What Level of Ecostrategy ?

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Résumé

The demand for environmental preservation is growing, but is difficult to measure. Knowing ex-ante the price consumers are ready to pay for environmental preservation could be of great help for implied managers.

The Contingent Valuation Method is based on consumers' direct revelation in contingent scenario situations. This permits revealing people's willingness to pay for non-marketed goods or services like a program of environmental preservation.

This paper presents an application of the Contingent Valuation Method on a public sector case for environmental preservation. A contingent valuation survey was carried out on a local sample (402 individuals) to reveal the value these individuals give to a particular biodiversity program. Methodology and results are explained in the aim they can become a tool for managers developing strategies that have an eco advantage.

Mots clés

Environmental preservation, Ecostrategy, Contingent Valuation, Research Methods, Pricing.

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1. INTRODUCTION

The 1992 World Summit clearly established the objective of sustainable development, particularly environmental preservation. Ten years later, that objective remains the goal of the world community (Millennium Development Goals). Achieving this objective requires considerable resources. The official financer, Official Development Assistance, will not have sufficient flows to meet the tremendous needs. Estimates indicate that it will take on the order of an additional US$40 to $60 billion a year to reach the Millennium Development Goals. Other sources of resources must be sought. Developing countries could generate some of the resources they need for environmental preservation. The private sector, developing countries, donors, and local communities could contribute to this effort. To define efficient ecostrategies, Managers need then a measure of the effort such entities would be ready to invest.

We assume people are willing to pay for environmental preservation benefits. However these benefits are likely to be implicitly treated as zero unless their dollar value is somehow estimated. The Contingent Valuation Method (CVM) was then developed and improved by economists (Davis, 1963, Arrow and alii, 1993) to estimate these both use and non use values. The CVM involves directly asking people, in a survey, how much they would be willing to pay for specific services. They are asked to state their Willingness To Pay (WTP) contingent on a specific hypothetical scenario and description of the service. This method is flexible relatively to it is based on revealed preferences rather than stated ones. But its use is very controversial too. People are asked to value a good in a hypothetical acquisition situation. Because it does not correspond to a real buying situation, the value may contain biases. A complete typology of these biases is given in Mitchell and Carson (1989). Guidelines to avoid biases were developed by the NOAA Panel (Arrow and alii, 1993) and constantly improved (recently Berrens and alii, 2002).

The CVM could become a necessary tool for experts, researchers, policy makers and business leaders who are involved in environmental preservation. Getting an ex-ante value of policies with an eco advantage is of great help for decisions. This paper proposes, thru a public sector case for environmental preservation, to describe the Contingent Valuation Methodology and results. Special care is given in the description of the questionnaire design.

The 1992 Earth Summit at Rio recommended discussions on approach to safeguard biodiversity and to implement national conservation strategies (UNEP, 1992). The presented case of this article is a pilot valuation study of a biodiversity preservation program. It was financed by the French Ministry of Environment. Literature shows that valuing biodiversity is complex for two main reasons (Gauthier, 1998). The first concerns the non-familiarity of individuals with the biodiversity good (Hanley and Spash, 1995). The individual WTP for a biodiversity preservation program may therefore not be accurate. The second reason is methodological, due to the possible generation of biases by the CVM (Mitchell and Carson, 1989). The study is described in section 2. Methodological choices are explained is section 3. Results are given in section 4. Section 5 contains conclusions.

2. STUDY

2.1. THE SITE

The Garonne River Forests, in the South of France, were selected. The Garonne River is the fourth longest river in France (600 km) and has historically played a large role in the local economical activities. Its forests have an important ecological role in terms of species reproduction and migration, natural pollution filters and bank stabilization. These forests have largely been modified by human activities and are today threatened by homogeneisation and disappearance of species by intensive production activities. The Ministry of the Environment and the Regional Agency of Midi-Pyrénées, needed a measure of the local population willingness for the site preservation to determine the level of preservation to implement.

2.2. THE GOOD TO VALUE

The good to value is the preservation program of the Garonne River Forests biodiversity. A possible preservation program with different levels of preservation was defined by the biologists of the CESAC (Tabacci and Tabacci, 1996). It concerns a 70 kilometers long portion. Different levels of preservation correspond to different widths of preservation around the River.

2.3. THE SURVEY

The contingent valuation survey was carried out, in 1996, on a local sample (402 individuals) of the “Départements” of the Tarn-et-Garonne and Haute-Garonne to reveal its value for the preservation program. The survey zones were uniformally distributed around the River. Individual quotas were chosen from the general return of population realised by the INSEE (French National Statistics Institute) with the quotas method. Criteria are sex, age and

employment. Descriptive statistics are given in appendix A. Interviews were conducted face-to-face by professional surveyors.

3. METHODOLOGICAL CHOICES

3.1. CVM IMPLICATIONS

Based on stated preferences rather than observed preferences, the CVM must be applied with a great care. People are invited to announce the price they would be willing to pay for a good in a hypothetical situation. This implies that (1) there is no real payment, (2) the interviewee may be no familiar with the good, (3) the announced price or value is strongly dependent on the questionnaire design.

- (1)There is no real payment. This implies that the scenario has to be realistic and the interviewee must feel when answering the questionnaire that the described scenario could happen. The implementation of the preservation program was presented like imminent. The choice of the local tax like payment vehicle implies every household will have to pay.
- (2)If there is no observed behaviour, it means the individual may be no familiar with the good, nor with the buying situation. The price he/she will announce is then strongly dependent on the information given by the questionnaire. The questionnaire must then present an objective and sufficient information to the interviewee (see 3.2Questionnaire design).
- (3)Depending on the education level of the interviewee, information given in the questionnaire and questions may be perceived differently. A pretest of the questionnaire is then recommended to avoid misspecifications or misunderstanding errors. The questionnaire was tested by the Verbal Protocols method and revised then.

3.2. QUESTIONNAIRE DESIGN

The structure of the questionnaire contains four parts: (i) description of the context, (ii) description of the good to value and the contingent scenario, (iii) revelation questions, (iv) questions relative to variables to study.

(i) The description of the context has to be complete and clear. “Neutral” photos and map from the site are here provided. A simple definition of the biodiversity is recalled.

(ii) The description of the good to value and the scenario in which the individual can get the good has to be precise and illustrated. Relied costs have to be shown if available. Graphical representations of the different levels of preservation are given in the study. Advantages and drawbacks are presented, for example some level of preservation may imply a forbidden access to the site.

(iii) The revelation question may be open or closed-ended. It must contain every part of the scenario: good to value (preservation program here), payment vehicle (local tax here) and duration of the program (5 years here). In this study, interviewees were first asked if they "accept or refuse to financially participate to the program" and second asked to reveal "the maximum amount" they "would accept to pay, each year and during five years, for the preservation of the biodiversity of the Garonne River forests". Questions to help interviewee to announce a relevant value relatively to his budget constraint may be introduced, for example a possible implication in other environmental programs. At the end people must have the opportunity to revise their value.

(iv) Other questions relative to parameters to study like socioeconomic variables are added.

4. RESULTS

The CVM leads to different levels of results. To define an eco strategy, the manager may just want to know the price people value a specific good, or may be interest in knowing parameters that determine this value or variables that explain the choice to financially participate.

4.1. PRICE OF GOOD

A first step consists in eliminating the "irrelevant" responses, for example incomplete responses. The average price is then obtained by the average mean for WTP for the reduced sample. The price of the good will then corresponds to the obtained average price multiplied by the size of the concerned population.

In 1996, the average WTP for the preservation of the Garonne River forests biodiversity was USD 14. This value is plausible relatively to interviewees' budget constraint and to values found in other similar studies. Aggregate value for the program of environmental preservation is then 2, 5 millions US dollars each year during five year.

4.2. SIGNIFICANT VARIABLES

Researchers, policy makers, business leaders and experts in eco strategies could be strongly interested in getting more information on the people incentives to participate. Such information could help building new projects for environmental preservation.

For the Garonne River forests case, the choice has been made to get information on the explaining variables of the WTP amount, but on the explaining variables of the choice to financially participate too (see appendix B). In the first step, people are asked if they accept or refuse to financially participate to the preservation program. Then $choice_i = 1$ if the individual wishes to participate and $choice_i = 0$ else. In the second step, people who chose to financially

participate are asked their WTP for the program. The Full-Likelihood model (Davidson and MacKinnon, 1993) allows revealing both the variables explaining the choice to participate and the amount of the WTP. This is written:

$$\begin{aligned} & choice_i^* = X_i\beta_2 + u_{i2} \\ & choice_i = 1 \text{ if } choice_i > 0 \\ & choice_i = 0 \text{ else} \\ & \text{and} \\ & \text{WTP}_i = Z_i\beta_1 + u_{i1} \end{aligned} \qquad (1)$$

with β_1 and β_2 are unknown parameter vectors, X_i : k x 1 i.i.d. variables vector, Z_i : l x 1 i.i.d. variables vector. We assume errors are correlated:

$$(u_{i1}, u_{i2}) \sim \text{N}\left(\begin{pmatrix}0\\0\end{pmatrix}, \begin{pmatrix}\sigma_1^2 & \rho\sigma_1\sigma_2\\ \rho\sigma_1\sigma_2 & \sigma_2^2\end{pmatrix}\right) \qquad (2)$$

The corresponding likelihood function L is given in appendix C. Log(L) is maximised by the Newton-Raphson algorithm. Estimations are computed with STATA.

Some results are intuitive, for example people giving priority to environmental preservation value the proposed program more, or people with a higher revenue level are more willing to financially participate than others. The frequentation of the site is negatively significant of the WTP, that means that the non-use part of the announced value is relatively important. A method based on stated preferences would not have allowed to get this result. Details of the results for the open-ended question are given in appendix D.

5. CONCLUSION

This paper proposed to present the Contingent Valuation Method to researchers and managers on the eco strategies. We assumed people are willing to pay for environmental preservation benefits. However these benefits are likely to be implicitly treated as zero unless their dollar value is somehow estimated.

The Contingent Valuation methodology allows getting a price for non-use benefits or non-marketed goods. Knowing such a price may help managers to define the optimal level of environmental preservation they have to implement.

The case study treated here gives a concrete illustration of the CVM. The description of the different steps may serve as guidelines to realise a study using this methodology.

The Garonne River forests site is not a frequented natural site. There is then no use value for that site. However the use of the CVM shows inhabitants are willing to preserve the site, and

moreover to pay for such a preservation. Local population is ready to pay 2, 5 millions US dollars each year during five year. The Regional Agency has then a concrete measure of the budget it may invest in that program. That will be of great help to define the level of preservation to implement.

Because the CVM is the only available method to obtain prices for non-use benefits of non-marketed goods, it is a source of many applications for managers. This could help finding solutions in front of the growing demand for sustainable development or more generally social responsibility e.g.

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appendices

A DESCRIPTIVE STATISTICS

Characteristics	Total sample
Marital status	
single	20%
married	56%
de facto	10%
widow	9%
divorced	5%
Number of persons in family	
1	24%
2	33%
3	15%
4 and more	28%
Number of financially depending persons	
0	59%
1	14%
2	18%
3	7%
4 and more	1%
Monthly family income	
less than 5 000FF (1000$)	17%
from 5 001 to 7 500 FF	30%
from 7 501 to 10 000 FF	18%
from 10 001 to 12 500 FF	16%
from 12 501 to 15 000 FF	8%
from 15 001 to 20 000 FF	7%
from 20 001 to 30 000 FF	3%
more than 30 000 FF	1%
Education level	
primary	27%
secondary without A-level	26%
secondary with A-level	13%
technological/technician certificate	16%
two years university	6%
more than 2 years university	12%

B DESCRIPTION OF VARIABLES

Var.	Meaning
Apprec	=1 if the individual takes the valuation exercise seriously, as estimated by the interviewer, =0 otherwise
Freq	=1 if the interviewee regularly frequents the river banks (at least 1 or 2 a month), =0 otherwise
Env	=1 if the environment is a priority for the individual, 0 otherwise
foy	number of persons in the family
Rev	monthly family income
Age	age of the interviewee
Sexe	=1 if the interviewee is a female, =0 otherwise
Stamar	=1 if the interviewee is married, =0 otherwise
Etu	individual education level, integer (from 1 : primary school to 7 : more than 2 years studies)
Impôt	amount of local taxes paid by the household last year
Enf	children on charge
Res	=1 if the individual principal residence is in the department, =0 otherwise

C LIKELIHOOD FUNCTION OF THE (1) MODEL

Let us assume that $\sigma_2 = 1$ (only $\frac{\beta_2}{\sigma_2}$ is identifiable). The likelihood contribution of individuals who refuse to financially participate is:

$$l(0;\beta_1,\beta_2) = \text{Prob}(u_{i2} \le -X_i\beta_2) = \Phi(-X_i\beta_2), \quad (3)$$

and the likelihood contribution of individuals who accept to financially participate is:

$$l(1,WTP_i;\beta_1,\beta_2) = \frac{1}{\sigma_1}\varphi\left(\frac{WTP_i - Z_i\beta_i}{\sigma_1}\right) * \text{Prob}\left(u_{i2} > \frac{-X_i\beta_2}{u_{i1}}\right), \quad (4)$$

with Φ is the cdf and φ is the normal density function.

We have $\frac{u_2}{u_1} \sim N\left(\frac{\rho u_1}{\sigma_1}, (1-\rho^2)\right)$ then

$$\text{Prob}\left(u_{i2} > \frac{-X_i\beta_2}{u_{i1}}\right) = \text{Prob}\left(z > \frac{-X_i\beta_2 - \frac{\rho(WTP_i - Z_i\beta_1)}{\sigma_1}}{\sqrt{1-\rho^2}}\right) \text{ with } z \sim N(0,1) \text{ then}$$

$$\text{Prob}\left(u_{i2} > \frac{-X_i\beta_2}{u_{i1}}\right) = \Phi\left(\frac{1}{\sqrt{1-\rho^2}}\left(X_i\beta_2 + \frac{\rho}{\sigma_1}(WTP_i - Z_i\beta_i)\right)\right) \quad (5)$$

The likelihood function is

$$\text{L} = \prod_{I_0}\Phi\left(\frac{-X_i\beta_2}{\sigma_2}\right) * \prod_{I_1}\left[\frac{1}{\sigma_1}\varphi\left(\frac{WTP_i - Z_i\beta_1}{\sigma_1}\right) * \Phi\left(\frac{1}{\sqrt{1-\rho^2}}\left(X_i\beta_2 + \frac{\rho}{\sigma_1}(WTP_i - Z_i\beta_1)\right)\right)\right]$$

with I_0 is the set of individuals i whose $Choice_i = 0$ and I_1 is the set of individuals i whose $Choice_i = 1$.

D OPEN-ENDED RESULTS

Var	Names in model	Full likelihood model	
		coefficients	t statistic
Choice			
Apprec	X_1	1.30	7.39
Freq	X_2	0.52	3.48
Env	X_3	-0.45	-1.76
Foy	X_4	0.07	1.38
Rev	X_5	0.15	3.58
const1	X_6	-1.86	-7.96
Rho		-0.119	
WTP			
Apprec	Z_1	61.81	1.55
Freq	Z_2	-47.15	-2.27
Env	Z_3	79.58	2.12
Foy	Z_4	-11.72	-1.63
const2	Z_5	135.48	2.18
mean WTP		142.76 (FF)	
Confidence interval		[41.45, 265.17]	
standard deviation		39.28	