Efficient vehicle ownership, energy literacy, and environmental attitudes

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Intro

Transport sector in Switzerland:

- Accounts for 36% of total energy consumption
- Vehicle energy labels introduced in 2003
- Bonus/malus system for efficient vehicles in most cantons
- Success of policies depends on awareness & knowledge of car buyers

Main research questions

1. What determines ownership of efficient cars?
2. What is the role of energy literacy (general and specific to cars)?
3. What is the impact of environmental attitudes?

Overview

- Probability of owning an efficient car given individual characteristics including level of energy literacy:

$$Pr(y = 1|x) = \theta(\beta' x)$$

- Efficient vehicle = lower average consumption than label A or B in dataset
- Car specific energy knowledge = knowledge of car label
- Knowing the car label and owning an efficient vehicle likely endogenous

Empirical model

We estimate a **recursive bivariate probit model** where the **vehicle label known variable** also appears as explanatory variable in the vehicle ownership equation:

$$y_1^* = \beta_1' x_1 + \epsilon_1, y_1 = 1 \text{ if } y_1^* > 0, y_1 = 0 \text{ otherwise,}$$

$$y_2^* = \beta_2' x_2 + \epsilon_2, y_2 = 1 \text{ if } y_2^* > 0, y_2 = 0 \text{ otherwise.}$$

y_1 = Energy literacy (=1 if car label is known)

y_2 = Vehicle ownership (=1 if car is classified as efficient)

Eq1: knowledge of vehicle label

$$y_1^* = \beta_1' x_1 + \epsilon_1, y_1 = 1 \text{ if } y_1^* > 0, y_1 = 0 \text{ otherwise}$$

Dependent variable: knows vehicle label (=1 if respondent knows label of vehicle

Independent variables:

- age of respondent
- sex of respondent
- environmental attitudes (biospheric)
- higher education
- household income
- general energy literacy index

Eq2: Efficient vehicle ownership

$$y_2^* = \beta_1' x_1 + \epsilon_1, y_2 = 1 \text{ if } y_2^* > 0, y_2 = 0 \text{ otherwise}$$

Dependent variable: vehicle ownership (=1 if vehicle is classified as efficient)

Independent variables:

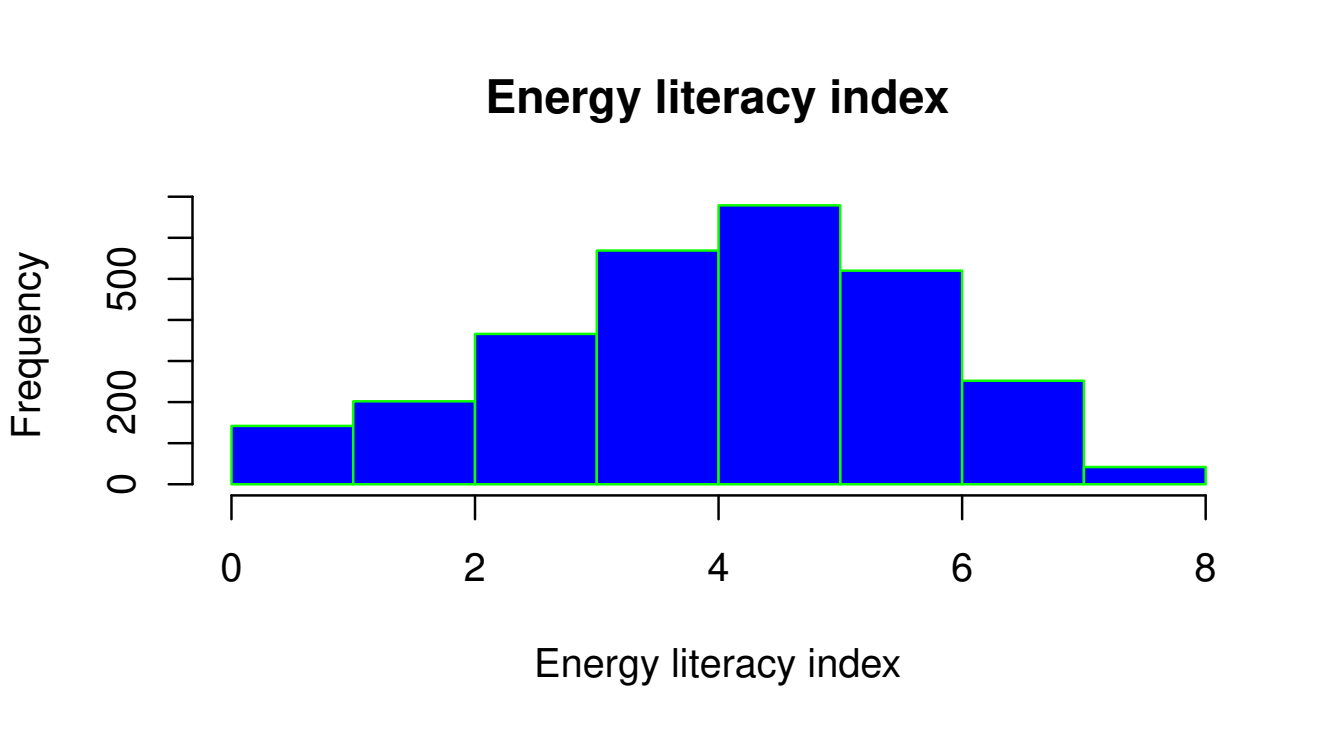
- vehicle label known
- household income
- age of respondent
- household size
- type of car (e.g. minivan/SUV, convertible, limousine)
- sex of respondent
- cantonal FE

Dataset

- Swiss Household Energy Data Survey
- First wave 2016
- 2772 households that own at least one vehicle
- data on energy behavior, environmental attitudes, energy literacy

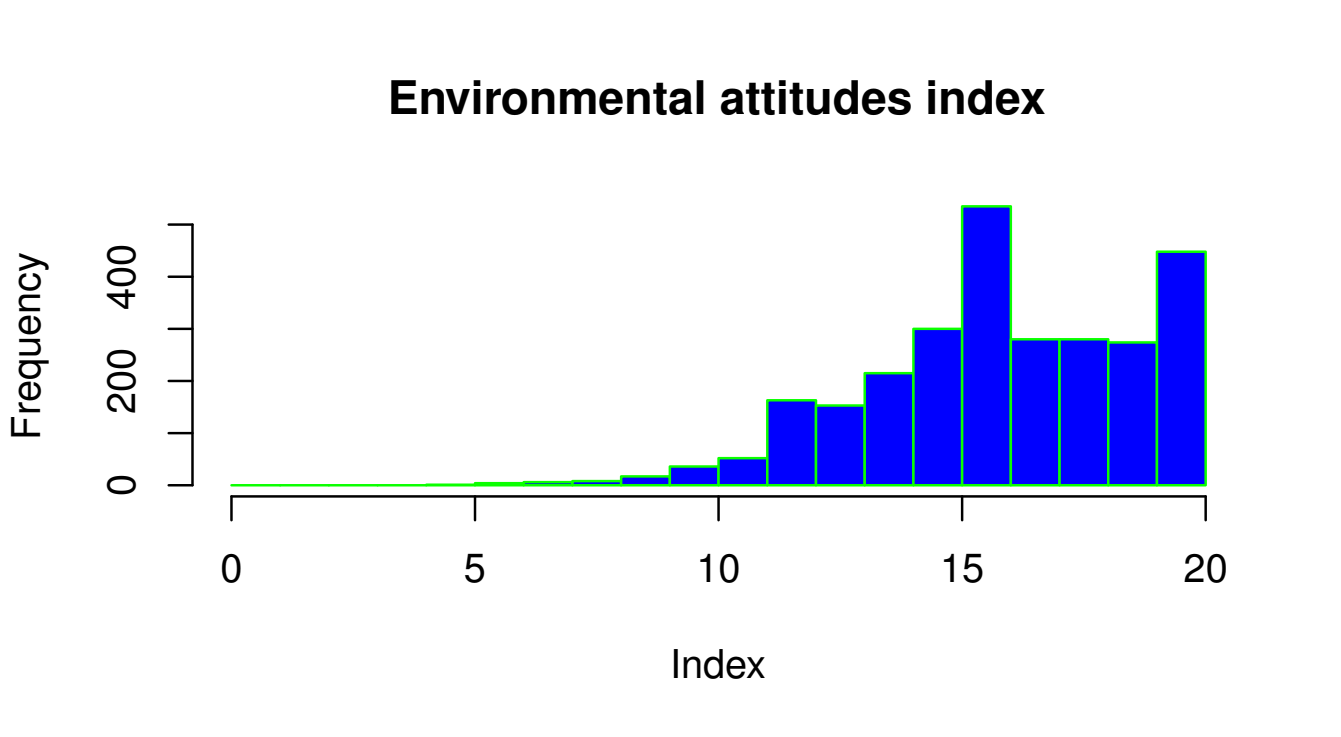
Energy literacy index

Sum of 9 questions on general energy knowledge (e.g. prices, consumption of household appliances etc.)



Environmental attitudes index

Sum of answers of 4 questions on importance of environment (1= not important, 5 = extremely important)



Knowing your vehicle label

- 35% of repondents knew their vehicle energy label
- 65% did not know the label
- Older repondents are more likely to know the label
- Men are twice as likely to know label than women

Label knowledge

age	-0.000144	(-0.08)
female	-0.444***	(-8.44)
pro_env	0.254	(1.73)
educ_higher	-0.0574	(-1.04)
2.income	0.284	(1.61)
3.income	0.126	(0.76)
4.income	0.240	(1.51)
5.income	0.267	(1.67)
6.income	0.377*	(2.32)
1.literacy_index	0.270	(1.13)
2.literacy_index	0.363	(1.64)
3.literacy_index	0.433*	(2.01)
4.literacy_index	0.511*	(2.32)
5.literacy_index	0.614**	(2.73)
6.literacy_index	0.565**	(2.60)
7.literacy_index	0.579*	(2.52)
8.literacy_index	0.889**	(3.23)
_cons	-1.198***	(-3.97)

Efficient vehicle ownership

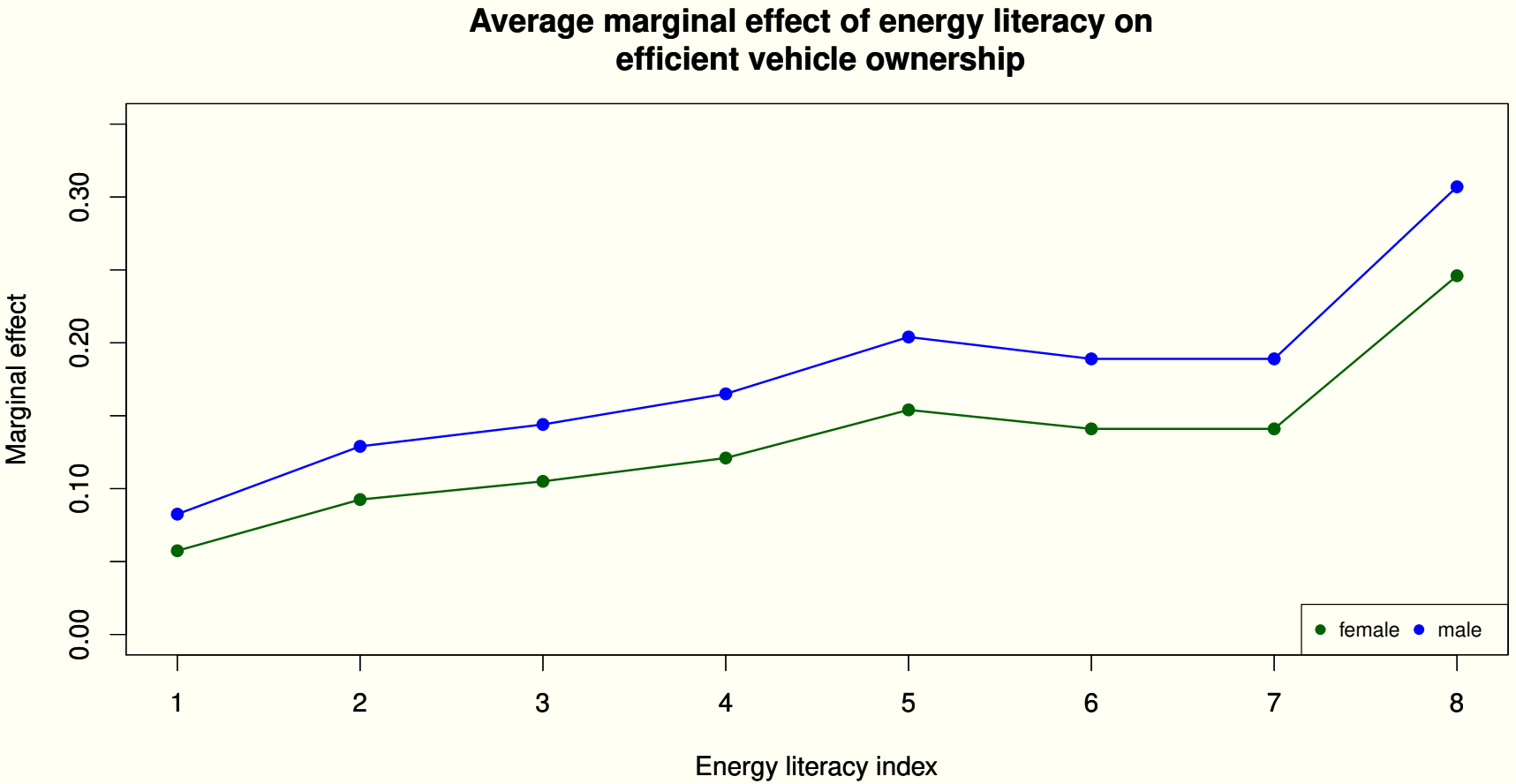
veh_lab_know	1.510***	(3.57)
age	-0.00582*	(-2.57)
female	0.364***	(4.26)
2.income	-0.267	(-1.57)
3.income	-0.169	(-1.11)
4.income	-0.189	(-1.21)
5.income	-0.146	(-0.88)
6.income	-0.392*	(-2.46)
2.md_hhgr	-0.0440	(-0.73)
3.md_hhgr	-0.169	(-1.91)
4.md_hhgr	-0.0735	(-0.95)
5.md_hhgr	-0.0848	(-0.78)
6.md_hhgr	-0.496*	(-2.01)
7.md_hhgr	-0.953	(-1.66)
8.md_hhgr	6.296	(0.00)
15.md_hhgr	4.861	(0.00)
convertible	-0.181	(-0.97)
station_wagon	-0.298***	(-3.33)
Cantonal FE	YES	

Results overview: marginal effects

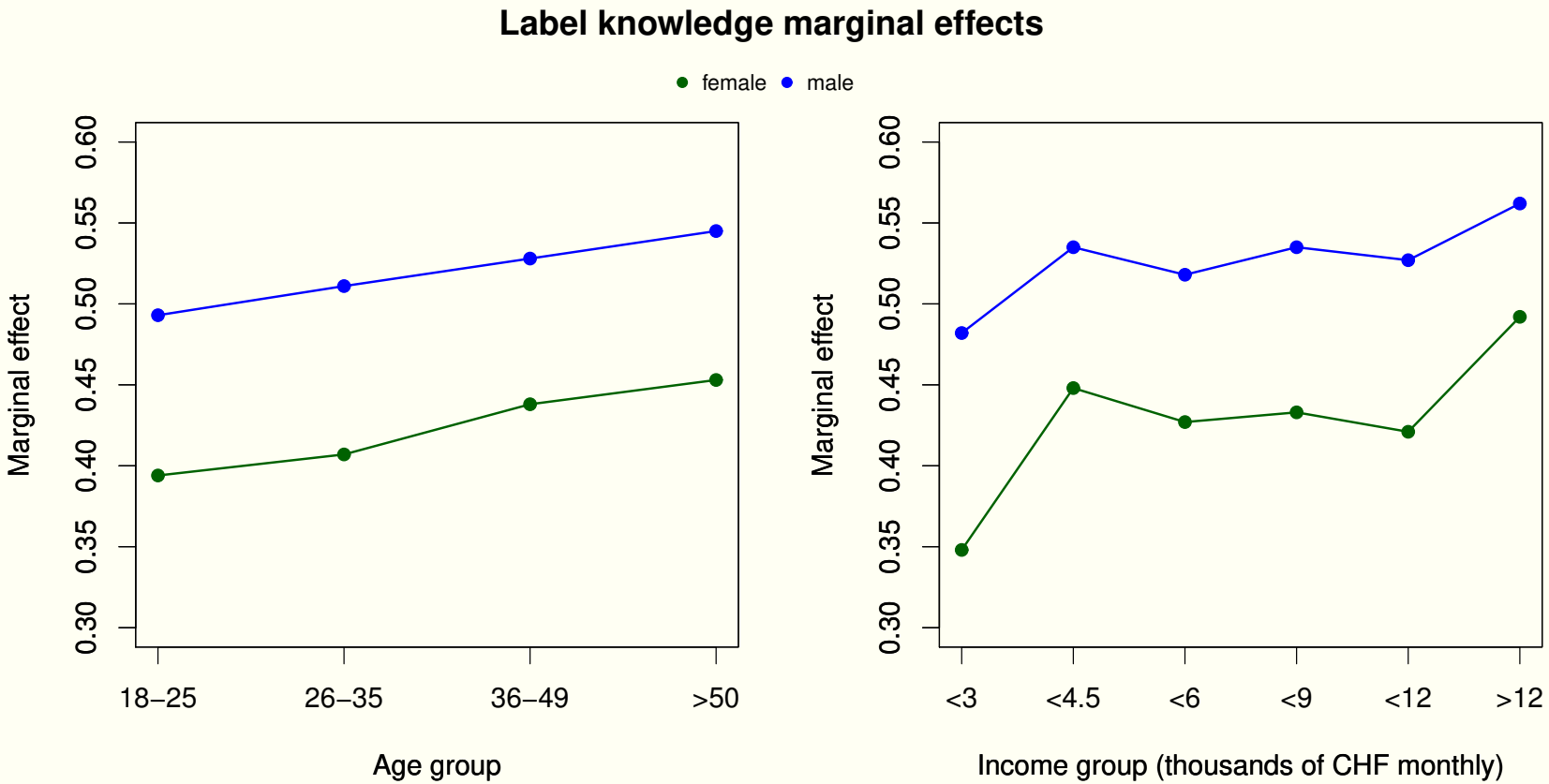
The probability to own an efficient vehicle increases on average by:

- **49%** if the respondent knows the car energy label
- **28%** if respondent has highest number on general energy literacy index (8)
- not significant if respondent has lowest number on general energy literacy index (1)
- not significant if respondent has pro-environmental attitude index (>15 out of 20)

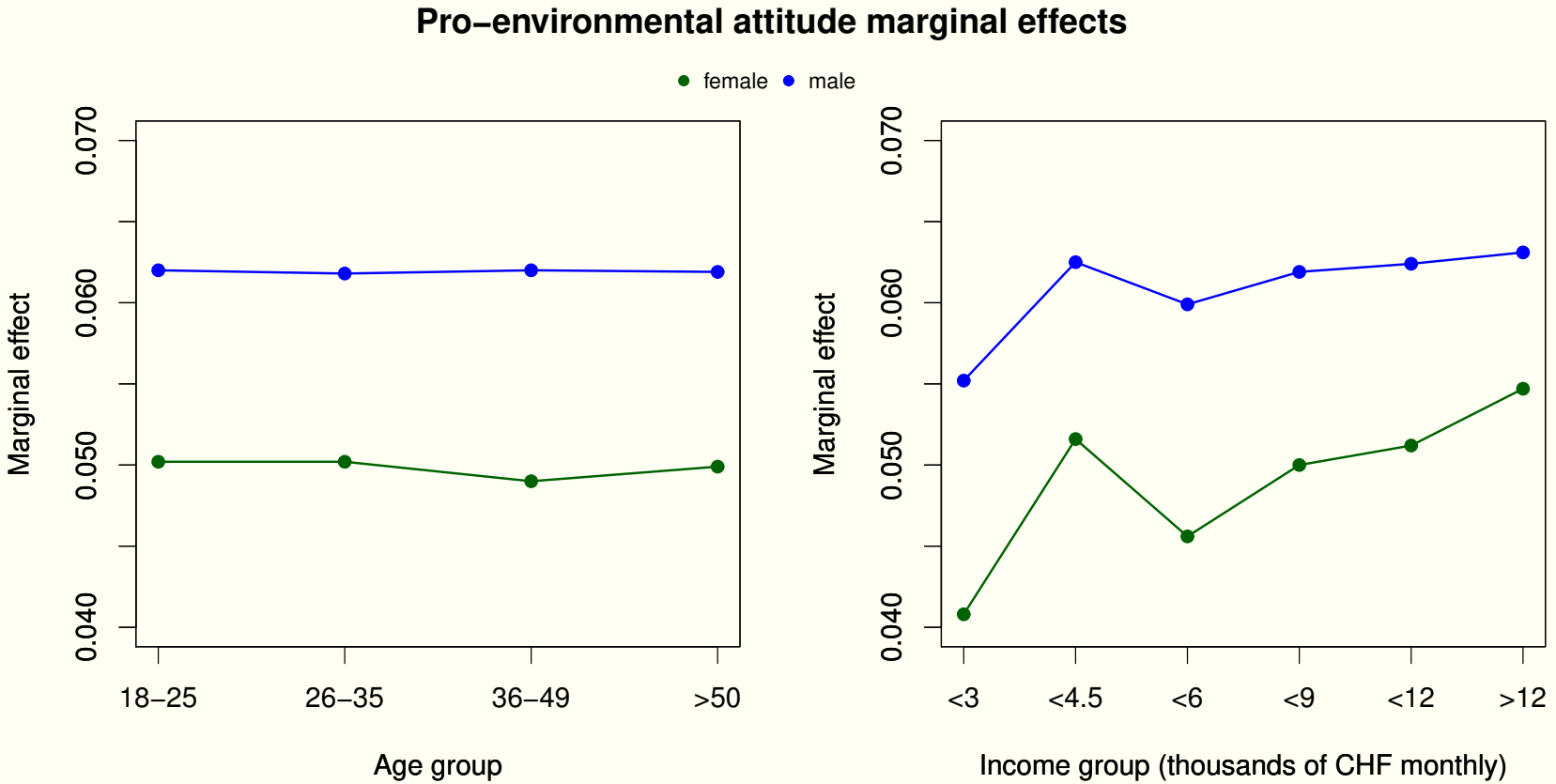
Energy literacy & vehicle ownership



Label knowledge & vehicle ownership



Pro-environmental attitudes & vehicle ownership

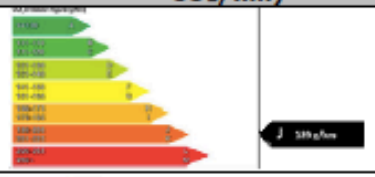
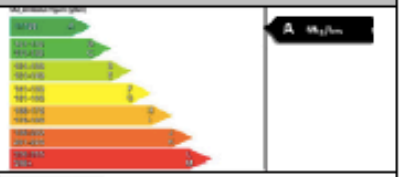
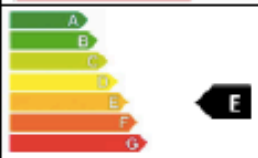
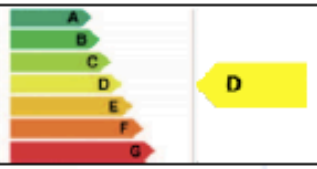
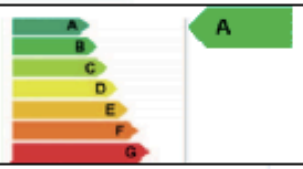


Conclusions

- Energy literacy significantly increases the probability to own an efficient vehicle
- This is true for both general and car-specific energy literacy (label knowledge)
- Although repondents value the environment highly, this does not impact vehicle ownership
- Policy conclusions: invest in customer awareness and education about energy, vehicle consumption, energy labels etc.

Discussion

Figure 2: Classification of exact same car models

Country	Format	Porsche Cayenne Diesel (189 g CO_2/km)	Citroen C1 (99 g CO_2/km)
United Kingdom[13]	*Absolute A to M*		
Switzer-land[14]	Relative A to G		
Nether-lands[15]	Relative A to G		
Germany[16]	Relative A+ to G		
Belgium[17]	Absolute A to G		
Denmark	Absolute A to G		

source: Carroll et al. (2014)