Quantitative analysis on merger simulation

Assignment 2: Analysis of Market and Firm Conduct

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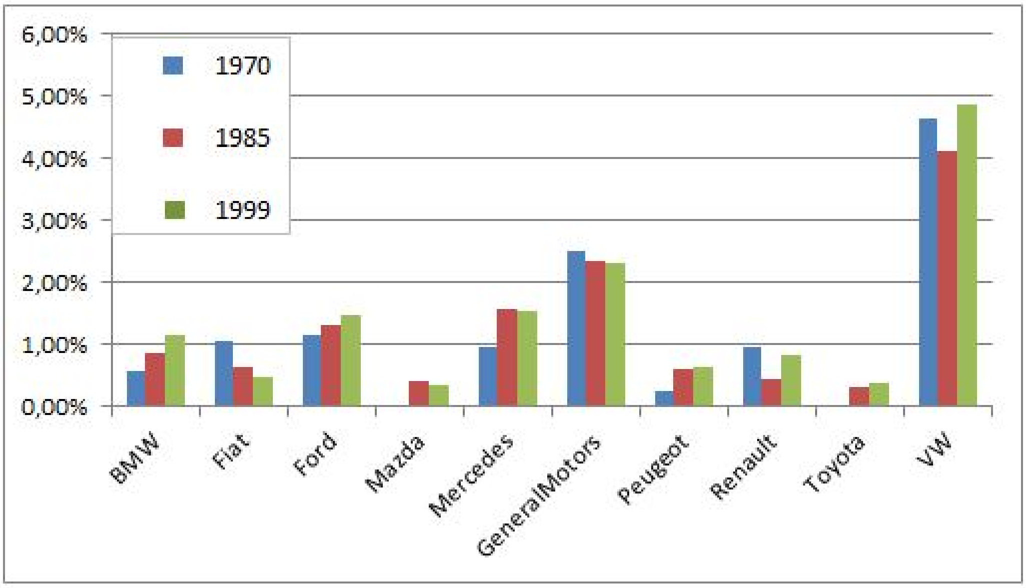
1.

Prepare a table with summary statistics of market shares, characteristics, and prices. You may inspect these statistics separately for each market, but in what you report, please pool all markets.

First of all we have decided to focus on Germany, because it has a dominant role in Europe's new car market, therefore we used data only for this country. In order to get an overall picture we picked three years (1970,1985,1999)[1] the begining, the middle and the end of the timeline. On the first figure there are the marketshares of the ten largest car seller companies in Germany across the three different years.

Figure 1: Marketshares of the ten largest firm in Germany in the new car market



We calculated the market share for every type of car[2] for every given year and then we summed up across companies. The highest market share owner across the sample years was Volkswagen (VW) meanwhile Toyota had the lowest market share. Notice that Mazda and Toyota did not operate in Germany in 1970. According to the graph BMW, Ford and VW produced significant marketshare growth in the 30 years. The steepest growing curve is belonging to Peugeot whose market share went up from 0.25% to 0.63%, that is a 157.19% growth. Fiat's market share has dropped the most dramatically from 1.07% to .48% that is a -54.60% growth.

The following tables report summary statistics (number of observations, mean, standard deviation, minimum value and maximum value) of prices and car characteristics such as horsepower, fuel, width and of averaged market shares per car type. The calculation of the market share per car type variable is discussed in more detail in section 2.

[1]For regression estimations we used the whole sample i.e. from 1970 to 1999.

[2]We devided the sales with the potential number of buyers, that is population over four. This assumes that every four people demand one unit of a new car. This assumption is reasonable in the sense that an avarage family (4 people) usually owns one car although detailed population data is needed for more precise estimation.

		1970					1985				
Segment	Variables	Obs.	Mean	Std. Dev.	Min	Max	Obs.	Mean	Std. Dev.	Min	Max
Subcompact	Price	21	5258.33	893.66	3600	6950	19	11429.42	1772.34	7790.00	14850.00
Compact	Price	12	7701.92	1575.00	5594	10250	20	15002.70	1889.80	12900.00	20590.00
Intermediate	Price	8	8611.88	2260.43	6500.00	12450.00	15	18386.00	2416.19	16320.00	24900.00
Standard	Price	12	10943.83	2216.86	8097.00	15500.00	13	22864.62	3375.15	19200.00	29990.00
Luxury	Price	3	14687.00	1556.56	13265.00	16350.00	7	30609.14	2277.88	26500.00	32800.00
Subcompact	Horsepower	21	27.31	8.59	13.00	40.50	19	31.42	7.94	17.50	48.00
Compact	Horsepower	12	49.25	12.41	32.50	66.00	20	47.00	6.05	37.00	55.00
Intermediate	Horsepower	8	55.06	14.52	40.50	83.00	15	61.97	15.43	44.00	100.00
Standard	Horsepower	12	65.21	13.01	48.00	88.50	13	70.62	12.24	55.00	96.00
Luxury	Horsepower	3	92.67	20.35	70.50	110.50	7	84.71	9.03	77.00	103.00
Subcompact	Fuel	21	6.70	1.02	5.30	8.40	19	5.18	0.44	4.20	6.10
Compact	Fuel	12	9.22	1.90	7.00	14.40	20	5.56	0.35	4.80	6.20
Intermediate	Fuel	8	9.84	1.06	8.70	11.60	15	6.43	1.42	4.90	10.00
Standard	Fuel	12	9.98	0.92	8.90	11.60	13	6.47	0.75	5.30	7.90
Luxury	Fuel	3	11.73	1.44	10.90	13.40	7	7.06	0.74	6.40	8.30
Subcompact	Width	21	149.19	8.28	129.50	163.50	19	152.05	6.40	137.50	162.00
Compact	Width	12	158.17	4.26	150.00	165.00	20	164.10	1.88	161.00	168.00
Intermediate	Width	8	163.06	4.07	156.50	171.00	15	167.13	1.88	163.00	170.50
Standard	Width	12	173.42	5.95	159.00	180.50	13	171.58	5.28	164.00	181.50
Luxury	Width	3	178.50	4.44	175.00	183.50	7	173.00	3.57	168.00	178.50
Subcompact	Market share	21	0.20259%	0.45053%	0.00237%	2.08048%	19	0.11817%	0.12083%	0.00459%	0.41538%
Compact	Market share	12	0.29887%	0.41516%	0.00305%	1.21497%	20	0.25201%	0.48509%	0.00262%	1.95621%
Intermediate	Market share	8	0.11725%	0.07368%	0.03227%	0.24712%	15	0.17996%	0.23143%	0.0036%	0.64329%
Standard	Market share	12	0.22794%	0.32372%	0.00273%	1.11026%	13	0.12796%	0.1864%	0.00798%	0.63591%
Luxury	Market share	3	0.38727%	0.49577%	0.06269%	0.95794%	7	0.27285%	0.3606%	0.00869%	0.80532%

		1999				
Segment	Variables	Obs.	Mean	Std. Dev.	Min	Max
Subcompact	Price	29	18558.10	2874.73	13990.00	27700.00
Compact	Price	22	25444.32	3488.54	20290.00	33400.00
Intermediate	Price	26	32489.62	6587.45	21800.00	51730.00
Standard	Price	13	44740.23	6484.13	35580.00	52250.00
Luxury	Price	9	57369.44	12941.26	45295.00	88800.00
Subcompact	Horsepower	29	41.14	5.12	33.00	54.00
Compact	Horsepower	22	58.82	8.12	44.00	76.00
Intermediate	Horsepower	26	75.88	12.34	55.00	105.00
Standard	Horsepower	13	95.54	9.70	77.00	114.00
Luxury	Horsepower	9	109.44	14.34	90.00	142.00
Subcompact	Fuel	29	5.15	0.39	4.30	6.00
Compact	Fuel	22	5.67	0.43	5.00	6.40
Intermediate	Fuel	26	6.18	0.52	5.30	7.80
Standard	Fuel	13	6.78	0.57	5.80	8.00
Luxury	Fuel	9	7.53	0.62	6.90	8.60
Subcompact	Width	29	160.45	6.21	144.00	169.00
Compact	Width	22	169.89	2.87	163.00	175.50
Intermediate	Width	26	172.71	3.41	166.00	182.00
Standard	Width	13	176.46	3.78	170.00	182.00
Luxury	Width	9	143.78	1.39	142.00	146.00
Subcompact	Market share	29	0.12758%	0.13723%	0.00916%	0.54731%
Compact	Market share	22	0.24351%	0.38412%	0.005%	1.52787%
Intermediate	Market share	26	0.121%	0.16452%	0.00237%	0.66606%
Standard	Market share	13	0.10774%	0.2002%	0.00176%	0.69912%
Luxury	Market share	9	0.16619%	0.23044%	0.00535%	0.59865%

As before we are looking at three different years: 1970, 1985 and 1999. Furthermore we make use of the segement dimension that has the following categories: subcompact, compact, intermediate, standard and luxury. The number of observations in the data has grown from 1970 to 1999, especially in the intermediate segment. In 1999 there were 18 more models sold then in 1970 in the intermediate segment, which means that this segment has experienced a growth of 225%. The average price growth from 1970 to 1999 is between 252% and 308% depending on the segment. However, the average market share per type has only increased in the standard segment by 3%, while having decreased between 18% and 57% in all other segments. While width and height have stayed nearly the same, fuel efficiency decreased by 30%. It is also very interesting that the standard deviation of prices have highly increased with a growth rate around 200% from 1970 to 1999 (without taking into account the most extrem case of the luxury cars where the standard deviation increase was 731%).

2.

You are asked to estimate the demand parameters using a logit model. Write down your estimable equation.

Our estimated equation is the following:

$$log\left(\frac{S_j}{S_0}\right) = \beta_0 + \beta_1 * Horsepower_j + \beta_2 * Fuel_j + \beta_3 * Width_j + \beta_4 * Height_j + \beta_5 * Domestic_j + \alpha * P_j + \xi_j$$

Where $S_j = \frac{q_j}{L}$ is the market share of product j.
$L = \frac{Population}{4}$ is the potential market size.
$S_0 = \frac{q_0}{L}$ is the market share of the outside good, that is $q_0 = L - Q$.
The total sales is given by: $Q = \sum_{j=1}^{J} q_j$

3.

In the estimation, what are the variables you will use and what are the parameters of interest?

The characteristics of the given type of car (or product j) is well described by the first five RHS variables. The names of these variables are self explanatory but for the sake of completness: Horsepower is the horsepower of the given car, Fuel is measuring fuel efficiency that is how much liters of fuel does a car consume per every traveled km with speed: 90 km/h. Width is the width of the car, while Height is it's height. Domestic is a dummy variable that takes value 1 if the car is sold by a domestic company and 0 otherwise. The price coefficient α is supposed to be negative, ($\alpha < 0$) meaning that cars are ordinary goods not giffen goods. That is to say the demand curve of a certain type of car is downward sloping. Finally ξ_j is the unobserved error term.

Given the panel structure of the dataset what we actually estimate is the following:

$$log\left(\frac{S_{jt}}{S_{0t}}\right) = \beta_0 + \beta_1 * Horsepower_{jt} + \beta_2 * Fuel_{jt} + \beta_3 * Width_{jt} + \beta_4 * Height_{jt} + \beta_5 * Domestic_{jt} + \alpha * P_{jt} + \xi_{jt}$$

Where index t runs from 1970 to 1999. Notice that the error term ξ_{jt} is composed by a time-invariant part: c_j (that is usually reffered as to the individual specific unobserved heterogeneity) and by a time-variant part: ϵ_{jt}, which changes over time. The pooled OLS estimation in this case is consistent, if price is not endogenous. Formally if: $cov(P_j, c_j) = 0$ which comes from: $cov(P_j, \xi_j) = 0$. If there is neither individual heterogeneity (i.e. $var(c_i) = 0$) nor endogeneity, pooled OLS is consistent and efficient. If there is individual heterogeneity, but it is uncorrelated with regressor(s) then one should use random-effects, while if there is both unobserved heterogeneity and correlation one should use fixed-effects.

4.

Given the data provided to you, what are valid (and relevant) instruments that help identification of the parameters of interest?

The problem of endogeneity arises in the equation above, because there are factors that affects the price of a car, but they are not included in the model, therefore they are captured by the error term. That is to say there is endogeneity caused by omitted variable(s). An instrumental variable estimation (2sls) can solve the endogeneity issue, if the instrument is valid. A valid instrument satisfies two conditions. The relevance condition, that is $cov(IV, Price) \neq 0$ and the exogeneity condition: $cov(IV, Error) = 0$. One can test the first condition and under certain circumstances the second too. In our approach we consider as valid instrument for a car's price, characteristics of other firms' cars. Namely we constructed a variable that is for car j the time average of the horsepower of cars sold by firms, that are not selling car j. Formally:

$$Instrument_j = \frac{1}{T}\frac{1}{J}\sum_{t=1}^{T}\sum_{k=1}^{J} Horsepower_{tk} \qquad t = 1970, ..., 1999;\ k = 1, ..., 980;\ j \in G;\ k \notin G$$

Now consider the validity of the instrumental variable by taking an example. For a car sold by BMW the error term is capturing input costs (eg.:wages) that affect the price of the BMW. The horsepower of other cars sold by firms but not BMW, (let us now focus on one competing firm) for instance by Mercedes is affecting both the price of the Mercedes and the BMW. Why? The change in the horsepower of a Mercedes is likely to change it's price and if BMW and Mercedes are in the same relevant market, the price change in Mercedes will affect the price of the BMW. Therefore we have just proved that $cov(IV_j, Price_j) \neq 0$. The relevance of the IV can be tested by checking the first stage regression of the two stage least squares (2sls) estimation. Therefore we shall apply the above described instrumental variable in order to recover in a consistent manner the price coefficient, that is crucial to estimate own/cross price elasticities.

5.

Estimate your logit model by OLS. Please report results and comment.

VARIABLES	(1) logmshareratios	(2) logmshareratios	(3) logmshareratios
price	3.19e-06		1.03e-05**
	(4.36e-06)		(4.60e-06)
horsepower	-0.0358***	-0.0264***	-0.0292***
	(0.00237)	(0.00244)	(0.00275)
fuel	-0.0561***	-0.0429***	-0.00814
	(0.0185)	(0.0144)	(0.0211)
width	0.0550***	0.0559***	0.0546***
	(0.00364)	(0.00358)	(0.00362)
height	0.00454	0.00684	0.00584
	(0.00466)	(0.00463)	(0.00465)
domestic	2.010***	2.091***	2.084***
	(0.0517)	(0.0538)	(0.0539)
princ		-0.888***	-1.060***
		(0.216)	(0.229)
Constant	-15.03***	-15.52***	-15.32***
	(0.805)	(0.800)	(0.804)
Observations	2,283	2,283	2,283
R-squared	0.548	0.551	0.552

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The table above shows estimation results of different specifications of the model described in section 2. In the first estimation we ran exactly the same model as it has been described in section 2. The main interest is on the coefficient of price that is positive but insignificant. Another feature of the first estimation is that horsepower has a significant negative effect on the market share of the given car which implies that the more horsepower a car has, the less it's market share keeping everything equal. Fuel has a significant negative sign wich means that the more fuel a car consumes the lower it's market share, wich makes sense. A domestic car has higher market share ceteris paribus since the coefficient of the domestic variable is positive. In this simple OLS estimation process we did not take into account that price is endogenous, so the estimated coefficients are inconsistent and biased. In the second coloum we used princ instead of price, which is the price of the car relative to the percapita gdp or income. Notice that here (in (2)) princ has a significant negative sign, that means the higher the price relative to the income the lower the market share.

The other paramters in terms of significance and sign are very similar to the previous case. In the third coloumn we applied both variables (price, princ) that made the price coefficient significant but still positive and the coefficient of princ has become smaller. What is going on here? Two things. First of all since princ and price are highly correlated ($corr(price, princ) = 0.7279$) one should be careful when deciding which one to use. Secondly the issue of endogeneity is still there so one should use a relevant instrumental variable in order to solve the problem of inconsistent parameter estimates.

6.

Estimate your logit model using instrumental variables (you can consider different combinations of instruments). Please report results and comment. Compare to the results obtained in 5.

In order to assess whether to use (since we have longitudinal data we should make use of the two source of variation (within and between entities) to produce a persuasive empirical evidence) pooled OLS or fixed-effects or random-effects we used the Hausmann test. The Hausman test in this panel scenario tests whether fixed-effects and random-effects predict significantly different parameter estimates. If yes the test gives a high number (relative to some variance-covariance matrix) and a low p-value (smaller than .05), so one is able to reject the null hypothesis of the test, that is the unobserved time-invariant heterogeneity factor is uncorrelated with other regressors. If the null hypothesis of the test is rejected then one should use fixed-effects estimation since it is consistent under the H_0, because it takes away the constant unobserved heterogeneity. If the null hypothesis can not be rejected one should compare random-effects with pooled OLS. With a Breusch-Pagan test one should test the null hypothesis: the variance of the unobserved heterogeneity factor is same across individuals or not. If the variance is zero then pooled OLS should be used, if not then random-effects. After using the Hausman test we obtained that the p-value is below the .05 treshold, so the problem of endogeneity occurs, namely the unobserved time-invariant error term is likely to be correlated with explanatory variable(s). Hence we used fixed-effects with one instrumental variable.

The results are presented in the table below. Firstly and most importantly the price coefficient is -.0002813 (it is significant and has a negative sign), that means keeping everything equal a one unit increase in price leads to a .02813% decrease in the market share or put it in a larger scale a 100 unit increase in price leads to a 2.813% decrease in market share ceteris paribus. Horsepower has a coefficient of .0621275, which means that if the horsepower of the given car increase by one unit keeping everything equal the market share will increase by 6.2%. Fuel efficiency has a significant and negative coefficient, namely: -.062874. It means that if the liter per km consumed by the car with 90km/h increases (i.e. the fuel efficiency decreases) the market share of the given care falls by 6.3% ceteris paribus. The coefficient of width is .0609471, that is significant and positive. The coefficient of the domestic dummy is negative but insignificant. Year has a positive and significant coefficient which means that keeping everything equal a one year increase in year the model has a higher market share of 15.2%, that basically means by time passes market shares rise.

VARIABLES	2nd stage regression logmsharerati os
price	-0.0002813**
	(0.000113)
horsepower	0.0621**
	(0.0297)
fuel	-0.0629**
	(0.0295)
width	0.0609***
	(0.00934)
height	0.0271*
	(0.0148)
domestic	-0.649
	(0.442)
year	0.152**
	(0.0765)
Constant	-320.0**
	(151.8)
Observations	2,283
Number of co	297

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Comparing the results here and those from section 5 one can notice that here the price coefficient is significant and negative meanwhile the horsepower means a higher market share ceteris paribus (i.e. positive coefficient). Fuel is negative as it was in section 5, although the coefficient of the domestic dummy negative and insignificant. This is probably due to the fact that there were only slightly changes in the domestic variable therefore the fixed-effects estimation can not handle it well (one big disadvantage of the fixed-effects models that they can not estimate coefficients for variables that do not change over time).

7.

Calculate the own- and cross-price elasticities using the estimated parameters in 5. Be explicit in how you calculate these measures.

The own price elasticity is given by:

$$\epsilon_{jj} = \frac{\partial S_j}{\partial P_j} * \frac{P_j}{S_j} = \alpha * S_j * (1 - S_j) * \frac{P_j}{S_j} = \alpha * P_j * (1 - S_j)$$

where $S_j = \frac{e^{\delta_j}}{1+\sum_{k=1}^{J} e^{\delta_k}}$ and $\delta_j = X_j * \beta + \alpha * P_j + \xi_j,$ k=1,...,J $\alpha < 0.$

Where S_j is the market share of one type of car, P_j is the price of the same car, $\alpha = -.0002813$ from the above estimation, and X_j is a matrix of characteristics of car j.

The cross-price elasticities are given by:

$$\epsilon_{jk} = \frac{\partial S_j}{\partial P_k} * \frac{P_k}{S_j} = -S_j * \alpha * S_k * \frac{P_k}{S_j} = -P_k * \alpha * S_k$$

$$j \neq k$$

$$\alpha < 0$$

.

Table 1: Summary statistics of elasticities using the model in 6.

Variable	**Mean**	**Std. Dev.**	**Min**	**Max**
Own-price elasticity	-5.589	3.290	-28.035	-1.012
Cross-price elasticity	0.010	0.018	.0000443	0.123
Number of observations		2283		

The table above represents the summary statistics of the own-and cross price elasticities using the price coefficient obtained from section 6 ($\alpha = -0.0002813$). The mean own-price elasticity is -5.588947 which means a quite elastic demand. To be exact it implies that a one percent increase in price keeping everything equal leads to a 5.6% fall in the quantity demanded. Even the highest own-price elasticity is below -1, that means that all estimated demands for every car in every period of time is elastic. This statement of course is very sensitive to the values of α. In terms of the cross-price elasticities we can find values between .0000443 and .1227514 that implies the cars are substitutes rather than complements, since every cross-price elasticity has a positive sign.

8.

Now, consider a two-level nested logit model where the upper nests relate to car segment (subcompact, compact, intermediate, standard, luxury) and the lower nests relates to origin of the car (domestic or foreign). Write down your estimable equation.

Our estimable equation is:

$$log\left(\frac{S_j}{S_0}\right) = \beta_0 + \alpha * P_j + \beta_1 * Hp_j + \beta_2 * Fuel_j + \beta_3 * Width_j + \beta_4 * Height_j + \beta_5 * Dom_j + \beta_6 * Year_t +$$

$$+ \sum_{s=1}^{4} \beta_{6+s} Segment_j + \sigma_h * log(S_{j|h}) + \sigma_g * log(S_{h|g}) + \xi_j$$

Where the Segment dummies reffers to the segment of the car. $S_{j|h}$ is car j's share within it's own subnest and $S_{h|g}$ is car j's subnest's share in car j's nest. Formally:

$$S_{j|h} = \frac{q_j}{\sum_{j \in H_g} q_j} \text{ and } S_{h|g} = \frac{\sum_{j \in H_g} q_j}{\sum_{h=1}^{H_g} \sum_{j \in H_g} q_j}.$$

σ_h is the correlation between utilities of products belonging to the same subnest and σ_g is the correlation between utilities of products belonging to the same nest. By assumption: $0 \leq \sigma_g \leq \sigma_h \leq 1$

9.

In the estimation, what are the variables you will use and what are the parameters of interest?

The characteristics of the car are still used in this model as well as the height, width, horsepower, etc. What is new compared to the model in section 2 is the segment dummies and the year variable. A segment dummy is equal to 1 if the car belongs to that specific segment and 0 otherwise. The year variable is capturing time effect, assuming that is the same for every year. One could include T-1 year dummies in order to capture seasonal fluctuations of the demand, but we decided to use the simple year variable. The two-level nested logit brings two new terms in the equation. Namely the share of car j within it's subnest (Domestic or Foreign). This effect is captured by the term: $S_{j|h}$. The share of car j's subnest within it's nest (Segments) is captured by the term: $S_{h|g}$. From the elasticity point of view our main parameter interests are the price coefficient i.e. α and the correlation effects between utilities namely σ_h and σ_g.

10.

Estimate your model. As a simplification, abstract from price endogeneity. Please report your parameter estimates.

VARIABLES	logmshareratios
price	-0.0000155***
	(1.43e-06)
year	0.0160***
	(0.00141)
domestic	0.103***
	(0.0221)
subcompact	0.306***
	(0.0342)
compact	0.708***
	(0.0247)
intermediate	0.420***
	(0.0208)
luxury	-0.0511*
	(0.0266)
horsepower	-0.0000975
	(0.000721)
fuel	-0.0144**
	(0.00577)
width	0.00778***
	(0.00120)
height	-0.00169
	(0.00126)
σ_h	0.960***
	(0.00560)
σ_g	0.944***
	(0.0124)
Constant	-36.33***
	(2.766)
Observations	2,283
R-squared	0.969

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

11.

Comment your estimates. Are they consistent with Economic theory?

If we abstract from the price endogeneity issue we get the above reported results of the two-level nested logit approach estimated by OLS. Here we would aside from the ceteris paribus interpretation of the parameters because of the inconsistent parameter estimates.

First of all the price coefficient is negative and significant namely $\alpha = -0.0000155$, that is consistent with the economic theory although in terms of magnitude this value is smaller (in absolute terms) compared to the one obtained in section 6. i.e. in the logit model estimated by 2sls using fixed effects. The year variable has a positive and very significant coefficient, but note that this coefficient is smaller than the one from the simple logit model. The domestic variable has a significant and positive effect as it was in the logit model estimated by OLS in section 5. Nevertheless it was negative and insignificant in section 6. Now turn the attention to the segment dummy variables. Note that the benchmark segment (nest) is the one that is omitted i.e. the standard segment. All the segments have significant coefficients at least at 10% significance level. Note that the subcompact, the compact and the compact dummies have a positive sign, meanwhile the luxury dummy got a negative sign. That would mean that keeping everything equal a luxury car has a lower market share compared to the standard segment's car. The horsepower variable has a negative but insignificant coefficient. The negative sign is similar as it was in the logit estimated by OLS, although there the parameter was very significant in section 5. But when we used an instrumental variable approach in section 6. it had a positive and significant coefficient, so the sign of this coefficient is ambiguous in terms of intuition. But again if we take the edogeneity issue seriously we would focus on the IV approach as in section 6. where horsepower had a positive sign.

Moreover the sign of the width variable is positive and significant as has been always regardless the method of estimation. The height variable has a negative but insignificant coefficient. In terms of the correlations namely σ_h and σ_g we have got a result that is consistent with the economic theory. Namely: $0 \leq \sigma_g = 0.944 \leq \sigma_h = 0.960 \leq 1$.

12.

Calculate the implied own- and cross- price elasticities for products within the same nests and across nests. Comment your results.

Table 2: Summary statistics of the own-price elasticities

Variable	Mean	Std. Dev.	Minimum	Maximum
Own-price elasticity	-7.087	4.242	-37.952	-0.808
Number of observations		2283		

Since every value is below 0 that means cars are really ordinary (and not giffen) goods. The mean of the own price elasticities is -7.087, which implies quite elastic demand functions namely a one percent increase in price leads to a 7 percent decrease in quantity ceteris paribus. The standard deviation is higher as well as the absolute value of the mean compared to the results from section 7. Notice that here the maximum value of the own-price elasticities is -0.808, which implies an inelastic demond curve. A one percent increase in price would lead to a 0.8 percent decrease in the quantity demanded keeping everything equal.

Segment	Domestic	1970	1985	1999	Change (70-99)
Subcompact	0	0,098096464	0,188654083	0,190546875	94%
Compact	0	0,231180058	0,171245372	0,28034614	21%
Intermediate	0	0,388238722	0,277727284	0,32871308	-15%
Standard	0	0,27644921	0,384888599	0,691523557	150%
Luxury	0	n.a.	1,785498758	1,451773508	-19%
Subcompact	1	0,348428667	0,839048175	0,769962392	121%
Compact	1	0,484518193	0,946949717	1,161435478	140%
Intermediate	1	0,755990076	1,4744169	2,123643071	181%
Standard	1	0,570535005	1,911969969	4,961677906	770%
Luxury	1	1,83E+00	2,256608278	5,175620976	183%

In the table right above we report the average of the within-subnest cross-price elasticities by segment/nest and by subnest (domestic dimension) for three different years obtained from estimating the two-level nested logit model. The highest within-subnest cross-price elasticity (5,176) was in 1999 in the luxury segment in the domestic car subnest, while the lowest value (0,0981) is for the subcompact segment in 1970 for foreign cars. The largest increase (770% growth) from 1970 to 1999 has taken place in the standard car segment in the subnest of domestic cars. The most radical drop (-19%) has taken place in the luxury segment within the foreign subnest. Notice that this change is calculated between 1985 and 1999 because of data availability. The following table reports the averages of the within-nest cross-price elasticities in the three chosen years.

Segment	1970	1985	1999	Change (70-99)
Subcompact	0,065989001	0,157459921	0,167815615	154%
Compact	0,170633583	0,197450729	0,302987294	78%
Intermediate	0,284199592	0,322449915	0,326835293	15%
Standard	0,248908765	0,461659356	0,905826001	264%
Luxury	1,28311E+00	1,148364918	1,676382152	46%

The highest average (1,676) of the within-nest cross-price elasticity is again in the luxury segment in 1999, that implies that the substitutability is the highest in this segment. The lowest value (0,066) is again appears in the subcompact segment in 1970, which implies that the lowest substitutability was in this segment. The highest change (264% growth) from 1970 to 1999 in the average of the within-nest cross-price elasticities were taken place in the standard segment which implies increasing substitutability in this segment as time keeps evolving. The lowest change (15% growth) has taken place in the intermediate segment. The following table reports the average cross-nest cross-price elasticities.

Year	Average	Change (year to year)
1970	0,00026	
1985	0,00051	98%
1999	0,00073	45%
	Total change (70-99)	187%

The highest value (0,00073) of the averages of the cross-nest cross-price elasticities was in 1999, while the lowest value (0,00026) was in 1970. The highest change (98% growth) was the change from 1970 to 1985. The total change (i.e. from 1970 to 1999) in the averages of the cross-nest cross-price elasticities are 187%. This implies that as time passes the substitutability of cars across different segments (i.e. nests) has been increasing but in a slowing pace.