Understanding Consumer Preferences to Foster Energy Efficiency: A Choice-based Experiment with Light Bulbs

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Introduction

It is widely accepted that there is an energy-efficiency gap between actual and optimal energy consumption levels (Jaffe and Stavins 1994). There have been numerous studies analyzing potential barriers and market failures, which can explain this energy-efficiency gap (Anderson and Claxton 1982; Golove, Eto et al. 1996; Brown 2001).

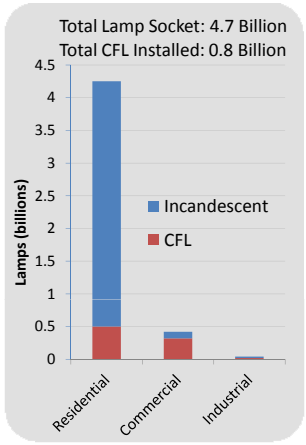

Figure 1. US national socket saturation
(Source: D&R International, 2009)

Barriers	Market failures
Uncertainty in future energy prices	Externalities not reflected in energy prices
Lack of access to financing (or capital)	Distortional regulations (subsidy etc.)
Perceived risks about performance	Imperfect information
Inseparability of features	Limited supply and availability of energy efficiency measures
Low priority of energy issues	Split incentives
Limited cognitive capacity	
Customs or habits	

While a barrier analysis can help us understand the energy gap problem qualitatively, it does not provide an analytical tool with which we can disaggregate or compare different barriers.

Objectives

Why do some individual consumers choose to buy energy-efficient light bulbs while others do not?

The main objectives of this study are:

- to analyze differences in consumer preferences for lighting and to suggest a direction for energy efficiency policy,
- to quantify the size of individual impact from different factors affecting consumer choices by discrete choice analysis,
- to measure implicit discount rates separated from those factors included in the model, and
- to understand how disclosing information of lifetime costs would affect choices.

Methodology

Discrete Choice Analysis: The discrete choice model statistically relates choices made by a person to the attributes of the person and/or of the alternatives available to him/her. From the choices made, we can estimate a quantitative model of consumer *n*'s utility U_{ni} from their choice of alternative *i*,

$$U_{ni} = V_{ni} + \varepsilon_{ni} = z_n\gamma_i + x_{ni}\beta + \varepsilon_{ni}$$
$$= \beta_0 + \beta_1 opcost_i + \beta_2 price_i + \cdots + \varepsilon_{ni},$$

where V_{ni} is utility determined by observed factors z_n and x_{ni}, which are consumer- and product-specific factors respectively. By assuming ε_{ni} has iid extreme value distribution, I can derive a closed-form probability P_{ni} of consumer *n* choosing an alternative *i*.

$$P_{ni} = \frac{e^{z_n\hat{\gamma}_i + x_{ni}\hat{\beta}}}{\sum_j e^{z_n\hat{\gamma}_j + x_{nj}\hat{\beta}}}$$

Estimating Implicit Discount Rate: Once I build the utility model, I can estimate the average implicit discount rate *r* from the relationship between the coefficients of the model depending on lifetime *q* of the product.

$$\frac{\hat{\beta}_2}{\hat{\beta}_1} = \frac{r}{1+r} \cdot \frac{1}{1-\frac{1}{(1+r)^q}}.$$

Experiment Plan

1. Preliminary Question (online)

Please rank the following factors in the order of importance which you consider when purchasing a light bulb.

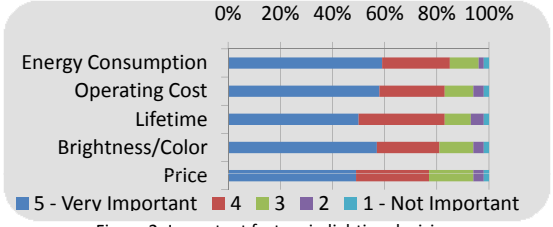

Figure 2. Important factors in lighting decisions
(Source: Sylvania socket survey 2010)

2. Online Pilot (Observing Stated Preference)

Two groups of participants will be given tasks that will consist of two parts: a) choice questions (12 questions) and b) demographic and awareness questions (12 questions). One group will be given lifetime cost information, while the other will not. Choice questions will ask participants to make 12 choices successively out of 12 sequential pairs of alternatives whose attributes are based on the results from the preliminary question. Awareness on electricity price, climate change, and mercury issues regarding CFLs will be asked.

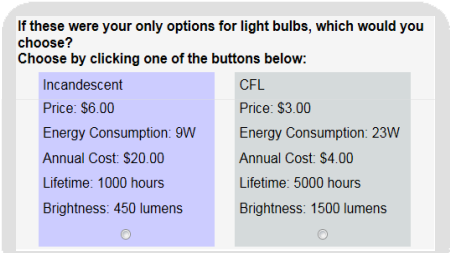

Figure 3. An example of choice questions

3. Field Experiment (Observing Revealed Preference)

Using the same questions as in the online pilot, I will provide a voucher ($7 worth) to each participant which he/she can use to buy an actual light bulb. The objective of the field experiment is to simulate consumer choices at the market. Change will be given to promote their actual purchase behavior.

Expected Result

By showing what factors constitute consumer preferences and how much each factor contributes to the probability of purchasing a particular lighting technology, this study will help federal agencies, such as DOE and EPA, envision what policy options can promote not just the adoption of energy efficient lighting but also other energy efficient technologies.

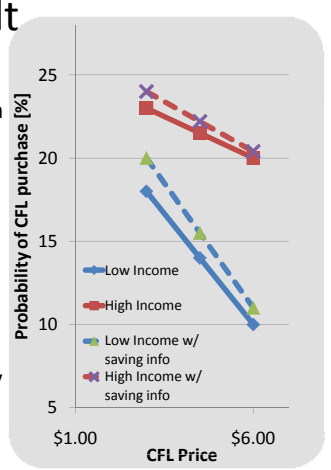

Figure 4. Potential effect of income and price on purchase

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