Rational Inattention and Energy Efficiency

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- Pigouvian tax efficient because everyone has same marginal incentive
- Notches provide uneven incentives – may not get low hanging fruit

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• Are there benefits to notches that might outweigh efficiency costs?
What are plausible benefits of notches?

- **Administrative ease**
  - “Lawyers prefer tables to formulas”
  - “Staffers can’t put logarithms into legalese”

- **Salience**
  - Notches create first-order welfare changes
  - Notches simplify (coarsen) consumer information
  - Fine-grained information might slip through net of consumer attention, whereas coarse information is snagged
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Why might coarse information be more effective than fine-grained information?

- Assume some cognitive cost of processing information
- Could be rational to ignore fine-grained information if expected gain small relative to cognitive cost
- **Is it rational for consumers to ignore energy efficiency when purchasing durables?**
  - Could justify notches
  - Could explain energy gap
Goal of this paper is to explore whether or not rational inattention is plausible.
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Research summary

1. Energy efficiency notches create distortions
2. Model: inattention more likely rational as...
   - Variance in energy costs smaller
   - Variance in other attributes larger
   - Cost of learning larger
3. Rational inattention is plausible
   - Learning about energy efficiency is valuable
   - But, variation in other attributes quite large
   - Learning is difficult
Producers respond to notches

Vehicles that paid the Gas Guzzler Tax

Source: Sallee & Slemrod 2010
Producers respond to notches

Cars subject to Gas Guzzler Tax

Source: Sallee & Slemrod 2010
Producers respond to notches

LEED certification (NC 2.2)
Producers respond to notches

LEED certification (NC 2.1)
Producers respond to notches

LEED certification (CI 2.0)

Density

Points

Sallee (Harris)
Producers respond to notches

LEED certification (CS 2.0)
Producers respond to notches

Energy Star (refrigerators)

% Percent Above Federal Standard

ES > 20%
Producers respond to notches

Energy Star (freezers)

ES>10%
Producers respond to notches

Energy Star (washers)

ES<=324

Density

ES<=324

kWh/year

Inattention
Heuristic model of rational inattention

- Consumer makes discrete choice between models
- Uncertain of exact lifetime fuel cost
- Can learn exact costs after incurring search cost
- Does consumer pay information cost, or just choose without resolving uncertainty?
• Two good example:
  - Risk neutral consumer $i$
  - Models $j$ and $k$
  - Difference in utility *not including energy cost surprise* is
    \[
    \theta_i = V_j + \varepsilon_{ij} - V_k - \varepsilon_{ik}
    \]
  - Energy cost surprise is $c \sim \mathcal{N}(0, \sigma_c)$ for both $j$ and $k$ (iid)
  - Search cost is $s$

• Consumer $i$ will search iff:

\[
(1 - \Phi(\theta_i/\sqrt{2\sigma_c})) \cdot \left[ \sqrt{2\sigma_c} \frac{\phi(\theta_i/\sqrt{2\sigma_c})}{1 - \Phi(\theta_i/\sqrt{2\sigma_c})} - \theta_i \right] > s.
\]

• Search more likely as...
  - utility difference between models $\theta_i$ smaller
  - search cost $s$ gets smaller
  - variance in energy costs $\sigma_c$ bigger
Search decision for different $\theta_i$, holding fixed $\sigma_c$ and $s$

- Consumers very far from indifferent $\theta_i > |\theta^*|$ will not search; choose without knowing true costs.
- Consumers who like $j$ and $k$ about the same will search.
- Inattention need not induce underprovision.
  - If $-c_j + c_k = B$, then all consumers who would change purchase search; no mistakes are made and demand is a function of true energy cost.
Automobile variation

Median and standard deviation in price and fuel cost by vehicle type

![Bar chart showing the median and standard deviation in price and fuel cost by vehicle type. The chart includes data for Compact Car, Midsize Car, Luxury Car, Sports Car, SUV, Pickup, and Van. The x-axis represents different vehicle types, while the y-axis represents price and fuel costs. Each vehicle type has three bars for price (blue), standard deviation of price (orange), and fuel cost (green), with a fourth bar for standard deviation of fuel cost (yellow).]
Automobile variation

Standard deviation in price \textit{within VIN} and fuel cost \textit{across VIN}

- Within VIN variation exceeds within class fuel cost variation
- Model year cycle: save \(\approx \$150/\text{month}\); one standard deviation change in \textit{timing} \(\approx \$750\)
• How hard is it to calculate fuel costs?
• Don’t labels solve this problem?
• How hard is it to calculate fuel costs?
• Don’t labels solve this problem?
• Information incomplete and imprecise

Variation in highway fuel economy between test methods

• EPA changed test procedure in 2008
• Mean change in lifetime fuel costs is $1,700
• Standard deviation in change in cost is $600
Appliance variation

Median and standard deviation in price and energy cost by appliance

![Graph showing median and standard deviation in price and energy cost by appliance](image)
What about appliance labels?

Based on standard U.S. Government tests

**ENERGYGUIDE**

Refrigerator-Freezer
With Automatic Defrost
With Side-Mounted Freezer
With Through-the-Door-Ice Service

XYZ Corporation
Model ABC-W
Capacity: 23 Cubic Feet

Compare the Energy Use of this Refrigerator with Others Before You Buy.

This Model Uses
600 kWh/year

**Energy use (kWh/year) range of all similar models**

Uses Least Energy
539

Uses Most Energy
698

kWh/year (kilowatt-hours per year) is a measure of energy (electricity) use. Your utility company uses it to compute your bill. Only models with 22.5 and 24.4 cubic feet and the above features are used in this scale.

Refrigerators using more energy cost more to operate. This model’s estimated yearly operating cost is:

$54

Based on a 2005 U.S. Government national average cost of 9.06¢ per kWh for electricity. Your actual operating cost will vary depending on your local utility rates and your use of the product.

Natural Resources Canada provides “second price tag” = lifetime cost of energy
But, they calculate this without discounting
Mistake creates large error in cost estimates
Mistakes much larger than true standard deviations in fuel costs
Summary

- Markets respond to notches ⇒ implies inefficiency
- Rational inattention plausible
  - Costs of information significant
  - Price variation large

Extensions

- Smaller appliances better candidates for inattention
- Discrete choice estimation to quantify distance, match model
- Second choice data to enable direct counting of mistakes
- Field experiments