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Modeling Supply and Demand in the Chinese Automobile Industry



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Motivation

- China is experiencing rapid economic growth and, along with it, rapid growth in vehicle ownership
- Evidence from Chinese cities suggests average annual growth rates in per capita vehicle ownership of 10% to 25%
- Vehicle ownership increased by nearly 56 times between 1990 and 2011
- Rapid growth in vehicle ownership and vehicle usage is linked to increasing global warming, emissions, air pollution, and other problems



Hangzhou,
Zhejiang Province

Research Objectives

- Analyze supply and demand in the Chinese automobile industry
- Model the behavior of state-owned automobile companies
- Analyze what factors affect the demand and cost of vehicles
- Analyze how consumers in China trade off various vehicle characteristics (such as fuel efficiency, whether the vehicle is an electric vehicle, etc.) with each other and with price
- Analyze the demand and cost for new vehicles
- Analyze the effects of various government policies, including those regarding alternative vehicles, on demand and cost

Methodology

- Develop and estimate a structural econometric model of demand and supply in the Chinese automobile market
- Estimate demand and cost parameters for all vehicles in China
- Estimate demand- and cost-side parameters, own- and cross-price elasticities, markups, and variable profits for alternative vehicles
- Use the model to simulate the demand and cost for new vehicles, and also the effects of various government policies on demand and cost

Advantages of Structural Econometric Models

- Use actual data on vehicle purchase decisions, not self-reported survey data
- Comprehensive data set on the vehicle purchase decisions of all vehicle owners in China, not just those of the consumers that are surveyed
- Econometric model will enable me to statistically control for multiple factors that may affect vehicle purchase decisions
- Parameters can be used to calculate consumer utility, firm profits, and welfare
- Estimate standard errors and confidence intervals for my parameters, which enables me ascertain whether my parameters are statistically significant
- Simulate demand, supply, and welfare under counterfactual policy scenarios

Demand Model Allows for Differences Among Consumers

- A traditional logit model of vehicle demand can generate unrealistic substitution patterns.
- In a logit model, if you take away a car model from the choice set, then consumers of that car will buy other cars according to their market shares.
- However, in reality, if you remove, say, a luxury car, the consumers of that luxury car are probably more likely to buy another luxury car than a random consumer would, even if luxury cars have low market share.

- In contrast, our random coefficients model of vehicle demand addresses this problem by allowing for interactions between unobserved consumer characteristics and observed product characteristics, thus allowing different consumers to vary in how much they like different car characteristics.

Utility of consumer i for vehicle model j :

$$\mu_{ij} = \delta_j + v_{ij}$$

where δ_j is the common component of the utility for vehicle model j :

$$\delta_j = x_j \beta - \alpha p_j + \xi_j$$

and v_{ij} interacts consumer and product characteristics:

$$v_{ij} = \sum_k x_{jk} \sigma_k \zeta_{ik} - \frac{1}{y_i} p_j + \varepsilon_{ij}$$



Qin-100
Plug-in Electric
Hybrid
Produced by BYD

Supply Model Allows State-Owned Firms to Have Different Objectives

Private firm maximize profit

State-owned firm maximize weighted sum of:

- Profit
- Consumer surplus
- Squared deviation from target number of hybrid vehicles
- Number of hybrid vehicles

We estimate the weights state-owned firms place on these different possible objectives



GX7
Produced by
Geely

Data

We are applying our model to annual data we have collected on sales, prices, and characteristics of the majority of vehicle makes and models in China, including electric vehicles, hybrid vehicles, and alternative-fueled vehicles, over the period 2004 to 2013.

Implications and Significance

- Our research is significant for industry, government, society, academia, and NGOs.
- Our model of the demand and cost in the Chinese automobile market will be significant for industry, particularly car manufacturers interested in better targeting cars, particularly alternative vehicles, for the Chinese market.
- Our estimates of the factors that affect demand and supply in the Chinese automobile market is significant for policy-makers interested in developing incentive policies to increase market penetration of alternative vehicles with potential environmental and climate benefits.

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