

Behavioral Issues in Environmental and Energy Economics

Lecture 14

ARE 264

March 3, 2022

What are the goals of this course?

- ① Make you familiar with core, **canonical ideas**
 - ② Make you familiar with **cutting edge** research and methods
 - ③ Give you a starting place for writing your own **models**, particularly those that pair with empirical analysis
 - ④ Discuss the **research process** (e.g., how to select projects and how to execute them)
 - ⑤ Discuss the **profession** (e.g., publication process)
 - ⑥ Provide **broad exposure**, but also great **depth**
 - ⑦ Shamelessly plug my own research
-
- Sadly, I am unable to execute all of these things in 14 lectures. There will be trade offs.

What is the plan of this course?

- **Part I.** Twelve standard lectures
 - Covering **canonical** topics on efficiency and equity of environmental policy
- **Part II.** Two non-standard class sessions
 - One research workshop (writing and idea development)
 - One modeling workshop
- **Part III.** Your work
 - Daily **bullet points** on reading or prompt
 - Two **problem sets** combining standard math problems and “build your own” math problems
 - Two **research skills** assignments

Rapid review of 264, module A

	Date	Title		Please read (* indicates deliverable required)
1	Tu Jan 18	The Pigouvian prescription		Cropper & Oates 1992, b(intake*)
2	Th Jan 20	Tradable permits		Goulder & Parry 2008, b(criteria*)
3	Tu Jan 25	Instrument choice		Pizer & Prest 2020, Coase 1960*
4	Th Jan 27	Performance standards		Jacobsen & van Benthem 2013*, Borenstein 2015
5	Tu Feb 1	Research workshop		b(Leaks*), b(Tarduno 2021*)
6	Th Feb 3	Incidence and equity		Kaplow 2004, Fullerton 2011, b(equity*)
7	Tu Feb 8	Compensation and targeting		b(Sallee 2020*), ALT 2018
8	Th Feb 10	Second-best (targeting)		Knittel & Sandler 2018, JKSVB, b(hetero*)
9	Tu Feb 15	Reviving the first-best		Segerson 1988, b(ambient*)
10	Th Feb 17	Modeling workshop		b(upload notes*)
11	Tu Feb 22	Second-best (fiscal)		Goulder 2013, Finkelstein & Hendren 2020
12	Th Feb 24	Second-best (other problems)		Goulder, Hafstead & Williams 2016*
13	Tu Mar 1	Behavioral EEE I		Myers, Puller and West 2020* , AMT 2014
14	Th Mar 3	Behavioral EEE II		Allcott and Kessler 2015, b(WTP*)

Feedback

- We will now take 5-8 minutes for you to provide feedback
- Your course evaluations are important, both for me to improve the course and for my colleagues to evaluate my effectiveness as a teacher
- First, official campus link:
<https://course-evaluations.berkeley.edu>
- Second, there is a 2-question bCourses anonymous survey

To do

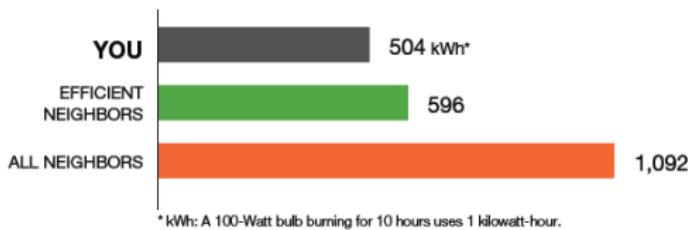
- Comments on Jacob Moscona's presentation

Outline

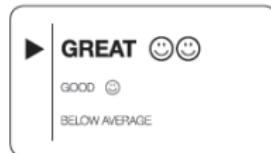
- ① Nudges: some example evidence
- ② Information provision: what do we know?
- ③ Energy efficiency gap: types of evidence

Last Month Neighborhood Comparison

Last month you used 15% LESS electricity than your efficient neighbors.



YOUR EFFICIENCY STANDING:

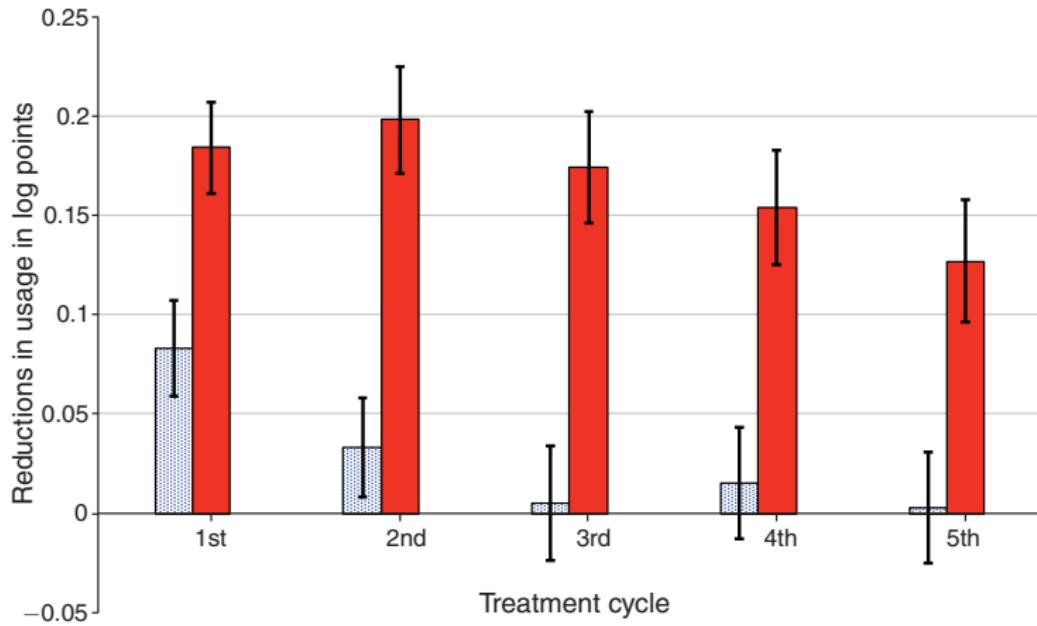


Allcott (2009)

- Many nudge effects are revealed in an RCT
- RCTs are wonderful, but they do leave some questions unanswered
- For nudges, a real concern is whether effects are persistent, or if they “wear off”. This is different than what we’d expect from rational price-based responses
- There is no way to systematically test whether nudges have stable, persistent effects, but here are two examples from electricity experiments

- Ito, Ida and Tanaka (AEJ: Policy 2018) “Moral Suasion and Economic Incentives: Field Experimental Evidence from Energy Demand”
- RCT in Japan
- Some consumers get peak price treatments
- Some get “moral suasion”, appeal asking them to reduce energy during peak hours
- Finding: price effects are more persistent over time

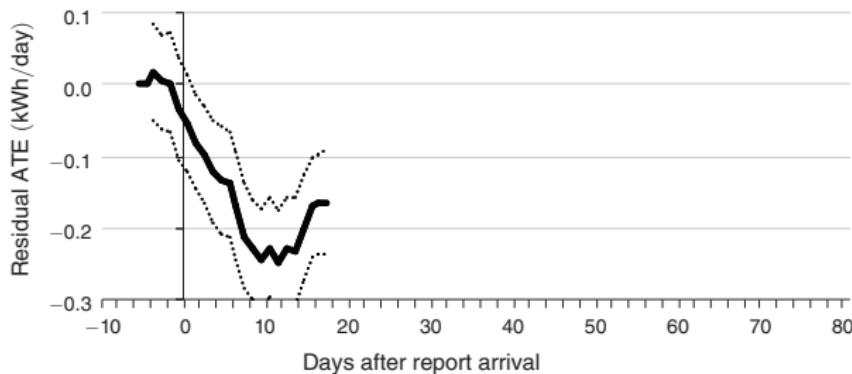
Panel A. Summer experiment



Ito, Ida and Tanaka (2018)

- Allcott and Rogers (AER 2014) “The Short-Run and Long-Run Effects of Behavioral Interventions”
- Look at OPower treatments over the long run. Find:
 - Substantial short-run response and backslide
 - Gradual decay of effect after treatment removed
 - Treatment still has impacts after 2 years

Panel A. Monthly: First four reports



Panel B. Quarterly: First four reports

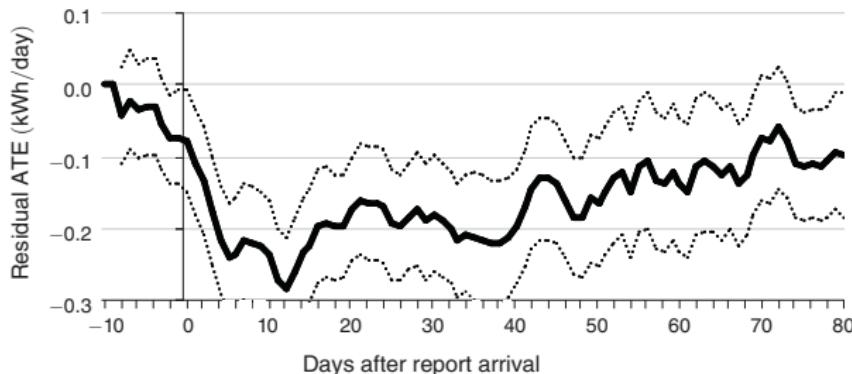
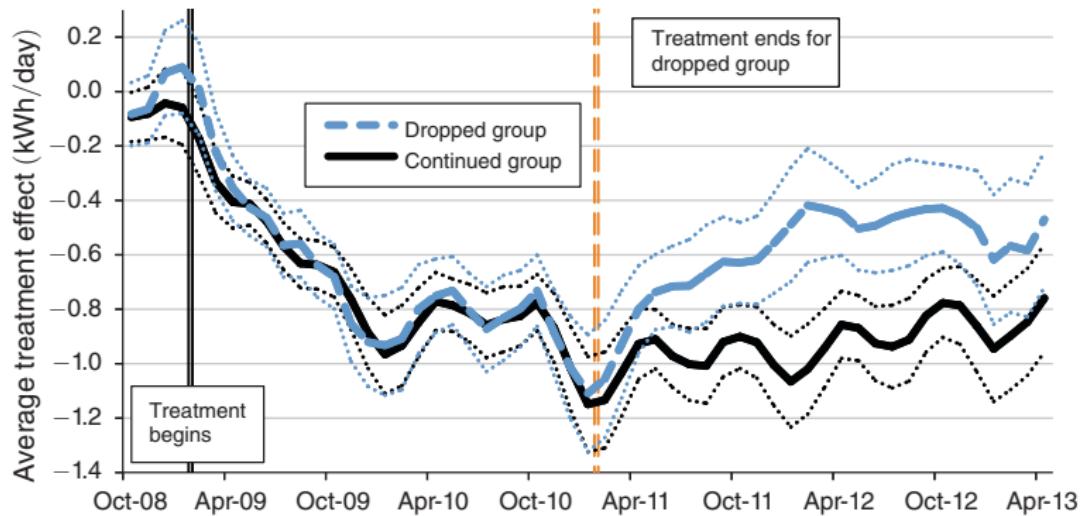


FIGURE 3A. HIGH-FREQUENCY EFFECTS IN EVENT TIME

Allcott and Rogers (2014)

Panel A. Site 1



Allcott and Rogers (2014)

- In general, welfare analysis is ambiguous and complicated once agents are not rational actors
- If you have a specific behavioral model in mind, then welfare may be (conceptually) straightforward
 - Houde is an example of empirical estimation for a specific model
- But if you start with an empirical finding (e.g., that a nudge has an effect), it is less clear how to proceed with welfare
 - **What ideas did you have for evaluating welfare of OPower as an example?**
- Allcott and Kessler (AEJ: Policy 2018) “The Welfare Effects of Nudges” tries a direct solution
- Related approach is “opt out studies” (DellaVingga, List and Malmendier QJE 2012)

- Start with a model that allows social pressure cost per unit consumption μ
- In their notation, γ are factors that may cause consumer to make mistakes
- e is energy consumption; α are tastes; \hat{f}' is observed demand function
- Consumption FOC depends on moral utility, price and bias
- Nudge might be affecting moral utility, or bias
- Experiment could shift quantity either by raising social cost μ or by debiasing choice via γ : observationally equivalent...

$$\hat{f}'(\tilde{e}; \alpha, \gamma) - \mu = p_e.$$

Tell us what you think — and earn a check for up to \$10!

Central Hudson has been sending you Home Energy Reports since last fall, and we want to know what you think about them. Would you take a moment to complete the survey below? For each question, please fill in one box with your answer.

What happens next?

1. When you're finished, mail the survey back to us in the enclosed prepaid envelope.
2. We will use a lottery to draw one of the first seven questions, and we'll mail you what you chose in that question — either a check or a check plus four more Home Energy Reports.

Thank you!

Your participation will help us make these reports even more useful for you. If you have any questions, please email us at HESSurvey@cenhud.com or call (845) 486-5221.

1. Which would you prefer?	+ \$10 4 more Home Energy Reports PLUS a \$10 check <input type="checkbox"/> OR <input type="checkbox"/>	<input type="checkbox"/> \$1 A \$1 check
2. Which would you prefer?	+ \$10 4 more Home Energy Reports PLUS a \$10 check <input type="checkbox"/> OR <input type="checkbox"/>	<input type="checkbox"/> \$5 A \$5 check
3. Which would you prefer?	+ \$10 4 more Home Energy Reports PLUS a \$10 check <input type="checkbox"/> OR <input type="checkbox"/>	<input type="checkbox"/> \$9 A \$9 check
4. Which would you prefer?	+ \$10 4 more Home Energy Reports PLUS a \$10 check <input type="checkbox"/> OR <input type="checkbox"/>	<input type="checkbox"/> \$10 A \$10 check
5. Which would you prefer?	+ \$9 4 more Home Energy Reports PLUS a \$9 check <input type="checkbox"/> OR <input type="checkbox"/>	<input type="checkbox"/> \$10 A \$10 check
6. Which would you prefer?	+ \$5 4 more Home Energy Reports PLUS a \$5 check <input type="checkbox"/> OR <input type="checkbox"/>	<input type="checkbox"/> \$10 A \$10 check
7. Which would you prefer?	+ \$1 4 more Home Energy Reports PLUS a \$1 check <input type="checkbox"/> OR <input type="checkbox"/>	<input type="checkbox"/> \$10 A \$10 check
8. Think back to when you received your first Home Energy Report. Did you find that you used more or less energy than you thought?	<input type="checkbox"/> Much less <input type="checkbox"/> Somewhat less <input type="checkbox"/> About what I thought <input type="checkbox"/> Somewhat more <input type="checkbox"/> Much more	

CHSE_2008_WELCOME LETTER SURVEY

- To distinguish, they elicit WTP for the nudge, and then interpret that as the net value to the consumer

Outline

- ① Nudges: some example evidence
- ② Information provision: what do we know?
- ③ Energy efficiency gap: types of evidence

Information provision as an intervention

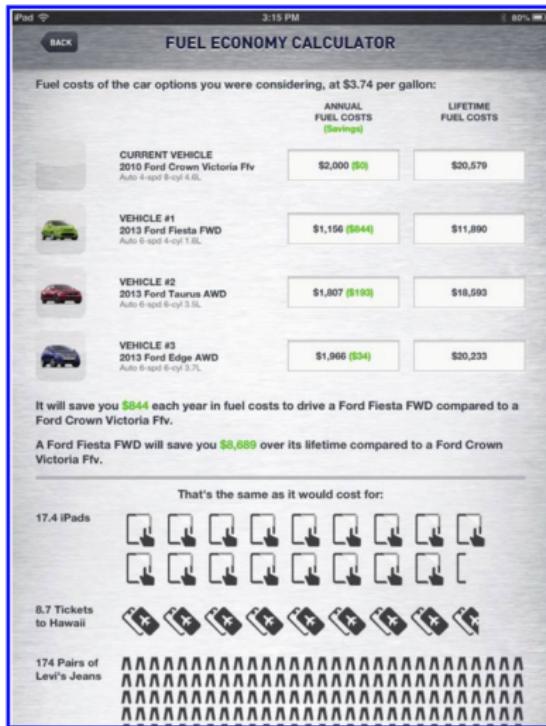


FIGURE 1. DEALERSHIP TREATMENT SCREEN

Notes: This is a screen capture from part of the dealership informational intervention, which was delivered via tablet computer. Vehicles #1, #2, and #3 were those that the participant had said he/she was considering purchasing, and fuel costs were based on self-reported driving patterns and expected gas prices.

- Allcott and Knittel AEJ 2019 run intervention among vehicle shoppers
- Common interpretation: can do welfare analysis based on revealed preference in standard way AFTER providing information
- Interpret this as “mistake free” environment

Ito as an example of information

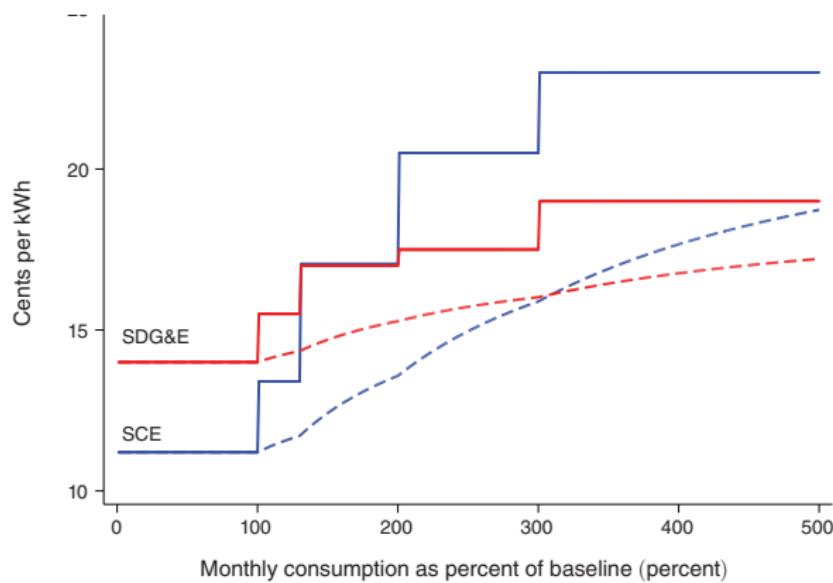


FIGURE 3. AN EXAMPLE OF CROSS-SECTIONAL PRICE VARIATION
IN NONLINEAR ELECTRICITY PRICING

- In some situations, prices are complicated
- Ito (2014) studies whether consumers respond to average versus marginal prices using clever variation

Ito as an example of information

TABLE 2—ENCOMPASSING TESTS: MARGINAL PRICE VERSUS AVERAGE PRICE

	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln(\text{marginal price}_t)$	-0.034 (0.004)		0.002 (0.011)			
$\Delta \ln(\text{average price}_t)$		-0.051 (0.005)	-0.054 (0.015)			
$\Delta \ln(\text{marginal price}_{t-1})$				-0.050 (0.004)		0.006 (0.011)
$\Delta \ln(\text{average price}_{t-1})$					-0.074 (0.005)	-0.082 (0.015)

Notes: This table shows the results of the IV regression in equation (3) with fixed effects and control variables specified in the equation. The unit of observation is household-level monthly electricity usage. The dependent variable is the log change in electricity consumption in billing period t from billing period $t - 12$. The sample period is from January 1999 to December 2007 and the sample size is 3,752,378. Standard errors in parentheses are clustered at the household level to adjust for serial correlation.

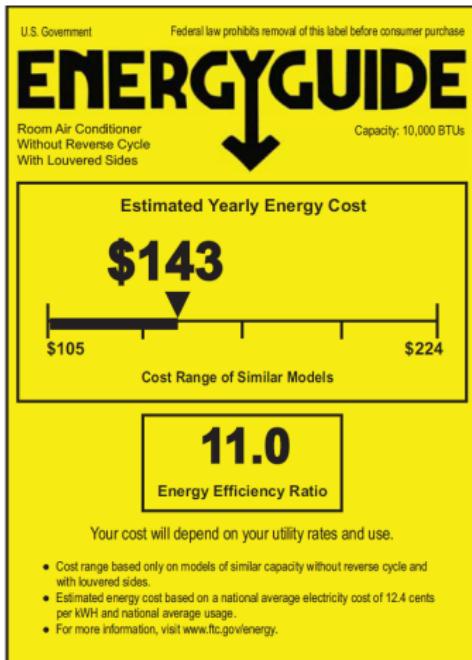
- Finds that people respond to average prices, not marginal. What should we conclude about this in terms of rate design, environmental policy, or welfare?
- Might interpret this as an **information** problem—people are not given clear information about marginal prices

Davis and Metcalf (JAERE 2016)

- Energy consumption labels use national prices
- Electricity prices vary a lot regionally
- Do choices change if you switch label to reflect local prices?

Figure 4: Control and Treatment Labels

Control Group



Treatment Group

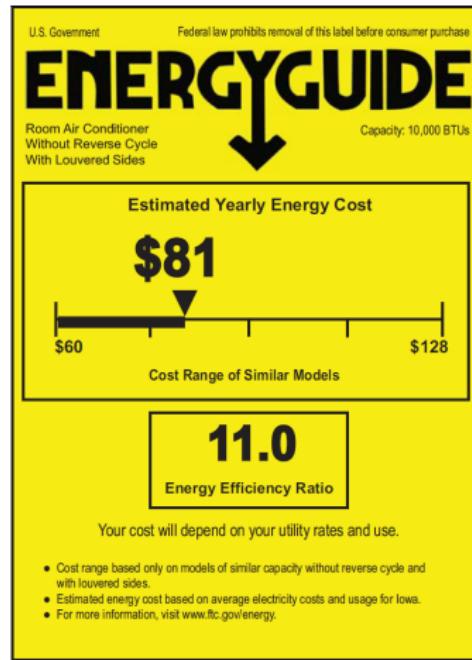
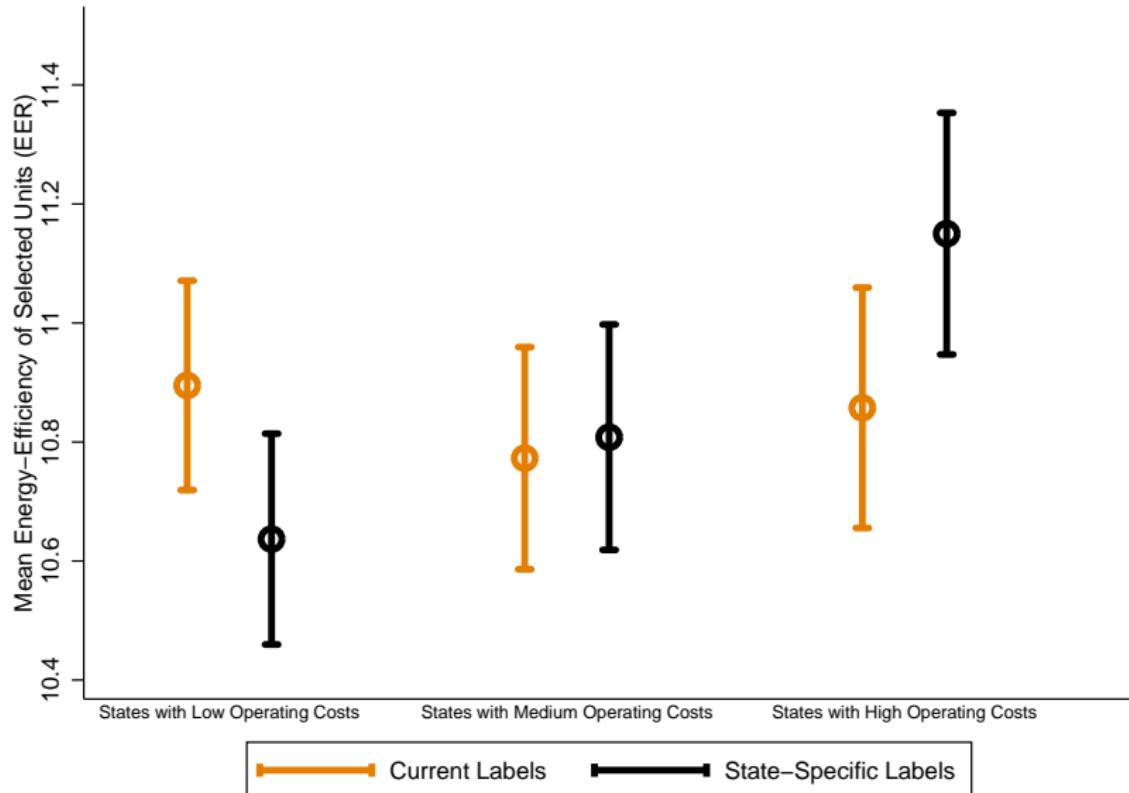


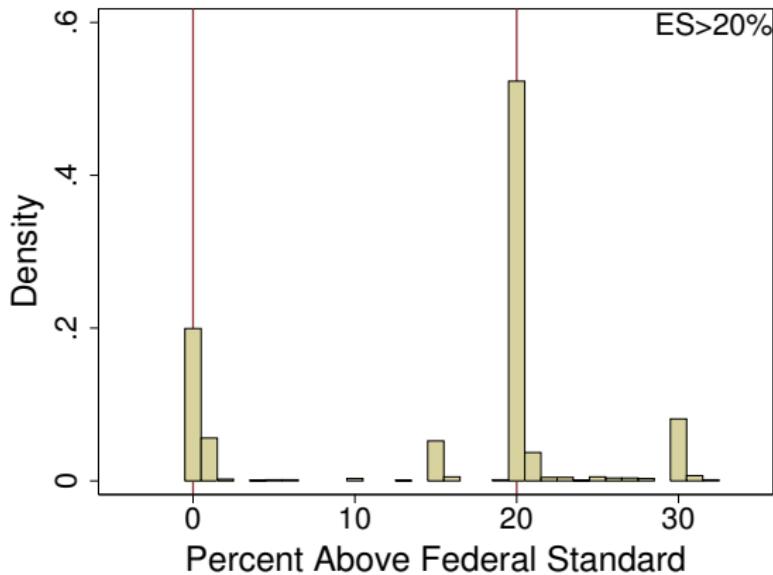
Figure 5. Do Better Labels Lead to Better Choices?



- How do you interpret the results? Are these better choices?
- There are some other interesting studies on labels:
- Newell and Siikimaki: stated preference tests of labels
- Houde (2017) on coarse certification labels
- But, in general, I think there is far too little study of how information is provided

- Is coarse information easier to digest?

Refrigerator efficiency



0% meets federal standard; 20% gets Energy Star label

How consumers respond to product certification and the value of energy information

Sébastien Houde*

I study how consumers respond to competing pieces of information that differ in their degree of complexity and informativeness. In particular, I study the choice of refrigerators in the United States, where a mandatory disclosure labelling program provides detailed information about energy cost, and a certification labelling program provides a simple binary-star rating related to energy use. I find that the coarse certification may help some consumers to pay attention to energy information, but for others, it may crowd out efforts to process more accurate, but complex, energy information. The effect of the certification on overall energy use is thus ambiguous.

Myers, Puller and West 2020

- What is the main contribution of Myers, Puller and West?
- What are the policy conclusions, or broader conclusions for economics?
- What do you think of the evidence presented in the paper?

Outline

- ① Nudges: some example evidence
- ② Information provision: what do we know?
- ③ Energy efficiency gap: types of evidence

What's the evidence for undervaluation?

- One explanation for efficiency gap is consumer undervaluation
- Original literature: Dubin and McFadden, Hausman
- Automobiles: \Rightarrow at most modest undervaluation
- Houses: \Rightarrow rational valuation for buyers
- Oft-cited surveys misleading in showing balance across papers with different methodological qualities (Greene; Helfand and Wolverton)
- Allcott and Greenstone (2012 JEP) survey asserts that there is little credible evidence of a paradox; i.e., “hard to reject the rational null”

Canonical setup

$$U_{ij} = \beta_j X_i - \alpha(p_j + \gamma PDV(c_j))$$

$$E[PDV(c_j)] = E \left[\sum_{t=0}^T \delta^t \times P_t^g \times m_t \times gpm_t \right]$$

- $\gamma < 1$ is evidence of present-bias
- Equivalent to solving for δ that makes $\gamma = 1$
- But construction of PDV not easy
 - Requires knowledge of lifespan, current and future prices, utilization schedule
 - Not much evidence on what people believe (Anderson, Kellogg and Sallee 2013)
 - Capitalization uncertain

Undervaluation

Hausman (1979)

TABLE 8

ESTIMATED DISCOUNT RATES USING MEAN POPULATION ESTIMATES

INCOME CLASS	NUMBER OF OBSERVATIONS	β_2	IMPLIED DISCOUNT RATE
1. \$6,000	6	-0.118	89%
2. \$10,000	15	-0.075	39%
3. \$15,000	16	-0.061	27%
4. \$25,000	17	-0.049	17%
5. \$35,000	8	-0.039	8.9%
6. \$50,000	3	-0.031	5.1%

What do you conclude?

Hedonic approach



© izmocars

Camry (27.3 MPG, \$23,955)

Accord (30.4 MPG, \$24,130)

- What we want to know is whether consumers are WTP the “right” amount for fuel economy. How could we test this?
- The discrete choice framework maps into a hedonic equation
- Want to compare prices of identical cars with different MPG
- Estimate WTP, compare WTP to a “rational” PDV calculation

Hedonic approach



© izmocars

Camry (27.3 MPG, \$23,955)

Accord (30.4 MPG, \$24,130)

- Average car driven $\approx 12,000/\text{year}$; with \$3 gas; difference in MPG saves $\approx \$130/\text{year}$
- \Rightarrow price difference accounted for with first year savings alone
- \Rightarrow Naive hedonic analysis implies massive undervaluation
- But this is inevitably vulnerable to omitted variable bias

- Many research papers have done hedonic-style analysis
 - They try to control for vehicle characteristics
 - But, never able to capture all relevant details
 - Use MSRP which can be very misleading
 - Results are mixed, but many find evidence of undervaluation
-
- We can do better
 - Ideal is to compare two cars that are identical but with different fuel economy
 - This may be impossible, but we can study how prices of identical cars change when PDV of fuel economy changes, because gasoline prices have changed

Hedonic approach



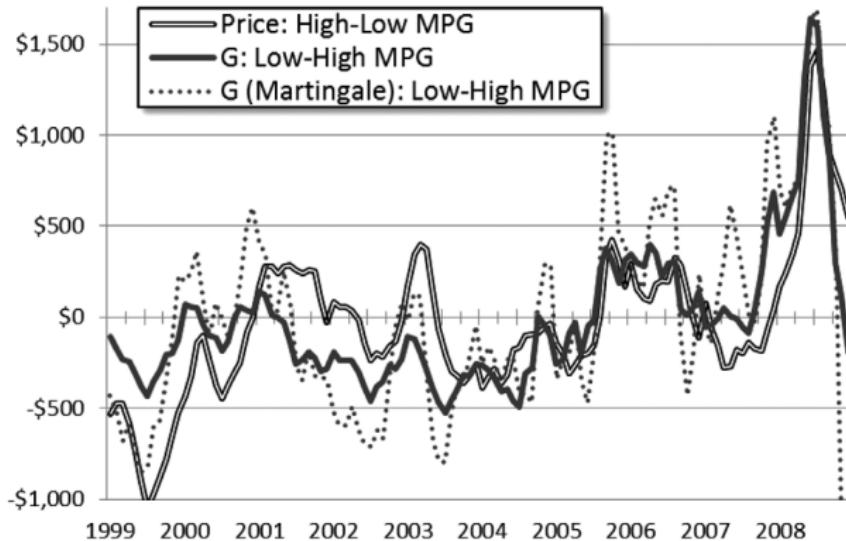
© izmocars

Camry (27.3 MPG, \$23,955)

Accord (30.4 MPG, \$24,130)

- If price of gasoline rises by \$1, cost of driving either car rises
- Cost of driving 12,000 miles: Camry $\uparrow \$440$ and Accord $\uparrow 394$
- Look at change in Camry price and change in Accord price when gasoline price changes; do people want Accord more?
- Compare those to rational changes predicted by PDV calculation

Conditional Variation Over Time



The double line is the difference in transaction-level average prices for above-median minus below-median MPG vehicles, conditional on vehicle fixed effects and MPG group by month-of-year dummies. The single line is the conditional difference in the PDV of gasoline costs using the futures forecast. The dotted line is the conditional difference in the PDV of gasoline costs using the martingale forecast.

Source: Allcott and Wozny (2014)

- Relative price of high MPG versus low MPG cars moves very closely with gasoline prices

Hedonic “panel” approach

- Several papers have used variation in fuel prices to try to test consumer willingness to pay for energy efficiency while controlling for unobservable factors that differ across cars
 - Busse, Knittel and Zettelmeyer (AER 2013), Allcott and Wozny (ReStat 2014), Sallee, West and Fan (JPubE 2016), Grigolon, Reynaert and Verboven (AEJ: Policy 2017)
 - Evidence suggests that consumers value fuel economy “about right”—often fail to reject null of full valuation
- Can we do the same thing for appliances? houses?

Homes and energy efficiency

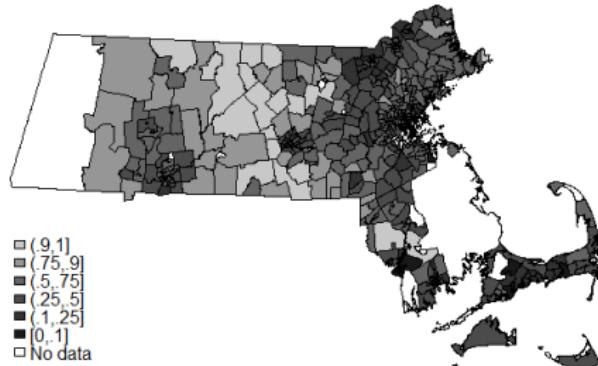


Figure 1: Proportion of Homes Heated With Oil

Source: Myers (2017)

- Myers (2017) adapts this idea to study homes
- In New England, some homes are heated with natural gas, others with heating oil
- Relative prices of heating oil vs. gas has changed a lot over time
- Myers shows how these relative changes translate into home prices

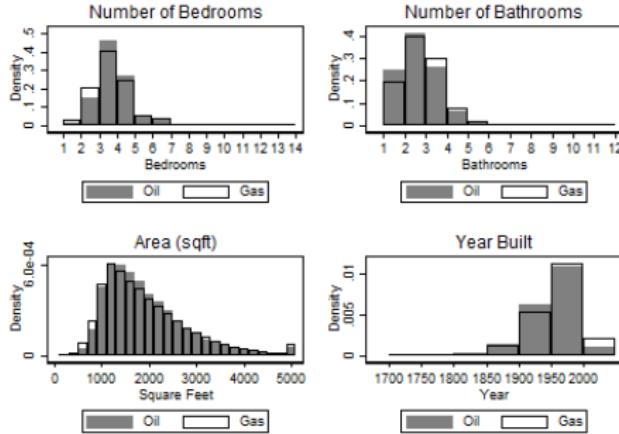
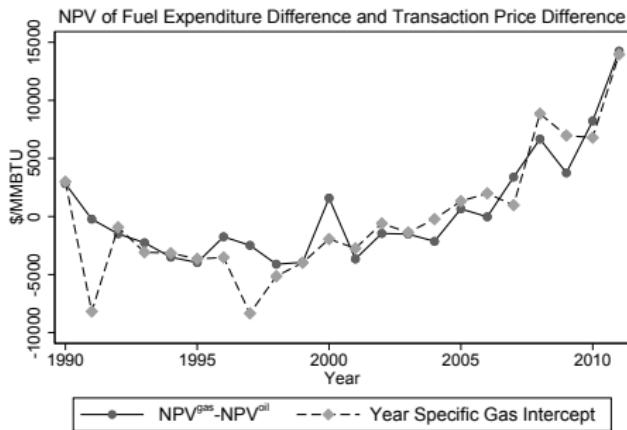


Figure 3: Overlap of Covariates

Source: Myers (2017)

- To implement hedonic analysis, tries to find homes that match on lots of characteristics (accounting for other differences)
- Goal is find WTP for natural gas heating (instead of oil)
- Does WTP move with PDV difference as fuel prices change?

Homes and energy efficiency



Source: Myers (2017)

- Myers (2017) finds that home prices move in line with PDV changes—consumers seem to have appropriate WTP for natural gas heating when buying a home
- Myers (2015) argues that story different for **renters**
- Finds evidence that renters have less information and don't respond to fuel price changes equally

Outline

- ① Nudges: some example evidence
- ② Information provision: what do we know?
- ③ Energy efficiency gap: types of evidence