BASQUE CENTRE
FOR CLIMATE CHANGE
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ECONOMIC EFFICIENCY, ENVIRONMENTAL EFFECTIVENESS AND POLITICAL FEASIBILITY OF ENERGY EFFICIENCY REBATES: THE CASE OF THE SPANISH ENERGY EFFICIENCY "RENOVE" PLAN.

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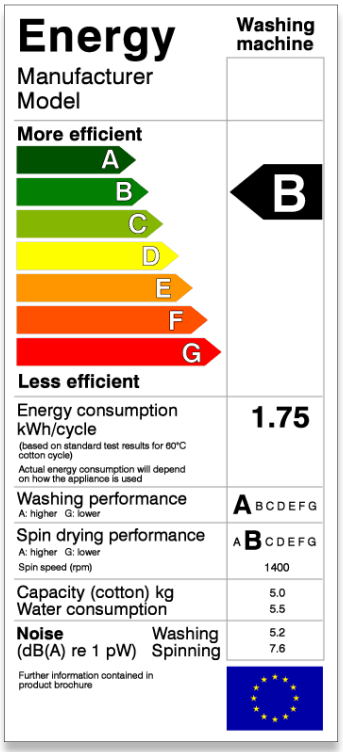
Overview

1. Energy labelling and the RENOVE subsidy scheme: some background
2. Research idea
3. Methodology
4. Results
5. Concluding remarks

1. Energy Labelling and the RENOVE subsidy scheme

- Energy labelling is acquiring a major importance in the light of the EU Climate and Energy package that sets the target of reducing energy consumption by 20% by 2020.
- The goal of a 27% energy saving in the residential sector (European Council 2006).
- Directive 92/75/ECC regulated information on energy and other resources consumption in household appliances.
- Since 2008 a “Proposal for a Directive of the European Parliament and of the Council on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products SEC (2008) 2862” has been under review.

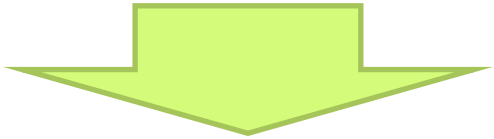


1. Energy Labelling and the RENOVE subsidy scheme

- In many countries subsidies are used to support labelled goods. The RENOVE program is the Spanish policy.
- Regulated by Royal Decree 208/2005, 25 February 2005, on electrical appliances and electronic devices and the management of their wastes.
- Set up by the Institute for Energy Diversification and Saving (IDAE, Instituto para la Diversificación y el Ahorro Energético) www.idae.es
- But run and managed by the Energy Boards of the Autonomous Communities (AC).
- Sets a minimum of €50 as a lump sum subsidy to consumers (both public or private) willing to purchase (exchange) highly efficient durables, i.e. labelled as class A or higher;
- Some AC have increased this premium to €70-90 and more.

2. Research idea

- How do policy makers estimate how much is the optimum subsidy?
- Do they “fine tune” the program each year according to an evaluation?
- How can we measure the impact of the scheme?



- We need to know how much people are willing to pay for those labels. Economic valuation technique. **Question A**.
- And we also need price elasticities of demand and supply to properly assess the impact of the policy. How can be estimate them? **Question B**.
- We can measure the impact of the scheme and perhaps propose alternatives (?). **Question C**.

2. Research idea

- Answer to A and to B in:
  - Galarraga, I, Heres, D. and González-Eguino, M. (2011), "Price premium for high-efficiency refrigerators and calculation of price-elasticities for close-substitutes: Combining Hedonic Pricing and Demand Systems". ***Journal of Cleaner Production***.
  - Galarraga, I, González-Eguino, M. and Markandya, A. (2011), "Willingness to pay and price elasticities of demand for energy-efficient appliances: combining the hedonic approach and demand systems". ***Energy Economics***, vol 33 pp. 66-74

- Answer to **C: Welfare analysis of proposed policy and other proposals.**
  - A **subsidy** for energy efficient appliances.(Existing policy!)
  - A **tax** for non-efficient appliances.
  - A combination of an **small tax on non labelled** ones that finances **a subsidy on labelled ones**. (**Bonus-Malus** type of approach).

2. Policy proposal

- Three principles:
  - **Economic efficiency**

To reduce the welfare losses of the policy options, i.e. dead weight losses.

  - **Environmental effectiveness**

Not to increase the energy bill, that is, no rebound effect.

  - **Political feasibility**

Balanced policy, should not generate any deficit.

- Setting the ground:

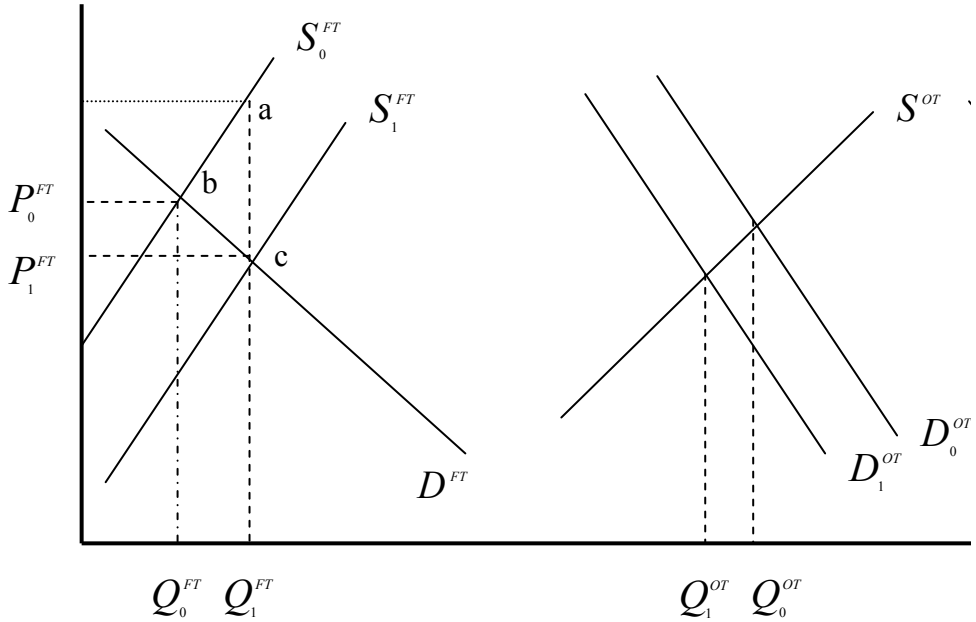
We firstly analyse the impact of the ongoing policy option (Energy-efficiency Rebates) according to in these three principles.

We then analyse alternatives that comply with the three policy principles.

Finally, several other options are studied.

3. Methodology: Effects of policies

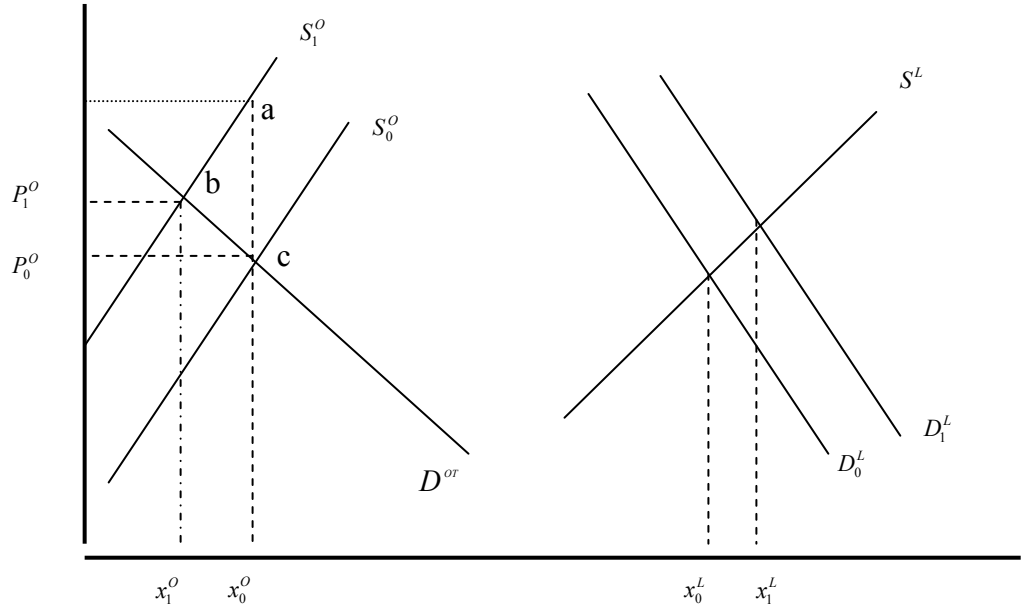
- The effect of a subsidy in labelled goods: when the price of labelled goods decreases (shift in supply) the demanded quantity increases and the demand for non-labelled ones decreases (substitution effect). We need information on demand (and supply) elasticities!



- It generates a DWL in the labelled good market and a loss of welfare in the non-labelled ones as a consequence of the reduction in the quantity demanded. Final outcome is an **increased loss of welfare comparing with a situation where no substitute exists**.

3. Methodology: Effects of policies

- The effect of a tax in non-labelled goods: when the price of non-labelled goods increases (shift in supply) the demanded quantity decreases and the demand for labelled ones increases (substitution effect). We need information on demand (and supply) elasticities!



- It generates a DWL in the non-labelled good market and a welfare GAIN in the labelled one as a consequence of the increase in the quantity demanded. Final outcome is an **reduced loss of welfare comparing with a situation where no substitute exists**.

3. Methodology: Mathematical illustration

$$x_i = f_i(P_i, P_j, m) \ \forall i = 1,2 \quad (1)$$

$$x_i = g_i(P_i, P_j) \ \forall i = 1,2 \quad (2)$$

These demand and supply function can be now approximated as constant elasticity functions.

$$x_i = P_i^{\mu_{ii}} P_j^{\mu_{ij}} m^{\eta_i} \ \forall i = 1,2 \quad (3)$$

$$x_i = P_i^{\varepsilon_{ii}} P_j^{\varepsilon_{ij}} \ \forall i = 1,2 \quad (4)$$

where μ_{ii} is the own price demand elasticity for product i, μ_{ij} is the cross price demand elasticity, ε_{ii} is the own price supply elasticity for good i, ε_{ij} is the cross price supply elasticity and η_i is the income elasticity of the ith product.

By differentiating equations (3) and (4) and using proportional notation we can obtain the following equations:

$$Ex_i = \mu_{ii} EP_i + \sum_{i \neq j} \mu_{ij} EP_j + \eta_i Em \ \forall i = 1,2 \quad (5)$$

$$Ex_i = \varepsilon_{ii} EP_i + \sum_{i \neq j} \varepsilon_{ij} EP_j \ \forall i = 1,2 \quad (6)$$

where E prefix stands for the proportional change in the variable.

3. Methodology: Mathematical illustration

The introduction of a tax (subsidy) as a proportional change in the supply of the product taxed (subsidised);

$$\frac{1}{\varepsilon_{ii}} Ex_i - EP_i - \frac{\varepsilon_{ij}}{\varepsilon_{ii}} EP_j = \frac{dP_i}{P_i} \quad \forall i = 1,2 \tag{7}$$

The change in income due to the tax (subsidy) is equal to the quantity consumed of such quantity times the price change originated by the tax (subsidy). That is, $dm = -x_i dP_i$. By introducing the proportionate change;

$$Em = -w_i EP_i \quad \forall i = 1,2 \tag{8}$$

where w_i stands for the expenditure share of good i.

The dead weight loss, Diamond & McFadden (1974) as,

$$DWL_i = (X_i^1 - X_i^0) * dP_i * 0.5 - \sum_{j=1}^{i-1} (X_j^1 - X_j^0) * dP_j \tag{9}$$

where X_i^0 is the quantity before the tax (subsidy), X_i^1 is the quantity after the entire tax (subsidy) for has been introduced.

3. Methodology: Values used

- Elasticities of demand:

	QDBS ($e_O = e_L = 0.4$ $e_{X/X} = -1$)		
Price Elasticity of demand own O/O ($e_{O/O}$)	**cross O/L ($e_{O/L}$)**	**own for L ($e_{L/L}$)**	**cross L/O ($e_{L/O}$)**
-0.5	0.10	-0.55	0.15

Source Galarraga et al. (2011).

- Elasticities of supply: Some 'well-guessed' supply elasticity values, these are: An own price elasticity of supply for other appliances of 1.5, an own price elasticity of supply for labelled ones of 1.2. The latter more inelastic.

- Initial equilibrium prices and quantities:

Product	Original Quantities (Units)	Original average Prices (Euro)
Non-labelled dishwashers (60%)	21,355	514
A+ Labelled dishwashers (40%)	12,325	514+80=594

Source: Galarraga et al. (2011)

4. Results: (1)

Results of a 80 € subsidy									
Market Segment	Original Quantities	Original Prices (€)	After Policy Quantities	After Policy Prices	Change in Quant. (%)	Change in Prices (%)	Balance of the policy (€)	Welfare loss (€)	Energy savings (€)
A+ Labelled dishwashers (40%)	12,325	594	12,961.28	541.39	5.16	-8.86	Subsidy Cost	25,800.95	-272,962.41
Non-labelled dishwashers (60%)	21,355	514	21,207.42	511.63	-0.69	-0.46	-1,036,902.08		75,562.80
Total	33,680	-	34,168.69						-197,399.61

- There is a **rebound effect** due to the increase in the total number of appliances. Although more efficient appliances the increase in the total number generates an increase in the energy bill.
- The policy has a **cost** of 1M€.
- Generates a **DWL** of 26,000€.

4. Results: (2) Policy alternatives

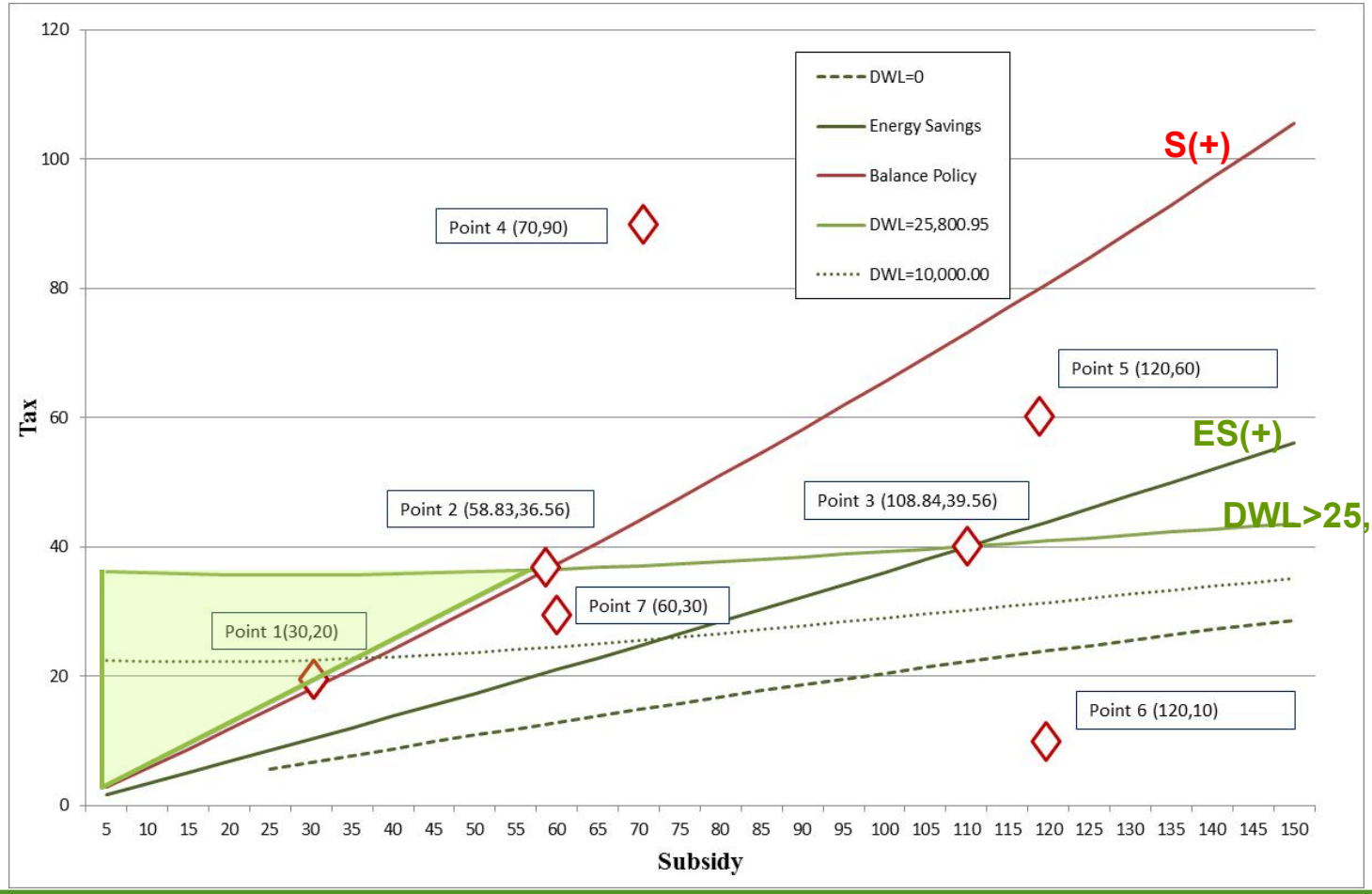
- Is a tax a better instrument?

Results of a 40 € tax									
Market Segment	Original Quantities	Original Prices (€)	After Policy Quantities	After Policy Prices	Change in Quant. (%)	Change in Prices (%)	Balance of the policy (€)	Welfare loss (€)	Energy savings (€)
A+ Labelled dishwashers (40%)	12,325	594	12,399.30	596.98	0.60	0.50	Collected 829,928.16	12,357.53	-31,875.41
Non-labelled dishwashers (60%)	21,355	514	20,748.20	545.02	-2.84	6.04			310,679.54
Total	33,680		33,147.51						278,804.14

- There NO **rebound effect**. In fact there is energy saving.
- The policy **collects money**.
- And it generates a much lower **DWL**.
- Can we improve this? What about tax and subsidies at the same time.

4. Results: (3) Policy alternatives

- "Malus-bonus" type of approaches



4. Results: (4) Policy alternatives

Results of a 30 € subsidy and 20€ tax (with income effect)									
Market Segment	Original Quantities	Original Prices (€)	After Policy Quantities	After Policy Prices	Change in Quant. (%)	Change in Prices (%)	Balance of the policy (€)	Welfare loss (€)	Energy savings (€)
A+ Labelled dishwashers (40%)	12,325	594	12,597.07	575.19	2.21	-3.17	Collected	7,738.55	-116,716.06
Non-labelled dishwashers (60%)	21,355	514	20,994.88	528.37	-1.69	2.80	41,985.68		184,380.41
Total	33,680	-	33,591.95						67,664.36

- There NO **rebound effect**. In fact there is energy saving.
- The policy collects money.
- And it generates a much lower **DWL**.

4. Results: (5) Policy alternatives

Results of a 58.83 € subsidy and 36.56 € tax (with income effect)									
Market Segment	Original Quantities	Original Prices (€)	After Policy Quantities	After Policy Prices	Change in Quant. (%)	Change in Prices (%)	Balance of the policy (€)	Welfare loss (€)	Energy savings (€)
A+ Labelled dishwashers (40%)	12,325	594	12,858.05	557.56	4.32	-6.13	Collected	25,806.40	-228,679.87
Non-labelled dishwashers (60%)	21,355	514	20,694.38	540.45	-3.09	5.15	147.32		338,236.59
Total	33,680	-	33,552.43						109,556.72

- There NO **rebound effect**. In fact there is energy saving.
- The policy collects money.
- And it generates a lower **DWL**.

4. Results: (6) Policy alternatives

Results of a 60 € subsidy and 30 € tax (with income effect)									
Market Segment	Original Quantities	Original Prices (€)	After Policy Quantities	After Policy Prices	Change in Quant. (%)	Change in Prices (%)	Balance of the policy (€)	Welfare loss (€)	Energy savings (€)
A+ Labelled dishwashers (40%)	12,325	594	12,855.20	556.32	4.30	-6.34	Collected	16,397.10	-227,455.32
Non-labelled dishwashers (60%)	21,355	514	20,790.26	535.24	-2.64	4.13	-147,604.18		289,147.71
Total	33,680	-	33,645.46						61,692.39

- There NO **rebound effect**. In fact there is energy saving.
- The policy has a cost.
- It generates a lower **DWL**.

4. Results: (7) Policy alternatives

Results of a 70 € subsidy and 90 € tax (with income effect)									
Market Segment	Original Quantities	Original Prices (€)	After Policy Quantities	After Policy Prices	Change in Quant. (%)	Change in Prices (%)	Balance of the policy (€)	Welfare loss (€)	Energy savings (€)
A+ Labelled dishwashers (40%)	12,325	594	13,048.90	554.42	5.87	-6.66	Collected	164,831.11	-310,553.94
Non-labelled dishwashers (60%)	21,355	514	19,894.17	584.11	-6.84	13.64	877,052.37		747,943.80
Total	33,680	-	32,943.07						437,389.86

- There NO **rebound effect**. In fact there is energy saving.
- The policy collects 0.8 M€.
- But it generates a much higher **DWL**.

5. Concluding remarks

- As a consequence of the subsidy scheme the total number of dishwashers at the market increased in 1%:
  - The labelled increased by 5% as a reduction in the equilibrium price of 9%.
  - 0.5% price reduction in equilibrium price reduces the quantity of non-labelled ones by 1%.
  - Net cost of 1 M€ euro. And as a consequence of the increase in the number of appliances there is an **increase in the energy bill of 196,000€**. This can interpreted as the cost of the **rebound effect**. (?)
- If instead a 40€ tax is implemented the total number of appliances will be reduced by 1.6% (and **no rebound effect** will be expected for this reason generating an energy saving of 0.3M€) while collecting 0.8 M €. DWL half of the subsidy.
  - When all cross effects are taken into account the equilibrium price will be 6% higher for non-labelled dishwashers (with a 2.6% decrease in demanded quantities) and 0.5% for labelled ones (with a 0.6% decrease in quantities).

5. Concluding remarks

- Finally, the paper proposes combinations of both instruments (subsidies that could be financed by smaller taxes on non-labelled market). One reasonable combination can be subsidy 30€ and a tax of 20€.
- This can be justified in terms of ethical beliefs, as the users of non efficient appliances should be the ones compensating the consumers that opt for efficient appliances instead of all society. But also in terms of the three principles.
- When (30,20) is implemented there is an **insignificant change in the total appliances demanded** (less that 1%) which is explained by a 2.21% increase in labelled segment and a 1.69% decrease in non-labelled one. The net result of the policy is a surplus of 42,000€ and a modest energy saving is also generated. Complies with the three principles.
- This policy is **illustrative** of what can be done with the methodology proposed in the paper when both own and cross price elasticities are available.

5. Concluding remarks

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Thank you!