A Meta analysis of Contingent Valuation in Environmental Quality Studies

Sujith P. Jayasooriya[1]

Introduction

Environmental quality is one of the major apprehensions in today's climate change forums. The importance of environmental quality has been questioned in many papers with respect to the well being of humans. From a welfare perspective, ecosystems provide countless goods and services. The objective of this meta-analysis of contingent valuation (CV) studies is to assess the marginal value of the different environmental management programmes providing certain environmental goods and services. There is much literature with respect to the CV of different environmental quality studies. In a similar fashion, the present study fits the results of multiple valuation studies of environmental quality management programmes.

Data Description

An exhaustive search of studies has been conducted in different databases including ECONLIT, EVRI, ENVALUE, and AGECONSEARCH. All studies are primary studies with the application of CV approach in environmental quality management. As a consequence of limited availability, the final data used for the Meta analysis comes from 42 studies (Refer to the table 1 in the Appendix). Homogenising all information, values were transformed to a standard measure, per year or one-time payment, per household and per individual, and transferred into current US dollars. The majority of the previous meta-analyses have used the mean instead of the median estimates (Smith and Osborne, 1996; Loomis and White, 1996; Horowitz and McConnell, 2002). However, with the objective of assessing whether there are differences in the factors affecting both welfare measures, two common models are estimated. The Willingness to Pay (WTP) values are expressed as in 2016 US$ updating them through purchasing power parity (PPP) rates.

Model Specification

The dependent variable in the Meta Regression (MR) function is a vector for WTP values, labeled as y. Given that in previous studies of MR, the independent variables were categorised into environmental goods/services, environmental quality characteristics, study characteristics, and socio-economics following Brender *et. al.* (2006), the following semi-log MR function was estimated.

---

[1] *Environmental Economist at Asian Development Bank spj0525@gmail.com*

The following baseline and extended models were established for estimating the regression coefficients for independent variables.

$$\ln y = \alpha + \beta_1 Env\_good_j + \beta_2 Env\_serv_j + \beta_3 Envn\_Qty_j + \beta_4 socio\_econ + e_j$$

The empirical estimation for the extended model is defined as;

$$\ln y = \alpha + \beta_1 Env\_good_j + \beta_2 Env\_serv_j + \beta_3 Envn\_Qty_j + \beta_4 stud\_char$$
$$+ \beta_5 study\_purpose + \beta_6 socio\_econ + e_j$$

The use of an extended model is useful since it controls for many independent variables in the estimation than the baseline model does. For the extended model, the same types of explanatory variables are included as in the previous models, in addition to a new set of variables.

Results

The following table (2) (refer Appendix) provides the variable description and summary statistics in the study. It presents the explanation of dependent and exploratory variables.

Regression results are displayed in Tables 3 and 4 (Refer Appendix). The first table presents the results for the baseline model. The model fits the data with adjusted R^2 of 0.783, explaining 78% of the variability of dependent variable by the independence variables. In all regressions, the estimated coefficients measure the percentage change in the dependent variable, given a one-unit change in explanatory variables. The results reinforce several consistent findings across the mean WTP regressions. In certain instances, the direct use of environment goods and services play a statistically significant role when valuing environment quality management programmes. In addition, other socio-economic variables such as the country's GDP and the period of study are also positive and statistically significant in determining WTP estimates. Furthermore, the extend of land has a negative impact on WTP estimates. In addition, agricultural quality, forest, man-made environment, water quality studies show significant positive relationships with WTP estimates.

Table 4 contains the results of the extended model, with the mean WTP as the dependent variable. The results show that the model fits the data quite well, with an adjusted R^2 of 0.69. Regarding the main variables of interest, a positive effect of the different environmental goods values on WTP estimates can be identified. The report, journal, Sweden, and GDP variables have a positive effect on the mean WTP and statistically significant at the 5% significance level. Variables such as specific valuation method and environmental services carry a positive coefficient but are not

statistically significant. In testing restrictions in the extended model, the result was an F statistic of 9.79 with degrees of freedom of (5, 42) and a p-value of 0.0000. This joint null hypothesis that these five variables are not significant could be rejected at the 1% level, justifying their inclusion in the regression. An environmental prevention programme that implies an avoidance of damage to general environmental quality carries a positive effect on WTP at the 5% level of significance. This provides that programmes with the objective of environmental protection generate a WTP estimate higher than those that made improvement outside the stated purpose of protecting environmental quality. Furthermore, the zero eutrophication and sustainable forestry have a positive and statistically significant at 5% results imply that the programmes with those objectives produce positive results in estimating the WTP.

In particular, agricultural landscape quality, forest quality, man-made environmental quality and wetland quality are significant at 5% level in the extended model, but wetland quality is negatively related to WTP estimates. It implies that the environmental quality programmes are highly associated with WTP measures in those studies. Moreover, the study characteristics also show positive relationship in estimating the WTP values including sample, method of WTP estimation and value function, and those are also significant positively at 5% level. Finally, the margin is predicted using Delta method that accounts for 3.142 (p=0.0000).

The environmental quality variables are shown a significant impact on estimating the WTP of the programmes. However, the positive and negative relationships of the environmental goods and services can be illustrated with the following graphs. Graphs 2 and 3 (Appendix) present the density of studies with respect to WTP values.

The positive relationship between the distribution of environmental goods and WTP values can be predicted by the individual density function of Graph 2,while a negative relationship between the distribution of the environmental services and WTP values can be predicted in the individual density function of the graph 3.

The estimation inputs cell frequencies for each study the mean and standard deviation in each group (for numerical outcomes), or the effect estimate and standard error from each study. Further it provides a comprehensive range of methods for meta-analysis, including inverse-variance–weighted meta-analysis, and creates new variables containing the treatment effect estimate and its standard error for each study. All the meta-analysis calculations available are based on standard methods (Deeks, Altman, and Bradburn, 2001).

The overall effect of WTP on the sample sizes of the studies is 3.01: ranging from -55.99 to 62.01 under 95% confidence interval. Testing I^2 for heterogeneity shows 0.08% given that the better study results of low variability among the studies. The overall effect for the response rate is 3.23 ranging from -17 to +23.47. Testing I^2 for heterogeneity shows 0.14% given that the better study results of low variability among the studies.

Conclusion

This study presents a comprehensive review of CV in environmental quality studies through a meta-regression accounting for the identification of the main determinants of programme valuation of ecosystem services. In this meta-analysis, the marginal value was estimated for different management programmes that provide a variety of environmental goods and services. The results show that the estimates for environmental quality management programmes are sensitive to the programme's objectives, particularly when linked to the provision of environmental goods and services. Other variables such as the type of forest, location, survey mode, or the type of respondent were also found to significantly affect the WTP estimates. From the study, it can be recommended that the environmental policy programmes related to the quality of the environment need to be adequately addressed in the wetlands, as well as with respect to the quality of air, water and forests.

Keywords: Meta-analysis, Environmental Quality, Contingent Valuation

References

Brander, L., Florax, R., Vermaat, J., 2006. The empirics of wetland valuation: a comprehensive summary and a meta-analysis of the literature. Environmental and Resource Economics 33, 223–250.

Brander, L., Van Beukering, P., Cesar, H., 2007. The recreational value of coral reefs: a meta-analysis. Ecological Economics 68, 209–218.

Loomis, J., White, D., 1996. Economic benefits of rare and endangered species: summary and meta-analysis. Ecological Economics 18, 197–206.

Loomis, J., Lockwood, M., DeLacy, T., 1993. Some empirical evidence of embedding effects in contingent valuation of forest protection. Journal of Environmental, Economics and Management 24, 45–55.

Loomis, J., Gonz.lez-Cab.n, A., Gregory, R., 1996. A Contingent Valuation Study of the Value of Reducing Fire Hazards to Old-Growth Forests in the Pacific Northwest. United States Department of Agriculture Forest Service Pacific Southwest Research Station Research Paper PSW-RP-229-Web.

Smith, V.K., Osborne, L.L., 1996. Do contingent valuation estimates pass a "scope" test? A meta-analysis. Journal of Environmental Economics and Management 31 (3), 287–301.