BAYESIAN MODEL AVERAGING TO PREDICT INTEREST IN ELECTRIC VEHICLES IN GERMANY

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Overview

Electric vehicles (EVs) have noteworthy potential to reduce global and local emissions and are expected to become a relevant future market for vehicle sales. Both policy makers and car manufacturers have an interest to understand the future EV user groups, also those beyond the current 'early adopter'. However, there are only a few empirical results available about potential future EV users. Here, we use data from a representative survey on EV interest from Germany to analyse factors that are related to interest in EVs of private car buyers. Interest in EV implies a positive attitude towards this new technology and is thus a prerequisite for later adoption. Since Our results show that technology affinity and the feeling that an EV can serve the user's driving need are positively connected to interest in EVs. Furthermore, persons that connect a strong feeling of independence with conventional vehicles are less likely to be interested in EVs. Our results indicate that automakers promoting EVs should focus their marketing on the new yet ready technology in the next years.

Data and Methods

Data

The data used for the analysis presented in this paper is taken from a representative survey for Germany that amongst other topics analysed different potential electricity tariffs for future EV-owners. For the survey 1,017 adult German citizens answered questions on attitudes towards ICEVs and EVs as well as the interest in EV and the intention to purchase an EV. The data was collected in April 2013 employing an online questionnaire taking advantage of a professionally managed online access panel. The sample is representative for the German population regarding gender, age, level of education, size of household and federal state.

4,017 German citizens were initially invited to participate out of which 1,107 individuals accessed the online questionnaire and 1,017 of these completed the questionnaire (overall response rate of 25 %). The questionnaire included several indicators in order to divide the respondents into four different groups connected to Rogers' (2003) five adopter categories. Here we follow an approach introduced by Peters and colleagues (cf. Peters & Dütschke, 2014; Peters, Agosti, Popp & Ryf, 2011) in which early and late majority are aggregated into one group. Peters et al. (2011) demonstrated the validity of this approach with respect to the target variable "intention to purchase and use an EV". Participants who confirmed that they own or regularly drive an EV in everyday life were selected as Innovators. Two further items assessed the general interest in EVs on the one hand and the intention to buy an EV within the next 5 years on the other hand. If both items were answered positively, the participant was assigned to the purchase intention group (Early Adopters). If only the interest item was affirmed, participants were classified as interested (Majority). Participants affirming none of the above were classified as not interested (Laggards).

Methods

We use logistic regression to predict interest in EV. Since many potential factors could play a role in EV interest, model selection plays an important role, However, many empirical studies do not take into account the uncertainty from the actual model selsction process. Instead, many studies show p-values from the final regression model suggesting over-confident findings. Here, we use Bayesian model averaging (BMA) to account for model uncertainty in a systematic fashion. BMA provides a coherent way to take model uncertainty into account (Hoeting et al. 1999). Based on Bayesian statistical reasoning it yields the posterior distribution for the coefficient β given data D as the average of K individual models M_K each weighted by its posterior model probability $\mathrm{pr}(\beta|D) = \Sigma_k \mathrm{pr}(\beta|M_k, D)\ \mathrm{pr}(M_k, D)$. The computational difficulty stems from the calculation of the many posterior model probabilities

$$\mathrm{pr}(M_k|D) = \frac{\mathrm{pr}(D|M_k)\mathrm{pr}(M_k)}{\sum_{l=1}^{K} \mathrm{pr}(D|M_l)\mathrm{pr}(M_l)}$$

since the denominator contains the integrated likelihood, a high-dimensional integral, and the large number of possible models 2^P if P is the number of variables (Hoeting et al. 1999).

Results

Several factors positively impact the probability to be interest in EV. In our data, the interest in technology has the largest positive marginal effect on interest in EV. Other positive factors are the willingness to pay for this new technology, the feeling to be able to perform all driving with an EV and the usage of public transport. A strong feeling of freedom or independence associated with conventional vehicles reduces the likelihood of being interested in EVs. In total, 1988 models were selected. The Table shows the resulting posterior effect probabilities as well as mean and SD of the coefficient over the different models weighted by the model qualitty (variables not shown had zero posterior effect probability).

In a second step, we examine the best model more closely and calculate marginal effects (at the variables mean vaules) for the predictors. The marginal effects for all variables of the best model (Technology affinity, willingness to pay more, Education, Autonomy with an EV, Freedom with a conventinal car, and Drivers license ownership) are highly significant.

Predictor	Posterior Effect Probability P(β≠0)	Posterior Mean	Posterior SD
Technology affinity	100.0	0.742	0.096
Willingness to pay more	100.0	0.063	0.010
Autonomy EV	100.0	0.337	0.059
Drivers license (yes)	99.3	1.161	0.317
Freedom ICE	85.2	-0.270	0.149
Education	64.7	0.123	0.106
Public Transport Available (yes)	30.1	0.118	0.203
Train Available	27.7	0.127	0.232
Availability ICE	18.3	0.033	0.079
sex (male)	16.7	0.052	0.132
Availability EV	14.9	0.016	0.044
Autonomy ICE	7.9	-0.016	0.070
Working	6.4	0.015	0.069
Children	5.1	-0.012	0.066
Independence ICE	4.7	-0.006	0.038
Independence EV	3.4	0.002	0.018
HH members	3.0	0.002	0.016
Climate	2.2	0.003	0.034
Age	1.7	0.000	0.001
Freedom EV	1.7	0.000	0.011

Conclusions

Mass market adoption of EVs requires large groups of consumers to seriously consider purchasing an EV. Here we analysed the next large group of potential buyers as those interested in EVs and factors predicting interest. Our results show that technological affinity and no or low association of freedom with conventional vehicles are main factors in predicting EV interest. Accordingly, automakers and policy makers should highlight the technological advancement in order to accelerate market diffusion of EVs.

References

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