

# *Choice Modeling of Passenger Car Purchase Behavior and Implications for Energy Use*

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## **Overview**

A significant share of CO<sub>2</sub> emissions and energy consumption of European consumers is caused by private transport. Understanding the decision making process of car buyers is therefore crucial for designing policies that address these issues. This paper analyzes the car purchasing behavior of new car buyers in five major European markets (Germany, France, the UK, Spain, and Italy). Exploiting a uniquely detailed set of survey data ranging from 2008 to 2017, we find the determinants of car buyers' decision making behavior with regard to brand and model choice. The data covers an extensive set of variables related to the car buyers and their decision making process. Using discrete choice modeling, we derive the Willingness to Pay (WTP) for different attributes. In particular, we are interested in understanding the choices of consumers regarding fuel economy and the relationship between fuel economy and driving behavior. The results will allow us to evaluate different policy measures aimed at curbing overall fuel usage of consumers, such as gasoline taxes, fuel efficiency standards, or tax incentives for fuel efficient cars.

## **Methods**

We conduct our analysis based on a mixed logit framework. Mixed logit provides a flexible and computationally feasible solution for modeling car adopters' choices. Mixed logit (MXL) can solve two major limitations of less sophisticated specifications, such as the multinomial logit (MNL) model. The first limitation is the Independence of Irrelevant Attributes (IIA), which forces the substitution patterns to be fixed between alternatives. Furthermore, unlike MNL, mixed logit models are able to capture differences in preferences that are not linked to observed attributes (random heterogeneity). A drawback of using mixed logit is the lack of a closed form solution of the log-likelihood function used for estimating the coefficients of the parameters. Instead, the results are obtained via numerical simulation.

## **Results**

Preliminary analyses show significant fluctuations between car segments over time. Across all markets, buyers move from medium- and full-size cars towards both smaller cars and larger SUVs and Off Road vehicles, respectively. The causes of these developments and their implications for fuel usage in the five European markets considered are yet to be analyzed in more detail.

## **Conclusions**

The results will allow us to compare and evaluate different policy measures aiming at influencing the behavior of car buyers and drivers with regard to fuel usage.

## **References**

Berry, Steven; Levinsohn, James; Pakes, Ariel (1995). Automobile Prices in Market Equilibrium. *Econometrica* 63 (4), 841-890.

Train, K. *Discrete Choice Methods with Simulation* (2009). Cambridge University Press, Cambridge.

Wang, M.; Chen, W.; Fu, Y.; Yang, Y. (2015). Analyzing and Predicting Heterogeneous Customer Preferences in China's Auto Market Using Choice. *SAE International Journal of Materials and Manufacturing* 8 (3), 668-677.