Empirical IO Homework 1

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1 Estimation of the model

Our estimation is done by using Matlab 2020b and you may encounter some dimensional errors with older versions.

1) As given by question, the utility function of consumer i for j automobile of k brand at year t is

$$U_{ijkt} = X_{jkt}\beta + \alpha_i p_{jkt} + \xi_{jkt} + \epsilon_{ijkt} \tag{1}$$

with X_{jkt} is a vector of observed automobile characteristics including intercept, cylinder capacity, weight, horsepower and fuel cost; p_{jkt} is the price of the specific automobile, ξ_{jkt} represents unobserved product characteristics, ϵ_{ijkt} is individual taste shock and assumed to be extrem value distributed.

We estimate the random coefficient model with standard BLP instruments to deal with price endogeneity. The estimated coefficients are shown below:

Table 1: Estimators with standard BLP IV

Variables	Estimators
Intercept	-7.227
Cylinder	-0.037
Weight	0.199
Horsepower	0.207
Fuel cost	-0.385
Price	-1.794

Table 1 shows that consumers less prefer to buy the automobile with higher price, larger cylinder and more fuel cost and prefer the automobile with more weight and higher horsepower. For us, the signs of estimates have the expected signs. For example, fixed the horsepower, more cylinder means more waste in fuel that leads to more cost; it is reasonable to expect the estimator of cylinder has negative sign. The negative sign of alpha is what we expected as well i.e. given a specification of a car, a lower price is better for the consumer.
2) Next, we add year and brand fixed effects into equation (1) and re-estimate the random coefficient logit model. The results are shown below: It is easy to see that the estimates change a lot after controlling time

Table 2: Estimators with standard BLP IV

Variables	Without fixed effects	With fixed effects
Intercept	-7.227	-4.985
Cylinder	-0.037	-0.215
Weight	0.199	0.363
Horsepower	0.207	0.189
Fuel cost	-0.385	-0.338
Price	-1.794	-5.035

and brand specific demand shock by adding time and brand fixed effects. The estimates of price coefficient is three times larger in scale than before, which shows without controlling unobserved time and brand demand shock leads an under-estimation of the price effect in scale.

2 Counterfactual simulation

Preliminary step

In this section, we recover the vector of marginal costs for the year and attain the average marginal cost of the industry is €22,895 for year 2008. Also, the average markup of the industry is 0.258, the total industry profit is €7.17 trillion and the average consumer surplus is €3330. Note that the average price is €31062.

2.1 Merger and economics of scale

1) In this section, we simulate a merger between VOLKSWAGEN and BMW to account for the potential market impacts. Base on our simulation, after merger, the average price increase by 0.77% (€238), the markup increase by 1.55% (0.004), the total profit of VOLKSWAGEN and BMW increase by 0.33% (€4.14 million), the total profit of the industry increase by 0.65% (€46.6 million), the average consumer surplus decrease by 0.39% (€13).
2) With a "brute force" approach, we compute the minimum efficiency gain is 1.7% for merger to generate no decrease in the average consumer surplus. We initially started with the grid range between 80% and 100% of the cost and gradually reduced the interval while increasing the number of points within the interval. In other words, we started from grid of [0.8:0.05:0.1] and finally reached to [0.982:0.001:0.983] by manually checking the consumer surplus depending on each cost reduction. Only the final grid is written on our code due to the long computational time.

2.2 Cross participation

(1) If RENAULT buy 30% shares of PSA, the simulated impacts of RENAULT, PSA and automobile industry are as followed:

Table 3: The change of RENAULT, PSA and Industry

	RENAULT	PSA	Industry
Average price	+1.82% (+€432)	+0.03% (+€8)	+0.08% (+€23)
Markup	+4.81% (0.013)	+0.12% (0.0003)	+0.35% (0.0009)
Profit	+42.70% (+€681.89 million)	-29.39% (-€664.39 million)	+0.63% (€45.07 million)

What's more, the total industry profit increase by 0.63% (€45.07 million), roughly €27.57 million more than the sum of the change of total profit of RENAULT and PSA. The average consumer surplus decrease by 0.41% (€14).
(2) As we showed above, after RENAULT acquiring PSA, the total profit of PSA will decrease by €664.39 million. We estimate that the total profit change of PSA if it also buys 30% shares of RENAULT after RENAULT's acquisition. Compared with the total profit of PSA after RENAULT's acquisition, the total profit of PSA will increase by €391.33 million; but its total profit still lower than the total profit without any acquisitions. To calculate the willingness to pay of PSA to buy the 30% shares of RENAULT, we take the 10 years France government bond yield in December 2008, 3.33%, as risk-free rate in our calculation. The maximal willingness to pay is €11.75 billion.

Now, everything is reset to the default; no purchasing of company shares. If PSA acquires 30% share of RENAULT, it will cause €481.67 million increase in total profit. Hence, the maximal willingness to pay for the 30% shares of RENAULT is €14.46 billion. It is about €2.71 billion higher than the willingness to pay with RENAULT's acquisition.

We think the difference is due to the gains from market power in different market structures. Under the acquisition by RENAULT, PSA's acquisition is more like a defence to recover its market power. However, RENAULT has gain a lot market power from PSA in previous acquisition that makes the acquisition of PSA less profitable. On the other hand, RENAULT has less market power without acquisition, it makes the acquisition from PSA more effective that PSA can gain more profits from the acquisiton. Hence, the maximal willingness to pay of PSA is higher.