# The Evolution of Market Power in the US Auto Industry

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# Motivation

**Question:** What is the evolution of industry performance and welfare in the U.S. car and light truck market for 1980-2018?

**What this paper does:**

(a) Estimates a differentiated products demand model.

(b) Compute marginal costs under Nash-Bertrand pricing.

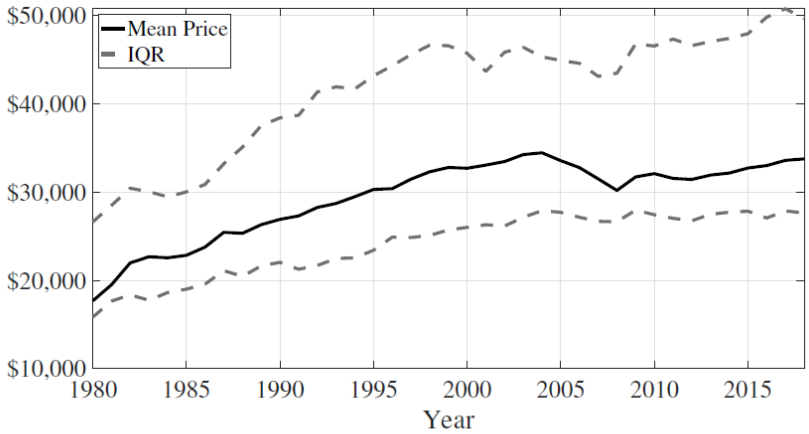
(c) Relate trends in consumer welfare and markups to industry trends in market structure and the composition of products.

**Key take away:** Consumer welfare in this market increased in the period, due to improving product quality and falling marginal costs.
**Interesting take away:** Markups can be misleading to assess welfare in an environment where products are improving over time.

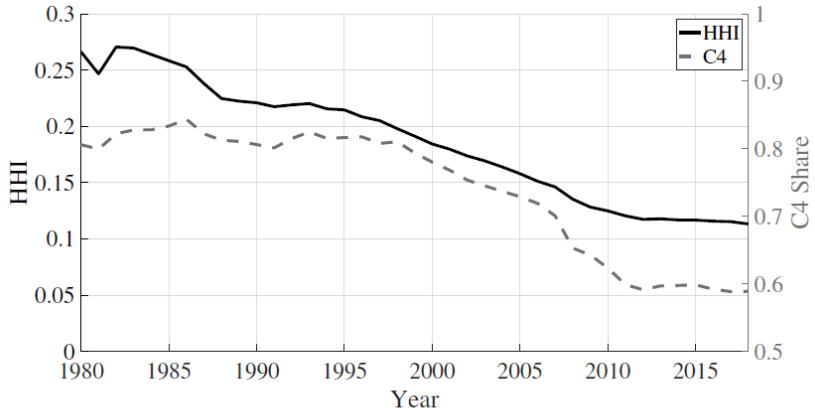
# Data

- Sales and characteristics of all cars and light trucks sold in the US from 1980 to 2018.
- Aggregated at the make (brand) model level (median across variants).
- 6,107 cars 2,213 SUVs, 676 trucks, and 618 vans in the sample.
- Consumer choices (ie. second choices).
- Consumer demographics.
- Real exchange rate (relative prices of two countries) to be used as an instrument for prices.

# The US car market evolution 1980-2018



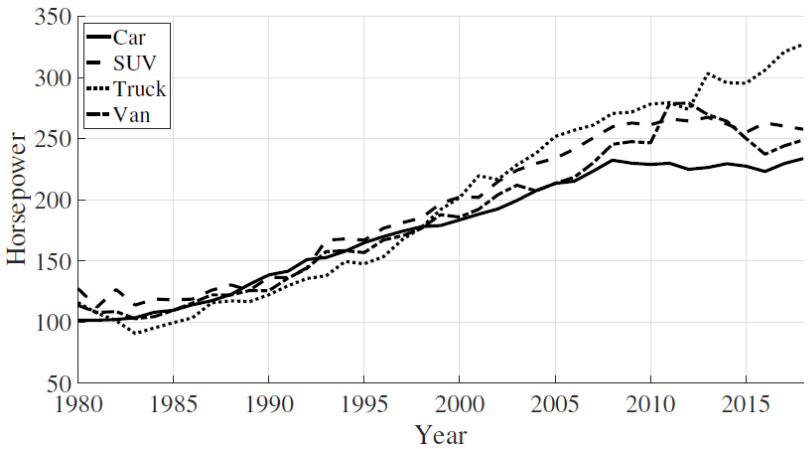

(a) Prices



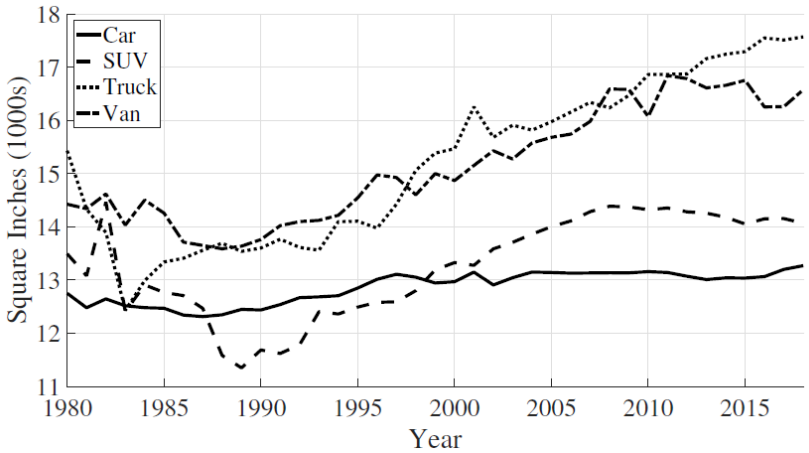

(b) Measures of Concentration

$\Longrightarrow$ Raise in price but lower concentration (?). Prices also depend on car physical characteristics, quality and production technology.

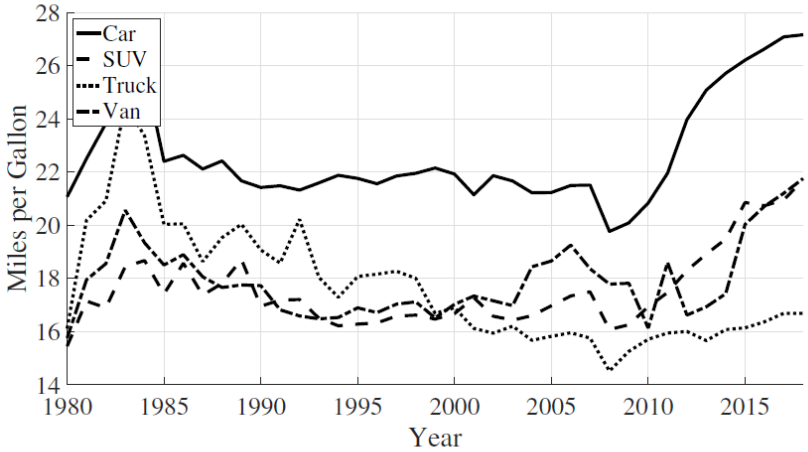
# Physical vehicule characteristics evolution



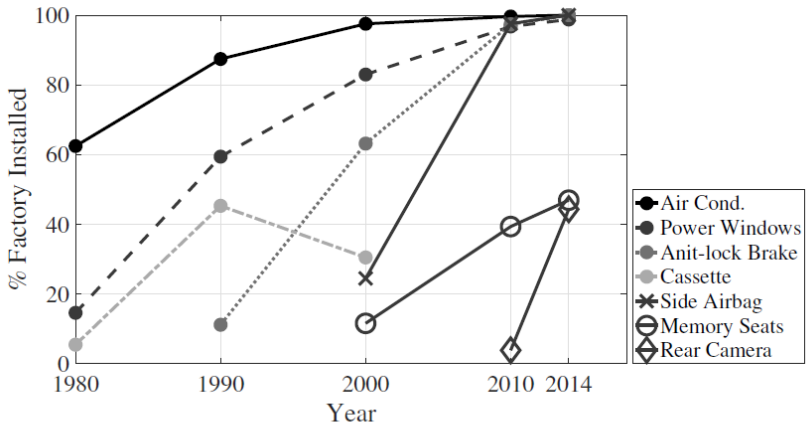

(a) Horsepower




(b) Size (length $\times$ width)




(c) Fuel Economy




(d) Additional Factory Installed Features

# Model: Consumers

Consumer $i$ choice alternative $j$ in year $t$ and an outside (no purchase) option, taking into account vehicles attributes ($x_{jt}$), price ($p_{jt}$), unobserved vehicle specific term ($\xi_{jt}$) and consumer-vehicle specific term ($\epsilon_{ijt}$). $\tau_t$ is the yearly average unobserved quality, $z_{jt}$ is a vector of instruments and $\gamma_t$ is the outside option value.

$$u_{ijt} = \beta x_{jt} + \alpha_i p_{jt} + \xi_{jt} + \epsilon_{ijt}$$

With $\xi_{jt} = \tau_t + \tilde{\xi}_{jt}$ and $\mathbb{E}[\tilde{\xi}_{jt}|z_{jt}] = 0$

To identify $\tau_t$ and $\gamma_t$, the following restriction is added:

$$\mathbb{E}[\xi_{jt} - \xi_{jt-1}] = \mathbb{E}[(\tau_t - \tau_{t-1}) + (\tilde{\xi}_{jt} - \tilde{\xi}_{jt-1})]$$

$\implies$ Models design hardly vary from year to year, although they might be idiosyncratic changes in features, marketing, or consumer taste.

# Model: Firms

- Automobile manufacturers, indexed by m, play a static, full information, simultaneous move pricing game each year.
- They observe prices from a NE to the pricing game assuming N-B pricing (no cartels).
- Firms have a constant marginal cost.

The pricing first order condition for vehicle $j$ is:

$$s_{jt} + \sum_{k} (p_{jt} - c_{jt}) \frac{\partial s_{jt}}{\partial p_{kt}} = 0$$

$\Longrightarrow$ FOC together with estimated demand system will be used to solve for each j MC. Then, MC will be used to compute price to cost ratios and for counterfactual analysis.

# Estimation strategy

Estimation in 3 steps using GMM:

1. Jointly estimate consumer heterogeneity and the mean consumer valuations.
2. Estimate $\bar{\alpha}$ and $\bar{\beta}$ and year fixed effects by regressing the estimated consumer mean valuations on product characteristics, prices, make dummies, and year dummies.
3. Separately estimate yearly average unobserved quality and the outside option value from the estimated year effects.

# 5 Results

1. Higher income individuals and older households are less price sensitive.
2. Very strong substitution patterns observed in the second-choice data: consumers substitute within vehicle style.
3. Automobiles have become more elastic over time, despite rising incomes, due to changes in the product set.
4. The unobservable vehicle quality is steadily increasing over time.
5. The value of the outside option increases over the time (except during recessions).

# Markup evolution

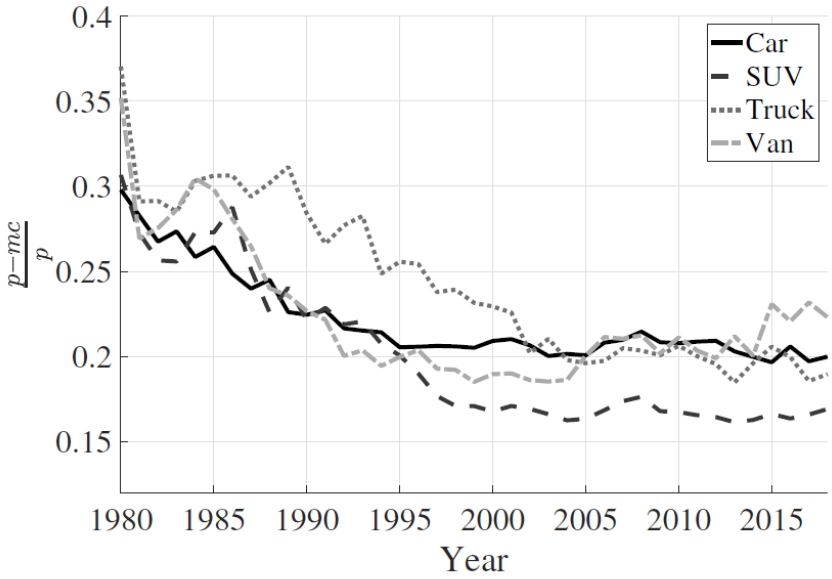
Markups defined as:

$$\frac{p - mc}{p} = \frac{1}{elas} = \frac{s}{p}\frac{1}{\frac{ds}{dp}}$$

Table 5: Own Price Elasticities by Income Quintile Over Time

| | Income Quintile | | | | |
|---|---|---|---|---|---|
| Year | 1 | 2 | 3 | 4 | 5 |
| 1980 | -5.96 | -5.78 | -5.49 | -5.13 | -4.30 |
| 2000 | -8.24 | -7.83 | -7.40 | -6.88 | -6.21 |
| 2018 | -9.37 | -8.56 | -7.69 | -6.90 | -6.46 |

Notes: This table reports the mean own price elasticity across products individuals conditional on income quintile of individuals in each reported year.



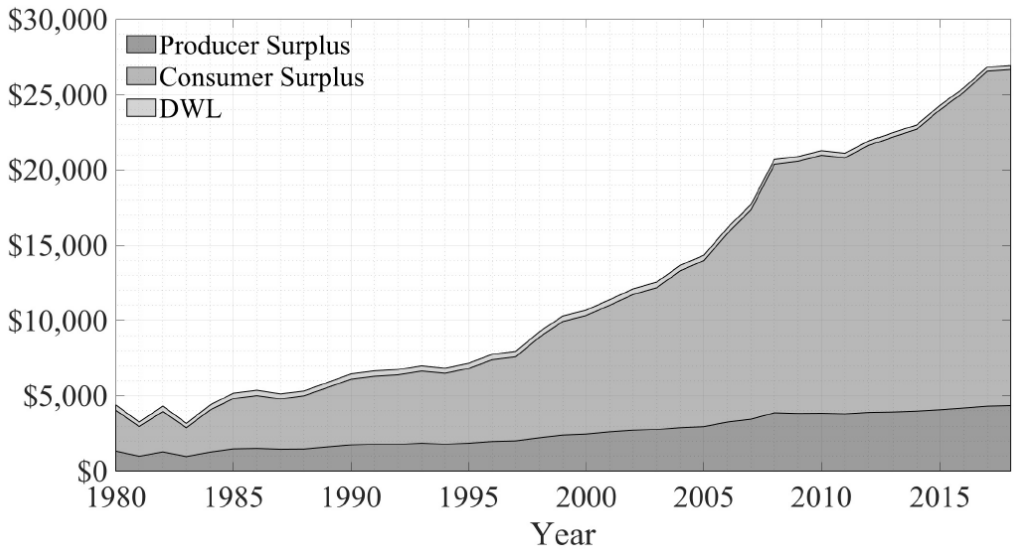

(a) Markups by Vehicle Style

Due to quality increase, the only component of the elasticity varying considerably are prices (share and derivative almost flat in time).

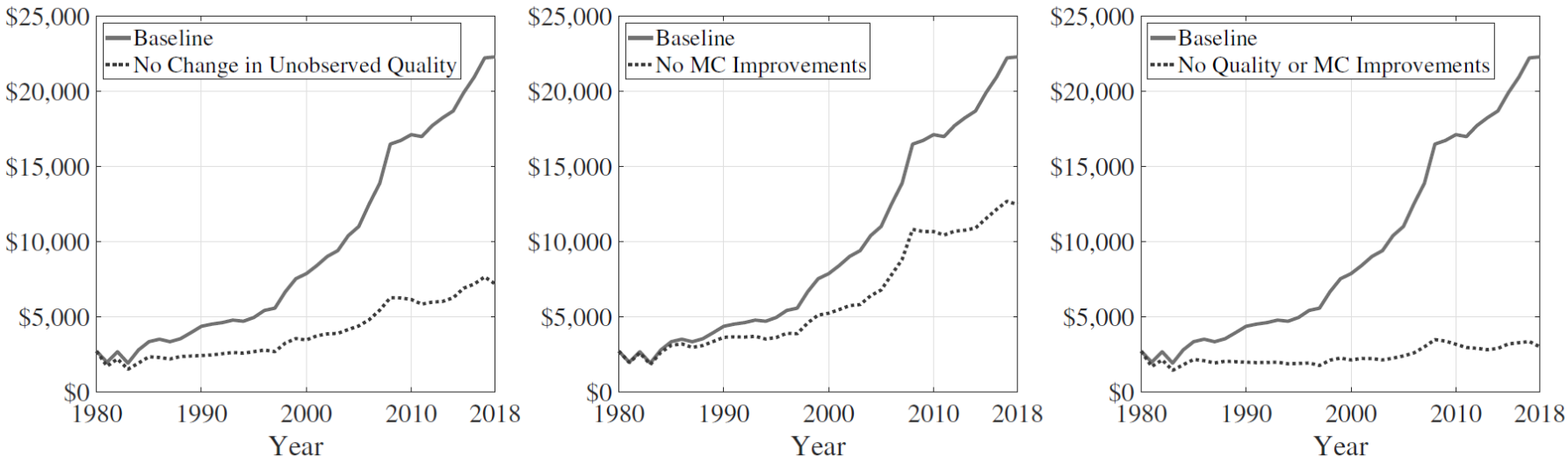
$\Longrightarrow$ Markup over time is not a conceptually attractive proxy for welfare when the product set is changing.

# The Evolution of Welfare

**Consumer surplus:** Compensating variation that would make consumers in year t indifferent between the product bundle they face and the average value of the outside option for all other years.



# $\Delta^+$ Quality + $\Delta^-$ MC $\Longrightarrow$ $\Delta^+$ Consumer surplus




Unobserved product quality increase: safety features (eg. rear view cameras), reliability improvements, and improved electronics (eg. Bluetooth audio systems)

# Personal comments

**Amazing stuff:**

- Employing a supply and demand industry oligopoly model with detailed micro-data seems to cover many edges.
- Demostrarte that the N-B competition assumption is in fact plausible.
- Smart counterfactual strategy to estimate main mechanisms of consumer surplus increase.

**One thing:** The unobservable quality product characteristics they mention are not that hard to include, why they don't do it?

**Just a thought:** When aggregating micro-data much heterogeneity is loss. Even-though looking at aggregates sounds informative it might be misleading. What is the appropriate BMK level of aggregation in the unlikely case of having all the data?