CAN RENEWABLE ENERGY BE FINANCED WITH HIGHER ELECTRICITY PRICES? EVIDENCE FROM SPAIN

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OBJECTIVES

- To assess willingness to pay for renewable energy electricity considering each individual renewable energy source (i.e. wind, solar and biomass) as a different attribute and their levels defined as the percentage of the total electrical use generated by the specific source
- To identify sources of heterogeneity in preferences for renewable energy electricity

SAMPLE AND SURVEY

SPANISH MID-SIZED TOWN (ZARAGOZA - 0.65 million inhabitants)

•400 individuals responsible for paying the household electricity selected using a stratified random sample on the basis of town district and age
•Face-to-face interviews during July 2010

QUESTIONNAIRE

•electricity provider and the current cost of their monthly electric service
•knowledge on renewable energy
•attitudes towards renewable energy
•concern with environmental issues
•choice experiment question (and follow-up question)
•socio-demographic characteristics (i.e. gender, family size and composition, age, educational level, income range) and different lifestyles

CHOICE SET DESIGN

FIVE ATTRIBUTES AND FOUR LEVELS

Attributes	Levels	Status quo
Price (€ per kWh)	0.17; 0.21; 0.24 and 0.28	0.14
% of electricity from wind	16%; 18%; 21% and 26%	13%
% of electricity from solar	6%; 10%; 14% and 18%	2%
% of electricity from biomass	2%; 3%; 5% and 6%	1%
Region of origin	Regional (Aragon) Unknown origin	Unknown origin

•The choice set design was created following Street and Burgess (2007) for 5 attributes with 4, 4, ,4 ,4 and 2 levels, respectively, and two alternatives to estimate only main effects

•32 pairs were obtained (this design is 94.91% D-efficient)

•The 32 choice sets were randomly split into 8 blocks of four choices

MODEL SPECIFICATION

Lancaster (1966) approach, utility function as follows

$$U_{njt} = ASC + \beta_1 PRICE_{njt} + \beta_2 WIND_{njt} + \beta_3 SOLAR_{njt} + \beta_4 BIOMASS_{njt} + \beta_5 REGION_{njt} + \varepsilon_{njt}$$

- J : each of the three options available in the choice set
- ASC is a dummy variable describing the status quo alternative.
- Price: the kWh price levels given to consumers for each electricity supply option
- WIND, SOLAR and BIOMASS are the different percentage levels of contribution to the electricity mix given to consumers
- REGION The geographic origin is an effect-coded variable

ESTIMATIONS

All coefficients are allowed to be random following a normal distribution
All estimations were conducted using NLOGIT 4.0.

	Model 1	Model 2	Model 3	Model 4
Mean Values				
ASC	-28.417 (-8.52)	-20.857 (-4.19)	-19.651 (-4.04)	-20.799 (-4.23)
PRICE	-261.670 (-11.72)	-222.042 (-11.47)	-22.004 (-11.56)	-217.189 (-11.19)
WIND	-0.0753 (-2.80)	-0.0431 (-1.97)	-0.0426 (-1.97)	-0.0771 (-2.99)
WIND*DCON$_W$				0.1556 (3.18)
SOLAR	-0.0192 (-0.72)	0.0780 (5.05)	0.0760 (4.72)	0.0654 (3.64)
SOLAR*DCON$_S$				0.0754 (1.93)
BIOMASS	-0.1519 (-2.52)	-0.1010 (-2.20)	-0.0870 (-2.18)	-0.0956 (-2.25)
BIOMASS*DCON$_B$				N.S.
REGION	0.5069 (6.58)	0.4275 (6.50)	0.4228 (6.72)	0.1616 (2.12)
REGION*DCON$_R$				0.5741 (5.14)
Standard deviations of parameter distributions				
WIND	0.2030 (5.71)	0.1353 (3.72)	0.1363 (4.07)	0.1322 (3.92)
SOLAR	0.3320 (10.56)	0.071 (2.19)	0.0866 (2.90)	0.0810 (2.86)
BIOMASS	0.4400 (5.04)	0.1907 (1.52)	N.S.	N.S.
REGION	0.8032 (7.17)	0.5738 (6.64)	0.5384 (6.39)	0.4571 (4.92)
Standard deviation of the latent random effect				
σ		5.84 (9.44)	5.62 (9.55)	5.26 (9.22)
N	4,8	4,8	4,8	4,8
Log likelihood	-1,27	-1,199	-1,199	-1,176
Pseudo R^2	974.28 0.275	1,117 0.315	1,117 0.315	1,162 0.328

t-values in brackets

RESULTS

WILLINGNESS TO PAY

	WTP	t-test	WTP as % of current kWh price	Monthly WTP (€)#
Respondents who ignore the attribute				
Wind	-0.0036	-3.33**	-2.5	-0.71
Solar	0.0030	3.69**	2.2	0.60
Biomass	-0.0044	-2.43**	-3.1	-0.88
Region	0.0074	2.14**	5.3	1.49
Respondents who consider the attribute				
Wind	0.0036	1.93*	2.6	0.72
Solar	0.0065	3.91**	4.6	1.30
Region	0.0339	8.50**	24.2	6.78

Assuming a monthly consumption of 200 kWh
** (*) Statistically significant at 5% (10%) level.

EXPLAINING HETEROGENEITY

Characteristics	Segment Less WTP	Segment Higher WTP	t-test/chi-square (p-value)
Enviromental concerns			
Air pollution	3.69	3.88	-1.76 (0.007)
Generation of municipal waste	3.56	3.78	-1.77 (0.076)
Water polution	3.77	4.39	-5.11 (0.000)
Climate change	3.73	4.14	-2.82 (0.005)
Attitudes towards renewable energy			
Generates waste that needs special treatment	2.14	2.47	-2.72 (0.007)
Diminishes the dependence from fossil fuels	3.69	3.87	-1.55 (0.12)
Reduces Greenhouse Gas Emissions	1.98	2.41	-3.85 (0.000)
Intention to use renewable electricity even at higher prices	48.6%	64.9%	6.64 (0.010)
Environmentally friendly behavior			
Efficient use of air-conditioning heating	74.3%	85.7%	4.5 (0.034)
Insulating their house	49.2%	70.1%	10.9 (0.001)
Environmental involvement			
Membership in environmental organizations	5.7%	13.0%	4.97 (0.005)
Dispose waste taking into account recycling	76.5%	90.9%	7.88 (0.005)
Avoid buying products with high environmental impact	29.1%	39.0%	2.82 (0.093)
Consume organic products	15.5%	29.9%	8.63 (0.003)
Participate in environmental conservation practices	34.4%	53.3%	9.41 (0.002)

CONCLUSIONS

- The majority of consumers are not willing to pay additional costs for increases in the renewable component of their electricity mix
- They would only accept an increase of the renewable mix at a discount for two of the three renewable sources considered (wind and biomass)
- On the contrary, people are indeed willing to pay for increases in the share of solar energy in the electricity mix of their supplier and generating electricity in the region rather than importing it
- However, preferences are heterogeneous and individuals are classified in two groups according to whether renewable sources are important for them
- The group of individuals more willing to pay for renewable shows higher environmental concerns, positive attitudes towards renewable energy, higher intention to use renewable electricity even at higher prices, more environmental friendly behavior and higher involvement with environmental practices than the group of less willing to pay