Targeting of Fuel Efficiency Programs in China’s Automobile Industry

Chia-Wen Chen  
Academia Sinica

Wei-Min Hu  
National Chengchi University

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Motivation: Subsidizing Fuel-Efficient Cars

- To reduce gasoline consumption and carbon dioxide emissions in China:
  - a national cash subsidy program for fuel-efficient cars from 2010 to 2013
  - must have an engine size less or equal to 1.6 liters to be eligible
  - each consumer received a 3000 RMB cash subsidy when he/she purchased an eligible car
  - provided 12 billion RMB subsidy on fuel-efficient vehicles by the end of 2011
- In Chen, Hu, and Knittel (2017), we show that the program was not cost-effective in reducing carbon dioxide emissions
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Our research questions in the present paper:
1. Who bought inefficient vehicles?
2. How well did the program target “biased” consumers?
A Thought Experiment

- Our approach: exploit individual level attributes
- Group of consumers: consumers with similar attributes (age and gender) demanding similar cars
  - example: 30 year old males living in a specific county buying a mid-size SUV
- Expected fuel inefficiency of all consumers demanding vehicles with similar attributes
- Bias: conditional on buying a vehicle, the difference between the observed and the expected average fuel inefficiency for a group of consumers
- Goal #1: find consumer attributes that correlate with the highest fuel inefficiency
- Goal #2: show how a subsidy program changed the distribution of the bias
The Cash Subsidy Program

- One of the many national programs that aim to promote energy-efficient products
- Provided a one-time 3000 RMB cash subsidy to consumers who purchase government certified fuel efficient vehicles
- A car dealer must affix an official program sticker to the side window of an eligible vehicle at display
- The government reimburses car manufacturers on a monthly basis
Program Eligibility

- Manufacturers must submit applications for their vehicles to be considered for a subsidy
- The program explicitly lays out its fuel efficiency standards for different types of vehicles
- Must have an engine size less or equal to **1.6 liters** to be eligible

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Cutoffs for Different Types of Vehicles

- Eligibility cutoff 1: two-row vehicles with manual transmission
- Eligibility cutoff 2: all other vehicles
Fuel Inefficiency and Curb Weights: Subsidized Vehicles

Chen and Hu

Targeting
Fuel Inefficiency and Curb Weights: Unsubsidized Vehicles

- Fuel Inefficiency (liters/100 km)
- Weight (kg)

Eligibility cutoff 1: two-row vehicles with manual transmission
Eligibility cutoff 2: all other vehicles
Subject to cutoff 1 vehicles
Subject to cutoff 2 vehicles
Vehicles with an engine size greater than 1.6 liters
Data

- **Sales:** all new passenger-vehicle sales at the monthly level for each county from 2007-2015
- **Individual characteristics**
  - location of residence: county level
  - gender and age
- **Vehicle characteristics**
  - vehicle model id, engine size, country of origin, type of transmission (directly from the data set)
  - fuel-inefficiency and weight (from the Ministry of Industry and Information Technology)
  - transaction prices are not available
- **Program eligibility:** from the Ministry of Industry and Information Technology
- Currently, the preliminary results are based on two months of data (May 2010 and July 2010)
Fuel Inefficiency, Demographics and Vehicle Attributes

\[ y_{ijt} = \alpha + \beta_1 \text{(male)}_i + \sum_{k=1}^{7} \beta_k \text{(age group} = k)_i + \sum_{l=1}^{7} \beta_l \text{(male)}_i \times \text{1(age group} = l)_i \\
+ \gamma \text{1(manual transmission)}_j + \sum_{r=1}^{5} \gamma_r \text{1(engine size group} = r)_j + \sum_{s=1}^{15} \gamma_s \text{1(weight group} = s)_j \\
+ \sum_{u=1}^{4} \gamma_u \text{1(brand country group} = u)_j + \sum_{j=1}^{30} \delta_j \text{1(province} = j) + \epsilon_{ijt}, \tag{1} \]

- \( y_{ijt} \): fuel inefficiency of vehicle \( j \) purchased by consumer \( i \) in month \( t \)
- Consumer level: \( \text{1(male)}_i, \text{1(age group} = k)_i, \text{and 1(province} = j)_i \)
- Vehicle level: \( \text{1(manual transmission)}_j, \text{1(engine size group} = r)_j, \text{1(weight group} = s)_j, \text{1(brand country group} = u)_j \)
**Fuel Inefficiency, Demographics and Vehicle Attributes**

\[ y_{ijt} = \alpha + \sum_{k=1}^{7} \beta_k 1(\text{age group} = k)_i \times 1(\text{province} = j)_i + \sum_{l=1}^{7} \beta_l 1(\text{male})_i \times 1(\text{age group} = l)_i \]

\[ + \gamma 1(\text{manual transmission})_j + \gamma_r 1(\text{engine size group} = r)_j + \gamma_s 1(\text{weight group} = s)_j \]

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- We then apply the model to post-subsidy data
- Predict counterfactual fuel inefficiency without the subsidy program, \( \hat{y}_{ijt} \)
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**Savings in fuel inefficiency** \( ijt = \hat{y}_{ijt} - y_{ijt} \).
Outline

- Introduction
- The Cash Subsidy Program
- Empirical Strategy and Data
- Results
# Model Estimates

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National Level: Subsidized Products

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Targeting
National Level: Unsubsidized Products
Provinces with Lowest Savings (Subsidized Products)

(a) Shanghai

(b) Beijing

(c) Guizhou

(d) Chongqing
Provinces with Highest Savings (Subsidized Products)

(a) Gansu

(b) Qinghai

(c) Ningxia

(d) Jilin

Chen and Hu Targeting
Conclusion

1. We find variation in fuel inefficiency associated with geographic differences.
2. We find that in some places, some groups of consumers would be more likely to be nudged and switched their vehicle choices all the way across the product space to buy subsidized products.
Thank you!