Paternalism and Energy Efficiency: An Overview

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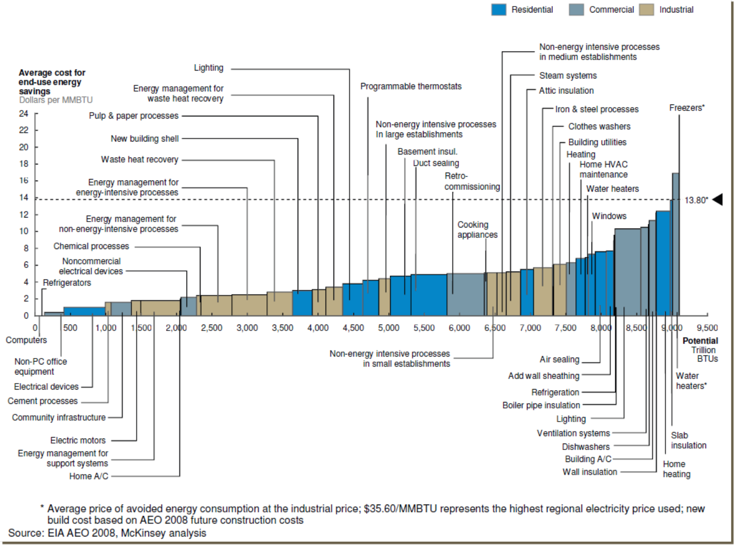
Outline

"McKinsey Curves": Large conservation opportunities



Source: McKinsey & Co. (2009)

McKinsey Curves: "Win-win argument"

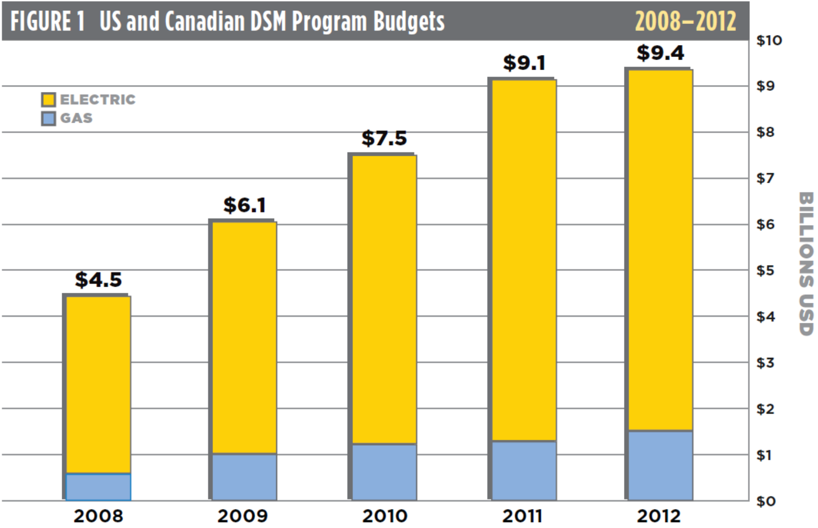
A holistic approach would yield gross energy savings worth more than $1.2 trillion, well above the $520 billion needed through 2020 for upfront investment in efficiency measures ...
Such a program is estimated to reduce end-use energy consumption in 2020 by 9.1 quadrillion BTUs, roughly 23 percent of projected demand, potentially abating up to 1.1 gigatons of greenhouse gases annually.

-McKinsey & Co. (2009): *Unlocking Energy Efficiency in the US Economy*

Suggestion: Energy efficiency is a "win-win"

1. Reduce externalities (climate change)
2. Save money

Policymakers have gotten the message



Source: Consortium for Energy Efficiency (2013)

What is the market failure?

But if more energy efficiency saves money, why aren't we doing it already?

Potential market failures:

1. Credit market imperfections
2. Incomplete information (landlord-tenant, buyer-seller)
3. Imperfect information and "internalities" (mistakes)
   3.1 This is the focus of today's talk

Additional possibility: Models overstate net benefits

Informational and behavioral assertions in policy debates

Corporate Average Fuel Economy (CAFE) Standard Final Rule

EPA projects significant private gains to consumers ... [which] appear to outweigh by a large margin the costs of the program, even without accounting for externalities ...

In short, the problem is that consumers appear not to purchase products that are in their economic self-interest. There are strong theoretical reasons why this might be so:

- *Consumers might be myopic...*
- *Consumers might lack information ...*
- *... the benefits of energy-efficient vehicles may not be sufficiently salient ...*

-Federal Register (2010)

Private benefits central to CAFE:

- Net private benefits = 8 × Externality reductions
- CAFE is much more stringent than can can be justified by carbon externality alone (Fischer, Harrington, and Parry 2007)

Informational and behavioral assertions in policy debates

Australian Incandescent Lightbulb Phase Out RIA (DEHWA 2008)

[Incandescent lightbulbs] continue to sell remarkably well because, if their energy costs are ignored, they appear cheap *...*

There are significant ***information failures*** *and split incentive problems in the market for energy efficient lamps. Energy bills are aggregated and periodic and therefore do not provide immediate feedback on the effectiveness of individual energy saving investments.* ***Consumers must therefore gather information and perform a reasonably sophisticated calculation*** *to compare the life-cycle costs of tungsten filament lamps and CFLs.* ***But many lack the skills****.* ***For others, the amounts saved are too small to justify the effort*** *or they do not remain at the same address long enough to benefit fully from a long lived energy saving lamp.*

Summarizing the issue

> *Energy-efficiency regulations and fuel economy regulations are therefore justified by [cost-benefit analyses] only by presuming that consumers are unable to make market decisions that yield personal savings, that the regulator is able to identify these consumer mistakes, and that the regulator should correct economic harm that people do to themselves.*

-Ted Gayer (2011) *Brookings Institution Working Paper*

Agenda

- This talk: Overview of application of behavioral economics to energy efficiency policy
  - Take seriously the hypothesis that mistakes cause us to be less energy efficient
  - Formalize with a simple **model**
  - Review and critique **empirical tests**
  - **Policy** implications
  - **Future research** directions
- Draws on existing work (see my website) in
  - *American Economic Review, Quarterly Journal of Economics, Review of Economics and Statistics, American Economic Journal: Economic Policy, Journal of Public Economics, Journal of Policy Analysis and Management, Journal of Economic Perspectives, Science*
- ... with many coauthors:
  - Michael Greenstone, Chris Knittel, Sendhil Mullainathan, Todd Rogers, Cass Sunstein, Rich Sweeney, Dmitry Taubinsky, Nathan Wozny

Paternalism in economic policy

- "Paternalism" used descriptively, not pejoratively.
- Governments frequently tax/subsidize, ban/mandate, nudge to protect us from our own choices:
  - Drug, alcohol, and cigarette taxes and bans
  - Food and consumer product safety standards
  - Helmet and seat belt laws
  - Usury laws and other financial services regulation
  - Retirement savings: "Life-cycle myopia" (Feldstein and Liebman 2002)
- Large existing literature in economics (and philosophy, law, etc.):
  - Baicker, Mullainathan, and Schwartzstein (2012), Bernheim and Rangel (2004, 2009), Carroll, Choi, Laibson, Madrian, and Metrick (2009), Gabaix and Laibson (2006), Grubb (2014), Grubb and Osborne (2013), Gruber and Koszegi (2004), Gul and Pesendorfer (2007), Gruber and Mullainathan (2005), Mullainathan, Schwartzstein, and Congdon (2012), O'Donoghue and Rabin (2006), and others.

Outline

Overview: Cost-Benefit Analysis with Internalities

- “Internalities”≈”Externalities the decisionmaker imposes on himself/herself”
- Standard cost-benefit analysis: Choices⇔Preferences
  - “If you bought cheesecake for $3, you got at least $3 of utility.”
- Behavioral public economics
  - Relax the standard assumption that Choices⇔Preferences
  - Empirically measure “true preferences”
  - Determine optimal policy
    - Income tax structure, retirement savings incentives, disclosure laws, energy efficiency standards, etc.

Formal model

- "Reduced form approach to behavioral public economics"
  - Allcott and Taubinsky (2015), Chetty (2015), Mullainathan, Schwartzstein, and Congdon (2012)
- Unit demand, with two goods: $j \in \{E, I\}$
- Perfectly competitive supply
  - $c = c_E - c_I =$Relative marginal cost
  - Policymaker sets subsidy s for good E
  - $p = c - s =$Relative price
- $v = v_E - v_I =$Consumers' true relative utility from E, $\sim F(v)$
- $b =$Bias, $\sim G(b|v)$
- $\hat{v} = v - b =$Consumers' perceived utility, $\sim H(\hat{v})$
- $D_B(p) = 1 - H(p) =$Market demand curve
- $B(p) = E_G(b|v - b = p) =$*Average marginal bias* at price p

Some potential models of bias

- Biased beliefs
  - Thinking about energy but misestimate benefits
  - Larrick and Soll (2008)
- Inattention
  - Costly or constrained information acquisition or information processing
  - Gabaix (2013), Gabaix and Laibson (2006), Sallee (2014), Sims (2003)
- Present bias
  - Requires no saving/borrowing or "present bias over cash flows"
  - Laibson (1997)
- Bias toward concentration
  - Undervalue energy costs because they occur in a stream of future payments
  - Koszegi and Szeidl (2013)

- Not all these models deliver $b > 0$; some have $b = 0$ or $b < 0$.

Policy implications

Social welfare function:

$$W(s) = Z(s) + v_I - p_I + \int_{v-b \geq p} (v - p) dF dG$$

Welfare gain from subsidy increase:

$$W'(s) = (\underbrace{s}_{\text{Harberger distortion}} - \underbrace{B(p)}_{\text{Internality reduction}}) \cdot \underbrace{D'_B(c-s)}_{\text{Change in demand}}$$

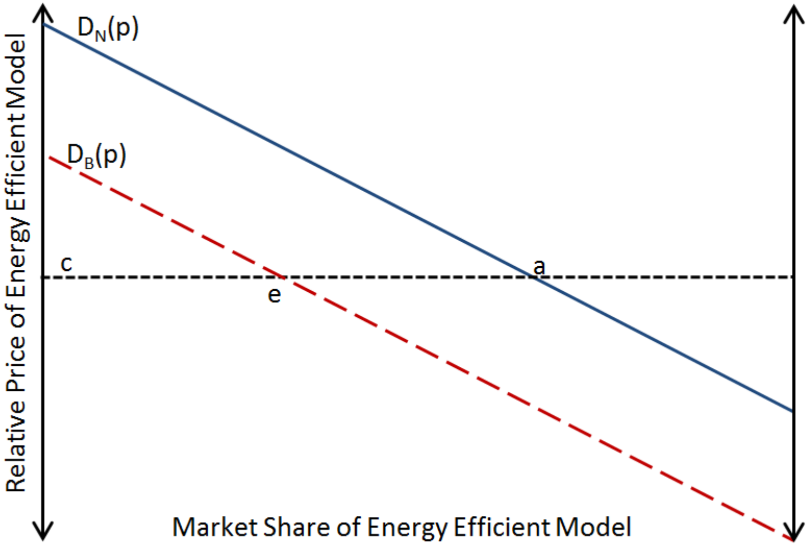
Optimal subsidy must satisfy:

$$s^* = B(c - s^*)$$

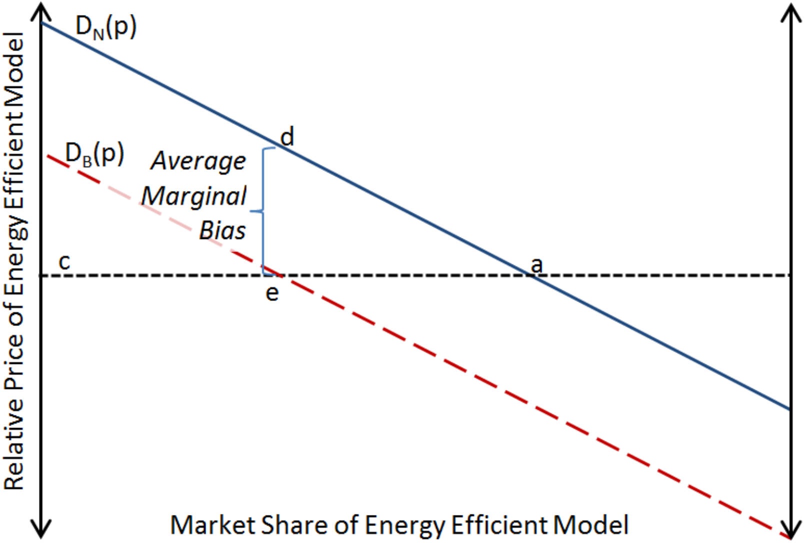
Welfare effect of a ban on good I (minimum standards):

$$\int_0^\infty W'(s) ds = \int_0^\infty (s - B(c-s)) D'_B(c-s) ds$$

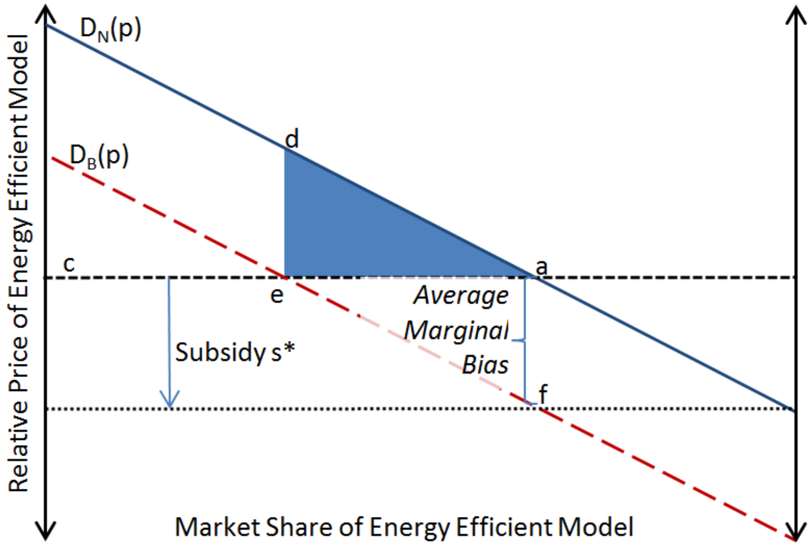
Graphical: Market demand vs. experienced utility



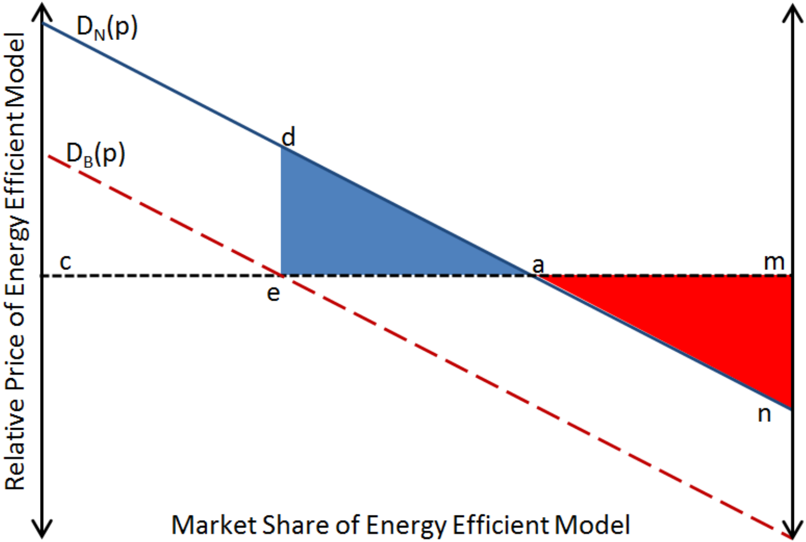
Graphical: Constant average marginal bias



Graphical: Welfare effect of a subsidy



Graphical: Welfare effect of a ban



Model: Comments

1. Close connection between externalities and internalities
2. Connection to the Hausman (1979) "implied discount rate" and policy assertion, but more precise.
3. Key object to estimate: Average marginal bias

Outline

Empirical Tests

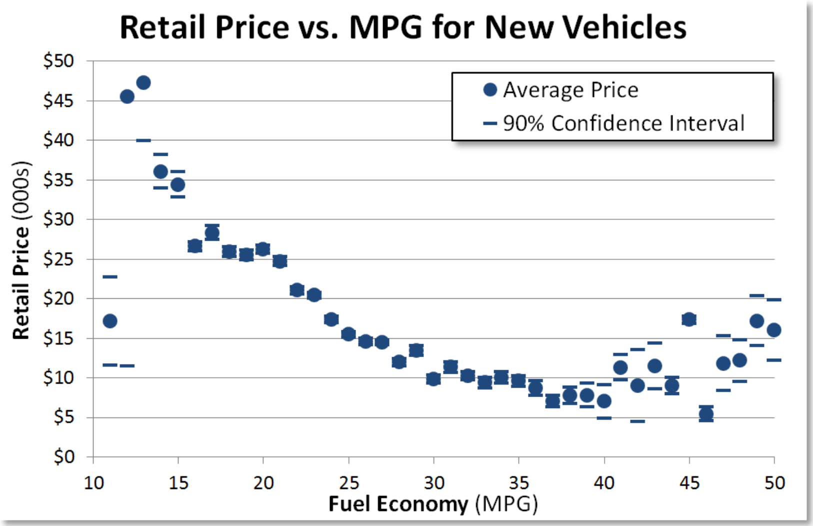
Three categories:

1. Comparing demand responses
2. Measuring effects of nudges
3. Belief elicitation

Empirical Test #1: Comparing Demand Responses

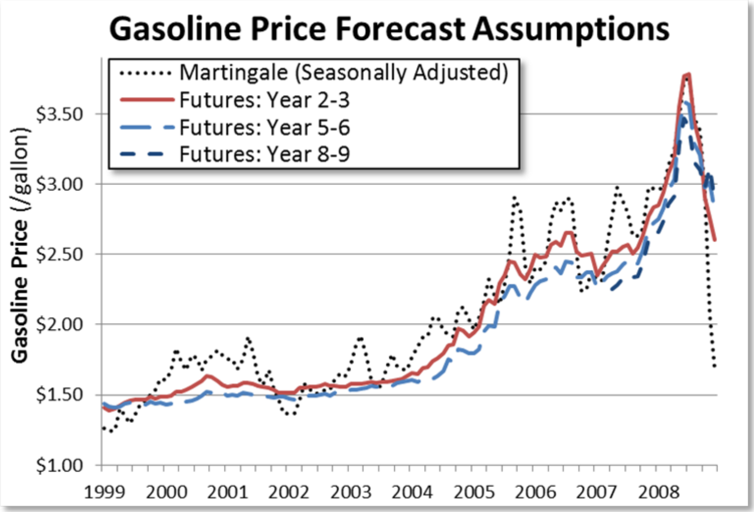
- Basic intuition: We should be indifferent between $1 in purchase price and $1 in present discounted value (PDV) of energy costs.
    - Hybrid car example: Costs $2000 more, does it save you $2000 in fuel over its life?
- First (big) problem: Measuring PDV of energy costs
- Second problem: Unobserved attributes correlated with fuel economy
    - Solution: Use vehicle fixed effects. As gas prices change over time, do relative vehicle prices move as much as predicted?

Potential bias from cross-sectional estimates



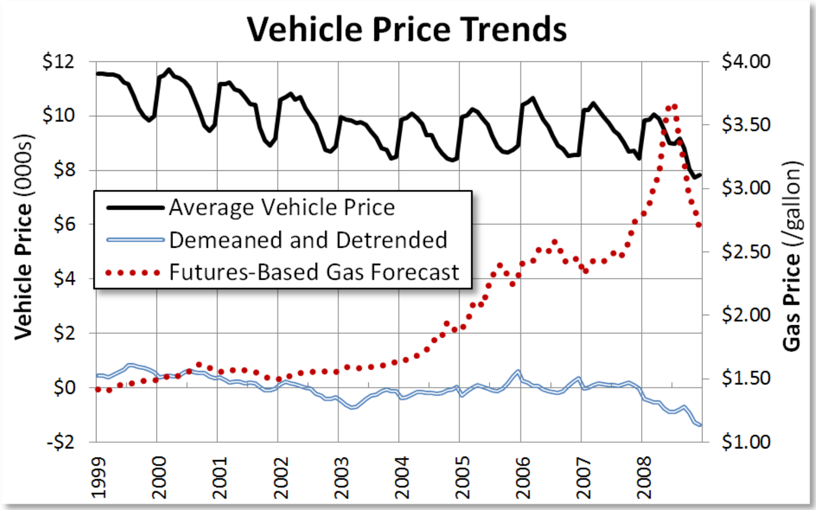
Source: Allcott and Wozny (2014)

Time-series identification from gas prices



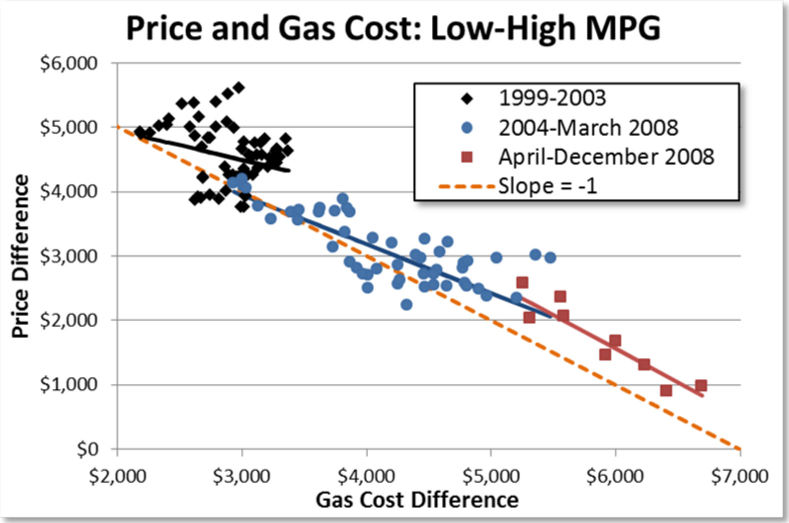
Source: Allcott and Wozny (2014)

Identifying assumption: No correlated trends



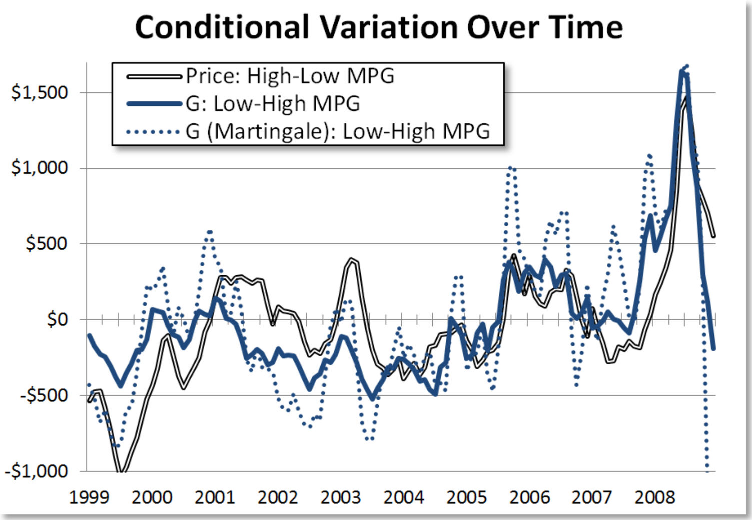
Source: Allcott and Wozny (2014)

Raw data scatterplot



Source: Allcott and Wozny (2014)

Conditional variation



Source: Allcott and Wozny (2014)

AW (2014): Regression results

Row	Specification	$\hat{\gamma}$	$SE(\hat{\gamma})$
Base			
0	2 MPG quantiles	0.76	0.046
Time Periods			
11	2004-March 2008	0.80	0.037
12	1999-end 2008	0.85	0.035
Discount rate			
21	$r = 0\%$	0.59	0.046
22	$r = 3\%$	0.67	0.035
23	$r = 10\%$	0.87	0.040
24	$r = 11\%$	0.90	0.053
25	$r = 15\%$	1.01	0.060
31-38: *Characteristics*		0.75-0.76	
41-45: *Preferences*		0.70-0.87	
51-53: *Age-by-time controls*		0.78-0.79	

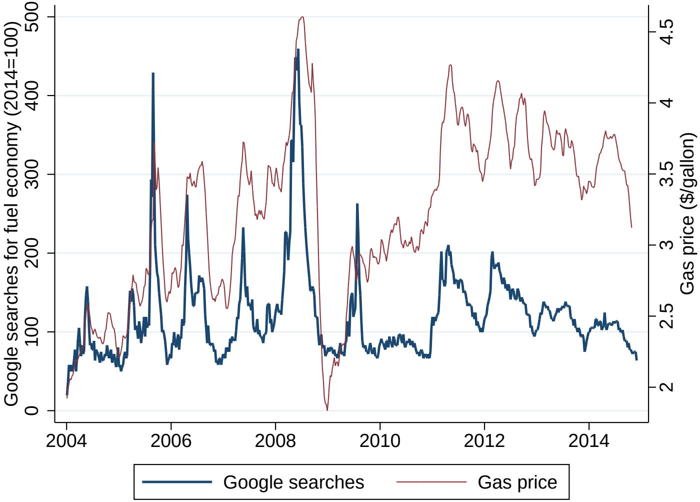
Puzzle: Much lower $\hat{\gamma}$ for older vehicles

Ages	(1) Transaction-Weighted $\hat{\gamma}$	(2) NHTS Survival Probs $\hat{\gamma}$	(3) JDPA Retail Prices $\hat{\gamma}$	(4) Equal Weight $\hat{\gamma}$	(5) Transactions per Obs.
All	0.76	0.84	0.60	0.62	37.8
	(0.046)	(0.050)	(0.041)	(0.027)	
1-3	0.93	1.03	0.66	0.97	89.2
	(0.074)	(0.082)	(0.057)	(0.072)	
4-6	0.64	0.70	0.52	0.56	43.9
	(0.054)	(0.060)	(0.055)	(0.049)	
7-10	0.45	0.50	0.37	0.48	21.3
	(0.032)	(0.036)	(0.040)	(0.030)	
11-15	0.26	0.28	0.18	0.24	7.7
	(0.017)	(0.019)	(0.032)	(0.015)	

Comparing demand responses: Results summary

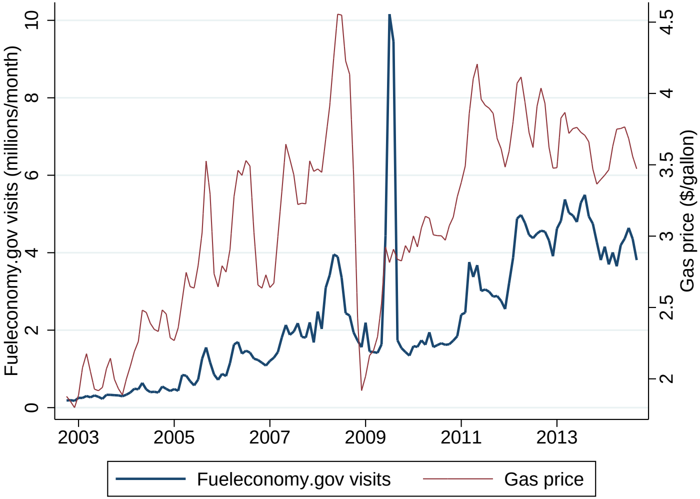
- Implicit discount rates:
  - AW: 15%. BKZ: 13% average (report range from -6.8% to 20.9%)
- Weighted average discount rate (auto loans, foregone savings)=6%
- At $\delta = \frac{1}{1+6\%}$: $\hat{\gamma} = 0.76$ (AW), $\hat{\gamma} = 0.78$ (BKZ)

Endogenous attention? Gas prices and Google Trends



Search terms: gas mileage, fuel economy, fuel efficiency, MPG, mileage calculator

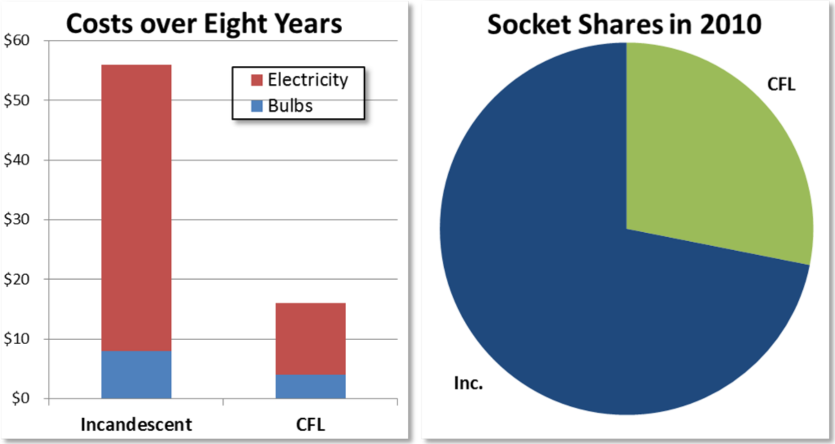
Gas prices and FuelEconomy.gov visits



Empirical Test #2: Measuring Effects of Nudges

- General test for imperfect information or inattention: Provide information
  - Use randomized experiment or "natural experiment" from a policy change
- Does additional information change choices?
- Use Allcott and Taubinsky (2015) example

Motivation: "The Lightbulb Paradox"



- What explains low CFL market shares?
  - Rational preferences?
  - Bias from imperfect information or inattention?

TESS experiment

Artefactual field experiment using Time-Sharing Experiments for the Social Sciences (TESS):

Process:

1. Give consumers a $10 “shopping budget”
2. Baseline choices: Purchase incandescents vs. CFLs via “multiple price list” format
3. Information provision
4. Endline choices

WTP change $\Rightarrow$Average marginal bias

TESS experiment: Overview

Groups and Shares of Population

Treatment

	Baseline & Endline	Endline-Only
Positive	27.5%	7.5%
Balanced	27.5%	7.5%

Control

30%

Process

1. **Baseline choices** (multiple price list)
2. **Information provision** (two screens, content varies by group)
3. **Endline choices** (multiple price list)
4. **Post-experiment survey** (beliefs, time preferences, etc.)

Lightbulb choices

We have given you a $10 shopping budget to purchase a package of light bulbs. Your first 15 purchase decisions will concern the two packages of light bulbs shown below.

Choice A
Philips 60-Watt-Equivalent
Compact Fluorescent Light Bulb, 1-Pack

Choice B
Philips 60-Watt Incandescent
Light Bulbs, 4-Pack

Click for detailed product information

Between the 15 decisions, the only thing that varies is the price. Each of these decisions has a chance of being the one choice (out of 30) that will become your official purchase, so you should think about each purchase carefully. Whatever money you do not spend on the light bulbs, you get to keep: any remaining money will be provided to you as cash-equivalent bonus points. Please think about each decision carefully.

Here is an example of how this might work. After you make all your decisions, suppose that Decision Number 6 from the set below were selected as your official purchase.

Lightbulb choices: Multiple price list

Now please make your decisions for each of the 15 choices below.

Decision Number	**Choice A** 60-Watt-Equivalent Compact Fluorescent Light Bulb, 1-Pack	**Choice B** 60-Watt Incandescent Light Bulbs, 4-Pack
	Purchase **Choice A for free**	Purchase **Choice B for $10**
1)	○	○
	Purchase **Choice A for free**	Purchase **Choice B for $8**
2)	○	○
	Purchase **Choice A for free**	Purchase **Choice B for $6**
3)	○	○
	Purchase **Choice A for free**	Purchase **Choice B for $4**
4)	○	○
	Purchase **Choice A for $1**	Purchase **Choice B for $4**
5)	○	○
	Purchase **Choice A for $2**	Purchase **Choice B for $4**
6)	○	○

Treatment Information

CFLs last longer than incandescents. At average usage:

- Incandescents burn out and have to be replaced every year.
- CFLs burn out and have to be replaced every eight years.

If one incandescent bulb costs $1 and one CFL costs $4, this means that the total purchase prices for eight years of light are:

- $8 for incandescents
- $4 for CFLs

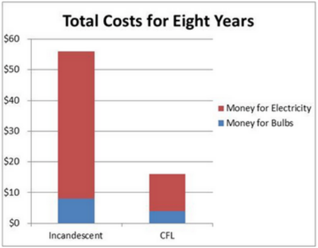
Also, CFLs use less electricity than incandescents. At national average usage and electricity prices:

- A standard (60-Watt) incandescent uses $6 in electricity each year.
- An equivalent CFL uses $1.50 in electricity each year.

Thus, for eight years of light, the total costs to purchase bulbs and electricity would be:

- $56 for incandescents: $8 for the bulbs plus $48 for electricity
- $16 for a CFL: $4 for the bulbs plus $12 for electricity

The graph below illustrates this:



Balanced Treatment

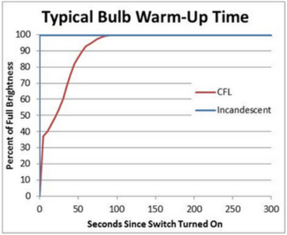
After they burn out, CFLs need proper disposal:

- Because CFLs contain mercury, it is recommended that they be properly recycled, and not simply disposed of in regular household trash. CFLs can be recycled through:
  - Local waste collection sites
  - Mail-back services that you can find online
  - Local retailers, including Ace Hardware, IKEA, Home Depot, and Lowe's, as well as other retailers.
- No special precautions need to be taken to dispose of an incandescent light bulb. Incandescents can be disposed of in regular household trash.

After the light switch is turned on, CFLs take longer to warm up than incandescents:

- An incandescent reaches full brightness immediately.
- A typical CFL can take 60 to 90 seconds to reach its full brightness.

The graph below illustrates this:



Question: About how much longer does it take a typical CFL to reach full brightness, as compared to an incandescent?

Type your answer below.

Control Screen 1 (Sales Trends)

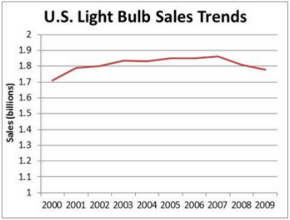
According to official sales data, sales of light bulbs in the United States have had the following trend:

- Sales increased in each year between 2000 and 2007.
- Sales decreased slightly in 2008 and 2009.

Total light bulb sales were different at the end of the decade compared to the beginning:

- Sales in 2000 were just over 1.7 billion bulbs.
- Sales in 2009 were just under 1.8 billion bulbs.

The graph below illustrates this:



<u>Question</u>: About how many light bulbs were sold in the United States in 2009?

To answer this question, you can enter whole numbers and/or decimals.

Type your answer below.

[ ] billion

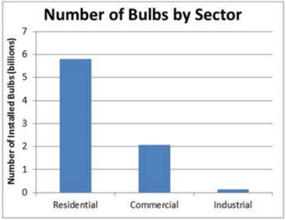
Control Screen 2 (Number of Bulbs)

According to official estimates, there are slightly more than eight billion light bulbs installed in the United States.

The US economy can be divided into three major sectors: residential, commercial, and industrial. Each sector has a different number of light bulbs:

- There are about 5.8 billion light bulbs installed in residential buildings in the U.S.
- There are about 2.1 billion light bulbs installed in commercial buildings in the U.S.
- There are about 0.14 billion light bulbs installed in industrial buildings in the U.S.

The graph below illustrates this:



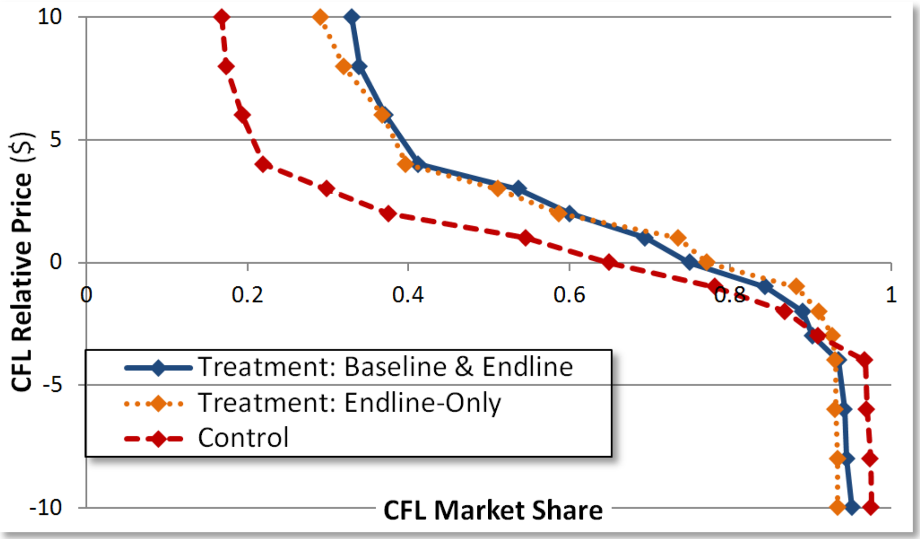
Question: About how many more light bulbs are installed in residential buildings compared to commercial buildings in the U.S.?

To answer this question, you can enter whole numbers and/or decimals.

Type your answer below.

[ ] billion

Results: Effects on demand curves

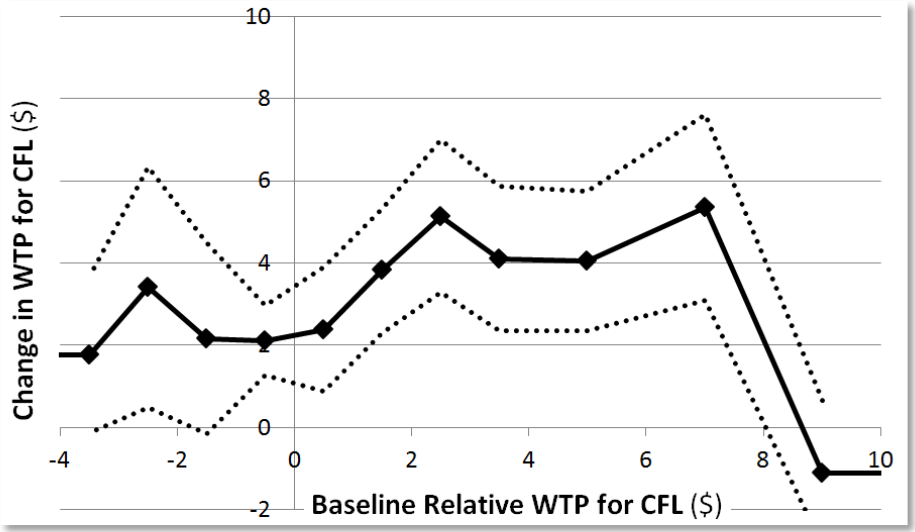


Effects of TESS informational intervention

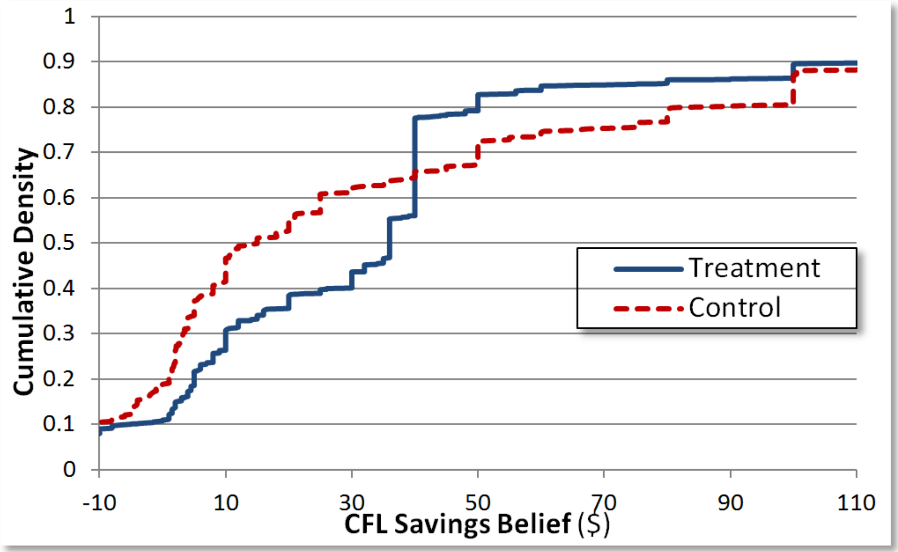
	(1)	(2)	(3)	(4)	(5)
1(Treatment)	2.54	2.28	2.30	3.16	2.29
	(0.55)***	(0.36)***	(0.37)***	(0.37)***	(0.54)***
1(Endline-Only)					-0.44
					(0.76)
1(Positive Treatment)					
R2	0.03	0.57	0.58	0.33	0.04
N	1,203	1,203	1,188	919	1,449
Baseline WTP Dummies	No	Yes	Yes	Yes	No
Individual Characteristics	No	No	Yes	Yes	Yes
Exclude Max./Min. WTP	No	No	No	Yes	No
Include Endline-Only	No	No	No	No	Yes

Notes: The outcome variable is endline willingness-to-pay for the CFL. 1(Treatment) pools all information sub-treatments. Robust standard errors in parenthesis. *, **, ***: Statistically significant with 90, 95, and 99 percent confidence, respectively. Observations are weighted for national representativeness.

Results: Conditional ATEs on WTP



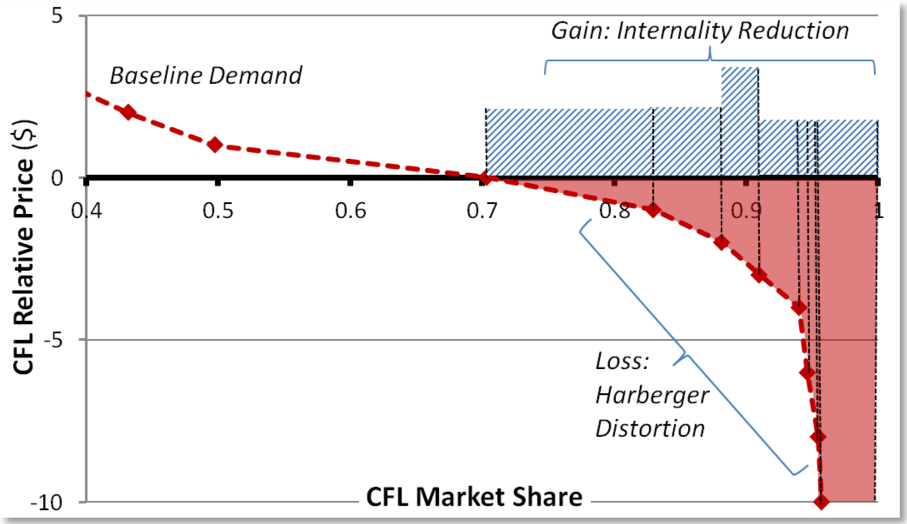
Effects on beliefs



Using treatment effects for policy evaluation

- Information treatments specifically designed to address imperfect information and inattention:
  - Hard info about energy costs
  - No social norms or "green"/environmental framing
  - Minimize demand effects and experimenter pressure
  - Comprehension ensured when possible
- Final section: Assume the info treatment is a "fully debiasing nudge"
  - $\tau(p) = B(p)$, the "average marginal internality" at price p
- Assumption is only an approximation (read: huge weakness)
  - Information understood, believed, and internalized?
  - Demand effects?
- But insight into $B(p)$ allows evaluation of behaviorally-motivated policies: CFL subsidies and incandescent ban

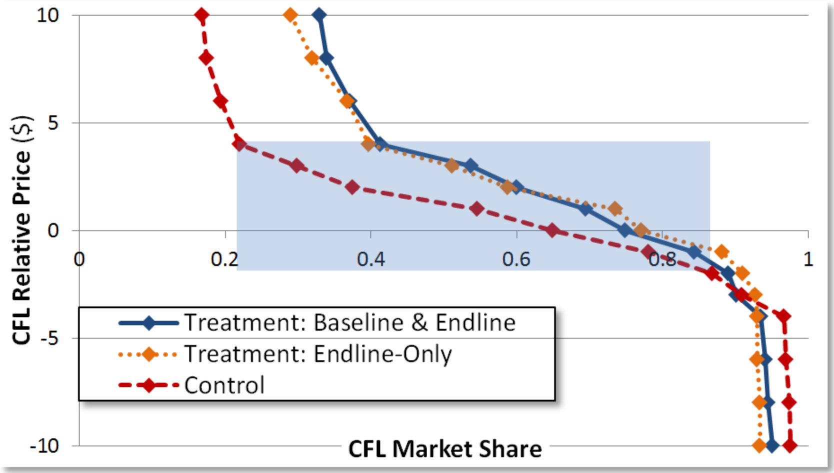
Welfare effects of lightbulb subsidy or ban



Welfare analysis under alternative assumptions

	Scenario	Optimal Subsidy ($/pack)	Ban Welfare Effect ($/package)	Ban Welfare Effect (% of surplus)
1	Base	3	-0.44	-41
	Alternative Censoring Assumptions: If censored, assume ...			
2	WTP={$12,-$12}	3	-0.34	-36
3	WTP={$20,-$20}	3	-0.60	-47
4	self-reported hypothetical WTP	3	-0.61	-43
	Alternatives to Assumption 1: Scale average marginal bias to match ...			
5	consumers who pass Treatment Info screen "quiz"	3	-0.41	-38
6	consumers with "correct" post-experiment beliefs	3	-0.22	-21
7	Balanced Treatment group	3	-0.48	-45
8	10 percent confidence bound	1	-0.92	-86
9	90 percent confidence bound	(Ban)	0.05	4
	Additional Distortion			
10	Excess mass consumers have $v = 7.66$	8	1.22	114

Puzzle: Excess mass in demand curve



- $w^1 = \hat{e} + n$; $\hat{e}$ =Perceived cost savings, n =other attributes
- Most $\hat{e} \gg 0$; n must *closely* offset this for most w^1 near 0.

Takeaway: Importance of within-subject design

- Within-subject design with multiple price lists tells us joint distribution of market demand $D_B(p)$ and average marginal internality $B(p)$.

Downsides:

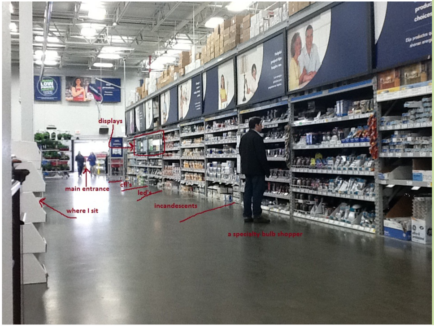
1. Requires an artefactual (artificial) experimental setting
2. Info may not be a fully-debiasing nudge

Benefits:

1. Benefit #1: Have $B(p)$ *function*; necessary for optimal subsidy
2. Benefit #2: Have $B(p)$ for *all inframarginal consumers*; necessary to evaluate a ban

- Neither benefit is possible with standard between-subject treatment/control design
  - Or with standard "comparing demand responses" approach

In-Store Experiment



Bulb Package Cost Comparison

	Incandescent	CFL	CFL Savings
Yearly Energy Costs	$5	$1	**$4**
Energy Costs for 8,000 hours	$48	$11	**$37**
Bulb Costs for 8,000 hours	$8	$4	**$4**
Total Costs for 8,000 hours	$56	$15	**$41**

Costs are $41 less over lifetime of CFL bulb package.

Recalculate | Next

- CFL bulb lasts around 8,000 hours vs. 1,000 hours for an Incandescent bulb
- Energy Cost = bulb wattage * bulb count * usage hours * (kWh cost/1000)

- 2x2 experiment: Randomize info (iPad) and prices (rebate card)

In-store results consistent with small bias

Effects of In-Store Information Treatment

	(1)	(2)	(3)
1(Treatment)	-0.002	0.004	-0.022
	(0.035)	(0.033)	(0.045)
1(Rebate)	0.094	0.105	0.078
	(0.035)***	(0.033)***	(0.047)*
1(Rebate and Treatment)			0.054
			(0.066)
R2	0.01	0.16	0.16
N	794	793	793
Individual Characteristics	No	Yes	Yes

Notes: This table presents estimates of a linear probability model with outcome variable 1(Purchased CFL). The dependent variable has mean 0.38. Robust standard errors in parenthesis. *, **, ***: Statistically significant with 90, 95, and 99 percent confidence, respectively.

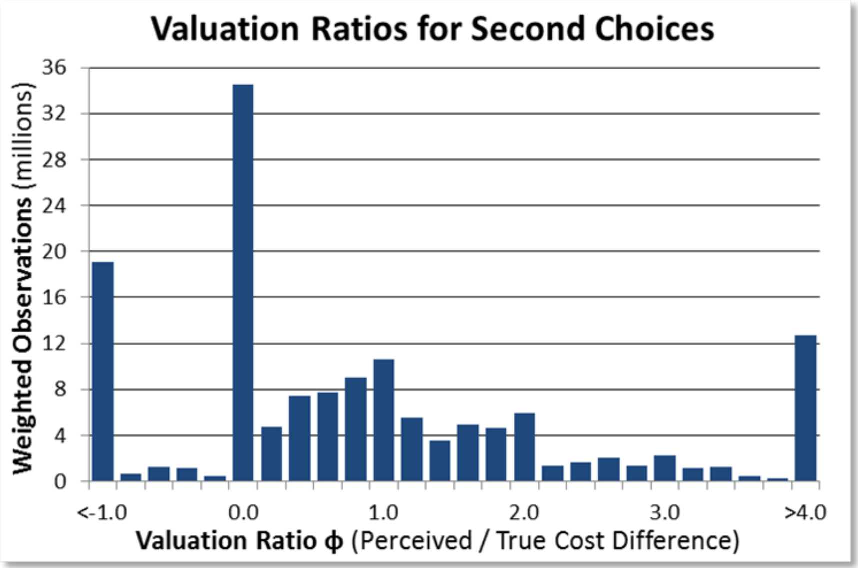
Empirical Test #3: Belief Elicitation

- Vehicle Ownership and Alternatives Survey (Allcott 2013)
- Record current vehicle and estimated flow of expenditures on fuel
- Ask "second-choice vehicle" and elicit fuel cost beliefs
- Posit hypothetical "replacement vehicle" with randomly-assigned MPG difference and elicit fuel cost beliefs.
- Details:
  - Respondents told to assume they drove the alternative vehicles the same amount as their current vehicle
  - Use various response frames (e.g. absolute vs. relative to current vehicle, annual vs. lifetime) to measure and limit confusion
- Construct "valuation ratio":

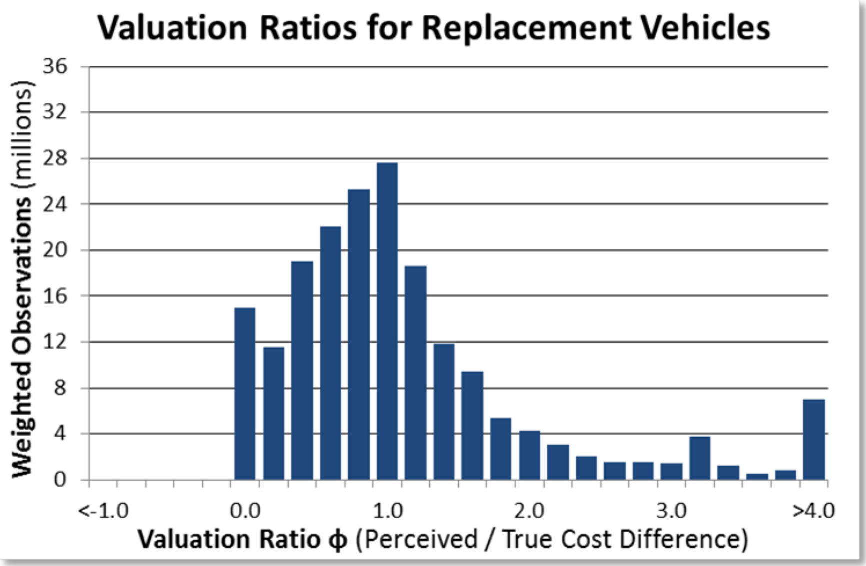
$$\phi_{ia} = \frac{\widetilde{G}_{ia} - \widetilde{G}_{io}}{G_{ia} - G_{io}}$$

- Where i =consumer, a =alternative vehicle, o =current vehicle, $\widetilde{G}$ =perceived G, G^* =true G

Belief elicitation: Results



Belief elicitation: Results



Belief elicitation: Regression results

Part 3: Second Choice Vehicle ϕ

	All	$\|\Delta$ GPM$\|>0.01$	$\|\Delta$ GPM$\|\leq0.01$	$\phi \neq 0$
	(1)	(2)	(3)	(4)
Mean	0.88 (0.08)	0.93 (0.05)	0.86 (0.12)	1.17 (0.16)
Median	0.70 (0.07)***	0.83 (0.04)***	0.35 (0.21)*	1.26 (0.1)**
Obs.	1415	461	954	671

Part 4: Replacement Vehicle ϕ

	All	$\|\Delta$ GPM$\|>0.01$	$\|\Delta$ GPM$\|\leq0.01$	$\phi \neq 0$
	(1)	(2)	(3)	(4)
Mean	1.33 (0.04)***	0.95 (0.02)**	1.77 (0.09)***	1.91 (0.09)***
Median	1.00 (0.009)	0.90 (0.03)***	1.24 (0.04)***	1.31 (0.05)***
Obs.	1875	1002	873	826

Notes: Excludes flagged observations. Weighted for national representativeness. Standard errors in parenthesis. *, **, ***: Statistically different *from one* with 90, 95, and 99 percent confidence, respectively.

Belief elicitation test: Comments

Methodological issues:

- Want beliefs as of time of purchase. How to incentivize thoughtful recall *without additional calculation*? Approach in Allcott (2013):
  - Moderate incentives with vague criteria: if answer "makes sense" given answers to other questions
  - Show indistinguishable results for incentive vs. non-incentive groups
- Wide variation in stated beliefs. Does this reflect true variation or reporting error? Approach in Allcott (2013):
  - Use median regression to estimate central tendency

Outline

Policy implications: Targeting

Is energy efficiency for wealthy environmentalists?

- Kahn (2007): "Greens drive hybrids"
- Model suggests implications for economic efficiency

Targeting: Overview

- Source: Allcott, Knittel, and Taubinsky (2015)
- Bias is almost certainly heterogeneous
- Subsidies distort rational types' decisions even as they improve decisions by biased types
- Definition: A "well-targeted" policy affects more distorted choices
  - "Poorly-targeted" policies can distort already-optimal choices
- Implication for welfare evaluation:
  - It doesn't just matter *how much* energy conservation a subsidy causes
  - It matters *who* is conserving
- Simple test: Do the marginal consumers look like they are subject to the distortions that motivate the policy?
  - e.g. credit-constrained renters who are uninformed about and inattentive to energy costs

Empirical results: Heterogeneous distortions

Covariance of Environmentalism with Beliefs and Attention

	(1)	(2)	(3)	(4)
Dependent Variable:	CFL Savings Belief	Energy Star Savings Belief	MPG Savings Belief	Fuel Cost Calculation Effort
Environmentalist	7.81	21.04	-2.70	0.193
	(3.08)**	(4.80)***	(3.24)	(0.112)*
N	1,475	799	1,392	1,483
Dataset	Lightbulbs	Water Heaters	VOAS	VOAS

	(1)	(2)	(3)	(4)
Dependent Variable:	1(Take up Utility Subsidy)	1(Take up Tax Credit)	1(Own Hybrid)	Subsidy Awareness
1(Green Pricing Participant)	0.015			
	(0.004)***			
1(Installed Solar System)	0.892			
	(0.002)***			
Income ($ millions)	0.543	0.505	0.278	1.022
	(0.066)***	(0.152)***	(0.136)**	(0.720)
1(Rent)	-0.068			-0.084
	(0.007)***			(0.081)
Environmentalist		0.121	0.020	0.248
		(0.024)***	(0.008)**	(0.116)**
Fuel Cost Calculation Effort		0.027	0.017	
		(0.011)**	(0.007)**	
N	75,591	2,982	1,483	1,516
Dataset	Utility	All TESS	VOAS	Lightbulbs
Dependent Variable Mean	.109	.102	.013	0

Mechanisms

1. Consumers who are aware of energy efficiency subsidies are the same types who are informed about and attentive to energy costs
2. Niche goods that appeal to only a small share of population + moderate subsidy + negative correlation between $\hat{v}$ and d.
    2.1 Only rich people, homeowners, and environmentalists like weatherization, hybrids, and CFLs enough to buy them, even with a moderate subsidy

Caveat

- These regressions characterize the average adopters, not marginal adopters
- Average adopter = marginal adopter if zero demand without subsidy
  - Not necessarily a realistic assumption
- At a minimum, it is clear that these subsidies are regressive.
- Doing this convincingly would be a valuable contribution

Targeting: Policy implications

- Policy arguments that don't justify subsidies:
  - "Market distortions reduce energy efficiency investments"
  - "Subsidies reduce energy use"
- Instead, need to document that the policies correct distorted decisions
  - Measure the "average marginal distortion"
- Tagging could have large welfare gains. Limit subsidies to:
  - Low-income households (e.g. WAP)
  - Landlords/renters
  - Households who have not previously participated in EE programs
- Alternatives if restricted eligibility not possible: Targeted marketing or differentiated subsidies
- Potentially counterintuitive:
  - Many utilities currently target marketing at consumers most likely to be interested in energy efficiency programs. This is most *cost effective* for compliance with current regulation
  - These results suggest that this approach doesn't maximize *welfare*

Policy implications: Magnitudes

Case	Base Case (1)	High γ (2)	Low γ (3)	High $\overline{\eta}$ (4)	Low γ, High $\overline{\eta}$ (5)	Uniform η (6)	High σ (7)
Parameters							
λ	0	0	0	0	0	0	0
γ	0.88	1.40	0.60	0.88	0.60	0.88	0.88
$\overline{\eta}$	0.19	0.19	0.19	0.39	0.39	0.19	0.10
σ	0.18	0.18	0.18	0.18	0.18	0.18	0.6
Fuel economy and gas use							
Δ Harmonic mean mpg	0.21	−0.63	0.77	0.34	1.33	0.39	0.17
Δ Gas costs ($/new vehicle sold)	−135	411	−473	−216	−800	−243	−110
Δ Gas costs ($millions per year)	−2,165	6,576	−7,572	−3,457	−12,793	−3,885	−1,752
Δ Gas costs (percent of total)	−0.0097	0.0293	−0.0337	−0.0154	−0.0570	−0.0173	−0.0078
Welfare							
Δ Consumer Welfare ($/vehicle)	8.1	81.9	94.9	12.9	157.2	14.6	6.6
Δ Consumer Welfare ($million/year)	130	1,310	1,519	207	2,515	233	105
Δ Consumer Welfare/Market Rev	0.00029	0.00294	0.00341	0.00046	0.00564	0.00052	0.00024

- $\gamma = 0.8$, High $\gamma = 1.4$, Low $\gamma = 0.6$; η from BLP, High η is 2x
- RIA long-run estimates also can't be explained: Not adopting $2600 in fuel savings vs. $940 in costs requires $\gamma = 940/2600 \approx 0.36$.

Outline

Open Research Questions

- Credible estimates of average marginal distortions
- What discount rate to use?
  - Basic tension: Consumers hold both savings and credit card debt (Laibson, Repetto, and Tobacman 2007)
- What is the role of the firm?
  - Can firms effectively provide information about energy efficiency? (Allcott and Sweeney 2016)
    - What are their incentives to do so? (Gabaix and Laibson 2006)
  - How might internalities affect product development decisions?
- How to design information disclosure?
  - Optimal coarseness: Houde (2014), Sallee (2014)
- What determines initial beliefs?
  - How do consumers form priors over an attribute's importance when deciding whether to pay attention? (infinite regress problem)
    - e.g. in Gabaix (2014) or any rational inattention model

Conclusion: What we're learning

- Evidence from information provision experiments: Imperfect information and inattention do not have economically large effects on aggregate demand.
  - Water heaters: Allcott and Sweeney (2016)
  - Lightbulbs: Allcott and Taubinsky (2015)
  - Cars: Allcott and Knittel (2016)
- Some subsidies may be poorly targeted at market failures that justify the policies
  - Allcott, Knittel, and Taubinsky (2015)
- Some subsidies and standards may be too aggressive
  - CAFE: Allcott (2013)
  - Incandescent lightbulb ban: Allcott and Taubinsky (2015)