WHEN MOTIVES MATTER: METHODOLOGICAL CONTRIBUTION AS A PUBLICATION SELECTION CRITERION FOR ACADEMIC JOURNALS

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ABSTRACT

This paper explores potential bias in value estimates provided in refereed journal articles as compared to those provided in government reports. Publication selection criteria have been identified for journals, including a predisposition for conventional views, expected results, statistically significant results, and methodological innovation. In contrast, government reports tend toward providing new estimates of value, although their peer-review process may be subject to similar selection criteria as journals. A Heckman two-stage sample selection model is estimated on recreation use values literature comprised of journal articles and government reports. Three proxy measures for selection criteria are constructed, including absolute deviations from a five-year moving average value (expected results); square root of the study's sample size (statistically significant results); and a dummy variable identifying methodological contribution as primary motive for the publication. Square root of sample size and methodological contribution are significant predictors in the selection equation for documents published in journals. The inverse Mill's ratio in the meta-regression equation of journal article values is statistically significant, showing an $18 per person per day premium for journal articles. An implication of this research is that journal article-provided estimates of value are systematically larger than estimates in government reports due to selection criteria of journals. Insofar as publication selection criteria for journals are not consistent with the provision of new estimates of value, journals may not be an appropriate source of information for benefit transfers. These results suggest that the motives of publishing do matter. We need to ensure that outlets for new estimates of value have a rigorous peer-review process with appropriate selection criteria.

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INTRODUCTION

Science is discovery—it is the development of new tools and uncovering new knowledge through the application of these tools. In environmental valuation, tools (e.g., methods and estimators) are developed to address issues of bias and efficiency in estimation and prediction, among others. The application of tools using standard assumptions regarding parameter values (e.g., time cost, mileage cost) and survey design lead to new estimates of value that add to our stock of knowledge governing real-world issues (e.g., resource policy or program evaluation). However, journals seem to be predisposed toward the discovery of tools, often requiring methodological novelty or interesting twists before publishing applications and results of primary research. Standard applications of existing tools do not seem to meet or exceed implied thresholds of discovery necessary to fill the pages of journals. In part this is due to the competitive nature of publishing within the constrained space of journals; the likelihood of publishing new estimates of value declining as the prestige of the journal increases.

Benefit transfer—the use of published estimates of value to inform policy or program issues with limited or no data—is entirely dependent upon the existence of value estimates. Insofar as publication selection suppresses value estimates from the literature, the potential for benefit transfer may be limited. In its most basic form publication selection, or the 'file-drawer problem' of Rosenthal (1978, 1979), suppresses working papers and other unpublished research. Card and Krueger (1995, p.239) generalize the 'file-drawer problem' by identifying three sources of publication selection in economics—(1) reviewers and editors may be predisposed to accept papers consistent with the conventional view; (2) researchers may use the presence of conventionally expected results as a model selection test or are unwilling to report estimates outside the range of previously reported values; and (3) everyone may possess a predisposition to treat 'statistically significant' results more favorably. Smith and Pattanayak (2002, p.273) identify another plausible source of publication selection bias—(4) most journals in the environmental economics field are not interested in new value estimates for their own sake. That is, most journals are predisposed to select manuscripts based primarily upon methodological innovations and contributions.

However, in environmental economics, the motivation to publish new estimates of value may be of primary importance. The venue through which these value estimates are published can include government reports such as US Forest Service general technical reports, US Fish and Wildlife Service technical bulletins, and university bulletins, to name a few. The question of publication bias arises in whether these two primary sources of value estimates (i.e., journals and government reports) provide estimates that are similar. While the process of peer-review for journals is a check on the quality and comparability of primary research, motivations other than standard applications of methods for the purpose of estimating values may take precedence. If the motivations behind publishing journal articles result in divergent empirical estimates of value, then evaluations of real-world issues may be biased if based in part or in whole on value estimates derived from journal articles. On the other hand, if non-journal publications do not include critical applications of tools as confirmed through peer-review, then this source of values may be biased as well.[1]

Formal evaluations have found evidence of publication selection biases across a variety of literatures; such biases may have substantial impacts on inferences derived from the literature (see Rosenberger and Johnston, forthcoming, and Rosenberger and Stanley, 2006 for a review). For example, price elasticities of water demand have been found to be exaggerated four-fold

[1] Most government reports undergo a peer-review. The primary difference is that government reports are most often evaluated for standard applications of existing tools, not methodological contributions.

through publication selection bias (Dalhuisen et al., 2003; Stanley, 2005). Several past meta-analyses have found a systematic difference in value estimates reported in journal articles using a dummy variable approach (Rosenberger and Stanley, 2006).[2]

A Heckman two-stage sample selection model has been suggested as a potential model for analyzing publication selection (Florax 2002; Smith and Huang 1993; Stanley 2006), along with several other parametric and nonparametric methods (Florax 2002; Stanley 2005, 2006). Smith and Huang (1993) apply a Heckman two-stage model for publication selection bias in the recreation literature. They hypothesize that conventionally-expected results would tend to be published in the peer-reviewed literature (primarily journal articles), while other studies will not be published. They do not find statistically significant correlations between published and unpublished studies in their model, which may have been due to limited access to all empirical studies available, in particular when these studies are not published in the mainstream literature.

Hoehn (2006) also applies the Heckman two-stage sample selection model to analyze the effect of research priority selection bias in primary research. He identifies four descriptors potentially correlated with the decision to conduct primary research on an environmental resource. These descriptors include society's awareness of the resource, the importance of the resource to stakeholders, the magnitude of the policy decisions to be made in response to conflicts over the resource, and the availability of funding to support primary research. Hoehn (2006) applies the model for the purpose of quantifying research priority selection in the wetland valuation literature. The inverse Mills ratio in his valuation equation is positive and statistically different than zero, indicating selection bias in this body of literature. The coefficient estimates in the Heckman corrected model for the most part decrease in absolute magnitude from the

[2] Several labels have been applied to the journal literature, including published and peer-reviewed. In most applications, a dummy variable was created for which 1 = source was a peer-reviewed journal and 0 = a non-journal source document.

uncorrected OLS model. The uncorrected generic wetland value is four times larger than the Heckman estimate, showing a substantial research priority selection bias.

This paper formalizes the selection criteria suggested by Card and Kreuger (1995) and Smith and Pattanayak (2002), and tests for significant effects in a stock of value estimates. The selection criteria effects are estimated using Heckman's two-stage sample selection model, as described below. The model is applied to the recreation use values literature where journal articles are contrasted with government reports as sources of primary information. It is hypothesized that journal selection criteria result in systematically different value estimates than government reports.

MODEL

Heckman's two-step procedure is used to derive an OLS test for selection effects in journal articles (Verbeek, 2004; Hoehn, 2006). Begin with a meta-regression function that relates estimates of value provided in journal articles with characteristics of the primary study:

(1) $v_i^* = x'_{1i}\,\beta_1 + \varepsilon_{1i}$,

where v_i^* denotes a reported estimate, x'_{1i} is a 1xK vector of characteristics of the study (e.g., resource type, survey method, estimator type), β_1 is a Kx1 vector of coefficients to be estimated, and ε_{1i} is a stochastic error term with $E[\varepsilon_1]=0$ and $E[\varepsilon_1^2]=\sigma_1^2$. Assume value estimates v_i^* are not published in a journal if the study does not meet the minimum threshold that allows it to survive the journal referee process, whether this process was initiated for the study or not.

A second equation, the binary selection equation, can be specified that describes whether a study survives the journal referee process:

(2) $h_i^* = x'_{2i}\,\beta_2 + \varepsilon_{2i}$.

The following observation rule applies:

(3)
$$v_i = v_i^*, h_i = 1 \quad if \;\; h_i^* > 0$$
$$v_i \; is \, not \, observed, h_i = 0 \quad if \;\; h_i^* \le 0,$$

where v_i denotes study *i*'s value estimate and h_i is a latent variable that indicates published in a journal or not. The independent variables that may affect h_i^* may include variables that measure the selection criterion for journal articles, to be described below. In (2), x'_{2i} is a 1xQ vector of the independent variables, β_2 is a Qx1 vector of coefficients to be estimated, and ε_{2i} is a stochastic error term with $E[\varepsilon_2]=0$ and $E[\varepsilon_2^2]=\sigma_2^2$. The selection equation is modeled as probit where $\Pr(h_i = 1) = \Phi(x'\beta)$ and $\Pr(h_i = 0) = 1 - \Phi(x'\beta)$.

The effect of publication selection in journals on the meta-regression of journal estimates of value is based on the conditional expectation of ε_{1i} given ε_{2i}, E[$\varepsilon_{1i} | \varepsilon_{2i}$]. That is, the conditional expected value estimate in a journal, given that value estimate is published in a journal article, is given by:

(4)
$$\begin{aligned} E[v_i^* \mid h_i = 1] &= x'_{1i}\,\beta_1 + E[\varepsilon_{1i} \mid h_1 = 1] \\ &= x'_{1i}\,\beta_1 + E[\varepsilon_{1i} \mid \varepsilon_{2i} > -x'_{2i}\,\beta_2] \\ &= x'_{1i}\,\beta_1 + \frac{\sigma_{12}}{\sigma_2^2} E[\varepsilon_{2i} \mid \varepsilon_{2i} > -x'_{2i}\,\beta_2] \\ &= x'_{1i}\,\beta_1 + \sigma_{12}\frac{\phi(x'_{2i}\,\beta_2)}{\Phi(x'_{2i}\,\beta_2)}, \end{aligned}$$

where σ_2^2 =1 is the normalization restriction of the standard probit model, ϕ is the normal density function and Φ is the cumulative normal density function (Verbeek, 2004). The last term $\frac{\phi(x'_{2i}\,\beta_2)}{\Phi(x'_{2i}\,\beta_2)}$ is the inverse Mill's ratio and is denoted $\lambda(x'_{2i}\,\beta_2)$ by Heckman (1979). Thus, (4) can be re-written as:

(5) $$E\left[v_i^* \mid h_i = 1\right] = x'_{1i}\,\beta_1 + \rho_{12}\sigma_1\lambda_i\left(x'_{2i}\,\beta_2\right),$$

with $\rho_{12}\sigma_1 = \sigma_{12}$. In this expression, ρ_{12} is the correlation coefficient between the two error terms. If $\sigma_{12} = \rho_{12} = 0$ (i.e., the two error terms are uncorrelated), then OLS is a consistent estimator of the meta regression equation. However, if $\sigma_{12} \neq 0$ (i.e., the error terms are correlated), then OLS is an inconsistent estimator for the meta regression equation as the result of sample selection bias.

Given ρ_{12} and σ_1 are constants and $\lambda\left(x'_{2i}\,\beta_2\right)$ is a variable determined by the independent variables that influence publication selection, (5) may be re-written as the Heckman meta-regression equation where $\rho_{12}\sigma_1 = \beta_\lambda$:

(6) $$E\left[v_i^* \mid h_i = 1\right] = x'_{1i}\,\beta_1 + \lambda_i\left(x'_{2i}\,\beta_2\right)'\beta_\lambda .$$

A simple test arises in this specification—$\beta_\lambda = 0$ is tested using a t-test in the Heckman meta-regression equation. If $\beta_\lambda > 0$, then a meta-regression model that ignores publication selection effects will have inconsistent coefficient estimates and invalid inferences based on inefficient standard errors. Therefore, the Heckman two-step procedure provides a simple and direct way to test and correct for publication selection.

DATA

The Heckman two-stage publication selection model (2 and 6) is applied to the recreation use values database (Rosenberger and Stanley 2007). The database currently contains 329 documents that jointly provide 2,705 estimates of recreation use values. The studies were documented from 1958 to 2006 based on data collected from 1956 to 2004. The use value estimates range from about \$0.50 to \$2,754 per person per activity day, covering 27 recreation activity types and primary studies conducted in the US and Canada. Estimates that are in the upper tail of this distribution are derived from bad models as identified by the authors; they included them for illustrative purposes only. Of the 36 estimates >$500, 60% are identified as being based on bad models. Therefore the database was trimmed of all estimates reported as being derived from bad models (n=96), and estimates >$500 (n=15), for a total reduction of the database by 111 estimates (i.e., we removed about 4% of the database). The remaining 2,594 estimates range from $0.50 to $486 in consumer surplus per person per day (in 2006 dollars).

The data were further restricted to only include estimates derived from journal articles and government agency reports (n = 1,976). An additional 302 estimates were dropped given the primary study document did not report the sample size for their data, resulting in 1,694 estimates used in this analysis. Table 1 describes the data. Journal articles provide 642 estimates of value, while government reports provide an additional 1,032 estimates of value. The dependent variable in the selection equation (2) is binary and identifies journal articles (=1) or government reports (=0). The dependent variable for the meta-regression equation (6) is reported consumer surplus per person per day (in 2006 dollars).[3] Mean consumer surpluses for journal articles and government reports are not statistically different based on an overlapping 95% confidence interval test; however, the variance for journal article estimates is higher than that for government report estimates based on standard deviations for the means. The mean inverse Mill's ratio estimated for journal articles (described below) is 0.632. The positive sign of the inverse Mill's ratio suggests positive correlation between journal publication selection and the magnitude of value estimates provided by journal articles.

[3] Our dependent variable for the meta-regression mixes Hicksian and Marshallian estimates of consumer surplus. While these estimates are not consistently defined (Smith and Pattanayak, 2002), the underlying heterogeneity of the data likely swamps the differences between these two types of measures. Furthermore, income effects for recreation participation are likely small, thus Hicksian and Marshallian measures are expected to converge (Willig, 1976).

The first journal selection criterion ((1) reviewers and editors may be predisposed to accept papers consistent with the conventional view) remains unmeasured. The second journal selection criterion ((2) researchers may use the presence of conventionally expected results as a model selection test or are unwilling to report estimates outside the range of previously reported values) is measured as absolute deviations from a journal mean estimate for the five-year period in which the document-specific (journal article or government report) value estimate is published.[4] This measure was calculated as follows: the mean value of journal article estimates reported in a five-year period (1970 or earlier 1971-1975, 1976-1980,…, 2001 or later) is calculated; the absolute deviation is the absolute value of the difference between an estimate in a document from the journal mean for the period in which the document was published. Table 1 shows that journal articles provided slightly larger estimates on average, whereas government reports provided slightly lower estimates on average, although they are not statistically different from each other. Again, journal articles' variance in this measure is larger than that for government reports, possibly indicating that conformity in value estimates to past research outcomes is not an important criterion for journal selection.

The third journal selection criterion ((3) everyone may possess a predisposition to treat 'statistically significant' results more favorably) is measured by the square root of the sample size (square root of N). On average, journal articles are based on studies with larger sample sizes than government reports. When there is publication selection, estimates from smaller samples are at a distinct disadvantage in finding statistical significance. Because the standard errors are typically larger in small samples, studies that use small samples will find it more difficult to produce statistically significant effects. Hence, small-sample studies will need to search longer

[4] Using the journal article five-year aggregate mean value as the conventionally expected result implies that researchers only use the journal literature for signals of conventional wisdom.

and harder from different model specifications, estimators, techniques, and measures to find the large estimate that statistical significance demands. Studies with larger sample sizes will generally not need to search quite so hard; thus, they will tend to report smaller effects. This association of publication bias with sample size (or standard error) forms the basis of several approaches to publication selection identification and correction (Stanley, 2005; 2008).

The fourth journal selection criterion ((4) most journals in the environmental economics field are not interested in new benefits estimates for their own sake) is measured by a binary variable that identifies each publication's primary contribution, either as a methodology contribution (=1) or a new estimate of value contribution (=0). Table 1 shows the journal article literature is split between methodological contributions and new estimates of value; whereas the government report literature is predominantly contributing new estimates of value. Methodology is further disaggregated, for illustrative purposes, into its methodological contributions as introduction of new econometric estimators or tests for bias (e.g., the effect of including the price of substitutes or different assumptions about the value of time in travel cost models, and the treatment of outliers and protest responses in the contingent valuation models). Table 1 shows that the government report literature does not contribute value estimates based on introducing new estimators, but has conducted bias tests. The journal article literature predominantly tests for biases in estimated models, but some of the articles do contribute value estimates in the guise of introducing new econometric estimators. The measure identifying new estimates of value is provided in Table 1 for completeness and illustrates the motivation for government reports to provide new estimates of value.

The remaining variables reported in Table 1 describe other characteristics of individual studies. Journal articles focus more intently on identifiable recreation sites (e.g., the value of salmon fishing in the Rogue River), whereas government reports primarily focus on providing generic value estimates for an activity that may be applicable to a broad region (e.g., the value of salmon fishing in Oregon) where differences in sites are suppressed. Journal articles have a higher proportion of estimates derived from revealed preference studies compared to more estimates derived from stated preference methods for government reports. The different types of contingent valuation methods and travel cost methods, along with corrections for biases (e.g., removal of outliers and protest responses in contingent valuation data, and the use of count data estimators and including substitute price in travel cost models) have relative proportions consistent with the proportions of revealed versus stated preference methods between the two types of documents.

The remaining variables that measure activity type, resource type, functional form, and region of study (e.g., northeast, Midwest, or national) are similar in proportion between the two literatures with the exception of big game hunting wherein government reports provide a disproportionately large number of estimates for this type of activity. This is likely due to the focus of state and federal wildlife agencies conducting or funding statewide and nationally-scoped studies (e.g., the US Fish and Wildlife Service's periodic national survey for hunting, fishing and wildlife-related activities).

RESULTS

Table 2 provides mean values for variables included in the selection equation (2), along with estimated coefficients and p-values. The mean values represent the pooled data for journal articles and government reports. The dependent variable is binary where 1 = published journal article and 0 = government report. The independent variables include the selection variables:

absolute deviations from the mean, sample size, primary contribution; and variables that measure site aggregation and valuation method. All variables are statistically significant, with the selection model correctly predicting the source document 78.0% of the time.

Greater absolute deviations from the five-year means for value estimates result in slight increases in probability of being published in a journal, but this effect is not statistically different than zero. This result may be due to measurement error in that the five-year averages ignore the activity and resource specific applications for which estimates are provided. Larger sample sizes are associated with a higher probability of being published in a journal. This is as expected given one of the quality criteria in journals is sufficient sample size. When the primary contribution of a document is methodological, it has a higher probability of being published in a journal, as expected.

Table 3 reports results for three meta-regression models. The dependent variable for all three models is consumer surplus per person per day (in 2006 dollars) as reported in journal articles. The data are weighted by the square root of the sample size to account for heterogeneity among the data. In addition, all models are fit using a linear functional form. Although semi-log models (i.e., natural log of dependent variable) fit the data better, the relative relationships are constant and the linear model is directly interpretable. All estimated coefficients across the three models are statistically significant at the 95% level; other variables were eliminated that were not found to be statistically significant. The first column of Table 3 lists the variables that were statistically significant from specification tests of the models.

The first model—second column of Table 3—is the weighted least squares (WLS) model ignoring selection effects; a form of omitted variable bias (Heckman, 1979). The baseline WLS model has an adjusted-R^2 of 0.30. The constant term ($66.90) is the value of a typical recreation activity at a site not explicitly detailed in the regression model specification. The coefficient on sample size shows that values increase by $2.10 for every increase of 100 observations in the sample of the underlying models. Individual TCM models are $32.76 per unit higher in value than other valuation methods, *ceteris paribus*. In general, individual TCM's produce value estimates that are higher than other methods, a result consistent with prior meta-analysis of recreation use values from a variety of source documents (Rosenberger and Loomis, 2000). Linear-linear and log-linear models generally result in lower value estimates. Five recreation activity types are statistically significant in the model—saltwater fishing, nonmotorized boating, hiking, big game hunting, and mountain biking. These recreation activities are the one with the highest value premium associated with them. Mountain biking and nonmotorized boating have the highest value premium of all activities. Land and lake/reservoir resources provide opportunities for activities with relatively lower value estimates than omitted resources such as river/stream and ocean (see saltwater fishing estimate) resources. Ocean, bay and estuary resource types are highly correlated with saltwater fishing and therefore not included in the model. Studies conducted in the Midwest or providing general values at the national level result in lower value estimates.

The WLS Test for journal publication selection effects (Column 3 of Table 3) shows that the inclusion of the inverse Mill's ratio estimated from the probit selection equation is statistically significant at the 99% level. This implies that for the WLS model the estimated coefficients are inconsistent and the variance estimate is invalid (Hoehn, 2006). Therefore, although the statistical significance of the coefficients does not change across the three models in Table 3, the magnitude of the coefficients are misleading in the WLS equation, leading to incorrect value predictions from the meta-regression model. For example, the baseline or constant value when all moderator effects are set to zero declines by about 23% (from $66.90 for the WLS model to $51.78 for the WLS Test and Heckman WLS models).

The WLS Test coefficients are consistent given selection, but the variance matrix and standard errors are not valid in Column 3 of Table 3. Estimation of the second stage equation from the Heckman WLS model (Column 4 of Table 3) provides consistent estimates of the standard errors and variance matrix. The coefficient estimates do not change between the WLS Test and Heckman WLS models, but the standard errors all decrease by a modest amount. The variable of primary interest, the inverse Mill's ratio, is statistically significant and positive in the Heckman WLS model. This means that, on average, the selection effect for publishing in journals results in a $17.92 premium, which is about a 35% increase in estimated value from the constant base dollars ($51.78 when all moderator variables are set to zero).

Table 4 reports the indirect effects of journal selection on value estimates. These indirect measures are calculated at the mean value for the variables in the pooled, probit selection model. The absolute deviations from reported mean values and square root of sample size do not have statistically significant indirect effects via the inverse Mill's ratio. Therefore, even though the square root of sample size is a significant determinant in the selection of studies for publication in journals, its indirect effect is negligible. This is likely due to the fact that square root of sample size directly affects value estimates as evidenced in the meta-regression models. The indirect effect of method contribution on the inverse Mill's ratio is negative and statistically significant, signaling that journal publications are biased upwards in value estimates.

CONCLUSIONS

Publication bias in the environmental valuation literature may be due to selection criteria associated with journal articles and the referee process. Selection criteria are enforced by editors, reviewers, and authors to ensure the advancement of science and the comparability of studies over time. However, existing selection criteria may be incompatible with other uses of the literature (such as benefit transfers). A Heckman two-stage sample selection model was developed and fit to a recreation use value estimate database to test and correct for publication selection bias in the journal literature. A selection equation was estimated in which journal publication selection was modeled as a function of conventionally expected results (absolute deviation from five-year moving average journal mean), statistically significant results (square root of sample size of primary study), and method contribution (dummy variable defined as 1 = primary contribution is methodological, 0 = primary contribution is new estimate of value). The second equation was a standard meta-regression model of estimated recreation use values reported in refereed journals.

The square root of sample size variable and method contribution variable were positively and statistically significantly associated with selection for journal publications. The inverse Mill's ratio in the Heckman meta-regression model was positive and statistically significantly related to value estimates reported in the journal literature. Thus journals seem to exhibit an upward bias in value estimates (in this case, about $18 per person per day in consumer surplus, or about 35% higher than the baseline surplus estimate). This upward bias primarily seems to be associated with the indirect effect of methodological contributions on the inverse Mill's ratio, whereas the effect of sample size on value estimation is direct and corrected through the meta-regression model (Stanley and Rosenberger, 2008).

The competitive nature and space-constraints of journals has resulted in a focus on methodological contributions in the environmental valuation literature. Since the primary goal of journal articles is not the reporting of new estimates of value (about 50% of estimates in journals), but instead the value estimates reported are an outcome of illustrating the methodological investigation of the journal article, it seems reasonable to caution against directly using estimates derived from journal articles for benefit transfers. And the higher the prestige of the journal, the more likely environmental valuation articles contained therein make methodological contributions and suffer from publication selection bias.

Government reports, in contrast, also are often peer-reviewed, but their primary purpose is estimation and reporting of new estimates of value (96% of estimates in government reports versus 51% of estimates in journal articles). Peer-review of government reports is to ensure their study design and model estimation conforms to the current state-of-the-science. This does not imply that government reports are better than journal articles as sources of value estimates *for the purpose of benefit transfer*, but that government reports and journal articles have different goals and roles in environmental valuation. If new estimates of values are to be considered important contributions in their own right, then selection criteria of existing journals should be revised. In many applied sciences new estimates have inherent worth (Smith and Pattanayak, 2002). However, given existing space constraints and competition are not likely to change in the existing suite of journals, additional outlets whose primary purpose is reporting of new estimates of value may be warranted. In this fashion, some publication selection biases as they affect benefit transfers may be avoided without restricting creativity and outlets for advancements in valuation methods.

Furthermore, elevating the importance of new estimates of values for their own sake may help overcome many of the barriers to using the empirical literature for benefit transfers (Loomis and Rosenberger, 2006). For example, selection criteria for new estimates of values may include full reporting of a study's sample (e.g., average income, age, and education level) and the spatial dimensions of the study site (e.g., the extent of the market, extent of the resource), two areas that are important for benefit transfers but routinely not reported in source documents for primary studies (Loomis and Rosenberger, 2006). If new estimates of value based on sound applications of existing tools are to become inherently valuable in environmental economics, then documentation of new values studies should be subject to a rigorous referee process using appropriate (and transparent) selection criteria.

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Table 1. Summary of variables: means (standard deviations).

VARIABLE	GOVERNMENT REPORTS	JOURNAL ARTICLES
CS/person/day	49.60 (45.55)	55.29 (71.35)
Inverse Mills ratio	---	0.632 (0.474)
Absolute deviation from mean reported values (@ 5-yr increments)[a]	32.694 (35.006)	46.893 (51.681)
Square root of N	15.399 (18.403)	27.171 (27.846)
Method contribution	0.037 (0.188)	0.488 (0.500)
New value estimate	0.963 (0.188)	0.512 (0.500)
New estimator	0	0.096 (0.296)
Bias testing	0.037 (0.188)	0.391 (0.488)
Single site model	0.124 (0.330)	0.532 (0.499)
Stated preference	0.710 (0.454)	0.202 (0.402)
Revealed preference	0.290 (0.454)	0.758 (0.428)
CVM-payment card	0.0572 (0.232)	0.003 (0.056)
CVM-open ended	0.373 (0.484)	0.121 (0.327)
CVM-dichotomous choice	0.204 (0.404)	0.058 (0.233)
Protests removed (CVM)	0.279 (0.449)	0.126 (0.332)
Outliers removed (CVM)	0.272 (0.445)	0.134 (0.341)
TCM-individual	0.101 (0.301)	0.391 (0.488)
TCM-zonal	0.188 (0.391)	0.307 (0.462)
TCM-RUM	0.001 (0.031)	0.101 (0.302)
Count data estimator	0.010 (0.098)	0.223 (0.416)
Price substitute modeled	0.186 (0.389)	0.371 (0.483)
Linear-linear functional form	0.193 (0.395)	0.170 (0.376)

VARIABLE	GOVERNMENT REPORTS	JOURNAL ARTICLES
Log-linear functional form	0.060 (0.238)	0.452 (0.498)
Linear-log functional form	0.023 (0.151)	0.019 (0.136)
Log-log functional form	0.136 (0.116)	0.136 (0.342)
Saltwater Fishing	0.010 (0.098)	0.039 (0.194)
Non-motorized boating	0.010 (0.098)	0.064 (0.245)
Hiking	0.010 (0.098)	0.061 (0.239)
Big game hunting	0.252 (0.434)	0.054 (0.227)
Mountain biking	0	0.023 (0.151)
Land resource	0.138 (0.346)	0.262 (0.440)
Lake/reservoir resource	0.092 (0.289)	0.260 (0.439)
River/stream resource	0.041 (0.198)	0.196 (0.397)
Ocean resource	0.020 (0.141)	0.033 (0.178)
Northeast region	0.141 (0.349)	0.114 (0.318)
Midwest region	0.145 (0.353)	0.140 (0.347)
South region	0.234 (0.424)	0.204 (0.403)
West region	0.414 (0.493)	0.416 (0.493)
National study	0.006 (0.076)	0.096 (0.296)
No. of observations	1032	642

[a]The range of deviations from the mean are similar across the document types.

Table 2. Selection equation coefficient estimates, probit.

VARIABLE	MEAN	COEFFICIENT (Std Error)	P-VALUE
Constant	---	-0.564 (0.059)	<0.01
Absolute deviation from mean reported values	46.592	<0.001 (<0.001)	0.76
Square root of N	46.944	0.005 (<0.001)	<0.01
Method contribution	0.279	1.884 (0.102)	<0.01
Log likelihood	---	-602.14	
Prob>chi^2	---	---	<0.01
Percent correct predictions	---	78.0	---
Number of observations	1674	---	---

The dependent variable is binary and identifies journal publications (=1) versus government reports (=0). All data were weighted by the square root of sample size to correct for heterogeneity.

Table 3. Meta regression equation estimates, weighted least squares.

VARIABLE	COEFFICIENT ESTIMATES[a] WLS	WLS TEST	HECKMAN WLS
Constant	66.901 (6.130)	51.783 (7.896)	51.783 (7.853)
Square root of N	0.210 (0.059)	0.268 (0.062)	0.268 (0.061)
TCM-individual	32.760 (5.620)	36.054 (5.690)	36.054 (5.622)
Linear-linear functional form	-32.890 (8.063)	-30.976 (8.037)	-30.976 (7.959)
Log-linear functional form	-43.803 (6.553)	-43.002 (6.517)	-43.002 (6.426)
Saltwater fishing	27.765 (12.163)	32.038 (12.168)	32.038 (12.111)
Nonmotorized boating	87.573 (11.794)	89.464 (11.736)	89.464 (11.609)
Hiking	42.883 (10.578)	41.085 (10.528)	41.085 (10.377)
Big game hunting	41.086 (10.472)	43.732 (10.443)	43.732 (10.329)
Mountain biking	114.158 (19.494)	116.670 (19.388)	116.670 (19.182)
Land resource	-29.673 (7.554)	-32.183 (7.552)	-32.183 (7.444)
Lake/reservoir resource	-25.803 (7.621)	-23.456 (7.612)	-23.456 (7.526)
Midwest	-19.617 (9.612)	-21.192 (9.566)	-21.192 (9.443)
National	-24.910 (7.853)	-27.272 (7.842)	-27.272 (7.726)
Inverse Mill's ratio	---	17.922 (5.955)	17.922 (5.921)
Adjusted R^2	0.30	0.31	0.31
Prob F>0	<0.01	<0.01	<0.01
Number of observations	642	642	642

[a]Coefficient standard errors reported in parentheses.
The dependent variable is consumer surplus per person per day (in 2006 dollars). All data were weighted by the square root of sample size to correct for heterogeneity.

Table 4. Indirect effects in inverse Mill's ratio of sample selection on value estimates.

VARIABLE	Indirect Effect[a] COEFFICIENT (Std Error)	Indirect Effect[a] P-VALUE
Constant	5.986 (2.062)	0.004
Absolute deviations from mean reported values	-0.002 (0.163)	0.988
Square root of N	-0.049 (0.162)	0.761
Method contribution	-20.007 (6.690)	0.003

[a]Calculated at mean value for full sample from probit equation.