

# Do households misperceive benefits from energy saving behaviors?

: Evidence from the Japanese household survey

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## (1) Overview

Promoting households to practice energy saving behaviors such as “turn TV off when unnecessary” is regarded as a significant measure against global warming. Only if households misperceive (imperfectly recognize) what extent the behaviors generate benefits, the promotions can work as the measures. That is, for the promotions, it is necessary that there is a gap between perceived and actual benefits from the behaviors. However, there are few studies examining the relationship between them in Japan. To examining the relationship, we conducted the household survey in Soka City in Japan and received 714 answers. As a result of our econometric analysis, we find that households on average overestimate their monetary benefit from the behaviors relative to actual ones. It is also revealed that single young male is likely to underestimate. We conclude that the promotions such as informing households of correct benefit are not always effective measures to reduce greenhouse gas emissions. Conversely, the promotions may discourage households to practice the behaviors. Policymakers should reconsider their promotions.

## (2) Methods

To examine the relationship between the perceived and actual benefits of energy saving behaviors, consumer survey was conducted in Soka City, Japan in January 2010. Soka City is a suburb of Tokyo, the capital of Japan. We received responses from 714 households (a collection rate of 59.5 percent). We selected 18 energy saving behaviors that were referenced from The Energy Conservation Center of Japan (2010). These analyzed behaviors are listed in Table 1.

Equipments	Behaviors	Equipments	Behaviors
air conditioner	set 28 degree in summer	crt tv	turn off when unnecessary
air conditioner	set 20 degree in winter	plasma tv	turn off when unnecessary
air conditioner	turn off when unnecessary	liquid crystal tv	turn off when unnecessary
air conditioner	clean filters	refrigerator	temperature control
gas heater	set 20 degree in winter	refrigerator	fixed away from wall
oil heater	set 20 degree in winter	electric pot	unplug when unnecessary
gas heater	turn off when unnecessary	water heater	set water temperature low
oil heater	turn off when unnecessary	water heater	refrain reheating water
electric carpet	frequent temperature control	water heater	turn shower off when unnecessary

**Fig. 1:** List of Energy Saving Behaviors

To consider the other factors that impact the relationship, the following econometric model is introduced, similar to Attari et al.(2011). Let  $PB_{ij}$  and  $AB_{ij}$  represent the perceived and actual benefits of household  $i$ 's energy saving behavior  $j$ , respectively, and let  $\mathbf{X}_{ij}$  and  $\mathbf{Z}_{ij}$  represent the vectors of the explanatory variables that capture the characteristics of households and household behaviors, respectively, where  $\beta_k, \gamma_k$  ( $k=0, 1, 2, 3$ ) are the parameter vectors to be estimated and  $\varepsilon_{ij}$  and  $\mu_{ij}$  are idiosyncratic error terms.

$$\text{Model 1 } PB_{ij} = \beta_0 + \beta_1 AB_{ij} + \mathbf{X}_{ij}\beta_2 + \mathbf{Z}_{ij}\beta_3 + \varepsilon_{ij}$$

$$\text{Model 2 } PB_{ij} = \gamma_0 + \gamma_1 AB_{ij}^2 + \gamma_2 AB_{ij} + \mathbf{X}_{ij}\gamma_2 + \mathbf{Z}_{ij}\gamma_3 + \mu_{ij}$$

## (3) Results

Table 2 shows the results from estimating models 1 and 2 by ordinary least squares. In results of model 1, the coefficient of the actual benefit is 0.52 with 5 percent significance under the null hypothesis that the coefficient is zero. Another null hypothesis, that the coefficient is equal to 1, is also rejected at the 1 percent level. In other words, households misestimate the monetary benefit of their energy savings.

These results highlight some very important issues related to current environmental policies targeted toward the household sector in Japan. Promoting the visualization of energy consumption, such as installing “smart meters”, is expected to play a role in GHG emission reduction policies for the household sector. If these meters are

placed in households and the household members view the actual monetary benefits of their energy saving behaviors, they will notice that their behaviors do not generate as much benefit as expected because the benefits are overestimated. Consequently, the installation of meters may actually discourage households from practicing energy saving behaviors. Nonetheless, the use of these meters may still improve social welfare by resolving the problem of incomplete household information.

Variables	Model 1			Model 2		
	Coef.	S.E.		Coef.	S.E.	
Actual Benefit	0.52	0.12	***	-1.13	0.43	***
Actual Benefit ^2				0.000262	0.0000687	***
Income	-9.71	94.7		3.34	94.6	
Age	-54.9	15.7	***	-52.6	15.6	***
Gender	1324.8	408.3	***	1324.3	406.9	***
Education	325.0	407.5		336.9	405.6	
Environmental Concern	82.2	369.4		111.3	367.4	
Priority	259.1	115.8	**	264.6	115.4	**
Marriage	-1639.5	811.4	**	-1641.6	808.8	**
Number of Households	-477.1	132.7	***	-463.4	132.4	***
Cooling Degree	-184.5	74.3	**	-180.6	74.3	**
Heating Degere	58.3	59.2		63.0	59.1	
Cooling Degree × Air Conditioner	-20.2	23.1		-36.5	23.4	
Heating Degere × Air Conditioner	6.2	25.2		12.8	25.1	
Electric Water Heating	50.6	473.0		38.7	472.2	
Oil-fired Water Heating	-115.4	783.6		-122.6	778.0	
Tenure	1239.8	486.5	**	1234.9	486.1	**
House Size	-106.5	148.6		-79.8	148.3	
House Age	4.6	17.1		2.6	17.0	
Number of Equipments	227.3	167.6		58.1	174.6	
Constant	11737.7	2813.2	***	13031.3	2826.7	***
Adjusted R-squared	0.03			0.04		
F value (P value)	4.91	(0.00)		4.97	(0.00)	

**Table 1:** estimation results

Note: “\*\*\*”, “\*\*” and “\*” denote significances at the 1percent, 5percent and 10percent levels, respectively. Obs. = 2496 (2496 = 250 households × approximately 10 behaviors). Robust standard errors are used in the estimations.

#### (4) Conclusions

This paper focused on household energy saving behaviors, which are crucial for mitigating GHG emissions in the household sector. However, there are few studies that examine how households perceive, recognize or practice energy saving behaviors. Therefore, the purpose of this paper was to examine the relationship between the perceived benefits and the actual benefits of energy saving behaviors by households.

As a result of the econometric models that were generated, we found that households overestimate the monetary benefits of their energy saving behaviors. Remarkably, single young males tend to overestimate these benefits the most, whereas married old females tend to underestimate these benefits the most. Therefore, informing a single young male of the actual benefits may discourage him from practicing energy saving behaviors, whereas informing a married old female of the actual benefits may encourage her to practice such behaviors.

This result is important for environmental policymakers for the following two reasons. First, informing households of the actual benefits is not always effective for reducing energy consumption because the benefits have been misestimated. Second, a uniform approach to providing information on energy saving behaviors may be inappropriate. Authorities should rethink their approach to providing information and provide households with appropriate recommendations according to their characteristics.

#### References

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