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## ***Economic Valuation of Environmental Problems using the Contingent Valuation Method***

### **Povzetek**

*Prispevek vsebuje opis, primer uporabe in kritično diskusijo v zvezi s kontingenčno metodo (CVM) vrednotenja, najbolj kontroverzna metoda za ekonomsko vrednotenje okoljskih problemov ali dobrin.*

*Predstavljena je na primeru študije, ki se nanaša na narodni park Kalkalpen v Avstriji. V prispevku je tudi kratek pregled priporočil odbora Nacionalnega združenja za oceane in atmosfero (National Oceanic and*

*Atmospheric Association – NOAA) za obliko študij kontingenčnega vrednotenja. V zadnjem delu so sklepne opombe in kratek opis metod za neekonomsko vrednotenje okoljskih problemov in dobrin.*

**Ključne besede:** Kontingenčna metoda vrednotenja, narodni park, materialni tokovi.

### **Summary**

*This paper contains a description, critical discussion and example of the Contingent Valuation Method (CVM), which is the most controversial economic valuation method for evaluating environmental problems*

*or assets. The example discussed is a study concerning the Kalkalpen national park in Austria. The guidelines of the National Oceanic and Atmospheric Association (NOAA) panel concerning the design of*

*Contingent Valuation studies are also briefly reviewed. Concluding remarks and a few words on non-economic valuation methods for environmental problems and assets follow in the final section.*

**Key words:** Contingent valuation method, national park, material flows.

JEL: Q000, Q260

### **1. Introduction**

In this article, we discuss the Contingent Valuation Method (CVM) for the valuation of environmental problems or assets. Contrary to other economic valuation methods for environmental problems (i.e. so-called indirect market methods, see e.g. Wagner, 1998), in CVM the preferences of the economic agents are investigated by means of interviews relating to hypothetical situations. This is different from "standard" economic analysis, which uses as its starting point market data based on actual outcomes. Clearly, using market data for environmental problems is an especially difficult issue, given that public

goods aspects, externalities and/or missing markets, typically characterise environmental problems.

Using hypothetical results based on interviews is the reason why the CVM is heavily disputed in the economics profession. The core of the argument is whether it is in principle feasible to unravel the preferences of economic agents by means of interviews relating to hypothetical situations. We discuss the pros and cons in detail in section 2. Section 3 closes with a brief mentioning of non-economic valuation methods for environmental problems to indicate that

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within the natural sciences, methods to evaluate environmental problems and the environmental impacts of human activity have been developed.

It is clear that assessment of the environmental implications of human activity, in particular economic activity, becomes ever more important. Thus, it is crucial for policy makers to understand the advantages, disadvantages and limitations of available methods (indirect market methods, CVM, natural science-based approaches) to reach better conclusions, potentially by appropriate combination of methods.

## 2. The Contingent Valuation Method

### 2.1. Description

The Contingent Valuation Method (CVM) was originally developed in the USA. The first study was published by Ciriacy-Wantrup in 1947 and dealt with soil erosion. Since then, several thousand studies using this method have been published.

The idea of CVM is to simulate hypothetical markets for environmental goods using interviews. This explains the name of the method; the responses and results are contingent upon the presented hypothetical market. This immediately leads to the conclusion that the description of the asset or project to be valued is an important part of a CV study and can be expected to have strong impact on the results.

In principle, there are 2 possibilities. Respondents can be asked for their willingness-to-pay (WTP) for an improvement of the environmental situation, or they can be asked about what compensation they would accept for a worsening environmental situation. The literature in general suggests using WTP for an improvement of the situation, since this measure is (supposedly) conservative, i.e. corresponding WTPs tend to be reported with a downward bias. Thus, the "true" value would be underestimated with a high probability but not overestimated.

A detailed description of CVM is given in Mitchell and Carson (1989). Here, we wish to only note a few important items for the design and implementation of a CV study.

As has already been mentioned, it is very important to explain the situation to the respondents as well as possible. The asset to be valued has to be described precisely and completely, and a so-called scenario description should be presented to the respondents. Portney (1994, p. 6) puts it as follows: *"In other words the scenario is intended to give the respondents a clear picture of the good that the respondent is asked to value."*

The mechanism for determining the value has to be explained and, if possible, tailored to the specific situation at hand. This includes issues such as closed or open questions, and whether the referendum format or a bidding game are chosen. Closed form means that the respondents have to choose from a given set of possible answers. Alternatively, in an open question format, the respondents are not restricted in their answers. The main argument for choosing closed form questionnaires is that the respondents are potentially not familiar enough with the environmental asset to be valued to be able to give quantitative valuations. A special case of closed form questionnaires is the referendum format. In this set-up questions like: "The government is considering realising project X with impacts Y. This implies that your tax payments will rise by the amount Z. Are you in favour of or against this project?" In a bidding game, the respondent has to answer whether she is willing to pay amount X for a certain asset or project. If yes, the amount is increased until the respondent answers with no. Thus, bidding games try to extract the maximum willingness-to-pay.

Usually, socio-economic characteristics (age, sex, profession, marital status, environmental consciousness, etc.) are also recorded. This allows, at least in principle, estimation of the WTP as a function of these and potentially other explanatory variables.

It is important to ensure that the respondents have correctly understood the problem at hand and whether they take the questionnaire seriously. This is typically validated by a set of follow-up questions.

Within the economics profession, there are large controversies over whether CVM is a valid method to value environmental assets. To answer this question, a high-level commission was formed in the USA, containing among others Nobel laureates Kenneth Arrow and Robert Solow. The question the commission had to answer was essentially: *"Is the contingent valuation method capable of providing estimates of lost non-use or existence values that are reliable enough to be used in natural resource damage assessments?"* Compare Portney (1994, p. 8).

The work of the commission resulted in a report stating important guidelines that should be followed when applying CVM. Some of the most important guidelines are:

- The interviews have to be performed personally, not via telephone.
- It is suggested to determine (in the interview set-up) the WTP to avoid a future accident and not the minimal compensation requirements for accidents that have already happened.

- The referendum format should be used, since this is a well-known situation for citizens (as voters).
- A detailed and understandable scenario description must be presented at the beginning.
- The respondents must be reminded that expenses for environmental assets reduce the disposable income for other goods and assets.
- The respondents have to be made aware of potentially available substitutes. If, as discussed below, the question to be addressed is the valuation of a national park, then other already existing national parks should be mentioned.
- At the end of the interview, follow-up questions should be asked in order to ensure that the respondents have understood the situation and to assess the motivation of the respondents.

The conclusion of the commission was that a carefully performed (i.e. according to the guidelines) CV study may lead to sufficiently precise estimates that can be used to assess damages. As mentioned previously, the question posed to the commission referred only to damage assessment.

## 2.2. Assessment of the Method

The CVM is heavily disputed – at least in part with not overly scientific arguments. Critique as well as support occurs at different levels. This means that the discussion is at both the level of detail concerning a particular study and the fundamental level of whether the method is in principle useful, i.e. whether it is possible to arrive at proper valuations based on questionnaires as opposed to only via actual market outcomes. Since it is too early for a conclusive assessment, we discuss below some of the aspects of the ongoing discussion.

The most fundamental part of the discussion centres on the question whether it is in principle possible (irrespective of the specific implementation) to arrive at “meaningful” valuations using interviews. The underlying mechanism for valuation in economics is based on the price system and real transactions. For a given good at a given price, somebody will purchase this good if the value of that particular good for the person is at least as high as the price. If the valuation is lower than the price, the good will not be purchased. The valuation and hence also the WTP varies across individuals. After the purchase, or non-purchase, a clear decision concerning the valuation of the good is possible, in well-functioning markets. However, in many cases, in particular for environmental goods, there are no prices, since these goods are not traded on markets. To nevertheless

arrive at price-based valuation systems, economists use so-called indirect market methods, as discussed in e.g. Wagner (1998). The discussion in that paper shows that these methods are applicable only under certain assumptions respectively circumstances (in particular, the availability of substitutes or complements that are traded on markets). This restriction is not binding when applying CVM, since the “market is created” in the interview situation. Consequently, CVM is usable without limitation – for any valuation problem, conditional upon accepting CVM.

Supporters of CVM argue that for environmental problems especially, where the market system is non-existent or fails (due to externalities and public good characteristics), other methods to determine preferences can and must be used. Hanemann (1994, p.28) writes that some “...conclude that these people are just making up their answer rather than evincing ‘true economic preferences’. But what are ‘true economic preferences’? If a subject responds thoughtfully to a question about voting to raise taxes for a public good, by what criterion is that not a valid preference;” and Hanemann (1994, p. 19) argues: “In the presence of externalities, market transactions do not fully capture preferences. Collective choice is the more relevant paradigm.”

Critics, however, focus on two effects leading to (potential) non-usability of CVM; these are the *warm glow* and the *embedding* effect. Warm glow refers to the possibility that the respondents, while sitting at home, obtain moral satisfaction via self-betrayal by reporting overly high WTPs for environmental goods. Since the respondents do not really have to pay the reported WTPs, it is indeed possible that actual WTPs, when real payments have to be made, could be lower. The embedding effect is closely related to warm glow and may be illustrated and discussed by means of an example. The discussion is based on Hanemann (1994) and Diamond and Hausman (1994). In an actually performed CV study, people were asked about their WTP to rescue respectively 2000, 20000 or 200000 birds. The result was that the WTPs were essentially equal in all three cases. This means that the WTP to rescue 2000 birds was as high as that to rescue 200000 birds. Such a finding is referred to as the embedding effect, and is not reconcilable with usual economic theory based on strictly concave preferences, which implies a higher WTP to rescue more birds, even when considering income and other effects. Opponents of CVM interpret such findings as being based on the warm glow effect: the respondents want to purchase some general form of environmental consciousness and are ready to pay some (hypothetical) amount for this that they consider to be appropriate for some reasons for environmental protection. If this is so, then it is not a specific environmental problem or asset that is valued, but one only obtains an indicator of some general environmental consciousness and WTP for

“the environment” of the respondents. Interpreting CVM results is clearly a major problem if the answers are driven primarily by this warm glow.

Supporters of CVM typically respond by pointing at the inappropriate design of such questionable CV results. In the discussed example, the interviews were carried out in a shopping mall and the respondents were asked: “What is your WTP to rescue much less than 1%, less than 1% or about 2% of an endangered bird population respectively?” Whether this is really a sensible and balanced formulation of the question is left to the reader to decide. The example has been chosen to illustrate the polemic between supporters and critics of CVM. It does however appear to be, beyond all polemics, a problem that the embedding effect is seemingly present and it is unclear how to correct for it.

For critics, especially, it is unclear whether CVM is a valid method, once the “mistakes and biases” due to the mentioned effects have been “corrected”. Critics argue that it is in general unclear to which distortions the mentioned problems lead, and hence it is unclear how to correct for them.

Several problems are also admitted by supporters of the method, these include *interviewer bias*, *protest zeros* and *trimming answers*. Interviewer bias refers to those errors that occur due to the fact that different interviewers have different ways of presenting the problem. How to account for and address this problem can probably best be clarified by market and opinion research institutes. Protest zeros refers to the fact that reported WTPs of zero are, according to certain criteria, interpreted as protest answers and excluded from further analysis. In principle, similarly also “too high” answers are excluded i.e. the answers are trimmed (on both sides). Excluding responses is at the discretion of the conductors of the study. By construction, the results of the study will depend upon the trimming procedure employed. This has to be taken into account throughout when considering the results of a CV study. It is further known (from marketing science) that answers are biased in the direction of the behaviour and decision under study, which typically will lead to over-estimation of the valuation. Marketing science has developed tools to correct for such effects e.g. in forecasting future sales based on interviews. It appears sensible to use knowledge gained in marketing science in CV studies also. Mitchell and Carson (1998) write: “Such ‘calibration’ is common practice in marketing designed to predict purchases. If a systematic divergence between actual and CV survey behaviour existed and could be quantified, calibration of CV results could be undertaken.” Calibration might be more complicated in the CV context, since these typically deal with public goods. Monetary valuation of public goods is a more

complicated and less common task than monetary valuation of goods traded in markets, which respondents are much more used to. This might complicate useful calibration of CV results.

Further psychological effects may also be present. It is known that responses are sensitive to the wording as well as the ordering of the questions. For example, *not allowed* and *forbidden* are interpreted and understood differently. Further, the WTPs to save (first) whales and (second) seals differ from those to save (first) whales and (second) seals. These and related effects are summarised under the term *response effects*. Pre-testing is used to quantify, explain and correct for these effects. The previous discussion implies that it is highly likely that better co-operation between economists, psychologists, sociologists and marketing experts might lead to an improvement of the usefulness and reliability of CV studies.

A further critique of CVM consists of the statement that the responses cannot be verified, since the payments only happen hypothetically. The hypothetical character is generally seen as the largest disadvantage of the CVM. Supporters of the method offer three possibilities for verification: repetition, comparison with results of other studies and – where possible – comparison with actual behaviour. With respect to repetition, it must be mentioned that obtaining similar results several times does not necessarily imply that the results are correct, since one can also obtain wrong results repeatedly.

Furthermore, critics of CVM argue that the value that an environmental good has for the individual is in fact only created during the interview i.e. the survey process creates the value. A thorough discussion of this problem would necessitate discussing fundamental issues with respect to preferences and the creation of preferences, i.e. whether preferences are firmly rooted and fixed in some part of the brain, or whether they also can be established in the short-run but yet are stable. Put more simply: it is clear that being asked about a certain problem implies that this problem gets attention which it may not have had before. Now, the question is whether this process leads to changes (and if so how) of the values. Behavioural economics is working on clarifying these questions and insights from the field may be beneficial for conducting CV studies.

One often hears that “normal people” are not capable or able to value environmental problems, since they lack expert knowledge and information. This is the reason for the emphasis on presenting a detailed scenario description at the beginning a CV study. Clearly, doing so does not transform the respondents into experts. However, this limitation also holds true for any market-based valuation problem. Customers

may buy a DVD player without having to prove that they have understood the technical principles at work inside the player. A standard objection at this point is that environmental problems are “more important” than everyday consumer decisions. This may or may not be the case, but in the end it is the respondents (as part of the population) who are affected by environmental problems. Neglecting the opinion of those affected cannot lead to an ultimate conclusion. This leads to the question, which cannot be answered only from an economic or scientific point of view, of who shall quantify concern in which way. Neither a central planning solution via an expert group nor voting about each problem appear to be desirable.

At the end of the discussion, one important advantage of CVM has to be mentioned. This is the only economic valuation method that allows quantifying – at least conceptually – also so-called non-use and existence values. None of the indirect market methods discussed e.g. in Wagner (1998) can do this. Therefore, with all critical points in mind, an assessment of CVM is warranted.

### 2.3. Example

Several CV studies have been performed in Austria. The first one was performed by Pruckner (1991), who tried to quantify the value of landscape cultivation (and other positive external effects) by Austrian farmers by asking domestic and foreign tourists. Other studies have dealt with valuing national parks: Kosz et al. (see Kosz, 1996, and Schönbäck, Kosz and Madreiter, 1997) with the Donauauen national park and Hackl and Pruckner (1995) with the Kalkalpen national park.

We discuss here the findings of Hackl and Pruckner (1995) in some detail. The focus in the presentation is on describing the interview and the scenario description. We do not discuss in detail the statistical analysis performed and the methods used by the authors; these details can be found by the interested reader in the original work.

In the 1990s, plans to establish a national park (NP) named “Oberösterreichische Kalkalpen” in the Austrian province of Upper Austria emerged. The aim of such an NP is the preservation of essentially untouched nature. The first stage of the Kalkalpen NP consists of an area of about 21500 hectares in two alpine areas – Hintergebirge and Sengengebirge. The creation of an NP has immediate economic consequences, including changes (in particular restrictions) in the use patterns of agriculture and forestry,

possible impacts on the extent and form of tourism (“soft tourism”), investments in relation to the establishment of the NP and subsequent income changes. There are also further impacts, not economic in the narrow sense e.g. related to utility gains of visitors. Quantifying these utility changes was the purpose of the study described.

In total 1410 personal interviews were conducted, with 604 respondents being residents of the NP area, 301 respondents tourists and 505 people were interviewed in Linz, the capital of the Upper Austria region. The NP region itself is sub-divided in two areas: Northeast (NE) and Southwest (SW). These two areas differ in tourism characteristics, average household incomes and also with respect to the intensity of information dissemination of the NP planning office. All respondents received the scenario description listed in Table 1 in written format.<sup>1</sup>

The residents were in addition informed about the economic consequences of the NP (compare Table 2). The authors argue that they correctly informed only residents about the economic consequences, since to a large extent it will be the residents who will face these consequences. Consequently, the authors did not show the economic consequences to the tourists or to residents of Linz. One could argue that at least the residents of Linz might also have found information concerning the economic impact of the NP interesting.

The majority of interviews were conducted in closed format. Some residents, however, were questioned in an open format to check potential differences in reported WTPs between closed and open questionnaire formats. In the open format, respondents were asked how much they are, as a whole household, willing to pay for an earmarked national park fund. The respondents could choose from a list of potential payments between 0 and 1500 Austrian Schillings (ATS), with this range being chosen according to some pre-testing. In the closed format, respondents were asked the following question: “*Would you vote for or against the NP, if your household has to pay a certain amount X per year, based on estimated costs, in an earmarked national park fund?*” If the respondent replied *yes*, in the second round a similar question was asked with a higher amount. If the respondent replied with *no* or *cannot say*, lower amounts were suggested in the second round. The amounts varied between 25 and 1100 ATS.

For tourists and residents of Linz who at the beginning of the interview stated their wish to visit the NP

<sup>1</sup> The scenario description and all other documents of the CV study, as well as the report of Hackl and Pruckner (1995) are in German. They have been translated by the author.

**Table 1: Scenario description given to the interviewed people**

<b>Impacts on NATURE</b>	
<b>without national park</b>	<b>with national park</b>
Extinction of several protected species (several butterflies, birds and orchids) in this area.	Conservation of several protected species (several butterflies, birds and orchids) in this area.
Economic interests shape the landscape.	Conservation respectively recreation of natural landscapes (e.g. mixed forests instead of monocultures).
Forestry in the core area of the NP.	No forestry in the core area of the NP.
No rest areas for areas that deserve to be particularly protected.	Rest areas without human interference (e.g. nesting sites for endangered bird species).
Hunting of protected species (mountain cock, black cock, etc.).	No hunting of protected species (mountain cock, black cock, etc.).
<b>Impacts on RECREATION</b>	
<b>without national park</b>	<b>with national park</b>
Increase of leisure activities with negative environmental effects.	Promotion of environmentally friendly leisure activities (e.g. hiking, observing, etc.).
Routes for motorised transport in remote areas of the Hinter- and Sengengebirge.	Routes for motorised transport only to the borders of the NP (Implementation of shuttle services and construction of cycle paths).
Construction of further hiking, cycle or bridle paths, cultivated Alps remain.	Currently existing hiking, cycle or bridle paths and cultivated Alps remain.
<b>Impacts on EDUCATION, RESEARCH, CULTURE</b>	
<b>without national park</b>	<b>with national park</b>
Hardly any activities that allow for understanding of the natural mechanisms in the NP area.	<ul style="list-style-type: none"> <li>• Education activities that foster understanding of nature (e.g. information centres, nature trails, guided tours);</li> <li>• Research in the NP;</li> <li>• Preservation of cultural buildings (e.g. alpine cottages, dams).</li> </ul>

Source: Table 1 is identical to Figure 3.1 in Hackl and Pruckner (1995), pp. 55–56.

**Table 2: Information concerning economic impacts of the project**

<b>ECONOMIC IMPACTS of the KALKALPEN NATIONAL PARK</b>
No forestry in the core area, no large construction projects in the outer area of the NP.
Possibility of subsidies for Alp cultivation in case certain ecological criteria are met.
Compensation for economic losses due to the NP.
Expenditures in the region: 100 million ATS for the construction of education and information centres; 40 million ATS per year on current expenses.
Increase of tourism, intensification of quality tourism.
No additional environmental restrictions outside the NP area.

Source: Table 2 is identical to Figure 3.2 in Hackl and Pruckner (1995), p. 56, ATS denotes Austrian Schillings.

at least once, the authors tried to discover the WTP per day of visit in the NP with similar questions to those outlined above. The amounts varied between 20 and 280 ATS per day visit per family with again two rounds of questions.

Tourists and residents of Linz who stated that they either did not intend to visit the NP or did not know whether they would visit the NP were asked in an open questionnaire format about their WTP for establishing the NP. The respondents could choose from amounts in the interval 0 to 800 ATS per year.

Table 3 reports the average WTPs of the residents based on the open-ended questionnaire.

In addition to the WTP, socio-economic characteristics were also investigated, including age, sex, occupation, income, number of persons in the household, etc., and in relation to motivations for NP usage such as hiking, seeing wildlife, etc. Furthermore, respondents were asked about their expected income changes, as well as information level and sources.

Based on all collected information, which was partly used to estimate WTP functions, the side effects of the CV study include, among others, information concerning the income distribution and expected changes in the sub-regions and information about the origins of tourists. This type of additional information can be expected to be collected in any carefully performed

**Table 3: Mean willingness-to-pay of residents**

Region	Sample size	Mean. in ATS	Median in ATS	Std.deviation
SW Communities	94	107.18	0	207.86
NE Communities	79	103.16	50	150.66

Source: Table 3 is identical to Table 3.19 in Hackl and Pruckner (1995), p. 86.

CV study. In the concrete example discussed here, it turned out that the average household income was significantly higher in the Southwest region than in the Northeast region.

Applying standard microeconomic methods, the WTP as well as utility gains of “typical” residents, residents of Linz and tourists were estimated. Since the closed format was used in referendum format i.e. with a dichotomous decision, Logit and Probit models were estimated. The authors emphasise that for any subsequent use of the estimated values, the conservative i.e. lower estimates of the WTP were used. Using conservative estimates appears important in light of the critique of the CVM discussed above, since conservative estimates reduce the probability of overestimation of values.

Table 4 displays the average individual value for three different groups of individuals (excluding residents). The estimates report WTP per day of visit in ATS based on all respondents that indicated an intention to visit the NP.

Respondents, both those from Linz and tourists, who indicated that they did not plan to visit the NP, indicate with their WTP the non-use existence value of the NP. Table 5 displays the average annual WTP in ATS.

Given that the average family size of the interviewed residents of Linz was 2.38 persons, this implies an average annual existence value of about 34.35 Mio ATS (with, however, a very high standard deviation).

The aggregation over all groups of potential visitors is based on the expected number of visits. Clearly, the expected total value depends critically upon the expected number of visits, since a major component of the total WTP is based on the WTP of potential visitors (i.e. upon use values). The authors used the numbers of visits in comparable NPs, in particular of the Engadin NP in Switzerland and the Berchtesgaden and Bayerischer Wald NPs, both in Bavaria. See Table 6.

Based on these visitor numbers, estimates for the total values of the NP were computed. Here scenario I refers to estimates based on the visitor numbers in the Engadin NP, scenario II is based on Berchtesgaden NP and scenario III is based on Bayerischer Wald NP.

The planners of the NP estimated the annual costs of the NP at about 40 million ATS. This implies that, even with the results based on the smallest number of visits, the NP project leads to a (monetarised) utility gain, i.e. its benefits outweigh its costs. Consequently, the study implies that the NP should be realised.

**Table 4: Average monetarised utility of the different user groups**

People in Linz	57.46
Tourists in the Northeast region	49.66
Tourists in the Southwest region	50.67

Source: Table 4 is identical to Table 3.27 in Hackl and Pruckner (1995), p. 94.

**Table 5: Empirical characteristics of WTPs of non-visitors**

Sample	Maximum	Minimum	Mean	Median	Std. deviation
94	450	0	81.91	50	85.91

Source: Table 5 is identical to Table 3.28 in Hackl and Pruckner (1995), p. 95.

**Table 6: Numbers of visitors in comparable national parks**

	Visitors	Size in hectares	Visitors per hectare
NP Engadin	450000	17000	26.47
NP Berchtesgaden	1.5 million	21000	71.43
NP Bayerischer Wald	1.7 million	13000	130.77

Source: Table 6 is identical to Table 3.29 in Hackl and Pruckner (1995), p. 97.

**Table 7: Results of monetarised utility estimation; disaggregated according to different user groups**

		Individual utility (ATS)	Population	Scenario I in ATS	Scenario II in ATS	Scenario III in ATS
Utility of residents in the Southwest region	Total value	41.45 per annum	21997 persons	911824	911824	911824
Utility of residents in the Northeast region	Total value	56.13 per annum	29777 persons	1671521	1671521	1671521
Utility of tourists in the Northeast Region	Value of visit	49.66 per day of visit	53470 days	2655210	2655210	2655210
	Value of Existence	34.35 per annum	10349 persons	355509	355509	355509
Utility of tourists in the Southwest Region	Value of visit	50.67 per day of visit	86191 days	4367292	4367292	4367292
	Value of Existence	34.35 per annum	22940 persons	787987	787987	787987
Utility of additional visitors		57.46 per day of visit	SC I: 428334 SC II: 1395825 SC III: 2671989	24612072	80204105	155532488
Value of existence for Upper Austrians		34.35 per annum	576843 persons			
Sum				55 million ATS	111 million ATS	184 million ATS

Source: Table 7 is identical to Table 3.30 in Hackl and Pruckner (1995), p. 99.

In fact, the NP Kalkalpen was opened in July 1997 and has been internationally recognised as an NP since 1998.

### 3. Concluding Remarks

As has become clear in this discussion, CVM is not free of problems. This holds true for all economic methods for environmental problem and asset evaluation; compare the discussion in Wagner (1998) for indirect market methods. Major problems relate to the plausibility of assumptions as well as to the issue of measurability of important quantities. Keeping in mind the problems related to the CV and other methods, it is nevertheless possible to contribute to a scientific assessment of environmental issues by using economic methods.

To close the discussion, there are also other, non-economic methods to evaluate environmental issues. One group of methods is the so-called *material flow* methods. The underlying idea of material flow methods – compare Baccini and Brunner (1991) – is that the immediate causes of environmental damage are material and energy flows that impact on the natural environment. Thus, such methods do not consider the motivation structure of economic agents, but focus on the physical consequences of human activity. Let us describe one particularly simple example of a material flow method, *MIPS* – *Material Intensity per Service Unit*, described by Schmidt-Bleek (1994). The basic

idea is as follows. The indicator for the environmental impact of a certain good is measured as the total material use (in kg) across the entire life cycle (i.e. from mining to eventual recycling) of use per unit of the good or per service unit (e.g. the transport of one person over one kilometre). It is clear that, in certain cases, a precise measurement will be very difficult. However, since measurement is in one common unit (in kg), different goods and services can be compared. One example is milk in glass bottles against milk in cartons. According to the MIPS concept, the solution with the smaller material use is preferable (in the example, the material usage in collection and cleaning of bottles in case of multiple usage has to be taken into account). It is clear that using masses alone is a crude approximation to the environmental pressure exerted, since in most aspects one kilogram of iron clearly has different impacts from one kilogram of mercury. Hence, using simple concepts like MIPS can best serve to give a first indication for potential impacts, which then must be substantiated by subsequent, more careful, analysis, especially when different goods imply using different materials.

Combining economic- and natural science-oriented approaches is clearly a key aspect for progress in environmental science and economics to allow for a more complete picture. An appropriate combination, based on clear understanding of the relative advantages and disadvantages of the methods employed, may lead to better decision-making.



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