

Economic Experiments and Consumer Behavior

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ideas42

E2e

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The Hague. May 15th, 2014

Economic Experiments and Consumer Behavior: Agenda

1. Insights from recent field experiments with energy consumers
2. Why field experiments are important
3. Avoiding pitfalls
4. Using field experiments to make policy

The science behind this presentation

- Allcott, Hunt, and Dmitry Taubinsky (2013). “The Lightbulb Paradox: Evidence from Two Randomized Experiments.” NBER Working Paper 19713 (December).
 - Revise and Resubmit, *American Economic Review*.
- Allcott, Hunt (2012). “Site Selection Bias in Program Evaluation.” NBER Working Paper 18373 (September).
- Allcott, Hunt, and Todd Rogers (2014). “The Short-Run and Long-Run Effects of Behavioral Interventions: Experimental Evidence from Energy Conservation.” Forthcoming, *American Economic Review*.
- Allcott, Hunt (2011). “Rethinking Real-Time Electricity Pricing.” *Resource and Energy Economics*, Vol. 33, No. 4 (November), pages 820-842.
- Allcott, Hunt (2011). “Social Norms and Energy Conservation.” *Journal of Public Economics*, Vol. 95, No 9-10 (October), pages 1082-1095.
- Allcott, Hunt, and Sendhil Mullainathan (2010). “Behavior and Energy Policy.” *Science*, Vol. 327, No. 5970 (March 5), pages 1204-1205

Part 1: Insights from Recent Field Experiments with Energy Consumers

1. The Opower energy conservation experiments
2. Real-time pricing experiments

We are pleased to provide this personalized report to you as part of an energy savings program.

The purpose of this report is to:

- Provide information
- Track your progress
- Share energy efficiency tips

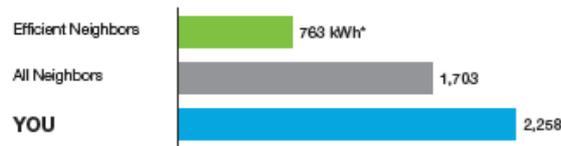


This information and more available at www.utilityco.com/reports

John Doe
1235 Main St.
Bellevue, WA 98006

Last 2 Months Neighbor Comparison

You used **33% more** electricity than your neighbors.



How you're doing:

You used more than average

Turn over for ways to save



* kWh: A 100-Watt bulb burning for 10 hours uses 1 kilowatt-hour.

■ All Neighbors: Approximately 100 occupied, nearby homes (avg 0.11 mi away)

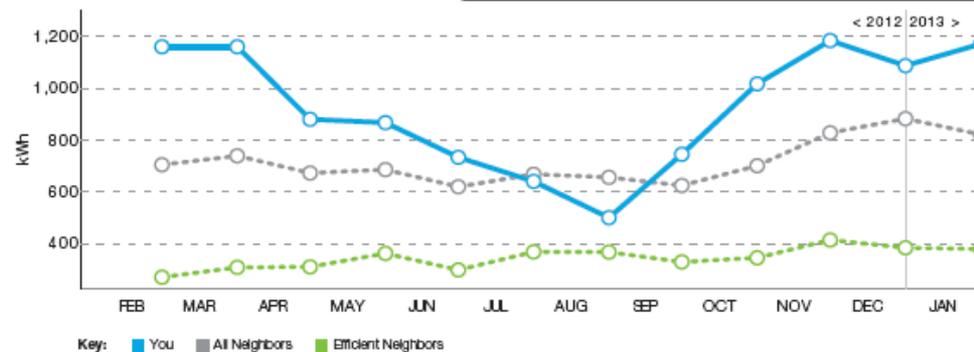
■ Efficient Neighbors: The most efficient 20 percent from the "All Neighbors" group

Are we comparing you correctly?

Tell us more about your home:
www.utilityco.com/reports

Last 12 Months Neighbor Comparison

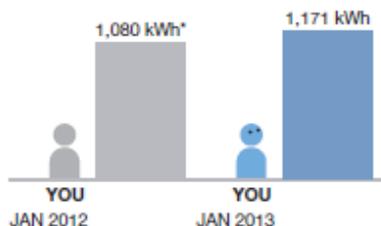
You used **30% more** electricity than your neighbors.
This costs you about **\$246 extra** per year.



Key: ■ You ■ All Neighbors ■ Efficient Neighbors

Personal Comparison

How you're doing compared to last year:



So far this year, you used **8% MORE** electricity than last year.

Looking for ways to save? Visit www.utilityco.com/reports

* kWh: A 100-Watt bulb burning for 10 hours uses 1 kilowatt-hour.

Action Steps | Personalized tips chosen for your home

Smart Purchase

An affordable way to save more

- Program your thermostat**
A programmable thermostat can automatically adjust your heat or air conditioning when you're away, then return to your preferred temperature when you're home to enjoy it.

If you don't already have a programmable thermostat, look for one at your local home improvement store. For comfort and convenience, be sure to program your thermostat with energy-efficient settings.

If you need help installing or programming your thermostat, consult your manual or call the manufacturer for assistance.

SAVE UP TO
\$80 PER YEAR

Smart Purchase

An affordable way to save more

- Check your air filters every month**
You can improve the energy efficiency of your heating and cooling systems and improve your indoor air quality by checking your filters monthly.

First, remove the filter — it usually slides right out. Next, hold the filter up to a light to see if it is clogged.

You can find an inexpensive replacement for a clogged disposable filter at your local hardware store. Check your manual for cleaning instructions if you have a permanent filter.

SAVE UP TO
\$45 PER YEAR

Smart Purchase

An affordable way to save more

- Seal air leaks**
Gaps and cracks between the inside and outside of your home can allow heated or cooled air to escape. This forces your heating or cooling system to work harder, increases energy costs, and decreases comfort.

To find leaks, follow drafts to their source. Check where materials meet, like between the foundation and walls, the chimney and siding, and where gas and electricity lines exit your house.

Seal any small cracks you find with caulk and larger ones with polyurethane foam.

SAVE UP TO
\$215 PER YEAR

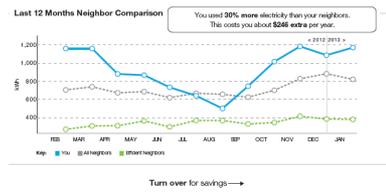
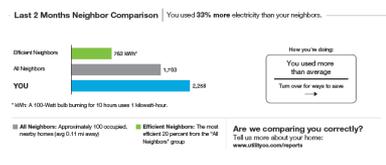
Measuring efficacy via randomized control trials (RCTs)

Treatment: Home Energy Report

UtilityCo

Home Energy Report
Account number: 123456789
Report period: 12/01/15-01/01/16
We are pleased to provide this personalized report to you as part of an energy savings program.
The purpose of this report is to:
• Provide information
• Track your progress
• Share energy efficiency tips
This information and more available at www.utilityco.com/reports

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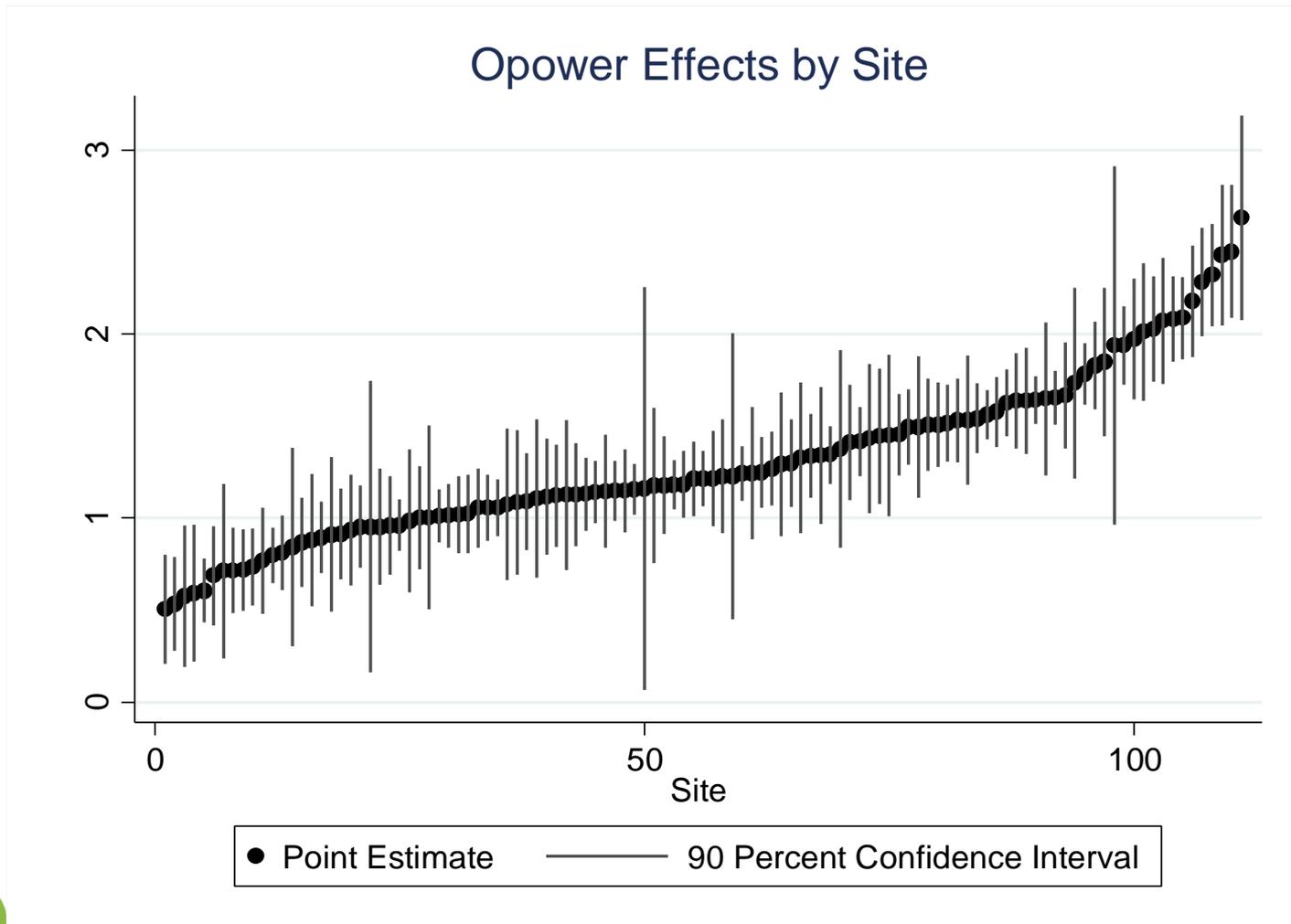


Control: Nothing

$$\text{Treatment Effect} = [\text{Usage}|\text{Treatment}] - [\text{Usage}|\text{Control}]$$

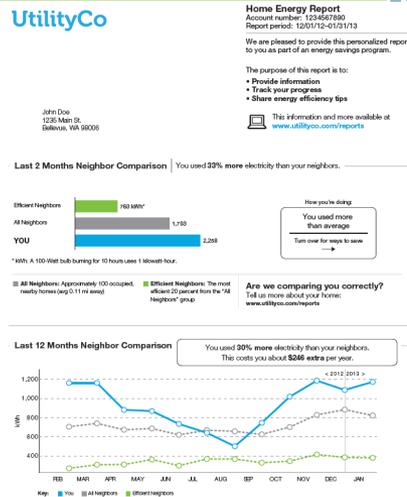
- RCTs are the standard way to test medicine, job training, online advertising, education programs, electricity pricing, etc, etc.
- Opower: 111 RCTs at 58 utilities, 8.6 million households in U.S.

Results from Opower randomized control trials



Measuring persistence and marginal benefit of continued treatment

“Continued Treatment”: 4 Years of Reports

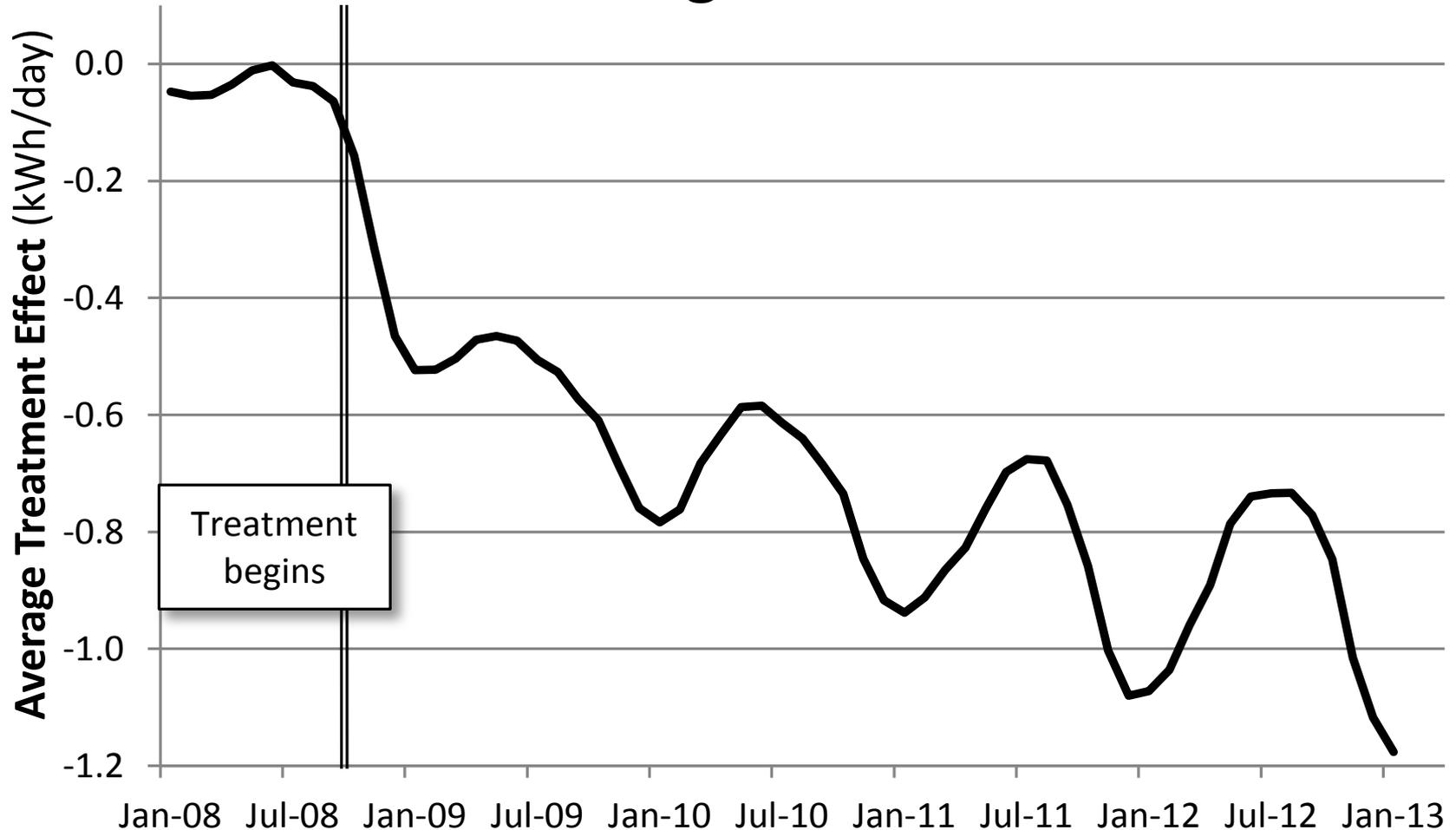


**Control:
Nothing**

“Dropped Treatment”: 2 Years of Reports

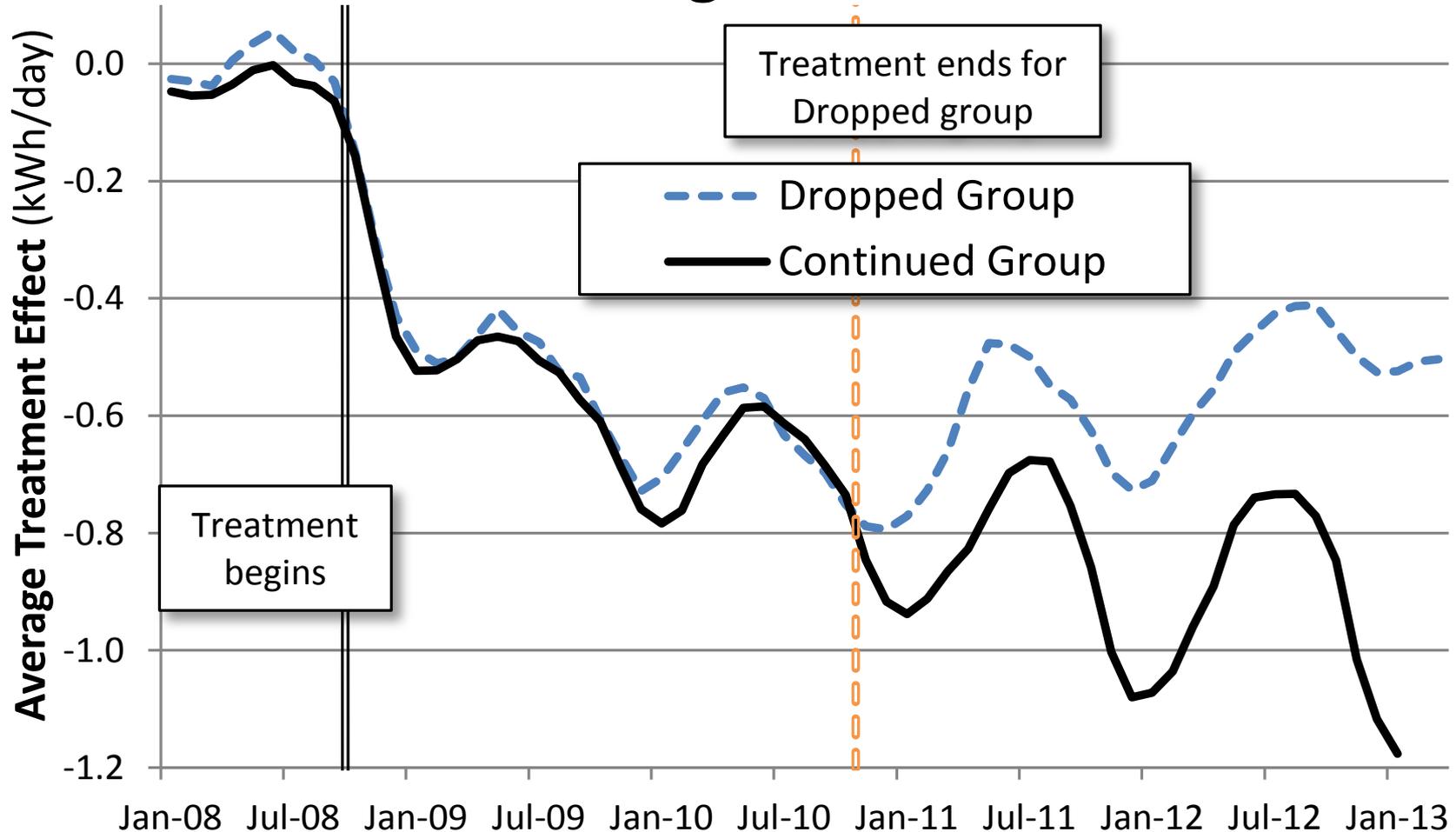
Opower effects grow while treatment continues

Site 2: Long-Run Effects



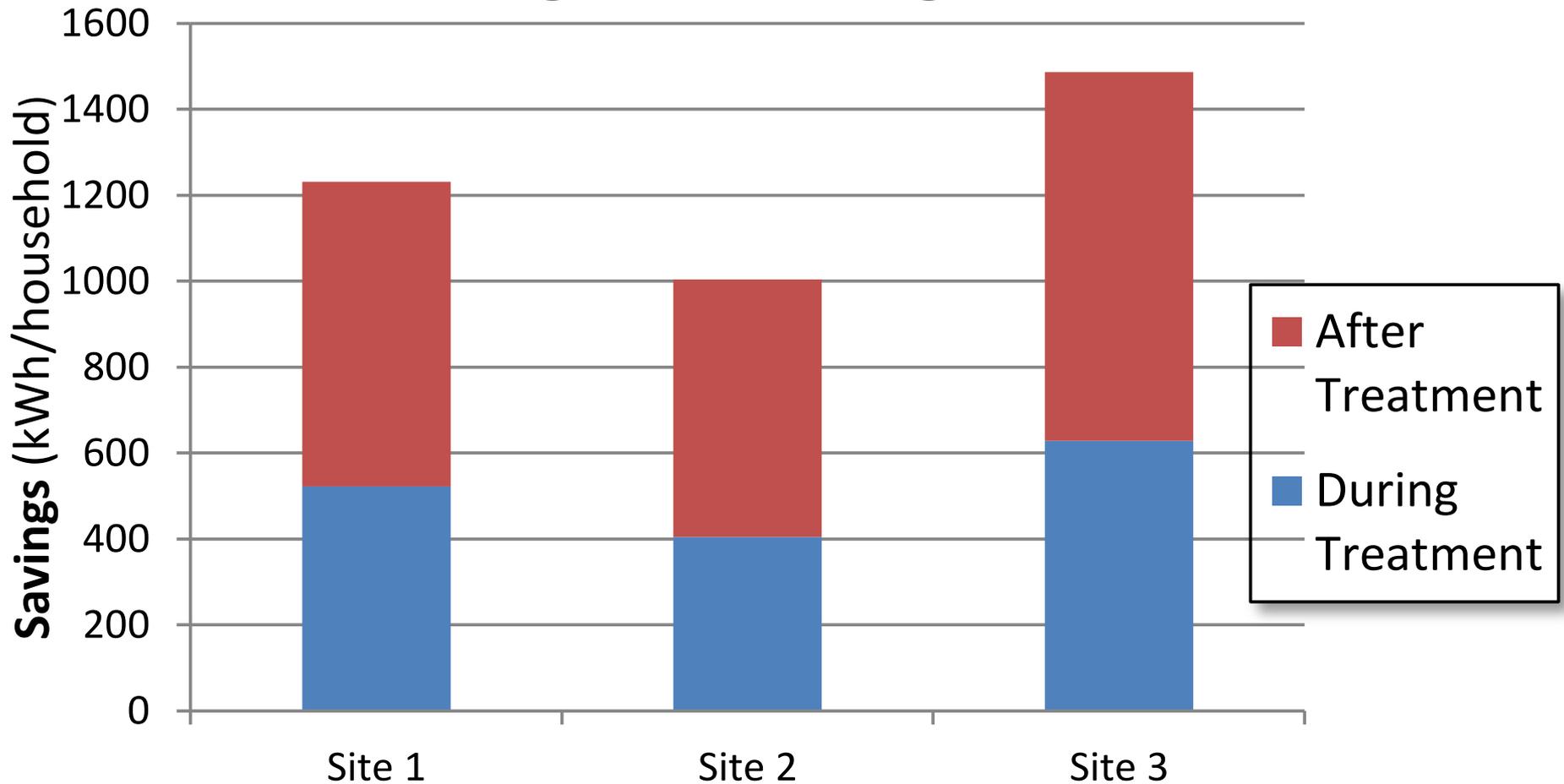
Remarkable persistence after treatment discontinued

Site 2: Long-Run Effects



More savings *after* treatment than *during*

Savings Over Program Life



Real-Time Pricing Experiments

Treatment: Real-Time Pricing



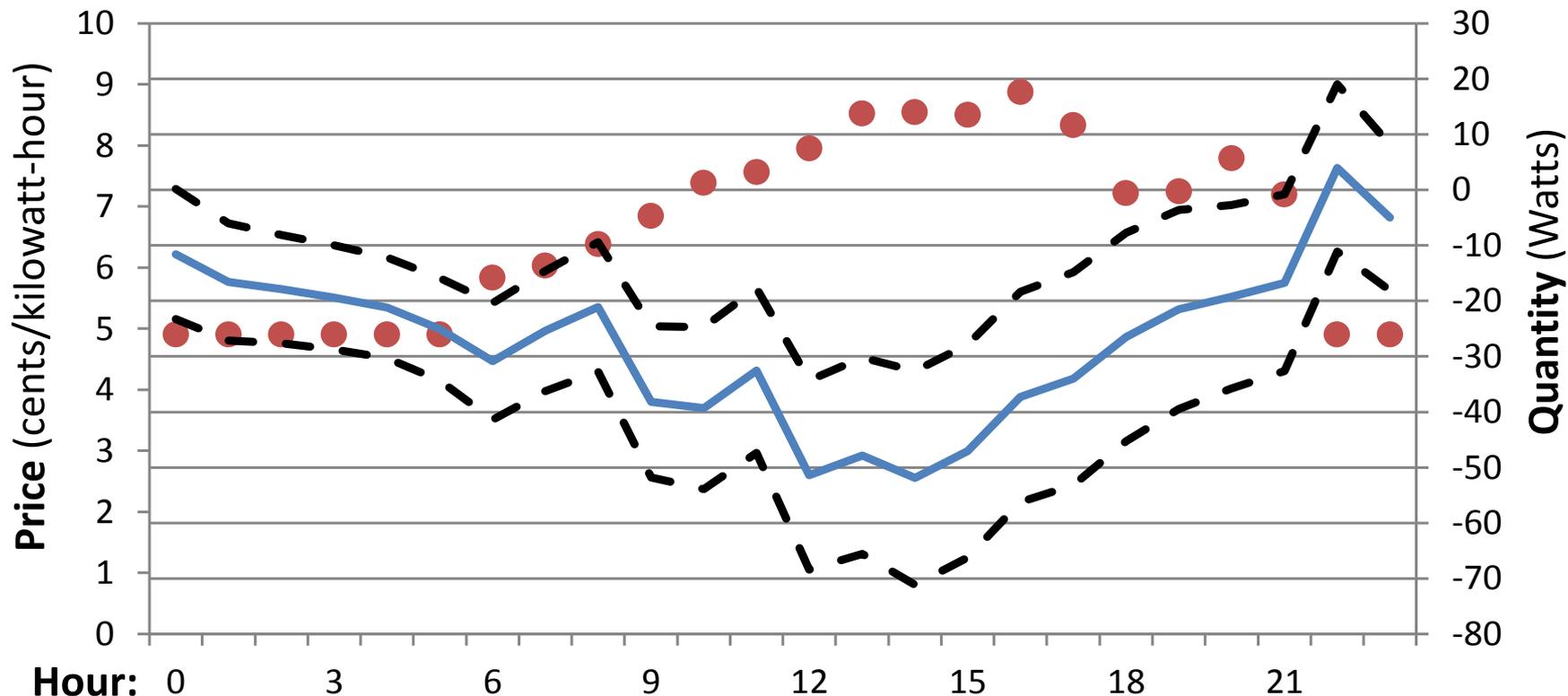
**Control: Standard
“Flat-Rate Tariff”**

$$\textit{Treatment Effect} = [\textit{Usage}|\textit{Treatment} - [\textit{Usage}|\textit{Control}]$$

$$\textit{Demand Slope} = \frac{\textit{Treatment Effect}}{\textit{Price Difference}}$$

ComEd example: Real-time pricing causes consumers to reduce peak demand

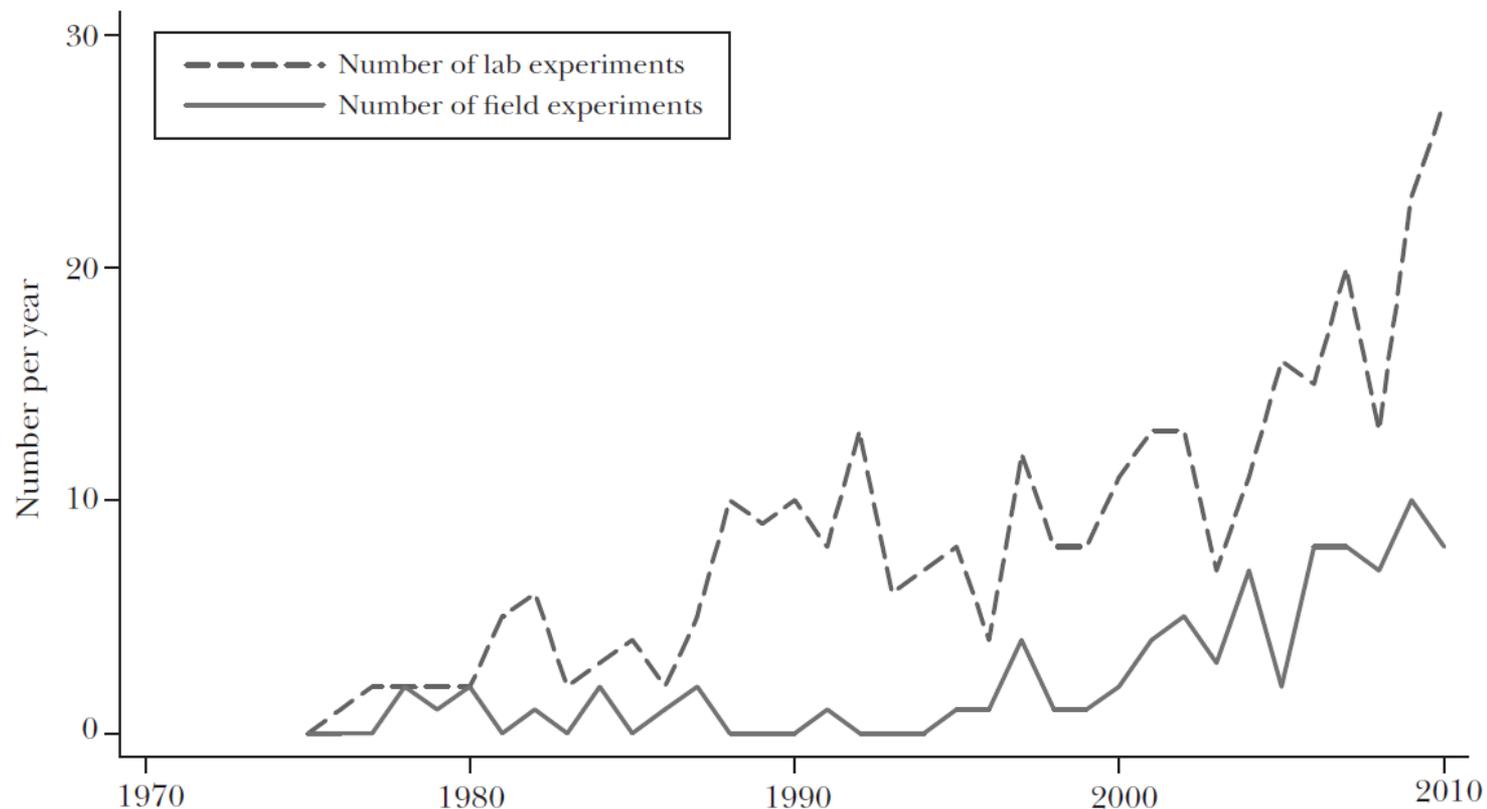
Summer Hourly ATEs: Non-High Price Days



● Mean Price — Average Treatment Effect - - 95% Confidence Interval

Part 2: Why Field Experiments Are Important

Number of Laboratory and Field Experiments Published in Five Top Economics Journals from 1975 to 2010



Note: The journals surveyed were the American Economic Review, Econometrica, the Journal of Political Economy, the Quarterly Journal of Economics, and the Review of Economic Studies.

The “Credibility Revolution”

- Why the growth in field experiments?
- “Credibility revolution” in data analysis.
- The data show that non-experimental results are wrong and misleading in many contexts.
 - Prominent early example: LaLonde (1986)
- Two major reasons for this:
 - Omitted variables bias
 - Reverse causality

(Conditional) Correlation does not imply causality

- Energy efficiency program example

X

(energy
efficiency
program)

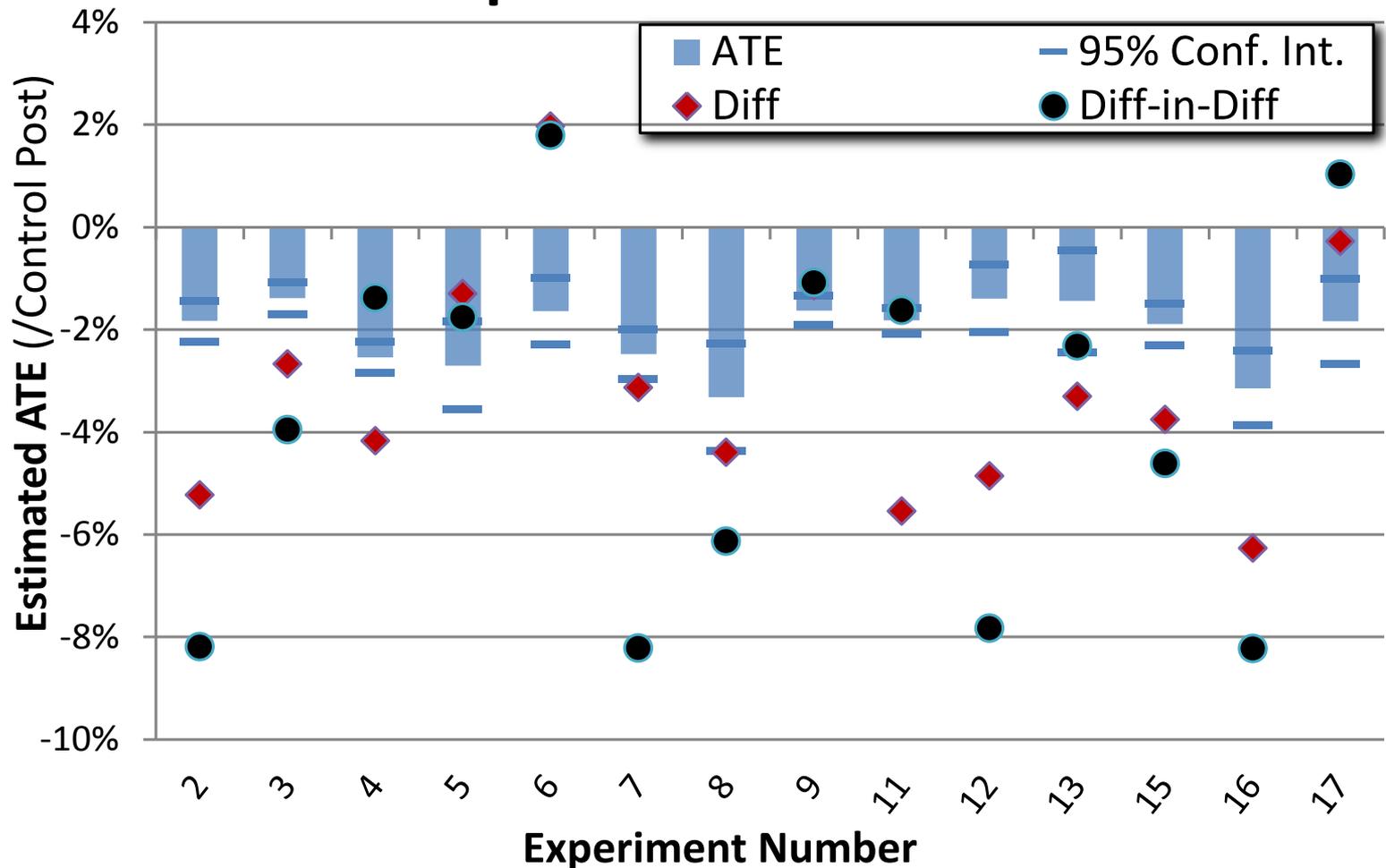


Y

(reduced
electricity use)

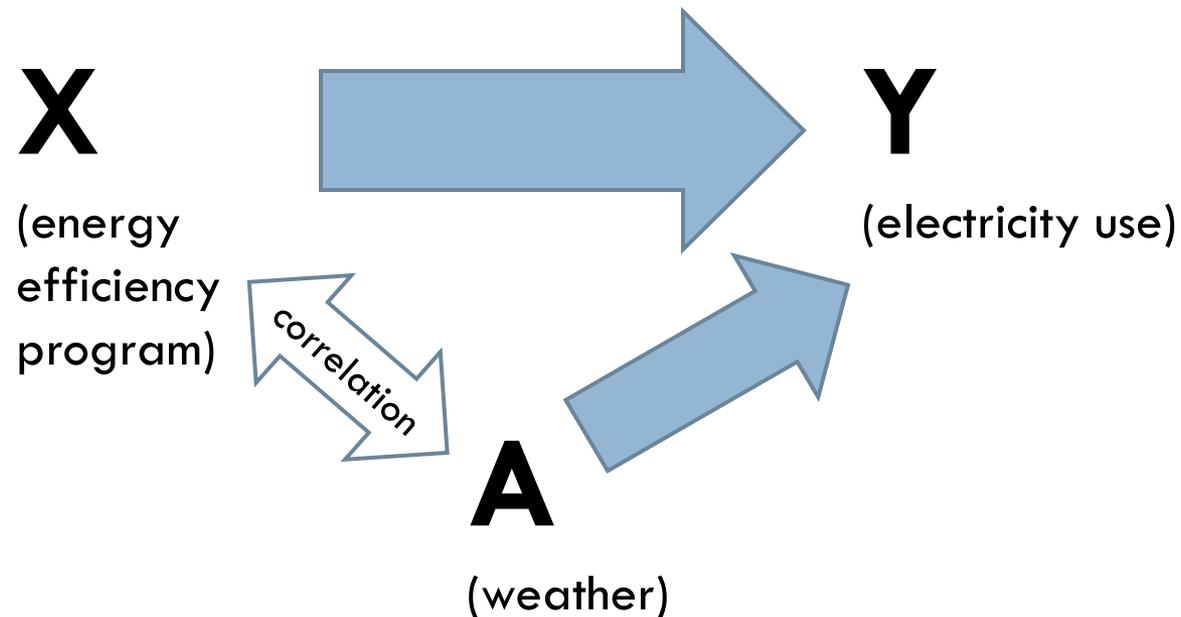
Omitted variables bias: Weather and other factors simultaneous to program implementation

Non-Experimental Estimators



(Conditional) Correlation does not imply causality

- Energy efficiency program example:



Omitted variables bias

(Conditional) Correlation does not imply causality

- Real-time pricing example:

X

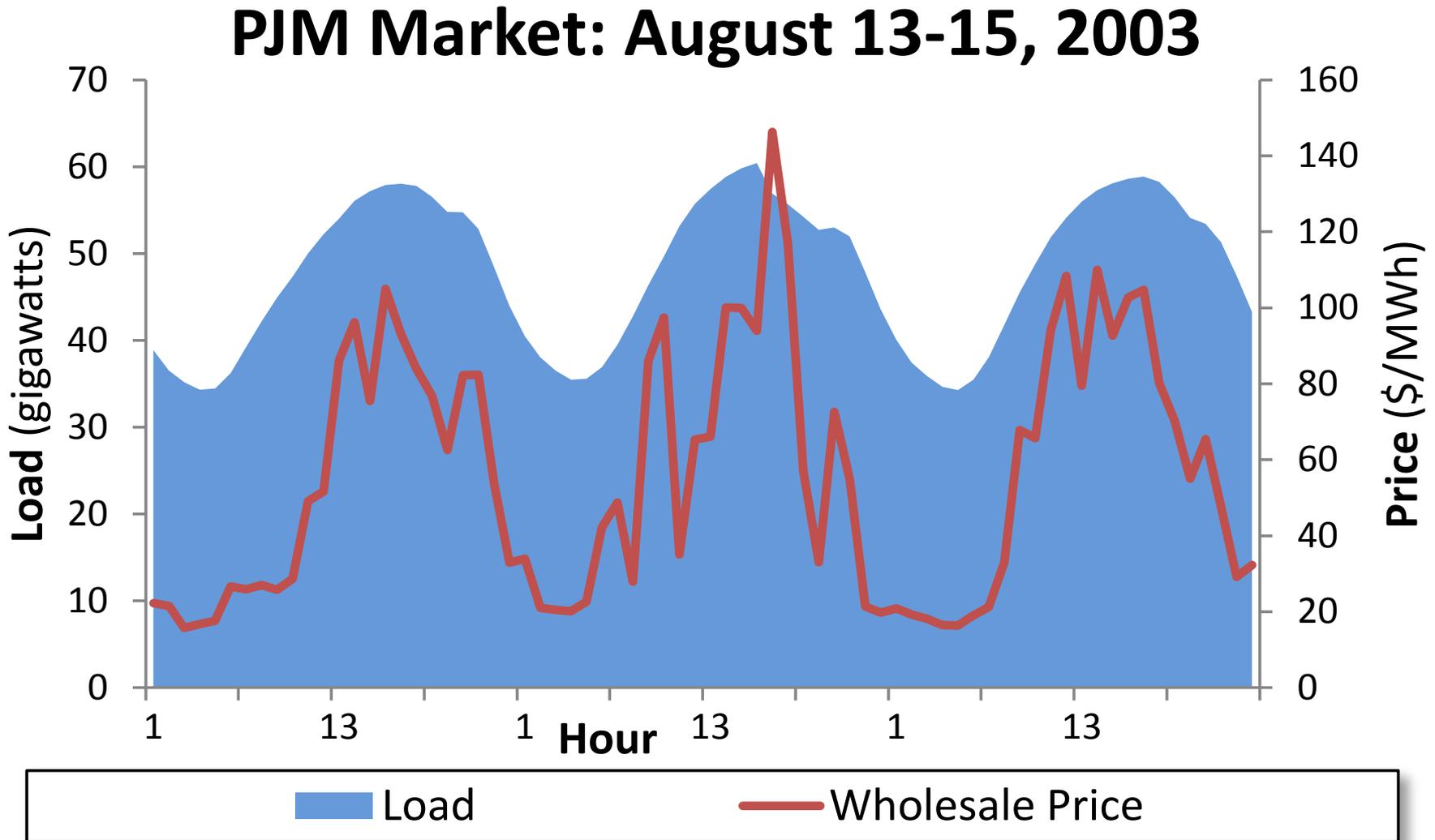
(higher peak
prices)



Y

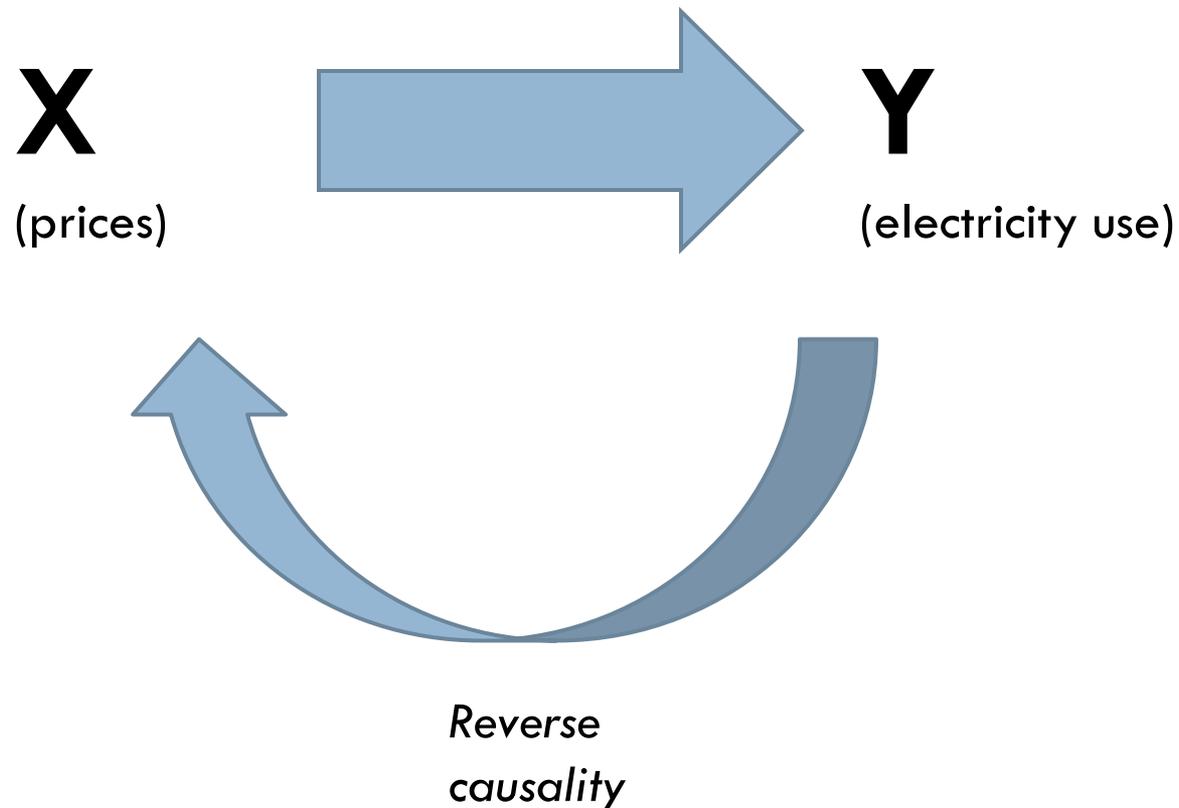
(reduced peak
electricity use)

Reverse causality: Quantities cause prices!



(Conditional) Correlation does not imply causality

- Real-time pricing example:

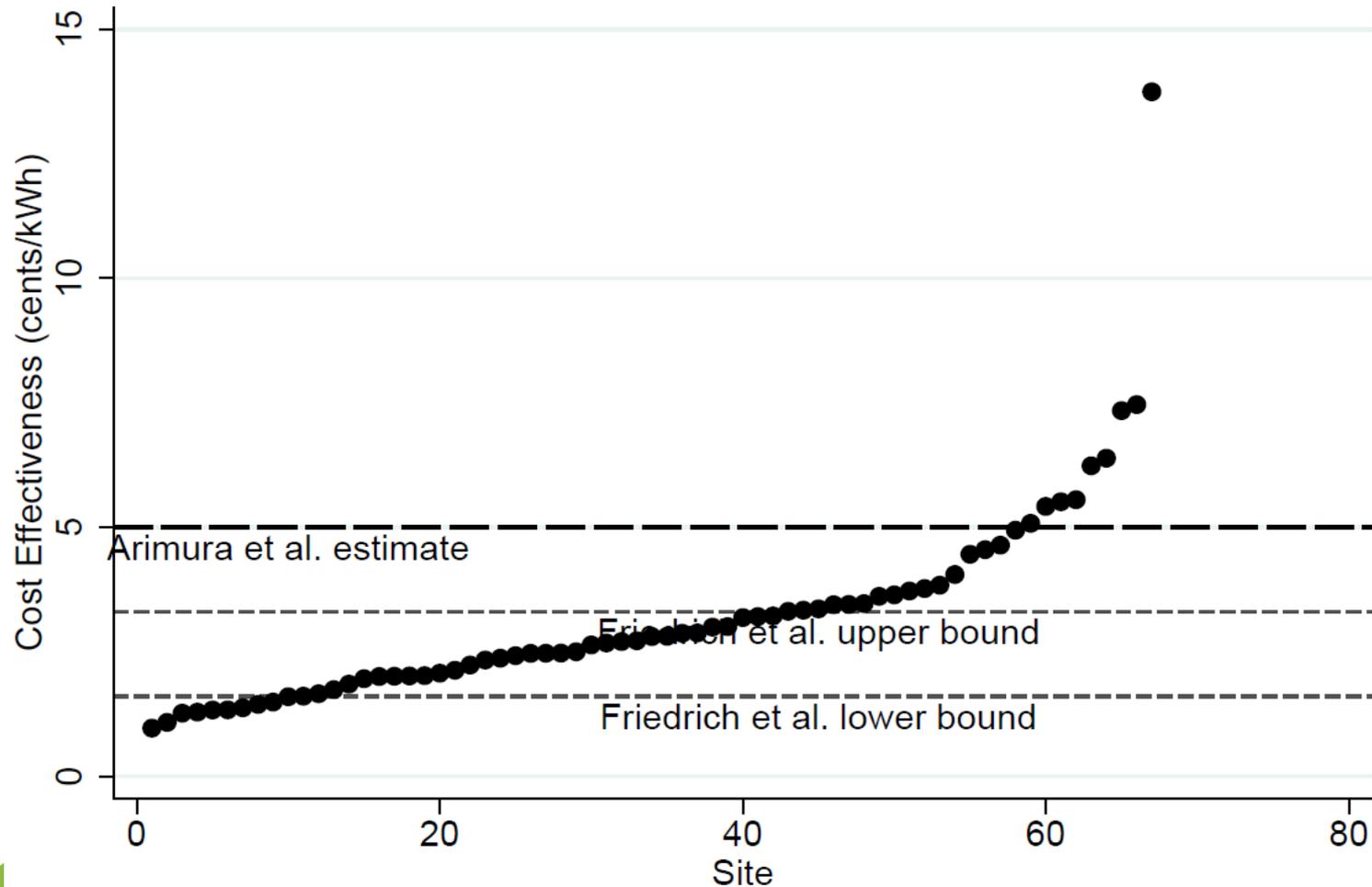


Part 3: Avoiding Pitfalls with Field Experiments

- External validity
- Spillovers
- Randomized encouragement

Opower: Effect variation matters for policy decisions

Two-Year Cost Effectiveness by Site



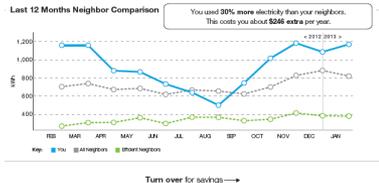
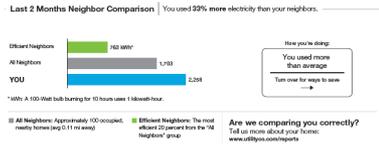
Use clustered randomization to avoid spillovers

Treatment: Home Energy Report

UtilityCo

Home Energy Report
Account number: 1234567890
Report period: 12/01/15-01/01/16
We are pleased to provide this personalized report to you as part of an energy savings program.
The purpose of this report is to:
• Provide information
• Track your progress
• Share energy efficiency tips
This information and more available at www.utilityco.com/reports

John Doe
1234 Main St.
Bellevue, WA 98006



Control:
Nothing

- Problem with clustered randomization: loss of power

Use randomized encouragement when not possible to force people in or out of a program

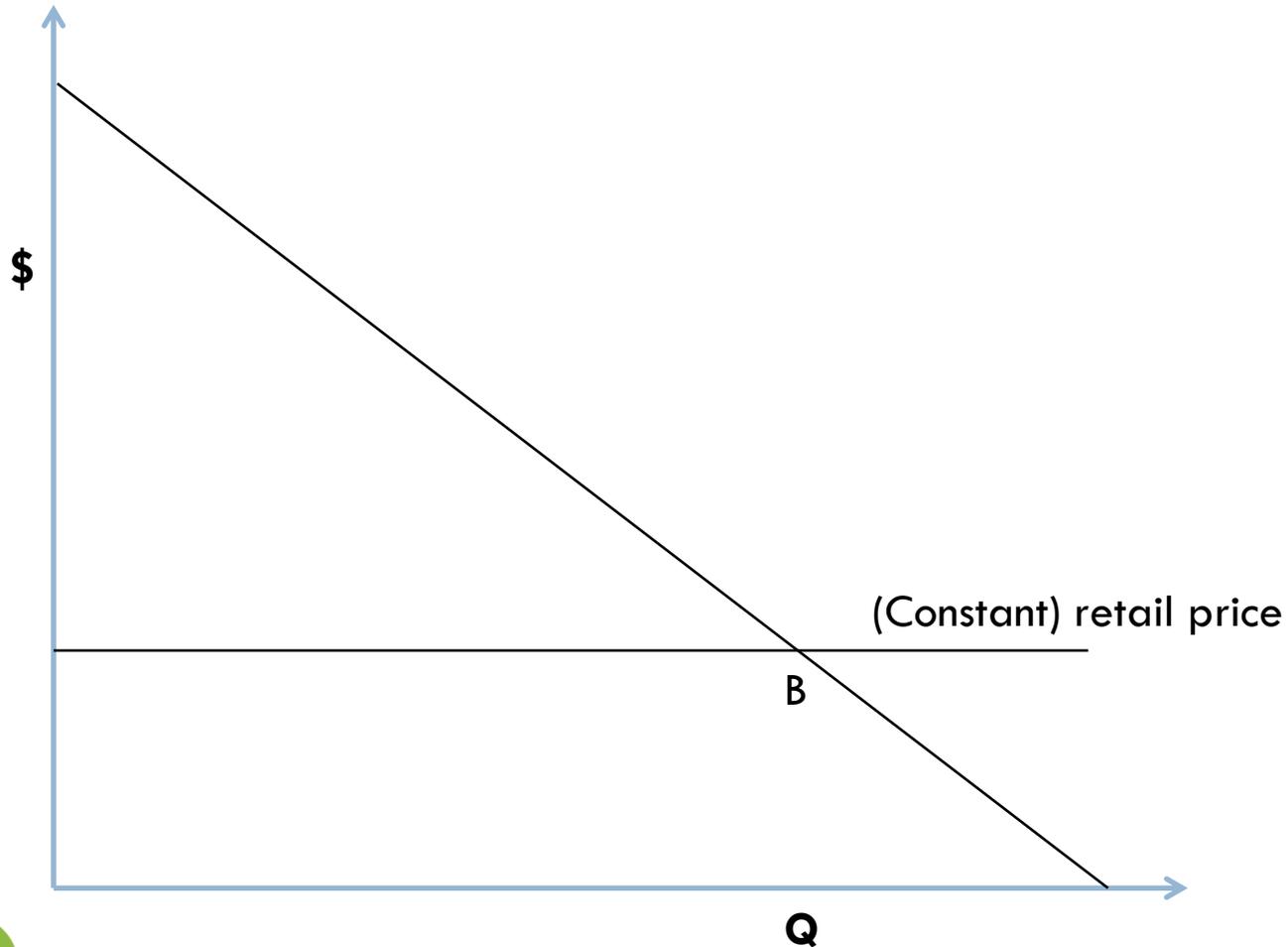


$$\text{Treatment Effect} = \frac{[Usage|Treatment] - [Usage|Control]}{[Takeup|Treatment] - [Takeup|Control]}$$

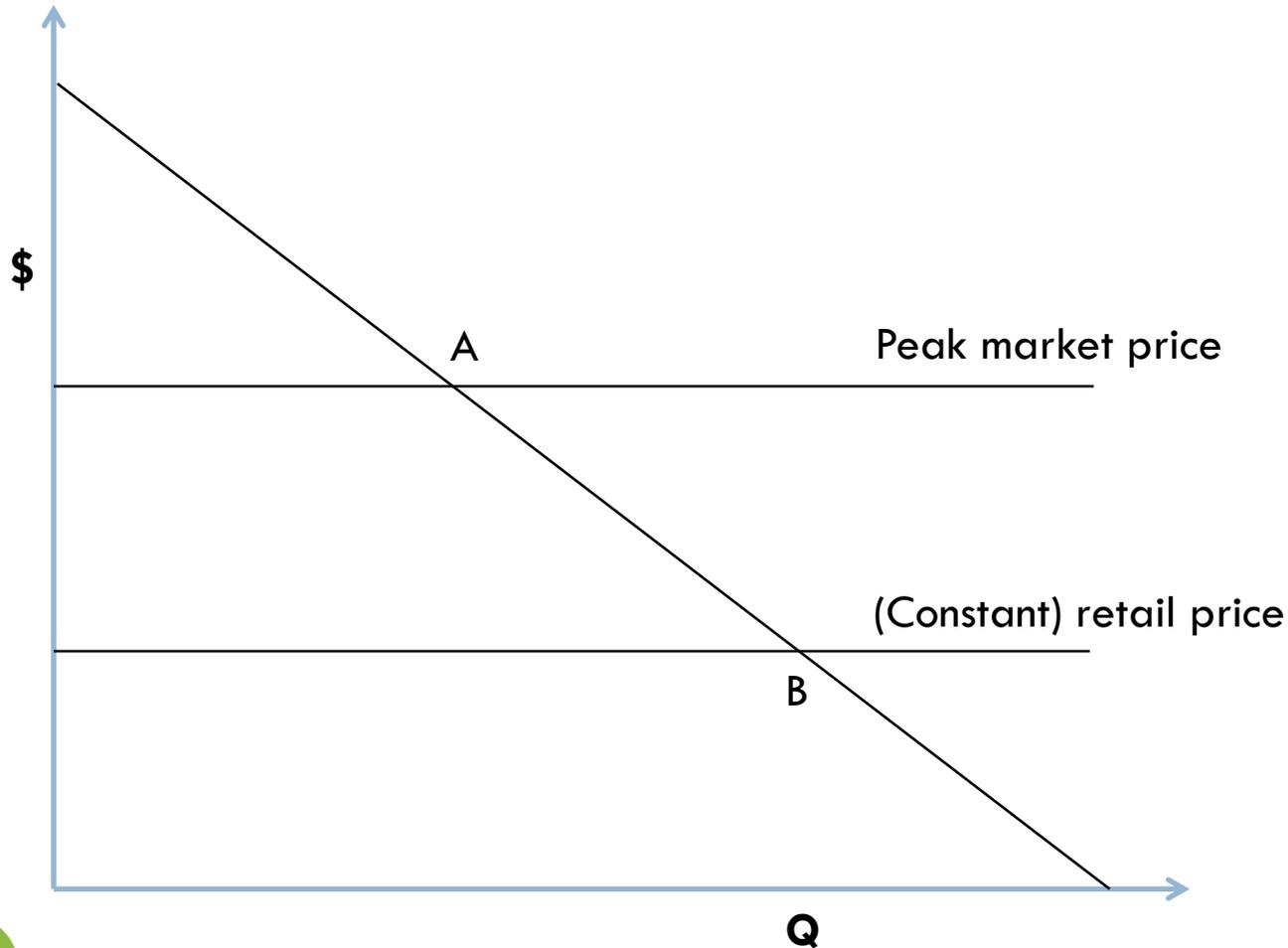
Part 4: Using Field Experiments to Make Policy

- Benefit-cost analysis, or “welfare analysis,” is the basic framework for making policy decisions.
 - Note: welfare analysis can accommodate equity concerns by quantifying costs and benefits for specific subgroups, e.g. low-income.
- Field experiments can provide necessary parameters for cost-benefit analysis.

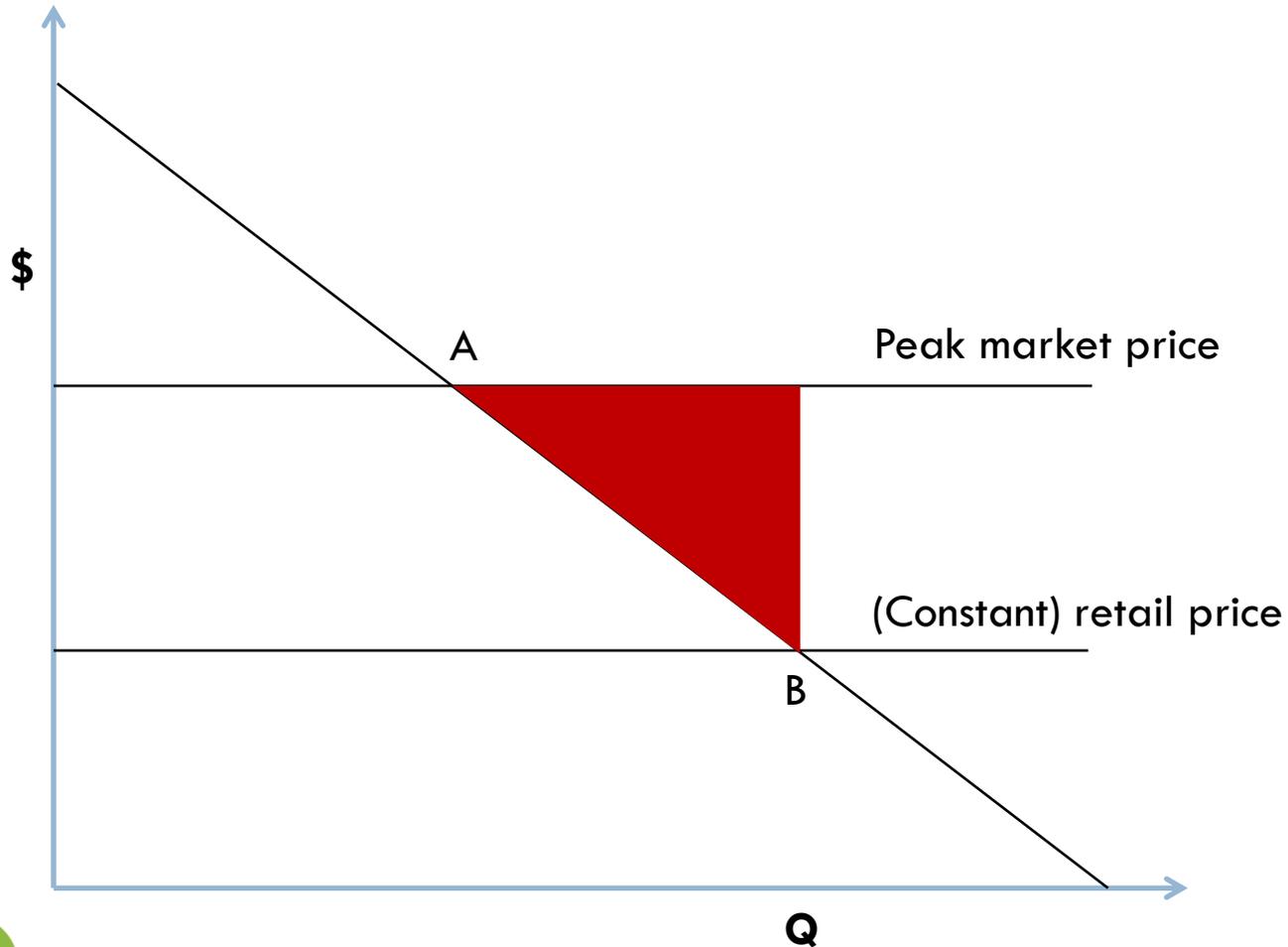
Welfare analysis of real-time pricing



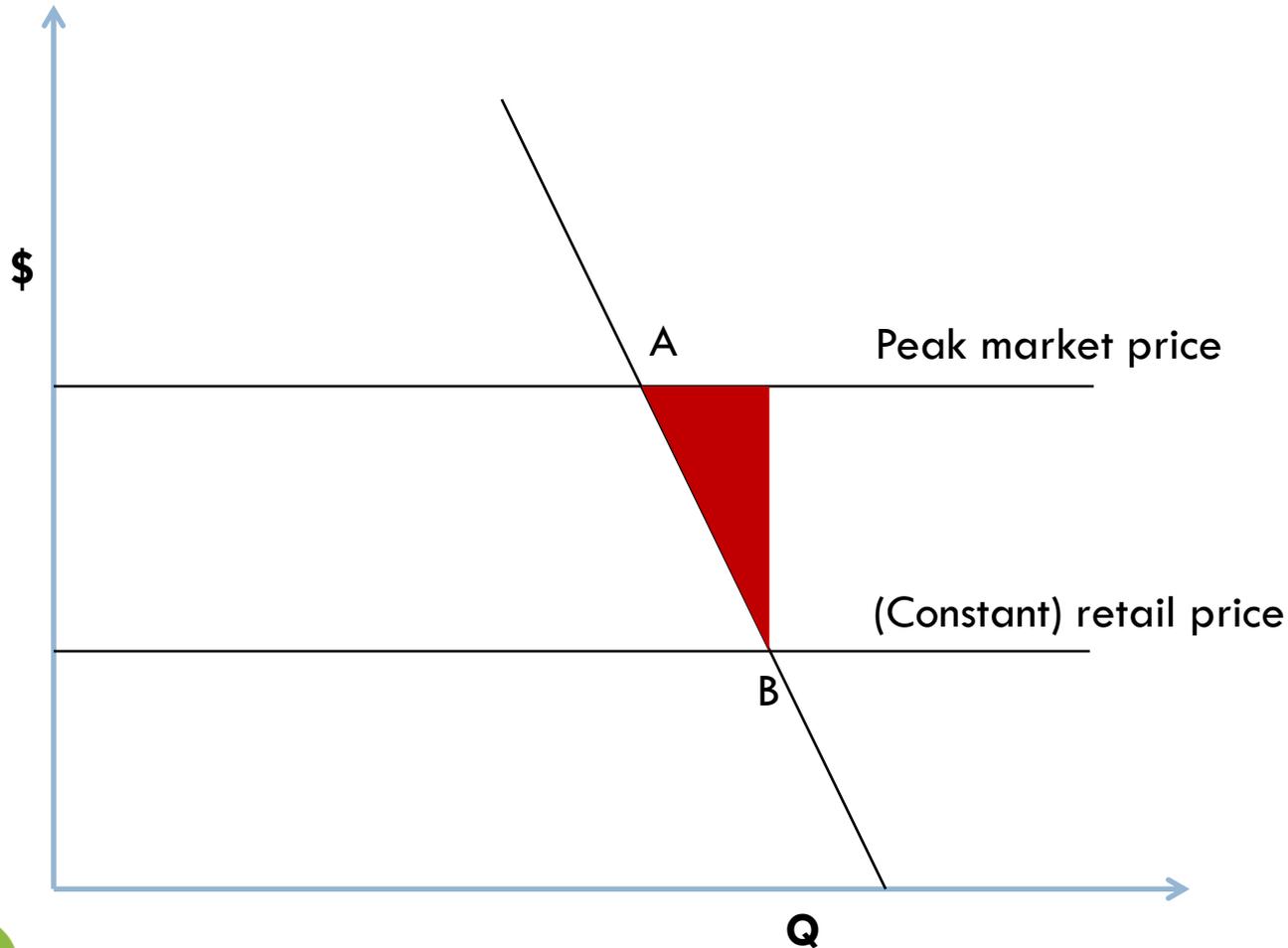
Welfare analysis of real-time pricing



Welfare analysis of real-time pricing



Inelastic demand implies smaller welfare losses



Cost-effectiveness \neq welfare

- Energy efficiency programs are often evaluated using cost effectiveness:
 - Example: program cost (cents) / energy saved (kWh)
- Common argument: a program should be run iff:
 - Program Cost/Energy Saved (c/kWh) < Retail Price (c/kWh)
- What is wrong with this argument?
 - Program Cost often doesn't include consumer costs
 - Retail Price is heavily distorted
 - Lack of real-time pricing
 - Amortization of fixed costs into marginal prices

Cost effectiveness \neq welfare: Examples

- Argument: a program should be run iff:
 - Program Cost/Energy Saved (c/kWh) < Retail Price (c/kWh)
- CFL replacement: Highly “cost effective” energy conservation program in US
 - Consumer surplus losses due to light quality
 - Lights used more at night when market price of electricity is low
- Opower:
 - Consumer cost examples: Buying new AC, time to turn off lights, psychic costs
 - Suggestive stylized fact: Opower opt-in programs have very low opt-in rates

Nudges not a substitute for good policy

The New York Times

The Opinion Pages

OP-ED CONTRIBUTIONS

Economics Behaving Badly

By Thomas H. Davenport and Peter A. ...

It seems that every week a new study is showing that irrational decisions are driving up the rise in health care costs.

Such insights draw on behavioral economics, a theory that incorporates elements from psychology and its emphasis on rational decisions. It explains why, for example, people don't exercise enough and eat too much and use too many appliances. And, by understanding human behavior, behavioral economics has opened up new ways to deal with them.

But the field has its limits. As it becomes clear that behavioral economics wasn't meant to address. Indeed, behavioral economics is being used as a political expedient to avoid painful but more effective solutions.

Take, for example, our nation's obesity epidemic. It's based on the belief that better information can influence consumers through nudges. There's a mandate in the health care law to get the number of calories in

Loewenstein and Ubel (2010):

- “It seems in some cases that behavioral economics is being used as a political expedient, allowing policymakers to avoid painful but more effective solutions rooted in traditional economics.”
- **Nudges are not substitutes for prices that reflect social costs.**
- **Once prices reflect social costs, do we need nudges?**

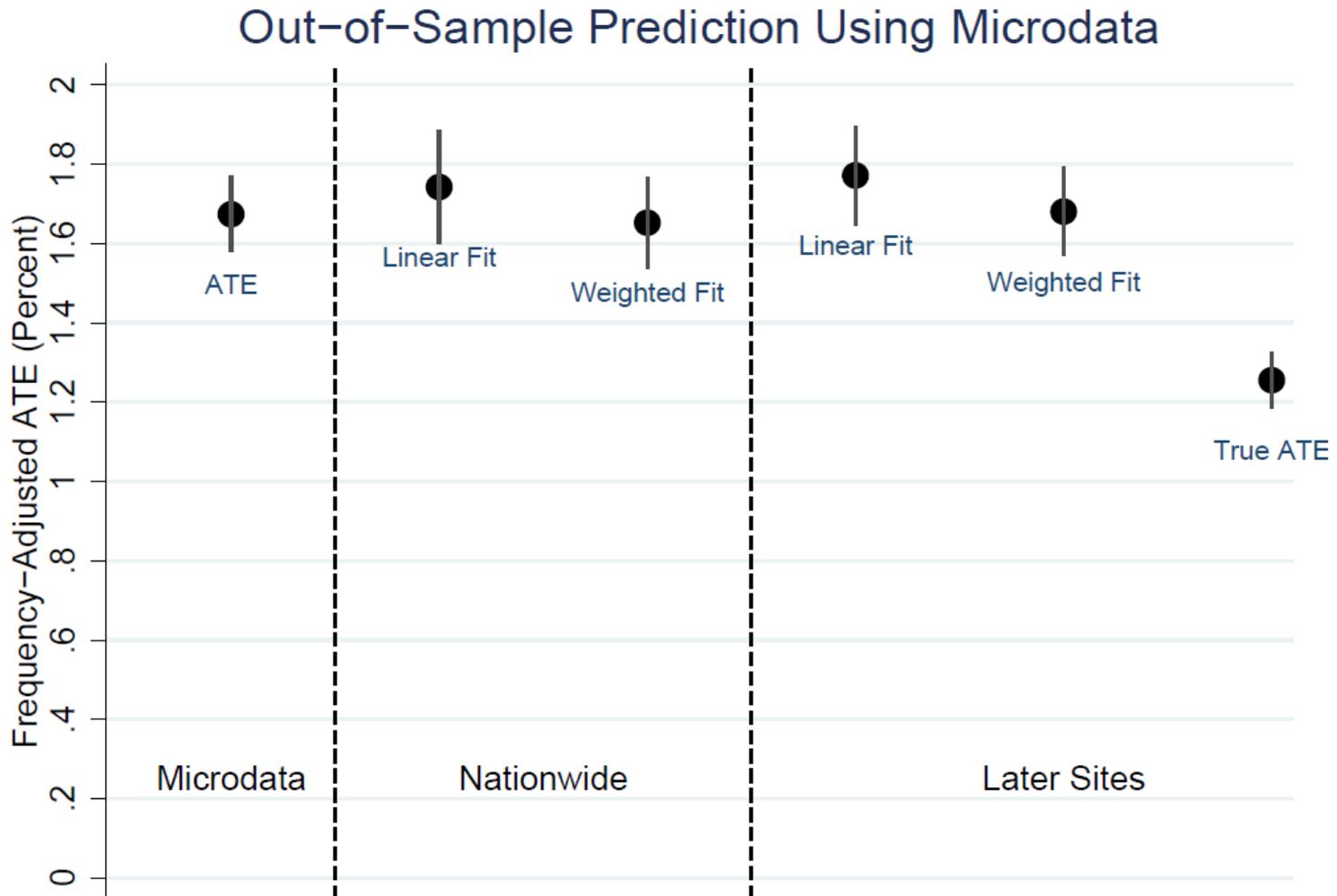
Key Messages

- In some cases, randomized field experiments are the only reliable way to measure a policy's impacts
- Alternative designs like randomized encouragement make randomized experiments possible in additional settings.
- There is no substitute for welfare analysis
 - Welfare analysis differs from cost-effectiveness analysis
 - Welfare analysis can be used to evaluate nudges
- Keep it simple: get prices right
- Field experiments \Rightarrow welfare analysis \Rightarrow policy decisions

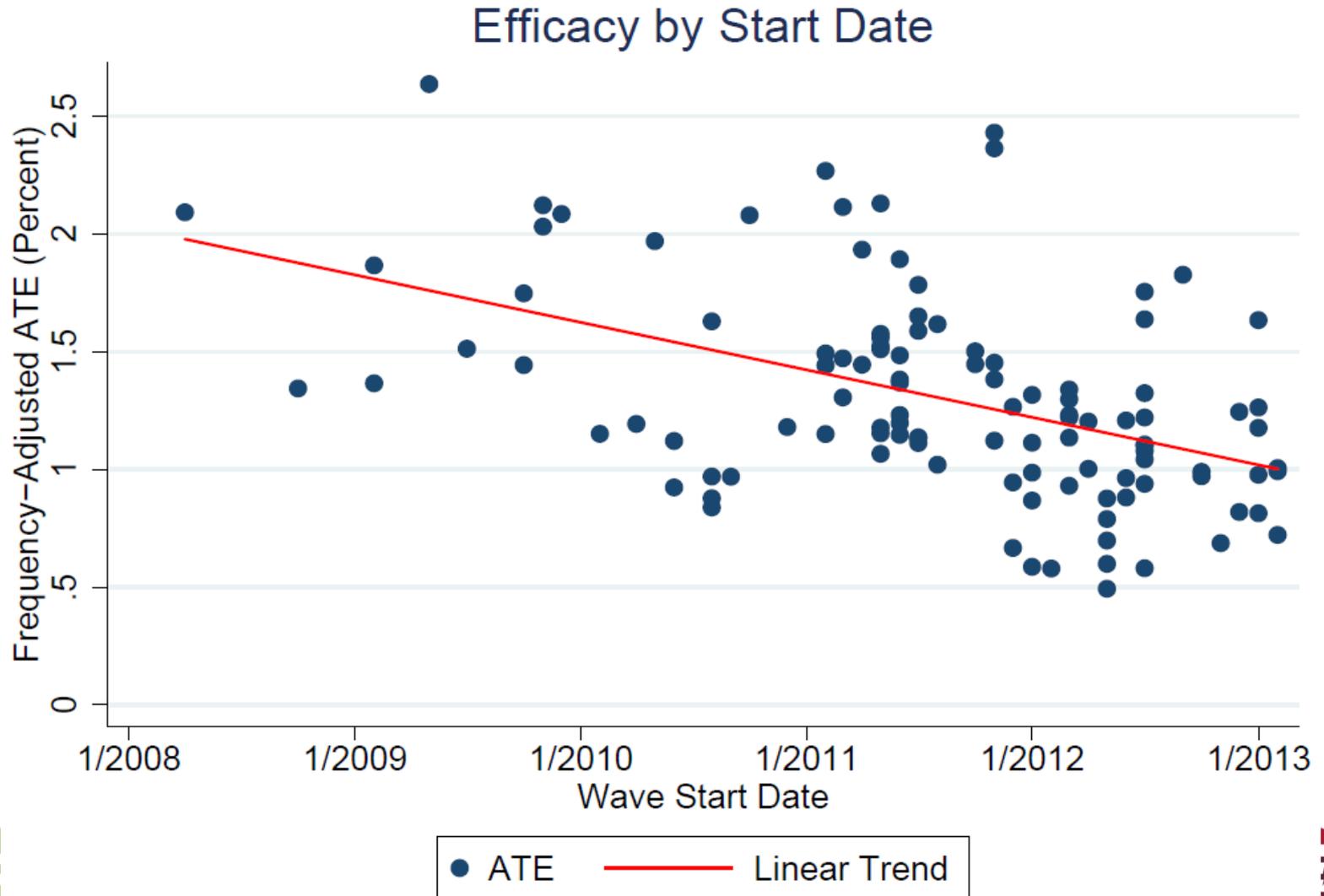
Appendix: Site Selection Bias Slides



Opower: Extrapolation from early sites overstates later results

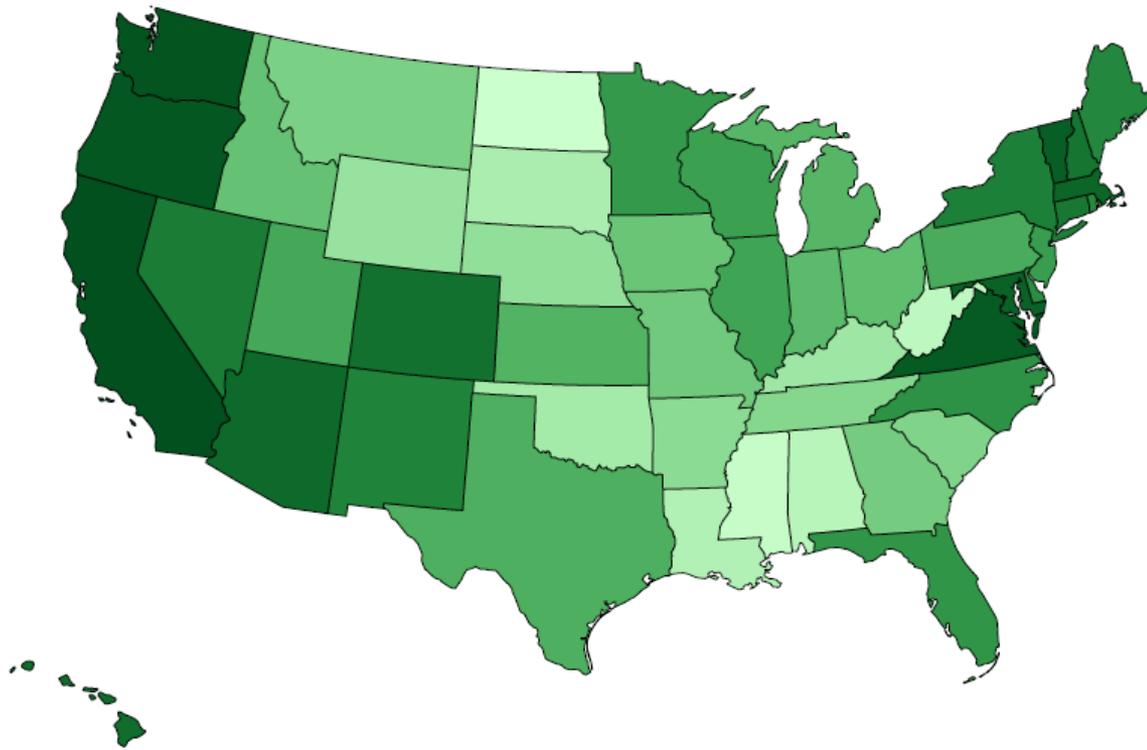


Opower: "Site Selection Bias"



Populations in some states are more environmentalist (and liberal)

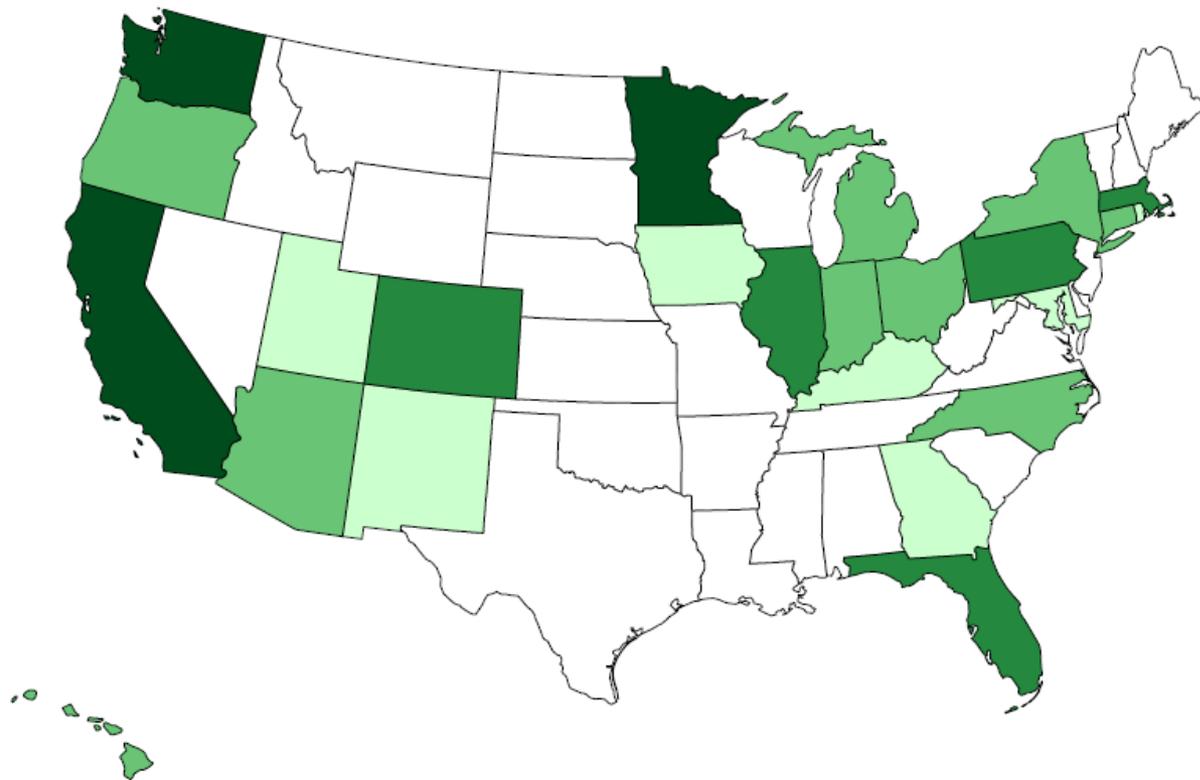
Figure 6c: State Hybrid Vehicle Shares



Notes: Darker shading represents a higher ratio of hybrid vehicles to total vehicles registered as of 2013.

Opower fulfills conservation mandates

Figure 6a: States with Opower Sites



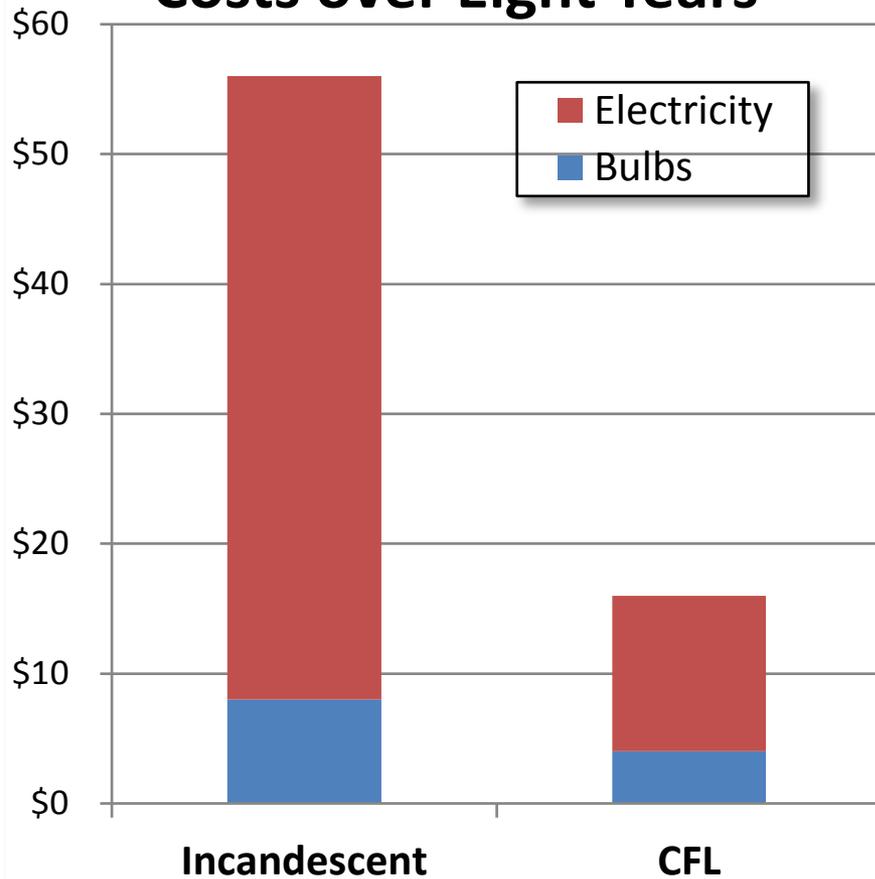
Notes: Shaded states have an Opower site. Darker colors indicate earlier program start dates.

Appendix: Lightbulb Paradox Slides

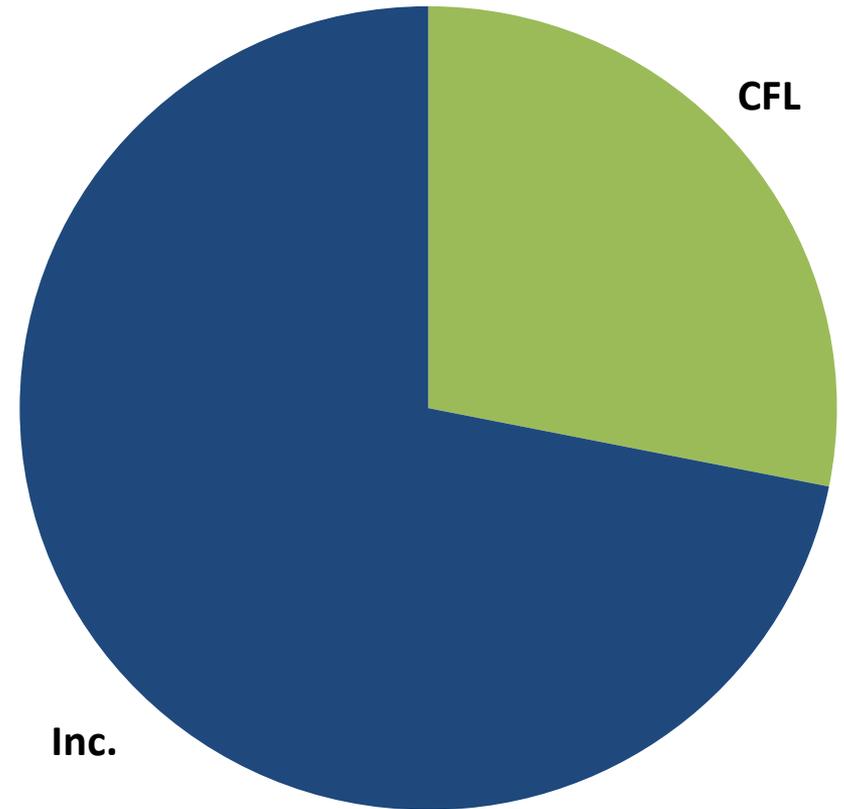


Lightbulb Paradox Field Experiment

Costs over Eight Years



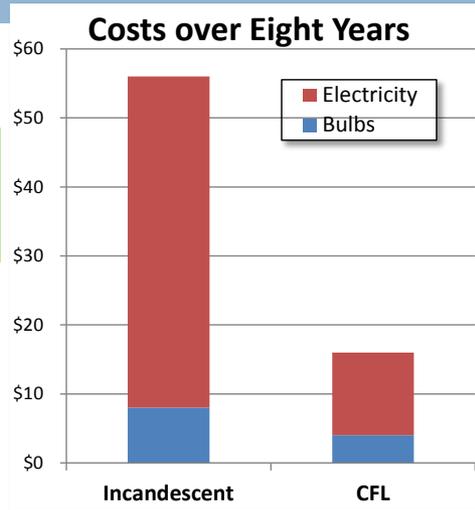
Market Shares



Measuring imperfect information and inattention with a field experiment

Treatment: Energy cost information

Consumers online or in a store



Informed consumer

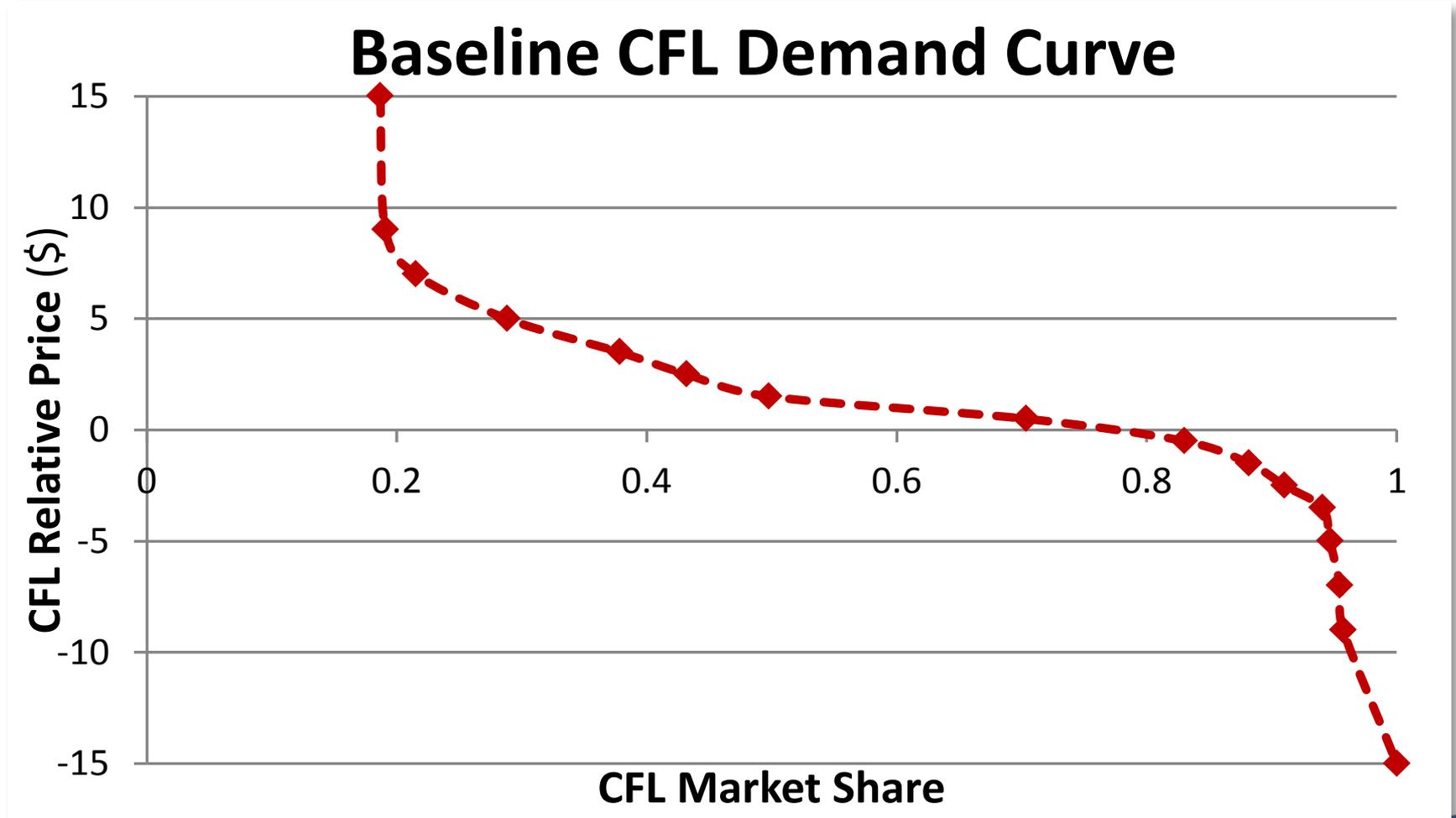


Potentially uninformed consumer

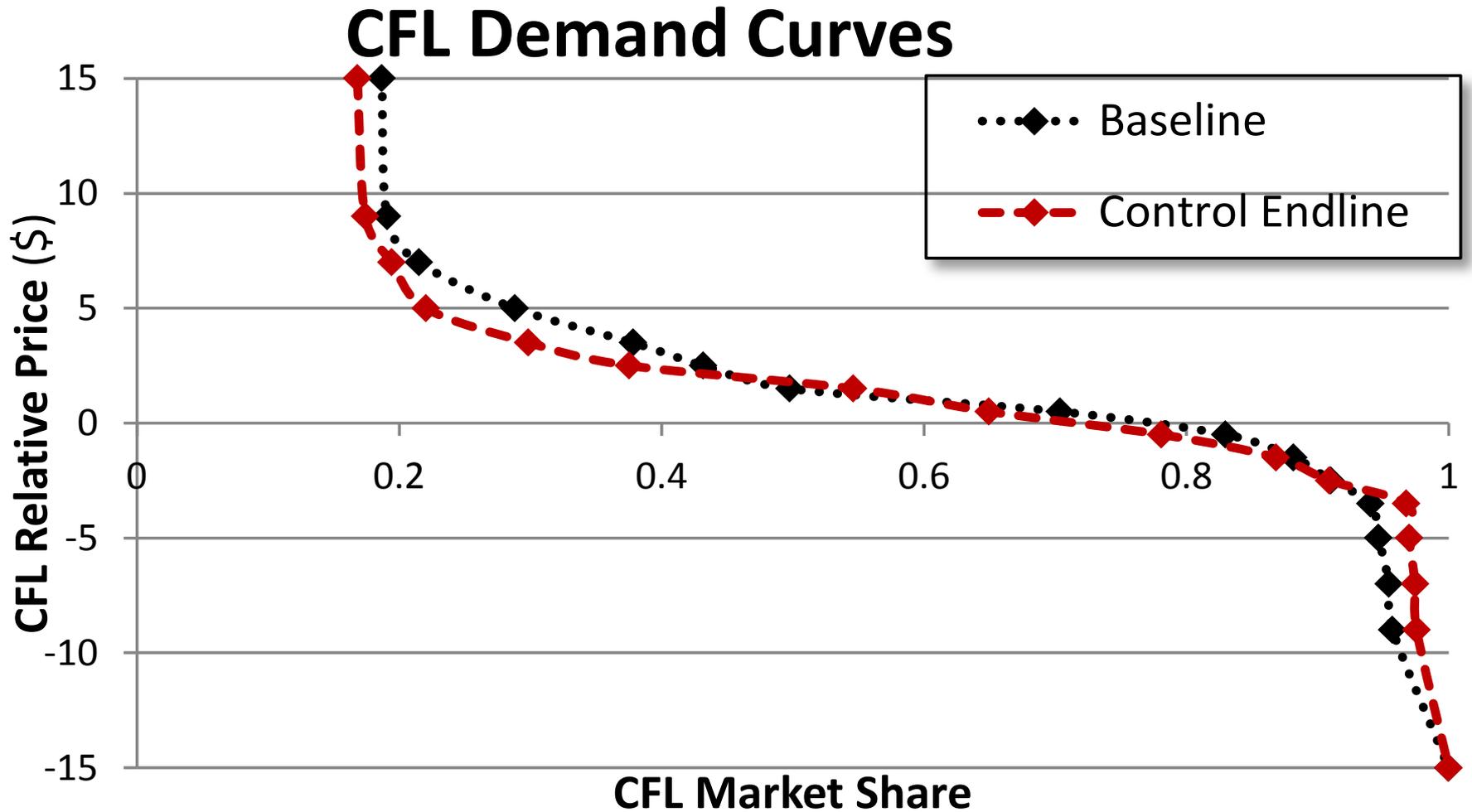


Control: No information

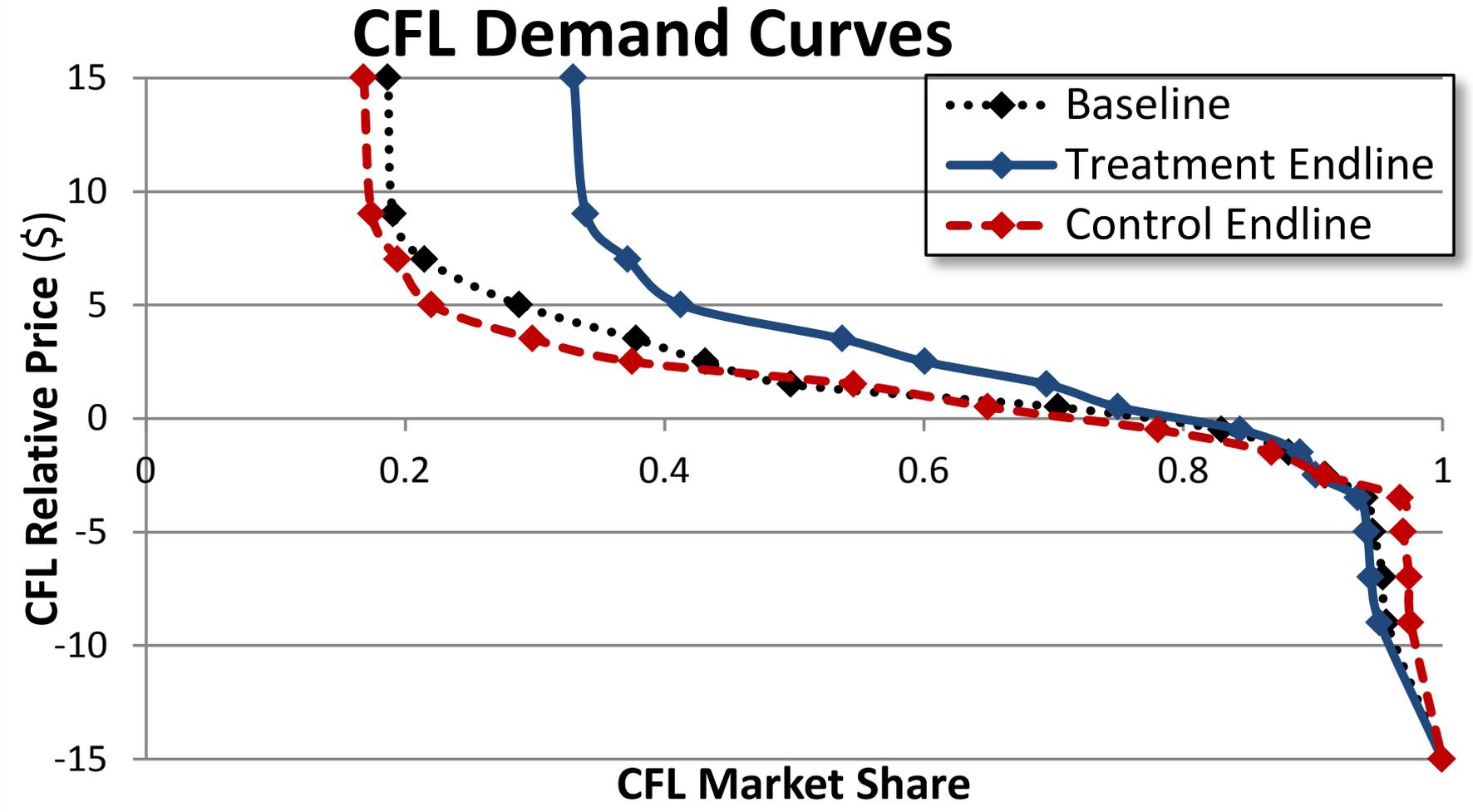
CFL demand in “TESS experiment”



Control group demand unaffected



Information increases CFL demand ... but many informed consumers still prefer incandescents



Welfare gains and losses from banning incandescents

TESS Welfare Calculation

