Transfer of values for the developing world: the case of air pollution

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Transfer of values for the developing world: The case of air pollution

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Abstract

Developing countries still lack valuation studies for several environmental goods. In this paper we present the results of an international benefit transfer exercise applied to air quality in Latin America. Our aim is to show whether it is relevant to employ transferred values in cost-benefit analysis for the particular case of air pollution in developing countries. Following the recommendations found in the literature, a protocol was created for the value transfer process. Results show a high discrepancy between actual and transferred values, which placed several doubts on the use of the benefit transfer technique for this kind of countries.

Keywords: international benefit transfer, meta-analysis, air quality, environmental valuation, database, online

JEL: H41, H43, Q51

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1. Introduction

Benefit transfer (BT) has been widely used in the benefit-cost analysis of public projects where the values of environmental assets are unavailable. Such a methodology is often seen as a cost-effective way of including the values of non-marketable goods in the analysis, provided that, with its application, the allocation of financial and human resources is avoided, or at least reduced, by substituting the process of eliciting those values with direct or indirect valuation methodologies. However, its inexpensive nature could be lessened in the context of developing countries for which very few primary studies exist, or in which access to important databases is constrained.

Generally speaking, BT infers the economic value of environmental goods and services in one place and time (a policy site) by using economic information obtained in another place and time (the study site). Three main issues have been discussed in the literature about the applicability of BT (Spash and Vatn, 2006; Bergstrom and Taylor, 2006): availability of information (studies) not only in terms of amount, but also of the quality of this information, provided that it is the main input in the transfer process; categories of the transfer: unit, function transfer, or meta-analysis; and the validity of the transfer between two sites.

Even though there is a certain consensus on using the function or meta-analysis approach in order to obtain more accurate and valid results (i.e., that transferred monetary values almost match that of the policy site if the later is estimated with primary information; Rosenberger and Phipps, 2007), the same is not true about what kind of data and variables we should handle when transfer values are estimated (Spash and Vatn, 2006).

Rosenberger and Johnston (2009) pointed out the potential biases related to the choices of the studies incorporated in the metadata set, biases that obviously affect the estimates coming out of meta-regression models. Besides addressing issues related to the resources and policy contexts, the meta-analyst must consider the possible biases derived from the selection of studies. Therefore, if sample selection bias is going to be avoided, different sources must be considered for the studies.

However, in spite of the dramatic increase in the number of primary valuation studies, many of which have been gathered in international (McComb et al., 2006) and specialized academic databases, we cannot say that access to them is easy. For instance, access to perhaps the most recognized international database, EVRI (Environmental Valuation Reference Inventory), is restricted to be used only by residents of "Australia, Canada, France, New Zealand, the United Kingdom or the United States."[2] Moreover, the European Union's Review of Externality Data was off-line at the time of writing this paper. Otherwise, if one wants to include studies published in scholarly journals, access to them is restricted to institutions with subscriptions either to particular journals or to recognized databases like JSTOR® or Science Direct®. If none of these are available, all that would remain for the meta-analyst would be gray literature which can be found either on the internet or in libraries within a reasonable distance.

In this paper, we aim to implement and test the BT technique to value air quality improvements in metropolitan areas of South America. With it, we want to show both the pros and the cons of undertaking the methodology in developing countries, taking into account the most relevant aspects of the experience and recommendations found in recent literature (Wilson and Hoehn, 2006; Navrud and Ready, 2007). The next part (section 2)

[2] For instance, after our request of access to EVRI's infobase, the response was that it would be possible only if either the Colombian government participated through a "contribution agreement" to EVRI, or if we provided 10 recent studies relevant to EVRI, not already available in their database (personal communication with V. Sanderson, Environmental Policy Analysis and Valuation Division Environment, Canada, 2009).

highlights the main issues of BT. In section three we present the case under investigation with the results, and the conclusions are presented in section four.

2. Methods

Roughly, BT has been defined as the transposition of monetary environmental values estimated at one site (the study site) through market-based or non-market-based economic valuation techniques and to a policy site (Brouwer, 2000). Such an extrapolation of values has been made possible by employing several techniques such as:

i) Adjusted unit value transfer (Navrud, 2004). Provided that income is assumed to be one of the most relevant factors to explain the willingness to pay (WTP), the unit value estimated in site *i* (study site) is adjusted for site *j* (policy site) using per capita income levels:

$$\mathrm{WTP_j = WTP_i\ (Y_j/Y_i)^e} \qquad [1]$$

where Y is the per capita income level and e is the income elasticity of the WTP for the environmental good. A critical assumption is needed for the latter, being the most common to assume the unity, although it has been pointed out (Navrud, 2004) that this assumption may understate the WTP for developing countries.

ii) Benefit function transfer (Loomis, 1992; Labandeira et al., 2007, pp. 200-212). The transfer of the value function from site *i* to site *j*. Thus, if the value function in site *i* is:

$$WTP_i=\alpha_i+\beta_i A_i+\delta_i B_i+\lambda_i C_i+\gamma_i Y_i+\varepsilon_i \qquad [2]$$

then the value function in site *j* would be:

$$WTP_j=\alpha_i+\beta_i A_j+\delta_i B_j+\lambda_i C_j+\gamma_i Y_j+\varepsilon_i+\varepsilon^i_j \qquad [3]$$

That is, the WTP in the policy site is assumed to depend upon the same variables than those in the study site, and to the same degree. However, a correction with the mean value for each variable is done in order to account for specific factors not included in the function, such as geography or idiosyncrasies. Additionally, this new function depends on the stochastic term of the original function (ε_i) plus the error incurred by the value transfer from site *i* to *j* (ε_j^i).

iii) Meta-analysis (Brouwer, 2000; Bergstrom and Taylor, 2006; Labandeira et al., 2007). This is a statistical procedure that summarizes the results from different primary studies with the aim of integrating them into a unique function, and evaluating the effect of changes in the underlying environmental attribute on the economic value (Woodward and Wui, 2001). Perhaps the simplest way to make the meta-analysis is to assume fixed-effect parameters. In doing so, one estimates:

$$DAP_i = \alpha_i + \beta_i x_i + \varepsilon_i \quad [4]$$

by using information gathered from primary studies. Besides including explanatory variables which should be common to all studies, dummy variables that account for factors like the valuation method or the payment vehicle could also be added in to [4].

iv) Preference calibration approach (structural benefit transfer) proposed by Smith et al. (2002, 2006). This methodology requires the selection and calibration of a preference function. This function is supposed to underlie the utility derived from the resource that has been valued.

Related to the terms ε_j^i of [3] and ε_i of [4], there are errors which should be managed so that the accuracy of the value transfer is maximized. Rosenberger and Stanley (2006) point out the following:

a) Generalization error. This occurs in the adaptation of the estimated value in a study site to the policy site. Hence, the more similar the study and policy sites are, the lower this error will be.

b) Measurement error. This entails random errors and research judgments that can affect the results of the primary studies. Decisions in regard to the valuation method, the survey design, or relevant data can affect the estimation of the welfare measure of any primary study. This error can also emerge when the meta-analyst is limited in his access to databases; or when access is available, but insufficient information from original studies makes the comparison of results across different studies more difficult.

c) Publication selection bias. In most cases, published studies are those that meet some standards such as statistical significance, certain theoretical expectations, or methodological innovation. However, this bias does not come from the meta-analyst himself, but from the features that characterize the editing process of journals. To moderate this bias, it is recommend not only to search in peer-reviewed journals, but also to attempt to include gray literature and working-paper series published on web pages.

In general, we could say that there are ways in which the analyst can manage to overcome all the obstacles placed in the transfer process. Notwithstanding avoiding these errors seems to be an art, the meticulous application of the recommendations made in the

BT literature is a key skill for an analyst if he is to succeed in the validity if this technique. In order to assess the feasibility of BT in the context of a developing country, we compare the values obtained through two different approaches (adjusted unit value and meta-analysis) to one particular environmental good: air quality. Benefit function transfer is not included in this example because normally researchers adopt closed-ended formats in their valuation studies.

2.1 Motivation to Undertake this Study

Air pollution is a critical environmental problem in several Latin American cities. For instance, in the Colombian Aburrá Valley, persistently high levels of pollutants are found in the air, in some parts of the region exceeding the legal maximum levels of emissions, with a consequently high impact on human well-being (Bedoya et al. 2004, 2005a, 2005b; AMVA, 2006). It is estimated that around 65% of the total of these emitted pollutants are from mobile sources, and that 66% of total emitted pollutants came from vehicles, and also that 70% of these are CO emissions (AMVA, 2006). In response to this, several policies have been proposed to deal with the problem. Some of the proposals include: using natural gas in vehicles, enforcing partial driving bans, and establishing emission trading schemes.

As part of the cost-benefit analysis, the estimation of the benefits due to welfare gains generated by any policy aiming to improve air quality is required by any environmental agency. Nevertheless, so far not much estimation of these benefits is made available to these agencies. Seeking to analyze the feasibility of applying international BT in a developing country context, we are carrying out this analysis for a specific policy: improvements in air quality. In addition, we are not aware of any other recent meta-analysis of air pollution economic valuation studies similar to the one we are undertaking in the present study.

Perhaps the main input to be found in economic values transfer is the information contained in primary studies. Several international databases available on the Internet contain many of the studies carried out in the last 3 decades. Some of these databases were summarized by McComb et al. (2006), who offers a description of the most popular databases such as EVRI, Envalue, the Ecosystem Services Database (ESD), and the Review of Externality Database (RED). In their review, McComb et al. highlight the point that in spite of the inclusion of fundamental information for basic BT, these databases have deficiencies in that there is still information required on more robust value transfer.

As mentioned above, access to EVRI is allowed only through servers located in certain countries. After a first exploration of other databases like RED and Envalue, we found that many of the studies included in them were dated. Additionally, searches in databases like JSTOR®, Science-Direct®, and American Economic Association's EconLit® were also carried out. We point out the fact that our access to these databases was eased thanks to the institutional subscription of the university we work for. However, such an access is not allowed to the public at large, and therefore the transfer process could have suffered a serious bias due to the lack of accessibility to either peer-reviewed journals or these databases. Also, our search through Internet search engines was done using two languages: Spanish and English. After using several keywords,[3] very few additional studies were found using these engines; some of them not accessible at all due to payment requirements.

2.2 Protocol

[3] Some of these keywords are: air pollution, air quality, value, valuation, benefits, and costs.

After searching in the databases described above, around 60 studies were found, of which 34 were selected.[4] In this data-set there is a trade -off between the number of estimates for WTP and the studies reporting covariates to explain these estimates. Contrary to what has been recommended (Navrud and Ready, 2007), only a few studies report socioeconomic information such as income level, education, and so on. Therefore, in order to have a representative sample, these kinds of variables do not constitute a part of the meta-analysis benefit transfer (MA-BT) function estimated below.

The criteria considered for study selection are as follows:

(i) Papers published in journals which are accessible through academic databases like JSTOR, Econlit, or Science-Direct. Each selected study had to contain an explicit welfare measure (mean/median of WTP).

(ii) Working papers found through Internet search engines.

(iii) The valued environmental good in each study was referred to as “air quality/pollution.”

(iv) Either stated or revealed preferences methods were employed to estimate the WTP.

In regards to criterion *ii*, despite the fact that some BT literature recommends looking only for studies regarding an environmental good alone, which in our case would correspond to the decline in an air pollutant, our database is more comprehensive in the sense that we included not just one particular pollutant, but all those available in the studies, which included: CO, NO_2, PM_{10}, SO_2, CH_4 and/or O_3. Including estimates for just one pollutant would make the sample very small. On the other hand, in order to work with conservative values, among revealed and stated preference methods, we excluded the dose-

[4] The data-set is available upon request through the authors.

response approach and the contingent valuation of a statistical life. From the literature it is clear that when people are asked about WTP for reducing the risk of dying, their answers tend to go up compared to measures for air-quality improvements alone, and/or when it is related to better visibility or reduction in respiratory disease symptoms.

As Woodward and Wui (2001) pointed out, there are diverse styles which can be used to present the characteristics of the good being valued. In some cases, we have found that a precise change in the amount of air pollutants is described, whereas in other ones an overall change is presented. For instance, a reduction in particulate matter from $366\mu g/m^3$ to $200\mu g/m^3$ (Murty et al., 2003) versus a reduction in the number of preventive alarms every time the amount of a given pollutant exceeds a standard (Yoo and Chae, 2001). In addition, contrary to what theory establishes (Freeman III, 2003, p. 33), we found several studies that did not value the change in human welfare derived from the change air quality, but which rather valued the environmental change *per se.*

Considering this, commodity consistency (Bergstrom and Taylor, 2006) was accounted for by considering only those studies which referred to valuation of improvements in air quality in big cities around the world, either through reductions in the concentration of pollutants in the atmosphere, or simply by reductions in the periods of illness caused by bad air quality conditions (two dummy variables are included to account for the possible effect of this different type of good). However, the aggregation of commodities' spatial and temporal scale is hard to consider because neither the geographical extent nor the time frame of the change is usually reported, at least in what concerns air quality economic valuation studies.

An uncommon practice in other meta-analyses, or at least not reported in their protocols, has been to make purchasing power parity (PPP) correction of monetary values, so as to convert measures of different countries into a common denominator. In our data-set, value estimates and income levels were adjusted for inflation to the 2005 local currency, and then converted to dollars using PPP.[5]

In that which concerns income level, several of the studies employed in the meta-analysis database did not report the mean income level, so we decided to construct a variable which shows the per capita income level of the country where the study was undertaken, using the International Monetary Fund (IMF) database. Provided that there are some WTP estimates constructed from scenarios in which periodical payments are proposed (e.g., monthly or annual payments), their adjustment was made by firstly computing the present value and taking the country's simple average interest rate for the 2001-2006 period[6] as the discount rate.

On the other hand, as suggested by Brouwer (2000), external validity is included in our dataset via response rates. It was not possible to test internal validity because studies hardly ever report information concerning statistical techniques used, manipulation of data, or variables of the WTP function either. For instance, in our dataset around 10 out the 34 studies reported the sampling process adopted in their surveys.

3. Results

There is not a specific theory to carry out BT. Instead, what it is found in the literature is a sort of "data mining" process in which several variables are run in a meta-regression with the WTP as a dependent variable. Table 1 describes the variables included in our analysis. Besides the per capita income level and the response rate, we generated

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[5] These values were adjusted using inflation rates from International Monetary Fund database (http://www.imf.org/external/data.htm), and PPP values from Penn World Table (http://pwt.econ.upenn.edu/php_site/pwt_index.php).
[6] Interest rates were taken from the United Nations Statistics Division (http://data.un.org/).

dummies for the type of pollutant offered in the scenario, the valuation method, and whether a particular improvement in health conditions is possible.

Table 1.

In order to try to explain as best as possible the variability of the WTP across sites, we ran several meta-regressions. After running them, the null hypothesis of homoscedasticity was rejected. The assumption of equal variance in the error term could have be violated due to differences in the relative precision of the estimation of the air pollution variable, the specification of the model used to estimate the WTP (Smith and Huang, 1995), difference in sample errors, the precision levels of the coefficients the WTP is estimated with, or also due to the error that underlies the estimation of the WTP through any of the valuation methods. Heteroscedasticity is corrected by estimating coefficients with the procedure suggested by Davidson and MacKinnon for small samples (Greene, 2000) using STATA (StataCorp, 2006). Considering the distribution of WTP (see Figure 1), its log was used in the estimated models (named *lnWTP*).

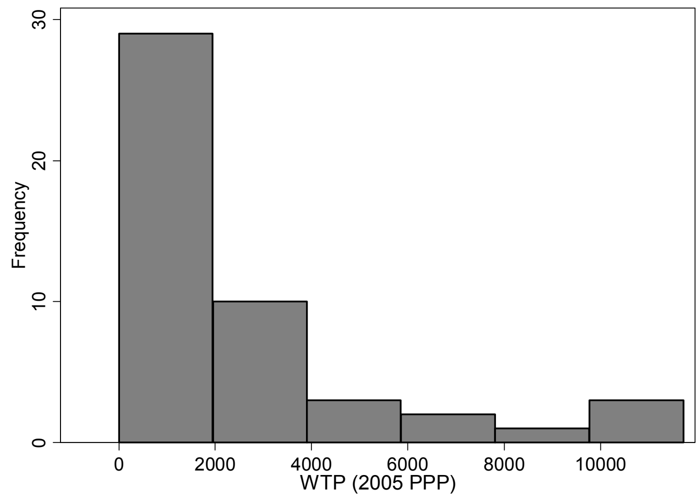

Figure 1. Distribution of WTP estimates for air pollution included in the meta-analysis

In a first regression (Model 1), with the log of WTP as a dependent variable, no covariate is significant at all, with just a slight significance in income; and the hypothesis that all the slopes are zero is not rejected (see the *F* statistic in Table 2). However, after a backward elimination procedure, besides the income level, variables regarding the method are significant. Thus, the contingent valuation method with iterative bidding design seems to have some influence on the mean WTP (Model 2).

This first set of regressions does not include the percentage change in the environmental good as a predictor due to the many values that were missing. In order to test the hypothesis of the impact of this variable on the mean WTP, we estimated another regression. With fewer observations, there is a lack of degrees of freedom, so the same set of regressors as we have in Model 1 cannot be considered. Therefore, in Model 3 only those variables for which both there is some level of significance and the regression is significant, are shown. Despite the apparent goodness-of-fit of this model, we find an unexpected and counterintuitive sign in the income coefficient, and a clear effect of the valuation method employed on the mean WTP. On the other hand, the change in the environmental good does not seems to affect the WTP, which could be an indication of an embedding effect in this set of studies.

Lastly, as expected for the contingent valuation method, the survey design matters for the determination of the WTP, although the response rate does not (see Model 4 in Table 2).

Table 2.

Provided we found studies with more than one estimate, and some authors with more than one air pollution study, we tested for a lead-author effect in order to see whether a researcher may have influenced the estimates (Rosenberger and Loomis, 2000); in other words, we tested for within-group correlation. This was done by running a fixed-effects panel data model, in which we wanted to test the null hypothesis that all unobserved heterogeneity (u_i) are equal to zero. With the lnWTP as the dependent variable, and for WTP as well, the F test[7] allowed rejecting this null hypothesis and concluding that there is a sort of researcher's influence on the estimate.[8] This effect can be clearly seen by comparing the model estimated with the complete set of observations, and a model in which we only code a single estimate per researcher in the data set (see Tables 2 and 3).

We found many studies providing only one observation. Therefore, panel data estimation is not a very convenient procedure. Instead, we coded a single observation per

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[7] This Chow test is computed by using the sum of squared residuals (SSR) of both the unrestricted model (least squares dummy variables regression) and a pooled least square regression assuming non "estimate-invariant" heterogeneity (restricted model; Wooldridge, 2002; Baltagi, 2005). The computed test was F(33, 10) = 21.86.

[8] In addition, following the approach of Bateman and Jones (2007), we tried to apply multilevel modeling so as to analyze this effect. However, the software available for this did not converge upon running a model with author as the second level, and the number of value estimates in the level 1.

study based on the average of the study's estimate when all the estimates are referring to the same good, or an estimate chosen randomly when different goods are valued (Model 5); and a conservative (minimum) study's estimate (Model 6; Rosenberger and Loomis, 2000). Both conventions produce similar results in terms of parameter estimates and goodness-of-fit (see Table 3). Model 5 is preferred over Model 6 as the BT function due to its relatively better goodness-of-fit.

Table 3.

We make a simple validity test of this function by comparing the WTP obtained by Cerda, et al. (2005) and the one obtained using the meta-regression function of Model 5. After putting measures of income and WTP in PPP terms, the mean WTP for an improvement in air quality for Santiago (Chile) is, according to Cerda et al. (2005), US$122. Meanwhile, using the estimated meta-regression function in Model 5, the WTP would be US$83, implying a transfer error of approximately 32%, which must be seen cautiously, although it could be acceptable for a cost-benefit analysis (Rozan, 2004; Kristofersson and Navrud, 2007).

On the other hand, we proceed to compare the results of two different value transfer approaches: the unit value transfer and the meta-analysis value transfer. On one hand, the estimation of the benefits of air quality improvements in Colombia might be carried out using the geographically closest site with an estimate like this. Thus, assuming the unity for the income elasticity of WTP (see equation [1])[9], and taking Cerda et al.'s paper as the reference study, the benefit (mean) of a better air quality in Colombia would approximately

[9] Although this assumption is not far from reality. For instance, in a contingent valuation study for Poland, Parry and Mendelsohn (2005) estimated an income elasticity of WTP close to the unity.

be US$67 (PPP terms). Nevertheless, if we considered the MA-BT function, this benefit decreases to US$45[10]. Therefore, if we are going to favor conservative values, estimates derived from the MA-BT function should be employed in the cost-benefit analysis (Lindhjem and Navrud, 2008).

Lastly, following Lindhjem and Navrud (2008), Figure 2 shows the plot of log of WTP and its predicted value according to Model 5, with WTP estimates assorted in ascending order. Similar to Brander et al. (2006) and Lindhjem and Navrud (2008), our estimation results in lower transfer errors for higher values of WTP. In addition, when we estimate a restricted Model 5, where the observation with the highest transfer error is left out, the same pattern is shown (see Figure 3). In the last case, the mean transfer error is 31%, ranging from 11 to 360%.

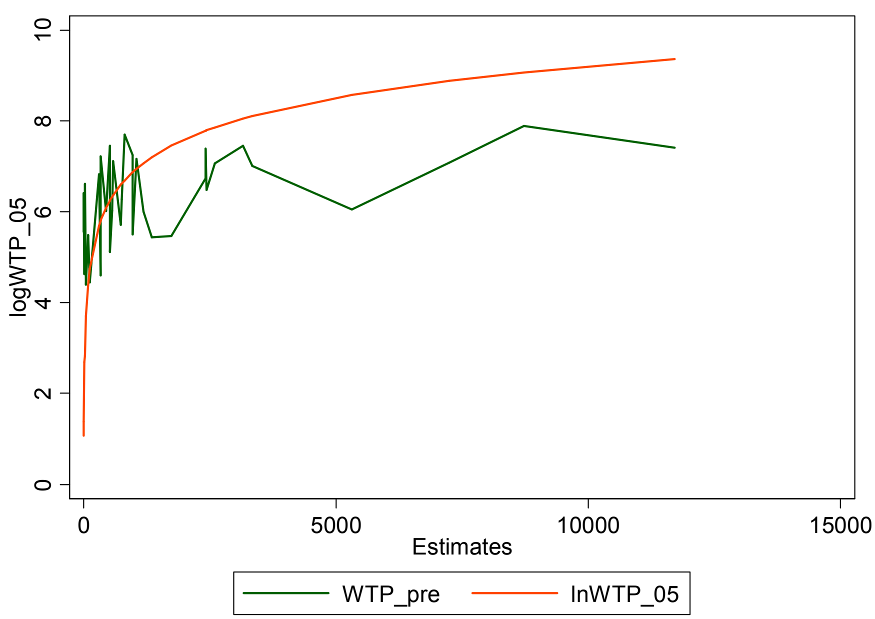

Figure 2. Plot of log WTP (lnWTP_05) estimates and predicted values (WTP_pre) for model 5 (within sample), sorted in ascending order.

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[10] For similar results see for example Lindhjem and Navrud (2008).

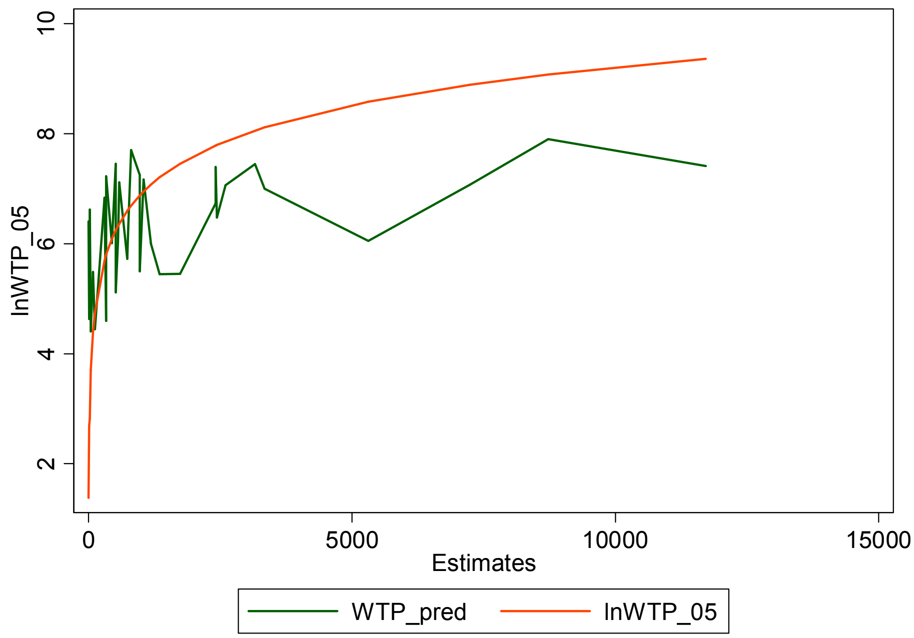

Figure 3. Plot of log WTP (lnWTP_05) estimates and predicted values (WTP_pred) for Model 5 restricted in the observation with the highest transfer error, sorted in ascending order.

4. **Conclusions**

Benefit transfer seems to be a cost-effective methodology to value non-marketable goods. However, this apparent advantage could be undermined if access to primary valuation studies is not good enough. We have experienced that access to an important dataset like EVRI is very restricted, and other datasets with open access such as RED (Review of Externality Database) have lacked important information like the income of the surveyed population; even more importantly, it has been unavailable on the internet (it was offline when consulted in April, 2010). Besides this, other difficulties are present, like those noted in Rosenberger and Loomis (2000): studies hardly ever report characteristics of their study site; characteristics which may make the benefit transfer process more robust than it really is.

The lack of socioeconomic and geographic data is a common feature in almost all the studies found in different sources. In fact, a key variable (such as income) is not available in many of them. Or, another key component of the hypothetical market created for the valuation study, the payment vehicle, is not reported either. Therefore, in spite of the common recommendation of using a meta-valuation function to transfer values, this is quite difficult to follow and therefore, biased values are expected to be received if the appropriate information is not included in the estimation process. That is, the measurement error (Rosenberger and Stanley, 2006) is latent in the benefit transfer process due to this lack of information that would otherwise enable researchers to compare studies.

For our particular case study, we found some ambiguity in the definition of the environmental good concerning air quality. In several studies there is no precise definition of the change in air pollution. However, the outcome of a model estimated using this variable allows us to conclude that there is sort of embedding effect. In consequence, future studies should be more careful in scenario construction and in the quantification of environmental change, not just putting it in general terms. But even more important is the fact that they ought to bear in mind the need to value not the environmental change *per se*, but to estimate the value of human welfare change due to the environmental change.

As previous studies undertaken in developed countries suggest (Brouwer and Spaninks, 1999; Muthke and Holl-Muller, 2004; Lindhjem and Navrud, 2008) but contrary to other literature (Vassanadumrongdee et al., 2004), we are implying in our paper that meta-analyses of valuation studies across countries do not seem to be a good option for benefit-cost analysis, or, at least such a meta-analysis must be viewed cautiously. Furthermore, we assert that its reliability and practicality over other simpler approaches (such as unit value transfer) is doubtful. However, the unavailability of national studies for many developing countries can make meta-analysis benefit transfer which uses international studies, a quasi cost-effective option to carry out CBA. For the environmental good we have analyzed, MA-BT produces a more conservative estimate than unit value transfer, but provided that *income* is the main covariate in both the MA-BT function and unit value transfer, the robustness of the MA-BT function and therefore its practicality over unit value transfer is weak, and the later might be used instead.

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Table 1. Description of variables

Description	Variable	Mean	Standard deviation	Min.	Max.
Mean WTP reported in the study (2005 US$)	*WTP*	2277.61	2984.4	2.9	11721.2
Dummy (= 1) when the good is explained with reference to pollution from fossil fuels	*Dufuel*	0.375	0.489	0	1
Dummy (= 1) when the good is explained with reference to overall greenhouse gases	*Dugei*	0.125	0.334	0	1
Response rate	*Resp_rate*	0.66	0.25	0.1	0.97
Per capita income of the country where the study was done	*Income*	22828.1	11408.6	2473.9	43959.8
Per capita income reported in the study	*Income_est*	28847.5	21308.7	1516.9	62681.9
Year in which the study was undertaken	*Year*	1994.6	8.87	1977	2007
Percent change in the environmental good	*Duchange*	0.69	0.47	0	1
Dummy (= 1) when a specific change in air pollution is proposed	*Duquant*	0.29	0.17	0.004	0.5
Dummy (= 1) when a health improvement due to air pollution decrease is proposed	*Duhealth*	0.21	0.41	0	1
Dummy (= 1) if study employed the hedonic prices method	*Duhedo*	0.33	0.48	0	1
Dummy (= 1) if study	*Duce*	0.1	0.31	0	1

Table 1. **Description of variables**

Description	**Variable**	**Mean**	**Standard deviation**	**Min.**	**Max.**
employed the choice experiment method					
Dummy (= 1) if study employed the contingent valuation method	*Duvc*	0.54	0.5	0	1
Dummy (= 1) if study employed the contingent valuation method, with open ended question	*Duvco*	0.25	0.44	0	1
Dummy (= 1) if study employed the contingent valuation method, with closed ended question	*Duvcd*	0.19	0.39	0	1
Dummy (= 1) if study employed the contingent valuation method, with iterative bidding	*Ducvi*	0.15	0.36	0	1

Table 2. Meta-regression estimated for WTP for air quality (complete sample, lnWTP)

Variable	Model 1		Model 2		Model 3		Model 4	
	Coeffi-cient	t-value	Coeffi-cient	t-value	Coeffi-cient	t-value	Coeffi-cient	t-value
Constant	-63.7	-0.59	5.37	7.51*	139.22	1.99**	8.3	3.1*
Dufuel	-0.84	-1.14						
Dugei	-0.65	-0.75						
Income	0.00005	1.43	0.00006	2.8*	-0.00005	-1.89***	0.00003	0.74
Year	0.04	0.64			-0.066	-1.87***		
Duquant					0.64	0.23		
Duchange	0.62	0.63						
Duhealth	0.51	0.56			1.64	2.29**		
Duhedo	0.6	0.37						
Duce	0.27	0.18			1.49	1.93***		
Duvco	-0.66	-0.59			-1.58	-1.82***	-1.24	-1.33*
Duvcd	-0.05	-0.04					-1.1	-1.04
Ducvi	-1.82	-1.56	-1.67	-2.77*	-2.06	-1.34	-2.55	-2.18**
Resp_rate							-1.64	-0.76
N	48		48		33		26	
R^2	0.31		0.22		0.34		0.3	
F-statistic	2.78		9.58		2.52		1.85	

* Significant at 1%. ** Significant at 5%. *** Significant at 10%.

Table 3. Meta-regression estimated for WTP for air quality (restricted sample, lnWTP).

	Model 5		Model 6	
Variable	**Coefficient**	**t-value**	**Coefficient**	**t-value**
Const.	5.29	6.14***	5.19	6.04***
Income	0.000059	2.25**	0.00006	2.18**
Ducvi	-1.87	-2.52**	-1.64	-1.77*
N	34		34	
R^2	0.25		0.22	
F-statistic	8.17		5.02	

* Significant at 1%. ** Significant at 5%. *** Significant at 10%.