A Structural model of the Irish Automobile Industry: Assessing Profits under various Pricing Regimes.

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Abstract

We use retail data on new car sales in 2003. The volume data was provided by the Central Statistics Office. List prices and model characteristics where compiled from the "Car Buyer Guide". Following Berry (1994), in a structural model of equilibrium we jointly estimate demand and cost primitives for the Irish new car industry. We estimate cost to not only improve efficiency but, in addition, estimate the burden of VAT and VRT taxation taken on by the supply side of the industry. Having estimated consumer preferences for car characteristics, including price and segments, we can back-out profits for each car model assuming various pricing regimes within our structural model of equilibrium. Regime I is where all models of cars compete in price; Regime II is where only cars of different manufacturers compete in price; Regime III is where only cars of different importers compete in price. Given within segment market share dominance of manufacturers and importers, we calculate the *"potential"* gains in profits that would result from price co-ordination amongst dealers of the same manufacturers or importer networks. These *"potential"* gains should only be taken as actual gains if widespread price co-ordination amongst dealers was proven in a court of law.

Key Words: Market Shares, Market Power, Differentiated Products, Irish New Care Industry.

JEL Classification: K2 , L11, L25, L40, L81

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1. Introduction

Our data on the new car market in Ireland in 2003 shows purchases of 133,000 automobiles, grossing 3.3 billion euro in sales. Even though we do not have all the car sales we are very close to having the full population. The top four-company concentration index (C4) shows the Irish automobile industry not to be particularly concentrated. In Table 1 and 2 we see the top four companies account for 46% of the market when measured in unit sales and 40 % when measured in terms of turnover. In terms of the consolidation of importing power, Table 1 and 2, we see the top four importers account for 57% of the market when measured in unit sales and 56 % when measured in terms of turnover. Conventional economic theory might interpret this as a signal that the industry is reasonably competitive in terms of import and sales structure.[1]

However this can be misleading if products are not homogenous, as in the case of automobiles. We can split the market into seven obvious segments, Compact (Medium)Cars, City (Small) Cars, Medium (Large) Cars, Executive Cars, Off Roads, SUV, 4X4 , Multi Purpose Vehicles and Convertible & Coupe. Table 1and 2 reports the market share of each segment and C4 indices within each segment. Unit sales and turnover are much more concentrated into the top 4 Companies or top 4 importers at the segment level. For companies, on average, we see a C4 of 64% in unit sales and 65% in turnover. For importers, on average, we see a C4 of 70% in unit sales and 71% in turnover. Economic theory tells us that this could lead to market power in the absence of price competition within the segments of the industry. Hence we estimate a structural model of the Irish automobile industry to back out subsequent profits earned by the

[1] Market power is a measure of the ability of pricing above the perfectly competitive level.

industry under different pricing regimes.[2] Regime I is where all models of cars compete in price; Regime II is where only cars of different manufacturers compete in price; Regime III is where only cars of different importers (sets of manufacturers) compete in price. We calculate estimated profit levels in the presence of price co-ordination amongst dealers of the same manufacturers or importers, moving from regime I to II or III. We estimate the degree of overcharging by segment caused by price co-ordination, assuming price co-ordination is a common practice across dealers of the industry. Off course the presence of price co-ordination has to be proven in a court of law. We are just highlighting, given consumer and cost primitives, the possible returns to price co-ordination in this industry.

2. Data

Our data do not let us to disentangle how dealers, distributors and producers share the profits and how the market power is allocated among the three categories. Therefore our use of the word industry is inclusive of all the three categories. Another restriction of our data is that we observe list price, therefore no information on potential discounts is available. This is not going to be a big issue but once we compute the market power and the profits we have to be aware that a certain percentage of market power and profits might be discounts. The data we use in our analysis come from two main sources:

- The volume data were provided by the Central Statistics Office, which collects the data from the revenue department for tax reasons. These data are also available from the SIMI (Body representing the Motoring Industry in Ireland).

[2] Structural models are well used by the Competition Authority in the United States, and start to be considered as well by the Antitrust Authority in Europe, to evaluate the level of competition in specific markets.

- The price and model characteristics data were compiled from the specialised press (mostly from "Car Buyer Guide").

We then followed the industry and experts classification system to allocate the models available in Ireland into the following seven segments, Appendix I documents the top 5 sellers in each of these segments.

- City (Peugeot 106, …)
- Compact (Peugeot 206, …)
- Convertible & Coupe (Megane Coupe, …)
- Multi Purpose Vehicle (Scenic)
- Off Roads, SUV, Four by Four (BMW X5, …)
- Executive (Audi A4, …)
- Medium (Ford Mondeo, …)

3. The model

In differentiated products industries, market share is no longer a good approximation of the ability to mark-up price over cost. The market is now made up of a number of products that are differentiated by product attributes. Some products (car models) are more similar than others in terms of these attributes. The competitive constraint on pricing is now determined by the degree of substitutability between the various makes of cars in the market. Things become even more complex in the case that companies (importers) can control multiple products in the market. The problem here is due to the complex way in which firms operate within a market: firms may specialise in producing goods with very similar attributes, or have a portfolio of goods with very different attributes.

The complex operation of multi-product firms over different segments in industries means that there is no longer a good theoretical foundation for the mapping of market concentration, even within segments, into market power. The question now arises as to how we may map this complexity of multi-product firms operating over different segments into market power? We next introduce a structural approach that backs-out market power for each product, by simultaneously estimating a demand and pricing (supply) system for differentiated products.

The Demand Equation

In order to evaluate market power where products are differentiated, it is necessary to estimate the degree of substitutability between the various products/cars, in the market. However, estimating demand for differentiated products has a dimensionality problem. A linear demand system for J brands has J^2 price parameters to estimate. One must therefore place some structure on the estimation.

A number of alternative demand specifications have been developed to deal with this dimensionality problem by reducing the dimensionality space into a product space. Representative consumer choice models include the distance metric model (Pinkse, Slade and Brett, 2002; Pinkse and Slade 2002), or the multi-stage budgeting model (Hausman, Leonard and Zona, 1994). Representative consumer choice models allow individuals to consume more than one brand, in variable amounts. Discrete choice models, which allow for consumer heterogeneity, include the vertical model (Bresnahan, 1987), the logit or nested logit models (Berry 1994) or a random coefficient model (Berry, Levinsohn and Pakes, 1995).

The vertical model is the simplest specification of demand used in this framework. Pioneering work by Bresnahan (1987) estimated competitive conduct for the differentiated automobile industry using the vertical model. This assumes that products compete only with the good located on either side of it in product space,[3] and that *all* characteristics of the product are observed (error is due only to measurement error). Generalisations of the demand function can yield more reasonable properties and thus allow for richer estimation of demand systems. In this paper we focus on the logit and nested logit models of demand. However, one may also specify a more general demand function compared with the logit and nested logit models to allow for greater variations in consumer substitution patters and a richer estimation of demand systems, as in Berry, Levinsohn and Pakes (1995).[4]

Berry (1994) develops an approach to estimating differentiated demand systems to (i) allow for more flexible substitution patterns (substitution patterns are symmetric over all product types) using the logit model, and (ii) to correct for price endogeneity, since we don't actually observe all product characteristics. The logit model defines the utility for individual *i* consuming product *j* as the mean quality of product *j* plus idiosyncratic consumer tastes for a product,

$$U_{ij} = x_j\beta - \alpha p_j + \xi_j + \varepsilon_{ij} \tag{1}$$

[3] As a result, cross-price elasticities for a product *j* are defined only with respect to neighbouring products.
[4] This specification of demand allows different individuals to have different tastes for different product characteristics and, in addition, can allow for consumer heterogeneity in terms of their response to prices. The random coefficients are designed to capture variations in the substitution patterns. Although more realistic than the logit or nested logit model, the estimation procedure is not so straightforward, requiring both simulation and numerical methods. See Mariuzzo, Walsh and Whelan (2004) for an example of this methodology applied to retail carbonated soft drinks market in the estimation of market power and its use in undertaking counterfactual exercises.

where x_j is a vector of observed product characteristics (cc, mpg etc), p_j is the price of product j, ξ_j is a vector of unobservable (to the econometrician) demand characteristics. The variation in consumer tastes enters only through ε_{ij}, consumer i's utility specific to product j, which is assumed to be an identically and independently distributed extreme value (over both products and individuals), leading the property of *Independence of Irrelevant Alternatives*.[5] This utility function can be re-written as,

$$U_{ij} = \delta_j + \varepsilon_{ij} \tag{1'}$$

where δ_j describes the mean quality of product j. This is a random co-efficient model, where each consumer consumes one unit of the good yielding the highest utility (including the outside good). The logit model is often used for its tractability, but the property of the *Independence of Irrelevant Alternatives* induces estimates of substitution effects that are often considered inappropriate.

The nested logit model (McFadden, 1978) is just a simple extension of the logit case, to allow for the fact that you have various segments or groups in the market (for example city cars etc).[6] Thus, the j brands or products are partitioned into G +1 groups, with $g = 0,1\ldots..G$ where the outside good j is the only one present in group 0. It allows for correlations in the error terms for products within a group, where groups are exogenously specified. The utility of consumer i for product j in the nested logit can thus be written,

$$U_{ij} = \delta_j + \zeta_{ig} + (1 - \sigma)\varepsilon_{ij} \tag{2}$$

[5] The fact that ε_{ij} is i.i.d. in logit models leads to the property of *Independence of Irrelevant Alternatives*, which means that the ratio of market share of any two goods does not depend on the characteristics of other goods in the market. This indicates that two goods with the same shares have the same cross-price elasticities with any other good.

[6] Individual variability now enters through the predetermined segmentation of the market, as well as through the error term which is still i.i.d. Thus we have *Independence of Irrelevant Nested Alternatives.*

where $\delta_j = x_j\beta - \alpha p_j + \xi_j$. For consumer i, ζ_{ig} is utility common to all products within a group g and has a distribution function that depends on σ, with $0 \leq \sigma < 1$. Higher values of σ indicates greater substitutability of products within groups. As the parameter σ approaches one, the within group correlation of utility levels across products goes to one (products within groups are perfect substitutes). As σ tends to zero, so too does the within group correlation.[7]

As shown in Berry (1994), from the defined utility function in equation (1), or more generally in (2) we can derive the product market shares which depend upon the unknown parameter vector δ (describing the mean utility level of a product), and we can treat these mean utility levels as known non-linear transformations of market shares such that δ_j can be written as the following linear demand equation,

$$\ln(s_j) - \ln(s_0) = x_j\beta - \alpha p_j + \sigma \ln(s_{jg}) + \xi_j \tag{3}$$

where s_j is product j's share of the entire market (inside plus outside goods total), s_0 is the outside goods share of the entire market, x_j is a vector of observed characteristics of product j, p_j is its price, s_{jg} is product j's share of the group g to which it belongs, and ξ_j is an unobserved (to the econometrician) product characteristic that is assumed to be mean independent of x.[8] Since prices and the within group share are endogenous variables in equation (3), they must be instrumented and the instruments need to vary by product.

The corresponding nested logit own-price and cross-price elasticities are given in equations (4) and (5) respectively,

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[7] When $\sigma = 0$ this reduces to the ordinary logit model in equation (12), where substitution possibilities are completely symmetric, for example as when all products belong to the same group.

[8] Inverting the market share function to yield equation (14) allows one to estimate demand parameters without the need for assumptions on either the parametric distribution of the unobservables ξ_j, or on the actual process that generates prices (Berry, 1994).

$$\varepsilon_{jj} = \alpha p_j \left[s_j - \frac{1}{(1-\sigma)} + \frac{\sigma}{(1-\sigma)} s_{jg} \right] \quad (4)$$

$$\varepsilon_{jk} = \begin{cases} \alpha p_k \left[s_k + \frac{\sigma}{(1-\sigma)} s_{jg} \right] & \text{if } k \neq j \text{ and } k \in g \\ \alpha p_k s_k & \text{if } k \neq j \text{ and } k \notin g \end{cases} \quad (5)$$

It is important to note that the elasticities here refer to the percentage change in *market share* in response to a change in price. The within group correlation of utility levels, σ, and market share within the group g, s_{jg}, are important determinants of the own-price elasticity and the cross-price elasticity with respect to other products within the same group. The cross-price elasticity between j and another product k located in a different group g is independent of j. [9]

In order to define the primitives of the demand function, or the own- and cross-price demand elasiticities for each product j, we derive estimates of α and σ from our demand equation (3). Using these demand side primitives, via an equilibrium pricing system of equations to be defined, we can then back out the price-cost mark-up (Lerner Index) for each brand j. We now consider the supply side and the Lerner Index for each product.

The Supply Function

A fully structural approach to estimating market power requires specifying the cost function to be estimated,

$$MC_j = \beta' \varpi_j + \rho \, ln(Per\ Unit\ Tax\ Take) + \omega_j \quad (6)$$

[9] The number of elasticities that we compute is equal to the square of the number of automobiles. This translates in our data into a number that exceeds one million.

where ϖ_j is a vector of observed product characteristics that determine manufacturing costs, ρ determines the impact of tax revenue paid for this model of car on the marginal cost (burden of the tax) and ω_j is a vector of product characteristics that are unobservable to the econometrician.

For simplicity, firstly assume single-product price setting firms and symmetry in the market. Given marginal costs c_j, a multi-product Nash equilibrium is given by the system of J first order conditions, one per product. The first order profit maximising condition for the nested logit implies a lerner index per car model as follows.

$$\frac{p_j - c_j}{p_j} = \frac{1}{p_j}\left[\frac{1-\sigma}{\alpha} \Big/ \left(1 - \sigma s_{jg} - (1-\sigma)s_j\right)\right] \tag{7}$$

The mark-up of list price on cost depends upon the substitution parameter σ and within group share s_{jg}. The higher σ is, the greater weight attached to within group product share. The bigger the within group product share, the higher will be the product price-cost mark-up. Thus we observe a positive relationship between size and market power within segments. If $\sigma = 0$, in the case that there is no segmentation, we have an ordinary logit result, such that the mark-up depends only on product share, s_j, and not the within group share. Using ρ we can determine per car what percentage of VAT and VRT (depends on cc of car) is in marginal cost. Hence, we can define the mark-up in terns of pre-tax prices (industry profits to be shared among, producers, distributors and dealers).

In a multi-product firm setting, firms maximise the sum of profits accruing from their products, f_j. In product price setting, p_b, the price of all other products are taken as a given. A firm/importer can internalises the cross-price effect on market share of the products it owns in the price setting of an individual product. The first order condition for each profit maximising brand will have the general form,

$$s_j + \sum_{b \in f_j} \left(p_j - c_j\right) \frac{\partial s_j}{\partial p_b} = 0 \qquad b, j \in f_j \tag{8}$$

Given marginal costs c_j, assuming multi-product price setting firms without symmetry, a multi-product Nash equilibrium is given by the system of J first order conditions. Using our demand primitives, of which we have J^2 in each period, the first order condition for the nested logit in equation (7) implies product price equals marginal cost plus a mark-up, so we get estimates of a Lerner Index per brand *j*.[10] Thus, given the primitives of the demand system and price we will be able to calculate a marginal cost for each brand.[11]

Estimation of the Structural Model

Berry (1994) proposes the simultaneous estimation of the logit or nested logit demand equation in (3) with a specified marginal cost (supply) equation in (6). Demand and costs are jointly estimated using Generalised Method of Moments (GMM), where the set of instruments need to be jointly orthogonal to the unobservable in both equations. Since we have an endogeneity issue in the simultaneous estimation of demand and supply, we need to instrument. Demand can be instrumented using cost shifters not present in the demand equation, while supply can be instrumented using demand shifters not in the cost equation. However, various alternatives have also been suggested.[12]

[10] This assumes that a Nash equilibrium exists. This has been proven for a general discrete choice model and assuming single product firms (Caplin and Nalebuff (1991)), and for the nested logit model with multiproduct firms in the symmetric case (Anderson and de Palma (1992)).

[11] Aggregating these estimates over a firm's brands gives an indicator of firm market power. This may be done by taking a strict average, median outcome, or a weighted (by brand share of firm sales) average.

[12] Berry (1994) and Berry, Levinsohn and Pakes (BLP) (1995) suggest rival product characteristics as instruments for own-price, since a product *j*'s price is affected by variations in the characteristics of

Employing a structural approach to estimating market power thus requires specifying both a demand and supply function, and estimating them jointly. A key advantage of this approach is the flexibility allowed in terms of undertaking various counterfactual exercises to examine the effect that a removal of the price constraining effects of firm ownership structures (through a change in brand ownership or the merger of firms for example) would have for welfare, consumer and producer surpluses (see Ivaldi and Verboven (2000) for the use of a model of demand (Nest Logit) and supply in the Volvo/Scania case.)

The approach we use is based on the above literature which assumes that individuals choose a particular automobile based on some physical and (non-physical) characteristics. Examples of characteristics we control for in our estimates are:

- list price, performance, cubic capacity, miles per gallon, horse power, length, height, acceleration, diesel (versus petrol), company-brands.

The discrete choice literature has so far gained a level of reliability that represents the best option to estimate reliable primitives of demand in a differentiated products industry. Logit and Nested Logit models are at the centre of this literature. The fact that we simultaneously estimate of demand and supply tailors our results to possible policy evaluations on different pricing regimes. It also allows us to estimate the share of tax

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competing products and are excluded from the utility function. This is not valid however, if rival characteristics enter the demand equation directly. Hausman and Taylor (1981) and Hausman, Leonard and Zona (1994) suggest prices in one segment can be used as instruments for prices in another, allowing for firm and segment fixed effects. The prices of a firm's products in other segments, after the elimination of segment and firm effects, are driven by common underlying costs correlated with product price, but uncorrelated with the disturbances in the product demand equations. A problem may arise however, if prices in other segments are correlated with unobserved product characteristics. One must test the validity of instruments used to ensure that they are uncorrelated with the error. This may be done by assessing the correlation between instruments and residuals, taking into account the fact that the residuals are estimates of errors.

revenues paid out of marginal cost (burden of taxation accepted by the supply chain). We use our estimates to evaluate different pricing scenarios.

- Regime 1 (competitive benchmark): the industry has 1169 models of cars, all compete in pricing.
- Regime 2: the industry consists of 36 companies that price co-ordinate within the portfolio of cars. We interpret this as a scenario where dealers can fix the prices of the products produced by the company they belong to (they are associated with).[13] In this framework, being the companies multi-products they can internalize price competition and benefit of market power (higher profits).
- Regime 3: the industry has 26 importers. We use information on the distribution of some producers that share the same distributors (O'Flaterty, Armalou, Convest, Others) which might lead to further price internalizations.

4. Results

We estimate the parameters of our demand and supply and compute for each car model (product) the level of market power and profits. In Table 3 we present the results from the estimation of the demand and cost reduced forms outlined in equation (3) and (6), respectively. The key parameters in demand are the α and σ. In supply the ρ can be used to calculate the burden of taxation on the supply side of the market. Having these parameters we can calculate the matrix of own-price and cross-price elasticities as given in equations (4) and (5), respectively. In Table 4 we average these by segment. We see

[13] Similarly, the dealers could fix the maximum discounts.

that there is less price competition in City, Compact and Medium segments relative to the other segments. This will lead to bigger mark-ups.

In Table 5 we report the weighted average (weights are the market shares of each automobile) of mark-ups in the market, net of taxation taken out of both list price and marginal costs of the brands (dictated by ρ). We report the mark-ups under our three pricing regimes. See clearly that internalization of cross-price effects within companies or within importers can lead to substantial increases in mark-ups. If dealers gave discounts of 8 %, regime I would leave us with economic profits close to zero, perfect competition. Yet, price co-ordination within dealers belonging to the same company (across the entire industry) can drive the estimated markup to 21% (increase estimated profits by approx 400 million). Price co-ordination within dealers belonging to the same importers (across the entire industry) can drive the estimated markup to 27% (increase estimated profits by approx 600 million). These are upper bound estimates on the profit gains due to price co-ordination within dealership associations or distribution networks. Clearly, the presence of price co-ordination in our structural model of equilibrium, given our estimated own-price and cross-price elasticities, means that estimated marginal costs have to be lower. Hence, a bigger proportion of the list price will be estimated to be profit that will be shared across Producers/Manufacturers, Importers/Distributors and Dealers/Retailers.

Finally, in Table 6 we document the average (weighted by unit sales) list price of the cars within segments. In column II we document the average (weighted by unit sales) estimated mark-up assuming no price co-ordination in the industry. In column III and IV we report the estimated mark-ups in the presence of price co-ordination between dealers of the same company and importer, respectively. We also give the estimated price increase that resulted from the presence of price co-ordination. For example, in compact cars, due to estimated mark-up increasing by 17% (9%-26%) of the list price, consumers have paid 3,504 per car over the odds, when price co-ordination is a common practice by dealers selling car models belonging to a company/manufacturing line. Clearly, this is an upper bound. Yet, the overall message is that returns from illegal price co-ordination are high in this industry. Off course the presence of price co-ordination has to be proven in a court of law. We are just highlighting, given consumer and cost primitives, the possible returns to price co-ordination in this industry. We only know the list price, how much of the list price is accounted for by costs, taxation or profit depends on our assumptions on pricing in our structural model of equilibrium. Assuming the presence of price co-ordination in this industry will give us an idea of the potential damages to the consumers. The presence of price co-ordination has to be proven in a court of law if we are to claim these are not just potential damages but actual upper bounds of overcharging due to price co-ordination.

Table 1: Top Four-Companies/Importer Concentration Index (Unit Sales)

Market	Unit Sales	C4 Brands	C4 Importers
	133, 000	**46 %**	**57%**
Segment	**% of Unit Sales by Segment**	**Within Segment C4 Brands**	**Within Segment C4 Importers**
Compact (Medium) Cars	31	61	64
City(Small) Cars	28	48	54
Medium (Large)Cars	20	58	74
Executive Cars	10	80	96
Off Roads, SUV, 4X4	5	55	55
Multi Purpose Vehicles	5	56	56
Convertible & Coupe	1	88	93
Average		**64%**	**70%**

Table 2. Top Four-Companies/Importer Concentration Index (Turnover)

Market	Turnover	C4 Brands	C4 Importers
	€3. 3 Billion	**40 %**	**56%**
Segment	**% of Unit Sales by Segment**	**Within Segment C4 Brands**	**Within Segment C4 Importers**
Compact (Medium)Cars	26	61	65
City (Small) Cars	18	50	56
Medium (Large) Cars	22	59	74
Executive Cars	18	86	96
Off Roads, SUV, 4X4	8	53	53
Multi Purpose Vehicles	5	58	58
Convertible & Coupe	3	87	92
Average		**65%**	**71%**

Table 3 Estimation Results

Demand System	GMM Estimation	GMM Estimation	GMM Estimation
Segment correlation (σ)	**.905** **(18.7)**	**.841** **(18.6)**	**.806** **(23.3)**
Price effect (α)	**-2.908** **(7.5)**	**-2.732** **(8.4)**	**-2.605** **(9.3)**
Product Characteristics	Yes	Yes	Yes
Dummy companies	Yes	Yes	Yes
R^2 Demand	.904	.904	.902
Marginal Cost System	**Pricing Regime III**	**Pricing Regime II**	**Pricing Regime I**
Per Unit Tax Take (ρ)	**1.2** **(9.6)**	**1.3** **(11.7)**	**1..1** **(12.6)**
Proportion of Tax (on average) paid by suppliers	59 %	61 %	58 %
Product Characteristics	Yes	Yes	Yes
Dummy Companies	Yes	Yes	Yes
R^2 Supply	.98	.99	.99
GMM Function	2.510	1.702	1.318
Observations	1168	1168	1168

t-stat in parenthesis Instruments for the Demand Regression include all the regressors, with the exception of pjt and ln(sgjt); Hausman-Taylor instrumental variables (brands of the same firm in other segments) with respect to pjt, and BLP instruments (brands of the other firms in the same segment) with respect to all characteristics. Instruments for the Supply (Cost) Regression , include all the regressors, with the exception of tax revenue; BLP instruments (brands of the other firms in the same segment) with respect to all characteristics in the demand equation.

Table 4 (Average Elasticities, - by Segment)

Segments	Own-price Elasticities	Sum cross-price Elasticities
Off Roads, SUV, 4X4	-8.5425	6.5118
City(Small) Cars	-2.82	2.7989
Compact (Medium) Cars	-3.954	3.6709
Multi Purpose Vehicles	-5.5405	4.4449
Executive Cars	-9.4284	7.2314
Medium (Large)Cars	-5.1123	4.4622
Convertible & Coupe	-12.547	7.3781

Table 5: Scenarios (Using estimated Demand Preferences and a Structural Model of Equilibrium, based on €3. 3 Billion Market Turnover).

Price Competition	Average Mark-Up (Weighted by share of Car Unit sales)	Profit (€ Millions)
Between all Cars	**8 %**	**264**
Only between Cars of Different Manufacturers	**21%**	**693**
Only between Cars of Different Importers	**27%**	**891**

Table 6. Scenarios (Using estimated Demand Preferences and a Structural Model of Equilibrium, based on €3. 3 Billion Market Turnover).

Segment	Average (Weighted by Unit Sales) Price	Average (Weighted by Unit Sales) Mark-up No price co-ordination	Average (Weighted by Unit Sales)Mark-up Price Increase due to price co-ordination between Cars of the same Manufacturer	Average (Weighted by Unit Sales)Mark-up Price Increase due to price co-ordination between Cars of the same Importer
Compact (Medium)Cars	20,615	9%	26% - 3,504	32% - 4,741
City (Small) Cars	16,533	12%	26% - 2,315	31% - 3,141
Medium (Large) Cars	26,249	8%	23% - 3,937	36% - 7,349
Executive Cars	46,088	4%	7% - 1,382	27% - 10,600
Off Roads, SUV, 4X4	41,324	4%	12% - 3,305	14%- 4,132
Multi Purpose Vehicles	28,764	9%	19% - 2,876	20% - 3,164
Convertible & Coupe	49, 376	8%	13% - 2,468	34% - 12,837

Appendix I: Top 5 Cars in each Segment of the Irish New Car Market

Segment	Unit Sales	Manufacturer	Range	Body	Petrol	List Price	Enginecc	Length	Width	Height	Weight	MPG	HorsePower	Maxspd	Acceleration	Doors
4x4	234	SUZUKI	GRAND VITARA	SUV	essence	22775	1590	476	178	174	1735	35.3	93	90	13.3	3
4x4	259	HONDA	CR-V	SUV	essence	36960	1998	453	175	167	1515	31	148	110	10.2	5
4x4	415	TOYOTA	RAV JEEP	SUV	essence	32005	1794	426	178	171	1490	38	125	109	12.3	5
4x4	496	HYUNDAI	SANTA FE	SUV	essence	29245	1975	450	182	173	1718	29.6	132	108	11.5	5
4x4	683	HYUNDAI	SANTA FE	SUV	diesel	34245	1991	450	182	173	1718	37.5	115	103	14.9	5
city	1528	VOLKSWAGEN	POLO	Hatch-Back	essence	15910	1198	389	165	146	1660	47.9	55	94	17.5	5
city	1883	TOYOTA	YARIS	Hatch-Back	essence	14995	998	364	166	150	1000	50.4	68	96	14.1	5
city	2070	FIAT	PUNTO	Hatch-Back	essence	13495	1242	386	166	148	1075	49.6	60	96	14.3	5
city	2188	FORD	FIESTA	Hatch-Back	essence	15945	1388	391	168	143	1152	44.1	79	101	13	5
city	3288	NISSAN	MICRA	Hatch-Back	essence	14990	988	371	166	154	1046	49	65	96	15.7	5
compact	1560	FORD	FOCUS	Saloon	diesel	22410	1753	438	170	143	1328	52.3	90	112	12.4	4
compact	1660	FORD	FOCUS	Hatch-Back	essence	19515	1388	417	170	143	1318	44.1	75	106	14.1	5
compact	1913	TOYOTA	COROLLA	Hatch-Back	essence	19565	1398	418	171	147	1345	42.2	97	115	12	5
compact	3567	TOYOTA	COROLLA	Saloon	essence	19680	1390	438	171	147	1295	42.2	97	115	12	4
compact	3731	NISSAN	ALMERA	Saloon	essence	19295	1498	443	170	144	1306	42.8	90	107	13.8	4
mpv	291	MITSUBISHI	SPACESTAR	medium mpv	essence	18665	1299	405	171	155	1265	41.5	86	105	13.5	5
mpv	333	HYUNDAI	TRAJET	mpv	diesel	31750	1997	469	184	176	1909	37.2	111	106	13.1	5
mpv	374	HYUNDAI	TRAJET	mpv	essence	28250	1997	469	184	176	1909	30.4	136	119	12.9	5
mpv	411	OPEL	ZAFIRA	medium mpv	essence	25355	1598	431	174	163	1525	34	99	108	13.5	5
mpv	614	OPEL	ZAFIRA	medium mpv	essence	27275	1598	431	174	163	1525	34	99	108	13.5	5
exec	440	BMW	300 SERIES	Saloon	diesel	35700	1796	448	175	141	1630	35.8	116	125	12.2	4
exec	447	VOLVO	S40	Saloon	essence	26820	1783	446	177	145	1426	40.9	122	124	10.5	4
exec	503	AUDI	A4	Saloon	diesel	38600	1896	454	177	142	1611	51.4	130	122	11.3	4
exec	794	MERCEDES-BENZ	C CLASS	Saloon	essence	39575	1796	461	174	142	1635	30.1	122	120	11.6	4
exec	1248	MERCEDES-BENZ	E CLASS	Saloon	essence	49880	1998	481	182	145	1835	33.6	163	145	13	4
medium	887	NISSAN	PRIMERA	Saloon	essence	23895	1596	456	176	148	1494	39.2	109	115	12.6	4
medium	895	VOLKSWAGEN	PASSAT	Saloon	diesel	29855	1896	470	174	146	1597	52.3	100	119	11.3	4
medium	1103	VOLKSWAGEN	PASSAT	Saloon	diesel	28220	1896	470	174	146	1597	52.3	100	119	11.3	4
medium	1594	TOYOTA	AVENSIS	Saloon	essence	25180	1598	463	176	148	1450	39.1	110	119	12	4
medium	1692	TOYOTA	AVENSIS	Saloon	essence	24250	1598	463	176	148	1450	39.1	110	119	12	4
cv&coupe	50	MERCEDES-BENZ	CLK CLASS	Sports / coupe non c	essence	62150	2397	463	174	141	1715	26.3	170	147	8.2	2
cv&coupe	54	MERCEDES-BENZ	SL CLASS	Sports / coupe non c	essence	123100	3724	453	181	129	1955	22.4	306	155	6.3	2
cv&coupe	99	HYUNDAI	COUPE	Sports / coupe non c	essence	28575	1998	439	176	133	1335	31.7	139	125	8.6	3
cv&coupe	367	MERCEDES-BENZ	CLK CLASS	Sports / coupe non c	essence	54300	1996	463	174	141	1715	33	163	143	12.5	2
cv&coupe	591	HYUNDAI	COUPE	Sports / coupe non c	essence	24745	1599	439	176	133	1335	36.7	116	120	11.2	3

References

Anderson, S.P. and A. de Palma, (1992), “Multiproduct Firms: A Nested Logit Approach”. *Journal of Industrial Economics*, 60, pp.261-276.

Berry, S. (1994), “Estimating Discrete-Choice Models of Product Differentiation”, *RAND Journal of Economics*, 25, pp.242-262.

Berry, S., Levinsohn, J. and A. Pakes, (1995) “Automobile Prices in Market Equilibrium” *Econometrica,* 63, pp841-890.

Bresnahan, T. (1982), “The Oligopoly Solution Concept is Identified”, *Economic Letters*, pp.87-92.

Bresnahan, T. (1987), “Competition and Collusion in the American Automobile Industry: The 1955 Price War”, *Journal of Industrial Economics*, 35, pp.457-482

Bresnahan, T. (1989), “Empirical Studies of Industries with Market Power”, Chapter 17, in Schmalansee, R. and Willig, R.D. ed. Handbook of Industrial Organization

Caplin A. and B. Nalebuff, (1991), “Aggregation and Imperfect Competition: On the Existence of Equilibrium”, *Econometrica*, 59, pp.25-60.

Hausman, J. (1978) “Specification Tests in Econometrics”, *Econometrica*, 46

Hausman**,** J. and W. Taylor (1981), “Panel and Unobservable Individual Effects”, *Econometric , 49*.

Hausman, J., G. Leonard, and J.D. Zona (1994), “Competitive Analysis with Differentiated Products”, *Annles D'Économie et de Statistique*,34, pp159-80.

Ivaldi, M. and F. Verboven, (2002), ``Quantifying the Effects from Horizontal Mergers in European Competition Policy", Report on Phase II Investigation of case No. COMP/M.1672 for Merger Task Force, Competition Directorate General, European Commission.

Mariuzzo, F., P.P. Walsh and C. Whelan, (2003), “Firm Size and Market Power in Carbonated Soft Drinks”, *Review of Industrial Organization*, Vol. 23, Issue 3-4, pp.283-299.

Mariuzzo, F., P.P. Walsh and C. Whelan, (2004), “Embedding Consumer Taste for Location into a Structural Model of Equilibrium”, Mimeograph, Trinity College Dublin.

McFadden, D. (1978), “Modelling the Choice of Residential Location”, in A. Kaelgvist et al eds., *Spatial Interaction Theory and Planning Models*. Amsterdam: North-Holland.

Pinkse, J. and M.E. Slade, (2002), "Mergers, Brand Competition, and the Price of a Pint", Department of Economics, University of British Columbia

Pinkse, J., Slade, M.E. and C. Brett, (2002), "Spatial Price Competition: A Semi-parametric Approach", *Econometrica*, 70, pp.1111-1155.

Schmalensee, R., (1989), "Inter-industry Studies of Structure and Performance", *Handbook of Industrial Organization.* Vol 2 Eds: Richard Schmalensee and Robert Willig. Amsterdam: North-Holland, 1989, pp. 951-1009.

Walsh, P.P. and C. Whelan (2002a), "Product Differentiation and Firm Size Distribution: An Application to Carbonated Soft Drinks", Discussion Papers Series EI/31, STICERD, LSE.

Walsh, P.P. and C. Whelan (2002b), "Portfolio Effects and Firm Size Distribution: Carbonated Soft Drinks", *Economic and Social Review*, Vol. 33, No. 1, pp.43-54.

Mariuzzo, F., Walsh P., and Van Parys O. (2005), "A Structural model of the Irish Automobile Industry", mimeo.