Problem Set 3: Endogenous Trucks

Date assigned: April 1, 2022.
Date due: April 15, 2022.

The data is in trucks.csv. It is a slice from the dataset from the paper `The Evolution of Market Power in the U.S. Automobile Industry` by Paul Grieco, Charlie Murry, and Ali Yurukoglu. It includes all of the "trucks" offered for sale in the U.S. from 1980 to 2018.

`make` Make of car (ex. Honda).
`model` Make and model of car (ex. Honda Accord). `parent` Ultimate owner/manufacturer (ex. VW owns VW and Audi and Porsche). `sales` Sales.
`msrp` Price.
`curbweight` weight of car with no passengers or cargo.
`footprint` width multiplied by length in square inches.
`hp` horsepower of car.
`mpg` Fuel economy rating of the car. `marketsize` scaled number of households in U.S.
`yearssincedesign` Number of years since the last styling redesign of the truck. Zero = the first year of the new design.

The goal of the problem set it to estimate the fixed costs of redesigning a truck. In practice, vehicles are redesigned roughly every 5-7 years, and this includes a change to the styling and update to mechanical components.

1. Data description.

i. How many years pass, on average, between re-design?
ii. Present graphical reduced form evidence that redesign increases sales (or doesn't).
iii. Plot the number of models and number of redesigns per year.

2. Estimate demand for trucks.

Estimate a simple logit demand for truck with the following specification for indirect utility.

$$u_{ijt} = X_{jt}\beta + \alpha p_{jt} + \xi_{jt} + \varepsilon_{jt}$$

where X includes `log(cubweight)`, `log(footprint)`, `log(hp)`, and `yearssincedesign`, `log(mpg)`, as well as `make` dummies and `year` dummies. You can estimste the

parameters of this model using OLS -- see Berry (1994) for details if you do not recall from IO I. (Typically, we would need to IV for price, but here the make and year dummies seem to do a decent job and getting us "reasonable" estimates of elasticities, so lets just stick with this empirical strategy.)

i. Report the coefficients in a table.
ii. Report the average own-price elasticity of demand.
iii. Graph average markups across time.

3. Estimate a marginal cost equation

$$log(mc_{jt}) = Z_{jt}\gamma + \omega_{jt}$$

and also include make and year effects, like in demand. Z should include everything in X except `yearssincedesign`.

i. Report the results.

4. Estimate fixed costs of redesign.

Eizenberg (2014) uses a revealed preference approach to estimate fixed cost bounds. In this section we will use the same approach to estimate fixed cost bounds for redesigning a truck.

If a firm chooses to redesign a truck j in year t, the following necessary condition must hold:

$$\mathbb{E}\pi_{jt}(R_{jt} = 0; X, p, R_{-jt}, \gamma, \alpha, \beta) \leq \mathbb{E}\pi_{jt}(R_{jt} = 1; X, p, R_{-jt}, \gamma, \alpha, \beta) - F_{jt}$$

R_{jt} is the decision to redesign truck j at time t, and R_{-jt} has the redesign decisions for all other products. The expectation is over the ξ and ω distributions, which we estimated in sections 2 and 3.

Use the following specification for fixed costs, which is analogous to Eizenberg's specification.

$$F_{jt} = F^{(f)} + e_{jt}$$

Some suggestions.

1. Don't use too many draws of ξ and ω.
2. Make sure you recompute pricing equilibrium for deviations.
3. Use deviations that involve a single year. For example, if a truck was redesigned in 2014, use 2013 as a deviation.

Note that there is a selection problem, i.e. conditional on observed decisions, $E(\nu_{jt}) \neq 0$. Because of this, you cannot use the mean of estimated $\bar{F}_{jt}$s to estimate $\bar{F}$, and the mean of estimated $\underline{F}_{jt}$s to estimate $\underline{F}$. Solve this selection problem as in Eizenberg (2014) to estimate $\bar{F}$ and $\underline{F}$.

i. Report your upper and lower bounds. You do not need report confidence intervals, as in Eizenberg (2014) eq. (14).

ii. Is the nature of selection different in this case than in the setting of Eizenberg? Why or why not? How different do the bounds look if you don't account for selection at all?

iii. Consider that in reality all truck manufacturers always redesigned as quickly as possible? In other words, the option to redesign 1 year earlier is not a feasible option and cannot be used to estimate $\bar{F}$. How would that change your results? Are there additional issues that arise?

iv. Without recomputing anything, explain how your results would change if there was a large random coefficient on the dummy variable for `U.S. Brand` ?