Transport Policy 33 (2014) 144–153

Contents lists available at ScienceDirect

Transport Policy

journal homepage: www.elsevier.com/locate/tranpol

Evaluating the public perception of a feebate policy in California through the estimation and cross-validation of an ordinal regression model

Elliot Martin *, Susan Shaheen, Timothy Lipman, Madonna Camel

Transportation Sustainability Research Center, University of California at Berkeley, 1301 S. 46th St., Bldg. 190, Richmond, CA 94804-4648, USA

ARTICLE INFO

Available online 10 April 2014

Keywords:
Feebate policy
Motor vehicle
Climate change
Fuel economy
Ordinal regression
Cross-validation

ABSTRACT

Understanding the key factors influencing policy perception can be critical for informing the design of public policies. Feebates is a unique public policy that is meant to influence vehicle purchases. It presents buyers with a rebate for purchasing low-emission vehicles and a fee for purchasing high-emission vehicles. Because feebates directly impacts the consumer, understanding the dynamics of public perception, support, and opposition is important. This study explores the public perception of a potential feebate policy within California, and evaluates the robustness of an ordinal regression model to predict policy sentiment. The authors conducted a series of 12 focus groups throughout the State, which were followed by a computer-assisted telephone interview (CATI) survey of 3072 California residents in Fall 2009. The survey results were used to gain insights into consumer response to the policy, while focus groups gauged participant understanding of the feebate concept and overall response in preparation for the statewide survey. The survey data was weighted to match key demographics of the population and probed respondents on sentiments towards climate change, foreign oil dependence, policy fairness as well as overall perceptions of the policy. The results suggested that roughly three quarters (~76%) of the population would have supported a feebate policy, while one-in-five (~22%) would have opposed it. To evaluate how key factors simultaneously influence policy support/opposition, the authors estimated an ordinal regression model on policy support, which could correctly re-predict 89.4% of the sample's policy support or opposition. To assess the model's robustness, it was validated through re-estimation with 10,000 randomly drawn subsamples. Models estimated using these subsamples were then applied to predict policy perception for the remaining hold-out sample. The model performed very well, as hold-out sample opinions were predicted at an average accuracy of 89.1%, with little variance in performance. The authors conclude with a discussion of the implications of these results on public support for feebates and comment on the use of ordinal regression to predict policy opinion.

1. Introduction

Transportation activity contributes about 27% of annual greenhouse gas (GHG) emissions in the United States (U.S.), with more than 90% fueled by petroleum. Cars and light duty trucks, which comprise almost two thirds of the sector's energy use, are responsible for nearly 44% of all U.S. oil consumption (Davis et al., 2012). Reducing this consumption has been a public policy objective for decades, and a variety of policies have been proposed and adopted.

One such proposed approach is a feebate policy. A traditional feebate policy is generally comprised of two parts: a rebate (price reduction) for the purchase of a low-emission vehicle and a fee (price increase) for vehicles that produce higher emissions. Feebate policies can establish fees and rebates based on vehicle GHG emissions, or consider other air pollutants or fuel economy as benchmarks. A “pivot point” of the policy identifies the level of vehicle emissions at which the feebate changes from granting a rebate to imposing a fee (German and Meszler, 2010). One advantage of feebates is that the policy funds itself either in whole or in part with the fee supporting the rebate. A common policy objective is revenue neutrality, such that additional governmental support is limited or not required. In addition, by shifting consumer preferences and demand, feebates may be able to indirectly encourage manufacturers to adopt new technologies and lower vehicle emissions per mile (Greene et al., 2005a,b).

* Corresponding author. Tel.: +1 510 665 3576.
E-mail addresses: elliot@berkeley.edu (E. Martin), sashaheen@tsrc.berkeley.edu (S. Shaheen), telipman@berkeley.edu (T. Lipman), madonna@tsrc.berkeley.edu (M. Camel).

http://dx.doi.org/10.1016/j.tranpol.2014.01.016
0967-070X

Recently, Liu et al. (2011) modeled the impact of a feebate policy on new vehicles in California using estimates for new vehicle sales and a vehicle stock model. They found that feebates could be effective in reducing GHG emissions by between 19.6 and 28.4 million metric tons (Mt) of carbon in California by 2020 (if implemented in 2011) depending on the policy design. Small (2012) conducted a simulation of several feebate policy designs and found that it would be about as effective as a policy he calls a "Pavley CAFE", in which federal standards for fuel efficiency follow those adopted by California through Assembly Bill 32.

This paper analyzes the perception of feebates in California through the analysis of a statewide survey and focus groups held in late 2009. The authors evaluate the relative influence of socio-economic and attitudinal variables with policy support and opposition through the estimation of an ordinal regression model to predict policy perception. The robustness of this model is then cross-validated by splitting the sample into two subsamples: one for coefficient estimation and the other for prediction. The process is repeated for many subsample draws, permitting a distribution of prediction accuracy to be generated. This approach is useful for evaluating the robustness of ordinal regression models and, in this case, shows that the model is quite reliable with a consistent prediction accuracy of about 90%.

The paper is organized into six main sections. First, a review of past feebate programs as well as previous research in policy acceptance is provided. Next, the study methodology and sampling frame are outlined. Third, basic survey and focus group results are discussed. Fourth, the ordinal regression model is presented, and then fifth, its robustness is evaluated. Finally, the authors conclude with a discussion of key points emerging from the analysis.

2. Past feebate policies and related research in policy acceptance

As of 2013, there were no vehicle feebate policies in effect in the United States. However, there have been feebates policies on vehicles enacted in several other countries including France, Canada, and The Netherlands. In Europe in particular, research has advanced understanding of the impacts of potential feebate policies through surveys and simulation. Research has also more broadly evaluated the acceptability of pricing in transportation through studies of consumer response to other policies such as road pricing. Previous work in Switzerland from Peters et al. (2008) evaluated the difference in the impact between the design of an absolute feebates policy and a relative feebates policy. Absolute feebates policies apply rebates and fees that are calculated strictly based on the emissions or energy consumption of the vehicle. A relative feebates design normalizes those rebates and fees within some vehicle classification (e.g., such as SUVs). To explore the distinction between these designs, they define vehicle classifications along the dimensions of vehicle size, price, and engine size. They then utilized a survey of 326 new car buyers to evaluate consumer willingness to shift vehicle purchases along these dimensions as well as probing their perception of a feebates policy. The authors found limited willingness in the sample to change car choice for a rebate, but did find this willingness to be stronger for smaller car buyers. They concluded that a relative feebate policy design would be more acceptable to the population (Peters et al., 2008). The potential impact of feebates has also been evaluated through market simulation as in de Haan et al. (2009). This study, also conducted in Switzerland, simulated the car market through agent-based simulation across seven vehicle classes using a model developed in Mueller and de Haan (2009). They simulated 1 million car sales during a reference year of 2005 with no policy intervention. They then implemented four simulations, two on relative feebates and two on absolute feebates. They evaluated policies in terms of efficacy, defined as the relative reduction in CO_2 emissions, and efficiency, defined as the costs per avoided ton of CO_2. One key conclusion was that absolute feebates is more effective at reducing emissions than relative feebates, but only slightly. Given the higher public acceptability conveyed for relative feebates (as found by Peters et al. (2008)), they concluded that the difference in efficacy was not large enough to justify the absolute feebate design (de Haan et al., 2009).

Other research has evaluated public perception of incentive policies in applications outside of feebates. These studies suggest that public perception of pricing policies are dependent upon individual background, attitudes, and characteristics; and show common trends useful for forecasting the potential success of feebates. For example, Eriksson et al. (2006) used data from a mail survey in Sweden and modeled the relationship to factors expected to influence acceptability of three TDM policies. These policies were improved public transportation, a brochure-based information campaign about reducing car use, and increased fuel taxes. The model was able to explain half the variance in acceptability and found improved public transportation to be the most acceptable policy, while fuel taxes were deemed the least acceptable. This acceptability turned in part on perceptions of fairness, in which fuel taxes were deemed unfair relative to improvements in public transportation. Eriksson et al. (2008) conducted a follow-on study with an additional survey evaluating the acceptability of fuel taxes (a push measure) in contrast to public transportation improvements and renewable fuel subsidies (pull measures). They found again that pull measures involving subsidies were considered to be more effective and fair than push measures. This was consistent with perceptions found earlier in Rienstra et al. (1999), who used questionnaire data collected in the early 1990s to evaluate the perception of transport problems in areas of safety, the environment, and congestion as well as perceived effectiveness and support for policies to mitigate those problems. Analysis of the survey results found pricing measures to be unpopular, particularly push policies (charging people money). But support for policies were found to be higher in cohorts that were older, highly educated, of higher income and lower car ownership (Rienstra et al., 1999). Perceived fairness has also been cited as a major factor determining whether drivers would accept road pricing in Sweden (Jakobsson et al., 2000). Fairness was again noted as important in a combined study of road pricing in Japan, Taiwan, and Sweden via authors Fujii et al. (2004). In addition to fairness, a report conducted for the EU in the late 20th century found that the acceptability of a policy was connected to the "social norm", "perceived effectiveness of the policy", "personal outcome expectations", and "approval of societal aims" (Schade and Schlag, 2000). This first variable, the "social norm" of a person, was defined as "what a person thinks other peers (family or otherwise) think" of a particular issue. This variable was found by researchers to be the most predictive of a person's acceptability of a policy (Schade and Schlag, 2003). Interestingly, a subsequent study found that the person's belief that a road pricing policy was inevitable increased positive attitudes towards it, while at the same time weakening the influence of the social norm (Schade and Baum, 2007). Personal outcome expectations of a policy have also been found to play an important role in other research. Jaensirisak et al. (2005) conducted a stated preference survey in Leeds and London on the topic of road pricing, finding that over half of non-car users believed in the effectiveness of road pricing, whereas a majority of car users did not perceive the policy would be effective (Jaensirisak et al., 2005).