Effect of Policies for Vehicle Manufacturers in Nash Equilibrium

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There is a rich landscape of policies shaping the future adoption and production of passenger vehicles

• Manufacturers:
  – Corporate Average Fuel Economy (CAFE) standards
  – Zero Emissions Vehicle (ZEV) mandate

• Consumers
  – Monetary incentives (tax credits, rebates)
  – High occupancy vehicle (HOV) lane access
Employing a Nash equilibrium model

Reasoning for model choice

• Pros
  – Flexible enough to incorporate many types of policies
  – Integrates a demand model based off of actual sales data

• Cons
  – Computationally intensive system
  – “Future” attributes are unknown

Model structure

• Demand side:
  \[
  \hat{S}_j = \frac{\exp(\alpha x_{jt}^{\text{price}} + \beta x_{jt}^{\text{emr}} + \delta z_{jt})}{\sum_j \exp(\alpha x_{jt}^{\text{price}} + \beta x_{jt}^{\text{emr}} + \delta z_{jt})}
  \]
  – Discrete choice model based off of observed vehicle attributes

• Supply side:
  \[
  \max_{x_{jt}^{\text{price}}, x_{jt}^{\text{emr}}} \pi_m = \sum_{j \in F_m} \sum_{i} S_{jt}(x_{jt}^{\text{price}} - f_{jt}^{\text{totCost}}(x_{jt}^{\text{emr}}))
  \]
  – Maximizing profit by altering vehicle price and fuel efficiency

• Iterate until Nash equilibrium condition met
Snapshot of results, emissions rate by manufacturers

- NoPolicy
- CAFE
- ZEV
- Both
Discussion

• Modeling behavior of both firms and consumers is critical to understanding how policies are a two-way street, even if they only target one group

• Modeling details and modeling complexity is an essential tradeoff to consider

• Results indicate possible strategic nature of complying with policies that could lead to unexpected outcomes