Benefit Transfer and the Economic Value of Air Quality Revisited[1]

Transferencia de beneficios y el valor económico de la calidad del aire revisitados

Transferência de benefícios e o valor econômico da qualidade do ar revisados.

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Recibido: 26.03.13
Aprobado: 27.06.14

1 This article has been done under the research project "Transferencia de Beneficios en el Análisis Costo-Beneficio de la Implementación de un Programa de Conversión a Combustibles Alternativos: el Caso del Gas Natural Vehicular en el Valle de Aburrá (Colombia)", undertaken by Grupo de Estudios Ambientales y Socio-políticos. Financial support from Vicerrectoría de Investigación of Universidad Nacional de Colombia is gratefully acknowledged. We also thank Sergio Chavarría for his very helpful research assistance, and Thomas Finken for editorial assistance.

2 M.Sc. Economía de Recursos Naturales y del Medio Ambiente.

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, considering the perspective of developing countries. Our aim is to show the importance to employ transferred values in cost-benefit analysis for the particular case of air pollution in urban areas of developing countries. Following the recommendations found in the literature, a protocol was created for the value transfer process. The results show a high discrepancy between actual and transferred values. Besides, other findings question the use of the benefit transfer technique for developing countries.

Keywords: International Benefit Transfer, Meta-Analysis, Air Quality, Environmental Valuation, Developing Countries.

JEL classification: H41, H43, Q51.

Resumen

Considerando la falta de estudios de valoración económica para diversos bienes ambientales en países en vías de desarrollo, en este artículo se presenta un ejercicio de transferencia de beneficios aplicado al caso de la calidad del aire. El propósito es mostrar la relevancia de la transferencia de valores en los análisis costo-beneficio para el caso particular de la contaminación atmosférica, desde una perspectiva de estos países. Siguiendo las recomendaciones de la literatura, se creó un protocolo para el proceso de transferencia de valores. Los resultados indican una alta discrepancia entre el valor real y los valores transferidos. Lo anterior, aunado a otros hallazgos, pone en duda el uso de esta técnica en países en vías de desarrollo.

Palabras clave: Transferencia Internacional de Beneficios, Meta-análisis, Calidad del Aire, Valoración del Medio Ambiente, Países en Desarrollo.

Resumo

Este artigo apresenta um exercício de transferência de benefícios, aplicado ao caso da qualidade do ar. O propósito é mostrar a relevância da transferência de valores nas análises custo-benefício para o caso específico da poluição atmosférica, a partir de perspectivas dos países referenciados. Seguindo as recomendações da literatura, criou-se um protocolo para o processo de transferência de valores. Usamos econometria de dados de painel para a meta- análise de estudos que oscilam entre 1977 e 2007. Os resultados indicam uma alta discrepância entre o valor real e os valores transferidos. Uma situação que junto a outros resultados, põem em questão o uso desta técnica em países em via de desenvolvimento.

Palavras chave: Transferência Internacional de Benefícios, Meta-Análises, Qualidade do Ar, Valoração do Meio Ambiente, Países em Desenvolvimento.

1. Introduction

Among the set of methods and techniques for finding the economic value of environmental assets (Freeman 2003), benefit transfer (BT) has been widely used in the cost-benefit analysis (CBA) 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): (i) availability of information (i.e., original studies) not only in terms of amount, but also of its quality; (ii) the techniques for transferring values, and; (iii) the validity of the transfer.

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 latter is estimated with primary information), 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 on international 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"[3]. Moreover, 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.

3 For instance, after our request for access to EVRI 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).

Additionally, the traditional welfare measure found in most economic valuation studies of environmental goods is the willingness-to-pay (WTP). This has been done regardless of the implied property rights on the environment, and of whether there is a decrease or an improvement in the environmental quality/quantity. Such a tradition perhaps derives from one of the recommendations done by the NOAA panel (Arrow *et al*. 1993).

With the purpose to contribute to the discussion about the use and applicability of BT, in this paper we implement and test the BT technique to value air quality improvements in the context of urban areas of any developing country. 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 (Navrud and Ready 2007). The next highlights section introduce the main issues of BT. In section 3 we present the motivation of this paper and the case under investigation. In section 4 we present the results. Some discussion and the conclusions are presented in section 5.

2. Methods

Roughly, BT has been defined as the transposition of monetary environmental values estimated at one site (the study site, *i*) through market-based or non-market-based economic valuation techniques to a policy site, *j*. Such an extrapolation of values has been made possible by employing several techniques such as[4]:

i) Adjusted unit value for site *j* using per capita income levels *Y* (Navrud 2004):

$$WTP_j = WTP_i \left(Y_j / Y_i \right)^e \qquad [1]$$

where *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. Nonetheless, Navrud 2004, points out that this assumption may understate the WTP for developing countries.

ii) Benefit function transfer (Loomis 1992). If the value function in site *i* is $WTP_i = \alpha_i + \beta_i X_i + \varepsilon_i$, then the value function in site *j* would be $WTP_j = \alpha_i + \beta_i X_j + \varepsilon_i + \varepsilon_j^i$. That is, the WTP in the policy site is assumed to depend upon the same set of variables as those in the study site (*X*), and to the same degree (β_i). 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). This is a statistical procedure that integrates the results from different primary studies into a unique function. Perhaps the simplest way to make the meta-analysis is to assume fixed-effect parameters. In doing so, one estimates:

4 Other techniques include structural benefit transfer (Smith, van Houtven and Pattanayak 2002), or bayesian methods.

$$WTP_i = \alpha_i + \beta_i X_i + \varepsilon_i \qquad [2]$$

by using information gathered from primary studies. Besides including explanatory variables (x) which should be common to all studies, dummy variables that account for factors like the valuation method or the payment vehicle could also be included in (2).

There are some sources of 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 these sites are, the lower this error will be. However, there is still no theory that provides insights on what *similar* is in BT.

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 recommended not only to search in peer-reviewed journals, but also to attempt to include gray literature and working-paper series published on Internet.

In general, we could say that there are ways in which the analyst can manage to overcome 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 would seem to make this technique valid[5]. 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[6].

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5 In BT, validity is defined as the degree of convergence between the value obtained through the transfer, and the one obtained in the policy site if a primary study had been done (Kristofersson and Navrud 2007).

6 To estimate a WTP function, the question format should be open-ended. In the closed-ended format, of the several functional forms that can be assumed for the indirect utility function, only semi-log and Box-Cox functional forms allow to have mean or median WTP as a function of *income*. These functional forms are seldom estimated in CV studies, so hardly ever there are WTP functions estimated under the closed-ended format that depends on income. The latter is a variable that is expected to be included in a WTP function.

3. Motivation to Undertake this Study

Air pollution is a critical environmental problem in different cities from both developed and developing countries. In several cases, most of the emitted pollutants come from mobile sources. In response to this, very much 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 a CBA, the estimation of the benefits associated to welfare gains generated by any policy that aims 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 in developing countries. Seeking to analyze the feasibility of applying international BT in a developing country context, we carry out this analysis for a specific policy: improvements in air quality and its impact on human welfare, excepting impact on mortality due to reasons we explain below. In addition, we are not aware of any other recent meta-analysis of air pollution economic valuation studies similar to the kind that we undertake in the present study.

Perhaps the main input of any economic value transfer is the information contained in primary studies. Several international databases on the internet contain many of the studies carried out in the last three 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.* (2006) 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 for a 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 Envalue, we found that many of the studies included in them were out of date. 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 (e.g., environmental protection offices, or consulting firms). Therefore, any transfer process could suffer 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[7], few additional studies were found using these engines; some of these studies were not accessible at all due to payment requirements.

4. Protocol

After searching in the databases described above, around 60 studies were found, of which 34 were selected[8]. In this data-set we found 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

7 Some of these keywords are: air pollution, air quality, value, valuation, benefits, and costs.
8 The data-set is available upon request through the author.

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 types 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: CO, NO_2, PM_{10}, SO_2, CH_4 and/or O_3. Including estimates for just one pollutant would make the sample smaller. On the other hand, in order to work with conservative values, among revealed and stated preference methods, we excluded the dose-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. Moreover, when we are talking about valuing the impact of air pollution on human welfare, we need to specify what the impact on human welfare is (Freeman 2003). In our case, we are thinking on the impact on morbidity. Indeed, the mere fact that values of statistical life (VSL) are much higher than the values we employ, means to us that the impact of air pollution on mortality and the impact of air pollution on morbidity are different environmental goods.

As Woodward and Wui (2002) 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, we found descriptions such as a reduction in particulate matter from 366μg/m^3 to 200μg/m^3 (Murty, Gulati and Banerjee 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 2003), 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*.

Bearing this issues in mind, 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 difference). However, the aggregation of commodities' spatial and temporal scale was hard to consider because neither the geographical extent nor the time frame of the change is usually reported, at least in what concerns to 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 dataset, value estimates and income levels were adjusted for inflation to the 2005 local currency, and then converted to dollars using PPP[9].

Concerning income level, several of the studies employed in the meta-analysis database did not report the mean income level. By using the International Monetary Fund database, we decided to construct a proxy variable which shows the per capita income level of the country where the study was undertaken. 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, taking as a proxy of the discount rate the country's simple average interest rate for the 2001-2006 period[10].

On the other hand, as suggested by Brouwer (2000), external validity is included in our dataset with the inclusion of 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. In our dataset only 10 out the 34 studies reported the sampling process adopted in their surveys.

5. 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, common to all studies, are run in a meta-regression with the WTP as a dependent variable. Following that "tradition," Table 1 describes the variables included in our analysis. Besides the per capita income level and the response rate, we generated dummies for the type of pollutant offered in the scenario, the valuation method, and whether the valuation scenario refers to better health conditions.

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

9 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). Both of them were accessed in March/2011.

10 Interest rates were taken from the United Nations Statistics Division (http://data.un.org/). It was accessed in March/2010.

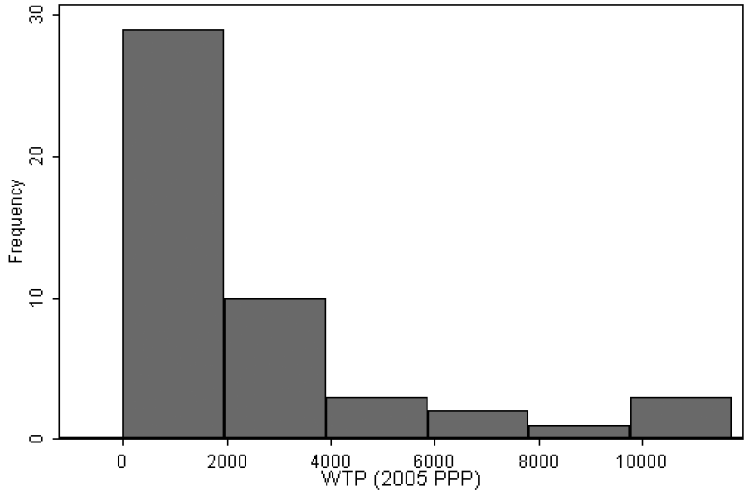
the error that underlies the estimation of the WTP through any of the valuation methods. Heteroscedasticity is corrected by estimating coefficients with the procedure suggested by Davidson and MacKinnon for small samples (Greene 2000) using STATA (StataCorp 2006). Considering the distribution of WTP (see Figure 1), its log was used in the estimated models (named lnWTP).

Table 1. Description of variables

Description	Variable	Mean	Standard deviation	Min.	Max.
Mean WTP reported in the study (2005 US$)	*WTP*	2277,6	2984,4	2,9	11721,2
Dummy (= 1) when the good is explained with reference to pollution from fossil fuels	*Dufuel*	0,375	0,489	0	1
Dummy (= 1) when the good is explained with reference to overall greenhouse gases	*Dugei*	0,125	0,334	0	1
Response rate	*Resp_rate*	0,66	0,25	0,1	0,97
Per capita income of the country where the study was done	*Income*	22828	11408,6	2473,9	43959,8
Per capita income reported in the study (2005 US$)	*Income_est*	28847	21308,7	1516,9	62681,9
Year in which the study was done	*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 employed the choice experiment method	*Duce*	0,1	0,31	0	1
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

Source: the author.

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



Source: the author.

In a first regression (Model 1), with lnWTP 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 (see Model 2 in Table 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 (see Table 2) only those variables for which 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 percentage 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).

In cases where 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) is equal to zero. With lnWTP

as the dependent variable, and for WTP as well, the F test[11] allowed rejecting this null hypothesis and concluding that there is a certain researcher's influence on the estimate[12]. 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).

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

Variable	Model 1		Model 2		Model 3		Model 4	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	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%.
Source: the author.

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 study based on: (i) the average of the study's estimate when all the estimates are referring to the same good; (ii) an estimate chosen randomly when different goods are valued (Model 5), and; (iii) 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 due to its relatively better goodness-of-fit.

11 This Chow test is computed by using the sum of squared residuals 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.

12 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.

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

Variable	Model 5		Model 6	
	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%.
Source: the author.

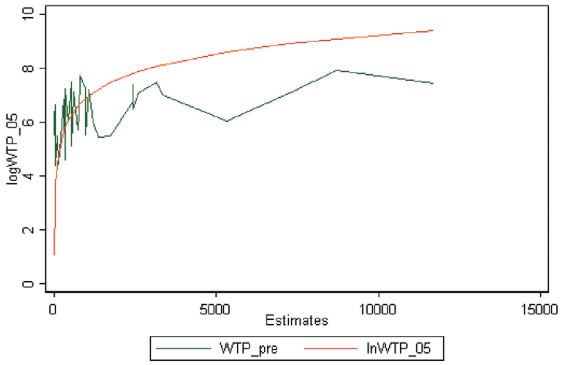
We make a simple validity test of our estimated MA-BT function obtained in Model 5 by comparing the WTP obtained by a study made in a developing country and the one obtained using the MA-BT function. As an example, consider the study by Cerda, Rojas and García (2007), who estimated the welfare measure of a reduction in air pollutants in Santiago, Chile. After putting measures of income and WTP in PPP terms, the mean WTP for an improvement in air quality for Santiago is, according to Cerda et al., US$122. Meanwhile, using our estimated MA-BT function, the WTP would be US$83, implying a transfer error of approximately 32%, which must be treated with caution, although it could be acceptable for a CBA (Rozan 2004; Kristofersson and Navrud 2007).

On the other hand, we compare the results of two different value transfer approaches: the unit value transfer and the meta-analysis value transfer. For example, the estimation of the benefits of air quality improvements for another developing country, Colombia in this example, might be carried out using the geographically closest site with an estimate like this. Assuming the unity for the income elasticity of WTP (see eq. (1))[13], and taking the work by Cerda, Rojas and García (2007) as the reference study and per capita incomes from Chile and Colombia (PPP terms), the benefit of a better air quality in Colombia would approximately be US$67. Nevertheless, if we considered the MA-BT function, this benefit decreases to US$45. Therefore, and similarly to Lindhjem and Navrud (2008), if we are going to favor conservative values, estimates derived from the MA-BT function should be employed in the CBA.

Lastly, following Lindhjem and Navrud (2008), Figure 2 shows the plot of lnWTP and its predicted value according to Model 5. Similar to Brander, Florax and Verrmaat (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%.

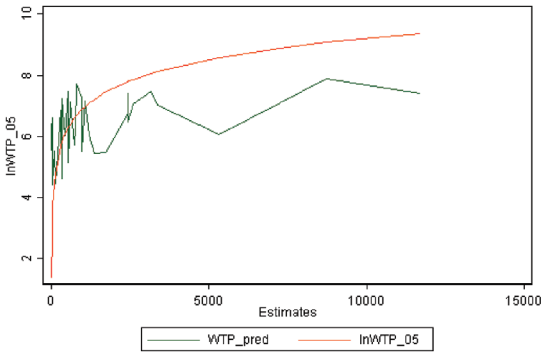
13 This assumption is not far from reality. For instance, in a contingent valuation study for Poland, Parry and Mendelsohn (2005) estimated an income elasticity of WTP close to the unity.

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



Source: the author.

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



Source: the author.

6. Discussion and Concluding Remarks

Benefit transfer seems to be a cost-effective methodology to value non-market 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 by the time of doing this research. Besides this, other difficulties like those noted in Rosenberger and Loomis (2000), are present: studies hardly ever report characteristics of their study site. These characteristics would make the benefit transfer process more robust.

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. Therefore, in spite of the common recommendation of using a meta-valuation function to transfer values, this is quite difficult to implement and therefore, biased values are expected to be generated if the appropriate information is not included in the estimation process. 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 researchers 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 (Freeman 2003).

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, Matsuoka and Shirakawa 2004), we are implying in our paper that meta-analyses of valuation studies across countries do not seem to be a good option for CBA, 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 absence of national studies for many developing countries can make MA-BT, which uses international studies, a quasi cost-effective option to carry out CBA. For the environmental good we have analyzed, MA-BT produces more conservative estimates than unit value transfer, but provided that *income* is one of the main covariates in our MA-BT function, and the only covariate in unit value transfer, the robustness of the MA-BT function and therefore its practicality over unit value transfer is weak, and the latter might be used instead.

Although the inconsistencies and weaknesses observed here may due to the technical issues aforementioned, it must be borne in mind a key assumption hold in BT: an estimate can be meaningfully transferred from one socio-economic setting to another. Behavioral economists have showed us that institutions matter (Shogren, Parkhurst and Banerjee 2006). Therefore, such a fact should be considered in future benefit transfers. But to make it possible, future valuation studies should report not only more and better information of the kind just mentioned, but also look for ways of including features of the institutional setting.

Finally, given that there is still no theory to carry out BT, one way of addressing this issue could be considering the approach suggested by Smith, van Houtven

and Pattanayak (2002). Future efforts in benefit transfer could go in the direction of combining their approach with what typically has been done so far.

References

Arrow, Kenneth, Robet Solow, Paul Portney, Edward Leamer, Roy Radner and Howard Schuman. «Report of the NOAA Panel on Contingent Valuation». *Federal Register*, Vol. 58, No. 10, 1993: 4601-4614.

Baltagi, Badi. *Econometric Analysis of Panel Data*. Chichester: 3rd Edition. Wiley & Sons Ltd., 2005.

Bateman, Ian and Andrew Jones. «Contrasting Conventional with Multi-Level Modeling Approaches to Meta-Analysis: Expectation Consistency in UK Woodland Recreation Values». In *Environmental Value Transfer: Issues and Methods*, Stale Navrud and Richard Ready (Eds.), 131-160. Dordrecht: Springer, 2007.

Bergstrom, John and Laura Taylor. «Using meta-analysis for benefit transfer: theory and practice». *Ecological Economics*, Vol. 60, No. 2, December 2006: 351-360.

Brander, Luke, Raymond Florax and Jan Verrmaat. «The Empirics of Wetland Valuation: a Comprehensive Summary and a Meta-Analysis of the Literature». *Environmental and Resource Economics*, Vol. 33, No. 2, February 2006: 223–250.

Brouwer, Roy. «Environmental Value Transfer: State of the Art and Future Prospects». *Ecological Economics*, Vol. 32, No. 1, January 2000: 137-152.

_____ and Frank Spaninks. «The Validity of Environmental Benefits Transfer: Further Empirical Testing». *Environmental and Resource Economics*, Vol. 14, No. 1, July 1999: 95-117.

Cerda, Arcadio, José Rojas and Leidy García. «Disposición a pagar por un mejoramiento en la calidad ambiental en el Gran Santiago, Chile». *Lecturas de Economía*, No. 67, July-December 2007: 143-160.

Freeman, A. Myrick. *The Measurement of Environmental and Resource Values: Theory and Methods*. Washington: RFF Press, 2003.

Greene, William. *Econometric Analysis*. New Jersey: Prentice-Hall, 2000.

Kristofersson, Daðy and Stale Navrud. «Can Use and Non-Use Values Be Transferred Across Countries?». In *Environmental Value Transfer: Issues and Methods*, Stale Navrud and Richard Ready (Eds.), 207-225. Dordrecht: Springer, 2007.

Lindhjem, Henrik and Stale Navrud. «How Reliable are Meta-Analyses for International Benefit Transfers?». *Ecological Economics*, Vol. 66, No. 2-3, June 2008: 425-435.

Loomis, John. «The Evolution of a More Rigorous Approach to Benefit Transfer: Benefit Function Transfer». *Water Resources Research*, Vol. 28, No. 3, July 1992: 701-705.

McComb, Greg, Van Lantz, Katrina Nash and Robyn Rittmaster. «International Valuation Databases: Overview, Methods and Operational Issues». *Ecological Economics*, Vol. 60, No. 2, December 2006: 361-372.

Murty, M., S. Gulati and A. Banerjee. *Hedonic Property Prices and Valuation of Benefits from Reducing Urban Air Pollution in India*. India: Institute of

Economic Growth, Delhi University Enclave, Delhi-110007, 2003. Last access 11 March 2013, http://www.iegindia.org/workpap/wp237.pdf

Muthke, Thilo and Karin Holm-Mueller. «National and international Benefit Transfer Testing with a Rigorous Test Procedure». *Environment and Resource Economics*, Vol. 9, No. 3, November 2004: 323-336.

Navrud, Stale. «Value Transfer and Environmental Policy». En *The International Yearbook of Environmental and Resource Economics 2004/2005*, T. Tietenberg and H. Folmer (Eds.), 189-217. Cheltenham: Edward Elgar Publishing, 2004.

_____ and Richard Ready. *Environmental Value Transfer: Issues and Methods*. Dordrecht: Springer, 2007.

Parry, Dominika Anna and Robert Mendelsohn. «Valuing Air Quality in Poland». *Environmental and Resource Economics*, Vol. 30, No. 1, February 2005: 131-163.

Rosenberger, Randall and Robert Johnston. «Selection Effects in Meta-Analysis and Benefit Transfer: Avoiding Unintended Consequences». *Land Economics*, Vol. 85, No. 3, August 2009: 410-428.

_____ and John Loomis. «Panel Stratification in Meta-Analysis of Economic Studies: an Investigation of its Effects in the Literature Recreation Valuation». *Journal of Agricultural and Applied Economics*, Vol. 32, No. 3, December 2000: 459-470.

_____ and Tom Stanley. «Measurement, Generalization, and Publication: Sources of Error in Benefit Transfers and their Management». *Ecological Economics*, Vol. 60, No.2, December 2006: 372-378.

Rozan, Anne. «Benefit Transfer: a Comparison of WTP for Air Quality Between France and Germany». *Environmental and Resource Economics*, Vol. 29, No. 2, November 2004: 295–306.

Shogren, Jason, Gregory Parkhurst and Prasenjit Banerjee. «Two Cheers and a Qualm for Behavioral Environmental Economics». *Environmental and Resource Economics*, Vol. 46, No. 2, June 2006: 235-247.

Smith, V. K. and Ju-Chin Huang. «Can Markets Value Air Quality? A Meta-Analysis of Hedonic Property Value Models». *Journal of Political Economy*, Vol. 103, No. 1, February 1995: 209-227.

_____, George van Houtven and Subhrendu Pattanayak. «Benefit Transfer Via Preference Calibration: Prudential Algebra for Policy». *Land Economics*, Vol. 78, No. 1, February 2002: 132–152.

Spash, Clive and Arild Vatn. «Transferring Environmental Value Estimates: Issues and Alternatives». *Ecological Economics*, Vol. 60, No. 2, December 2002: 379-388.

Vassanadumrongdee, Sujitra, Shunji Matsuoka and Hiroaki Shirakawa. «Meta-Analysis of Contingent Valuation Studies on Air Pollution-Related Morbidity Risks». *Environmental Economics and Policy Studies*, Vol. 6, No. 1, March 2004: 11-47.

Woodward, Richard and Yong-Suhk Wui. «The Economic Value of Wetland Services: a Meta-Analysis». *Ecological Economics*, Vol. 37, No. 2, May 2002: 257-270.

Wooldridge, Jeffrey. *Econometric Analysis of Cross Section and Panel Data*. London: MIT Press, 2002.

Yoo, Seung-Hoon and Kyung-Suk Chae. «Measuring the Economic Benefits of the Ozone Pollution Control Policy in Seoul: Results of a Contingent Valuation Survey». *Urban Studies*, Vol. 38, No. 1, January 2001: 49-60.

Database

Statacorp (2006). *Intercooled STATA 9.2 for Windows*. Licensed to Universidad Nacional de Colombia – Sede Medellín.