Valuing cross-border effects of transport projects: are Dutch citizens willing to trade domestic time savings for foreign time savings?

Authors: Niek Mouter, Jose Ignacio Hernandez, Sander van Cranenburgh

Department of Engineering Systems and Services, Faculty of Technology, Policy and Management, Delft University of Technology, Jaffalaan 5, 2628BX, The Netherlands

1. Introduction

Cost–benefit analysis (CBA) is a widely used economic appraisal method which aims to support government decision-making on transport projects (e.g. Asplund and Eliasson, 2016). Academic studies universally find that politicians and civil servants have a positive attitude towards the institutionalization of CBA for the evaluation of transport projects (Nyborg, 1998; Mouter, 2017). Despite its popularity, various scholars have criticized the normative foundations of CBA and politicians argue that their disagreement with some of CBA's normative foundations is a reason why the results of a CBA do not (or only marginally) affect their decisions (Nyborg, 1998). One postulation of CBA which is criticized in the literature refers to the individuals and preferences that are (not) included in the analysis which is also known as the question of 'standing'. CBA departs from the postulation of 'welfarism' which means that the preferences of individual citizens form the basis of a CBA (Sen, 1979). This implies that consequences for animals, and nature in general, only count when humans value them. The question of standing is not only relevant for animals and nature, but also for foreigners. More specifically, analysts and policy makers face the normative question whether a CBA should include the benefits and costs of a government project accruing to foreigners. Rowell and Wexler (2014) observe that in practice the question of standing of foreigners and non-citizens is answered in an ambiguous way. Based on a review of CBA Guidelines that are applied in the United States they conclude that multiple approaches are used to value foreign lives (ranging from valuing foreign lives equally to not at all) in an unreasoned and non-transparent way. Rowell and Wexler (2014) find that most of the Guidelines adopt the view that agencies of the United States government should focus only on Americans because any government owes its sole democratic responsibility to its own citizens. This view aligns with the default in CBA which involves excluding residents of other countries affected by a government policy (Johnston et al., 2017). However, cosmopolitans assert that governments should treat foreigners and residents in the same way in a CBA because it is unethical to discriminatorily allocate resources as between domestic and foreign persons (Singer, 1972). They emphasize that the impacts of a government policy do not magically cease at political borders and believe that a government is morally obliged to treat cross-border impacts and domestic impacts in a similar way (Rowell and Wexler, 2014). Posner and Sunstein (2017) defend a third position by arguing that a CBA should include people who live outside of a state's political boundaries in a derivative fashion. They assert that the impacts for foreigners should be included to the extent that Americans care about this which can be elicited with willingness to pay methods. In their view, some kind of empirical analysis would be necessary to test whether the citizens' willingness to pay for benefits of foreigners is large or small. Rowell and Wexler (2014) also recommend this as the default valuation method for

policymakers as it fits consistently with the valuation practices in CBA, which routinely relies on willingness to pay to determine how many resources should be allocated towards the impacts of a government policy.

Although scholars argue that from a theoretical perspective the derivative approach can be regarded as the most appealing one, the empirical analyses that are necessary to operationalize this approach are missing in the transport literature. This paper aims to alleviate this gap in the scientific literature by empirically investigating how Dutch citizens value travel time savings accruing to foreign citizens. Specifically, we conduct a Stated Choice experiment in which Dutch citizens are asked to allocate public budget to one out of two road projects. The two road projects differ in the extent to which they result in travel time savings for citizens who live in the Netherlands and citizens who live outside the Netherlands. We focus in this study on travel time savings because this is the most dominant benefit in CBAs for transport infrastructure investments (Mackie et al., 2001). To the best of our knowledge, our study is the first study worldwide which scrutinizes citizens' preferences for travel time savings accruing to foreigners.

2. Methodology and data collection

Given that little guidance is available in the literature concerning empirically measuring citizens' preferences for benefits of transport policies for foreigners we performed an extensive pretesting of these SC experiments which involved several rounds of pilot experiments. Based on questions raised by the participants in the pilot experiments we decided to make the choice context more specific. That is, we communicated in the experiment that: 1) the projects are fully funded by the Dutch government; 2) the projects will be built on Dutch territory; 3) the transport projects concerned road investments; 4) foreigners are operationalized as persons who reside outside the Netherlands.

After reading through an introductory text, respondents were asked to complete twelve choice tasks. In these choice tasks, respondents were asked to choose between two possible road projects which differed in the extent to which they resulted in travel time savings for citizens who live in the Netherlands and citizens who live outside the Netherlands. Figure 1 depicts an example of a choice task.

In this 2-attribute binary choice format, each choice task implicitly embeds a what we call Boundary Value-of-Foreigners (BVoF). The BVoF is the implicit boundary value of travel time savings for foreigners, expressed in terms of travel time savings of Dutch citizens. The BVoF is given by Equation 1 where alternative 1 denotes the alternative with the highest travel time savings for Dutch citizen and lowest for foreigners, and alternative 2 denotes the alternative with the lowest travel time savings for Dutch citizens and the highest for foreigners. The BVoF can be perceived as a valuation threshold as a respondent choosing the alternative with the highest travel time savings for foreigners reveals a VoF which is (most likely) above the BVoF, while a respondent choosing the alternative with the highest travel time savings for Dutch citizens reveals a VoF which is (most likely) below the BVoF.

$$BVoF = -\frac{(TTS_{NL,2n} - TTS_{NL,1n})}{(TTS_{FO,2n} - TTS_{FO,1n})}, \quad (1)$$

where TTS_{NL1} and TTS_{NL2} denote the number of Dutch citizens experiencing 10 minutes of travel time savings in alternative 1 and 2 respectively, and $TTS_{FO1\ and}$ TTS_{FO2} denotes the number of foreigners experiencing 10 minutes travel time savings in alternative 1 and 2 respectively.

A survey company (Kantar Public) was asked to draw a random sample of Dutch citizens of 18 years and older. The survey company recruited 113 respondents and provided us with additional information about the socio-demographic characteristics of each respondent (e.g. gender, age, income, car ownership and education).

There are multiple locations in the Netherlands where the Government can reduce travel times by investing in road infrastructure.

Especially for infrastructure projects that are located close to the border it holds true that both the travel times for car drivers who live in the Netherlands and car drivers who do not live in the Netherlands can be reduced as a result of these investments.

The government needs to make choices regarding investments in the road network. There is not enough money to fund all potential road projects.

The government wants to know which type of road projects you prefer.

Hence, the government will present you with two Road Projects and asks you whether you would recommend Road Project 1 or Road Project 2.

Below you will find the characteristics of the Road Projects.

You can assume the following:

- The Road projects are only built on Dutch territory and the costs of the projects are paid for by the Dutch government.
- The Road Projects only differ in terms of travel times saved for citizens who live in the Netherlands and citizens who live outside the Netherlands (for instance, citizens who live in Germany and Belgium).
- The Road Projects do not differ in costs, safety effects and environmental effects, amongst other things.
- The government is interested in general preferences of Dutch households. Hence, it is not made clear whether you would experience any effects (positive or negative) from the Road Projects

Please select the Road Project which you would recommend to the government.

	Road Project 1	Road Project 2
Travel time savings for car drivers who live in the Netherlands	Travel time reduction of 10 minutes for **60,000 travelers** per day	Travel time reduction of 10 minutes for **50,000 travelers** per day
Travel time savings for car drivers who do **not** live in the Netherlands	Travel time reduction of 10 minutes for **10,000 travelers** per day	Travel time reduction of 10 minutes for **31,000 travelers** per day

FIGURE 1 Design of the experiment.

3. Results

3.1 Random Valuation model results

We analyse our data by using discrete choice models. In particular, we estimate Random Valuation (RV) models (Cameron and James 1987; Ojeda-Cabral and Chorus, 2016), as these models allow for a direct estimation and straightforward interpretation of the results in terms of marginal rates of substitution, i.e. the VoF. This RV model postulates that decision makers choose the alternative with the highest travel time savings for foreigners if the decision maker's VoF is higher than the probed BVoF. If the decision maker's VoF is lower than the BVoF, the alternative with the highest travel time savings for Dutch citizens is chosen. Like conventional linear-additive Random Utility Maximisation (RUM) models, the RV model consists of an additive error term to accommodate for randomness. In the RV model, μ represents the scale factor, which is estimated jointly with the VoF. Note that RV models are consistent with RUM; i.e. they can also be casted as a RUM model with a specific form of heteroscedasticity in the error term. The utilities of decision-maker n for alternatives 1 and 2 is given by:

$$U_{1n} = \mu \cdot BVoF + \varepsilon_{1n},$$
$$U_{2n} = \mu \cdot VoF + \varepsilon_{2n}, \quad (2)$$

where, VoF is an estimable parameter that reflects the price of travel time savings for foreigners, expressed in terms of travel time savings for Dutch citizens. In other words, it is the marginal rate of substitution of travel time savings between Dutch citizens and foreigners, μ is a scale parameter, and ε_{in} is a stochastic error with an Extreme Value Type 1 distribution. Table 1 presents the estimation results.

Table 1: Estimation results

	Estimate
RV Parameters	
Scale	2.5447***
	(0.2337)
VoF (MRS)	0.6139***
	(0.0293)
Estimation information and Goodness-of-fit measures	
Observations	1355
Log-Likelihood	-829.1
AIC	1662.3
BIC	1672.7

Standard Errors in parenthesis. ***p < 0.001, **p < 0.01, *p < 0.05, +p < 0.1

A number of inferences can be made based on Table 1. Firstly, the estimates are all highly significantly different from zero. More importantly, the marginal rate of substitution between foreigners who experience ten minutes of travel time savings and Dutch inhabitants

experiencing ten minutes of travel time savings is 0.61 which means that Dutch citizen derive a similar marginal utility from ten minutes of travel time savings for 10,000 foreigners and 6,000 Dutch inhabitants[1].

3.2 Latent class analysis

In addition, we estimated a Latent Class (LC) model to investigate the presence of discrete heterogeneity among respondents' preferences. In this framework, each individual in the population belongs, up to a probability, to a certain class of similar characteristics. The class membership is explained based on individuals' sociodemographic characteristics (gender, education level) and political orientation (to reduce the number of variables we clustered political parties along the political compass globalists versus nationalists and leftwing versus rightwing). In terms of per-class taste parameters, we used the same utility structure of the original model, but we estimated separate parameters for each class. To determine the optimal number of classes, we estimated several LC models with different numbers of classes, and selected the one with the highest Bayesian Information Criterion (BIC). From this procedure we decided to use a use a three-class model.

Table 2 summarizes estimation results of the three-class RV model. As expected, heterogeneity is present, which is reflected by different MRS of travel time savings. This allows us to assess the trade-off between travel time savings for Dutch citizens and foreign citizens.

[1] We also analyzed the data using linear-additive MNL and Panel Mixed Logit models and this resulted in a mean marginal rate of substitution parameter of 0.6 and 0.59 respectively. The fact that RV, MNL and ML models produce the same mean marginal rates of substitution parameters testifies that these findings are not to a large extent driven by the model specifications that are being used.

Table 2: Regression results of LC model – fixed parameters in class 1.

	Class 1	Class 2	Class 3
RV parameters			
Scale	2.9105	2.0278**	5.9431***
	(1.8704)	(0.6408)	(0.6320)
VoF (MRS)	-0.6746	0.4239***	0.7603***
	(0.6199)	(0.0681)	(0.0298)
Class membership parameters			
Class Constant	0.0000	0.0184	0.4780
		(0.9284)	(0.8863)
Sex	0.0000	0.7347	1.2664+
		(0.7834)	(0.6712)
Mid-High Education	0.0000	0.5656	0.7004
		(0.7789)	(0.6711)
High Education	0.0000	14.4901***	12.8138***
		(3.3586)	(3.5093)
Left - Globalists	0.0000	-0.6847	-0.2912
		(1.2520)	(1.2981)
Left - Nationalists	0.0000	-12.6561*	-0.3663
		(5.6664)	(1.2123)
Right - Globalists	0.0000	0.3476	0.2016
		(1.1155)	(1.1489)
Right - Nationalists	0.0000	1.2211	0.5771
		(1.8208)	(1.8249)
Class probability	**0.1350**	**0.2941**	**0.5709**
Estimation information and Goodness-of-fit measures			
Observations		1355	
Log-Likelihood		-640.0	
AIC		1324.0	
BIC		1438.7	

Standard Errors in parenthesis. $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$, $^{+}p < 0.1$

From the MRS estimates, it is possible to estimate three population classes. First, Class 1 (14%) characterizes individuals that are not interested in road projects benefiting foreigners as they don't make a trade-off between travel time savings of foreigners and Dutch citizens. Second, Class 2 (29%) shows more moderate individuals who value travel time savings of foreigners at about 50% of that of Dutch travel time savings. Finally, Class 3 (57%) reflects individuals who strongly value travel time savings accruing to foreigners. They value travel time savings of foreigners at about 75% of that of Dutch travel time savings.

Finally, we analyzed how each class probability is distributed under changes in the sociodemographic variables that are part of the class membership function. Figures 2a and 2b summarize this analysis for male and female respondents respectively. In each figure, the vertical axis represents the probability of being member of a class, while each bar along the horizontal axis shows the probability for a given education level and political orientation. For

example, the first set of bars in Figure 2a represents the class probability distribution of male respondents that have a Left-Globalists political orientation, for each educational level of these individuals.

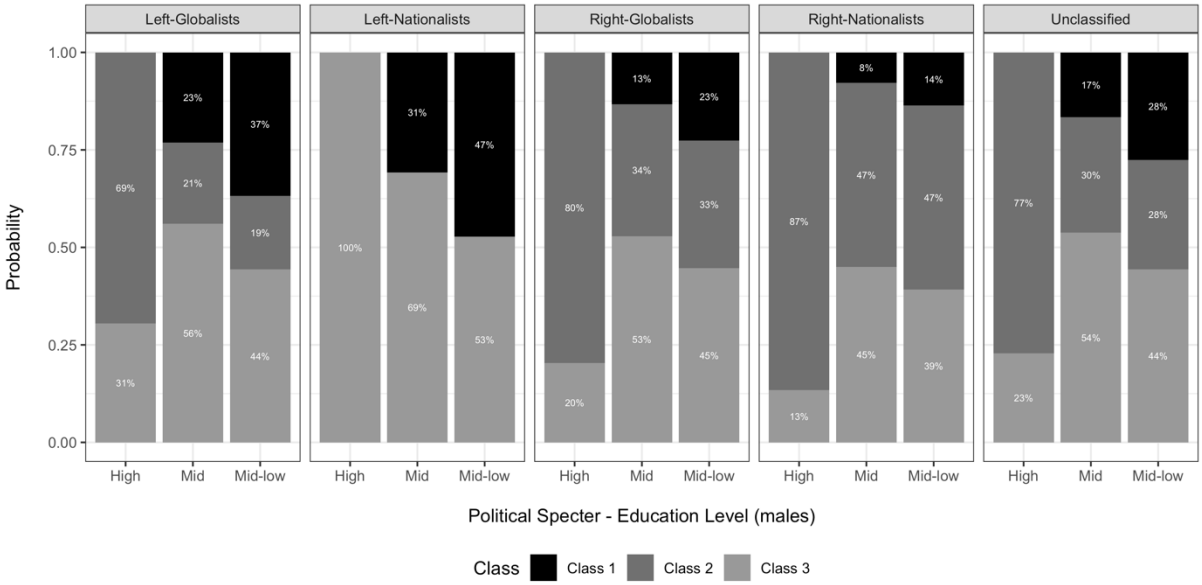

Figure 2a: Distribution of class probabilities among sociodemographic variables (Males)

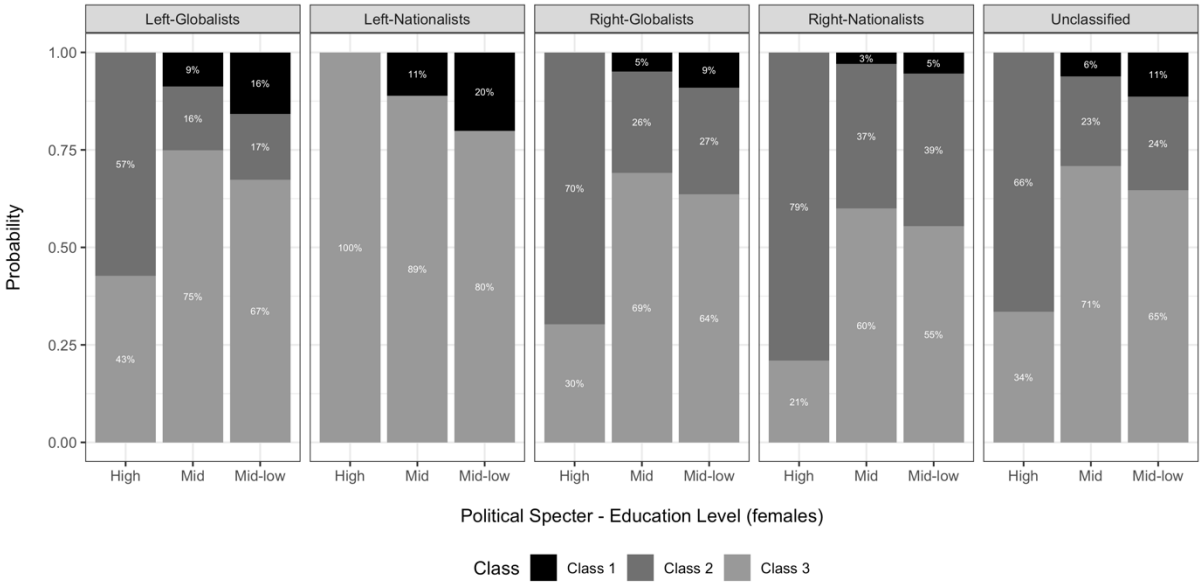

Figure 2b: Distribution of class probabilities among sociodemographic variables (Females)

From these two figures it is possible to observe differences in terms of gender, educational level and political orientation. First, male individuals are more prone than females to be part of Class 1 (i.e. individuals who don't want to sacrifice travel time savings of Dutch citizens for the sake of travel time savings for foreigners). This difference between males and females can be observed for all categories of respondents in terms of political orientation and educational level. Second, it is observed that respondents with a lower level of education have a higher

probability of being part of Class 1. Moreover, according to our analysis, individuals tagged as "high educated" are never part of Class 1.

4. Conclusions

This paper presents empirical insights into Dutch citizens' valuation of travel time savings for foreign citizens. We conducted a Stated Choice experiment in which we asked respondents to choose between two possible road projects which differ in the extent to which they result in travel time savings for citizens who live in the Netherlands and citizens who live outside the Netherlands. Our results suggest that a vast majority of Dutch citizens values travel time savings for foreigners in the sense that they are willing to trade domestic time savings for foreign time savings. The mean marginal rate of substitution between foreigners who experience ten minutes of travel time savings and Dutch inhabitants experiencing ten minutes of travel time savings is 0.6 which means that Dutch citizen derive a similar marginal utility from ten minutes of travel time savings for 10,000 foreigners and 6,000 Dutch inhabitants.

Specifically, the latent class analysis reveals three distinct segments (classes) in the population. The people in the first segment (14%) primarily care about the travel time savings for Dutch people, and do not care about travel time savings for foreigners; people in the second segment (29%) value travel time savings of foreigners at about 50% of that of Dutch travel time savings; people in the third segment (57%) value travel time savings of foreigners at about 75% of that of travel time savings accruing to Dutch citizens. Class membership is explained by socio demographics: gender and education level, as well as political orientation. For instance, we find that people with a higher education level are more likely to (positively) value travel time savings of foreigners.

Our study primarily contributes to the academic literature by providing empirical insights in people's preferences for impacts of transport projects accruing to foreigners. We argue that this is relevant information for policy makers, since the findings enable policy makers to determine the extent to which public resources should be allocated to (projects promoting) impacts for foreigners. The most important implication of our research is that valuing travel time savings accruing to foreigners at zero – as appears to be the norm in practice – underestimates the value that citizens assign to travel time reductions of foreigners.

References

Asplund, D., Eliasson, J., 2016. Does uncertainty make cost-benefit analyses pointless? Transportation Research Part A 92, pp. 195-205.

Cameron, T.A., James, M.D., 1987. Efficient estimation methods for 'closed-ended' contingent valuation surveys. Rev. Econ. Stat. 69(2), 269-276.

Johnston, R.J., Boyle, K.J., Adamowicz, W., Bennett, J., Brouwer, R., Cameron, T.A., Hanemann, W.M., Hanley, N., Ryan, M., Scarpa, R., Tourangeau, R., Vossler, C.A., 2017. Contemporary guidance for stated preference studies. Journal of the Association of Environmental and Resource Economics 4 (2).

Mackie, P.J., Jara-Díaz, S., Fowkes, A.S., 2001. The value of travel time savings in evaluation. Transportation Research Part E 37, 91-106.

Mouter, N., 2017. Dutch politicians' use of Cost-Benefit Analysis. Transportation 44(5), pp. 1127-1145

Nyborg, K., 1998. Some Norwegian politicians' use of cost-benefit analysis. Public Choice 95, 381-401.

Ojeda-Cabral, M., & Chorus, C. G. (2016). Value of travel time changes: Theory and simulation to understand the connection between Random Valuation and Random Utility methods. Transport Policy, 48, 139-145.

Posner, E.A., Sunstein, C.R. (2005). Dollars and Death. 72 University of Chicago Law Review 537-598.

Rowell, A., Wexler, L. (2014). Valuing Foreign Lives. Georgia Law Review 499, 524–39.

Sen, A.K. (1979) Utilitarianism and Welfarism. The journal of philosophy 76 (9), 463-489.

Singer, P. (1972). Famine, Affluence, and Morality. Philosophy and Public Affairs 1 (3), 229 – 243.