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2.1 Introduction

Even though the Contingent Valuation Method (CVM) has been widely used in most countries in Northern Europe, the two studies presented here are the first applications in France, where there has been a certain distrust in its suitability. There seem to be two main reasons for this:

1) the reluctance of the economists who consider that environmental assets cannot be assigned a monetary value (their price is infinite);
2) the absence of social traditions to include environmental constraints in the economic calculus.

Even for other valuation methods, based on the observation of behaviour, such as the travel cost method or the hedonic price method, no studies have been published recently in France, to our knowledge.

The first part of this chapter evaluates the ecological and recreational benefits of an alternative management of the waterlevel of a reservoir (Desaigues & Lesgards 1991); the second part concerns the value of sports fishing in Western France (Bonnieux et al. 1991). Both studies were carried out in 1990, and the amounts are given in 1990-French francs (FF) (Add 3.5 % to convert these amounts to 1991-FF).

2.2 Ecological and recreational value of a reservoir

The study concerns the Lac de la Forêt d'Orient, a reservoir located on the Seine some 200 km upstream from Paris. The dam was built in the sixties (and opened in 1966) to regulate the flow of the Seine. In 1970, the site was recognized as a regional natural park because of

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the richness of its birds. The current management of the dam does, however, entail certain negative effects:

- the rise of the water level during spring interferes with the reproduction of fish and birds (ducks, waterfowls, etc); the site is considered of European importance in the field of ornithology.
- the decrease of the water level during summer and fall has a negative impact on the recreational use, making access to the water and sailing more difficult.

The study was commissioned by EDF, the national electric utility of France, and the CNRS (National Center for Scientific Research).

2.2.1 THE CONTINGENT VALUATION STUDY

Presentation of the study
The CVM was applied to measure the social costs associated with the current management of the dam and to assess the benefits from an alternative management mode: that of maintaining more nearly constant levels of water in the reservoir from April to June to improve the ecological functions, and of retarding the release of water to improve the recreational uses.

The alternative management during spring eliminates the protection from spring floods. This solution is acceptable because the probability of occurrence (24 floods in 90 years), and the cost of damage (the floods concern essentially agricultural lands) are sufficiently low. The current management assumes a variation of the level of water of 1.5 meter between April and June. The delay in water release in autumn affects mainly boating activities. Under the curent management, the level begins to decrease in July and refilling begins in October. Boating activities are affected in September.

The study was conducted in the form of personal interviews of 30 minutes on the site during the month of July (one weekend). Foreign tourists were interviewed in English (mostly Dutch and English tourists). 101 persons where interviewed on the ecological impact (maintaining a constant level of water from April to June), and 98 persons on the use impact (retarding the release of water until the end of August, or the end of September). The questionnaire was divided into three parts, the first part concerning the different uses of the site, and the frequency of visits, the second part concerning the willingness to pay (WTP) either for improving the quality of the ecosystem or for lengthening the period for recreational use, the third part concerning the socioeconomic information. Only 2 % refused to answer the questionnaire. Most of the persons interviewed had a good knowledge of the site, which facilitates the exercise of contingent valuation. Moreover, graphics and photographs were shown as visual support, to illustrate the current as well as the alternative management of the dam. A payment card which suggests different amounts starting at a low level was used to avoid the starting point bias. The respondents were also allowed to choose amounts different from the ones stated on the payment card. The payment vehicle was plausible: an entrance fee, or an extra amount added to the annual fee for fishing and boating.

The recreational population was divided into three groups according to their main activity: swimmers and hikers along the shore (the beaches are open in July and August); fishermen who can fish from March to December; boaters who can practise their activities from March to November. The first results, based on information on the frequency of visits, have permitted an estimate of the composition of the total population of visitors to the site (22 700 swimmers, 4500 boaters, and 3300 fishermen annually).

Treatment of biases

Many biases can affect the quality of the result (Mitchell Carson 1989), and the validity of the mean WTP. In this study we considered the two most important biases to be the hypothetical bias and the non-respondent bias.

a) Hypothetical bias

This bias appears when the interviewees are not familiar with the contingent market and tend to overvalue their WTP. Laboratory experiments testing for this bias (Coursey, Hovis Schulze 1987; Kealy et al. 1990; Irwin et al. 1991), have shown that people submitted to repeated valuation exercises tend to lower their WTP. Moreover, the distribution of values becomes more centered round the mean. To correct for this bias, we have assumed that the error is proportional to the stated WTP (see also the work of McClelland et al. 1991). A logarithmic transformation allows for a reduction of the bias of the mean by making the distribution of errors more normal. If we write W for the real WTP and W* for the response in the interview, this transformation is:

$$W^* = W\rho, \text{ and thus } \log W^* = \log W + \log\rho \qquad (2.1)$$

with the error term $\log\rho = \varepsilon$.

We assume that the distribution of the error is log normal, $E(\varepsilon)$
$= 0$ and $V(\varepsilon) = \sigma^2$ and that the correct model is:

$$\log W^* = \log W + \varepsilon \tag{2.2.}$$

This transformation is ill-defined for responses that are equal to zero (10 % for the ecological impact, 50 % for the use impact). To avoid this problem, we have modified this transformation by adding a small uniform amount to W, We have considered three different values for this amount, 10 FF, 25 FF, and 50 FF, in order to test the sensitivity of the results for this value. With 10 FF we have obtained the results with the highest R^2 and the model becomes:

$$\log (W^*+10) = \log (W+10) + \log \rho \ . \tag{2.3.}$$

A more general transformation is the Box-Cox transformation of W*. The Box-Cox transformation can be applied to the dependent variable alone or to dependent and independent variables (even with different parameters). This makes it possible to obtain error distributions that are more nearly normal. In this study it was applied only to the dependent variable (W+10).

b) Non-response bias

The non-respondent bias appears when a certain percentage of the population does not answer to the questionnaire (30 to 50 % in mail surveys), or is unable or unwilling to elicit a value (often 20 to 30 % of the respondents). A zero value can reflect two possibilities: a true value of zero, or a protest bid. In order to distinguish a protest bid from a real zero value, a complementary question needs to be asked about the reason for the zero value. In our study the non-response bias concerns only the second case. To correct for this bias, we have used a tobit model, which is a regression model with censored variables. In this survey the WTP cannot be negative, one way to solve this problem, and to attach a value to the non-responses, is to use the Heckman 2 steps method. In this method the censored variables are treated as an error term, calculated by the probit model (as inverse of the Mills ratio), and then introduced in the ordinary least squares (OLS) regression model. The principal advantage of this method is that it allows for a reconstitution of the dependent variable when its value is missing.

2.2.2 ECOLOGICAL IMPACTS OF ALTERNATIVE MANAGEMENT OF THE DAM

Of the 101 persons interviewed, 76 gave a positive WTP, 21 a WTP equal to zero and 4 refused to answer. The reasons given for a refusal to pay allow for the classification of the 25 persons who did not give a positive WTP into 2 groups: those whose WTP is truly zero (10 persons), and those who would probably agree to pay, for instance, in the form of an entrance fee (15 persons who were reluctant to pay for others, or who rejected the principle of paying).

A model of discrete choice

In order to understand the factors which increase the probability of giving a positive WTP, it is interesting to build a discrete choice model. In this case the independent variable represents the probability of giving a WTP >0, or WTP $= 0$. The dependent variables are the socioeconomic characteristics of the individuals. Two functional forms were used, the logit model and the probit model. These two models give very similar results. But if we consider the residuals (the weighted sum of square residuals), the probit model seems better suited.

The independent variables of the probit model are the following:

- sex: dummy variable, 0 for men, 1 for women
- fishermen: dummy variable, 1 for fishermen, 0 otherwise
- boaters: dummy variable, 1 for boaters, 0 otherwise
- visits: the number of days of visits on the site in one year
- length of stay: 1 if less than one week, 2 if one to two weeks, 3 if more than two weeks
- substitute: dummy variable, 1 if there is, 0 otherwise
- sensitivity: dummy variable, 1 if sensitive or very sensitive, 0 otherwise
- family situation: dummy variable, 1 if married, 0 otherwise
- children: number of children
- distance origin: distance from the principal residence in km
- nationality: dummy variable, 0 if French, 1 otherwise
- age: divided into 5 classes by ascending order
- education: dummy variable, 1 for students, managerial staff, liberal professions, 0 otherwise
- revenue: divided into 6 classes in ascending order
- goal: dummy variable, 1 if the reservoir is the goal of the travel, 0 otherwise

- type of lodging: dummy variable, 1 if it is the principal or secondary residence, 0 otherwise (hotel, camping, etc.)
- distance from lodging (on the site) in km.

The results of the probit model show that the main explanatory variables are sex (women more easily give a positive WTP), sensitivity to the impact on the ecosystem, existence of a substitute (which lowers the probability), family situation, number of children, probability of giving a possitive WTP decreases with number of children), nationality (being a foreigner increases the probability of giving a positive WTP), age (young people have a higher probability of giving a positive WTP), revenue, goal, type of lodging (owners of a principal or secondary residence are less willing to give a positive value), distance from the lodging. These results are consistent with the implicit theoretical model: the probability of the willingness to pay increases with revenue and with distance. The educational variable is not significant in the model, presumably because its categories were not sufficiently detailed; it was obtained by grouping the socio-professional categories.

Estimating the mean WTP for ecological improvements

Two hypotheses were considered:

1) the zero responses *and* the non-responses are equivalent to a WTP = 0,
2) only zero responses have WTP = 0, while the non responses are replaced by "true" values as estimated from the model.

a) The first hypothesis:
Four models have been tested: the tobit model, the OLS regression, the loglinear model and the Box-Cox model. Only the most significant variables were included. Thus, the variables: boaters, substitute, family situation, education and distance were omitted. These variables were significant in explaining the probability of the willingness to pay, but not the amount of payment. The results are presented in table 2.1. The difference between the mean WTP obtained by the linear model (91FF) and by the Box-Cox transformation (66FF) can be explained by the existence of the hypothetical bias. The tobit model does not allow for correcting this bias even if it gives a better estimator. The hypothetical bias tends to overvalue the mean WTP by 30%.

Table. 2.1 Review of models for estimating mean, annual WTP (in FF) per person for ecological improvements, hypothesis 1. (β = parameters, t = t-statistic).

Variables	Tobit model		Linear model		Loglinear model		Box-Cox model	
	β	t	β	t	β	t	β	t
Sex	41.3	1.6	29.0	1.3	0.4	1.6	0.8	1.6
Boaters	-42.6	-1.5	-32.2	-1.4	-0.2	-0.9	-0.6	-1.0
Visits	1.5	2.2	1.4	2.4	0.01	1.8	0.02	2.0
Sensitivity	88.5	2.4	46.5	1.7	1.0	2.9	1.9	2.7
Children	-16.7	-1.7	-8.4	-1.1	-0.2	-1.9	-0.3	-1.8
Nationality	87.0	2.4	61.5	2.1	0.8	2.3	1.6	2.3
Age	-25.3	-2.3	-18.3	-2.1	-0.2	-2.4	-0.5	-2.4
Revenue	21.5	2.5	14.6	2.1	0.2	2.2	0.4	2.3
Goal	105.3	2.9	87.2	3.1	0.9	2.8	2.0	2.9
Lodging	-25.9	-1.0	-26.8	-1.3	-0.1	-0.5	-0.3	-0.7
Constant	-96.6	-1.5	-27.5	-0.5	2.5	4.0	3.0	2.4
R^2	0.3		0.29		0.3		0.31	
WTP (FF)	94.3		91.8		60.4		66	
σ	52.6		88.6		53.9		44.8 with λ = 0.18	

b) The second hypothesis:
This hypothesis can be considered as more plausible because for some people it is difficult to make a contingent valuation. For these persons, the model permits for the reconstitution of a nominal value, the quality of the results depending on the quality of the model. Two models have been tested: the linear and the loglinear model, both of which take into account the inverse of the Mills ratio. The main advantage of the Heckman method is to allow for the estimation of the missing dependent variables. The independent variables are different from the first hypothesis: the sex variable is no longer significant, but the distance from the lodging becomes significant. The other variables remain unchanged. The results are presented in table 2.2. The loglinear model corrected by the Mills ratio gives a high R^2 (0.66), which means that it is the best model to explain the amount of the WTP. Moreover, the error distribution is more normal and the correlation between the errors and the dependent variable is 0.33 (0.57 for the linear model).

Table 2.2 Review of models for estimating mean, annual WTP (in FF) per person for ecological improvements, hypothesis 2. (β = parameters, t = t-statistic).

Variables	Linear model		Loglinear model	
	β	t	β	t
Fishermen	-56.8	2.5	-0.3	1.9
Visits	1.2	2.1	0.01	1.9
Sensitivity	41.9	1.6	1.0	4.7
Children	-10.7	1.3	-0.2	2.4
Nationality	51.4	1.5	0.6	2.3
Age	-20.4	2.4	-0.3	3.9
Revenue	16.7	2.5	0.2	3.2
Goal	98.2	3.1	0.9	3.9
Lodging	-36.0	1.7	-0.2	1.2
Distance	-0.2	0.8	0.0	0.7
1/Mills ratio	78.4	3.8	1.3	8.2
Constant	0.4		2.9	
R^2	0.42		0.66	
WTP (FF)	88.5		77	
σ	78.4		68.4	
95 % confid. interval WTP	73–104		65.4–88.5	

In conclusion, according to the hypothesis concerning the non-responses, we must retain as mean WTP, either 66F or 77F, and not 91F as an ordinary, but conservative, linear analysis would have supposed.

2.2.3 THE USE VALUE OF AN ALTERNATIVE MANAGEMENT OF THE DAM

Of the 98 persons interviewed on this question, 44 persons gave a positive WTP, 16 a zero WTP, and 38 did not give any response. If we examine the reasons given for the non or zero response, the 54 persons can be separated in to two groups. 43 persons with a WTP = 0, and 11 who are not able to give a WTP (reluctant to pay for others). A majority of persons say that they are not bothered by the variation of the level of water, except for the boaters interviewed in September.

A model of discrete choice
One independent variable was added to the use value, to take into account the persons interviewed in September (a dummy variable 1, if the activity took place in September). The probability that WTP = 0 is high, which explains the difference in the results if compared to the value for ecological impact. The most significant independent variables are the number of visits (which increases the probability), the sensitivity to the use impact, age (with a negative sign as for the ecological value) and revenue. The distance from lodging is no longer significant.

Estimating the mean WTP for improved opportunities for recreational use

As for the ecological improvement, two hypotheses were tested:

1) all the zero and non responses were considered to be equal to zero
2) 43 responses (of 98) were considered to be equal to zero, and 11 as non-responses which can be reconstituted by the model.

a) The first hypothesis:
The results of the four models are presented in table 2.3. The Box-Cox model gives the best adjustment, with $\lambda = 0.41$, which suggests that the hypothetical bias is more important for the use value than for the ecological value. The difference between the mean WTP obtained by the linear regression (55FF) and the Box-Cox model (25FF) is quite large (40 %), and can be attributed to the existence of two distinctly different groups of users; those sensitive to the impact and those who are indifferent.

The significant independent variables are different from those in the ecological improvement case. The number of visits and their length is becoming significant, while goal and type of lodging are losing their significance.

b) The second hypothesis:
In this hypothesis we have reconstituted the WTP for 11 persons. The results are presented in table 2.4. Despite a relatively high R^2, the parameters of the explanatory variables of the linear model are less significant, except for the sensitivity or the inverse of the Mills ratio. On the contrary, the loglinear model is doubtless the best explicative model of the mean WTP. It confirms the results obtained for the ecological value. In conclusion, the mean WTP is 25F or 49F, depending on the treatment of the non-responses. This result shows the great sensitivity of the mean to the way the non-responses are treated when the probability of giving a non-positive value is high.

Table 2.3 Review of models for estimating mean, annual WTP (in FF) per person for recreational improvements, hypothesis 1. (β = parameters, t = t-statistic).

Variables	Tobit model		Linear model		Loglinear model		Box-Cox model	
	β	t	β	t	β	t	β	t
Visits	1.4	1.8	0.5	1.5	0.01	1.5	0.01	1.4
Length	-43.3	-1.6	-18.5	-1.5	-0.3	-1.8	-0.1	-1.9
Sensitivity	208.0	6.2	83.1	5.9	1.5	7.6	0.4	7.8
Family	-43.9	-1.2	-13.3	-0.8	-0.3	-1.3	-0.1	-1.4
Education	-40.2	-1.3	-15.1	-0.9	-0.5	-2.0	-0.1	-2.3
Age	-31.7	-2.2	-11.1	-1.6	-0.2	-2.3	-0.1	-2.4
Revenue	22.1	1.9	7.0	1.3	0.2	2.5	0.04	2.7
Distance	-0.3	-1.3	-0.03	-0.3	0.0	-0.9	0.0	-1.0
Constant	-38.7	-0.7	45.0	1.8	3.3	9.3	1.7	21.1
R^2	0.33		0.34		0.48		0.5	
WTP (FF)	53.9		55.3		32.2		24.7	
σ	52.7		46.7		33.2		30.3 with λ = -.41	

To conclude, the application of the CVM in valuing the recreational and patrimonial benefits induced by a modification in the management of the dam has shown that:

1) people are able to make a relation between a change in their utility function and the WTP. It is interesting to notice that the non-use (ecological) benefits are clearly more highly valued per person than the use benefits (even though one might have expected the opposite);
2) the mean WTP to be used in a cost-benefit analysis depends on the hypothesis made to treat the non-responses, and on whether or not the hypothetical bias is taken into account. If it is not, the results can be over-estimated by 30–40 %.

Table 2.4 Review of models for estimating mean, annual WTP (in FF) per person for recreational improvements, hypothesis 2. (β = parameters, t = t-statistic).

Variables	Linear model		Loglinear model	
	β	t	β	t
September	17.6	1.0	0.3	2.1
Visits	0.5	1.5	0.01	2.3
Length	-6.6	-0.5	-0.1	-1.2
Sensitivity	94.7	6.1	1.6	12.2
Education	4.7	0.3	-0.2	-1.2
Age	-9.8	-1.4	-0.2	-3.9
Revenue	-1.8	-0.3	0.1	1.2
Distance origine	-0.03	-0.4	-0.01	-1.5
1/Mills ratio	40.2	3.0	1.1	9.2
Constant	37.6		3.1	
R^2	0.56		0.86	
WTP (FF)	64.3		48.8	
σ	58.5		53.8	
95 % confid. interval WTP	52.2–75.9		37.9–69.5	

2.3 Valuing game angling

This section deals only with salmon and sea-trout fishing in France. There is no commercial fishery (e.g. in river mouths with nets) so fishing is restricted to game angling in freshwater for recreational purposes only. There are relatively few people involved in these activities: 3000 for salmon and 3300 for sea-trout in 1990, but expenditures per angler are great, so game angling has significant economic impacts.

We present some results of surveys conducted on four rivers located in Western France: three predominantly for salmon (Elorn, Sée, Sélune) and one predominantly for sea-trout (Touques). 20 % of salmon anglers fish in the first three and 40 % of sea-trout anglers in fourth. On-site surveys were run during the 1990 fishing season. A common questionnaire was designed to provide background information which is summarized in the first paragraph. The following two paragraphs review the results from Contingent Valuation questions designed to value changes in the management of these two fisheries.

2.3.1 PRESENTATION OF ON-SITE SURVEYS

Information on the surveys was given in local newspapers and on T.V. As a matter of fact, the fishermen welcomed the interviewers since only two anglers (suspected of poaching) refused to answer. For salmon it was possible to compare the sample to the target population. There is no evidence of specific bias so we expect it is also true for the sea-trout sample.

The questionnaire was quite long but it was expected that the face-to-face interview would need no more than 20 minutes. However, most of the individuals wanted to add comments which are often valuable, so the interview usually took 30 minutes. It reviewed anglers' characteristics, fishing experience and effort, and expenditures. It gives sufficient information to apply the travel cost approach on micro data. Notice that the only question for which non-response is significant involves income. People were asked to locate their family income on a ladder, and 25 % refused. But for the other 75 %, answers are consistent with age and occupation.

Data reported in table 2.5 show differences between the two samples. Salmon anglers are older and fish for a longer time than sea-trout anglers. The value of equipment is similar, but both the length of the fishing day and the number of trips during the fishing period are greater for salmon than for sea-trout anglers. There is a significant difference in terms of behaviour which is well known. Salmon anglers are very keen and don't hesitate to spend several days at a time catching nothing; their total catch is less than 2 salmon per year! Sea-trout anglers are not so eager and visit the river for a half-day only. They are more successful in terms of fish caught: 3.5 per year, but 48 % did not catch any trout! In any case, they enjoy their experience since 90 % plan to come back next year.

Table 2.5 Game angling basic data

	Salmon	Sea-trout
Number of anglers 1990[1]	680	1300
Sample size	173	177
Sampling rate	.25	.14
ANGLERS' CHARACTERISTICS (average)		
Age (years)	45	40
Training (years)	15	7
Effort Number of hours per fishing day	7	5
- cost of equipment (FFFF)[2]	5560	5140
Round-trip distance (km)	162	176
Yearly total fishing fees (FF)[3]	1217	959
Cost of a fishing season (FF)[4]	8544	5759

[1] Approximation: salmon angling (Elorn, Sée and Sélune), sea-trout angling (Touques)
[2] Including reels, rods and lines.
[3] Including licence, fishing society fees, special fees for salmon and sea-trout.
[4] Including transportation costs, food, lodging, fishing and depreciation of equipment.

Game angling is expensive in terms of equipment, fees and transportation costs, and people surveyed are wealthy compared with the general French population. Round-trip distances are similar for both types of anglers and close to figures reported elsewhere, for example, 158 km to participate in angling activities in Maryland (Walsh p. 114). But salmon angling costs more than sea-trout angling. There is a difference in fees owing the higher price of the specific salmon fee. However, behaviours are significantly different since salmon anglers visit the river more often than sea-trout anglers, so transportation expenditures explain the difference in cost of a fishing season. Moreover, there are more salmon anglers who visit a substitute river than sea-trout anglers: 63 % vs. 30 %.

2.3.2 CONTINGENT VALUATION SURVEYS

On-site surveys provide background data on game angling in Western France. In order to get extra information on hypothetical questions, we conducted contingent valuation surveys. These deal with river management and address specific issues for each of the two fish species. For salmon we have considered a revision of the quota system combined with an increase in duration of the fishing season. For sea-trout angling there are new opportunities to increase the length of banks available for angling, so questions in connection with this point were asked. These two topics will be successively considered.

Salmon angling

Until 1990, the fishing season started in mid-March and closed in mid-July. This regulation of the Atlantic salmon fisheries was combined with an individual quota system. Catches were restricted, four salmon per angler before June 1st plus two after. This management scheme was implemented to improve the long-term position of the fishery. However, it is often considered as being inconsistent since it allows for the fishing of spring-salmon which are rare, and drastically limits the catches of grilses whose stock is relatively large.

In order to eliminate this drawback, it was decided for the 1991 season to postpone the closing date until mid-August, but for dryfly fishing only. However, the quota system has not been modified and the upper limit of six salmon per angler annually has been kept. The four salmon per angler limit for the first period is not drastic, because it is very difficult to catch four salmon before June. But with an increase of 25 % in the duration of the fishing period, the annual limit of six salmon could be severe. So we have designed a contingent study to assess that new regulation.

A mail survey was conducted just before the 1991 fishing season. A very simple questionnaire was sent to all the salmon anglers who gave their address in the on-site survey. The first question dealt with anglers' opinion on the quota system.

- Would you agree with a suppression of the quota system after June 1st?

Yes, No, Don't know Refused

Then a payment card was used to elicit the willingness to pay of the individuals who answered positively:

- What amount on this card (or any amount in between or above) is the most you would be willing to pay for angling without catch limitation after June 1st?

In addition, an open question asked individuals to comment on fishery management and to provide suggestions. Finally, the name and address of the respondents were asked in order to link the information from the on-site and mail surveys.

Among a total of 149 mailed questionnaires, 84 were returned (i.e. a response rate of 56 %). Thirty-five agreed with a suppression of quota, 45 didn't agree and 4 didn't know. It is interesting to note that most people who answered negatively lacked information about grilses. Despite information given in the questionnaire, they think the stock is severely depleted so the fishing pressure has to be lessened. Thirty-three individuals give amounts ranging from zero (7 obs.) to 300FF (4 obs.). The average amount equals 103FF, which is very close to 25 % of the specific salmon fee. This result looks meaningful because involved anglers are willing to pay 25 % more if they can fish 25 % longer.

Sea-trout angling

Until the 1990 season, only 26 km of the Touques banks, upstream from the mouth, were devoted to recreational fishing. The building of a fish ladder could give new opportunities to increase the length of banks available for angling since sea trout will proceed 45 km further up the river. But these banks are privately owned so angling societies wish to obtain access to the river in order to increase the availability of recreational angling, and thereby improve the fishing for their members.

One possibility would be to buy a narrow corridor along the river provided enough money is collected. Thus, the CV study emphasizes this point by asking people to voluntarily contribute to a fund to buy 5 km of river banks. A questionnaire had been successfully tested on site during the last stage of the on-site survey in October 1990, when 50 individuals were asked and answered questions. Then a questionnaire was sent to each angler surveyed before October who had given his address. Ninety-seven questionnaires were mailed and 47 returned (i.e. a response rate of 48 %).

Pooling together both subsamples provides a sample size of 97. A majority of 75 anglers wish to benefit from greater facilities in order to be able to fish upstream from the fish ladder, and 51 agree to participate in a fund to buy 5 km, knowing they would be entitled to fish freely for three years. A payment card was used to assess the willingness to pay for 5 km. All give an amount greater than zero, the average amount equals 578 FF per person annually. There is an iteration in order to assess the average amount to buy an additional 5 km. Forty were willing to pay and the average amount equals 567 FF. Unfortunately the sample size was too small to run a new stage, but it is interesting to notice that the number of positive answers decreases.

If we assume the surveyed individuals to be representative of individuals angling in the Touques river, it is possible to assess an aggregate amount for extra km. For the first 5 km section, we get 26 300 FF per km per year. For the second section, the amount is smaller and equals 20 200 FF. These values make sense since the yearly rent (including restoration, cleaning up and maintenance) is 15 000 FF per km. Moreover, there are some problems with poachers who use nets to catch fish in the river mouth. Therefore, surveyed anglers were asked about their willingness to pay to hire more river-keepers. It is interesting to notice that protest answers are significant. Forty per cent of the sample refuse to pay because they already pay taxes for police control so a private body (the fishing society) should not take the role of the state. However, 50 % give positive amounts ranging from 20 FF to 500 FF per year. The average amount equals 160 FF per person annually.

2.3.3 WTP FOR SEA-TROUT ANGLING

Here we deal only with the sample of sea-trout anglers. They are faced with a dichotomous choice as they are asked to accept or reject voluntarily participation in a fund. So a discrete regression model is first considered. Then the WTP amount is taken into account, and a tobit model is specified to deal with the censored nature of the data.

Probit and logit models

If the dependent variable is a yes/no answer it is usual to try a probit or a logit model. Both have been estimated and results are reported in table 2.6 with six independent variables. Two variables, income and years of training, help to describe the anglers. Cost of equipment is a proxy for fishing effort, and catch (number of sea-trout caught during the 1989 season) is an indicator of fishing experience in the Touques river. We have defined a dummy variable to take into account substitute rivers. We have also considered the distance travelled to fish as a potential factor influencing demand.

Both models provide similar results. They perform poor statistically, but the signs of the coefficients look correct. There is good reason to believe that the demand for game angling rises with income. Thus, the positive coefficient for this variable was expected. Moreover, anglers who own many reels and rods (the average is 2.6 for each type of equipment, but 20 % own more than 5) make the greatest fishing effort. Therefore the value of equipment, which is a proxy for fishing effort, positively affects demand.

Table 2.6 Sea-trout angling demand; probit and logit models (Asymptotic t values in parentheses).

Variables	Probit	Logit
Intercept	0.657 (1.7)	1.00 (1.4)
Substitute site (dummy)	0.318 (0.6)	0.581 (0.6)
Trip distance (km)	0.008 (1.7)	0.014 (1.6)
Cost of equipment (FF)	0.017 (0.7)	0.024 (0.5)
Catches	-0.002 (-0.3)	-0.0049 (-0.3)
Monthly income: 17 classes (increasing with income)	0.0001 (0.3)	0.0002 (0.2)
Years of training	-0.023 (-1.0)	-0.034 (-0.8)
Log likelihood	-24.95	-25.15

The positive signs for the dummy variable for substitute sites and for the distance are consistent. First, anglers who fish in substitute rivers are expected to have greater requirements in terms of fishing experience. Second, anglers living far from the Touques will stay for a week-end or for a vacation in the Touques area. For both categories, the length of banks available for angling is limited, and anglers are likely to ask for extra kilometres of banks. Therefore, these underlying explanatory variables positively affect angling demand.

The negative sign of the years of training variable requires some explanation. First, note that this variable is positively correlated with the angler's age. However, sport fishing demands great physical effort. Some of the comments support this point and indicate that senior citizens sometime move to other types of fishing. The current availability of banks fulfills their requirements. Finally, we have a negative sign for the catch variable, which is obviously inconsistent with our expectations.

Tobit model

Probit and logit models do not use all the information available. To go further, let us first consider anglers who are willing to pay a positive amount to increase angling supply. They already pay something; a licence to angling societies and specific fees. There is a game angling market, and fishing fees x_i paid by angler i are a proxy for effective fishing demand. Therefore, a positive WTP_i implicitly means a greater demand.

Let us now consider anglers who reject the deal. There is empirical evidence that some of them are unsatisfied with their fishing experience, and that others fish only a small portion of the river. The comments they make show they feel x is too much and they would like to reduce the fishing fees. Thus, for this category a negative WTP_i would be logical. However, anglers do not have the opportunity to state negative amounts.

To deal with both categories let us write:

$$x_i^* = \begin{cases} x_i + WTP_i & \text{if } WTP_i > 0 \\ x_i & \text{otherwise} \end{cases} \qquad (2.4.)$$

For the first category, x^*_i is a Marshallian demand, whereas for the second category it is not an optimal demand. Thus, we will specify a tobit model with a specific threshold for each observation.

The tobit model uses the first category of anglers to derive what would be the optimal level of x^*_i for anglers in the second category. So the underlying logic takes into account negative WTP_i which are not observed, but which do exist.

The model was estimated by the maximum likelihood with a Newton-Raphson algorithm. Standard errors of coefficients were computed from the inverse of the observed information matrix. Results are reported in table 2.7, x^*_i being espressed in logarithm.

The results reported in table 2.6 and in table 2.7 can be compared since they are based on the same sample and the same independent variables. The tobit model seems better because all signs are consistent and t-ratios are greater. As expected, a positive correlation between catch and angling demand is obtained.

The model was used to estimate average WTP for an additional 5 km of river banks. We got 363 FF per angler per year, which is smaller than the value given above, which is based upon a simple mean. This is consistent, as the tobit model implicitly takes into account negative WTP. Therefore aggregate WTP per km and per year equals 16 500 FF and is close to the actual yearly rent (15 000 FF).

Table 2.7 Sea-trout angling demand, tobit model (asymptotic t values in parentheses)

Variables	Tobit
Intercept	5.81 (17.1)
Site substitute (dummy)	0.27 (1.04)
Trip distance (km)	0.002 (2.5)
Cost of equipment (FF)	0.175 (2.2)
Catches	0.030 (2.2)
Monthly income: 17 classes (increasing with income)	0.033 (1.3)
Years of training	-0.025 (-1.9)
Log likelihood	-34.69

Some comments

We have reported some results from work in progress done in cooperation with angling societies. Some people in charge of these societies were afraid that results given above would push prices up. Thus, it will be interesting to observe the market in the future.

We think that hypothetical bias is not a serious problem in this study because there is already a market for game angling. People are not confronted with an imaginary situation, and therefore we can expect them to behave the same way in the actual market. The most difficult point concerns non-responses, which in this survey correspond to strategic behaviour. To deal with that, we intend to improve the model specification, using a generalized tobit model.

2.3 Conclusion

These studies show that the traditional scepticism vis-à-vis the CVM in France is totally unfounded. Our results are quite consistent with what has been observed in other countries. The individuals who have been interviewed, seem to have a sufficiently clear understanding of the issues to assign monetary values to environmental matters. We recommend and encourage further utilization of this method in France, especially for public projects.

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