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FOR CLIMATE CHANGE
Klima Aldaketa Ikergai

Consumer purchases of energy-efficient cars: behavioural implications for policy

Ibon Galarraga, Josu Lucas and Steffen Kallbekken

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EUSKO JAURLARITZA GOBIERNO VASCO
HEZKUNTZA, UNIBERTSITATE ETA IKERKETA SAILA
DEPARTAMENTO DE EDUCACIÓN, UNIVERSIDADES E INVESTIGACIÓN
INGURUMEN, LURRALDE PLANGINTZA, NEKAZARITZA ETA ARRANTZA SAILA
DEPARTAMENTO DE MEDIO AMBIENTE, PLANIFICACIÓN TERRITORIAL, AGRICULTURA Y PESCA

Universidad del País Vasco Euskal Herriko Unibertsitatea

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Basque Foundation for Science

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Overview

1. Introduction
2. Problem: Energy Efficiency Gap
3. Existing evidence: Car market in Spain
4. Concluding remarks

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3. Existing evidence: Car market in Spain
4. Concluding remarks

The importance of energy efficiency

- Efforts to reduce fossil-fuel use in the different sectors (e.g. transport, industry, building).
- European Commission identifies increased energy-efficiency (EE) as the most cost-effective and rapid way to reduce CO2 emissions.
- The IEA estimates that EE measures can reduce global CO2 emissions by up to 10–15% per year at no direct additional cost.
- IPCC (2014) suggests an investment in energy efficiency (EE) in transport, industry and building of 336 billion US$.
- EU Climate and Energy package that sets the target of reducing energy consumption by 20% by 2020.

The importance of energy efficiency

- Building accounts for almost 20% of global GHG emissions, industry with 31%, transport with 14.3%. Buildings large potential for cost-effective energy savings.
- The EU goal of a 27% energy saving in the residential sector (European Council 2006).

1. Introduction

2. Problem: Energy Efficiency Gap

3. Existing evidence: Car market in Spain

4. Concluding remarks

Some problems:

- BUT, **Energy Efficiency Paradox** exists (Howarth and Andersson, 1993; Jaffe et al., 2009):
  - Private investments in energy efficiency that seem to be economically worthwhile are not always made. And,
  - Some individuals make investments in EE when economically they would not appear to be worthwhile.
- Can be explained:
  - insufficient information, → **Cannot know efficiency, hidden costs…**
  - principal-agent problems, → **Owner/tenant**
  - lack of access to capital,
  - divergences between social and private discount rates,
  - consumer behaviour that is motivated by non economic factors, such as a desire to contribute to a public good.

Energy efficiency paradox: (Ramos et al., 2015)

Table 1. Reasons for the Energy Efficiency Paradox

	Market failure	Behavioral failure	Other barriers
Low energy prices	X		X
Hidden and transaction costs			X
Uncertainty and irreversibility		X	X
Information failures	X	X	
Decision-making heuristics and biases		X	
Slowness of technological diffusion	X		
Principal-agent problem	X		
Capital markets imperfections			X
Heterogeneity of consumers			X
Divergence with social discount rates			X

Instruments: Labels and certification (Ramos et al., 2015)

- Labels might help overcoming information failures:
  - incomplete and/or asymmetric.
  - Transaction costs.
  - Uncertainties.
- Also behavioural failures:
  - Limited attention
  - Aversion to uncertainty
- And finally, principal agent problems.
- Great potential (Ramos et al., 2015). More effective to show energy savings or economic losses than potential benefits.

1. Introduction
2. Problem: Energy Efficiency Gap
3. **Existing evidence: Car market in Spain**
4. Concluding remarks

EU policy in Spain:

- The EU has energy labels for domestic appliances since 1995. In 1999 this was extended to include cars (Directive 1999/94/CE). Retailers have to display characteristics of the car (size, consumption and CO2 emissions).
- Also a voluntary comparative labelling scheme with different categories of energy efficiency (from A, the most efficient, to G, the least efficient).
- The label also can include other information (running costs, annual tax costs, or additional attributes of the vehicle).
- Thus, major differences between labels in different countries.
- In Spain the Directive was transposed by Royal Decree 837/2002, and today all car retailers have to show both the standard EU label and the comparative label for their vehicles.

EU policy in Spain:

- In EU countries 40% disagreed with the statement that it was easily recognisable; and 44.5 % agreed that car labels were unfamiliar to them. The differences also include the way in which categories of efficiency are calculated. (Codagnone et al, 2013)
- **Absolute labelling** scheme for all the cars in the market: the most efficient cars which pollute the least, usually the smallest cars, are labelled A class, while other cars, bigger or less efficient, are labelled B, C, D, E or G. In most European countries, including France, Belgium, Denmark and the United Kingdom (Brannigan et al, 2011).
- **Relative labelling** (Brannigan et al, 2011) the label of the car depends on how much the fuel consumption and emissions of the car deviates from the average within its market segment (for instance small, mini, small sedan, big sedan, etc.). Spain and Germany.

EU policy in Spain: PIVE

- The **PIVE** (Programa de Incentivos al Vehículo Eficiente) plan was implemented in 2012 and is currently in its 7th edition in 2015.
- The PIVE subsidises the purchase of cars categorised as class A or B, electric cars, and cars which use gas or other alternative fuels.
- The subsidy is only applicable to cars up to a maximum price of €25,000, and it consists of a minimum discount of €1,000 in the price before taxes, which the producer or retailer has to apply, plus a subsidy of at least €1,000 after taxes financed by public funding earmarked for the PIVE. To the best of our knowledge there are, as yet, no studies assessing the impact of the policy.

Energy efficiency in Spanish car market:

- To the best of our knowledge, there are no official statistics on the energy efficiency class of the new light-duty vehicles sold in the Spanish market.
- The National Association of Car and Truck Producers (Asociación Nacional de Fabricantes de Automóviles y Camiones, ANFAC) offers monthly data on the number of cars sold, but does not collect information on the energy efficiency performance of the cars sold.
- As a supplement to this information, The Spanish Energy Diversification and Saving Institute (Instituto de Diversificación y Ahorro Energético, IDEA) offers a list of the cars and models available and their energy efficiency attributes.

- 41% of the cars in 2012 were very efficient (A class).
- A and B label cars make up more than 75% of all cars sold
- Most of the cars sold were small (27.8%) or small sedans (27.3%).
- The share of sport and luxury cars was very low.
- The proportion of efficient cars varies from one segment to another: the proportion of Sport, all types of SUV and Big Minivans with class A was very low, while more than half of all small and big sedans were class A. The energy efficiency of SUVs was very low.
- **Are the high sales of efficient cars a consequence of the current (and previous) PIVE rebate schemes?**
- **Perhaps other factors such as high fuel prices might also have influenced the high proportion of efficient cars sold?**
- How frequently the labels granted in a labelling scheme are reviewed also has an important effect on the proportion of efficient cars sold. In Spain annually.

Source: Own calculations using data from IDAE and ANFAC.

Energy Efficiency private vehicles - Spain

- Study: Galarraga et al. (2014) → cars
- Cross-sectional data with more than 3.000 observations containing official prices and a set of detailed vehicles‘ characteristics, including the energy efficiency label.
- Subsample of almost 400 observations with retail prices (gathered by the Mystery Shopping method) performed by an specialized survey company during September-November 2012.
- Each observation was matched with its correspondent EE label from the IDAE database.
- Methodology: Hedonic price approach with mystery shopping.
- Results:

  A statistically significant coefficient of the variable that measures the effect of (A, B) energy-efficiency labels: 3%-5.9% price premium (official listing and ‘mystery shopping’).

Energy Efficiency private vehicles - Spain

- Compare WTP for a labelled A vehicle during the 10 years expected lifetime with the present value of the corresponding energy savings.

WTP for and savings from energy-efficient vehicles

Discounted fuel savings		WTP for a vehicle labelled A, using the average price for the official-price subsample	WTP for a vehicle labelled A, using the average price for the retail-price sample
r= 5%	2606.2 Euros	1997.92	4860,6
r= 10%	2073.9 Euros		
r=15%	1693.9 Euros		

Consumers undervaluing EE? Energy efficiency paradox?

Overestimation of WTP?

Energy Efficiency private vehicles – Spain

- We consider two alternative hypotheses about how consumers make this decision. This is a simplification as many consumers make decisions using simultaneous or nested processes (Noblet et al., 2006). But this simplification does fit well with the policy analysis in Brannigan et al., (2011) and serves well to explore the implications of choosing one type of labelling or the other.
- As far as we are aware no empirical studies are available to support the type of labelling chosen in EU Member States. If such studies existed they could have offered some insights on how purchasing decisions are made in each country.

Energy Efficiency private vehicles – Spain

- **Absolute decision**: Concerned consumers select the most energy efficient car in the market independent of segment.
- **Relative decision**: Consumers first decide what type of car (i.e. the segment) and then choose the efficiency within the segment.
- A third way, consumers who select the brand and even the model, and then within those options select the most efficient one. Not discussed here.
- Let us “estimate” (calibrate) elasticities!
- **Quantity Based Demand System!** (Galarraga and Markandya, 2004)

Quantity Based Demand System

V_i: demand for quality i (energy efficiency) of good V (appliance) in comparable units. That is:

P_i: price of quality i of good V.

M: total expenditure.

P: aggregate price of good V

w_j: expenditure share of good V.

The demand for quality i of good V can be defined as

$$\frac{V_i}{V} = \beta_i \left(\frac{P_i}{P}\right)^{-\infty}$$

Where $\beta_i \geq 0$ is a constant and $\alpha \geq 0$ is the price sensitivity

If we now define a price index P as

$$P = \prod_i P_i^{s_i} \qquad \text{where } s_i \geq 0 \text{ and } \sum s_i = 1$$

$$\in_{ii} = -\alpha + (\alpha - \mu)s_i$$

$$\in_{ij} = (\alpha - \mu)s_j$$

Quantity Based Demand System

- We need own elasticity of less efficient (other) cars, the income elasticity of demand for cars and the expenditure shares for both efficient and non-efficient (or less efficient) cars.
- Own price elasticities from -0.35 to -1.2 and income elasticity 0.3, 0.5 and 1. (Whelan, G.A., 2007, Hymans, 1971 and Matas and Raymond, 2008).
- Expenditure shares for non-efficient cars from Spain's National Office of Statistics.
- We use the price premium estimate of 0.0592% of the average car price (Galarraga et al., 2014) to calculate the expenditure shares for efficient cars (class A).
- The expenditure shares are:

WO=0.009278206 WA=0.006849049 WX=0.98387275

Absolute : Income least 1, 0.5 and 0.3

Table 2C: Own and cross price elasticities of demand QBDS (Income elasticity = 0.3)			
Own O	Cross OA	Own A	Cross AO
-0.35	0.0500	-0.3677	0.0677
-0.45	0.1500	-0.5032	0.2032
-0.55	0.2500	-0.6387	0.3387
-0.85	0.5500	-1.0451	0.7451
-1.1	0.8000	-1.3837	1.0837
-1.2	0.9000	-1.5192	1.2192

- **The demand for efficient cars (A) is slightly more elastic** than demand for non-efficient cars (O). The demand for efficient cars decreases (increases) more than demand for non-efficient ones when the price of cars increases (decreases).
- The cross effects also suggest that **changes in the demand for efficient cars are greater than the effect on other**, less efficient ones.
- This **difference increases as the price elasticities increase**.

Relative

Table 4c: Own and cross price elasticities of demand per segment (Income elasticity = 0.3)							
SEDAN				**SPORT & LUXURY**			
Own O	Cross OA	Own A	Cross AO	Own O	Cross OA	Own A	Cross AO
-0.35	0.0500	-0.3342	0.0342	-0.35	0.0500	-0.4000	0.1000
-0.45	0.1500	-0.4026	0.1026	-0.45	0.1500	-0.6000	0.3000
-0.55	0.2500	-0.4711	0.1711	-0.55	0.2500	-0.8000	0.5000
-0.85	0.5500	-0.6763	0.3763	-0.85	0.5500	-1.4000	1.1000
-1.1	0.8000	-0.8474	0.5474	-1.1	0.8000	-1.9000	1.6000
-1.2	0.9000	-0.9158	0.6158	-1.2	0.9000	-2.1000	1.8000
MINI				**SMALL**			
Own O	Cross OA	Own A	Cross AO	Own O	Cross OA	Own A	Cross AO

- The **demand for the most efficient cars (class A) is less elastic** than demand for non-efficient cars.
- This result is driven by the fact that the proportion of efficient vehicles in the market is lower than that of non-efficient ones for all segments except sedans.
- The range of elasticity values varies significantly for the cases of Mini, Sports and Luxury and SUV vehicles

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3. Existing evidence
4. **Concluding remarks**

Concluding remarks

- Energy efficiency is part of the long term climate solution, and it is smart way if saving resources.
- Labels, audits, feedback, taxes, subsidies, standards and many other instruments exist. We need to combine them well!
- Energy labelling is one of my favourites. And is acquiring a major importance in the light of the EU Climate and Energy.
- It can be used to reduce information asymmetries but also to support other policy instruments such as taxes and subsidies. Many examples exist in EU.
- Policies should be well designed and it is not always the case.

Concluding remarks

- With Absolute decision the demand for vehicles with higher efficiency level are greater than that for less efficient ones. Pricing policies are likely to be more effective when applied to A labelled cars and therefore policies based on pricing systems may have a role to play in incentivising the purchase of more efficient vehicles.
- When relative decision is assumed, that is, when consumers choose the car segment first and then the energy performance, the opposite result is found.
- Additionally, in all but one of the cases the cross price elasticities AO are greater than cross OA, which means that impacts of changes in prices of the labelled car segment affect the demand for less efficient ones much less than in the opposite direction. This is an expected result when the share of non-efficient vehicles is greater than the share of A labelled ones.

Concluding remarks

- The exception to this is the case of A labelled Sedan vehicles with a greater share in this market segment that makes the cross elasticticity AO lower than the cross OA. That is, in this case changes in prices in A labelled cars affects the demand of non-labelled ones more. This effect cannot be noticed when showing values under absolute decision making hypothesis because the impacts on the rest of the segments overturn this.

BC3

Contact:

ibon.galarraga@bc3research.org

www.bc3research.org

Thank you!