Lake Water Quality Valuation —Benefit Transfer Approach vs. Empirical Evidence

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1. Introduction

If decision-making follows economic optimality criterion, a public authority may rely on benefit-costs analysis in which involved costs and benefits are compared. Acquiring monetary values particularly for non-market goods and services by primary studies may however be time-consuming and costly. One of the possible solutions is Benefit Transfer (BT). This method has been increasingly popular in the literature, since it is much faster and cheaper (Champ et al. 2003).

Benefit Transfer basically presents a technique of adopting values being derived by original study to a new (policy) site. The method has its origins in publications by U.S. Water Resources Council of daily estimates for recreation activities, which were used in evaluating water-related projects (Ro senberger and Loomis 2001). The method was first formally described by Freeman (1984). The first approaches explored value transfer techniques based on transferring original results from a 'study' site directly to a policy site with some adjustments where needed. Such adjustments of the existing values could be caused by inconsistency in time (CPI corrections), currency (PPP) or income (income elasticities).

The basis for function transfer were laid down by Loomis (1992). The idea behind this approach is transferring an entire estimated demand (or WTP) function, which obviously depends on a study site context. This approach is believed to be a more reliable method since statistical analysis allows for preparing a function in a way that would fit the policy site characteristics best. Implicit assumption however also results in a drawback of this approach; i.e. the same predictors and regression coefficients for original and policy site are expected. This assumption doesn't have to be satisfied, especially for regions differing in many characteristics (e.g. Loomis 1992, Loomis et al. 1995, Downing and Ozuna 1996, van den Berg et al. 2001).

There are many empirical studies testing validity of benefit transfer between countries (e.g. Krupnick et al. 1996, Ready et al. 2004 or Rozan 2004).

Evidence is rather scarce for transfers between developed and developing countries or economies in transition. Some results were provided for example by Chestnut (1997), Barton and Mourato (2003), unsurprisingly showing even higher transfer errors in these cases. The task of transferring values from developed to developing countries—that indeed differ in many of characteristics—thus seems to be the most difficult. There is also no empirical study testing validity of transfer to the new EU member states either from former member states or even between post-communist countries which joined the EU in May 2004.[1]

The question of robustness of benefit transfer between countries remains to a large extent unanswered. So far there is no consistent, systematic and commonly accepted protocol to be used in benefit transfer studies. Developing best practice methods for appropriate developing and calibrating data by primary empirical studies is recommended to be the best way of perfectioning the method (Bergland et al. 1995). To test how good the benefit transfer really is the original data from not only a 'study' site, but also from a 'policy' site is needed. The validity is tested by comparing estimated and 'true', collected values at the 'policy' site. To track the difference coming from difference in sites only it would be best to keep all the other factors constant, which would mean the same scenario and the questionnaire used. The need for comparative studies, conducting the same valuation studies of environmental amenities in many countries at the same time is also stressed by Navrud (2004). Conducting such studies brings an opportunity to produce calibration factors which would improve BT between countries. The case studies reported here were designed specifically for this reason and are aiming to aid future benefit transfer applications.

The main objective of our paper is to examine how benefit transfer for new EU member states can work. Specifically, we aim to analyse what is a validity of transferring values from Western Europe to Central European Countries and between two countries both geographically located in the region of Central Europe and both being post-communist countries. Since these two countries—Poland and the Czech Republic—seem to be in many ways similar, this might prove to be an efficient and reliable exercise.

Compensating surplus for water quality improvement in highly eutrophic lake is analysed in a benefit transfer exercise. The surplus is measured by a willingness-to-pay measure that is elicited from stated preferences by contingent valuation method. The surveys conducted used the protocols and surveys constructed in as similar way as possible. The basis for the studies in Poland and in the Czech Republic was the survey conducted in Norway in 1994

[1] According our knowledge, there is only one empirical study that indirectly tests transfer benefit between former EU–15 (Italy) and new Member State, the Czech Republic (Alberini et al., 2005, mortality valuation). Some evidence will also be provided by the EC funded NEEDS project focusing on mortality effects due to air pollution in 7 European countries, including three new EU member states (Desaigues et al., forthcoming).

by Bergland, Magnussen and Navrud (Bergland et al., 1995) and later applied for another two lakes in Norway (Magnussen 1997) and two in Germany (Muthke and Holm-Mueller 2004). The sites and scenarios in our cases were carefully chosen to make them suitable for benefit transfer in a way they were kept as similar to the original Norwegian site as possible.

The structure of this paper is as follows: section 2 gives sites and survey description. Section 3 describes data. Next section provides estimates of willingness-to-pay for water quality improvement. Section 5 test benefit transfer by exploring several techniques including value adjustments and function transfer. Section 6 concludes.

2. Description of the scenario, site and survey

2.1. The Scenario

The contingent scenario used was based on a hypothetical benefit from an improvement of water quality in a lake which is strongly euthrophicated and therefore not usable. Water quality was classified by a five-level scale of total phosphorus content. Each class was described by proxies such as environmental living conditions for water animals, occurrence of algae and serviceability as a possible source of drinking water, recreational use (swimming, water sports, recreational fishing) and irrigation (see Appendix 1). The phosphorus limits for each class could be different in each country due to different geological and natural conditions typical for the country[2]. The classification of lake water eutrophication was done in accordance with official scales[3] or in case there were no national standards—prepared by water pollution experts.

Hypothetical water quality improvement from actual quality level by 1 class or 2 classes respectively was considered as the contingent product. Welfare change due to provision of the contingent product was measured by compensation surplus derived from the willingness-to-pay of the residents. The interviewers rotated the level of water quality improvement (1 or 2 classes) asked first. It allows us to analyse an external validity of the scenario and its possible effect on stated WTP.

The payment vehicle for WTP used in the scenario was an increase of sewage charge paid by respondent's household or in case of households not connected to public sewage system or water supply an increased price for cleaning septic tanks and treating the wastewater was used.[4] In the surveys, two

[2] These include depth, volume, water exchange rate, catchment area, turbidity, dissolved particulate matter, light penetration and other factors which are typical for natural conditions of the lakes in each country. A five level water eutrophication classification was supposed to classify the lake with comparison to average national conditions. The phosphorus limits used for water quality classification in Norway, Poland and the Czech Republic are quoted in Appendix 2.

[3] Water body assessment for swimming by the Czech Regional Sanitary Offices

thirds of the Czech respondents and 42% of the Polish did not consider the payment vehicle appropriate. Only negligible number of the Czech respondents ($N = 3$) however considered the payment vehicle to be the main reason for protesting. In the Polish sample the qualititative analysis of the responses in focus groups and verbal protocols suggest that objections to the payment vehicle could have been caused by the belief, that sewage charges in the vicinity of the Polish lake were already among the highest in Poland. Other reasons given were inappropriate operation of the sewage treatment facility in the past, which had to be modernized several times, and a belief that the polluters or 'the government' should pay.

As Mitchel and Carson (1989, p. 245) note,

> **the scenario must be so designed that respondents who are not willing to pay anything for the amenity feel comfortable in giving that response.**

Unwillingness-to-pay however does not have to mean a principal rejecting a scenario. Kriström (1997) and Reiser and Shechter (1999) showed the importance of not excluding true zero bids from the statistical analysis. Protest zero responses were then identified if a respondent chose a 'not willing to pay anything' option and stated that water quality is important to his household however it is others' responsibility to pay for the water quality improvement. All the surveys (including the two Norwegian) used the same protest zero response identification criteria.

2.2. The Site

Łęgowskie Lake in Poland and Máchovo Lake in the Czech Republic were chosen for the study.[5] The study sites were chosen to match the Norwegian originals and follow the criteria on pollution source, the level of pollution, tourist attractiveness and existence of the lake's substitutes. The criteria specifically include:

— The main source of pollution was supposed to be agriculture and municipal sewage but not industry. The reason for this was to minimize the number of protesting responses by not allowing for the industry to be blamed. The surrounding areas of Łęgowskie and Mácha lakes is predominantly agricultural.

— The lakes should be heavily eutrophied, ie. the class was supposed to be 4 or 5 at the 5-class scale based on total phosphorus concentration. Apart from that, the water should not be polluted with other substances, e.g.

[4] In the Czech sample only 65% of the households living in the vicinity of the lake were connected to a municipal sewage system (and 95% to a public water supply), 36% of them still had their own septic tanks and 20% could use their own wells.

[5] The process of selecting the lakes, gathering the data about phosphorus in water, and preparation of the maps used in the questionnaire were all carried out in cooperation with nationally recognized water pollution experts.

heavy metals or toxics. Removing the excessive content of nutrients from the lake should leave the lake relatively clean. Łęgowskie Lake was assigned to the worst, 5th class, while the Czech and the Norwegian lakes were all class 4.

— The site was supposed not to be a tourist spot since only the local residents were to be questioned; this was in order not to give the possibility of shifting the burden of cleaning the lake to tourists and not to expect additional income from cleaning the lake. This criterion was easily satisfied in Poland due to the large number of lakes many of which are eutrophic.[6] Except natural lakes situated in the mountain areas and drinking water reservoirs, which are clean, water bodies in the Czech Republic are artificial ponds used for fish farming and/or lakes appointed for recreational use. This caused a problem with attractiveness of a Czech site. Mácha Lake is located to the north of Prague and is a rather famous tourist resort, especially for the visitors from Prague. The lake is artificial, founded in the 14th century, and was used for fish farming until the middle of the 20th century. Therefore it was fertilized with super phosphates in the forties and fifties. This has been used in the scenario as one of the possible pollution sources, in addition to the municipal wastewater. The scenario was mostly accepted by the respondents since although 21% of them considered the tourists responsible for Mácha Lake pollution, only 2.6% of all respondents were convinced the tourists should finance relevant measures of improving the lake's water quality. Therefore Mácha Lake was decided to be the site suitable for comparison with the Polish and Norwegian lakes.

— Presence of substitutes in the lake vicinity might, as an important issue, influence the values stated by the respondents. While the Norwegian lakes of the original 1997 study and Mácha Lake have no similar substitutes in the surrounding area, there are over ten alternative options within the 10km radius around Łęgowskie Lake. We believe this issue was one of the most important differences between the analyzed lakes.

Apart from substitutes available and tourist attractiveness, the main difference between the sites is the size. Łęgowskie Lake with its surface of 68.4 ha is very small in depth, 1.8 m in average. It has a high water exchange rate and very high ratio of catchment area (1,088 km^2) to lake volume (ca. 1,226,600 m^3) which determine high susceptibility of the lake to eutrophication. The surface area of Mácha lake is 280 ha and the mean depth is 2.5 m, the total catchment area is 100 km^2, the lake's volume is 5,500,000 m^3 and the average long-term flow rate is 0.563 m^3/s.

The local area around Polish site is inhabited by approximately 35,000 people, with abut 300 living in a village of Łęgowo situated at the lake banks, and 24,000 living in the city of Wągrowiec (3 km away). The total population of

[6] Poland has about 9,000 lakes larger than 1 ha and some 1,040 are of surface area exceeding 50 ha.

the two towns on the lake banks and local villages in the close surrounding to Mácha lake is approximately 5,000.

Both Polish settlements are connected to public water supply and to sewage system, which is important for the scenario's payment vehicle. Two towns on the bank of Mácha lake are connected to a municipal sewage system, although there have been significant leakages detected. Four smaller villages in the close surrounding are not connected to a municipal sewage system, but the households use their own septic tanks and thus pay for sewage from septic tanks treatment.

Although, both lakes included in the study were chosen with regard to the initial criteria on benefit transfer and comparability with original Norwegian study not all of them had been met. In Poland a major deviation from the original study is high amount of easily accessible and much less polluted substitutes, in the Czech Republic tourism attractiveness of the site was the main difference. A brief comparison of the sites can be found in Appendix 1.

2.3. Survey

The questionnaire was divided into nine parts. In the first part the respondents were asked about their opinions on economic, social and environmental problems in their country in general and especially with regard to water pollution. This introduction was followed by the description of the eutrophication problem and the current situation and pollution sources. The five-class scale and the possible water quality improvement were described with help of maps and a chart containing descriptions of each pollution level (see Appendix 3). The scenario aimed at preparing the respondents for the questions about WTP for water quality improvement. This part was followed by questions designed to distinguish protest responses and true zero WTP values. Then questions about the respondents' relation to the lake and its recreational use were set. Finally, a few questions were asked to register the socio-economic variables of the respondents. The questionnaire closed with a set of debriefing questions and questions for the interviewer about the respondent.

The Polish questionnaire kept the design and questionnaire's content as similar to the Norwegian original as possible. The Czech questionnaire had to be modified in order to increase its comprehensibility, although the basic content was maintained. Photos of the different eutrophication level, were not used in the Czech survey due to their weak comprehensibility.

Both studies were preceded by a pilot study. The main study was conducted in October—November 2005 by university students assisted by researchers. The interviews were conducted in Łęgowo—a village directly at the lake banks (all the houses in the village were visited) and in Wągrowiec—a town 3 km from the lake. The target population in the Czech study, except the households living in the two towns at the bank of the lake, included also residents living in four surrounding villages (39% of respondents). Houses were chosen randomly.

To boost the response level, the local municipal authorities were contacted and asked to prepare information for the population about the survey. Information leaflets were hung on important meeting points in each of the targeted municipalities. A fee of 50 CZK (3.4 USD at PPP) was offered to each Czech respondent. There are 430 valid observations in total, 202 from Polish survey and 228 in the Czech one (excluding pilot data). In the Norwegian 1997 study there were two 300-observation surveys.

3. Data description

3.1. Basic statistics

Analysis of socio-economic data from both the Czech and the Polish surveys allows to draw a conclusion of high representativeness of both samples (age, household members, incomes are close to national averages). Means of the respondents' monthly net incomes are equal to 692,26 USD in the Czech sample, and 532,62 USD in the Polish one, mean net household incomes are 1567,90 USD, and 1074,85 USD respectively.[7] Respondents in the Czech sample are less educated and fewer are unemployed. See Appendix 5 for all descriptive statistics.

For both samples, the majority of the respondents lived in the region close to the lake for most of their lives, on average 70% and for 34 years. The relatively more touristy character of Mácha Lake leads to a higher share of respondents who benefit from its existence, for instance from running a pension or providing any other service for tourists. Moreover, 8% of the Czech respondents own a recreational house in the proximity of the lake. The Czech respondents also more often heard about the problem of polluted lake and were slightly more engaged in environmental problems and members of ecological organisations (predictors that can likely influence stated WTP). Appendix 6 gives site and scenario descriptive statistics.

3.2. Protest and true zero responses

In treatment of zero responses, the following approach was used: firstly, protest zero responses in the group of zero WTPs were identified; then a discrete model was built in order to analyze the factors influencing a choice between the protesting and stating a non-negative value.

The share of non-positive WTP statements is higher in the Czech sample. The highest share of zeros was stated for 1-class water improvement of Mácha Lake (30%), the lowest for 2-class in Łęgowskie Lake (22%). The share of zero

[7] All monetary values reported in USD here are PPP corrected following International Monetary Fund, World Economic Outlook Database; i.e. 1 USD = 14.788 CZK, 1 USD = 1.816 PLN.

WTP responses was smaller for 2-class water improvement in both studies. On the contrary to total zeros, there is a lower share of respondents who protest against the scenario in the Czech sample, i.e. 12% to 19% in the Polish sample. There are more protesters if the payment vehicle is considered inappropriate, this however does not hold for the Czech respondents. Protesting—similarly as zeros—declines with a magnitude of offered water quality improvement. Table 1 below gives numbers of all, protest and true zero responses in each of the samples. In the study (Magnussen 1997) we intend to test BT for and we follow, there is 6.4% of protesting zeros in Ånøya and Gaustadvatnet and 10.7% in Lagenvassdraget.

Table 1.

Zero response analysis[8]

	CZECH (*N* = 228)			POLISH (*N* = 202)		
	all zeros	true zeros	protest	all zeros	true zeros	protest
WTP1	69	43	26	53	8	45
% *N*	30.3	18.9	11.4	26.2	4.0	22.3
% *N* without protests		21.3			5.1	
WTP2	51	26	25	48	4	44
% *N*	22.4	11.4	11.0	23.8	2.0	21.8
% *N* without protests		12.9			2.5	

An occurrence of the protest zero responses was analyzed by a discrete Probit model. The probability of binary switch between protesting and stating true zero or positive WTP was modeled. We found that neither financial situation of the household of respondent nor uses of the lake explain the discrete choice. Indeed, there must be a different stochastic process involved in deciding about participating or protesting if a Tobit model is used for censored data. See Probit model in Appendix 4 for results. In the further statistical and econometrical analyses the protest zero responses were rejected.

As found in contingent valuation studies, acceptance of the payment vehicle can affect significantly acceptance of the contingent scenario as well as stated WTP. Indeed 65% of Czech and 71% of Polish protesters respectively were those who found the payment vehicle inappropriate. The share of protesters is almost four times higher in the group that disagreed with the payment vehicle in Poland, while this share was the same in the Czech sample (about 11%)[9]. Table 2 below summarizes the payment vehicle and protest zero response analysis.

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[8] Hereafter, WTP1 states for WTP for a 1-level improvement, WTP2 for a 2-level improvement.

[9] For possible explanations see section 2.1 of this paper.

Table 2.

Protest zero responses and the payment vehicle

Respondents	CZECH REPUBLIC (Mácha)			POLAND (Łęgowskie)		
	Accepting payment vehicle	Objecting to payment vehicle	Total (% of total)	Accepting payment vehicle	Objecting to payment vehicle	Total (% of total)
Non-protesters	66	136	202 (89%)	104	53	157 (78%)
% of non-protesters. who accepted or object PV	33%	67%		66%	34%	
% of 'accepting'/ 'objecting', who did not protest	88%	89%		89%	62%	
Protesters	9	17	26 (11%)	13	32	45 (22%)
% of protesters, who accepted or object PV	35%	65%		29%	71%	
% of 'accepting'/ 'objecting', who did protest	12%	11%		11%	38%	
Total (% of total)	75 (33%)	153 (67%)	228	117 (58%)	85 (42%)	202

3.3. Non-use value and alternatives

There are many ways in which a lake may provide use value for a typical respondent. It is possible to bathe, take boat trips, fish, do water sports or sports in general (such as biking or jogging), perhaps only enjoy the surroundings of the lake for strolls. Mácha Lake is more extensively used by residents for swimming, boating, sporting or walking than Łęgowskie Lake. In the Polish study, the Łęgowskie Lake was relatively so unattractive that hardly any of the respondents claimed to have been using it for purposes other than walking around. Although, mean number of days spent close to the lake for those respondents who spent there at least one day a year is similar (about 64 days per year), there are only 28% of Polish respondents in comparison with 71% of Czech, who claimed to have spent at least a day at the lake last year. For all respondents considered, mean number of days spent close to the lake is 18 for Polish and 45 for the Czech sample. 72% of Polish respondents did not use the lake for any reason, while there were only 29% of such cases in the Czech sample.

Possible users and non-users of the lake were identified on the basis of having used the lake at least once during last year or owning a recreational cottage by the lake. 12% of Czech respondents had a profit and 7% owned a cottage. There was only negligible number of such households in the Polish sample; 6 respondents from 202 had jobs related to tourism in the region, and 3 of them received profits from tourism in the region. However it cannot be assumed that these jobs and profits were related to the existence of Łęgowskie Lake due to its pollution and proximity of clean substitutes. There are 23% non-users in the Czech and a very high 70% in the Polish sample. The positive willingness to pay of these respondents can then be interpreted as a non-use value, i.e. either bequeathed to others or given to existence of the lake itself.

Low demand for Łęgowskie Lake can also be explained by the availability of many substitute lakes in the area, all with much better water quality. Indeed 85% of Polish respondents used one of the alternative lakes. There were no alternative lakes in the proximity of Mácha Lake. According to the respondents' answers, if the lakes were cleaned only the Czech one would be more extensively used. There was also a very strong emotional relationship to Mácha Lake (stated by 92% of the respondents), while Łęgowskie Lake had no significant meaning for 64% of the Polish respondents.

The equivalence of mean WTP of two groups of respondents, i.e. users versus nonusers, was analyzed by a t-test separately for each country sample. If equal variances cannot be assumed at 0.95 confidence level, we use a non-parametric Satterthwaite unpooled t-test on the mean difference. If a p-value of a t-test is smaller than 0.05 we reject null hypothesis of equality of means. A small size of the sub-samples should however be considered for the meaningfulness of the results given. The results of the analysis can be found in Appendix 7.

Mean WTP of the lake users was higher than that of the non-users in the Polish sample, while this does not hold for the Czech sample. Unexpectedly in the Czech sample t-test could not reject the null hypothesis of equality of mean WTP stated by these two groups at 0.95 confidence level. It was possible however to reject the null hypothesis of equality of WTP mean in the Polish data for both products, i.e. 1-class and 2-class improvement, at 0.10 significance level. In all cases t-test for equality of variances is not satisfied at 0.95 confidence level. In all cases non-parametric Satterhwaite unpooled t-test was used as the equivalence of variances could not be assumed. Thus a greater impact of variables describing using the lake on stated WTP in Polish sample would be expected than in the Czech sample if there were more observations.

3.4. Test of comprehensiveness

A comprehensiveness of the contingent product was tested by asking the respondents what they thought the collected resources from increased sewage charge would be used for. There were four possible options to be chosen by a respondent. Water quality improvement at the site—Mácha or Łęgowskie Lake, was explicitly considered by 34% of Czech and 22% of the Polish respondents. Water quality improvement in the region was thought of by about 15% of respondents in both studies and water quality improvement in the entire country was taken into account by 9% or 13% respectively. From one fifth to one forth had in mind an improvement of environmental quality within the country in general while declaring their willingness to pay.

A hypothesis of equality of mean WTP for one specific group of respondents and the rest of them cannot be statistically rejected at 0.05 level for any of four groups of respondents and any country sample (mean WTP can be interpreted to be equal). Mean WTP and p-values of each t-test is reported in Appendix 8. Difference in mean WTP for those Czech respondents who considered improvement of water bodies in the entire country and mean WTP of the rest of Czech respondents can be accepted at 0.07 or 0.08 significance level respectively. Intuitive interpretation of country differences can lay in different emotional relationship of Czech versus Polish respondents to the considered lake and its attractiveness and therefore potential further use. Equality of WTP means cannot be statistically rejected, however, in the most of cases equality of variances cannot be accepted. It may yield one's supposition that possible WTP means can likely be statistically different if the (sub-)samples were larger and statistical tests could yield more robust estimations. This should also lead to a more careful explanation given to the respondent of what the money would be used for.

4. Estimating WTP

Several approaches were applied to estimate mean and median WTP values. As shown by Cameron and Huppert (1988) or Alberini and Krupnick (2003), payment card responses are correctly interpreted as binding WTP between the amount chosen, referring to the lower bound, and the next bid at the payment card, referring to the upper bound. Consequently, we apply interval-data maximum likelihood estimation in our WTP models as well as Random Utility Models. For comparison the results of two simpler approaches are given (mid-point and minimum legitimate WTP approach).

In data analysis, we first paid special attention to zero treatment. As shown above, protest responses were detected allowing distinguish them from true zero values of WTP. A discrete Probit model was applied in order to predict which respondents were more probable to protest against the scenario (see Appendix 4). Then such observations were excluded from further statistical analysis, as different stochastic process between the protesting and stating any non-negative value was reported.

4.1. Mean and median WTP

Table 3 summarizes the estimates in national currencies. The most conservative approach, minimum legitimate WTP, takes the highest BID amount marked on a payment card as a WTP of a respondent. This is followed by a midpoint approach, where the respondent's WTP is assumed to be equal to the midpoint between a highest BID a respondent was definitely willing to pay and the next BID on a payment card (not chosen).

A group of models used for estimation were Random Willingness to Pay or Expenditure Difference models, where several parametric approaches were employed. Following methodology of Haab and McConnell (2003) and Greene (2002) Table 3 reports the results for normal and logistic distributions of disturbance terms of linear Willingness to Pay Function. This is followed by a Weibull distribution approach. These constant only bid functions were estimated to select the 'best' model on the grounds of having the highest value for the likelihood function. For estimating mean or median WTP a constant only bid function was used as suggested by Bateman et. al. (2004).

Table 3.

Mean and median WTP[10] estimates

	Czech survey (n = 228) WTP in CZK		Polish survey (n = 202) WTP in PLN	
	WTP1	WTP2	WTP1	WTP2
protest responses	10.7%	9.1%	28.7%	27.8%
true zero responses	22.8%	15.3%	5.4%	2.6%
minimum BID	0	0	0	0
maximum BID	6,000	6,000	250	250
Lower bound (mean)	418.8	634.1	23.0	30.2
Midpoint (mean)	491.7	735.2	28.5	37.8
Normal (mean = median)	501.1	758.5	27.7	36.7
Logistic (mean = median)	496.2	755.6	27.4	36.5
Weibull (median)	516.3	782.0	28.7	38.3
Spike (mean)	461.3	675.4	24.2	31.8
Tobit (fit1; mean)	342.5	593.6	24.2	32.1
Tobit (hincome + age; mean)	338.8	582.6	21.4	28.1
Normal (Norwegian fit)	517.7	780.7	24.4	31.5

A considerable amount of responses declared their WTP to be zero, even after protest zero responses elimination. For this reason one more model was tried—the Spike Model (Kriström 1997). To prevent negative WTP the exponential utility function was applied. The spike model provided the highest likelihood values and thus mean WTP estimated with the Spike Model is used below, as the best estimate of true WTP. The Spike model mean was used thorough the rest of the paper.

The last three rows of Table 3 report WTP estimates of models including more explanatory values, which were designed and used specifically for

[10] Hereafter, WTP1 states for WTP for a 1-level improvement, WTP2 for a 2-level improvement.

function transfer approach described below. It is worth noting that all the estimated WTP values are considerably close.

4.2. Effect of scope and rotation

4.2.1. Scope effect

Assuming water quality improvement belongs to normal goods, it can be expected that WTP should be higher for two-level improvement than for one-level. A normality of goods can be tested by a weak or strong scope test. A weak scope test is satisfied if WTP is increasing with quantity of a valued product. Strong scope test refers to a situation when stated WTP increases proportionally with the quantity. While there is general evidence supporting weak scope test for non-market goods, this is not the case for strong scope test (see e.g. Alberini et al. 2006 for WTP for risk reduction of dying).

The majority of the respondents stated the same WTP for a one-class and two-class water quality improvement. 66% of Polish and 39% of the Czech respondents thus did not distinguish between the scope of the improvement. A strong scope test is satisfied only for 10% of Poland and 16% of the Czech sample. About 20% of respondents stated smaller WTP for a two-class improvement then twice WTP for one-class. Two-class improvement was considered better contingent product for those who stated WTP2 two-times higher than WTP1 (6% of respondents) or for those who stated positive WTP for a two-class improvement while their WTP1 was a 'true zero' (a kind of corner solution). The mean WTP2 was 1.4 times higher than WTP1. Table 4 below reports the ratios.

Table 4.

WTP2/WTP1 ratio: WTP for a 2-class improvement versus WTP for a 2-class improvement

	N	Mean	Median	WTP2/WTP1 (midpoint)						
				WTP1 =0 WTP2 = 0	< 1	= 1	(1,2)	= 2	> 2	WTP1 = 0 WTP2 = 0
Czech	192	1.45	1.20	9%	2%	39%	20%	16%	6%	8%
Polish	148	1.34	1.00	21%	0%	66%	18%	10%	6%	2.5%

Note: Mean and median calculated only for a positive WTP2/WTP1 ratio (WTP1=0 are excluded).

4.2.2. Rotation of the product

The design of the questionnaire allows for testing an effect of rotating the order of WTP1 and WTP2 questions. The results show that the order in which WTP1 and WTP2 questions were asked did not result in a significantly different mean values. It is worth noting however that especially for one-class water improvement the percentage of zero responses was significantly higher. The explanatory power of variable "WTP1 asked first" is explored further in the econometric model below.

The equivalence of variations was rejected even at a 0.01 significance level in the three cases, for the last one (1-class improvement, the Czech data) at 0.10 significant level. Equality of mean WTPs cannot be rejected by t test at 0.05 significant level in any case. Therefore, a conclusion can be drawn that rotating of the WTP question did not have statistically significant impact on the stated WTP values. Non-equivalence of variances however leads to a supposition that bigger samples could lead to higher differences in observed WTP. The statistical analysis can be found in Appendix 9

4.3. Explanatory variables of a stated WTP

4.3.1. The Norwegian (1997) model

The original Norwegian study (Magnussen 1997) reported a model specifically designed to aid future BT exercises. The variables used in the model were: age over 50, household income, being a user of the lake, primary education, college, and asking for WTP1 prior to WTP2 question (WTP1first). The interval-data maximum likelihood estimation procedure was applied assuming normal distribution of WTP (following the Norwegian study in this respect). Three regressions were tried, for polled, Czech, and Polish data. The Norwegian model fitted neither the Polish nor the Czech data. The only predictor that proved to be significant was household income for pooled and Polish data. The variable 'Age > 50', 'user' and 'primary education' were significant for both countries at almost 0.10 significance level. Mean WTP values derived from the Norwegian model were relatively higher then mean WTP values estimated with the Spike model applied above. For estimation results see Appendix 10.

4.3.2. Other explanatory models

Another approach consisted in finding the best explanatory model, which would fit both the Polish and the Czech data. Because of this explanatory variables significant for both samples were chosen in order to test validity of function transfer between Czech and Polish study sites only.

For finding explanatory variables of WTP values, on the contrary to the Norwegian model, a Tobit model was applied (Tobin, 1958).[11] There are, however, two restrictions of applying a Tobit model. Firstly, the same stochastic process should determine the value of continuous observations of the dependent variable and the discrete choice between having positive and zero values. Zero observation of the dependent variable then represents a corner solution. Secondly, the corner solution restricts determinants such as misreporting or infrequency in buying the good (see e.g. Deaton and Irish, 1984; or Blundell and Meghir, 1987). Misreporting is not the case of our study as only observa-

[11] Several two-parameter distributions for WTP were tested, from which the lognormal and the Weibull distributions fit the data best. It also supported the choice of a Tobit model to analyse censored data.

tions with reported data are included in our dataset. Infrequencies can appear as service provided by water quality improvement relates to a particular season—summer. We therefore collected the data just after a summer season, keeping experience with the lake pollution fresh in the respondents' minds. While we cannot prove the same stochastic process for a discrete choice between protesting and stating WTP value, the mechanisms assumed was a zero-one switch to state positive values as well as WTP magnitude. It is theoretically possible to assume negative WTP, however, based on the carefully conducted pretesting we did not allow such values in our models.

The significant explanatory variables were carefully selected and their sign verified. The variables 'male', 'consider the payment vehicle inappropriate' and 'alternatives to the lake used' proved to have a negative sign while 'heard about environmental problem in media', 'considering environmental problems important' and 'postmaterialism'[12] were negative. These predictors were not statistically significant (p-values of 0.2). Statistically insignificant were also education level 'no A-level' and 'college', 'having children' and 'household size' The final model includes the variables 'personal income', 'age' and two dummy variables 'easy to state WTP' and 'considering environment improvement for the country in general when stating WTP'. Alternatively, a model including only 'household income' and 'age' was applied. Both models yield relatively comparable mean WTP estimates. For the results see Appendix 11 and Appendix 12.

5. Benefit transfer

5.1. Introduction

The best way to test benefit transfer is to conduct comparative studies, with all the possible factors unchanged. Using the same questionnaire, payment vehicle, sampling strategy and choosing as similar goods being valued as possible should leave the remaining difference in values ideally sourcing in differences in individual preferences of the respondents at different sites.

In total there have been 8 surveys conducted in Europe in the period of 1994–2005 on eight different lakes in 4 countries and at 4 different time points. The original study of the 1994 (Bergland et al., 1995) aimed at valuing two Norwegian lakes Vansjo-Hobol and Orre. The same study with some important methodological improvements was conducted later, in 1997, on two other Norwegian lakes: Lagenvassdraget and Ånøya and Gaustadvatnet (Magnussen 1997). In 2000 the original survey was used again in Germany to value the lakes Guestrowel-Seen and Ville-Seen (Muthke and Holm-Mueller 2004). All these results, combined with Polish Łęgowskie Lake and the Czech

[12] Postmaterialism is a proxy for social preference having a value 1 if the respondent considered environmental, education and health policy as important issues the attention should be particularly paid for in policy decision-making process.

Mácha Lake would provide a great opportunity to test benefit transfer options if not methodological differences in case of ’94 and ’00 studies.

Despite the fact that the similar questionnaire was used, there were substantial differences at some study sites. The original 1994-Norwegian study and 2000-German study used double-bounded dichotomous choice format of WTP questions, while all the others employed payment cards. The Norwegian studies valued not only water quality improvement for bathing, boating and fishing—as German, Czech and Polish ones did—but WTP questions aimed also at valuing biodiversity and preparation and maintenance of footpaths.

In all eight studies a similar 5-level classification of a lake water quality was used. Only the German study however used a scenario where respondents were asked about WTP to prevent degradation (from level 3 to level 4 and from level 3 to level 5). Thus while the German study aimed at equivalent surplus measurement, all the other studies measured compensation surplus. Relative size of hypothetical improvement also differed; the improvement from class 5 to 4 and 3 was applied in the Polish and in the Norwegian 1994 study, while in the Czech study a change from level 4 to 3 and 2. Internal scope test could not be applied to the Norwegian 1997 study because only the improvement from class 4 to 3 was implemented. External scope test could be applied only for Norwegian and German studies since all valuation exercises were carried out simultaneously at two lakes, while in Poland and Czech Republic at one site only. All sample sizes ranged between 200 and 300 respondents who were residents living close to the relevant site.

Bearing the above in mind we believe that only the results of the Norwegian 1997 study of Lagenvassdraget and Ånøya and Gaustadvatnet is directly comparable with the one conducted in Poland and the Czech Republic, which all used the same setting, questionnaire and payment vehicle.

After 1992 there were many benefit transfer validity studies conducted aiming at testing and perfectioning existing approaches as well as methodological guidelines. One of them worth noting, which is applied here, was suggested by Kristófersson and Navrud (2005). The usual practice is stating a null hypothesis of no difference between the original and the transferred estimated values. The authors suggest using equivalence tests, which are appropriate to test for equivalence and not for difference of the values. The equivalency testing combines statistical and political significance into one test, by defining an acceptable transfer error before conducting validity test. The null hypothesis of an equivalence test is that values are different. Only through rejection of the null hypothesis can one conclude that the values are equivalent.

Several approaches to benefit transfer were tried: first a naïve value transfer is reported, followed by a value transfer with purchasing power parity corrected values. The next approach applied controls for income differences using income elasticity approach. Finally a benefit transfer function technique is applied.

The error rates were calculated following a formula given by Kirchhoff et. al. (1997) and are given as a percentage difference between WTP transferred and the actual WTP known from a primary study: $[WTP_{transferred} - WTP_{predicted}]/WTP_{predicted}$.

5.2. Naive value transfer

The simplest approach to transfer benefit estimates assumes that well-being experienced by an average individual at one site is the same as well-being of an average individual at another site. This means it is possible to directly transfer WTP from one site to another, correcting only the monetary value with a market exchange rate. If the studies were conducted in different time points the values could also be deflated using the Consumer Price Index. Table 5 below summarizes the mean WTP values recorded at all 8 sites in national currencies and USD (2005) at market exchange rate.

Table 5.

Survey results in national currency and USD (2005)

Study	Country	WTP for 1 class		WTP for 2 classes	
		National currency	USD[13]	National currency	USD
Mácha Lake (2005)	Czech Rep.	461.33	18.72	675.40	27.41
Łęgowskie (2005)	Poland	24.22	7.36	31.84	9.68
Lagenvassdraget (1997)	Norway	804.00	142.44	–	–
Ånøya and Gaustadvatnet (1997)	Norway	607.00	107.54	–	–
Vansjo-Hobol (1994)	Norway	2247.00	423.56	2171.00	409.24
Orre (1994)	Norway	2984.00	562.49	3145.00	592.84
Guestrower-Seen (2000)	Germany	59.00	75.79	66.00	84.78
Ville-Seen (2000)	Germany	83.00	106.62	103.00	132.31

The error rates of naïve value transfers from Western European countries to Poland and the Czech Republic turn out to be very large. The highest error rates were recorded for transfers from the Norwegian 1994 study reaching over 2000% (more than 20-times higher WTP) or even 7500% for Polish. The lowest error rates are reported for transfers from German sites, especially from Guestrower-Seen to Czech Mácha Lake, they are still in the range of 200% to 300% however.

[13] Market exchange rate for 2005 Q4, source: http://www.oecd.org/dataoecd/55/63/18624791.pdf, USD values CPI corrected where necessary.

Error rates for naïve transfer between the Polish and Czech study sites are 61% for WTP1 and 65% for WTP2 while for transfers from Poland to the Czech Republic the error rates are 154% and 183% respectively.

5.3. Adjusted value transfer

Another source of potential incomparability are political and macroeconomic risk factors which may influence the official currency exchange rates. To correct for this factor another transformation factor may be used—Purchasing Power Parity corrected exchange rate. Adjusting values by PPP takes into account the relative power of disposable incomes of households in different countries. Table 6 below presents the results CPI corrected for 2005 Q4 and exchanged to USD (2005) with a PPP.

Table 6.

Survey results CPI and PPP corrected, in USD (2005)

Study	Country	WTP for 1 class	WTP for 2 classes
		USD[14]	USD
Mácha Lake (2005)	Czech Rep.	31.20	45.67
Łęgowskie (2005)	Poland	13.33	17.53
Lagenvassdraget (1997)	Norway	96.39	–
Ånøya and Gaustadvatnet (1997)	Norway	72.77	–
Vansjo-Hobol (1994)	Norway	286.64	276.95
Orre (1994)	Norway	380.66	401.20
Guestrower-Seen (2000)	Germany	71.06	79.49
Ville-Seen (2000)	Germany	99.96	124.05

As can be seen in Table 6, the range of values is quite wide, from 13 USD (for Poland) up to 380 USD (for Norway). A few observations can be made. First of all the differences of WTP values are smaller. The Norwegian WTPs from the 1994 study are again much higher than all the others (error rate up to 1500% for Polish and 800% for Czech site for WTP2). The reasons for this were discussed before—the results for Norway (1994) and Germany (2000) should not be compared directly, despite of the fact that we report the corrected values. The range of WTP of comparable studies is 13–96 USD; the highest WTP was estimated for the Norwegian 1994 study, the values for the Czech Republic are almost 3 times lower, and more or less the same ratio can be found be-

[14] Implied PPP conversion rate used, National currency per US dollar used, source: International Monetary Fund, World Economic Outlook Database, September 2005, http://www. internationalmonetaryfund.com/external/pubs/ft/weo/2005/02/data/dbcoutm.cfm?SD=1994&ED=2006&R1=1&R2=1&CS=3&SS=2&OS=C&DD=1&OUT=1&C=142–964–935–134&S=PPPEX-PCPI&CMP=0&x=47&y=7.

tween the Czech and the Polish data. Error rates of value transfers to the Czech and Polish site are lower if transferring from Ånøya and Gaustadvatnet Lake (133% and 446% respectively) in comparison with Lagenvassdraget (209% and 623% respectively).

5.4. Income elasticity approach

The income elasticity approach may be particularly useful for benefit transfer between countries with different income levels and costs of living. In this approach the benefit transfer at a policy site can be calculated as

$$WTP'_{PS} = WTP_{SS}\left(\frac{Y_{PS}}{Y_{SS}}\right)^{\beta_{PS}}$$

where $_{PS}$ and $_{SS}$ subscripts stand for 'policy site'—where a value is being transferred, and 'study site'—where original, primary data is available, Y stand for income and β_{PS} is income elasticity at the policy site.

The primary assumption in value transfer is that income elasticity of demand for environmental goods is equal to one (Navrud 2004). This approach is consistent with the comparison of the ratios of WTP to income level at each of the sites described in chapter 5.6 below. Income elasticity of demand for an environmental good was generally proved to be lower than one. Krupnick et al. (1996) used 0.35 as a base value in their study of air pollution in Central and Eastern Europe; moreover they note that the evidence from the USA shows that income elasticity of demand for lower mortality risk is smaller than 1. Evidence on income elasticity of demand for environmental goods smaller than one is also provided by Kriström and Riera's (1996) and Hökby and Söderqvist (2001).

To test validity of this approach we used original data from two sites to estimate 'implied' income elasticity, i.e. income elasticity that would ensure validity of income elasticity approach to value transfer from the Norwegian 1997 study to Mácha and Polish Łęgowskie Lake.

Table 7.

'Implied' income elasticities in Polish and Czech 'policy sites' calculated for different income level and 'study site' values

	Y = mean personal income		*Y* = GDP p.c.	
	Lagenvassdraget	Ånøya and Gaustadvatnet	Lagenvassdraget	Ånøya and Gaustadvatnet
policy site = POLAND	1.40	1.72	2.31	1.98
policy site = CZECH	0.98	1.17	2.32	1.74

As can be seen from Table 7 above the income elasticities in Poland and the Czech Republic would have to be substantially larger to ensure zero error rates for such transfers. It would also result in luxurious character of our environmental contingent goods. To test this possibility original WTP and income levels recorded during the studies in Poland and Czech Republic were used to estimate 'real' income elasticities of WTP for 1 level water class improvement of the lake. Assuming the demand curves to be iso-elastic and using mid-point WTP data of each respondent together with his reported income level, income elasticity was estimated from logarithmic WTP function:

$$\log(WTP) = a + b * \log(Y)$$

where *WTP* was reported as mid-point *WTP* and *Y* is reported as a net personal monthly income.[15] The estimated income elasticities were estimated using respondents' net personal, household and household per family member income. The results are summarized in Table 8.

Table 8.

'Real' income elasticities of WTP for 1 level water class improvement (WTP1) for different income data used

	Y = personal income	*Y* = household income	*Y* = household income per family member
POLAND	0.41	0.75	0.42
CZECH	0.56	0.54	0.40

Table 9.

Transferred WTP and error rates for income elasticity adjustments

Model for transfer	Mid-point		Spike model		Tobit—fit1		Mid-point		Spike model		Tobit—fit1	
Contingent product	1 class improvement						2 classes improvement					
Policy site	CZ	POL	CZ	POL	CZ	POL	CZ	POL	CZ	POL	CZ	POL
Observed or modelled WTP	34,28	15,68	31,20	13,33	23,16	13,31	51,83	20,83	45,67	17,53	40,14	17,66
personal income												
household income	18,15	30,75	15,44	27,98	15,41	20,77	24,11	46,49	20,30	40,97	20,45	36,01
Hincome p.c.	19,26	25,78	16,38	23,47	16,35	17,42	25,58	38,99	21,54	34,36	21,69	30,20
Error rates	16,18	33,16	13,76	30,18	13,74	22,41	21,49	50,15	18,09	44,19	18,22	38,84
personal income												
household income	–47%	96%	–51%	110%	–33%	56%	–53%	123%	–56%	134%	–49%	104%
Hincome p.c.	–44%	64%	–47%	76%	–29%	31%	–51%	87%	–53%	96%	–46%	71%

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[15] In the above formula the parameter *b*, being a slope, is also the income elasticity of WTP, therefore, which gives the income elasticity of WTP

$$\Delta\log(WTP) = \frac{\Delta WTP}{WTP} = b(\Delta\log(Y)) = b\frac{\Delta Y}{Y}, \text{ therefore } b = \frac{\frac{\Delta WTP}{WTP}}{\frac{\Delta Y}{Y}},$$

which gives the income elasticity of WTP.

Benefit transfer with income elasticity adjustments for three income options and WTP estimates of mid-point, Spike and Tobit models was conducted. The lowest error rate for benefit transfer between the Czech and Polish site holds for transfer based on Tobit model, followed by mid-point approach and the Spike model. Using benefit transfer based on net household income yields the lowest error rates, while using net household income per family member resulted in the highest errors. Table 9 above summarizes the results.

We also provided benefit transfer adjusted by income elasticity approach from 1997-Norwegian study to the Czech and Polish site for 1 class improvement. The lowest error rates are given if transferred WTP values are compared with WTP mid-points and mean WTP by Spike model given from Czech and Polish data. The highest error rates are given if these benefit transfers are based on total household net income (we use PPP adjusted values for all options of defined incomes in the BT). Transfers from Ånøya and Gaustadvatnet site yields lower errors in both cases. Table 10 below provides results for the error rates if the Czech and Polish mean WTP by Spike model was compared with transferred values from 1997-Norwegian study. High error rates of a naive value transfer get smaller if values are adjusted by purchasing power parity, especially for transfer to the Czech site. The error rates however remain relatively large. Error rates are reduced significantly if transferred WTP values are income elasticity adjustments; this holds particularly for the transfer to the Czech site.

Table 10.

Error rates for benefit transfers from 1997-Norwegian study to Czech and Polish sites

Approach	policy site = Mácha Lake	policy site = Łęgowskie Lake
Naive value transfer		
Lagenvassdraget (1997)	661%	1834%
Ånøya and Gaustadvatnet (1997)	474%	1360%
PPP adjusted value transfer		
Lagenvassdraget (1997)	661%	623%
Ånøya and Gaustadvatnet (1997)	474%	446%
Income elasticity adjusted value transfer		
Lagenvassdraget (1997)	81%	159%
Ånøya and Gaustadvatnet (1997)	64%	151%

5.5. BTF best fit

The Norwegian 1997 study included a function transfer prepared and designed specifically for benefit transfer exercises on other sites. Unfortunately, the explanatory variables proposed turned out to be insignificant making the function inapplicable.[16] Therefore two own function transfers were prepared. Both of them used Tobit approach appropriate for censored data. We apply interval-data maximum likelihood estimation of WTP using 4 or 2 explanatory variables expressed income predictors and WTP in USD adjusted by purchasing power parity for both samples. See Appendix 10—12 for results.

The benefit transfer function validity tests were conducted following Rozan (2004). A comparison of the transferred WTP and the predicted WTP obtained directly from the contingent valuation studies was performed. WTP is predicted by two alternative options: as mean of WTP mid-points and as mean value estimated by two variants of Tobit model as described in Chapter 4 above (see also Appendix 10). Transferred WTP for the policy site i is calculated using Tobit model coefficients for the study site j and site data from the policy site. For each transferred WTP a confidence interval is calculated at the 95% confidence level. The null hypothesis is the equality of the observed and predicted WTP.

In all cases the observed WTP exceeds the 95% confidential interval (CI) of transferred WTP. It leads to rejecting the hypothesis of the observed and transferred values being equal. The error rates are 40% and 98% for 1-class improvement and 98% and 137% for 2-class improvement (consult with Table 11). Benefit transfer conducted as a function transfer is relatively more plausible for valuation of water quality improvement by 1-class and if conducted from Poland to the Czech Republic. The error rate even in this case is at a high 40%.[17] The null hypothesis of equality between the observed and transferred WTP is therefore rejected.

Table 11.

Benefit Function Transfer results

		Policy sites			
Study sites		Czech Mácha Lake		Polish Łęgowskie Lake	
		WTP 1 level	WTP 2 levels	WTP 1 level	WTP 2 levels
Observed	Mean WTP	23.16	40.14	13.31	17.66
	95% CI	(20.48, 25.84)	(35.72, 44.56)	(12.05, 14.57)	(16.02, 19.30)
Transferred	Mean WTP	13.80	18.38	26.29	41.84
	95% CI	(12.50, 15.09)	(16.68, 20.08)	(23.03, 29.56)	(37.16, 46.51)
Error rates		–40%	–54%	98%	137%

[16] Because we did not have original Norwegian data, we could not test the best model fit holding for all three country data.

[16] If mid-point of WTP was used, the error rate declines for the Czech transfers to Polish site and increases for Polish transfers. Error rates however remain still relatively high over 60%.

6. Concluding remarks

Benefit function transfer approach yielded significantly reduced error rates. The lowest error rates were however acquired by value transfer with income elasticity adjustment, particularly ones based on WTP modelling by Tobit model and household rather than personal income. The results are summarized by Table 12 below.

Table 12.

Error rates of benefit transfers between the Czech and Polish sites

Study	ps = Mácha Lake		ps = Łęgowskie Lake	
	WTP1	WTP2	WTP1	WTP2
Naive benefit transfer	–61%	–65%	154%	183%
Transfer with PPP adjustment	–57%	–62%	134%	160%
Transfer with income elasticity adjustment				
• Tobit; household income	–29%	–46%	31%	71%
• Tobit; personal income	–33%	–49%	56%	104%
• Spike; household income	–47%	–53%	76%	96%
• Spike; personal income	–51%	–56%	110%	134%
Benefit Transfer Function				
• predicted modelled by Tobit, transferred by Tobit fit1	40%	54%	98%	137%
• predicted as WTP mid-points, transferred by Tobit fit1	58%	62%	68%	101%

Since lakes and economic situation of households in different countries seem to be substantially different, choice of a transfer unit might play an important role in explaining the differences in the reported WTP. Ideally, the same goods should be an object of a valuation exercise in any benefit transfer validity tests. This can be however a very strong assumption in case of landscape amenity, biotope or a habitat valuation. Indeed, our sites can hardly be considered as identical. Benefit transfer validity tests provided in our paper are thus biased even if we valued the same 'product', 1-class or 2-class water quality improvement. Ideal validity test of benefit transfer should thus consider many characteristics of the lakes inter alia lake's surface, its perimeter and in particular a length of perimeter easily accessible by potential users, character of surrounding area, flora and fauna at and around the lake.

Therefore another approach was applied based on defining a different unit of transfer. Firstly, we investigated if stated WTP differ with the size of a lake being valued. Another source of differences is the level of income of the communities surrounding the lakes. To control for this factor a unit of transfer tested was a ratio of WTP to an income level. To describe income levels we used GDP per capita (PPP corrected) and personal income data, which was available from the survey conducted (also PPP corrected). Finally, the last transfer unit tried was the WTP as a relative increase in the current sewage fee, which was also a payment vehicle used in the survey.

Table 13 below presents results for different units of transfer in relation to the value calculated for Polish lake (as 100%). All monetary values (WTP, incomes, fees) are deflated to fourth quarter of 2005 using CPI and then expressed in USD (2005) using PPP. For numerical results and more detailed comparisons see Appendix 13–15.

Table 13.

Different units of transfer. Percentage of a value at a site in relation to the value for Łęgowskie Lake (Poland = 100%)

	Mácha Lake	Lagenvassdraget Lake	Ånøya and Gaustadvatnet Lake
WTP	234%	723%	546%
WTP/surface	57%	339%	32%
WTP/GDP p.c.	161%	261%	197%
WTP/pincome	180%	175%	203%
WTP/GDP p.c./surface	39%	122%	11%
WTP/pincome/surface	44%	82%	12%
WTP/sewage charge	253%	34%	25%

It can be seen that very high differences in WTP for 1 level of water class improvement get smaller if the size of a lake is taken into account. This approach is not capable of explaining high WTP for Lagenvassdraget, which is a relatively small lake. When WTP is treated as a relation of expenditures for water quality improvement to GDP per capita or personal income the differences between Norway and central European countries decrease. It can be seen from the results that personal income in the surroundings of Lagenvassdraget Lake (the city of Ski) is substantially lower than the average for Norway (GDP per capita), which makes comparisons using personal income more methodologically correct. The ratio of WTP to respondent's income is very close for the Czech Republic and the two Norwegian lakes, they are however still almost twice higher than Polish ratio, which might suggest other factors influencing the value there. When both surface and personal income are included, the results for Poland are on the contrary the highest, twice higher than Czech, eight times higher than Ånøya and Gaustadvatnet but only 20% higher than the results for Lagenvassdraget. Finally the comparison of relative increases of sewage fees shows 3–4 times higher willingness to increase the current level of these fees in Poland than in Norway. Concluding, there is no single unit of transfer that would outperform other units in all settings. A reliability of the proposed units of transfer should be carefully tested in further research.

Natural conditions of the lakes in different countries make comparability of WTP for water quality improvement difficult. Specifically natural conditions in Scandinavian countries (Norway, Sweden, Finland), result in lake eutrophication on a much smaller scale. In Norway for instance phosphorus concentration exceeding 0.05 mg P/l is characteristic for the lowest (fifth) level considered as heavily eutrophic, while both in Poland and in the Czech Republic concentration of 0.05 to 0.10 mg P/l would fall in the third category (as medium eutrophied).

Another restrictions of the sites comparability come from the use and alternative options. The Czech and Polish lakes were used mostly for walking, by 67% of Czech and 26% of Polish respondents. Five Czech respondents used it to swim and boat, 14% did some sort of sports. There were only 5% of such respondents at the Polish site. The most frequent activity at the 1997-Norwegian study was fishing that was done by the majority of the respondents; there were however just 7% of fishermen at the Polish site and even less—2% in the Czech Mácha Lake. These differences might play an important role in valuation of a lake by surrounding population.

Payment vehicle used in a study can also be differently viewed by citizens of various countries. Scandinavian economies representing welfare states with well-established civic society and well-performed control of institutions could have different attitudes towards user charges and local or general taxes. Indeed, two thirds of the Czech respondents and 42% of the Polish did not consider the payment vehicle used appropriate. Alternative option of the payment vehicle was asked in the Czech study; a payment to a special public fund was identified as the most appropriate way to pay for water quality improvement (49%), followed by a price increase of consumption goods possibly causing water pollution such as detergents and phosphated washing powders (24%), while an increase of general taxes was identified as the least favourable payment vehicle (2%).

Even though the questionnaires were designed as similarly as possible, the locations were matched possibly best and the same surveys were used, the empirical study yielded different results regarding welfare measures for water quality improvement in our two countries. Error rates are much higher for transferring values from Western Europe to Central European countries than between Czech Mácha Lake and Polish Łęgowskie Lake.

Validity test of benefit transfer between two post-communist countries—the Czech Republic and Poland, resulted in very useful evidence. Error rates for naive unit transfer seem too large to be useful for any policy application. Transfers adjusted by purchasing power decrease these errors, however, they still remain very large. The error rates were further reduced when benefit transfer function and income elasticity approach were applied. The lowest error remains as high as 30%. Further benefit transfer validity tests can bring more light in this very policy-relevant exercise. The results show that further studies on validity of benefit transfer are relevant even for countries which are considered to be 'very' similar. A specific identity of a site can however remain as a problem never-overcome.

Acknowledgements

The research has been supported by the European Commission of the European Communities within the R&D project MethodEx "Methods and data on environmental and health externalities: harmonising and sharing of operational estimates". The support is gratefully acknowledged. We are also grateful to Tomasz Żylicz, Stale Navrud and Jan Atle Liodden for very helpful comments and data. Responsibility for any errors remains with the authors.

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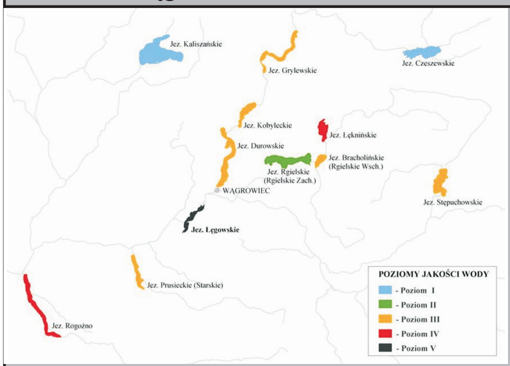
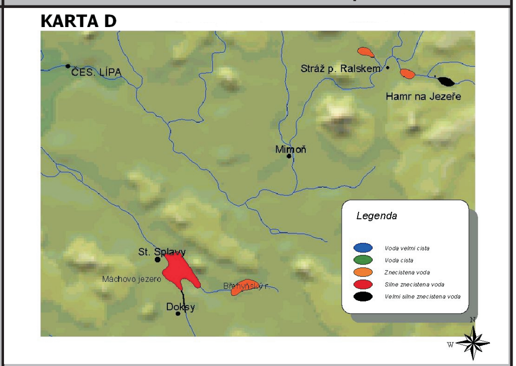
Appendix 1: Comparison of the sites

Box. Comparison of the sites

<table>
<tr><th>Łęgowskie Lake (Poland)</th><th>Mácha Lake (Czech Rep.)</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>pollution: 5th class</td><td>pollution: 4th class</td></tr>
<tr><td>total catchment area: 1,088 km^2</td><td>total catchment area: 100 km^2</td></tr>
<tr><td>69 ha and 1.8 m depth</td><td>280 ha and 2.5 m depth</td></tr>
<tr><td>35,000 population (300 on banks; 24,000 town 3 km from the lake)</td><td>5,000 population most living in 2 towns on the banks and small villages around</td></tr>
<tr><td>over 10 alternative lakes</td><td>no alternative lakes up to 20 km</td></tr>
<tr><td>tourist attractiveness: no</td><td>tourist attractiveness: yes</td></tr>
<tr><td>municipal sewage system</td><td>municipal sewage system in towns, septic tanks in the villages</td></tr>
</table>

Łęgowskie Lake (Poland)	Mácha Lake (Czech Rep.)
remuneration fee: none	remuneration fee: 3.4$ (50 CZK)
mean sewage charge: 66 USD a person a year	mean sewage charge: 47 USD a person a year
average respondent's income: 532.62 USD	average respondent's income: 692.26 USD
average household income: 1074.85 USD	average household income: 1567.90 USD
sample size: N = 202	sample size: *N* = 228

Appendix 2: The phosphorus limits used for water quality classification in Norway, Poland and the Czech Republic

Water class	NO scale	PL—lakes	CR scale
1	L 7 ìgP/l	L 30 ìgP/l	< 30 ìgP/l
2	7–11 ìgP/l	30–50 ìgP/l	< 150 ìgP/l
3	11–20 ìgP/l	50–100 ìgP/l	< 400 ìgP/l
4	20–50 ìgP/l	100–200 ìgP/l	< 1000 ìgP/l
5	> 50 ìgP/l	> 200 ìgP/l	> 1000 ìgP/l

Appendix 3: Water quality levels described by a card from the Norwegian 1995-survey

Eutrophication - Water quality - environmental quality classes-Suitability

	Description	Suitability
Class I Very good	Clear water Sufficient oxygen level Small or none growth of algae No growth of algae on stones	Drinking water Well suitable Bathing Well suitable Irrigation of arable land Well suitable Recreational fishing Well suitable Use of boat Well suitable
Class II Good	Relatively clear water Most often sufficient level of oxygen Some growth of algae on stones	Drinking water Suitable Bathing Suitable Irrigation of arable land Well suitable Recreational fishing Well suitable Use of boat Well suitable
Class III Fair	Some turbidity Low level of oxygen in deep layers Moderate growth of algae Slippery stones with algae growth	Drinking water Less suitable Bathing Less suitable Irrigation of arable land Suitable Recreational fishing Suitable Use of boats Suitable
Class IIII Bad	Turbid water Low level of oxygen in deep layers Strong growth of algae Strong growth of algae on stones Often too poor quality for species of salmon Imminent danger for blooms of blue-green algae	Drinking water Unsuitable Bathing Unsuitable Irrigation of arable land Less Suitable Recreational fishing Less Suitable Use of boats Less Suitable
Class V Very bad	High turbidity Frequent episodes of anoxia Very growth of algae on stones Very growth of algae on stones, overgrown Usually not living conditions for species of salmon Frequent blooms of blue-green algae	Drinking water Unsuitable Bathing Unsuitable Irrigation of arable land Unsuitable Recreational fishing Unsuitable Use of boats Unsuitable

Appendix 4: Probit models for protest responses (protest = 1)

	CZECH (protest for WTP1)			CZECH (protest for WTP2)			POLISH		
	coeff.	s.e.	p-value	coeff.	s.e.	p-value	coeff.	s.e.	p-value
Intercept	–1.097	0.418	0.009	–1.347	0.385	0.001	–0.720	0.556	0.196
Male	0.412	0.243	0.090	0.525	0.243	0.031			
Retired							–0.514	0.321	0.109
Age							0.022	0.011	0.038
Agestay	–0.336	0.413	0.415						
media	0.566	0.318	0.075						
only_lake	–1.576	0.423	0.000	–1.147	0.413	0.006			
water_region	–1.237	0.482	0.010						
envi_country							–1.555	0.467	0.001
good_understood				–0.641	0.271	0.018	–0.918	0.286	0.001
agreed_status				0.767	0.344	0.026			
N of observations	220			226			202		

Description of used predictors:
male (dummy)—sex of the respondent (male = 1)
retired (dummy) -retirement status (retired = 1)
agestay (continuos)—years of living close to the lake
media (dummy)—heaving heard about water pollution in media
only_lake (dummy)—the respondent claims to have been thinking only about water improvement in the lake at question while stating WTP
water_region (dummy)—water improvement in the region was considered while stating WTP
envi_country (dummy)—environment improvement in country in general was considered while stating WTP
good_understood (dummy)—good understanding of the product (indicator of scenario comprehensiveness)
agreed_status (dummy)—agreed with a description of current status of quality

Appendix 5: Descriptive statistics—socio-economic and demographic

Variable	Variable Type	Czech sample			Polish sample		
		N	Mean	Std Dev	N	Mean	Std Dev
Male	dummy	226	0.43	0.50	202	0.42	0.49
Age	continuous	226	49.76	16.94	202	48.76	15.31
age 18–40	dummy	228	0.32	0.47	202	0.30	0.46
age 41–60	dummy	228	0.39	0.49	202	0.50	0.50
age 61+	dummy	228	0.29	0.45	202	0.20	0.40
Household members	continuous	227	3.12	1.42	191	3.19	1.44
Number of children	continuous	227	0.58	0.88	202	0.62	0.94
Education, no A-levels	dummy	228	0.52	0.50	202	0.40	0.49
College	dummy	228	0.15	0.36	202	0.19	0.40
Unemployed	dummy	228	0.04	0.20	202	0.08	0.28
Retired	dummy	228	0.36	0.48	202	0.35	0.48
No income from work	dummy	228	0.16	0.37	202	0.20	0.40
Years of living close to the lake	continuous	224	34.10	18.79	202	33.56	17.78
Share of life at the lake	continuous	222	0.70	0.31	202	0.70	0.31
Public sewage system	dummy	228	0.64	0.48	202	0.98	0.16
Personal income	$USD_{PPP/month}$	212	692.26	471.99	191	532.62	430.66
Household income	$USD_{PPP/month}$	188	1567.90	914.13	182	1074.85	605.96
Household income p.c.	$USD_{PPP/month}$	188	424.98	332.99	173	392.83	247.76
Income power (respondent income/household income)	continuous (0,1)	188	0.56	0.40	181	0.53	0.34

* income power is defined as a share of as personal net income on household net income and indicates income power of the respondent within the household he/she lives.

Appendix 6: Descriptive statistics—the site and the scenario

Variable	Variable Type	Czech sample			Polish sample		
		N	Mean	Std Dev	N	Mean	Std Dev
User							
Non-user of the lake	dummy	228	0.23	0.42	202	0.70	0.46
Swimmer	dummy	228	0.26	0.44	202	0.03	0.17
Boating	dummy	228	0.23	0.42	202	0.05	0.22
Fishing	dummy	228	0.02	0.15	202	0.07	0.26
Sporting	dummy	228	0.14	0.35	202	0.05	0.22
Walking	dummy	228	0.67	0.47	202	0.26	0.44
Profit from the lake	dummy	228	0.12	0.33	202	0.01	0.12

Alternative lake							
Alternative lake	dummy	n.a.			202	0.87	0.34
Alternative used	dummy	n.a.			202	0.85	0.36
Goods considered while stating *WTP*							
Only the lake	dummy	228	0.34	0.47	202	0.22	0.42
Water improvement in the region	dummy	228	0.15	0.36	202	0.16	0.37
Water improvement in the country	dummy	228	0.09	0.28	202	0.13	0.34
Environment improvement within the country	dummy	228	0.18	0.38	202	0.26	0.44
Comprehensiveness							
Easy (= 1) to state *WTP* than difficult (= 0)	dummy	228	0.59	0.49	202	0.68	0.47
Good understanding of the product (water improvement)	dummy	228	0.82	0.38	202	0.87	0.34
Agreed with a description of current status of quality	dummy	228	0.75	0.44	202	0.78	0.41
Respondent's awareness							
Heard about water pollution in media	dummy	228	0.74	0.44	202	0.34	0.48
Engagement in environment protection	dummy	228	0.33	0.47	202	0.30	0.46
Member of an ecological organization	dummy	228	0.05	0.21	202	0.02	0.14

Appendix 7: WTP stated by users versous nonusers.

	CZECH									
	WTP for 1 class					WTP for 2 classes				
	N	mean USD_{ppp}	s.e.	Eq. of Var (Pr > F)	T-Test (Pr > |t|)	*N*	mean USD_{ppp}	s.e.	Eq. of Var (Pr > F)	T-Test (Pr > |t|)
user	157	31.7	3.712	<.0001	0.746	157	48.2	5.340	<.0001	0.837
nonuser	45	35.8	12.060			45	51.6	15.573		
	POLISH									
	WTP for 1 class					WTP for 2 classes				
	N	mean USD_{ppp}	s.e.	Eq. of Var (Pr > F)	T-Test (Pr > |t|)	*N*	mean USD_{ppp}	s.e.	Eq. of Var (Pr > F)	T-Test (Pr > |t|)
user	50	22.1	4.657	<.0001	0.061	50	28.4	5.021	0.032	0.053
nonuser	107	12.7	1.589			107	17.2	2.666		

Appendix 8: WTP stated by respondents who considered the product similarly versus the rest of them

	CZECH									
	WTP for 1 class					WTP for 2 classes				
	N	mean USD_{ppp}	s.e.	Eq. of Var (Pr > F)	T-Test (Pr > |t|)	*N*	mean USD_{ppp}	s.e.	Eq. of Var (Pr > F)	T-Test (Pr > |t|)
only_ake	76	36.9	6.718	0.437	0.399	76	58.4	9.1938	0.436	0.177
water_region	34	34.8	9.078	0.677	0.804	34	52.1	14.649	0.290	0.793
water_country	20	21.4	5.208	<.0001	0.072	20	31.7	9.0722	0.001	0.084
envi_country	41	45.1	11.509	0.001	0.202	41	62.4	13.435	0.194	0.209
	POLISH									
	WTP for 1 class					WTP for 2 classes				
	N	mean USD_{ppp}	s.e.	Eq. of Var (Pr > F)	T-Test (Pr > |t|)	*N*	mean USD_{ppp}	s.e.	Eq. of Var (Pr > F)	T-Test (Pr > |t|)
only_lake	45	19.7	5.049	<.0001	0.287	45	24.1	5.3247	0.059	0.396
water_region	32	19.0	3.884	0.651	0.360	32	28.8	7.462	0.000	0.208
water_country	26	13.0	2.991	0.007	0.397	26	17.2	3.7126	0.003	0.366
envi_country	51	12.2	2.071	<.0001	0.119	51	15.9	2.8692	<.0001	0.100

Appendix 9: WTP stated by those who valued firstly 1-class improvement versus 2-class.

	CZECH									
	WTP1					WTP2				
	N	mean	s.e.	Eq. of Var (Pr > F)	T-Test (Pr > |t|)	*N*	mean	s.e.	Eq. of Var (Pr > F)	T-Test (Pr > |t|)
WTP1 first	105	31.7	5.005	0.097	0.806	105	43.9	6.0893	0.000	0.340
WTP2 first	97	33.6	6.151			97	54.4	9.0842		
	POLISH									
	WTP1					WTP2				
	N	mean	s.e.	Eq. of Var (Pr > F)	T-Test (Pr > |t|)	*N*	mean	s.e.	Eq. of Var (Pr > F)	T-Test (Pr > |t|)
WTP1 first	87	14.9	1.760	<.0001	0.678	87	19.5	2.3486	<.0001	0.585
WTP2 first	70	16.6	3.568			70	22.4	4.664		

Appendix 10: Estimation of WTP model following original Norwegian study

	WTP for 1-level improvement						WTP for 2-level improvement					
	pooled		Czech		Polish		pooled		Czech		Polish	
	Coeff	p-value	Coeff	p-value	Coeff	p-value	Coeff	p-value	Coeff	p-value	Coeff	p-value
Intercept	15.770	0.015	48.932	0.000	6.957	0.035	16.884	0.058	65.892	0.000	6.141	0.164
age > 50	–5.612	0.246	–15.097	0.083	–3.575	0.144	–4.599	0.487	–16.573	0.165	–4.940	0.132
hincome	0.009	0.005	0.004	0.383	0.007	0.001	0.017	<.0001	0.010	0.115	0.011	<.0001
user	4.495	0.360	–15.272	0.125	4.411	0.087	7.906	0.239	–21.551	0.114	7.414	0.032
primary education	–10.512	0.173	–20.347	0.107	–7.066	0.107	–12.380	0.241	–26.076	0.131	–8.790	0.133
college	–0.769	0.903	11.510	0.331	–2.340	0.443	0.668	0.938	20.991	0.195	–2.945	0.471
WTP1 first	–1.254	0.792	–0.872	0.917	0.476	0.843	–6.763	0.299	–9.385	0.410	0.070	0.983
Scale	41.626		53.449		14.042		56.932		73.082		18.777	
LogLikelihood	–1166.9		–652.3		–406.7		–1209.7		–674.7		–421.8	
N	309		167		142		309		167		142	
mean WTP (std)			35.01 (13.13)		13.42 (5.95)				52.79 (20.87)		17.37 (9.26)	

Appendix 11: Estimation of WTP model for benefit transfer

	WTP for 1-level improvement						WTP for 2-level improvement					
	pooled		Czech		Polish		pooled		Czech		Polish	
	Coeff	p-value	Coeff	p-value	Coeff	p-value	Coeff	p-value	Coeff	p-value	Coeff	p-value
Intercept	25.888	0.005	36.915	0.021	21.757	0.000	31.391	0.008	41.213	0.037	29.726	<.0001
Personal income	0.016	0.004	0.015	0.103	0.010	0.004	0.034	<.0001	0.041	0.000	0.013	0.005
Age	–0.563	0.000	–0.884	0.001	–0.362	0.000	–0.727	0.000	–1.067	0.001	–0.476	0.000
WTP easy	14.373	0.006	21.734	0.019	6.948	0.034	18.904	0.005	29.623	0.009	8.473	0.046
envi_country	5.912	0.296	24.384	0.026	–5.013	0.122	4.081	0.573	26.243	0.051	–7.458	0.075
Scale	44.862		59.212		18.029		57.928		74.005		23.397	
LogLikelihood	–1 126.8		–604.3		–436.8		–1 218.1		–672.0		–456.7	
Observations used	338		189		149		338		189		149	
Missings	21		13		8		21		13		8	
Mean WTP (std.)	19.20 (13.50)		23.16 (18.81)		13.31 (7.86)		30.49 (21.93)		40.14 (30.99)		17.66 (10.24)	

Appendix 12: Estimation of WTP model for benefit transfer

	WTP for 1-level improvement						WTP for 2-level improvement					
	pooled		Czech		Polish		pooled		Czech		Polish	
	Coeff	p-value	Coeff	p-value	Coeff	p-value	Coeff	p-value	Coeff	p-value	Coeff	p-value
Intercept	27.231	0.008	52.986	0.006	10.775	0.038	30.404	0.023	64.843	0.008	11.390	0.098
Household income	0.010	0.003	0.006	0.318	0.008	0.000	0.019	<.0001	0.014	0.047	0.013	<.0001
AGE	–0.391	0.022	–0.706	0.021	–0.137	0.116	–0.458	0.039	–0.815	0.037	–0.172	0.134
Scale	45.456		62.039		14.942		59.981		80.169		19.753	
LogLikelihood	–1 055.9		–559.4		–392.8		–1 139.4		–617.2		–414.8	
Observations used	309		167		142		309		167		142	
Missings	50		35		15		50		35		15	
Mean WTP	18.67 (12.59)		22.91 (16.28)		11.79 (6.42)		29.24 (20.56)		39.40 (26.01)		15.45 (9.42)	

Appendix 13: Comparison of different units of transfer 1

WTP best estimates (in USD 2005)			
		WTP1	WTP2
NO	Lagenvassdraget	96.39	
	Ånøya and Gaustadvatnet	72.77	
	Vansjo-Hobol	286.64	276.95
	Orre	380.66	401.20
GER	Guestrower-Seen	71.06	79.49
	Ville-Seen	99.96	124.05
PL	Łęgowskie	13.33	17.53
CZ	Mácha	31.20	45.67

WTP/surface			
		WTP1	WTP2
NO	Lagenvassdraget	66.02	
	Ånøya and Gaustadvatnet	6.19	
	Vansjo-Hobol	7.87	7.61
	Orre	46.99	49.53
GER	Guestrower-Seen	16.22	18.15
	Ville-Seen		
PL	Łęgowskie	19.49	25.63
CZ	Mácha	11.14	16.31

WTP ratios (PL = 100%)			
		WTP1	WTP2
NO	Lagenvassdraget	723%	
	Ånøya and Gaustadvatnet	546%	
	Vansjo-Hobol	2150%	1580%
	Orre	2855%	2288%
GER	Guestrower-Seen	533%	453%
	Ville-Seen	750%	707%
PL	Łęgowskie	100%	100%
CZ	Mácha	234%	260%

WTP ratios (PL = 100%)			
		WTP1	WTP2
NO	Lagenvassdraget	339%	
	Ånøya and Gaustadvatnet	32%	
	Vansjo-Hobol	40%	30%
	Orre	241%	193%
GER	Guestrower-Seen	83%	71%
	Ville-Seen		
PL	Łęgowskie	100%	100%
CZ	Mácha	57%	64%

Appendix 14: Comparison of different units of transfer 2

WTP/GDP per capita * 1000000			
		WTP1	WTP2
NO	Lagenvassdraget	2591.04	
	Ånøya and Gaustadvatnet	1956.17	
	Vansjo-Hobol	8708.03	8413.50
	Orre	11564.20	12188.14
GER	Guestrower-Seen	2409.96	2695.89
	Ville-Seen	3390.29	4207.23
PL	Łęgowskie	992.16	1304.61
CZ	Mácha	1600.76	2343.54

WTP/GDP per capita/surface * 1000000			
		WTP1	WTP2
NO	Ski	1774.68	
	Ånøya and Gaustadvatnet	166.48	
	Vansjo-Hobol	741.11	716.04
	Orre	984.19	1037.29
GER	Guestrower-Seen	550.22	615.50
	Ville-Seen		
PL	Łęgowskie	1450.52	1907.32
CZ	Mácha	571.70	836.98

WTP ratios (PL = 100%)			
		WTP1	WTP2
NO	Lagenvassdraget	261%	
	Ånøya and Gaustadvatnet	197%	
	Vansjo-Hobol	878%	645%
	Orre	1166%	934%
GER	Guestrower-Seen	243%	207%
	Ville-Seen	342%	322%
PL	Łęgowskie	100%	100%
CZ	Mácha	161%	180%

WTP ratios (PL = 100%)			
		WTP1	WTP2
NO	Ski	122%	
	Ånøya and Gaustadvatnet	11%	
	Vansjo-Hobol	51%	38%
	Orre	68%	54%
GER	Guestrower-Seen	38%	32%
	Ville-Seen		
PL	Łęgowskie	100%	100%
CZ	Mácha	39%	44%

Appendix 15: Comparisn of different units of transfer 3

WTP/pincome * 1000000			
		WTP1	WTP2
NO	Lagenvassdraget	43854.55	
	Ånøya and Gaustadvatnet	50937.06	
	Vansjo-Hobol	217596.62	210236.87
	Orre	266911.08	281312.12
GER	Guestrower-Seen		
	Ville-Seen		
PL	Łęgowskie	25035.57	32919.75
CZ	Mácha	45063.94	65974.62

WTP/pincome * 1000000			
		WTP1	WTP2
NO	Lagenvassdraget	30037.36	
	Ånøya and Gaustadvatnet	4335.07	
	Vansjo-Hobol	5977.93	5775.74
	Orre	32951.99	34729.89
GER	Guestrower-Seen		
	Ville-Seen		
PL	Łęgowskie	36601.70	48128.28
CZ	Mácha	16094.26	23562.36

WTP ratios (PL = 100%)			
		WTP1	WTP2
NO	Lagenvassdraget	175%	
	Ånøya and Gaustadvatnet	203%	
	Vansjo-Hobol	869%	639%
	Orre	1066%	855%
GER	Guestrower-Seen		
	Ville-Seen		
PL	Łęgowskie	100%	100%
CZ	Mácha	180%	200%

WTP ratios (PL = 100%)			
		WTP1	WTP2
NO	Lagenvassdraget	82%	
	Ånøya and Gaustadvatnet	12%	
	Vansjo-Hobol	16%	12%
	Orre	90%	72%
GER	Guestrower-Seen		
	Ville-Seen		
PL	Łęgowskie	100%	100%
CZ	Mácha	44%	49%

WTP/mean sewage charge * 100			
		WTP1	WTP2
NO	Lagenvassdraget	6.88	
	Ånøya and Gaustadvatnet	4.98	
	Vansjo-Hobol	8.34	8.06
	Orre	11.08	11.68
GER	Guestrower-Seen		
	Ville-Seen		
PL	Łęgowskie	20.18	26.53
CZ	Mácha	66.86	97.88

WTP ratios (PL = 100%)			
		WTP2	WTP2
NO	Lagenvassdraget	34%	
	Ånøya and Gaustadvatnet	25%	
	Vansjo-Hobol	41%	30%
	Orre	55%	44%
GER	Guestrower-Seen		
	Ville-Seen		
PL	Łęgowskie	100%	100%
CZ	Mácha	331%	369%

Abstract

Lake Water Quality Valuation—Benefit Transfer Approach vs. Empirical Evidence

The paper reports research in benefit transfer validity between Norway and two New Member States of EU-Poland and the Czech Republic. Based on the original eutrophication contingent valuation study conducted in Norway in 1994, repeated later in Norway (1997) and Germany (2000), two studies were conducted in Poland and the Czech Republic in 2005 in which we ask residents for willingness-to-pay for a hypothetical improvement of water quality in a lake which is strongly euthrophicated and therefore not usable for all recreational activities. The studies were designed in a way that would match the Norwegian original as closely as possible, with regard to site selection, scenario, payment vehicle and even the questionnaire design. The experience gained and the data collected serves to test for possibilities for future BT from Western European countries to new EU Member States as well as between two new member countries. Naive single benefit transfer yields the largest error rates. Transfers adjusted by purchasing power decrease these errors, however, they still remain very large. The error rates are more reduced by transfer benefit function and particularly after adjustments by income elasticities. Following our best transfer, the lowest error remains as high as 30%. Error rates for transferring benefits from Norwegian 1997-study which is just comparable with the Czech and Polish one from even after purchasing power adjustments remain. The paper summarizes the process of collecting data and results, analyzes main differences between the original and two latter studies as well as between the new studies. Finally, value transfer and function transfer are conducted and followed by validity tests.