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How Do Travellers Respond to Health and Environmental Policies to Reduce Air Pollution?☆

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ABSTRACT

Despite the various measures taken to reduce air pollution in France, the French continue to use high-emission vehicles. We propose to evaluate the Willingness To Pay (WTP) for four means of transport: two high-emission vehicles (diesel taxi and diesel personal vehicle) and two low-emission vehicles (rented electric vehicle and public transport). Successive messages revealing the effects of air pollution on health and the environment are provided to individuals in a different order. The information conveyed changes both of the WTP of individuals and of their choices. However, the use of high-emission vehicles has not diminished, personal vehicles remain the most popular. Using data collected from our survey, a multinomial logit model is used to determine individual choices. We find that improving individuals' confidence in air pollution recommendations would be a good way to lead them to choose low-emission rather than high-emission means of transport. Moreover, these estimates also indicate that individuals who attach great importance to comfort are less likely to choose low-emission vehicles than those who value price above other factors. Individual interest can therefore prevail over collective interest, thus verifying the theory of the tragedy of the commons. Different policies (taxes, subsidies, or standard) to encourage people to adopt low-emission vehicles are then tested.

1. Introduction

Many actions have been conducted in France to reduce the negative impact of means of transport, such as taxis or diesel vehicles, on air quality. These actions were aimed at encouraging people to use low-emission vehicles, in particular public transport and electric vehicles. Actually, many studies about the adverse effects of air pollution on health have been conducted. Douglas et al. (1993) and Krewski et al. (2004) found a consistent and statistically significant association between long-term exposure to fine particles with a diameter of 2.5 μm ($PM_{2.5}$) coming from fossil fuels in vehicles and the risk of mortality. Using the fifty-one cities from the American Cancer Society study, Pope et al. (2009) reported that wide reductions in $PM_{2.5}$ concentration between 1980 and 2000 were strongly associated with an increase in life expectancy. In 2015, according to a French Senate committee, once the cost of all measures to fight air pollution has been deducted, the net health benefit for France of combating air pollution would be over 11 billion e per year.

Moreover, air pollutants have also a negative impact on the environment.[1] When fossil fuels are burned, it may create acid rain, which damages trees, buildings and makes the water unsuitable for wildlife. In addition, vehicles contribute to eutrophication, which stimulates blooms of algae and causes fish death and loss of plant and animal diversity. Air pollution from high-emission vehicles also increases haze. Air pollution can also damage crops and trees in reducing growth and survivability of tree seedlings and increasing plant susceptibility to disease. In addition, air pollution is responsible for greenhouse gases, which is a cause of global climate change. In 2015, the French Senate committee estimates the cost of air pollution in France to > 100 billion e per year.

So why do the French continue to use high-emission vehicles? Are they aware of the negative impact of air pollution on health and the environment? How to lead them to use low-emission vehicles? We built a questionnaire in which we informed respondents about these negative impacts. We consider two groups of respondents that receive two different questionnaires. The questionnaires only differ by the information order received by the respondents. Group 1 first receives information on the negative impact on health and then on the environment of air pollution, while Group 2 first receives information on the negative

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[1] See the US Environmental Protection Agency (EPA) for more details.

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impact on the environment and then on health. In order to characterize the respondents' preferences for each means of transport, we use the Willingness To Pay method (WTP). Policy-makers are faced with difficult choices when implementing air pollution reduction measures. Understanding people's preferences for these measures allows policy-makers to choose the best health and environmental policies.

Our approach relies on two building blocks. First, our paper is linked to the literature that examines the interaction between the WTP and information acquisition. The WTP approach is a stated preference method. Kroes and Sheldon (1988) and Louviere et al. (2000) present and develop the use of this method in diverse fields. This method has been notably used for estimating the individual preferences for means of transport (Baidoo and Nyarko, 2015, for a study in Accra central (Republic of Ghana); Hensher, 1994, for a review on the application of stated preference models in the transportation market; Petrik et al., 2016, for a study in Portugal; Wardman, 1988, for a study in the United Kingdom). Moreover, the WTP approach has also been used in air pollution issues. Kotchena et al. (2013) have studied the WTP for climate change policies in the United States, Suna et al. (2016) and Wanga et al. (2016) have focused on the WTP for smog mitigation in China. Our paper contributes to this literature by investigating the WTP for four means of transport (low-emission vehicles: public transport and rented electric vehicle, and high-emission vehicles: taxi and personal vehicle) in France. We find that people have a strong preference for personal vehicles, which are one of the high-emission means of transport. We introduce the precise impact of information on the travellers' WTP for the different means of transport. We then conduct an analysis to elicit the WTP for different means of transport with increasing levels of information on the negative impact of air pollution on health and the environment. We observe that information matters but the order of information does not. Indeed, the information caused changes both of the WTP of travellers and their choices. However, the use of high-emission vehicles has not diminished and the personal vehicle is still the preferred mean of transport. Using data collected from our survey, a multinomial logit model was used to determine individual choices. We observe that improving travellers' confidence in air pollution recommendations would be a good way to lead them to choose low-emission rather than high-emission means of transport. Moreover, these estimates indicate that travellers who attach great importance to comfort are less likely necessarily to choose low-emission vehicles than those who value price. Individual interest can therefore prevail over the collective interest, thus verifying the theory of the tragedy of the commons.[2]

Furthermore, we contribute to economics literature on the reduction of air pollution. There is a consensus on the harmful consequences on health and the environment of air pollution due to high-emission vehicles. We then test health and environmental policies: an information campaign on the consequences on health and the environment of air pollution, a tax policy in which high-emission vehicles are taxed, a subsidy policy in which low-emission vehicles are subsidised, and finally, a standard under which high-emission vehicles are forbidden. We also analyse combined policies (tax and subsidy, information campaign and the other tools, standard and subsidy). Some works have analysed the impact of air pollution policies on the structural changes at sectorial level and on energy use (Bollena and Brink, 2014; Naqvi and Zwickl, 2017). Others consider that the volume of pollution produced by an automobile is determined by drivers' behaviour vis–vis three criteria (vehicle selection, kilometres driven, and on-road fuel economy) and they study the optimal policies which could change the driver's behaviour (Montag, 2015). Agostinia and Jimnez (2015) have focused on the gasoline tax as the best instrument of climate policy. Nevertheless, none of these works has studied the impact of health and environmental policies on travellers' behaviour concerning their choice of means of transport. We find that choosing between these health and environmental policies will depend on regulator's priorities. However, two of these policies seem to be good alternatives, namely subsidizing low-emission vehicles with or without information campaign.

The paper is organized as follows. Section 2 details the study. Section 3 presents the results with a descriptive analysis and the determinants of travellers' WTP. Section 4 shows the welfare analysis, the determinants of travellers' choices and regulatory advice. Finally, Section 5 concludes.

2. The Study

According to Avem,[3] pollution related to transport has increased by over 30% in 20 years, the main cause being the increase in vehicle traffic. Indeed, urban congestion contributes to 75% of photochemical pollution and 40% of acid deposition. We then propose to analyse French travellers' Willingness To Pay in order to reduce air pollution related to transport.

2.1. Target Respondents

During February 2015, we conducted the study through Marketest.[4] We asked Marketest to create two groups of respondents. Each group was selected by using the quota method, i.e., the same proportions of gender, age and socioeconomic status (income and occupation) criteria in the group of respondents as in the census report of the French population by the Institut national de la statistique et des ´etudes conomiques (INSEE) in 2013. We had prepared specifically for this study two questionnaires, one for each group, to be posted online. The two questionnaires only differed by the order in the information received by the respondents. Group 1 first received information on the negative impact of air pollution, first on health and then on the environment. Group 2, on the other hand, first received information on the negative impact on the environment and then on health. Group 1 target respondents consists of 177 French people aged between 20 and 65. Group 2 target respondents are 165 French people aged between 20 and 80.

Table 1 presents the socioeconomic characteristics (gender, age, income, and occupation) of the respondents. Differences between the two groups and INSEE data are tested using the Pearson chi-squared test. A P-value (against the null hypothesis of no difference) of $< 5\%$ is considered significant. The results in the last three columns of Table 1 suggest that the three groups are not significantly different.

Through informational questions on the respondents, we understand that for 41.8% of Group 1 respondents and 34.6% of Group 2 respondents, price is the first criterion for selecting their means of transport. 29.4% of Group 1 respondents and 36.9% of Group 2 respondents take into account primarily travel time, and 28.8% of Group 1 respondents and 28.5% of Group 2 respondents the well-being during the ride. Only 33.3% of Group 1 respondents and 33.9% of Group 2 respondents are directly or indirectly (through family) affected by air pollution health issues such as asthma, respiratory disorders or allergies. Finally, 56.5% of Group 1 respondents and 65.5% of Group 2 respondents take into account the recommendations when a pollution peak is announced. Therefore, the majority of respondents in both groups' trusts the air pollution recommendations.

[2] The tragedy of the commons describes a situation in a shared resource system where individual users acting independently for their own benefit behave in a way that is contrary to the common good of all users by depleting or degrading that resource through their collective action. In our study, the common resource is the air, which is a shared resource, and the degradation is due to the pollution created by high-emission transports.

[3] See: http://www.avem.fr/index.php?page=pollution.

[4] For more details on Marketest see: http://www.marketest.co.uk/.

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