ASSESSING THE EFFECT OF GREEN TAXATION OF PRIVATE CARS ON ECONOMIC WELFARE IN ISRAEL

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Overview

Energy efficiency policies in the transportation sector are necessary to cope with the severe climate crisis. One important method is to incentivize car manufacturers, importers, and retailers to offer customers energy efficient cars, and incentivize customers to adopt such cars. Such a policy was introduced in 2009 in the private car market in Israel and is still in effect (Steren et al., 2016; 2022). According to this policy, the purchase tax on new cars is determined according to the emissions level of the car. Effectively, this policy was designed to motivate consumers to buy vehicles with low emissions, which are more energy efficient, by subsidizing the sales tax for such vehicles (i.e. a Pigouvian tax).

While the advantages of implementing a Pigouvian tax in a competitive market have been studied extensively, the outcome of this tax policy in markets with imperfect competition is more complex. The literature considers the automobile industry as a relatively centralized market. Furthermore, the Israeli car market is even more centralized than other car markets in the world as it has no local manufacturers, each brand is imported exclusively by one importer and the number of importers is small. Therefore, a key research question is, what would be the effects of a Pigouvian tax on the economic welfare in a concentrated market? Our working hypothesis is that due to the imperfect nature of the Israeli car market, importers respond strategically to the policy measures. As a result, the consequences of the policy are suboptimal in terms of enhancing the energy efficiency of the car fleet and in terms of consumer surplus. Using a differentiated goods econometric model, we determine the importers' markup under the green tax policy and use simulations to conduct a complete analysis of the consequences of alternative tax policies.

Methods

We use official data from the Israel Ministry of Transport and Road Safety. The data consist of *all* new cars marketed in Israel between 2007 and 2018. Each observation corresponds to a specific car configuration (year, brand, model name, category, engine size, weight, engine type, safety systems, market price, etc.). Employing configurations with at least 50 sales per year, our dataset contains 4,019 configurations of 1,169,165 cars.

We use a differentiated goods econometric model, based on the work of Fershtman and Gandal (1998) and Fershtman et al. (1999). This is a model of an oligopolistic car market containing two equations – demand (1) and pricing (2) – which are estimated simultaneously. To create a realistic substitution pattern between products, we use the nested logit model that assumes that substitution effects between products in this market depend primarily on predetermined car categories. In other words, consumers tend to first choose a car category according to their needs (e.g., family cars, mini cars, SUVs) and only then choose a specific car model from that category (e.g., Adamou et al., 2014; Greene et al., 2005).

The demand equation is:

$$ln\left(S_{jt} \,/\, S_{0t}\right) = X_{jt}\beta - \alpha p_{jt} + \sigma\, ln\left(\bar{S}_{j/gt}\right) + \xi_{jt}, \tag{1}$$

where S_{jt} is the market share for car j at time t, S_{0t} is the proportion of consumers that choose the outside good, that is, choose not to purchase a new car (e.g., Adamou et al., 2014; Berry et al., 1995). X_{jt} is the vector of observable product characteristics (such as engine size, fuel type, etc.) at time t, β is the vector of the coefficients of the car's parameters to be estimated and p_{jt} is the price of car j at time t (endogenous). $\bar{S}_{j/gt}$ is the market share of car j in category (nest) g at time t and $0 \leq \sigma < 1$ is the corresponding coefficient, which measures the degree of substitution among products in the same category. When $\sigma = 0$, the model collapses to a standard logit model, which means that car categories do not affect the consumers' choice process when purchasing a car. σ increases with the relevance of other car categories, meaning the substitution between cars from the same category is greater than between cars from different categories. The share $\bar{S}_{j/gt}$ is, by construction, endogenous, and therefore must be estimated with instruments. ξ_{jt} represents the average value of car j's unobserved characteristics at time t.

The pricing equation is:

$$\frac{p_{jt}}{1+T} = W_{jt}\gamma + \frac{(1-\sigma)}{\alpha(1+T)\left[1-\sigma\sum_{k\epsilon f_{gt}} q_{kt}/Q_{gt} - (1-\sigma)\sum_{k\epsilon f_{gt}} q_{kt}/\mathrm{M}\right]} + v_{jt}, \tag{2}$$

where f_{gt} represents the set of products that firm f is selling in category g at time t, Q_{gt} is the total number of sales in category g at time t, $\mathrm{M} = \sum_{i=1}^{N} q_{it}$, p_{kt} is the retail price of product k at time t, q_{kt} is the corresponding quantity sold, and T is the tax rate. W_{jt} is a vector of observable characteristics at time t and γ is a vector of unknown parameters. As Equation 2 shows, the price of each car model depends on the marginal cost associated with W_{jt} and the markup term. The markup increases as the market share increases. Having a larger market share in a category gives a firm more market power, which translates into a higher markup. Finally, we use the exchange rate of the local currency vs. the currency of the country from which the car was imported as an instrumental variable for the price.

Results

We estimated the model using a generalized method of moments (GMM). The correlation between the actual and predicted price is relatively high: 0.91. Model results are shown in Table 1. The parameters of interest are the coefficients α and σ. Both are statistically significant and are in line with the literature. We calculate the markup to range between 40 and 52K NIS (before taxes). Commercial vehicle is the category with the highest average markup (49K), followed by sports car (46K) and luxury car (43K). Next, we will use these results to simulate and assess the economic welfare associated with green car taxation.

Table 1- GMM estimation results (SE) – selected variables

Variables	Demand Equation		Pricing Equation	
Engine (cc)	0.00107***	(0.000292)	24.02***	(2.290)
Automatic transmission	0.868***	(0.104)	15,561***	(1,912)
Power steering	-23.75	(22.08)	21,972***	(2,232)
Magnesium wheels	-0.320***	(0.0503)	2,995**	(1,206)
Sunroof	0.329**	(0.160)	27,250***	(1,687)
Exchange rate			3.071***	(0.390)
Cost on international market			1.989***	(0.0555)
Category fixed effects	yes		yes	
Constant	4.707	(22.06)	-244,363***	(7,600)
α	2.05e-05***		(4.16e-06)	
σ	0.169***		(0.0485)	
Observations (configurations)	4,019			

*** $p < .001$

Prices reflect 2007 real values in New Israeli Shekels (1NIS= $\sim USD0.25$).

Conclusions

This study employs a nested logit model, designed for a differentiated goods market, based on data from the Israeli new car market between 2007 and 2018. The equations are estimated as a system using GMM. By using this model and estimation method, we are able to determine the car importers' markups and calculate the market's equilibrium. We use a green taxation policy implemented in Israel in 2009, which is a unique case of a structural change in the taxation of new cars. This unique setting is exceptionally helpful for examining firms' pricing strategy. The green taxation policy implemented in Israel was intended to improve the energy efficiency of the local car fleet. It is instrumental in identifying the pricing strategy of market entities, in our case – car importers, in an oligopolistic competition.

References

Adamou, A., Clerides, S., & Zachariadis, T. (2014). Welfare implications of car feebates: A simulation analysis. *The Economic Journal*, 124(578), F420-F443.

Berry, S., Levinsohn, J., & Pakes, A. (1995). Automobile Prices in Market Equilibrium. *Econometrica*, 63(4), 841–890.

Fershtman, C., & Gandal, N. (1998). The Effect of the Arab Boycott on Israel: The Automobile Market. *The RAND Journal of Economics*, 29(1), 193– 214.

Fershtman, C., Gandal, N., & Markovich, S. (1999). Estimating the effect of tax reform in differentiated product oligopolistic markets. *Journal of Public Economics*, 74(2), 151-170.

Greene, D. L., P. D. Patterson, M. Singh M., and J. Li J. (2005). Feebates, Rebates and Gas-Guzzler Taxes: A Study of Incentives for Increased Fuel Economy, *Energy Policy* 33, 757–775.

Steren, A., Rubin, O. D., & Rosenzweig, S. (2016). Assessing the rebound effect using a natural experiment setting: Evidence from the private transportation sector in Israel. *Energy Policy*, 93, 41–49.

Steren, A., Rubin, O. D., & Rosenzweig, S. (2022). Energy-efficiency policies targeting consumers may not save energy in the long run: A rebound effect that cannot be ignored, *Energy Research & Social Science*, 90, 102600.