Demand Estimation for Iranian Automobile Industry *

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Abstract

This paper focuses on the frequently-used methods of demand estimation for discrete choice models for Iranian automobile industry. It provides estimation of demand with different methodologies and compares the accuracy of each model in estimating demand parameters. Furthermore, a couple of counterfactuals are investigated in the studied case. Effects of changes in population attributes on automobile demand are predicted through multinomial logit methodology. Using nested logit method, a nested structure is suggested to characterize consumer behavior in the market. And finally, BLP(Berry, Levinsohn and Pakes 1995) and Nevo(2000) method is used to predict marginal costs and markups of firms in order to investigate the tariff policy on imported and domestic goods.

Keywords: Demand Estimation, Multinomial Logit, Nested Logit, Discrete Choice

1 Introduction

Choices based on the relative utilities of different alternatives are called discrete choice situations. Individuals choose from a set of mutually exclusive options to gain the most possible utility. However, utilities are not measured directly while some of the attributes that influence the utilities are unobservable. Such an approach to model discrete choice situations has been widely studied under the Random Utility Maximization assumptions where the utilities of alternatives for individuals depend both on the characteristics of the consumers and

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the characteristics of the alternatives, and demographics are used as a proxy for consumer heterogeneity.

The multinomial logit model is a frequently used model to estimate random utility maximization problems. The probabilities of choosing different alternatives are computed as a function of the attributes of the alternatives under the assumptions of this model. Various authors have applied the multinomial logit model in their papers. Guadagni and Little, 1983 use multinomial logit model in coffee market, Domencich and McFadden(1975) apply the model in transportation planning in choosing the mode of transportation(car, bus or etc.). The multinomial logit model implies that substitution patterns are proportional where the choice probabilities of alternatives depend only on their own characteristics and are independent of the characteristics of other present choices. As a result, multinomial logit model fails to give reasonable explanation of substitution patterns between different choices in the models where utilities are described as a function of attributes of choices.

Nested logit model by Goldberg(1995) is another method of demand estimation for discrete choice models. It provides applausive estimates of demand parameters with the contribution of considering IIA (Independence of Irrelevant Alternatives) assumption within only the choices of each class rather than all available choices across different groups, thus, leading to much reasonable substitution patterns between alternatives. The idea of nested logit modeling is to design a hierarchical structure where similar alternatives are put in the same nest. Furthermore, it is assumed that the error terms of choices are correlated among the alternatives of nests and uncorrelated with choices across nests.

To allow for more intuitive substitution patterns between alternatives with not too many cross-price elasticities of demand, Berry(1994) and Berry, Levinsohn and Pakes(1995) have used more flexible characteristic-based utilities. Market-level demand functions are obtained from aggregating over customer-level demand functions where customer-level functions are relating market equilibrium prices to the shares of goods in market. They determine the equilibrium prices as a result of interaction between supply and demand functions and developed new methods to estimate cost parameters as well as the demand ones. The method has been developed and implemented by many authors for other differentiated markets. Nevo(2000) and Nevo(2001) use this procedure for the ready-to-eat cereal market and develop methods for the merger analysis. Petrin(2002) developes the method by adding more moments from the micro-level data to obtain more precise estimates in US-Automobile industry.

2 Models

2.1 Multinomial Logit

Multinomial logit method is used to investigate the effects of population characteristics on the demand structure in the Iranian national auto market. Utility from purchasing a car consists of two observable and unobservable parts. The observable part of utility from purchasing a car depends on the mean utility of car varying with the characteristics of individuals, X_i (including income, age, education, family-size and sex of the buyer in our model) i.e. people with different family-size are more likely to pick up some certain cars. The general form of utility of a person with characteristics (X_i) from choosing alternative j is presented as

$$U_{ij} = X_i\beta_j + \epsilon_{ij} \tag{1}$$

Where ϵ_{ij} is assumed to be a type 1 extreme value distribution.

The strong assumption used in the simulation is to allow mean exogenous utilities for goods to allow for individual characteristics act as proxies to illustrate the substitution patterns between different models of cars. The specific mean utility of cars are estimated through the first entry of β_j where the corresponding coefficient is one in the X_i vector. Berry(1994) computes the probability of choosing alternative j among J available alternatives by integrating over all possible unobservable errors to allow for utility from good j exceed utilities of all other goods and obtains

$$prob(purchasegoodj|X_i) = \frac{e^{X_i\beta_j}}{\sum_k e^{X_i\beta_k}} \tag{2}$$

Having access to micro-level data we have information on people who have chosen the outside option which means they have not purchased any car, at all. Letting for the coefficients of outside option be zero, we have resolved the identification issue by comparing the utilities from different alternatives with respect to the zero utility of our base model - outside option.

The estimates on Iranian Auto industry are used to illustrate the marginal effects of age and income on demand. The effects of income are of interest since the average real income of Iran is dependent on the exported oil price, resulting in a volatile real income in the country. Marginal effects of age are also considered in this simulation to investigate the changes in average population age. The latter is of interest where we can find examples of baby-boom in Iranian population.

2.2 Nested Logit

Grouping choices in a simple two layer nested logit model, utility is defined as

$$U_{ij} = \delta_j + \varsigma_{ig} + (1-\sigma)\varepsilon_{ij} \tag{3}$$

Where:

$$\delta_j = x_j\bar{\beta} - \alpha p_j + \xi_j \tag{4}$$

And

$$\varepsilon_{ij} \approx e^{-e^{-\xi}} \tag{5}$$

Assuming IIA assumption within and not across nests, utility of consumer i from purchasing good j consists of a mean utility (δ_j), group-specific utiliy (ς) and error term (ε) where value of σ Determines within-group correlation. Mean utility consists of two observable and unobservable parts. The observable part depends on the characteristics(price, length, width, displacement, Number of cylinders, weight, safety and other amenities[1]) and the price of the alternative(p_j). The unobservable part is choice-specific unobservable characteristic (ξ_j). Having extreme value distributional assumption on ε we can assume that also $[\varsigma + (1-\sigma)\varepsilon]$ has an extreme value distribution in order to be able to do estimation with market shares using nested logit methodology.

Similar to the estimation method used by Goldberg(1995), market share of good j as a function of total group share is found as:

$$s^{\star}_{j\backslash g}(\delta,\sigma) = \frac{e^{\frac{\delta_j}{1-\sigma}}}{D_g} \tag{6}$$

Where

$$D_g = \sum_{j\in\gamma_g} e^{\frac{\delta_j}{1-\sigma}} \tag{7}$$

And the market share of group g as

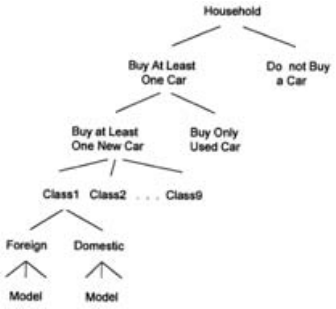
$$s^{\star}_{g}(\delta,\sigma) = \frac{D_g^{1-\sigma}}{\sum_g D_g^{1-\sigma}} \tag{8}$$

Inverting market shares from mean utilities using Berry(1994), the following equation is obtained for estimation

$$Ln(s_j) - Ln(s_0) = x_j\bar{\beta} - \alpha p_j + \sigma Ln(s_{j\backslash g}) + \xi_j \tag{9}$$

[1]Safety is an indicator which is one for the cars with Airbag and ABS braking equipments and amenities is an indicator for the power-steering and air-conditioning equipments of cars

Figure 1: Automobile Choice Model. Goldberg 1995



This equation can be estimated easily using Instrument variables because of the endogeneity of within-group shares. The extra instruments used in our model consist of two sets of instruments. The first set of instruments for each car is obtained from the sum of the characteristics of all other cars inside the nest. And the second set of instruments used is the sum the characteristics of all cars excluding the cars of the nest to which cars belong.

The Automobile choice model used in this paper consists of five sequential decisions. Each step is depicted as branches of the tree in Figure 1. The classification and choice pattern is that, at the very first stage, every individual decides whether or not to buy a car. At the second step, he/she decides whether to buy a used car or a new car. Stage three is where a buyer makes a decision on whether to buy a domestic or a foreign car. Then he chooses among different classes of cars (subcompact, compact, full, premium, truck and SUV) at stage four. Finally, the buyer reaches the last stage to choose a model between the models in selected class.

2.3 BLP(Berry, Levinsohn and Pakes)

To allow for interaction between individual and product characteristics, Berry , Levinsohn and Pakes (1995) consider the following model for utility with the introduction of random variables to denote the different preferences for the characteristics of products:

$$U(\zeta_i, p_j, x_j, \xi_j; \theta) = x_j\bar{\beta} - \alpha p_j + \xi_j + \sum_k \sigma_k x_{jk}\nu_{ik} + \epsilon_{ij} \tag{10}$$

Where similarly, the utility is composed of mean utility of purchasing a car defined as

$$\delta_j = x_j\bar{\beta} - \alpha p_j + \xi_j \tag{11}$$

And a deviation from the mean

$$\mu_{ij} = \sum_k \sigma_k x_{jk} \nu_{ik} + \epsilon_{ij} \tag{12}$$

Using the extreme value distributional assumption on the error term similar to the method explained in nested logit estimation they express market shares in terms of mean utilities

$$s_j = \frac{e^{\delta_j}}{\sum_{j \in J} e^{\delta_j}} \tag{13}$$

To use them back up the mean utilities from market shares as

$$\delta_j = Ln(s_j) - Ln(s_0) \tag{14}$$

Hence estimating the equation

$$Ln(s_j) - Ln(s_0) = x_j \bar{\beta} - \alpha p_j + \xi_j \tag{15}$$

The model represented above which is known as BLP is superior from the point that it presents a more intuitive representation of utility and exhibits acceptable cross price elasticity of demand. Furthermore, with the help of assuming Bertrand-Nash equilibrium in the market, they assume that the profit functions of the firms are of the form:

$$\Pi_f = \sum_{j \in \Im_j} (p_j - mc_j) M s_j(p, x, \xi; \theta) \tag{16}$$

Where mc_j Is the marginal cost of producing good j and $\Im$ is the set of cars produced by firm f. Given the assumptions, any product from firm f must have a price p_j, satisfying the first order condition

$$s_j(p, x, \xi; \theta) + \sum_{r \in \Im_j} (p_r - mc_r) \frac{\partial s_j(p, x, \xi; \theta)}{\partial p_j} = 0 \tag{17}$$

The J first order conditions are used to obtain markups $\frac{(p_j - mc_j)}{p_j}$. To do so, a new J by J matrix is defined, where its (j, r) element is given by:

$$\Delta_{jr} = \begin{cases} \frac{-\partial s_r}{\partial p_j} & \text{if } r \text{ and } j \text{ are produced by the same firm} \\ 0 & \text{otherwise} \end{cases} \tag{18}$$

To solve and obtain:

$$p = mc + \Delta(p, x, \xi; \theta)^{-1} s(P, x, \xi; \theta) \tag{19}$$

The last equation can be used to investigate the effects of perturbations in the market on equilibrium prices using the estimated costs.

3 Data

Iranian auto industry is composed of imported cars and domestic cars produced by a relatively few number of manufacturers(Iran-Khodro Co., Saipa Yadak Co. and etc.).

Three collections of data have been used for the demand side. Data-sets contain rich information based on individuals which we used to link the different data-sets together. The first data-set which is gathered by the authors, contains characteristics of all cars in the market - including displacement, weight, length, width and etc. Authors have used the formal websites of producers to gather the necessary information on the characteristics of the automobiles. The second data-set is the Consumer Expenditure survey(CES) published by Statistical Center of Iran every year. More than 100,000 observations on individuals are reported by CES every year. The CES for the solar year 1384(2005) contains the expenditures of each household for the last 12-month period, specific characteristics of individuals (family-size, education, sex, age, marriage status and occupation) and details about household expenditure. The most important feature of the CES is that CES reports the expenditure of durable goods, such as the exenditure on cars, in the last 12 month-period. We have used this feature a lot to merge our data sets. The third data set is the sensor accompanied by the Marketing Management in IKCO(MMI). This data-set contains 30,438 observations of random car-owners in Tehran. It is gathered in fuel stations and reports purchased car model,sex, family-size and occupation for the owners. The data-set contains all types of cars in its observations containing samples from all imported and exported cars in the solar year 1384(2005).

Table 1 shows the real market shares for each car, formally reported by manufacturers. Although the MMI is gathered in Tehran, market shares (Table 2) in the data-set are close to the real market share. Therefore, we have used the market shares in the MMI data-set as an approximation to the real market shares of all cars in the market. The MMI contains 38 car models, 12 imported and the rest 18 produced by 5 companies. Prices range from 5.5 MT [2] for Vanet to 43 MT for Benz-Chairman. The data on prices is reported by IDRO [3].

To link data sets, we use common factors. Choosing the MMI as the base data set, we have applied serious restrictions in merging the data sets. To insert new attributes for individuals in MMI, household income for example, we have found the distribution of income conditional of family size, occupation and the type of purchased car and then we have done a random draw from the obtained conditional distribution. To be more precise in the mentioned example, we use CES to construct a conditional distribution of income for teachers (as occupation) who own Toyota Camry (as type of car) and with family size equal to three to do a random draw for a buyer of Toyota Camry with family size three and

[2] Million Tomans

[3] Industrial Development and Renovation Organization of Iran

Table 1: The real production of three big companies and their market shares for 1384(2005)

Company	Car	Sales	Market Share
IKCO	Peykan	156599	9.8
	Samand	72,468	7.8
	RD	54,960	7.9
	GLX	101,612	12.9
	Pegoet 206	79,969	8.6
	Pars	27,139	4.1
	Vanet	177,364	14.5
SAIPA	Pride	250,010	32.3
	Xantia	11,947	1.4
	Rio	0	0.3
	Caravan	868	0.1
PARS	Nissan	2,271	0.2
	Pride	0	32.3
	Maxima	2,768	0.3

Table 2: MMI production of three big companies and their market shares for 1384(2005)

Company	Car	Sales	Market Share
IKCO	Peykan	2636	9.9
	Samand	2189	8.2
	RD	2434	9.1
	GLX	3342	12.5
	Pegoet 206	2800	10.5
	Pars	1231	4.6
	Vanet	647	2.4
SAIPA	Pride	10566	39.5
	Xantia	511	1.9
	Rio	13	0
	Caravan	39	0.1
PARS	Nissan	174	0.7
	Pride	10566	39.5
	Maxima	163	0.6

occupation as teacher. Having access to rich data sets, such a method enables us to end up with a much more accurate final data set than the frequently used method of doing a complete random draw from aggregate distributions.

4 Results

4.1 Mutinomial Logit

The multinomial logit model described in section 2.1 is used to illustrate the role of the attributes of consumers on utilities and demand functions of cars. The attributes of consumers used in the estimation are sex, family-size, age, education status and income of the individuals. Estimation results privided Table 3 are pretty significant - according to the t-statistics in parentheses - implying interesting facts about Iranian market. For example, the coefficients on the sex of cosumers(one indicating female and zero indicating male) suggest that females get higher utility from all models of Peugeot 206, Reno, Matiz and Gol and less utility from Nissan-Pickup and Sinad which makes a lot of sense in Iranian auto market. Family-size has bigger coefficients for bigger cars and smaller coefficients for smaller cars, indicating a remarkable correlation between car size and family-size.

Furthermore, we have calculated the marginal effects of each attribute on the probability of choosing outside option(not purchasing any new car) in Table 4. Since changes in probabilities of choosing goods are proportional to the changes in market shares of goods, marginal effects could be very good measures of investigating the changes of market shares due to changes in population attributes of the market.

The simulation results suggest that one unit increase in average family-size, one year increase in average age and one unit increase in average income - equivalent to hundred thousand Tomans in our simulation - will result in %0.51, %0.04 and -%0.0008 change in the probability of ending up with outside option. According to the CES data almost %6 of households buy new cars every year and %94 of households are the people who dont buy any new car whom we denote as the ouside option buyers. Taking into consideration that more than 1,100,000 cars are produced every year, the mentioned changes in consumer attributes may result in approximately -83000, -6700 and 130 changes in the number of total annual car sales. This might be of interest from the policy making perspectives for the manufacturers who would like to have estimates of demand changes due to the changes in population demographics. As an example, the baby-boom phenomenon in Iran which resulted in younger average population trend in 80s could be an explanation to the decreasing market share of outside option. Another interesting feature of these estimates could be the investigation of demand under a change in average income of people. Because of high depen-

Table 3: Mutinominal Logit Regression (with the corresponding t-statistics in parentheses)

car	sex	family size	age	education	income	constant
Peykan	-3.582	-0.041	-0.013	0.011	-0.002	-4.230
	(-29.550)	(-3.450)	(-8.650)	(12.340)	(-2.940)	(-48.450)
Vanet	-4.373	-0.123	-0.026	0.003	0.000	-4.551
	(-12.290)	(-4.840)	(-8.350)	(1.460)	(-0.290)	(-25.910)
RD	-2.943	-0.115	-0.013	0.013	-0.001	-4.047
	(-32.190)	(-9.050)	(-9.010)	(13.540)	(-1.510)	(-46.100)
GLI	-3.012	-0.128	-0.011	0.014	-0.001	-6.273
	(-11.000)	(-3.490)	(-2.610)	(5.440)	(-0.580)	(-24.820)
206 V2	-1.462	-0.276	-0.017	0.018	0.001	-4.041
	(-24.450)	(-17.000)	(-10.250)	(18.000)	(2.480)	(-40.430)
GLX	-2.682	-0.141	-0.013	0.017	0.002	-4.022
	(-36.020)	(-11.960)	(-9.570)	(20.820)	(6.610)	(-50.500)
Samand	-2.656	-0.146	-0.017	0.014	0.000	-4.050
	(-30.680)	(-10.480)	(-10.300)	(14.610)	(0.470)	(-43.290)
Samand LX	-2.422	-0.092	-0.014	0.018	0.001	-5.797
	(-16.410)	(-3.620)	(-4.500)	(10.210)	(0.830)	(-33.070)
206 v3	-1.437	-0.344	-0.018	0.015	0.001	-4.353
	(-17.280)	(-14.870)	(-7.630)	(10.170)	(1.370)	(-31.060)
206 v5	-1.602	-0.350	-0.019	0.019	0.001	-4.741
	(-15.330)	(-12.580)	(-6.860)	(11.120)	(1.230)	(-28.730)
206 v6	-1.789	-0.309	-0.017	0.018	0.001	-5.510
	(-12.050)	(-8.510)	(-4.500)	(8.080)	(1.660)	(-24.930)
Pars	-2.573	-0.193	-0.020	0.016	0.001	-4.409
	(-22.990)	(-10.010)	(-9.410)	(12.790)	(2.050)	(-35.580)
ELX	-2.584	-0.133	-0.017	0.018	0.000	-7.318
	(-6.590)	(-2.040)	(-2.250)	(4.200)	(0.150)	(-16.970)
Nasim	-1.851	-0.164	-0.014	0.017	0.000	-5.340
	(-17.120)	(-6.740)	(-5.160)	(10.270)	(-0.130)	(-33.320)
Saba	-2.137	-0.227	-0.014	0.013	0.000	-2.331
	(-65.520)	(-33.490)	(-19.880)	(28.960)	(0.890)	(-52.780)
Xantia	-2.770	-0.185	-0.024	0.019	0.001	-5.240
	(-14.710)	(-6.130)	(-6.960)	(9.610)	(1.270)	(-27.580)
Rio	-1.689	-0.520	-0.020	0.021	0.003	-8.255
	(-2.200)	(-2.490)	(-1.040)	(1.810)	(1.330)	(-7.160)
Caravan	-2.168	-0.100	-0.029	0.009	0.001	-7.633
	(-4.110)	(-0.960)	(-2.210)	(1.120)	(0.490)	(-10.790)
Matiz	-0.947	-0.216	-0.016	0.020	0.002	-7.201
	(-4.690)	(-3.510)	(-2.480)	(5.170)	(1.690)	(-18.490)
Mazda	-1.987	-0.244	-0.020	0.017	0.002	-6.141
	(-9.320)	(-5.120)	(-3.870)	(5.720)	(2.760)	(-20.600)
Pajiro	-2.311	-0.052	-0.084	0.017	-0.011	-7.010
	(-2.200)	(-0.230)	(-2.280)	(1.070)	(-0.640)	(-5.150)
Reno	-0.954	-0.347	-0.011	0.019	0.001	-5.320
	(-10.380)	(-11.970)	(-4.130)	(10.870)	(1.770)	(-30.360)
Maxima	-3.262	-0.046	-0.023	0.018	0.001	-6.903
	(-7.840)	(-0.940)	(-3.610)	(5.280)	(0.950)	(-20.310)
Pickup	-29.529	-0.447	-0.024	0.007	0.001	-5.929
	(0.000)	(-5.170)	(-2.780)	(1.290)	(0.590)	(-11.550)

car	sex	family size	age	education	income2	constant
Vanet Mazda	-3.702	-0.171	-0.025	0.008	-0.002	-5.321
	(-9.670)	(-4.400)	(-5.530)	(2.680)	(-0.670)	(-20.690)
Roniz	-2.014	-0.179	-0.037	0.034	0.002	-7.260
	(-5.980)	(-2.320)	(-3.900)	(7.100)	(1.670)	(-15.990)
Proton	-3.428	-0.349	-0.026	0.027	0.000	-7.619
	(-3.370)	(-2.710)	(-1.970)	(3.550)	(-0.070)	(-10.440)
Sinad	-29.411	-0.113	-0.004	0.029	-0.021	-10.530
	(0.000)	(-0.440)	(-0.150)	(1.930)	(-0.890)	(-6.230)
Verna	-1.029	-0.028	-0.019	0.019	-0.003	-8.074
	(-3.950)	(-0.390)	(-2.090)	(3.760)	(-0.660)	(-16.230)
Gol	-1.115	-0.167	-0.028	0.024	-0.005	-7.233
	(-4.330)	(-2.170)	(-3.190)	(4.920)	(-0.950)	(-15.420)
Musu	-1.767	-0.003	-0.046	0.015	0.002	-7.413
	(-4.320)	(-0.040)	(-3.320)	(2.120)	(0.860)	(-11.670)
Benz Chairman	-2.638	-0.119	-0.034	0.012	0.000	-7.258
	(-4.410)	(-1.190)	(-2.680)	(1.650)	(-0.010)	(-11.150)
Corolla	-2.836	0.037	-0.042	0.010	0.003	-8.476
	(-2.760)	(0.270)	(-1.910)	(0.850)	(1.540)	(-8.130)
Camry	-2.741	0.038	-0.057	0.013	0.002	-7.402
	(-3.760)	(0.360)	(-3.200)	(1.570)	(0.740)	(-9.640)
Avente	-2.039	-0.378	-0.008	0.011	0.002	-7.734
	(-3.840)	(-3.210)	(-0.720)	(1.420)	(0.880)	(-10.540)
Prado	-3.299	-0.295	-0.055	0.015	0.002	-6.478
	(-3.240)	(-2.040)	(-3.020)	(1.650)	(1.120)	(-7.840)
Cielo	-2.185	-0.121	-0.031	0.022	0.000	-6.872
	(-6.870)	(-1.870)	(-3.850)	(5.050)	(0.200)	(-16.760)
Patrol	-2.296	-0.417	-0.025	0.009	-0.004	-7.809
	(-2.190)	(-1.890)	(-1.170)	(0.590)	(-0.270)	(-6.040)

Table 4: Marginal Effect for multinomial Logit Regression. ($\frac{\partial y}{\partial x}$ is for discrete change of dummy variable from 0 to 1)

Variable	$\frac{\partial y}{\partial x}$	Std. Err.	z	p-value
Sex	0.0691	0.0005	132.2400	0.0000
Family size	0.0051	0.0001	48.3400	0.0000
Age	0.0004	0.0000	34.0400	0.0000
Education	-0.0004	0.0000	-50.5600	0.0000
Income	-0.00000839	0.0043025	-1.9500	0.0510

Table 5: Nested Logit Regression (Number of Observation is equal to 38, Wald Test $\chi^2(10) = 56.25$)

logshare	Coef.	Std. Err.	t-test	P-value
Price	-0.2076	0.1007	-2.0600	0.0390
Bottom Cluster Corr.	0.6437	0.2818	2.2800	0.0220
Upper Cluster Corr.	0.5659	0.2494	2.2700	0.0230
Length	0.8245	0.7925	1.0400	0.2980
Width	-1.2889	3.2077	-0.4000	0.6880
Displacment (cm^3)	0.0038	0.0039	0.9800	0.3290
Number of Cylinders	-0.5147	1.3175	-0.3900	0.6960
Anemities	0.3498	0.9124	0.3800	0.7010
Weight (kg)	-0.0040	0.0025	-1.6000	0.1100
Safety	1.3188	1.0456	1.2600	0.2070
Constant	-3.8931	7.0852	-0.5500	0.5830

dence of Iran on oil revenue, the average income of Iranian households is volatile over years and the estimates can partially describe the reason of temporary delays of companies in manufacturing automobiles in some high-demand periods.

4.2 Nested Logit

The mentioned five-stage nested structure with the stages of deciding whether or not to buy a car, whether to buy a used or a new car, to buy a foreign or domestic car, to choose a specific class of cars and the last decision on make and model of car is estimated using two sets of instruments mentioned in chapter 2.2. The characteristics of cars used in the estimation are price, length, width, displacement, Number of cylinders, weight, safety and amenities. Estimation results are available in the Table 5:

All the estimation coefficients show reasonable signs with different significances. The estimation suggests relatively high correlation within the nests of the structure - %57 is the correlation within the upper cluster of cars(domestic and foreign) and %64 is the estimated correlation within the lower cluster of classes(subcompact, compact, full, premium, truck and SUV). These high correlations indicate that people value imported cars differently than the way they value domestic cars, and there is a significant correlation within different classes of cars.

4.3 BLP

The estimates from equation 15 are presented in table 6 where all coefficients have reasonable signs (negative sign on price, positive sign on safety, negative sign on weight and etc.). The coefficient on price is lower compared to the one

Table 6: BLP Estimation (Number of Observation is equal to 38, Wald Test $\chi^2(8) = 16.77$)

logshare	Coef.	Std. Err.	t-test	P-value
Price	-0.4487	0.1899	-2.3600	0.0180
length	-0.0093	1.2668	-0.0100	0.9940
width	-6.1303	5.2101	-1.1800	0.2390
Displacement (cm^3)	0.0134	0.0062	2.1500	0.0320
Number of Cylinders	-3.4119	1.9954	-1.7100	0.0870
Weight (kg)	-0.0081	0.0038	-2.1400	0.0330
Safety	3.6099	1.8661	1.9300	0.0530
Amenities	1.3427	1.5201	0.8800	0.3770
Constant	7.9305	11.1354	0.7100	0.4760

obtained in nested logit. This difference is due to the nesting structure and the instrument variables used in the nested logit estimation puts more restrictions on the estimates.

Furthermore, estimates of marginal costs for all cars are computed from Equation 19 to use BLP(1995) and Nevo(2000)s method in order to obtain markups for all the cars in the market. The estimates of marginal costs and markups are summarized in table 7. Having Access to the private data on reports of marginal costs for the automobiles produced by IKCo., the authors have compared the estimates of marginal costs. The estimates are applaudable from the sense that in average, they show no more than %8 difference from the the reported ones.

Comparing the markups for different cars, we can see that the markups are significantly higher for domestic cars where most of the first 20 cars in the table are domestic and most of the last 18 cars in the table are imported cars. This is an indication that domestic producers are enjoying from their higher markups which is mostly due to the tariff policy by Iranian government on Auto-producers. The tariff policy by Iranian government puts %70 tariff on intermediary goods purchased by domestic manufacturers which they use in production lines and there is almost %100 on the prices of imported automobiles. In order to make the market more competitive such that consumer surplus and total surplus both increase, the government should apply a tariff policy to reduce market powers of domestic producers. Therefore, a decrease in tariff for imported automobiles is the suggestion of this paper to make Iranian auto market more competitive in order to achieve higher total surplus.

Table 7: Marginal costs and Markups for Automobiles

Car	Markup(%)	Marginal Cost(MT)	Car	Markup(%)	Marginal Cost(MT)
Peykan	37.3965	3.8188	Mazda	10.0208	19.7954
Vanet	41.4761	3.2188	Pajiro	4.0826	51.7954
RD	33.0607	4.6188	Reno	44.5911	2.7427
GLI	22.1475	8.0188	Maxima	5.9656	34.7927
206 V2	21.4196	8.3688	Pickup	9.0092	22.2927
GLX	18.6219	9.9688	Vanet Mazda	20.999	8.2951
Samand	20.4591	8.8688	Roniz	7.2262	28.2960
Samand LX	17.4136	10.8188	Proton	16.2041	11.3962
206 v3	19.6654	9.3188	Sinad	23.2452	7.2764
206 v5	18.3967	10.1188	Verna	16.1107	11.4761
206 v6	16.8977	11.2188	Gol	16.8242	10.8960
Pars	14.7173	13.2188	Musu	5.2075	40.1162
ELX	13.0354	15.2188	Benz Chairman	4.8974	42.7962
Nasim	33.9081	4.3951	Corolla	8.1618	24.7963
Saba	32.2127	4.7451	Camry	5.3360	39.0962
Xantia	10.089	20.0951	Avente	9.1824	21.7962
Rio	19.7797	9.1451	Prado	4.4075	47.7963
Caravan	18.0391	10.2451	Cielo	18.5263	9.6954
Matiz	29.0083	5.3954	Patrol	14.6911	12.7963

5 Conclusion

Iranian automobile market is an example of oligopolistic differentiated products market with a few number of domestic manufacturers and a number of imported types of automobiles. This paper considers Iranian auto market as a case study and provides estimates of demand parameters using different methodologies.

The estimations in this paper investigate the market from three perspectives. First of all, the effects of changes in the attributes of people in the market are probed. The estimations suggest that increase in average income, decrease in average family size of Iranian households and decrease in the average population age will result in more proportion of households purchasing automobiles every year. Estimates of marginal effects of the mentioned attributes on demand can be used by manufacturers for use in production policies in the cases of changes in Iranian social welfare and the gradual changes in Iranian family attributes. Furthermore, this paper suggests that the behavior of consumers in purchasing vehicles can be categorized. People choose between buying domestic and foreign cars. Afterwards, they choose between different classes of choices, and finally, a decision is made on the make and model. Such a hierarchical pattern results in a more reasonable and applausive estimation. The last and maybe the most interesting investigation performed in this paper is on the analysis of equilibrium prices and markups in the market which suggests that the domestic producers

are enjoying from higher markups. In order to increase the social welfare by increasing the competition between firms in the market, it is suggested that the government puts lower tariffs on imported automobiles.

Further interesting extensions - some of which are being researched by the authors of his paper - can be done by future researchers. A more thorough analysis on markups and a more precise estimation can be done by using a panel data of production in multiple years. Merger analysis can be performed to analyze the effects of the merger between different companies. Furthermore, using the market structure and the estimates of markups, it is of interest to analyze the profitability of the production of a common product by companies. Such an example exists in the recent years where the two largest companies(IKCo. and Saipa) have started to produce Tondar L90, collaborately.

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