



Willingness to pay for a cleaner car: The case of car pollution in Quebec and France



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ABSTRACT

The problem of air pollution and greenhouse gas emissions is omnipresent today. Governments and civil society organizations are acting in concert to implement controls to limit the environmental consequences of human actions. The private sector is also changing, but it continues to lack strong incentives to initiate a substantial technological change in the direction of more “green products”. One argument used is the high cost of these technologies and individuals' limited willingness to pay for their benefits. The purpose of this paper is to establish, through a contingent valuation study, the value that Quebecers and French citizens attribute to a reduction in air pollution emitted from vehicles. To accomplish this objective, a price increase for less-polluting vehicles with similar performance as their more-polluting counterparts was proposed. Various econometric estimation methods were applied and corrections to the responses were made according to both the degree of certainty indicated in respondents' willingness to pay answers and the method of considering “Don't Know” answers. Results indicate a maximum willingness to pay of several thousand Canadian dollars (estimated between \$3000 and \$8000). The willingness to pay is also higher in France than in Quebec.

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1. Introduction

Gasoline and diesel fueled vehicles are the world's dominant mode of rural and urban transport [16]. These vehicles generate approximately one-sixth [20] to one-fifth [13] of the world's greenhouse gas emissions and are a major contributor of local air pollutants. These emissions substantially contribute to the deteriorating ecological balance and lead to various health problems [18]. In their study, West et al. [49] indicate that global greenhouse gas mitigation could avoid 0.5 and 1.3 million premature deaths in 2030 and 2050, respectively. In many countries, this situation has forced governments, environmentalists and automobile manufacturers to pay greater attention to vehicles powered by alternative energy sources. Given this fact, technological efforts have been deployed and have led to a new generation of low-emission automobiles and alternative-fuel vehicles. These new vehicles are expected to produce approximately 40% fewer emissions than traditional gasoline-powered vehicles while maintaining both

flexibility and performance [44]. For example, it has been observed that two hybrid electric vehicles – the Honda Civic and the Toyota Prius II – presented improved energy efficiency and pollutant emissions with 40 and 60% fuel reduction, respectively [12]. In the near future, hydrogen-, ethanol-, electricity- or solar energy-based technologies are expected to achieve emission reductions of up to 80–100% compared with present-day vehicles [9]. In their study, Gonzales Palencia et al. [14] also indicate that lightweighting vehicles could reduce CO₂ emissions by 48%. However, a critical issue that could slow down this revolution is the cost of these green technologies and people's willingness to pay (WTP) for vehicles powered by alternative fuels. The focus of this paper is to estimate Quebec and French citizens' WTP for cleaner cars. One major difference from previous published studies on this topic is that this study both considered uncertainty in respondents' answers and tested two different populations. The method used is that of contingent valuation (CV). In section 2, an overview of previously published studies on this topic is provided. The sampling strategy and survey design are presented in section 3. Section 4 introduces the econometric strategy and section 5 presents the results of the study. Those results are discussed in section 6 and conclusions are provided in section 7.

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2. Previously published studies

To our knowledge, no studies on Quebec and French citizens' WTP for cleaner cars have been conducted. However, studies on this topic have been published examining citizens of Ontario (Canada), the United States, Germany, Turkey and Japan.

Potoglou and Kanaroglou [40] evaluated the WTP for clean vehicles in Hamilton, Ontario, using a choice experiment (CE) design and an Internet survey. They found that reduced fuel cost, purchase-tax relief and low emission rates would encourage households to adopt cleaner vehicles. According to that study, the probability of choosing hybrids and alternative-fuel vehicles decreased when pollution levels were that of 75% of an average present-day car. For a 90% reduction in the pollution emission of a present-day average car, they have calculated an additional WTP (in terms of purchase price) between 2034 and 4819 CAD, depending on household income. This WTP was almost the same as the WTP for either an annual savings of 1000 CAD in fuel costs or the opportunity to purchase a tax-free vehicle. Three other studies have been conducted in North America, including the oldest study on this topic. That study is by Bunch et al. [6], who conducted a CE-based mail-back survey in Southern California. The clean-fuel vehicles that they assessed encompassed both electric and unspecified liquid and gaseous fuel vehicles. They found a WTP of 10,000 and 6000 USD for a 90% and 63% reduction in emissions levels, respectively. They also found a WTP of approximately 6000 USD for a fuel cost reduction of 50% per mile. Martin et al. [33] also studied a sample from California and assessed the WTP premium for hydrogen fuel-cell vehicles during a "ride and drive clinic" in Northern California. These authors used a CV method, and the mean WTP for a car that offset environmental externalities was 4005 USD. This study also investigated the annual operating cost premium deemed acceptable by consumers and found a WTP premium of approximately 925 USD. In the web-based study by Hidrue et al. [22], a CE was used to estimate the WTP for five electric vehicle attributes. The WTP premium ranged from 6000 to 16,000 USD for an electric vehicle with the most desirable attributes. The attribute of pollution reduction ranged between 1935 and 4346 USD for a reduction of between 50 and 95%. For a 75% reduction, this WTP was 2645 USD. Those authors also indicated that respondents capitalized approximately five years of fuel savings into the purchase price of an electric vehicle (i.e., a 500 USD reduction per year).

In Germany, Achtnicht [2] evaluated the WTP of car buyers for a reduction in CO₂ emissions per kilometer. This survey was conducted in the showrooms of car dealers of different brands and in selected offices of the technical inspection authority. Using the CE method, they found a WTP of 2720 euros in exchange for a 25% reduction in CO₂ emissions. For a 62.5% reduction, the WTP was multiplied by 2.5. In this study, the derived WTP can be translated into 476 euros per ton of CO₂. In Turkey, Erdem et al. [11] conducted a Web-based random survey to estimate the WTP premium for hybrid automobiles. They used a CV method and found an average premium of 858 USD for a hybrid electric vehicle that corresponded to a 50% reduction in pollution.

Finally, two studies have been conducted in Japan. Kishi and Satoh [26] analyzed Japanese respondents' evaluations of a low-pollution car purchase price to identify a suitable price range. The study was conducted in two cities – Tokyo and Sapporo – using a price-sensitivity measurement survey. The low-pollution car was a hybrid car, but they did not state a pollution reduction percentage. They found the acceptable price for a hybrid car to be lower than that of a gas-powered car. However, for people with high environmental awareness, the WTP premium for the hybrid car ranged between 130 and 280,000 yen in 2003 (i.e., 6–12% of the WTP for a

gas-powered car). Ito et al. [24] estimated how much Japanese citizens' WTP was for alternative fuel vehicles (electric, hybrid and fuel cell) using a Web-based survey with a CE design; these authors calculated that their respondents' WTP premium for a cleaner vehicle (with a 60% reduction in carbon dioxide) of with similar performance was 5293 USD.

3. Sampling and survey design

Quebec and France are culturally and linguistically close, but people's attitudes regarding environmental protection may vary. This study will enable us to assess whether these two populations have similar interests in cleaner vehicles and if so, to what extent. A random recruitment of subjects using an online questionnaire was conducted. After a pretest with university students, the questionnaire was sent to a random selection of email addresses from a database compiled by the researchers to conduct online surveys. Next, it was turned to an online survey sampling company that randomly distributed the questionnaire to its panelists. The survey was conducted between February and July 2009 and was equally distributed in Quebec and France.

Each questionnaire consisted of two parts. The first part included demographic and socioeconomic questions both to establish respondents' profile and to better determine the factors affecting the formation of WTP. The second part included not only various questions about the vehicles owned by the respondents but also the WTP question. The method used for WTP was a simple bid referendum [35]. The WTP question was as follows: "Given the problems created by the exhaust gases of motor vehicles (increased frequency of respiratory diseases, global warming, etc.), how much more would you be willing to pay for the next vehicle you purchase to emit X times [50% or 75%] less polluting gases than another vehicle from the same range that you could buy? Would you be willing to pay X dollars/euros more for this type of environmentally friendly vehicle?"

A simple bid referendum which provided a single bid price with eight price levels was used: 300, 800, 2000, 3000, 4000, 6000, 8000 and 10,000 Canadian Dollars in Quebec and 200, 500, 1000, 2000, 3000, 4000, 5000 and 6000 euros in France. The closed-ended referendum WTP question is perceived as less biased than an open-ended question [15,29]. Indeed, some researchers Haab and McConnell [17] have shown that an open-ended question might lead some respondents to give "protest" answers corresponding either to zero values or to very high values. A simple dichotomous question calling for a "yes/no" answer limits this bias by reducing the number of "protest" answers related to the open nature of an open-ended question. To the extent that there are different levels of certainty in the answers given to the WTP question, the referendum WTP question was followed by a question regarding the degree of certainty in the WTP answer. The different options to answer this question were as follows: very uncertain, un certain, more or less certain, certain, and very certain.

Furthermore, because the WTP question is hypothetical, it is reasonable to consider whether respondents will give random responses to complete the questionnaire more quickly. Arrow et al. [3] and Whitehead [50] offer two suggestions to mitigate this problem: 1) introducing the option of a "Don't Know" response, so that respondents can complete their questionnaire quickly without generating a WTP that makes no sense; 2) studying the validity of responses by examining whether the WTP varies with characteristics such as income, education, gender, etc. These suggestions were considered in the design of the questionnaire. To control for the potential problem of "scope effect", in half of the questionnaires, a 50% reduction of polluting gases was considered, whereas in the other half, a 75% reduction was considered.

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