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:

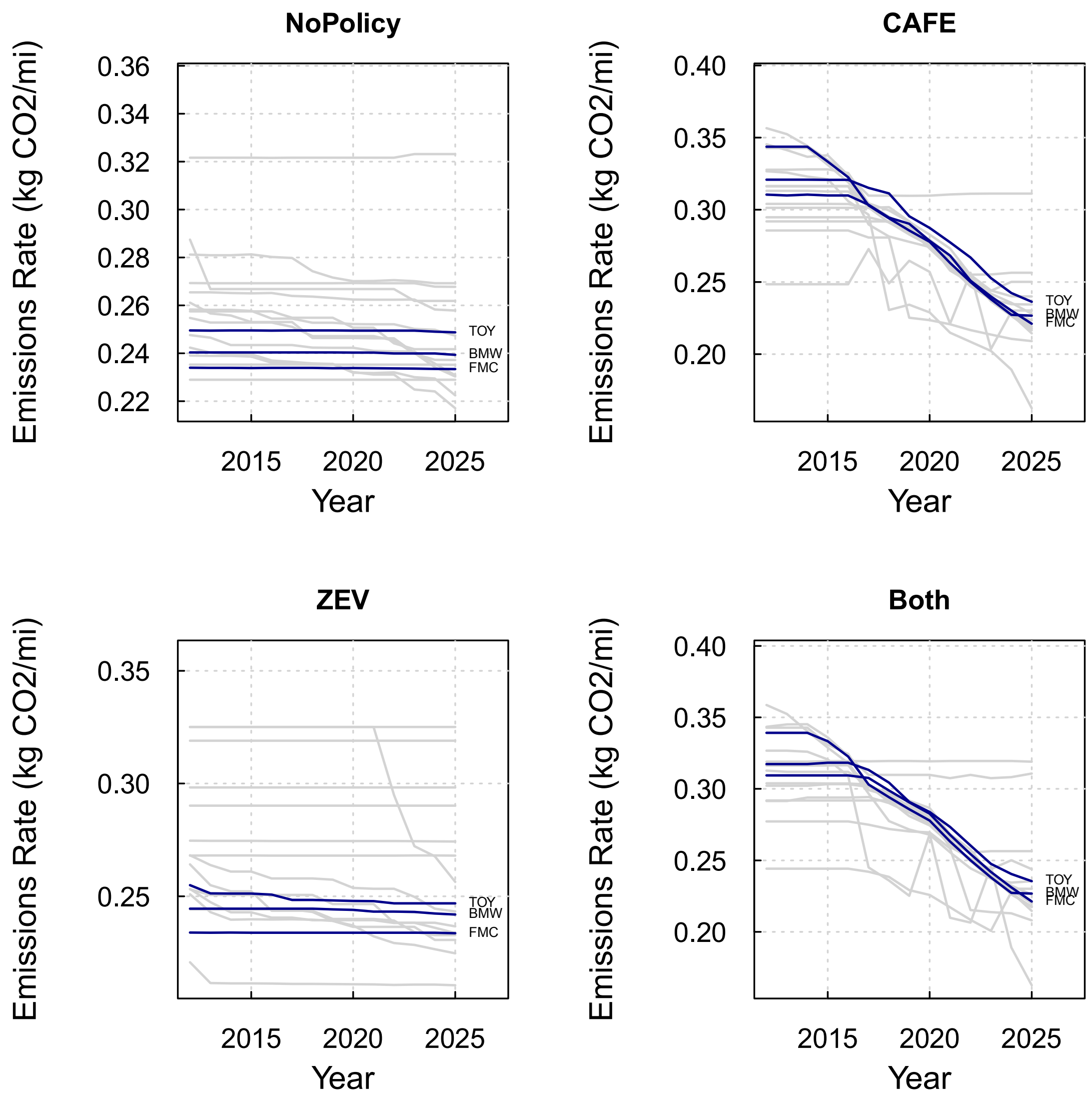
$$\widehat{S}_j = \frac{\exp\left(\alpha x_j^{\text{price}} + \beta x_j^{\text{emr}} + \delta_a z_{ja}\right)}{\sum_j \exp\left(\alpha x_j^{\text{price}} + \beta x_j^{\text{emr}} + \delta_a z_{ja}\right)}$$

  - Discrete choice model based off of observed vehicle attributes
- Supply side:

$$\max_{x_{jt}^{\text{price}}, x_{jt}^{\text{emr}}} \pi_m = \sum_{j \in F_m} \sum_t S_{jt}\left(x_{jt}^{\text{price}} - f_{jt}^{\text{totCost}}\left(x_{jt}^{\text{emr}}\right)\right)$$

  - Maximizing profit by altering vehicle price and fuel efficiency
- Iterate until Nash equilbrium condition met

Snapshot of results, emissions rate by manufacturers



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