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French households' preferences for alternative fuel vehicles: A discrete choice analysis of Stated Preference data

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Abstract

The challenge of transforming the structure of the car fleet in favour of energy-efficient and clean vehicles (e.g. electric, hybrid and bio-fuel cars) is not merely a matter of technical feasibility. Equally important is the requirement of economic viability of a technology. Despite an increasing number of models put on the market, purchases of electric vehicles (EVs) and hybrid vehicles remain very low in comparison to the overall new car registrations in most European countries (CCFA, 2016, p. 75).¹ In the case of France, even if the sales increased over the last few years, the market shares attained only 0.9% for EVs and 3.2% for hybrids (among a total of 1,917,226 new cars) in 2015.² The sales figures for the remaining alternative fuel vehicle (AFV) types are also still negligible: 129 super-ethanol cars, 38 NGV cars and 1467 bi-fuelled cars (i.e. gasoline + LPG or NGV) during the first 9 months of 2015 (CCFA, 2015, p. 33).

A wide-scale diffusion of AFVs presupposes acceptance and willingness to adopt by a sufficiently large proportion of the consumers. New car buyers constitute the main population segment through which this diffusion could materialise. Knowledge of their preferences, opinions and attitudes is essential to elucidate the reluctance to switch to AFVs and draw lessons as to possible levers of action to encourage such behavioural change.

We investigate the preferences of households (who own the bulk of the car fleet) in France regarding the choice of a new car in view of its technical characteristics and performance, purchase and use costs, and practical aspects of use (e.g. availability of refuelling/charging stations).

The data are from a Stated Preference survey carried out in the second half of 2012. The sample was drawn from the new car registrations database, based on the energy source of the car. Thus, the sampled individuals still had in memory the purchase context and the important factors that they had to consider in determining their choice. Each respondent was presented 12 choice situations comparing each time two alternatives. Five vehicle types were considered: conventional, bio-fuel, hydrogen, electric, and hybrid. Each alternative was described by a set of attributes: purchase price, cost of fuel/energy per 100 km, density of refuelling/charging stations, range, engine power, level of CO₂ emissions (g/km), and amount

¹ Two notable exceptions are Norway (17.1% of new car registrations for EVs and 10.4% for hybrids in 2015) and the Netherlands (12.5% for hybrids but only 0.7% for EVs in 2015).

² EV purchases were 184 in 2010, 2630 in 2011, 5663 in 2012, 8779 in 2013, 10561 in 2014 and 17268 in 2015. The figures for hybrids were, respectively, 9655, 13635, 27889, 46745, 43143 and 61619.

of ecological bonus or penalty. For EVs, two additional characteristics were given: duration of complete recharging of battery at home, and whether the car has a range extender (allowing 50 or 100 km). The attribute levels were pivoted around those of the car bought. This introduces more realism by ensuring that the alternatives proposed to the respondent are not too different from his/her recent purchase experience. Concerning the characteristics not mentioned, the respondent was asked to consider them as identical to those of the car he/she recently bought. In addition to car preferences, the survey collected information on, among others, the respondent and his/her household, the new car bought and the other car considered before final choice (if any), opinions on car technologies, environmental problems in relation to the car, and attitudes towards the environment. Over 4,300 interviews were completed.

The stated choices are analysed by means of Multinomial Logit and Mixed Logit models to estimate the effects on the probability of choosing a vehicle type of, notably, its technical characteristics and performance (e.g., engine power, range, CO₂ emission), the density of the network of refuelling/charging stations (when relevant), purchase and use costs, fiscal incentives, and socio-demographic factors (e.g., income, household composition, residential location, education level). The aim is to identify favourable factors for and hindrances to the adoption of AFVs, to assess households' willingness to pay for these vehicles and to estimate their market potential under different scenarios about attribute levels.

The first modelling results show, in particular, the high importance attached to a sufficient range. This appears through the effects of the range level, of the density of the network of filling/charging stations, and of the availability of a range extender (RE) for EVs. The results also show a strong penalizing impact of high polluting emissions (CO₂) on the choice of a vehicle. The effects of the ecological bonuses and penalties, linked to the CO₂ emission levels, are not symmetric: the dissuasive effect of the penalty is stronger than the incentivizing effect of the bonus. Finally, the fact that the car actually bought by the respondent was a non-conventional one (whether LPG, electric, hybrid or super-ethanol E85) increases the probability of choice for all the AFV types considered in the SP games.

Focusing attention on electric vehicles, anxiety about range appears as a major hindrance to their adoption. Apart from a sufficiently high battery performance, this could be alleviated by the availability of a RE (even more if it allowed an additional distance of 100 km instead of 50 km) and a fairly dense network of public charging stations. A further barrier to the adoption of EVs is their relatively high purchase price. Respondents' actual new car purchase decisions (made during the few months preceding the survey) show that in most cases where they considered purchasing an EV but ultimately abandoned it in favour of another vehicle type (mainly a conventional vehicle), the EV was significantly more expensive than the car that was finally bought (a price difference of at least 10%). Also hindering is the negative perception of EVs as to their reliability and/or safety by part of the respondents (among the reasons frequently put forward to motivate systematic rejection). Finally, owning only one car lowers the chances of a shift to an EV, in view of its (perceived) limited range and the diversity of trips made by car (including long distance trips for holidays). The EV seems to be perceived rather as a second car. Indeed, all but one of the (very rare) respondents who bought an EV owned at least two cars. Furthermore, when an EV was considered and then abandoned, the car finally bought was in a sizeable proportion of cases the only car owned.

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