeshore property owners' WTP for a program to prevent invasion of their lake by an aquatic invasive species

[1] The quotes are taken from the Valdez survey, which can be found at lead author Richard Carson's website: http://econ.ucsd.edu/~rcarson/AKsurvey.pdf.