CITIZENS IN ENERGY TRANSITION: HIGHLIGHTING THE ROLE PLAYED BY SPATIAL PREFERENCE HETEROGENEITY IN PUBLIC ACCEPTANCE OF BIOFUELS

Anthony Paris, LEO, University of Orléans, + 33 1 47 52 52 28, paris.anthony@parisnanterre.fr
Benoît Chèze, IFPEN and EconomiX-CNRS University of Paris Nanterre, + 33 1 47 52 51 26 , benoit.cheze@ifpen
Pascal Gastineau, AME-EASE Gustave Eiffel University, + 33 2 40 84 58 52, pascal.gastineau@ifsttar.fr
Pierre-Alexandre Mahieu, LEMNA, University of Nantes, +33 2 40 30 60 43, pierre-alexandre.mahieu@univ-nantes.fr

Overview

In France, transportation sector accounts for 34% of the final energy consumed and 26.4% of national greenhouse gas (GHG) emissions (excluding land use changes).It is the biggest emitter of GHGs at the French level. To reduce dependence on oil imports and tackle climate change, policy makers want to shift consumption behaviour towards local "greener" energies. Renewable fuels development is an integral part of the public policies mix highlighted by policy makers to decarbonize the transportation sector. Since 2006, the consumption of biofuels has been multiplied by five in France. However, biofuels actually used are first-generation biofuels coming from agricultural crops. The use of agricultural raw materials for their production has largely called into question their sustainability. Indeed, these biofuels induce an additional demand for agricultural raw materials initially used for food, inducing at the same time a competition on the uses with food (and thus potentially a rise of prices) leading to the well-known *"food versus fuel*" debate, but also a competition on the uses of arable landand uses of water for irrigation. Several pathways exist to limit the environmental consequences of the transportation sector without using agricultural raw materials. One is the development of new types biofuels, also called second-generation biofuels, mainly relying on lignocellulosic biomass or agricultural residues.

Arguably, the widespread deployment of energy transition technologies will largely depends on the attitudes of consumers and citizens. Despite their increasing role in the transportation sector, the general public has low knowledge about biofuels (Van de Velde et al., 2009; Pacini and Silveira, 2011; Aguilar et al., 2015) and fuel-cell or electric vehicles are seen as a better technology to replace fossil-fuel vehicles (Petrolia et al., 2010; Aguilar et al.,2015). However, according to various studies (e.g., Solomon and Johnson, 2009; Van de Velde et al., 2009; Farrowet al., 2011; Johnson et al., 2011; Dragojlovic and Einsiedel, 2015) citizens have a rather positive opinion about biofuels in term of environmental benefits but prefer biofuels from non-edible feedstock (Jensen et al., 2010; Farrow et al., 2011; Delshad and Raymond, 2013; Aguilar et al., 2015; Dragojlovic and Einsiedel, 2015).

This article investigates the acceptance by the French citizens of a new annual tax to finance the development of biofuels in order to reduce greenhouse gas emissions in the transportation sector. To do so, a Discrete Choice Experiment (DCE) has been conducted in March 2018 among a set of 1000 respondents, representative of the French population. To our knowledge, this is the first study of stated preferences for biofuels in France. In addition, unlike previous studies of this type, we are not interested in preferences for a biofuel at the gas pump but rather in preferences for the development of biofuels as a solution to reduce GHGs emissions in transport.

Results of this survey are presented here. We *i)* analyse preferences for the main characteristics of biofuels, *ii)* highlight spatial preference heterogeneity in public acceptance of biofuels and *iii)* infer some insights for policy makers regarding the development of second-generation biofuels.

Methods

The DCE modeling framework relies on the characteristics theory of value (Lancaster, 1966) and the random utility theory (McFadden, 1974). In a DCE survey, respondents must choose from several options defined by their attributes (*i.e.,* fundamental characteristics of the respondents' situation). Often, three options are presented: nothing changes (*i.e.,* the *status quo*) and two alternative options. Respondents then choose their favorite option. Each option has different levels of the attributes. One of these attributes usually represents the monetary contribution of the respondents. Other attributes can include environmental or social implications of the issue under consideration. After discussions with biofuels and fuels experts as well as with fuels consumers having knowledge of biofuels or not, we selected four main attributes: *i)* the monetary vehicle, *i.e.,* an annual fiscal contribution during five years, *ii)* the support for agricultural sector, *iii)* the variation in GHGs emissions and *iv)* the impact on food prices. GHGs emissions reduction is a traditional attribute in DCEs addressing biofuels issues (Jensen et al., 2010; Susaeta et al., 2010; Farrow et al., 2011; Jensen et al., 2012).6 The two other attributes allow us to distinguish biofuels according

to their type (*i.e.*, first- or second-generation) and their feedstock without providing too many informations to respondents.

To select the optimal combinations of attributes' levels in choices cards presented to respondents, we use the D-optimality criterion providing ten choices cards. These were randomly blocked to two different blocks containing five choices cards. This first design has been administrated to a test sample comprising 42 respondents, *i.e.* 630 observations, to estimate priors used in a second efficient design.

Following Campbell (2007), Abildtrup et al. (2013) and Yao et al. (2014), we use a two-stage estimation procedure to identify and quantify the determinants of the individual-specific WTP estimates. We first estimate a Random Parameters Logit (RPL) model to obtain the individual-specific parameters for the biofuels attributes. We then infer individual-specific marginal WTP for each attribute. In a second step, Random-effects models for panel data are used to *i)* analyze the heterogeneity of these estimated individual-specific WTPs and *ii)* determine their main determinants.

Results

As expected, monetary contribution affects negatively the respondent's utility with a positive coefficient as the contribution monetary is used in negative form. In addition, results highlight non linearity in preferences concerning the emission reduction attribute with a significant and different impact on respondents utility for 20%, 30% and 50% reduction in GHGs emissions compared to the 5% level. This reduction in emissions positively impacts the utility confirming results in previous studies (Susaeta et al., 2010; Jensen et al., 2010, 2012; Gracia et al., 2011). The sign of the ASC coefficient is negative and significant at the 1% level, indicating that respondents value negatively the fact of staying in the status quo situation: respondents thus value positively a tax for biofuel development. Concerning others biofuel characteristics, results are in line with our expectation. The utility of the biofuel development for the French citizens increases with biofuel production supporting agricultural sector and avoiding an increase in food prices. This last result is in line with the negative impact of the bread price increase on the utility found by Kallas and Gil (2015).

Results of the second step show that French citizens can be split into two categories depending on the agricultural specialization of their location. Respondents living in area specialized in livestock farming, poly-culture and market gardening (54%) have greater mWTP to support agricultural sector and to avoid food price increase compared to French citizens coming from biofuels crops, viticultures and non agricultural areas (46%). Compared to the latter cluster, the former is less willing to pay for a reduction of 50% in GHG and is negatively impacted by the perception of tax burden.

Conclusions

This article investigates French population's motivations and obstacles to finance new biofuels development in the transportation sector. First, on the whole, there is a relative equality in the parameter linked to the GHG emissions reduction. Reduction in GHG emissions impacts all respondents' utility in a similar way. The mean of mWTP are 71, 105 and 142 euros per year for a reduction of respectively 20%, 30% and 50% in GHG emissions. Second, our results clearly highlight the role played by spatial preference heterogeneity in public acceptance of biofuels. However, heterogeneity in respondents' behavior is more linked to biofuel characteristics than to the fight against climate change through reduction in GHG emissions.

Our results confirm a strong preference for second-generation biofuels (no impact on food prices) allowing agricultural support, whatever the cluster under consideration. This first insight for policy makers is in line with the adoption of the EU directive 2015/1513 to limit the use of first-generation biofuels to 7% of the final consumption of energy in the transport sector by 2020. As a second insight, we would like to emphasise the fact that more than half of the respondents (54%) appears to be negatively impacted by the perception of tax burden. This result anticipates the Yellow Vests movement that started against carbon taxation in France in September 2018 as this survey has been conducted in March 2018. It provides a clear message for policy makers: caution should be taken on the way to finance the energy transition.

References

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