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The Demand for and the Supply of Fuel Efficiency in Models of Industrial Organization

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Counterfactuals

Counterfactual simulations of the impact of policy instruments on fuel use in the motor vehicle sector require knowledge of several primitives:

Consumers

- Purchase a vehicle (LT)
- Decide the intensity of use of their vehicles (ST)

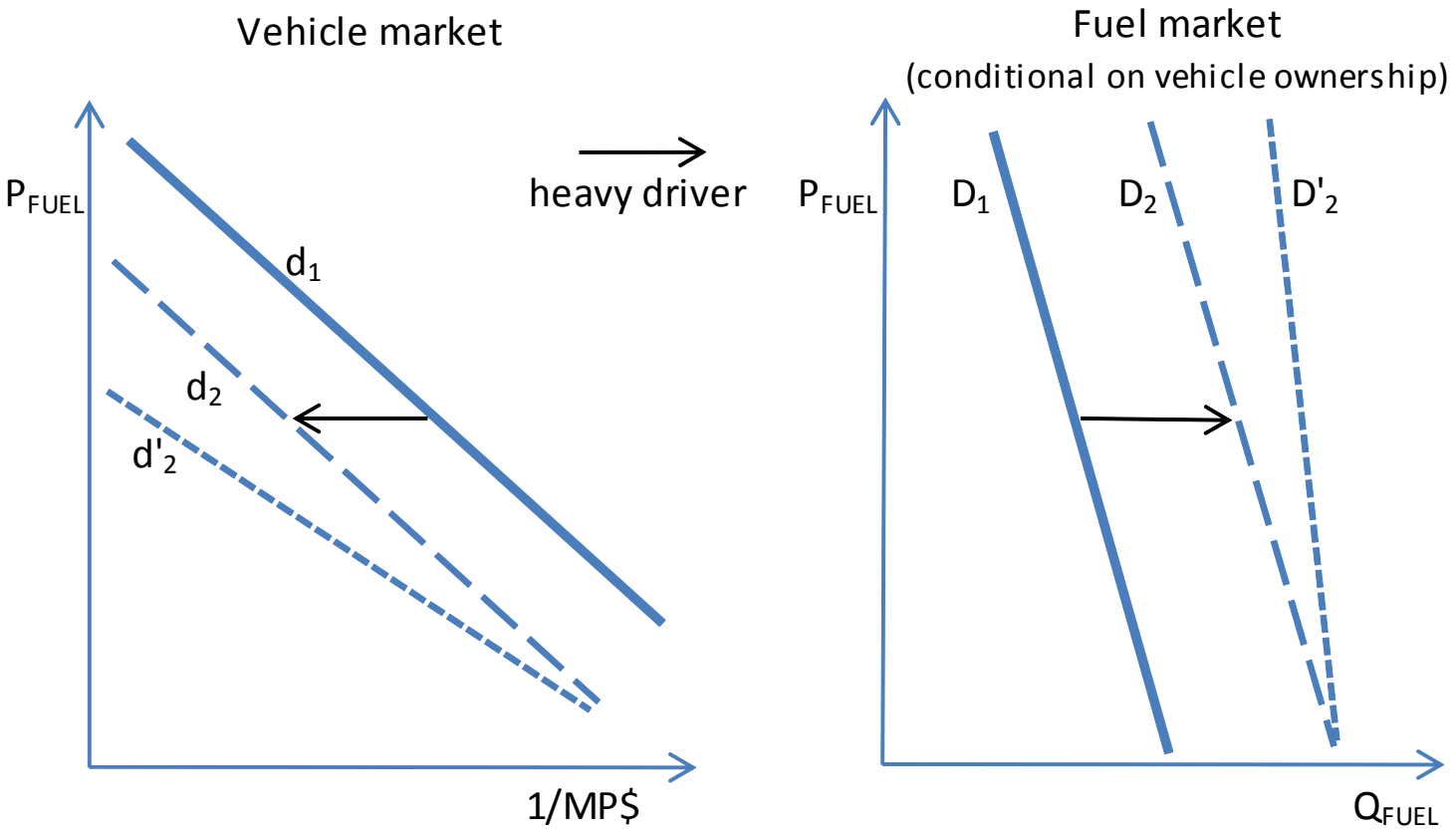
Producers

- Invest in technology to determine a fuel efficiency frontier (LT)
- Offer models along the frontier (ST)

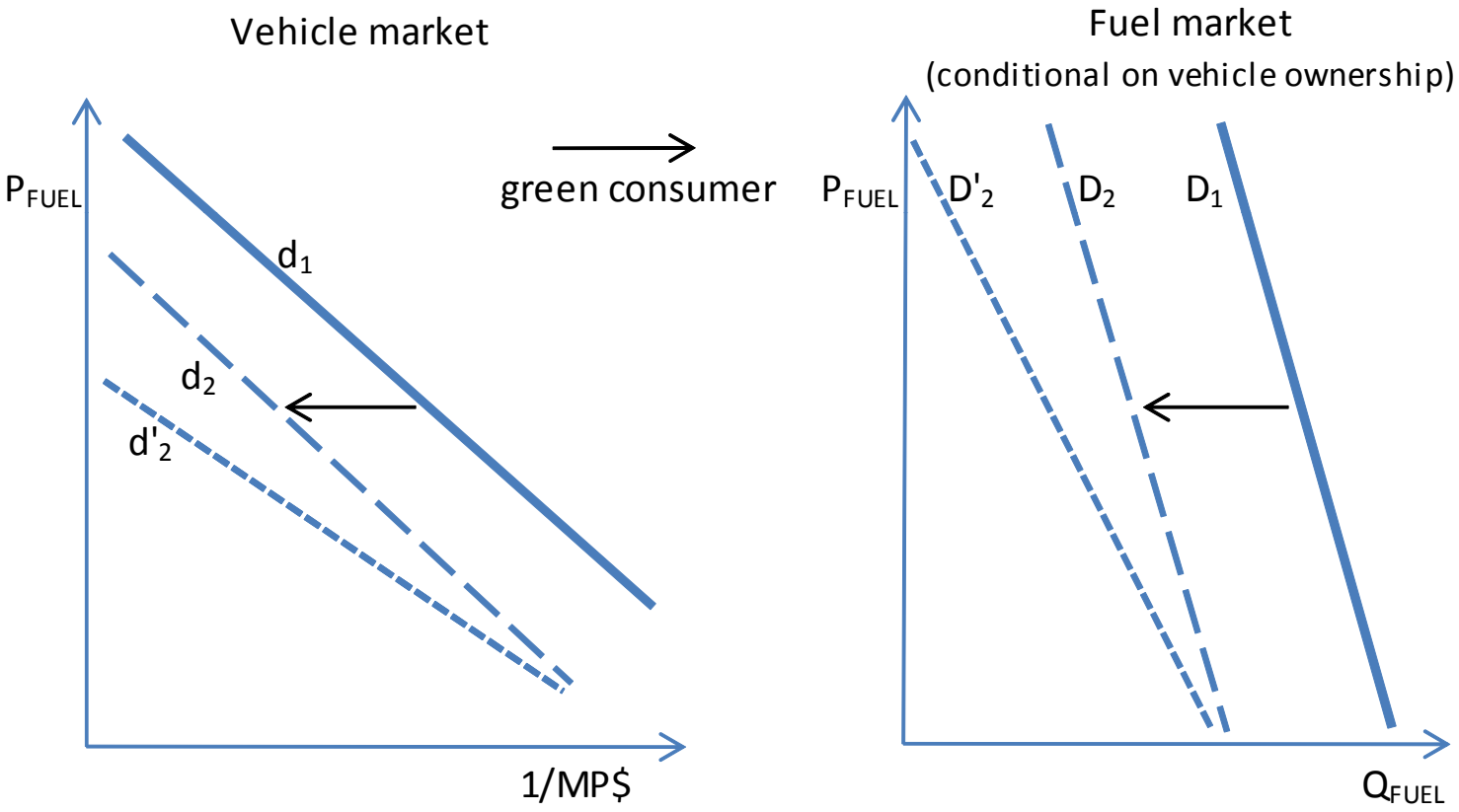
Consumer demand

- Short term demand for fuel conditional on (i) the stock of vehicles, (ii) commuting patterns, …
  - → Inelastic, even less elastic than in 1970s
  - → Important heterogeneity both in level and slope
- Demand for fuel efficiency enters the vehicle purchase decision (long term effects)
  - → Again, heterogeneous in the population
  - → Does not seem constant over time

Consumer demand: "heavy drivers"

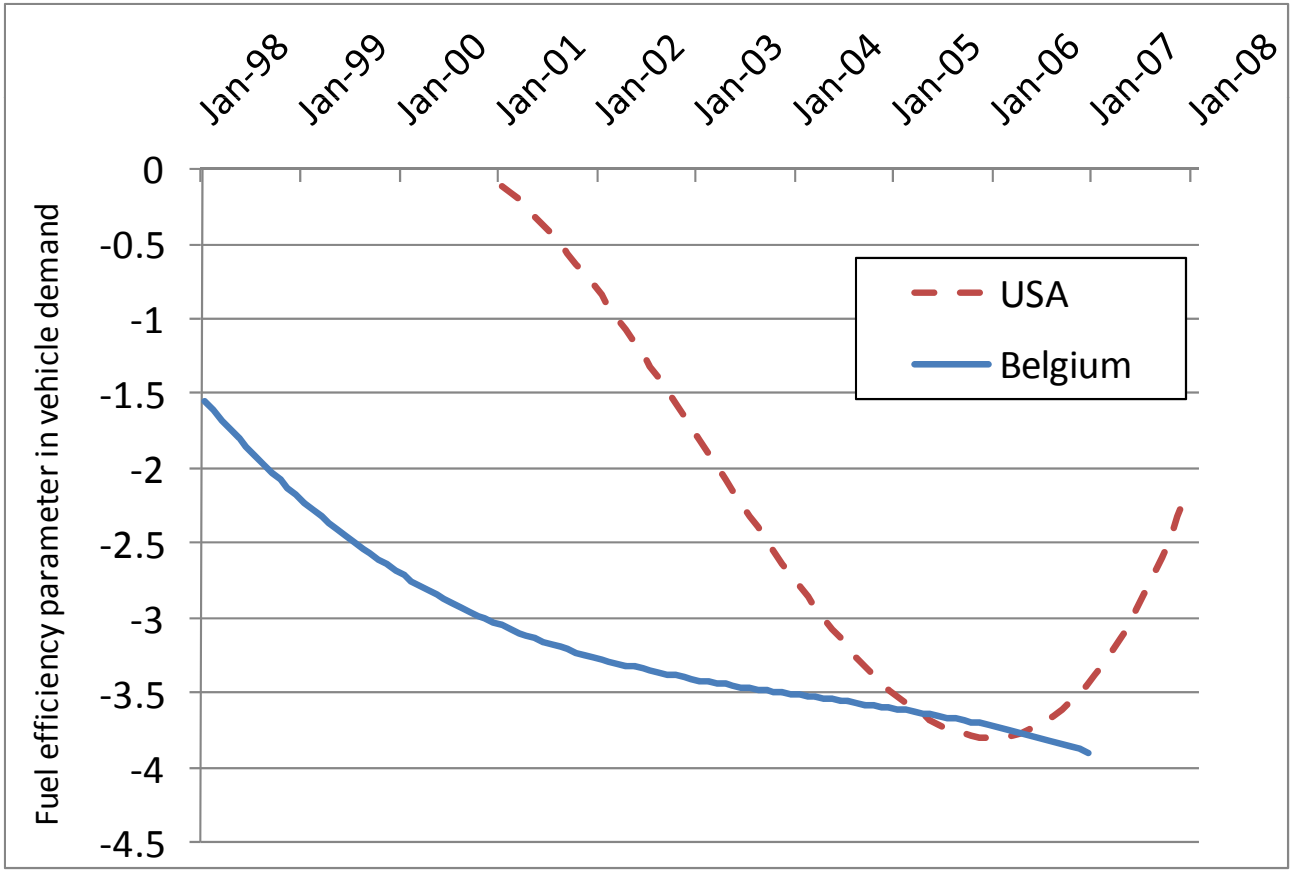


Consumer demand: "green consumers"



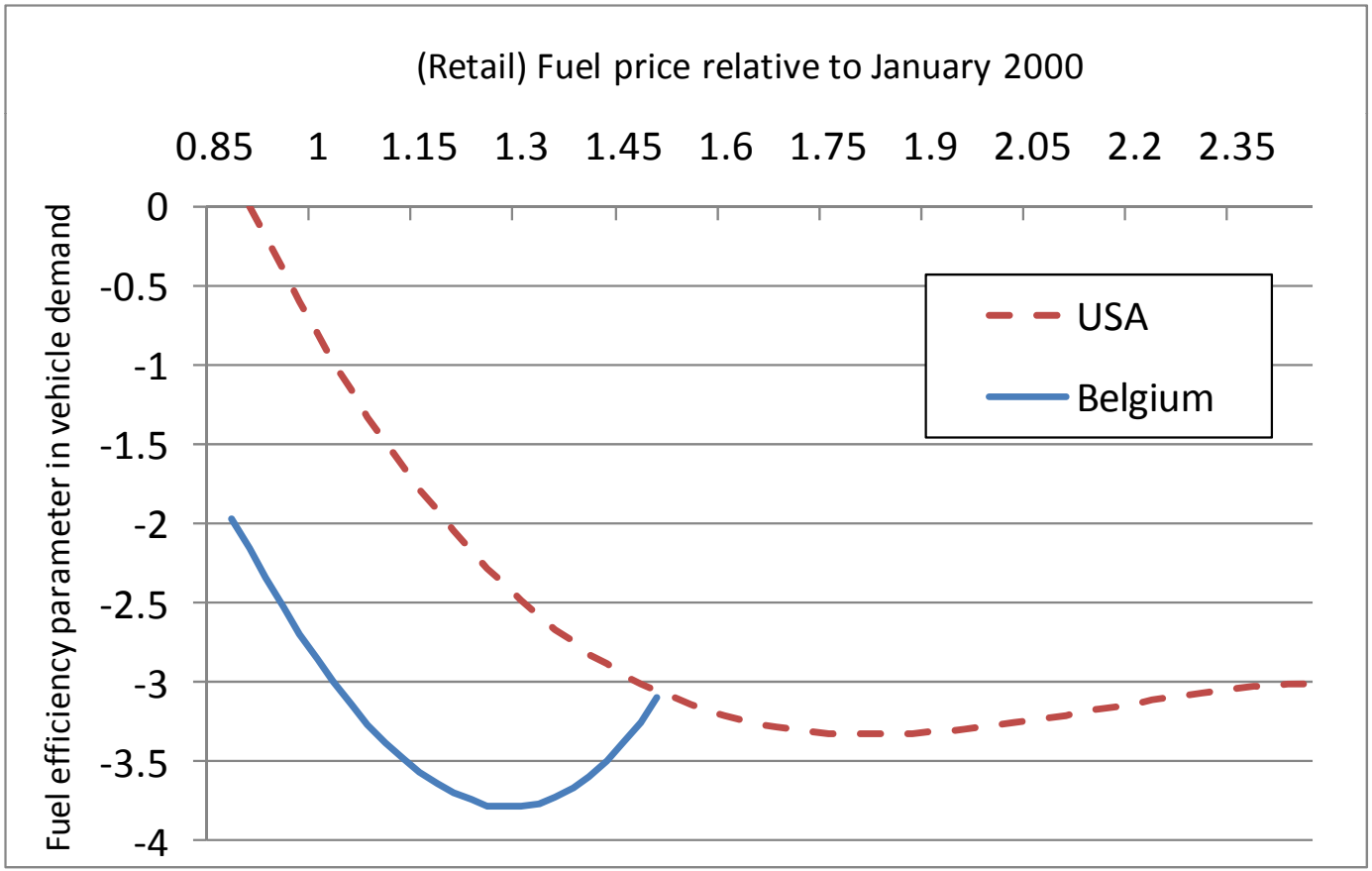
Some new evidence: WTP over time

"Elasticity of demand for most fuel efficient model variant with respect to the fuel price (conditional on model purchase)"

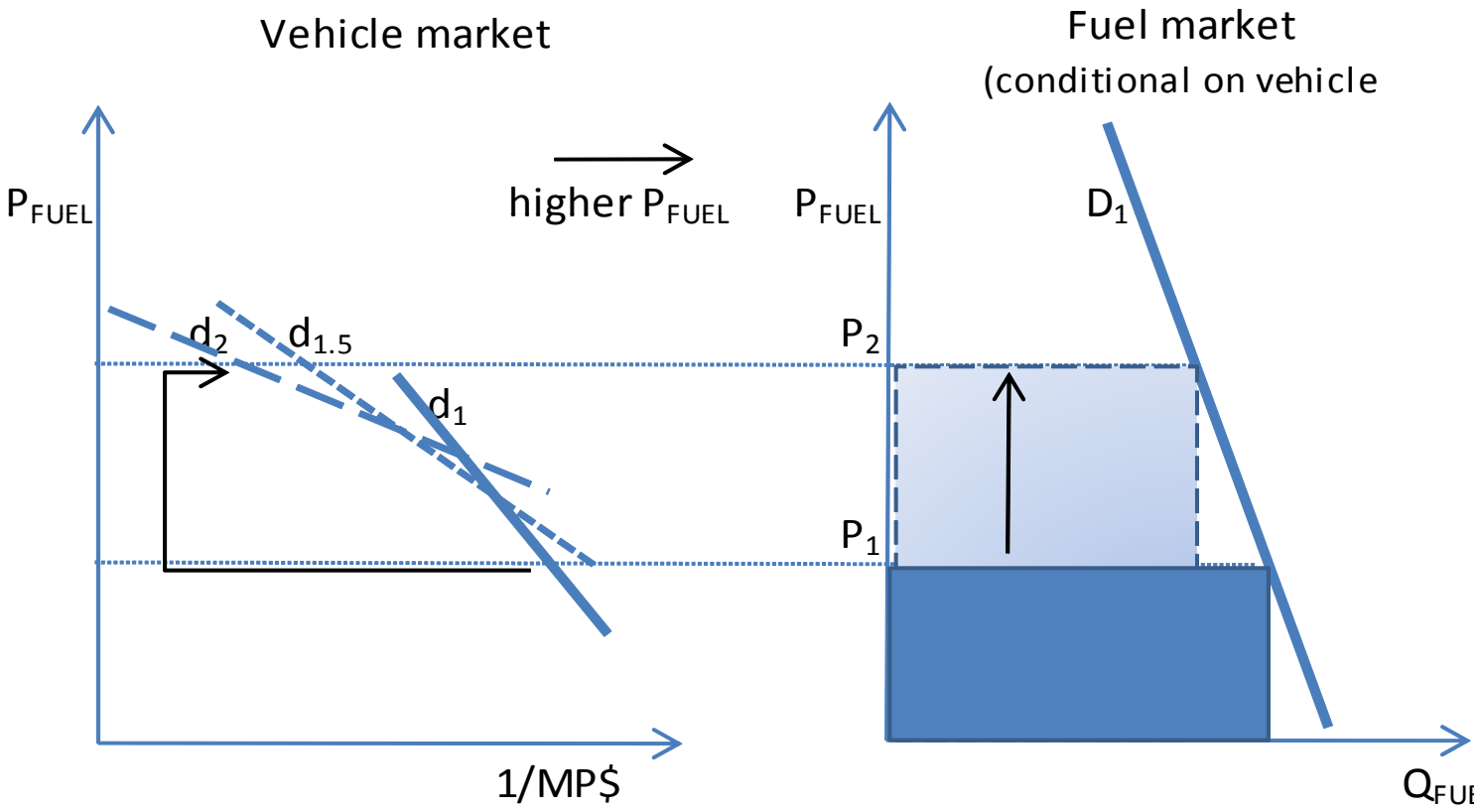


Some new evidence: WTP as $f(p_{FUEL})$

"Elasticity of demand for most fuel efficient model variant with respect to the fuel price (conditional on model purchase)"



Consumer D: in high fuel price regime



Consumer demand

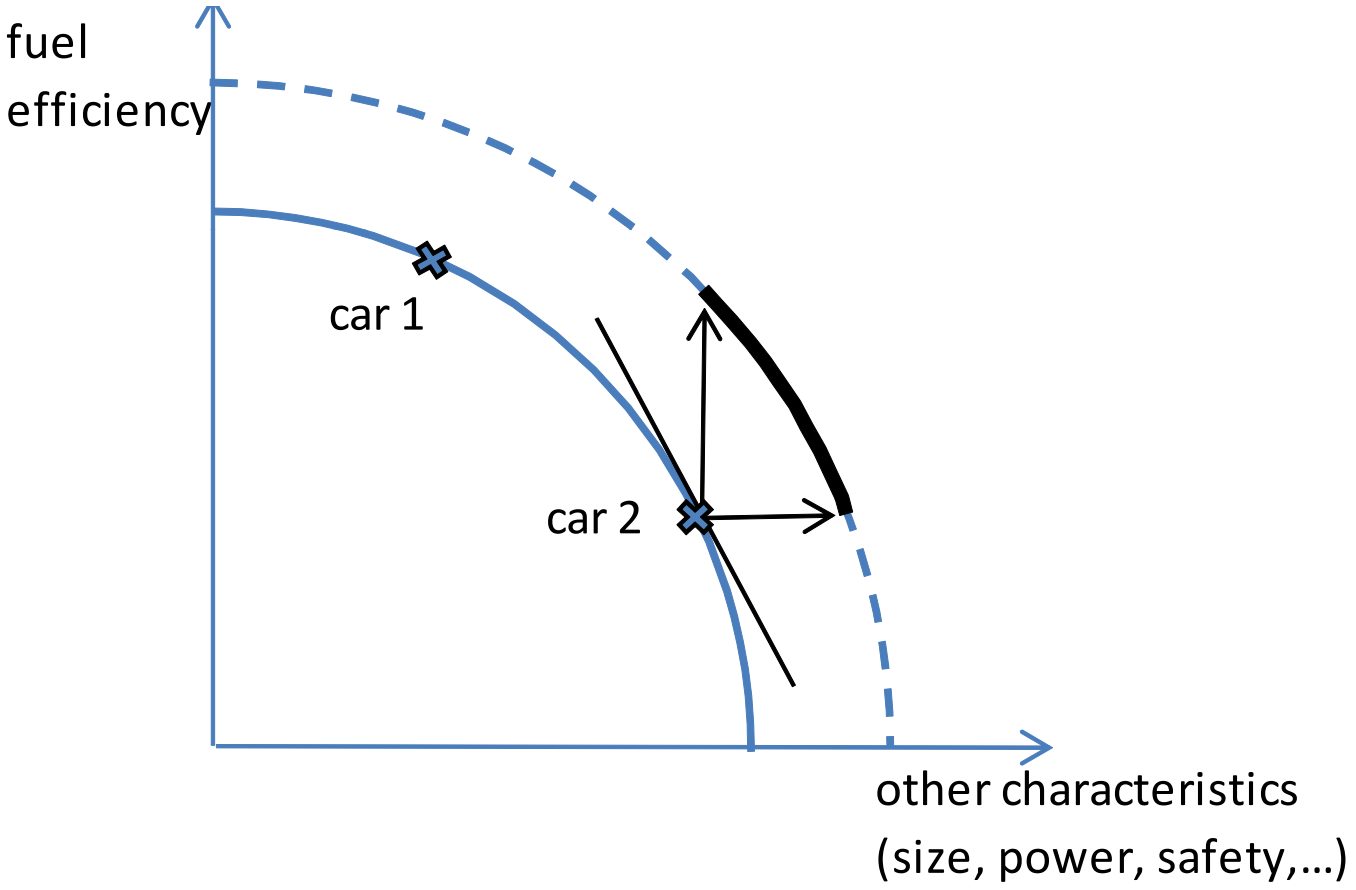
Where do we stand?

1. Need to take consumer heterogeneity into account in estimation, but also in counterfactual simulation
2. Need to take interrelation between vehicle use and vehicle choice into account, going beyond a representative consumer
3. Need to model more explicitly how consumers trade-off money spent on purchase price now and money spend on fuel in the future

Producer supply of models

- Short term: production possibility frontier
  - ➔ There is a trade-off between fuel efficiency and other desirable vehicle characteristics
  - ➔ Determined by technology
- Long term: technological change
  - ➔ Firms invest in new technologies to shift out this frontier
  - ➔ Higher efficiency has become possible at a cost (diesel, hybrid technology) without sacrificing features

"Fuel efficiency" frontier



Producer behavior I

- These issues matter greatly for demand estimation
  - ➔ The frontier interferes with the identification strategy for demand as fuel efficiency is endogenous **and** strongly correlated with other features
  - ➔ As fuel prices change and consumers' implicit price for fuel efficiency (in terms of other characteristics) varies, firms will update the position of their models along the frontier

Producer behavior II

- These issues matter greatly when the supply side is incorporated in the model
  - ➔ Firms do not count in mpg, but in dollars. They position products where profits are highest. The cost curve associated with fuel efficiency is only one element entering their behavior
  - ➔ Innovation is a strategic decision and should not be analyzed in a single-agent decision model with an exogenous cost function for mpg improvements.

Producer side

Where do we stand?

1. Need to take introduction of models, model-varieties, or vehicle characteristics into account. Fuel efficiency supply will **not** lie along the technologically determined cost curve
2. Should not characterize the supply of fuel efficiency in a single-agent framework

Counterfactual simulations

Where do we stand?

- I hesitate to quote numbers from the literature

Two key suggestions

1. Introduce consumer heterogeneity
   - ➔ For example, using annual mileage data
2. Augment the cost function for fuel efficiency with a behavioral model of how vehicles are positioned along the "fuel efficiency" frontier by strategic firms
   - ➔ Even with some (strong) functional form assumptions