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CONSUMER'S WILLINGNESS TO PAY FOR GREEN ELECTRICITY: A META-ANALYSIS OF THE LITERATURE

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Overview

Many industrialized countries have ambiguous renewable energy targets to mitigate climate change and/or to gain independence of fossil fuel imports. At present, electricity generated from power plants using renewables is more costly compared with those using conventional fuels. The difference is paid by the consumers either directly or indirectly through a higher price for renewable energy or indirectly through taxes. As a response to this, a number of studies have investigated consumer's willingness to pay (WTP) for a higher share of renewable energy in the electricity mix. Using a meta-analysis of the current literature, we quantify global differences in WTP estimation with the help of a meta-regression. Based on these results, we perform a value transfer to discuss the necessity of further studies which elicit WTP for a higher renewable energy share in the electricity mix.

Method

We gain 85 WTP observations from 18 studies to perform a meta-regression. We suspect a simple semi-log linear relationship between WTP per household and month, as well as country and study specific effects. Since there are no remarkable panel effects, which might be due to multiple values per study, we use a weighted ordinary least squares regression with robust standard errors. To adjust for bias through residential electricity consumption and household size, we perform a second regression on WTP per kilowatt-hour.

By using an *n-1* data splitting technique, we predict 85 out-of-sample WTPs, which are based on 85 different meta-regressions. To verify the validity of this value-transfer technique, we directly compare these predicted WTP values with their "observed" values. For this, we perform a t-test if the mean difference of predicted and observed values is equal to zero. Additionally, we investigate the significance of Pearson's correlation coefficient. Further, we calculate the absolute (percentage) error, and finally, we conduct a regression of the observed on the predicted WTP to test if the coefficients of this estimation have desirable sizes; that is, the constant equals zero and the coefficient of predicted WTP equals one.

Results

A higher renewable energy share in electricity generation increases WTP, whereas a higher hydro power share decreases WTP. If a study is conducted in the US, WTP increases per household and month. But, this effect vanishes if we adjust WTP for residential electricity consumption per capita, which is at least twice as high as the other investigated countries, but Finland. Same holds for different stated preference methods - in our case only contingent valuation or choice experiments - used to elicit WTP. While a contingent valuation study increases WTP compared to a choice experiment if the unit is US$ per household and month, the effect is insignificant if the unit is US-Cents per kilowatt-hour.

Further, WTP decreases if the status quo scenario is not well defined; that is, the power plant to be substituted by renewables is not defined. The effect, if an exploratory variable is included in study's initial WTP estimation, has the same direction as the effect in the initial estimation; e.g. we find that in the literature, income always has a positive effect on WTP, thus, if income is included in study's initial regression, WTP increases as well.

At first glance, the mean absolute percentage error (*MAPE*) of our value transfer is pretty high compared to other meta-regression value transfers. But, the high absolute percentage values are caused by WTP observations measuring an increase in biomass. This is, because WTP for biomass has a high range of values, which cannot be explained by our meta-regression, since there are study specific scenarios, which, additionally, influence the acceptance of biomass.

Eliminating observations which measure an increase in biomass and additionally excluding a WTP value, which measures a climate change mitigating policy, leads to more desirable results. Median absolute percentage error is below 30% and *MAPE* ranges between 34% and 43%. Absolute error of value transfer is about 3US$ per household and month and about 0.8 US-Cents per kilowatt-hour.

Conclusions

We show that, with the help of a meta-regression, it is possible to perform a practically feasible forecast of WTP for a higher share of renewable energy in the electricity mix, at least for our sample. Preferences for biomass vary, so they have to be excluded from value transfer to avoid absolute percentage errors larger than 200%. So, if a policy maker needs a hint, which WTP he can expect for his country, it is feasible to use our meta-regression function and approximate it. Since, there is no underlying study design; one can discuss to set either all study values to zero or to one.

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