REVISITING VEHICLE OWNERSHIP IN ACTIVITY-BASED MODELS CONSIDERING ALTERNATIVE FUEL VEHICLES

Arash Asadabadi, Aref Darzi,

Lei Zhang(lei@umd.edu)

Maryland Transportation Institute

University of Maryland

http://mti.umd.edu

Introduction

- **Number of vehicles available ➡ As a long term choice affects travel behavior**

- **MPOs have incorporated vehicle ownership in ABMs**

- **Number of Vehicles available ~ Household, Person, Zonal and Transportation variables**

- **Vehicle ownership models : Estimated based on household travel surveys**

- **No information for alternative fuel vehicle's ownership ➡ Cannot take the vehicles variety into account**

Change in Ownership Pattern

Fuel Type	2009 NHTS	2017 NHTS
Gasoline	208,744,732	211,899,839
Diesel	2,648,210	5,441,249
Alternative fuel	7,458	4,766,108

- **~ 63000% increase in alternative fuel vehicle ownership!**

- **2.1% share of all vehicles are alternative fuel vehicles**

- **Bloomberg New Energy Finance: 33% electric vehicles by year 2040**

- **Current models will no longer give good projection for vehicle ownership in future scenarios**

Future Scenarios

- **Future Scenarios: Auto Operating Cost?**
- **Change in ownership pattern change the auto cost significantly: Mode Choice, Destination Choice and other chained decisions will be affected**

| Auto Cost= Fuel Price * MPG + Operating Cost	Auto Cost= Electricity Price * MPGe + Operating Cost
Conventional Vehicles	**Electric Vehicles**

- **Current practices: Use previous ownership models and assume a share for electric vehicles based on SP surveys and other projections.**
- **2017 NHTS: capability to estimates EV ownership model!**
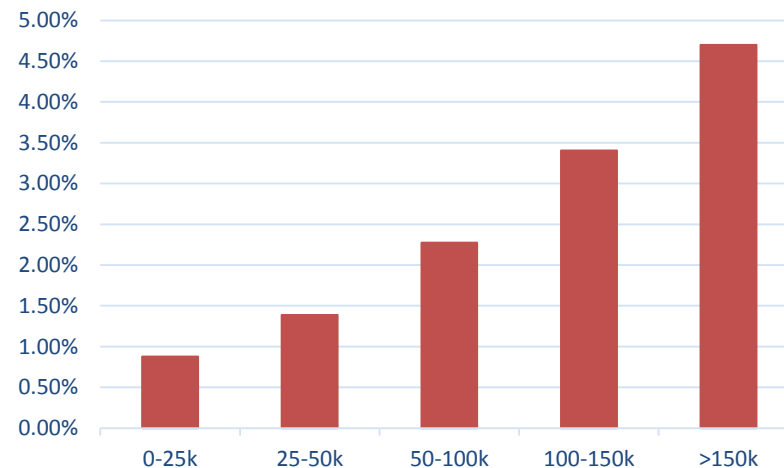
Alternative Fuel Vehicles in NHTS

- **Income Level**

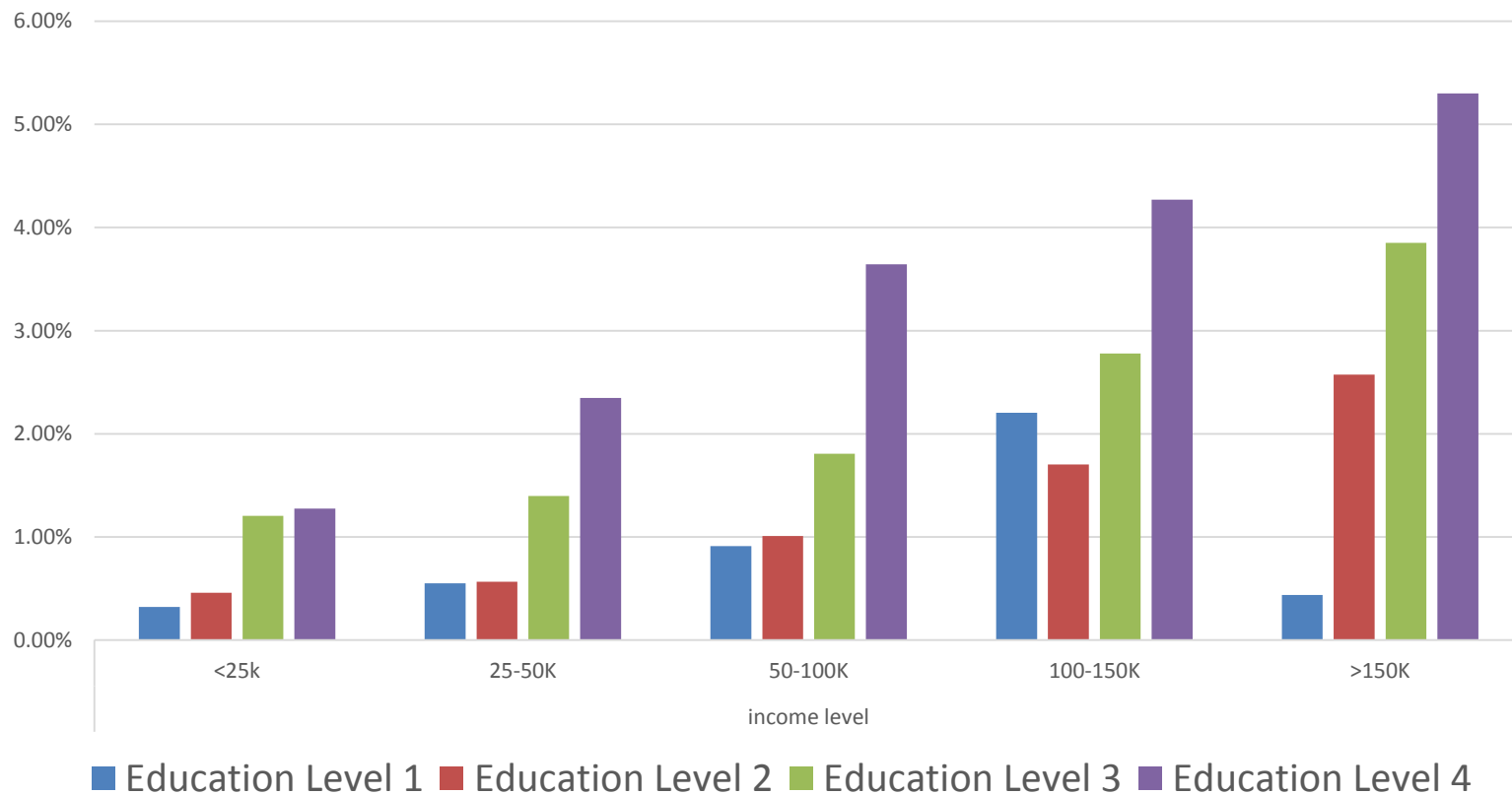### Gasoline car ownership share for different income groups
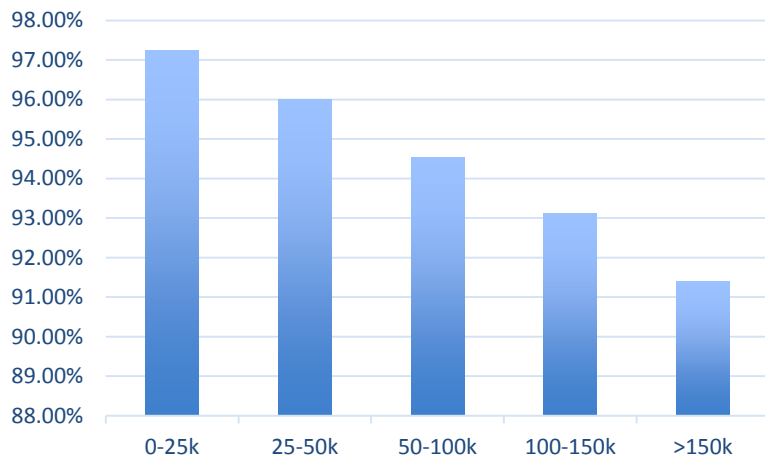
Alternative Fuel car ownership share for different income groups

Alternative Fuel Vehicles in NHTS

Share of Alternative Fuel vehicle Ownership for different Education levels

Electric Vehicle Incentive

- **In addition to the federal income tax credits, several states and local utilities offer additional incentives.**

- **Many states also offer non-cash incentive such as carpool lane access in California**
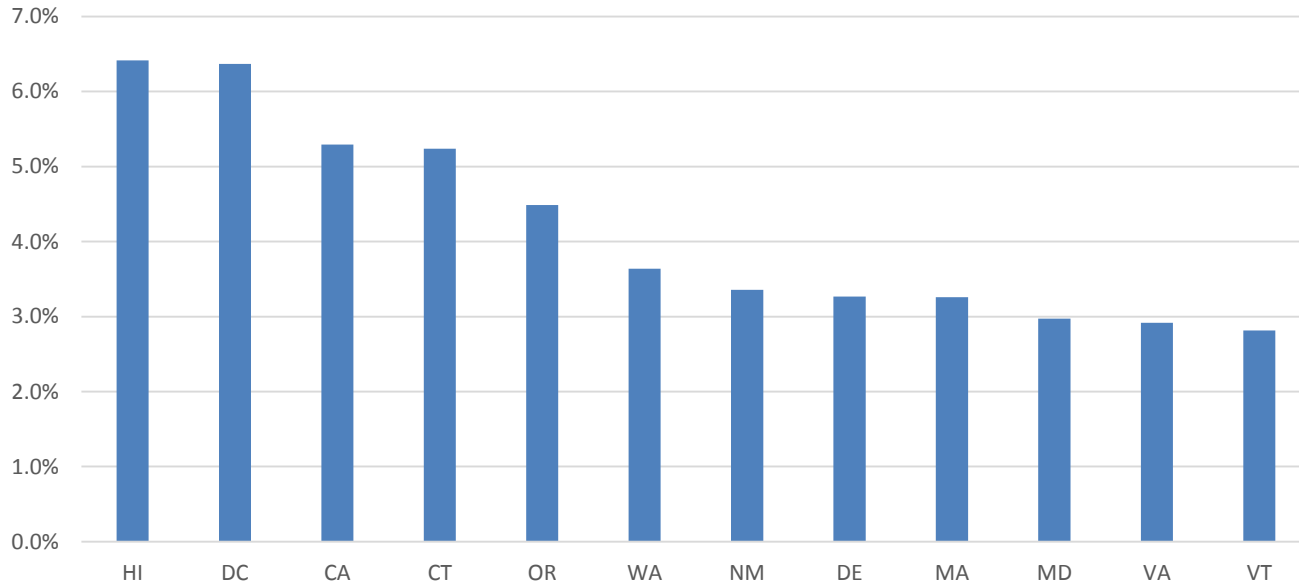
State	Incentive
Maryland	$3,000 excise tax credit for new vehicles with a total price under $60k
California	$2,500 rebate (based on income eligibility)
Connecticut	$3,000 rebate for new vehicles with a base price under $60,000
Hawaii	Carpool lane access and reduced rates for electric vehicle charging

- **AZ, CO, DE, LA, MA, NV, NJ, NY, PA, and DC offer incentives**

Alternative Fuel Vehicles in NHTS

States with highest share of alternative fuel vehicles

Bar chart showing: HI ~6.4%, DC ~6.35%, CA ~5.3%, CT ~5.25%, OR ~4.5%, WA ~3.65%, NM ~3.35%, DE ~3.25%, MA ~3.25%, MD ~3.0%, VA ~2.9%, VT ~2.8%
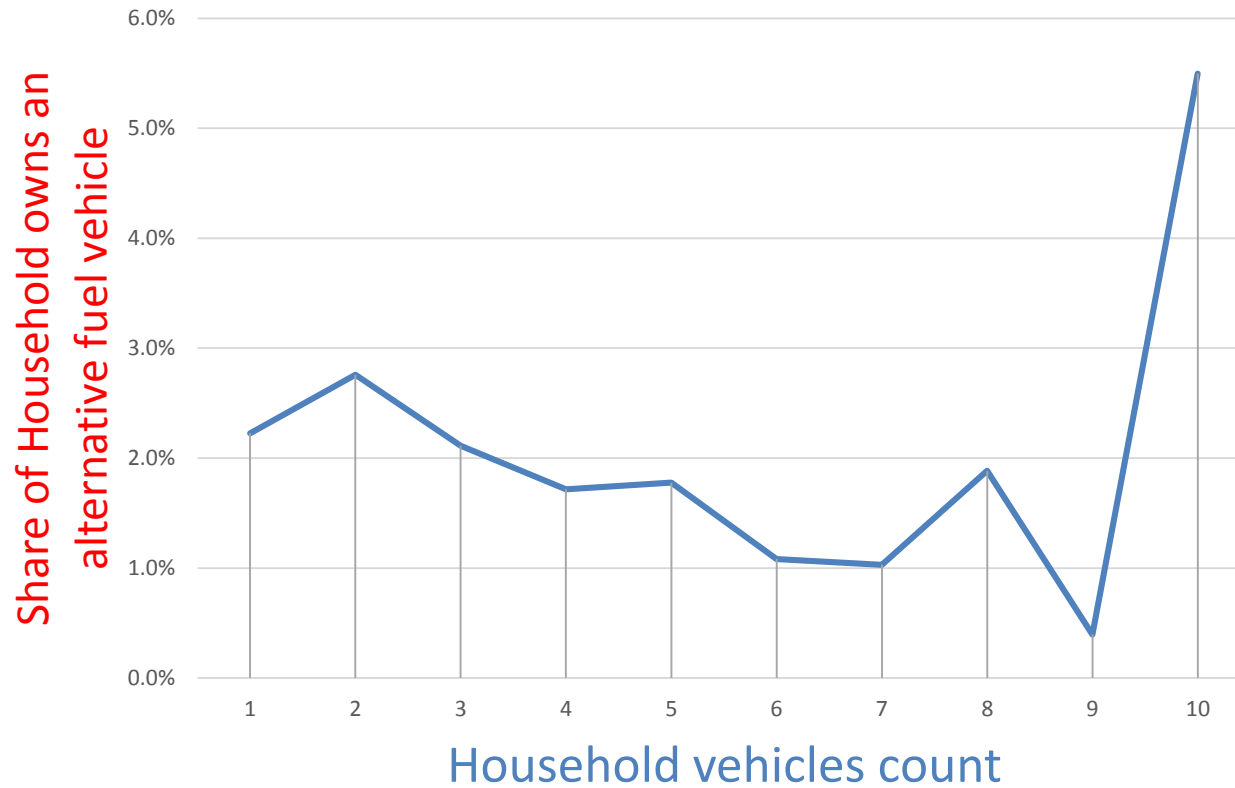
- **States with incentives have more share of alternative fuel vehicles(2.4% Vs 1.7% average)**

Methodology

- **Two-Level Model**

Level 1	→	Total Number of household available vehicles

Level 2	→	Number of EV for each household
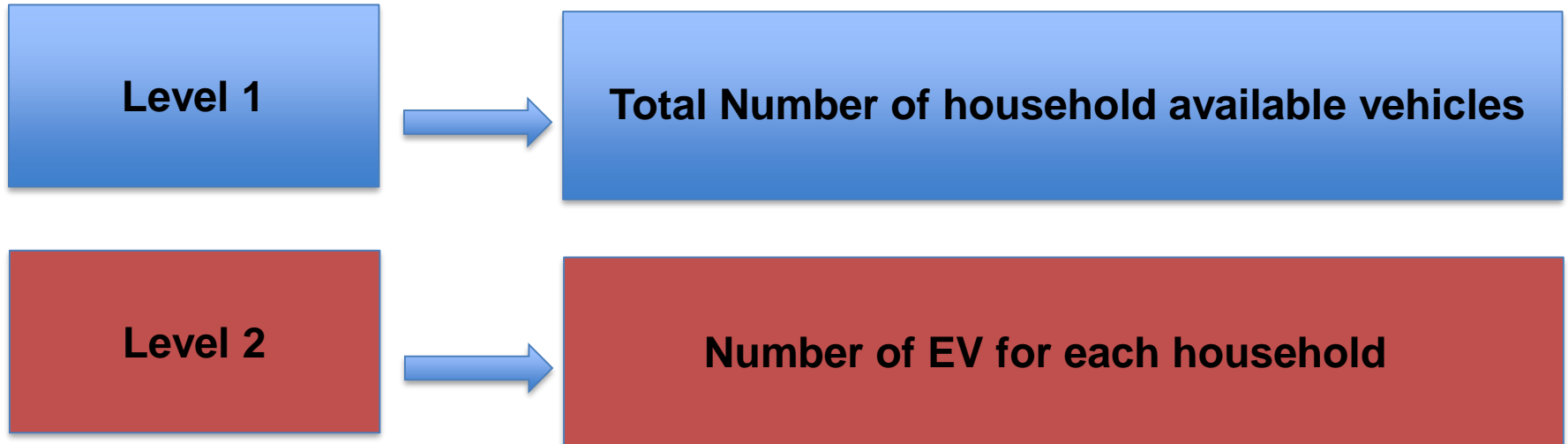
- **Independency of vehicles count and EV count are assumed**

MARYLAND
TRANSPORTATION
INSTITUTE

Methodology

Methodology

- **Three discrete choice model structure could be considered: MNL, ORL, and NL models.**

- **ORL model is specifically suited for choice contexts where the alternatives follow some natural ordering**

- **ORL assumes a single continuous latent function.**

- **Alternatives were chosen as no EV, one EV, and two or more EVs.**

Model Estimation

■ **ORL model result**

Variable	Coefficient	t-value
Income	0.24815	19.072
Size	0.07601	22.280
Education	0.35411	5.775
Incentive	0.20634	4.425
Urban	-0.05144	-4.365

Application and Ongoing Research

- **This model can be used as a complimentary model in MSTM 2.0 vehicle ownership model to predict electric vehicle ownership in future year scenarios.**

- **Use of geocoded data to count for network features in explanatory variables.**

- **Use of one-level modeling system : EV count condition on total number of vehicles $P(EV / N)$**

Thank You!

Questions, Comments, and Suggestions are Welcome.