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Foreword by Donald M. McLeod, Editor
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It is my pleasure to feature three exemplary articles in this Special Issue of **Western Economics Forum**.

The first by Little, Broadbent and Berrens focuses on a long standing contention that Contingent Valuation (CV) suffers from hypothetical bias. They use meta-analysis to combine and estimate the contribution different phenomena have to hypothetical bias (actually the disparity between hypothetical v. actual responses) from nearly 100 existing studies. The probability of disparity models indicate that how data is collected, the demographics of the sample, the importance of the good and the value elicitation format all have an impact on the deviation of hypothetical from actual valuation responses. A key outcome is that "no evidence here (*exists)* that private goods are less prone to observing hypothetical bias." They find similar results for Choice Experiments v. CV as well as willingness to pay compared to willingness to accept formats.

The second article by Taylor and Rollins uses rangelands as a basis for organizing how economic analysis may be applied to policies targeting landscape-scale ecological change. The scale of analysis implies the consideration of collections of species and multiple ecological services rather than a piece-wise analysis. They offer a benefits transfer approach with ex post estimation coming from aggregated sites as a means to obtain welfare changes associated with ecological changes. They indicate the importance of spatial and temporal scale considerations in addition to considering the uncertainty of a given management action achieving an intended policy outcome.

Finally the piece by Loomis gives perspective on economic analysis (CV) of public lands management decisions. He provides a holistic approach as implied by the valuation of management alternatives as compared to separate valuation of individual outputs of management decisions. Several prescriptions and opportunities are offered. CV should target the change in values for different landscapes and even desired landscape conditions, perhaps ultimately as embedded values in GIS layers. Open space valuation should inform the value of public lands open space on the wildland urban interface. Although an array of nonmarket techniques may be useful for valuation, stated preference techniques offer the best framework for large scale management plans and desired future conditions.

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Special Issue: Contingent Valuation

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The Western Economics Forum

A peer-reviewed publication from the Western Agricultural Economics Association

Purpose

One of the consequences of regional associations nationalizing their journals is that professional agricultural economists in each region have lost one of their best forums for exchanging ideas unique to their area of the country. The purpose of this publication is to provide a forum for western issues.

Audience

The target audience is professional agricultural economists with a Masters degree, Ph.D. or equivalent understanding of the field that are working on agricultural and resource economic, business or policy issues in the West.

Subject

This publication is specifically targeted at informing professionals in the West about issues, methods, data, or other content addressing the following objectives:

- Summarize knowledge about issues of interest to western professionals
- To convey ideas and analysis techniques to non-academic, professional economists working on agricultural or resource issues
- To demonstrate methods and applications that can be adapted across fields in economics
- To facilitate open debate on western issues

Structure and Distribution

The *Western Economics Forum* is a peer reviewed publication. It usually contains three to five articles per issue, with approximately 2,500 words each (maximum 3,000), and as much diversity as possible across the following areas:

- Farm/ranch management and production
- Marketing and agribusiness
- Natural resources and the environment
- Institutions and policy
- Regional and community development

There are two issues of the *Western Economics Forum* per year (Spring and Fall).

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Meta-Analysis of the Probability of Disparity between Actual and Hypothetical Valuation Responses: Extension and Preliminary New Results[1]

Joseph Little[2], Craig D. Broadbent[3] and Robert P. Berrens[4]

Introduction and Background

How we think about, interact with, and value the open spaces and public places that characterize large swaths of the western United States and elsewhere help define us as a society. Likewise, consideration of those open spaces and public places also produces ongoing challenges for public lands management. Information about public preferences over access and preservation versus development issues on public lands, and the myriad ecosystem services they provide, can be important inputs to cost-benefit analyses, natural resource damage assessments and resource planning processes (Loomis, 2002; PCAST, 2011). As part of the battery of non-market valuation techniques developed by economists and others over the last 60 years to value changes in environmental goods and services, survey-based stated preference approaches, such as the contingent valuation (CV) method, can be highly flexible tools for collecting preference information. The available literature on CV and related approaches is extensive (Carson, 2012; Li and Ho, 2008), across both theoretical and applied domains (e.g., experimental design, survey collection and econometric issues).

For researchers and policy analysts, there are no shortages of interesting and important topics and applications for stated preference studies involving public lands management. These range from valuing access to a wide variety of outdoor recreation opportunities (e.g., see Loomis et al., 2008), including acceptance of recreational fees (e.g., Aadland et al., 2012), wilderness area preservation (see summary in Loomis, 2002), and applications of community forestry, and wildfire risk mitigation in the Wildland Urban Interface (WUI) (e.g., Loomis et al., 2011; Talberth et al., 2006;). Data from stated preference approaches, such as CV or Contingent Behavior (CB) studies, can also be combined with revealed preference information from trip-taking behavior (e.g., Grijalva et al. [2003] on rock-climbing trips), actual transactions (e.g., Little et al. [2006] examine elk hunting raffles on the Valles Caldera National Preserve), or with experimental laboratory results to help verify observed patterns (e.g, Talberth et al. [2006] examine wildfire risk mitigation behavior in the WUI).

Despite important and useful attempts to establish reference operating conditions (Cummings et al., 1986) and "blue-ribbon panel" guidelines (Arrow et al., 1993), there perhaps remains no single Method (with a capital "M") to follow for applied CV studies. However, the applied researcher can access useful primers, reference volumes and manuals (e.g., Bateman et al., 2002; Boyle, 2003; Champ et al., 2003), participate in an open discourse community as it sorts through a kind of ever-evolving "local, provisional methodology" (LPM) (Randall, 1993), and strive to generally apply high quality social science methods (with a small "m"). Such an approach is consistent with arguments to avoid focusing on the results from single studies

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(Randall, 1998) and instead trying to draw inferences from patterns across studies. Meta-analyses provide us with an important tool for doing that, and often are a good place to start for the applied researcher (e.g., see Loomis et al., 2008; and Richardson and Loomis, 2009).

In implementing CV and related approaches, the applied researcher often must focus on the proposed policy change or issue of interest, but should also be aware of persistent methodological concerns and emerging perspectives. Wherever possible, the applied researcher is encouraged to think carefully about experimental design (e.g., Rose et al., 2011), whether or not the respondent is likely to view the survey as consequential to a real outcome or decision (Carson and Groves, 2007), possible effects of alternative survey modes (e.g., Berrens et al., 2003; Champ, 2003; Loomis et al., 2011), possible follow-ups to the chosen valuation question (e.g., Champ et al., 2009) and building specific hypotheses and validity tests into their research.

Of particular note, concerns over upward, hypothetical bias in CV results are persistent and should be of interest to any applied researcher. Hypothetical bias is interpreted as the tendency for valuation responses in a survey setting to be different (typically larger) than in some actual setting involving real economic commitments (e.g., Arrow et al., 1993; Cummings et al., 1995; List et al., 2004). Loomis (2011) offers a useful recent review, including summarizing some early meta-analysis results, as well as adding additional insights. Further, viewing CV studies from a "consequentiality" perspective (Carson and Groves, 2007 and 2011) offers an important emerging perspective. Poe and Vossler (2011) provide an assessment of this perspective, which rejects simply bifurcating data into purely hypothetical versus actual, or viewing all stated preference surveys under the term "hypothetical." Rather, hypothetical surveys can be differentiated between consequential and inconsequential. Consequential survey questions are seen by the respondent (or agent) as potentially influencing a policy outcome (i.e., there is a reason to take them seriously), and have incentive properties that can be theoretically evaluated. Assuming a survey has been designed so that the respondent will view it as potentially consequential to them (and see Herriges et al., 2010; Nepal et al., 2009), then it is possible to make theoretical predictions on truthful revelation of preferences based on the incentive structure of the elicitation format, type of good and all the information provided. This does not imply that all consequential surveys will be compatible with truthful revelation of preferences (Poe and Vossler, 2011). For example, following Carson and Groves (2007), it is expected that binding referenda for public goods will be incentive compatible, whereas the more common voluntary contribution dichotomous choice formats, or surveys involving possible introductions of private goods (e.g., Cummings et al., 1995) will not. To date, early tests of induced value public goods referenda appear to provide initial support for the consequentiality perspective or paradigm (Poe and Vossler, 2011; Taylor et al., 2001; and Vossler and McKee, 2006).

In the spirit of mapping performance characteristics across different study designs (Randall, 1998), this analysis attempts to improve our understanding of potential determinants of hypothetical bias in CV and other stated preference studies. Meta-analysis is used to investigate the determinants of the probability of observing a statistically significant disparity between hypothetical and actual valuation responses. Early results from induced value tests of the consequentiality perspective (Poe and Vossler, 2011) also help us re-think what we may be able to isolate in a meta-analysis of hypothetical versus actual comparisons. For example, understanding incentive-compatibility in any setting probably requires controlling for particular combinations of elicitation format and good type (public or private). Further, Carson and Groves, (2011) argue that inconsequential questions can easily be created in laboratory settings, but are much less likely to happen in field settings. Thus, it is important to control for general laboratory-type settings (with "homegrown values" brought to the experiment), versus explicit induced value experiments, or field settings, and possibly to further control for student versus non-student samples (Loomis, 2011).

Data and Modeling Approach

There have been a number of prior studies that have used meta-analysis to investigate "calibration factors" of willingness to pay (WTP) or willingness to accept (WTA) values for the magnitude of hypothetical bias from various comparison studies (List and Gallet, 2001; Little and Berrens, 2004; Murphy et al., 2005). This investigation extends a related analysis also presented in Little and Berrens (2004), which briefly analyzed the probability determinants of the presence of a significant hypothetical bias in comparison studies. Notably, since many studies only investigate dichotomous yes or no responses to a single payment amount for comparisons, and can not produce a calibration factor since WTP or WTA value estimates are not made, there are considerably more total comparisons that can be utilized. Here, we extend the analysis of Little and Berrens (2004) on the presence of hypothetical bias by increasing the original dataset from 85 observations from 53 studies, to 225 observations from 96 studies (220 usable observations).

Since List and Gallet (2001) published their first meta-analysis investigating hypothetical bias, the literature has continued to grow. In an effort to include as many new observations as possible, studies were added as long as they reported a test of significance related to hypothetical bias. Again, because we are using a probability of disparity model it was not necessary for the studies to report hypothetical and actual mean valuation amounts; rather, we only needed a test of significance to be reported in the study. Published studies were found by doing a search for 'hypothetical bias' using Econlit as the search vehicle. In addition, we also reviewed recent publications to find studies that may not have been indexed on Econlit. All studies were collected by the end of the 2011 calendar year. The data is available upon request, and the reference list of all studies used in this analysis can be found at: www.tech-teachers.net/craig.

The meta-analysis attempts to improve the understanding of observed disparities between actual and hypothetical stated values. Using 220 of the possible 225 observations, the dependent variable (DISPARITY) in a probit probability model is the presence (1) or absence (0) of a significant disparity between actual and stated values in a comparison study. Explanatory variables are chosen to allow preliminary investigation of arguments in recent theoretical (Carson and Groves, 2007, and 2011) and review (Loomis, 2011) studies; they include study and sample characteristics (laboratory, induced value, student/nonstudent samples, sample size, etc.), a set of dummy variables representing different pairings of elicitation format (open-ended, referenda, voluntary contribution dichotomous choice, etc.) the nature of the good (public or private), and use of attempted corrections methods (e.g., certainty corrections and cheap talk scripts).

The different pairings of elicitation formats and the nature of the good may be particularly important in beginning to explore hypotheses, such as incentive compatibility for truthful revelation of preferences in consequential CV designs (Carson and Groves, 2007). For example, in contrast to prior meta-analyses of hypothetical bias, which included a single binary variable to distinguish between private and public goods, our approach allows us to isolate studies, for example, that paired a referendum elicitation format with a public good (PUB-REF). We expect PUB-REF to have a negative impact on the probability of observing a disparity between actual and hypothetical responses relative to any of the cases that are not incentive compatible. The latter set would include: a public good with a generic dichotomous choice format (PUB-DC) which are essentially all voluntary contributions settings (but not always explicitly presented as such), or any private good case (where the respondent may be trying to influence the probability of provision) with either an open-ended format (PRIV-OE), or

dichotomous choice format (PRIV-DC), or even the somewhat odd case of a referendum format (PRIV-REF).

Finally, any meta-analysis involves choices by the analyst between the lumping and splitting of observations in the creation of the explanatory variables. It would perhaps be ideal to follow prior meta-analyses exactly in the choice of explanatory variables for comparison purposes (Loomis, 2011). We do not follow that approach here for two reasons. First, as discussed above, we create pairings of elicitation format and good type in an attempt to be more sensitive to the emerging consequentiality paradigm (Carson and Groves, 2007 and 2011; Poe and Vossler, 2011). This allows us a much more nuanced look than early determinations about public and private goods, which were designated by a single dummy variable. For example, from meta-analysis results for calibration factors, List and Gallet (2001) found that private goods studies were subject to less hypothetical bias than public good studies. Second, prior meta-analyses (e.g., see List and Gallet, 2001) were dominated by the statistically significant effects of several dummy variables on elicitation formats (e.g., specific auction types or formats) that had only a small handful of observations (e.g., 3 or fewer) with that study attribute or characteristic. Examples include Smith auctions, Becker-DeGroot Marschak (BDM) mechanisms, and Random-n^{th} price auctions. To avoid this problem, we somewhat arbitrarily only include variables with at least four percent of the total observations in our meta-data, with that attribute or study characteristic. Thus, in this preliminary analysis we lump all auction formats together. Certainly, not all auctions have the same demand revealing properties, and there is a need for further refinement as more comparison studies are completed. But, it does allow us to isolate or control the general auction group, and focus on particular comparisons of interest (e.g., PUB-REF against, PUB-DC or PRIV-DC). Following this rule ($\geq$ 4%), we also lump a group of payment card and multiple category, and provision point mechanisms together in an "other" elicitation format grouping; however, given that only public goods (PUB-OTHER) matched with that lumping, there is no PRIV-OTHER variable (0 observations). Additionally, this preliminary rule also causes us to drop one of the possible pairings of elicitation format and good type – an auction format with a public good (PUB-AUCT), which only had 5 observations. This resulted in a set of 10 pairings we can use in our modeling.

Results

Table 1 provides the variable definitions and their descriptive statistics out of 225 observations. Of note, the mean for the dependent variable, DISPARITY, is 0.6. That is, 60 percent of the comparisons in the literature have been stated by the authors to show a statistically significant disparity between hypothetical and actual valuation responses. Since the choice of statistical significance level (e.g., 0.05 or 0.10 level, etc.) varies across studies, in this preliminary analysis we let it vary by study, and define it here as whether or not (1 or 0, respectively) the author(s) state there is a disparity. Notably, of the different pairings of elicitation format and good type, the most common is PRIV-DC with 20 percent of the observations in the data.

Table 2 presents the results from two probit model specifications (both n= 220). Both estimated coefficients and marginal effects (showing the magnitude of the effect on the probability of observing a disparity) are presented. Model 1 is the baseline model specification, while Model 2 is an extended specification that includes several additional variables related to sample size, year of the study, and whether or not the study occurred after the "blue ribbon" panel report (Arrow et al., 1993), which greatly increased attention on hypothetical bias concerns and is captured in the dummy variable POST-NOAA. PRIV-DC provides the base case for the set of dummy variables on pairings of elicitation formats and good type, and is omitted from the specification. Note again that all observations (5) with PUB-AUCT are dropped from the analysis (and would get dropped from any regression due to collinearity since this variable would predict failure perfectly, with no variation [all 1's]).

Table 1: Variable Definitions and Descriptive Statistics

Variable	Definition	Mean	Std. Err.
DISPARITY	=1 if disparity between hypothetical and real payments is stated by author, 0 if no disparity stated by author	0.609	0.489
LAB	=1 if experimental setting as stated by author is in a controlled laboratory, 0 otherwise	0.516	0.499
STUDENT	=1 if student population strictly used, 0 otherwise	0.409	0.493
INDUCED	=1 if an induced value experiment, 0 otherwise	0.062	0.242
WTP	=1 if WTP study, 0 if WTA study	0.938	0.242
W-GROUP	=1 if a within-group comparison, 0 if between group comparison	0.253	0.436
PRIV-DC	= 1 if a private good valued in a dichotomous choice format, 0 otherwise	0.20	0.401
PUB-DC	=1 if a public good valued in a dichotomous choice format, 0 otherwise	0.138	0.345
PRIV-REF	=1 if a private good valued in a referendum format, 0 otherwise	0.044	0.207
PUB-REF	=1 if a public good valued in a referendum format, 0 otherwise	0.138	0.345
PRIV-AUCT	=1 if a private good valued in any type of auction format, 0 otherwise	0.169	0.375
PUB-AUCT	=1 if a public good valued in any type of an auction format	0.022	0.148
PRIV-OE	=1 if a private good in an open ended format, 0 otherwise	0.049	0.216
PUB-OE	=1 if a public good in an open ended format, 0 otherwise	0.062	0.242
PUB-OTHER	=1 if a private good in any other elicitation format, 0 otherwise	0.04	0.196
PRIV-CE	=1 if a private good using a choice experiment format, 0 otherwise	0.098	0.298
PUB-CE	=1 if a public good using a choice experiment format, 0 otherwise	0.071	0.258
CERTAINTY	=1 if a certainty correction is utilized, 0 otherwise	0.098	0.298
CHEAP-TALK	=1 if a cheap talk script is utilized, 0 otherwise	0.093	0.292
POST-NOAA	=1 if study is after the NOAA Panel Report (Arrow et al. 1993), 0 otherwise	0.844	0.363
OBS	total number of observations in each study	632.8	1036.2
SAMPLE-SIZE	total number of participants in each study	279.4	327.31
YEAR	year study was published	2002.0	7.63

Table 2: Probability of Disparity Probit Models (n=220), Clustering Corrections

	Model 1: Baseline		Model 2: Extended	
Variable	**Estimate**	**Marginal Effects**	**Estimate**	**Marginal Effects**
LAB	-0.162	-0.062	-0.351	-0.135
	(0.377)[a]	(0.145)	(0.389)	(0.148)
STUDENT	0.472	0.179	0.627*	0.235*
	(0.378)	(0.139)	(0.37)	(0.132)
INDUCED	-1.21**	-0.439**	-1.198**	-0.436**
	(0.553)	(0.152)	(0.592)	(0.164)
WTP	0.534	0.211	0.50	0.198
	(0.36)	(0.139)	(0.42)	(0.163)
W-GROUP	0.293	0.111	0.309	0.116
	(0.26)	(0.094)	(0.259)	(0.094)
PUB-DC	0.168	0.637	0.142	0.054
	(0.318)	(0.118)	(0.341)	(0.127)
PRIV-REF	-0.422	-0.167	-0.512	-0.202
	(0.458)	(0.18)	(0.506)	(0.196)
PUB-REF	-0.807**	-0.313**	-0.863**	-0.333**
	(0.362)	(0.132)	(0.395)	(0.141)
PRIV-AUCT	-0.34	-0.134	-0.309	-0.122
	(0.334)	(0.132)	(0.36)	(0.143)
PRIV-OE	0.06	0.023	0.055	0.021
	(0.484)	(0.184)	(0.51)	(0.194)
PUB-OE	-0.885*	-0.339**	-0.928*	-0.353**
	(0.499)	(0.169)	(0.486)	(0.161)
PUB-OTHER	-1.22**	-0.44**	-1.351**	-0.473**
	(0.457)	(0.122)	(0.474)	(0.113)
PRIV-CE	-0.539	-0.212	-0.119	-0.047
	(0.474)	(0.183)	(0.623)	(0.245)
PUB-CE	-0.591	-0.232	-0.469	-0.185
	(0.436)	(0.167)	(0.521)	(0.204)
CERTAINTY	-2.662**	-0.68**	-2.764**	-0.689**
	(0.562)	(0.053)	(0.644)	(0.053)
CHEAP-TALK	-1.183**	-0.435**	-1.266**	-0.46**
	(0.323)	(0.096)	(0.339)	(0.095)
POST-NOAA			0.55	0.216
			(0.524)	(0.203)
OBS			-0.0002	-0.00007
			(0.0002)	(0.00007)
SAMPLE-SIZE			0.0002	0.0006
			(0.0005)	(0.0002)

Table 2 Continued

Variable	Estimate	Marginal Effects	Estimate	Marginal Effects
YEAR			-0.011	-0.004
			(0.0253)	(0.009)
CONSTANT	0.385		21.177	
	(0.333)		(50.238)	
Pseudo R^2	0.256		0.2668	
LR Chi Squared Statistic	52.26**		60.33**	

Table 2 notes: * Significant at the 0.10 level; ** Significant at the 0.05 level; [a] values in parentheses are robust standard errors.

Further, the presence of multiple observations from individual studies could potentially bias estimated standard errors. To address this concern, the probit probability models (1 and 2) presented in Table 2 correct for clustering bias and are estimated using robust standard errors. The clustering correction relaxes the assumption of independence between observations drawn from the same study while maintaining the assumption of independence for observations across studies.

Pseudo R^2 measures range from 0.256 in (Model 1) to 0.267 in (Model 2). Adding the four extra study/sample characteristics variables (POST-NOAA, OBS, SAMPLESIZE and YEAR) provides no significant change in explaining overall variation, and none of the estimated coefficients on these individual variables are statistically significant.

Across both model specifications (baseline and extended) the estimated coefficients on the variables INDUCED, CERTAINTY and CHEAP-TALK are negative and significant at the 0.05 level. INDUCED represents a particular experimental laboratory setting where values are induced to participants. Certainty corrections (CERTAINTY) use responses to follow-up (un)certainly level questions and various re-coding schemes on original valuation responses (e.g., to convert relatively uncertain yes responses in a dichotomous choice or referendum format to no responses). Cheap talk designs (CHEAP-TALK) use a variety of stylized scripts inserted prior to valuation questions in a survey to discourage potential hypothetical bias. All three of these variables significantly reduce the probability of observing a disparity between actual and hypothetical responses. In contrast, the estimated coefficient on the variable STUDENT is positive and significant (increasing the probability of observing a disparity), but only in the extended model specification at the 0.10 level.

Across both model specifications (baseline and extended), the estimated coefficients on the indicator variables for three different pairs of elicitation format-good type (PUB-REF, PUB-OE, and PUB-OTHER) are negative and statistically significant at either the 0.05 level (PUB-REF and PUB-OTHER) or 0.10 level (PUB-OE). None of the other estimated coefficients on pairings are significantly different from the base case of PRIV-DC. Of particular interest, relative to the prominent case of PRIV-DC (which would not be incentive compatible for truthful revelation of preferences), the PUB-REF case (which would be incentive compatible with truthful revelation of preferences) would reduce the probability of observing a disparity between actual and stated values. This is also clearly seen in the raw data, where 29 out of 45 observations (65%) for PRIV-DC were 1's (significant disparity identified), versus only 13 of 31 observations (42%) for PUB-REF. Finally, with a range from -0.31 to -0.47 across the significant variables PUB-REF, PUB-OE and PUB-OTHER, the observed marginal effects (against a sample mean probability of

observing a disparity of 0.60) are clearly large enough to effect a transposition from whether or not there is an expectation of observing a disparity.

Discussion and Conclusions

This preliminary analysis extends a probability of disparity meta-analysis approach first applied to the CV and stated preference literature by Little and Berrens (2004). Specifically, this study modifies that initial analysis by using the much larger set of comparisons now available, and adding a variety of new explanatory variables, including a set of dummy variables that represent combinations of elicitation format and the nature of the good (private or public). Preliminary econometric analysis from a set of probit probability models, with clustering corrections and robust standard errors, provide some intriguing new results.

First, controlling for any possible effect of more generically described "Lab" conditions for the study, induced value experimental studies (versus what are commonly referred to as "homegrown preference" studies") are significantly less likely to observe a disparity in hypothetical versus real response comparisons.

Second, while somewhat mixed, there is at least preliminary evidence supporting the argument (e.g., Loomis, 2011) that student samples may increase the probability of observing hypothetical bias. Split-sample treatments of student versus non-student samples, while controlling for other factors and the pairing of elicitation format and good type, are probably called for in future hypothetical bias comparison studies.

Third, combinations or pairings of chosen elicitation format and the nature of the good (public or private) clearly matter in the likelihood of observing hypothetical bias. This is consistent with the general Carson and Groves (2007) theoretical framework for differentiating between consequential and inconsequential valuation questions, as different pairings will have different incentive compatibility properties. More specifically, the preliminary meta-analysis results appear to support the theoretical prediction that public goods referenda will minimize the probability of disparity between hypothetical and actual responses relative to the baseline case of a private good dichotomous choice format (e.g., voluntary contribution). More generally, the evidence indicates that comparisons of several different combinations of elicitation formats (REF and OE and OTHER) with public goods are likely to reduce the probability of observing hypothetical bias against this baseline case. In the initial probability of disparity results, with a much smaller sample, Little and Berrens (2004) found no difference between public and private goods, using only the broad dummy variable indicator. (The initial List and Gallet [2001] calibration factor results found that private goods were less prone to hypothetical bias; but, this was not found in Little and Berrens [2004] calibration factor results). The probability of disparity results found here suggest that public and private goods are different, when paired with different elicitation formats. There is no evidence here that private goods are less prone to observing hypothetical bias. This raises doubts over any argument that results from studies with private goods (e.g., Cummings et al., 1995) should be used to make inferences involving public goods, even if the elicitation formats are the same. Certainly, using, say, student samples, in an experimental lab setting involving "homegrown values," when combined with a non-incentive compatible elicitation format and good type (e.g., PRIV-DC), is highly likely to generate "hypothetical bias."

Fourth, while often largely ad hoc in nature, commonly used (un)certainty corrections and cheap talk scripts are both estimated to significantly reduce the probability of observing a disparity in hypothetical versus real responses comparisons. Marginal effects estimates suggest that certainty corrections, in comparison to cheap talk scripts, have a larger incremental impact on reducing the probability of observing a disparity. But, there is still much that we do not

understand about both of these types of corrections, and they both have different variations with apparently differential impacts (Carson and Groves, 2011; and Champ et al., 2009). Thus, it appears important to increase the number of split-sample comparisons of different types of each of these approaches in future hypothetical versus real comparisons.

Fifth, the statistical evidence does not support the argument that choice experiments (CE) are somehow less prone to hypothetical bias than more typical CV approaches and formats, as has been hypothesized by some (e.g. Arrow et al., 1993; Hanley et al., 2001).

Sixth, the statistical evidence does not support the argument that WTP studies are less prone to hypothetical bias than WTA studies (e.g., Arrow et al., 1993; List and Gallet, 2001).

In closing, these results are presented as preliminary. We hope that they help the applied researcher access an evolving literature, and where possible spur additional comparison studies of actual and hypothetical valuation responses. Some of the cells in the experimental design of this meta-analysis should be expanded with additional observations, and there could be refinements in the explanatory variables (e.g., altering some of the "lumping and splitting" choices, and adding interaction terms). Further, some interesting treatments in comparison studies, such as varying the degree of social isolation or context (e.g., List et al., 2004; Mozumder and Berrens, 2011) or controlling in some way the real or perceived consequentiality of the responses (e.g., Broadbent et al., 2010; Landry and List, 2007) are still too rare to create explanatory variables in a meta-analysis. Planned future research includes continuing to collect additional studies, and estimating both probability of disparity models, and updated calibration factor models, which make use of pairings of elicitation formats and the type of good. This could include further breakdowns than simply private versus public (e.g., quasi-private and quasi-public goods). Ideally, robust meta-data may allow rigorous hypothesis testing of the pattern of evidence of emerging theoretical frameworks (e.g., Carson and Groves, 2007 and 2011), which can never be fully tested in individual studies. While that remains to be seen, the emerging consequentiality perspective or paradigm (Poe and Vossler, 2011) may be shifting any "local, provisional methodology" (Randall, 1993) around CV and related approaches. Understanding patterns in stated preference survey results "is more complicated than previously thought" (Carson and Groves, 2011, p. 307). As further tests and comparisons emerge, improved meta-analyses will need to be rich enough to map these performance characteristics (e.g., controlling for factors that affect consequentiality, and known incentive compatibility properties).

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Using Ecological Models to Coordinate Valuation of Ecological Change on Western Rangelands for ex post Application to Policy Analysis

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Introduction

The economic valuation of landscape-scale ecological change is increasingly considered necessary for policy-making. In the United States, ecosystem-level management goals have been formally adopted in federal and state land management policy for a variety of ecosystems (Malone 2000). Valuation of ecosystem services has had important impacts on policy decisions involving ecosystem management (Barbier 2012). Indeed, two of the six summary recommendations in the 2011 Presidents' Council of Advisors on Science and Technology report to President Obama relate specifically to the need for valuation of ecosystems and ecosystem services for policy decisions (PCAST 2011). Despite the recognition of the need for economic valuation of landscape-scale ecological change, there continues to be a perception among scientists and public lands decision-makers that economic theory and methods are not up to the task of providing accurate, timely, and policy-relevant estimates of the values associated with ecosystem change for use in policy-making (Nelson 2006).[2]

In this article, we argue that several practical steps can be taken to counter this criticism and to coordinate research output from independent non-market valuation studies to facilitate their routine ex-post application to ecosystem management policy on public and private lands.[3] Our focus is on facilitating the application of economic analysis to policies that target landscape-scale ecological change – changes that typically influence multiple ecosystem goods and services, over large areas, and over long periods of time, rather than policies that target changes in the quality or quantity of a specific good or service (i.e., hunting days, miles of trail, and congestion). Our primary point of reference in this article is ecological change on sagebrush rangelands in the western United States. We focus on rangelands, in part, because rangeland management policy in the western United States has increasingly targeted landscape scale ecological change (Havstad et al 2007; McIver et al 2010; Menke and Bradford 1992). While this article provides suggestions and insights from our work valuing ecological change on western rangelands, we argue that the obstacles to coordinating the results from valuation studies to performing policy-relevant, ex-post benefit-cost analysis that we identify are broadly shared by all ecosystems.

We argue that the most important step to promoting the ex-post application of valuation studies to policy-making is to ensure that the change in the ecological good or service being valued

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[2] Nelson (2006) goes as far as to argue that where science-based ecosystem management objectives have replaced the traditional multiple-use management paradigm in national public lands policy, "in place of economic benefits, ecosystem management substitutes biological goals that cannot effectively be captured by economic methods."

[3] Numerous studies that have integrated ecological and economic modeling to value ecological change (e.g., Polasky et al 2011; Eichner and Tschirhart 2007; Tschirhart 2012; Taylor et al 2012; Bockstael et al 1995) attest to the fact that this perception is not due to a fundamental inability of economic theory and methods to measure the cost and benefits of ecosystem change.

corresponds to the ecological change that policy-makers hope to influence through management. The primary advantage of including policy-relevant assumptions about ecological change into primary valuation studies is that it removes the onus on policy-makers to translate the ecological outcome they are attempting to achieve into units of the environmental good or service that has previously been valued in relevant primary valuation studies..[4] In addition to ex-post policy relevance, we argue that scientific accuracy and congruence with available data are important criteria for selecting an ecological framework for a valuation study. Furthermore, we propose that the state-and-transition model (STM) framework from rangeland ecology is the appropriate ecological framework for economic analysis of ecosystem change on western rangelands given these considerations (Stringham, Krueger, and Shaver 2003).

The ex-post application of valuation studies to ecosystem management policy on public and private lands is further complicated by the fact that landscape-scale changes often influence multiple ecological goods and services resulting in welfare changes for numerous groups in society. Valuing each ecological good or service often requires separate estimation methods, data needs, and expertise on the part of the researcher, and is typically accomplished in separate studies. Combining the results of separate studies ex-post to get a complete picture of the welfare consequences of landscape-scale ecological change can be difficult, if not impossible. This is particularly the case if there are differences in the component studies regarding spatial and temporal scales, explanatory variables, and assumptions about the underlying ecological change. We argue that in addition to sharing a common, policy-relevant ecological framework, the data collection and analysis in each component study (i) must be broad enough regarding biophysical context, and socio-demographic information, to encompass a range of potential policy sites within the ecosystem, (ii) be capable of addressing the uncertainty inherent in any ex-ante benefit-cost analysis of ecosystem management policy, and (iii) should consider the fact that the spatial and temporal scales of any ex-post cost-benefit analysis is determined by the component study with the broadest spatial and temporal scales.

The approach discussed in this article has many parallels with benefit transfer, defined by Rosenberger and Loomis (2000, p 1097) as "the application of values and other information from a 'study site' where data are collected to a 'policy site' with little or no data." Indeed, we consider the approach discussed in this article as a special case of benefit transfer where the study and policy sites are in the same ecological setting, and where the analysis at the study sites is coordinated ex-ante to facilitate the development of a "site-to-site transfer function" capable of addressing spatial, temporal and other ecological details that are specific to the ecosystem. Unlike standard benefit transfer, however, each component study under our approach is performed with the express goal of ex-post application to valuing ecological change in a specific ecosystem. That is, primacy is given to maintaining a common ecological framework across studies that target specific ecosystems. The importance of similarity between the policy and study sites for the validity and reliability of the benefit transfer approach is widely recognized (Rosenberger and Johnston, 2010). We suggest that many of the barriers to ex-post application to policy sites can be overcome if additional steps are taken (i) to insure that the ecological good or service being valued corresponds to the ecological change that policy-makers hope to influence through their management and (ii) that given the fact that most landscape-scale ecosystem management policies will involve multiple ecosystem goods and

[4] Several previous authors have suggested that fundamental differences in spatial, temporal, and conceptual frameworks between ecology and economics create challenges to the use of economic information in environmental management (Lunney et al 1997; Drechsler et al 2007; Barbier 2012).

service, researchers are cognizant of the fact the ecological framework, spatial scale, and temporal scale of each component study places constraints on their joint ex-post application.[5]

Ecological Change on Western Rangelands and the Objectives of Land Management

Sagebrush rangelands occupy over 100 million acres of high desert in the western United States. These rangelands provide habitat for more than 300 species of wildlife, are an important forage base for the western livestock industry, and support one of the fastest growing human populations in the country (Knick et al., 2003). Sagebrush rangelands are undergoing rapid ecological change as a result of invasive annual grasses, such as cheatgrass (*Bromus tectorum*), from the expansion of native conifers, such as junipers and pinyon pine (*Juniperus occidentalis, Juniperus osteosperma*; *Pinus monophylla, Pinus edulis*), and from the acceleration of rangeland fire cycles to increasingly severe and more frequent wildfire. This ecological change threatens to permanently impair the ability of these rangelands to support native wildlife and plants, increase wildfire suppression costs, degrade hydrologic function, and may undermine the ecological and economic stability of the entire region (Devine 1993; BLM 1999, 2000; Pellant, Abbey, and Karl 2004). The Nature Conservancy ranked the sagebrush steppe as the third most endangered ecosystem in the United States (Noss et al. 1995; Stein et al. 2000).

A main objective of rangeland management policy in the western U.S. is to prevent further landscape-level ecological change and to rehabilitate lands that have undergone change to undesirable ecological states. These strategies necessarily target large areas, often at watershed scales, and are intended to alter ecological conditions over long time horizons. Relevant policy decisions include whether or not to treat, how large an area to treat, timing of treatment, and type of treatment to use in a given situation taking into account differences in treatment costs and success rates.

Ecological Framework

For economic valuation studies to be most useful for ex-post application to ecosystem management policy each primary valuation study would ideally share a common ecological framework, and value ecological changes that correspond to the framework of ecological change that natural scientists and policy-makers ascribe to. In this section, we discuss several factors that should be considered when selecting a common ecological framework to be used across valuation studies, and that the state-and-transition model (STM) framework from rangeland ecology is the appropriate ecological framework for economic studies valuing ecological change on sagebrush rangelands.

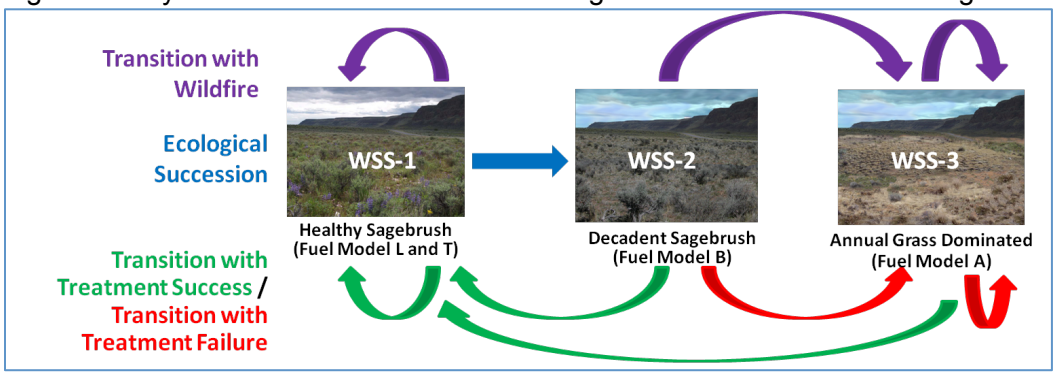
The STM framework divides an ecosystem into a series of "ecological sites" based on characteristic plant communities (Briske et al. 2003; Stringham, Krueger, and Shaver 2003; Bestelmeyer et al. 2009).[6] Each ecological site has a corresponding STM. An STM describes

[5] Rosenberger and Loomis (2006) identify the lack of incentive for individual scholars engaging in valuation studies to design their studies to be of greater practical use for policy as a major problem for benefit transfer. This problem may be even more acute in our approach, as it requires that primary valuation studies within an ecosystem use parallel ecological frameworks.

[6] The Society for Range Management (SRM, 1989) defines an ecological site as, "an area of land with the potential to produce and sustain distinctive kinds and amounts of vegetation under its particular combination or environmental factors, particularly climate, soils, and associate native biota." The USDA

the alternative "ecological states" that could characterize a given site, depending on vegetation, soils, and other factors, as well as potential transitions between states. In rangeland ecosystems, transitions between ecological states can be triggered by natural events such as drought, wildfire, and invasive plants, or by human activities such as excessive livestock grazing, and transitions can only be reversed with active (and often expensive) management effort (Briske et al., 2006; McIver et al., 2010). A stylized version of an STM that we developed in collaboration with ecologists for the purposes of economic valuation of sagebrush rangeland ecological change accommodates many specific STMs (through different parameterizations), and is illustrated in Figure 1.

Figure 1: Stylized State and Transition Ecological Model for Western Rangelands



The scientific validity of the STM framework for western rangeland has been established in the scientific literature (Briske et al. 2003; Stringham, Krueger, and Shaver 2003; Bestelmeyer et al. 2009). Concerning the generality of welfare estimates based on the state-and-transition framework, it would not be feasible to conduct economic analysis of the welfare impacts of ecological change on each ecological site in western rangeland ecosystems. There are over 1,000 sagebrush ecological sites in the State of Nevada alone (Stringham and Freese, 2011). For this reason, when valuing the benefits of pre-fire vegetation management treatments in terms of wildfire suppression costs avoided, Taylor et al. (2011) consider stylized STMs for two rangeland ecosystems – the Wyoming Sagebrush Steppe and Mountain Big Sagebrush ecosystems – rather than presenting results for hundreds of specific ecological sites within each system. The stylized STMs that are intended to be broadly representative of ecological sites found in the two ecosystems. While analyzing stylized STMs involves a loss in scientific accuracy, using groupings of similar ecological sites has the advantage that the estimated models can be applied to estimate the welfare implications of ecosystem change for each ecological site described by the aggregate grouping of sites described by the stylized STMs.

In addition to having defined an ecological framework that corresponds to that used in decision-making, the ecological change being valued in each component empirical study – i.e., the "good" being valued – should correspond to the ranges of ecological change that policy-makers generally expect to influence through management. The STM framework is an appropriate framework for western rangelands according to this criterion because management activities on western rangelands are generally aimed at either rehabilitating rangeland from degraded ecological states dominated by invasive plants and noxious weeds, or at preventing healthy rangeland from transitioning to degraded ecological states. For example, a management objective on western rangelands may be to rehabilitate a site from the annual grass dominated ecological state (WSS-3 in Figure 1) to the healthy sagebrush state (WSS-1 in Figure 1). An

Natural Resources Conservation Service uses a land classification system based on the ecological site concept to organize information for the purposes of monitoring, assessment and management.

estimate of the benefits from achieving this management objective can then be obtained and compared against the management costs if the relevant primary valuation studies estimate the value of the change in ecosystem goods and services associated with the movement from WSS-3 to WSS-1.

Additionally, the common ecological framework selected for component empirical studies ideally would correspond to existing data available for policy making. This means that the ecological framework and the description of the ecological change used in the definition of the good for valuation purposes must correspond to the data collection protocols currently in place and used for policy and management decisions in the ecosystem being evaluated. The STM framework for western rangelands has been formally by the USDA Natural Resources Conservation Service, and is used as the basis for data collection and access (USDA, NRCS 2006; TNC 2009).

Finally, it is important to consider the constraints placed upon the scientific detail of the common ecological framework by the specific data needs for estimating non-market benefits measured in each component valuation study. For example, estimating the change in expected wildfire suppression costs resulting from annual grass invasion requires estimates of both the change in wildfire frequency due to the transition to an invasive annual grasses dominate state and the change in the expected cost of a wildfire given ignition. Either of these two steps can restrict the use of a common ecological framework. If the data on changes in wildfire frequency is only available at broad ecological classifications, then it will not be possible to estimate change in the costs of wildfire suppression for specific ecological sites, even if suppression costs data is available at this finer degree of ecological resolution. Taylor et al (2012) base their model for estimating benefits of landscape level fuel treatments on the STM framework for western rangelands, so that the estimates correspond with ecosystem shifts that are targeted by management efforts.

Spatial Scale

Coordination of the spatial scales from component valuation studies is necessary so that estimates can be combined in ex-post analysis of policies targeted at influencing landscape-scale ecological change. There are two factors to consider when selecting the appropriate spatial scale for component valuation studies. First, the goal of many policy applications is landscape scale assessment of the costs and benefits of ecological change. Evaluating ecological change at the landscape scale, however, is often problematic because the accuracy of ecological predictions of ecosystem function declines with increases in spatial scale (Stringham, Krueger, and Shaver 2003). This loss in predictive power imposes restrictions on the probabilities that any given management action will have the intended outcome. The use of the STM framework we advocate adopting for western rangelands incorporates probabilities of success and failure of management actions. These probabilities can be included as indicating risk into stated preference frameworks, so that the valuation of alternative outcomes corresponds with the ecological models used by land managers.

Second, the spatial scale of the most aggregate component study places constraints on the spatial scales of ex-post policy applications. These limitations imply that that analysis of costs and benefits that correspond to spatial scales smaller than those used in primary valuation studies will necessarily be incomplete.

Time Scale and Discounting

Coordination of the temporal scales of component studies is necessary so that estimates can be combined in an ex-post policy analysis of landscape-scale ecological change. As with spatial scale, the temporal scale of the most aggregate component study constrains the temporal scale of any ex post applications. For example, if a primary valuation study values a permanent ecological change where “non-use” or “existence” values for ecological change are relevant, then it may be incorrect to apply these results in an ex-post application to evaluate the costs and/or benefits of ecosystem change on a shorter time frame than in is described in the original definition of the good in the primary valuation study.

Uncertainty

Any evaluation of the benefits and costs of a proposed ecosystem management policy or program requires understanding how the ecosystem is expected to evolve with and without the policy in place, and how determining how these differences will influence the provision of ecosystem good and services. The change in the future provision of ecosystem goods and services resulting from an ecosystem management policy or programs is, of course, uncertain. In addition, there is uncertainty about whether and ecosystem management policy or program will succeed at meeting its objective. In rangeland ecosystems, this uncertainty is often related to stochastic factors such as wildfire and drought. For these reasons, each component valuation study must make provisions for the uncertainty inherent in any appraisal of the benefits and costs of a proposed ecosystem management policy or program by capturing the welfare consequences associated with the range ecological outcomes that could result from relevant policy applications

Conclusions

In this article, we discuss several practical steps that can be taken to coordinate research output from independent non-market valuation studies to facilitate their routine ex-post application to ecosystem management policy on public and private lands. We argue that in order to facilitate ex-post application to policy-making it is necessary to have the change in the ecological good or service being valued correspond to the ecological change that policy-makers hope to influence through management, and that the ecological framework in the primary valuation studies be both scientifically accurate and agree with the available data for the ecosystem. Our discussion emphasizes that decisions about the ecological framework, spatial scale, and temporal scale of each study valuing ecosystem change place constraints on their ex-post application to policy issues, and that the limitations imposed by these constraints can be mitigated if the design of each component valuation study is coordinated with the goal of joint ex-post application in mind. In light of the discussion, we argue that the state-and-transition from rangeland ecology is the appropriate ecological framework for studying the benefits and costs of ecological change and analyzing land management policy on western rangelands.

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Ways to Make Stated Preference Methods More Valuable to Public Land Managers

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Introduction

Federal public lands such as National Forests, National Parks/Monuments, National Wildlife Refuges, lands administered by the Bureau of Land Management and military lands represent one-third of our nation's lands and natural resources. When state public lands (e.g., state parks, state forests) and county public lands (e.g. open space areas) are added to this, it is clear that public land management has a profound effect on the quality of the environment and quality of lives of tens of millions of people. In this article, I will use the term public lands to collectively refer to all these types of lands.

With some starts and stops due to changes in administrations in Washington DC, the two largest public land management agencies, the U.S. Forest Service (USFS) and the Bureau of Land Management (BLM), have evolved from solely multiple use management philosophy to that which also includes an ecosystem management perspective over the last two decades. The growing emphasis on ecosystem management among all federal land managers has brought recognition of the need to value ecosystem services in their land management plans, including Department of Defense for its military bases, Bureau of Land Management (BLM), National Forests, and National Wildlife Refuges (see Rhul, 2010 for a summary). The newly released final National Forest System Land and Management Planning rule brings this to the fore: *"This planning rule sets forth process and content requirements to guide the development, amendment, and revision of land management plans to maintain and restore NFS land and water ecosystems while providing for ecosystem services and multiple uses. The planning rule is designed to ensure that plans provide for the sustainability of ecosystems and resources."* (Federal Register, 2012: 21162). While jobs are also mentioned further on in the summary, the reader can see that the USFS planning and management is not focused solely on multiple use and jobs.

Unfortunately, much of the economic analysis performed by and for public land management agencies on a day to day basis is often limited to standard regional economic analyses they have been conducting for decades. While regional economic models such as IMPLAN provide insights on one dimension of the public land-economic interface, it often does not reflect the increasingly dominate values of public lands. In particular, recreation and wildlife/fish now constitute 95% of the economic values generated by National Forests (Bergrstrom et al. 2005), as calculated using a scientifically sound sampling design of visitor use on all National Forests conducted every year, on a five year cycle (e.g., the National Visitor Use Model—NVUM). When passive use values such as existence and bequest values are added to the non-market use values of recreation and wildlife, it is easy to see why federal agencies are being increasingly criticized for incomplete economic analysis of public land management alternatives when they fail to provide an adequate analysis of non market values.

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However, the agencies have begun to broaden their thinking on economic analysis. In the last ten years both BLM and USFS have been putting their staffs through economics training courses that focus as much on non-market valuation as on regional economic analysis. This has been done via BLM's National Training Center (first as a series of training courses around the west and now on-line), and USFS's cooperative agreement with University of Georgia and Portland State University for its Resource Policy Values and Economics training (http://www.fs.fed.us/biology/education/workshops/rpve/index.html). Agencies such as BLM's Washington Office has been circulating a draft Instruction Memorandum on non market values in preparation for issuing to the field (email from Robert Winthrop, Washington DC, April 9, 2011).

In part the increased recognition of non market and ecosystem values is in response to increased number of public comments the agencies are receiving on their management plans and EIS's to provide more balanced economic analysis of commodity production versus recreational, wildlife and amenity values. One such recent example has been the revision of the U.S. Forest Service EIS on the Rosemont Copper Mine, south of Tucson, Arizona. Here the agency has had to significantly broaden the economic analysis in response to public comments ranging from individuals to Pima county commissioners (Pima County, 2011). In particular, the Pima county commissioners asked the USFS to perform a more complete economic analysis of the mining proposal that would go beyond only displaying the income and employment effects of the copper mine but also consider recreation and tourism as well as non-market environmental values such air quality, groundwater, scenery, and health that would be adversely affected due to the copper mine. This request and those of conservation organizations resulting in the USFS hiring a consulting firm to address many of these issues using USFS visitation data, literature review and benefit transfer.

In the last decade, public land management agencies have begun to make forays into incorporating non-market valuation into their EIS's and management plans. What the notable examples often share is making valuation more holistic and in most cases valuing the discrete management alternatives, rather than the separately valuing multiple use outputs of each of those alternatives. This article makes the case that tying non-market valuation to either total economic valuation of the plan or EIS alternatives or valuing the characteristics of that alternative, would aid in integrating non-market values into agency decision making. I start by elaborating the concept of valuing entire management alternatives (often reflecting the agency's decisions on allocation of lands to various uses). I then provide an example where BLM requested and used a CVM study on valuation of broad land management alternatives.

Agencies Compare Management Alternatives: This is What Economists Need to Value

Since the advent of ecosystem management, the USFS has largely moved in the direction of BLM's long-standing approach of describing how many acres of their land will be in particular management zone (e.g., open or closed to off highway vehicles, open or closed to mineral leasing) or management class (e.g., type of timber management—clear cut or select cut, recreation management objective) with each alternative. There is very little attention to quantifying how much multiple use outputs will be produced with each alternative, in each decade (e.g. little information is provided concerning how many visitor days, tons of coal, acre feet of water).

Given the current and apparent future direction of public land management agency plans and EIS's, if economic dimensions are to be considered, economists need to adapt their valuation techniques. There are two approaches that economists could offer managers. The first, is to

provide a more holistic valuation of an entire management plan alternative. That is, provide a single total economic valuation of an entire management plan elicited from the public via a single contingent valuation WTP question. This would require one CVM -WTP question for each management alternative. However, sometimes the particular types and levels of ecosystem services in a given plan alternative maybe subject to change due to either public comments or new information obtained during the long time periods between draft and final management plans. In this case, the manager may wish to know the value each ecosystem services. If this is the situation, then a choice experiment format may be more useful to the manager.

These requirements suggest that Stated Preference methods in general, and perhaps Choice Experiments in particular, would be ideally suited to provide public land managers economic information within the current ecosystem management paradigm.

Example of using CVM to Value Alternatives in BLM Resource Management Plan
As part of its Resource Management Plan (RMP), BLM requested an economic analysis of alternative management scenarios for its scattered tracts of public land along the Snake River south of Grand Teton National Park in Jackson Hole, Wyoming. Since the majority of the lands along the river outside the National Park are in private ownership, the BLM lands provide some of the only public access to the Snake River for rafting and fishing. These lands provide some of the only publicly accessible lands for wildlife viewing, especially bald eagle watching. It was also grazed by a few livestock, and provided some sand/gravel for the Town of Jackson and Teton County.

The CVM survey was designed jointly by the BLM and the author, to value, what was at the time, the basic themes of the four alternatives to be considered by BLM in their RMP. The first alternative (#1) analyzed was developed in response to pressure from some corners of the Federal Government for BLM to sell the lands. Given the multi-million dollar real estate value of the lands this might very well have the highest financial return. A second alternative (#2) was retention of the public land and BLM accommodating increasing recreation use of the river corridor via increasing number of boating permits offered, adding a new boat ramp and allowing boat-in camping. A third alternative (#3) was to emphasize wildlife management with BLM and Wyoming Game and Fish retaining the public lands, and slightly reducing current recreation use. Finally, a fourth alternative (#4) was to open up more parcels for leasing for sand and gravel along the river channel and make available additional parcels for livestock grazing.

BLM was interested in the economic values to the public, broadly defined to include Teton County, rest of Wyoming and because of the national prominence of these lands, the rest of the U.S. As part of the agency's public involvement process, a survey was developed through focus groups and pretests and then mailed to a sample of residents in each of the three geographic areas.

The Contingent Valuation Method (CVM) survey valued Alternatives #2, #3 and #4 against Alternative #1, which was sale of the lands to private landowners (with inevitable development). Each alternative was compared on 7 criteria: (1) amount of land in public and private ownership; (2) Recreation (including amount of permitted use, whether motorized access allowed, and provision of boat-in camping); (3) whether additional livestock grazing was permitted; (4) whether sand and gravel mining would continue; (5) whether wildlife habitat for raptors and other species (e.g., elk) would be less than current or maintaining current levels; (6) financial (revenue to federal government and change in BLM management costs); (7) cost to each household in the form of an increase in federal income taxes for managing the lands according to that alternative (i.e., either 2, 3, or 4 depending on the scenario).

While this has all the makings of a choice experiment, the expense of printing the necessary versions of a color mail survey to perform a main effects orthogonal design ruled out a full choice experiment. In fact it was more intuitive to the agency to simply value each alternative, in its entirety. Nonetheless, a WTP function was estimated that related the probability of a yes vote to the bid amount, acres of public land retained, and amount of recreation allowed in visitor days (see Nahuelhaul, Louriero and Loomis, 2004 for more details).

The results of the survey indicated that there was a similar ranking of WTP in all three samples (Teton County residents, rest of Wyoming residents and rest of US residents) for the top two management alternatives: The highest WTP for all three samples was for Alternative #3 emphasizing wildlife management, followed by Alternative #2 for recreation. In the end, BLM kept all the parcels in public ownership, but to be managed by other state and county agencies with more of a physical presence in the area than BLM (whose office was about 100 miles away).

Agency's Manage for Desired Future Condition of Landscape & How Economists Might Value This

Another commonly used approach in public land management in the last decade has been management of public lands toward a "desired" future condition. This is often interpreted as moving the forest or ecosystem to a more sustainable, self regulating, and resilient ecosystems capable of accommodating natural variations in weather (e.g., droughts) and native pests, and natural disturbance (e.g., lightning caused fires). The Interior Columbia Basin Ecosystem Management Plan (ICEBMP) the land management alternatives are typical of what many of the newer federal land management plans reflect. Alternatives range from very active restoration efforts (e.g., forest thinning, prescribed fire, replanting riparian vegetation, re-contouring stream beds) to a slow and steady adaptive management approach to designation of lands as protective reserves with a "hands off" management style (Loomis, 2002: 553)). Economists have had some experience with valuing management actions that involve protective reserves such as Wilderness designations (Walsh, et al., 1984; Keith, et al., 1996) or Wild and Scenic River designations (Sanders, et al, 1990).

The "outputs" of the desired future condition plan alternatives generally emphasized restored acres of forest and rangeland, stream miles restored, and incidental production of livestock grazing AUM's or board feet of timber. However, what the key "outputs" embody is progress toward the desired future condition of the landscape. Comparison of these alternatives is often made spatially and visually with GIS maps, and in some cases photo-simulations or drawings of aspects of the landscape by decade.

For economic valuation to be relevant to this conceptualization of public land management planning, contingent valuation surveys need to be designed to allow people to value different landscapes. The landscape characteristics should include more than their visual elements and also include their ecological characteristics. This should not be too challenging as economists have experience with valuation of restoration programs (Loomis, et al. 2000; Brookshire, et al. 2010). Simplifications of the agency's GIS maps by alternatives, their photo-simulations, and their graphics may prove a starting point for survey design and pretesting.

Valuing alternatives involving adaptive management is even more challenging, as adaptive management is an evolving learning process. With adaptive management, there are different conditional management paths, the choice of which depends on the outcome of the initial

management, and the knowledge gained about the system response. In particular, adaptive management conducts initial management actions as experiments to learn more about ecosystem response to the management actions, e.g., does the action result in the anticipated level of species recovery or not. If yes, the manager continues the management action, if not a different management action is selected, often based upon what was learned from implementation of the first one. Part of the challenge for economists, is that the disciplinary specialists may not know enough to assign probabilities to the various possible outcomes or management paths. In this case, economists' usual tool of expected value calculations cannot be used. However, simulation models like agent based modeling may offer some hope in attempting to value these possible series of potential management actions (Loomis, Bond and Harpman, 2009). In particular, agent based modeling may be a useful tool for simulating the many alternative conditional management paths. From each of these paths, economists can then value the likely outcomes of each path. This array of values, associated with each path, provides another information input on the economic consequences of that path to the manager for informing the task of selecting the initial adaptive management path.

Economists have the basic stated preference methods that can be applied to valuation of a landscape approach to public land management. What is required is for us to re-think how they are to be tailored to these new approaches to public land management. However, the advantage of stated preference methods is their flexibility to be applied to future hypothetical scenarios. This is just what planning is all about: ex ante evaluation of possible alternatives. Hence there is a good match between what the agencies need to value with landscape management and the valuation tools available to economists.

Ultimately, what I believe agencies would find most useful is to have values per acre for different landscape conditions (e.g., old growth forests, second growth forests, healthy rangelands, open space) that are site specific. While contingent valuation methods and their applications have certainly generated values for many different landscape types (e.g., wetlands), obtaining site specific values that can be spatially mapped onto a GIS layer will be far more challenging. As economists has been discovering this last decade, spatial details such as contiguity matters. A wetland next to or near a campground may have far more use value than a wetland in the interior of a large wilderness area with no trails nearby. Software packages such as InVEST (Integrated Valuation of Environmental Services and Tradeoffs) have values per acre derived from benefit transfer, and then using GIS of land cover types to place them on the landscape, noting their proximity to human population centers. InVEST serves as an example of the type of valuation system that may be popular with land managers, especially those that seek "turn-key" valuation of ecosystem services. For example, Department of Defense has begun to test InVEST as a way to measure the economic value of ecosystem services on military lands. Much like the testing that has taken place to measure benefit transfer errors, there is a need to test the relative error with using secondary data approaches like InVEST against primary contingent valuation applications. Unfortunately, this has yet to begin and offers an important research opportunity to learn more about trade-offs between ecosystem valuation transfer and original valuation. For more information on InVEST go to Stanford University's Natural Capital Project, InVEST website (http://www.naturalcapitalproject.org/InVEST.html#How).

Open Space Value of Public Lands at the Wildland Urban Interface

The other growing value of public lands is in the open space these lands provide to sprawling cities and suburbs in the west. Public lands not only provide the many values of open space themselves (e.g., scenic, recreational) but also provide the "last stand" against further sprawl in many cases. This buffering capability of public lands exists in numerous cities including Salt Lake City, Tucson, and Portland, for example. While economists have performed dozens of studies on the economic values of open space (Bergstrom and Ready, 2008) nearly all of this has focused on agricultural land preservation or private land preservation, with much of this being done in the eastern U.S. These private land open space values may, at best, provide some insights on the economic values of public land open space near urban areas. In addition, the techniques "perfected" in valuing open space elsewhere provide an excellent starting point for valuing open space adjacent to public lands in the wildland urban interfaces of the west. To date there have only been a few studies that have addressed the economic values that undeveloped lands provide to nearby residential and urban areas (Banzhaf, 2007). While stated preference studies can be used, hedonic property studies are clearly appropriate here as well. See Thorsnes (2002) and Bolitzer and Netusil, (2000) in general, and particularly, Phillips (2000), who looked at the value of nearby Wilderness on property values.

Implications for the Future

Economists need to keep abreast of the changing paradigms used by public land managers in their planning and resource allocations on public lands. While this is no easy task (e.g., the U.S. Forest Service has been struggling with draft planning regulations on a seemingly perpetual cycle every five years but has now issued final planning rules—see Federal Register 2012), economists risk being less and less relevant to public land managers and management if our tools are rooted in old paradigms of multiple use. In my opinion, stated preference methods offer useful tools to value entire resource management alternatives and desired future conditions of landscapes.

How to proceed? Clearly we need for more demonstration projects such as the San Pedro River where an attempt was made to value an entire water dependent ecosystem (e.g., riparian wildlife habitat—see Brookshire, et al. 2010) and Department of Defense's recent funding of an ecosystem service valuation research on its military bases using Stanford University's InVEST.

Certainly barriers such as budgets, time and sometimes U.S. Office Management and Budget (OMB) survey review often stand in the way. At least the time limitations can be overcome by early involvement of economists in agency planning processes. If economic issues are raised at the scoping stage of land management plans and Environmental Impact Statements (EIS's), then sufficient time would be available for conducting stated preference surveys of users and the public. There are several successful solutions to the OMB survey clearance problem whereby obtaining official permission for a federal agency to conduct a survey can take a minimum of 6 months. Perhaps the most promising and frequently used is to build upon the increasing involvement of stakeholder groups participation in public land and resource management planning. The composition of stakeholder groups often reflects industry associations, conservation groups, county and state governments and their agencies. None of these groups are required to follow OMB guidelines if they fund a survey effort. Using the collective resources of these groups to actually fund the survey implementation and data collection, with the federal agencies paying for the data analysis and report writing has proven successful in at least three cases the author is aware of. This joint federal and state collaboration and division of labor fits the public land agency's stakeholder collaborative model

and often ties to existing data collections routinely performed by state agencies such as a wildlife management agency.

Another option that has proven successful in the past is for the agency to indicate that a survey is part of its public involvement process to gauge public preferences for land management alternatives. Administration of contingent valuation surveys in group settings has been successfully done in the past, and may provide a way to cost effectively administer surveys. Of course the agency would need to select a representative sample of the public for such meetings. But this is a much needed supplement to traditional public meetings where only those with strong vested interests show up, each claiming to represent the public's views.

Certainly, stated preference methods are not the only way to value the numerous outputs of public lands. Public land open space adjacent to towns and suburbs can be valued with hedonic property methods. Recreation valued with travel cost models. Benefit transfer can be used to value wetlands. But stated preference methods are probably the most comprehensive tool to provide holistic values entire land management plans or desired future conditions of landscapes. Economists have the basic tools, but to make a contribution to improving natural resource management on one-third of our nation's land we must be more proactive and make known our willingness to engage early in the planning process. Economists must continue to educate managers and their staffs that stated preference methods are available to provide the more complete economic analysis of public lands that stakeholders are increasingly asking the agencies to perform.

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