Implications of behavioral economics for public utility policies

Policy Research Talk

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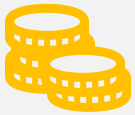
Public utility policy concerns

Cost-recovery –

How much to charge for the service vs. for connection to cover investment and operating cost?

Expanding access –

Is willingness-to-pay high enough to justify expansion? If not, how much of a subsidy is required?



Affordability for the poor –

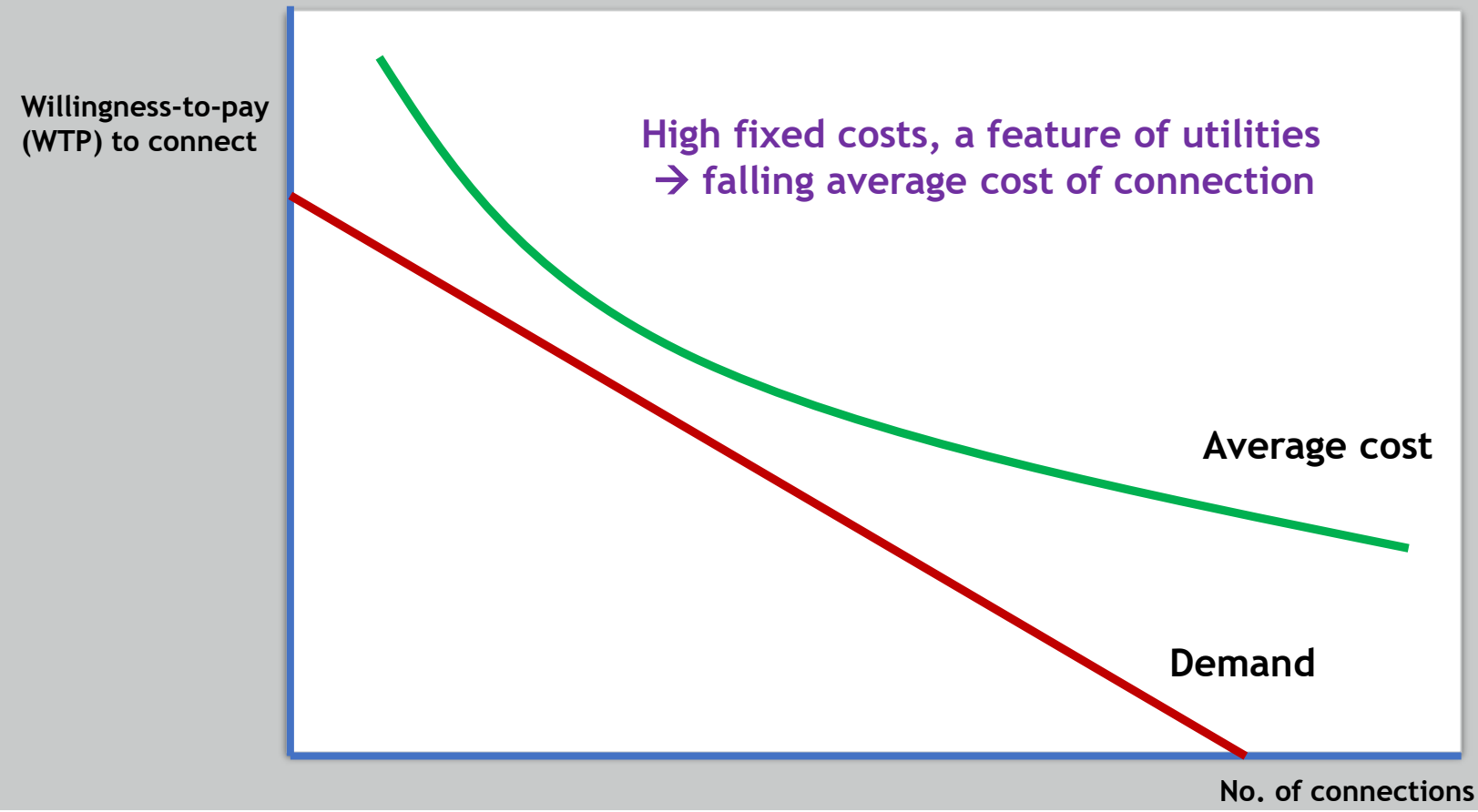
How should the “social tariff” be set? What are the welfare and distributional impacts of (e.g., energy) subsidy reform.

Conservation/efficiency goals –

How do consumers respond to conservation incentives (e.g., peak-load pricing)? Role of usage information?

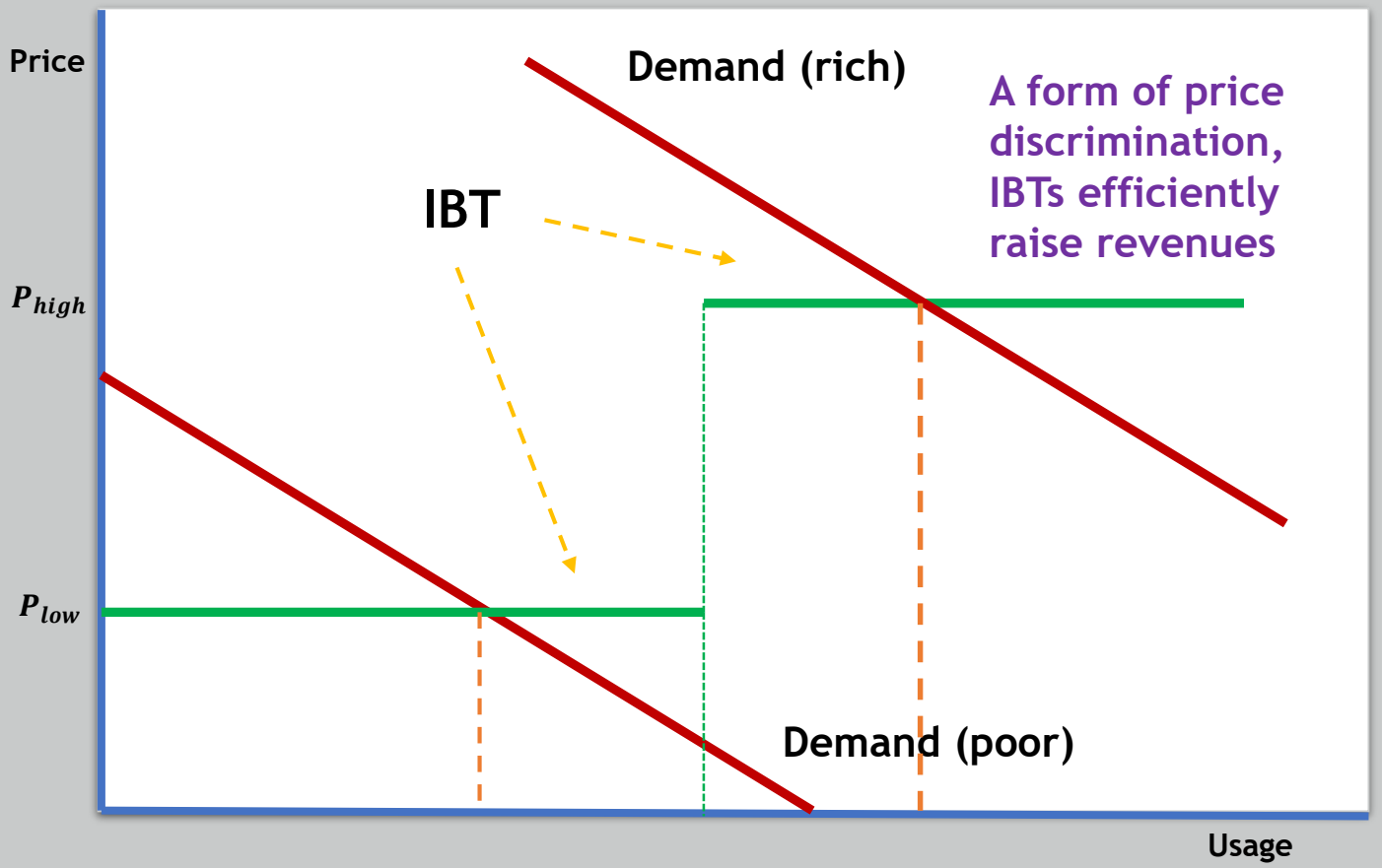
How does neoclassical economics approach these policy questions?

The “toolkit”…



1. extensive margin

e.g. Lee et al. (2020)



2. intensive margin

e.g. McRae (2015)

What is behavioral economics about?

- ***Inattention***
  - to true prices
  - to true ability (overconfidence)
  - to the future (hyperbolic discounting)
  - to future circumstances by anchoring on present circumstances (projection bias)

and so on (Xabaix 2019)

- Nudges (Thaler and Sunstein, 2018)
  - e.g., changing default option, social heuristics
  - normative program – 'improve' decision-making
    - eMBeD at the WB
  - but nudges are often not costless ➔ CBA

Can we apply the insights of behavioral economics to utility policy questions?

Methods: Utility experimentation

- Why experiments?
  - Fixed customer base (intensive margin)
  - Homogeneous good
  - Metered consumption
- Early examples in US – Aigner (1984)
  - Time-of-Use (peak-load) electricity pricing
  - Do consumer gains outweigh cost of metering?
- Real time pricing (RTP) – Allcott (2011)
- Allcott and Mullainathan (2009)
  - RCTs for energy pricing/efficiency
  - ***behavioral*** interventions

Two utility experiments in Vietnam

- **Electricity**: What is the value of usage information when consumers are inattentive?

Do, Jacoby and Li (2020) *Informing Inattentive Agents: Evidence from a Residential Electricity Experiment,* work in progress

- **Piped water**: How should new utility services be priced when consumers unwittingly form habits.

Do and Jacoby (2020) *Optimal Utility Pricing when Consumers Form Habits : The Case of Piped Water in Vietnam,* WPS 9207

The electricity experiment

Inattention and increasing block tariffs

- IBTs for both water and electricity are ubiquitous (Komives et al 2005)
- IBTs help utility recover costs – a form of progressive taxation. But…
- IBTs create a welfare distortion when consumers face future demand uncertainty ➔ marginal price is uncertain
- Welfare distortion of IBTs compounded when consumers are inattentive to usage ➔ further misinformed about marginal price
- Scope for welfare-improving provision of usage information
- Can these welfare gains be quantified?

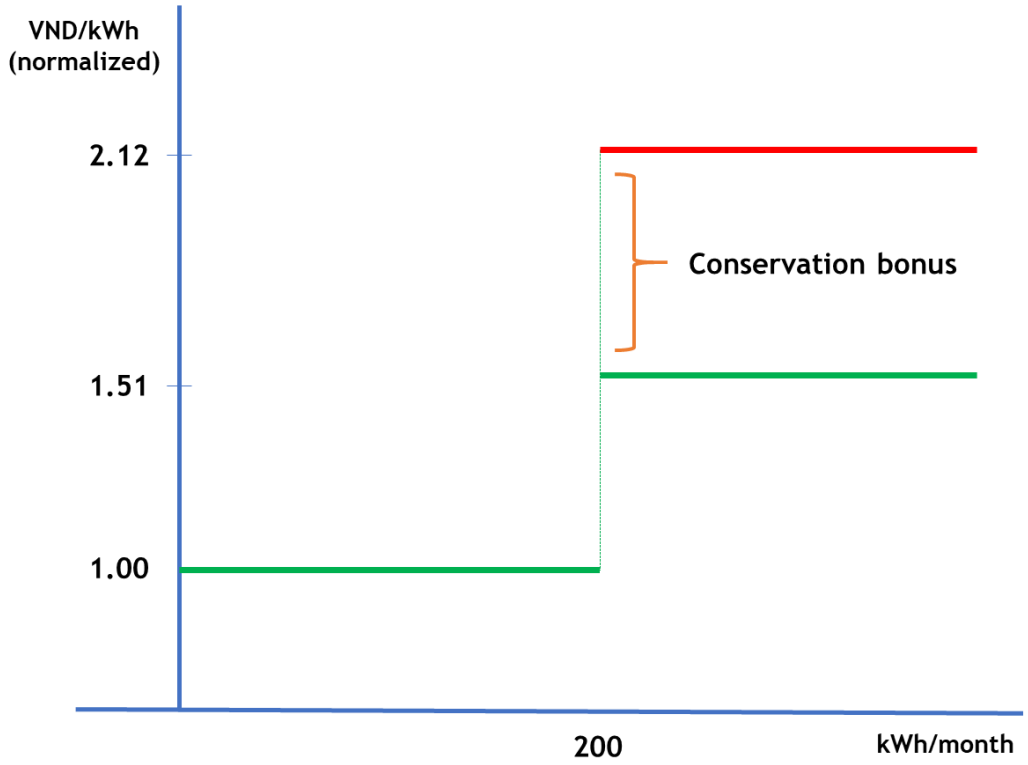
Research setting

- Urban Vietnam
  - Fast growing residential power demand driven by AC
  - Digital metering ➔ can provide real-time usage info
  - Bill payment default rare

Residential AC unit in Vinh Phuc

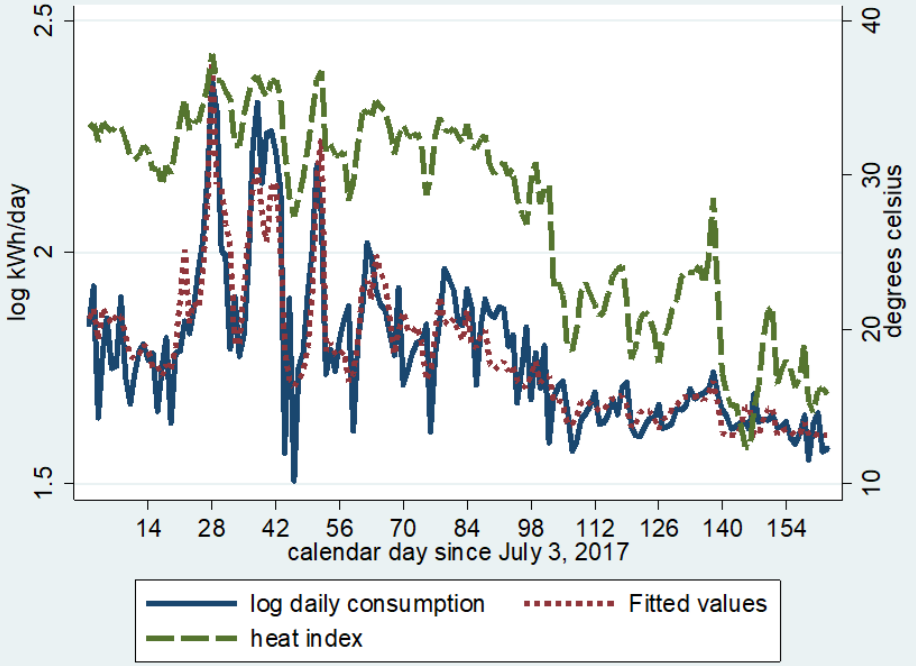
Experiment

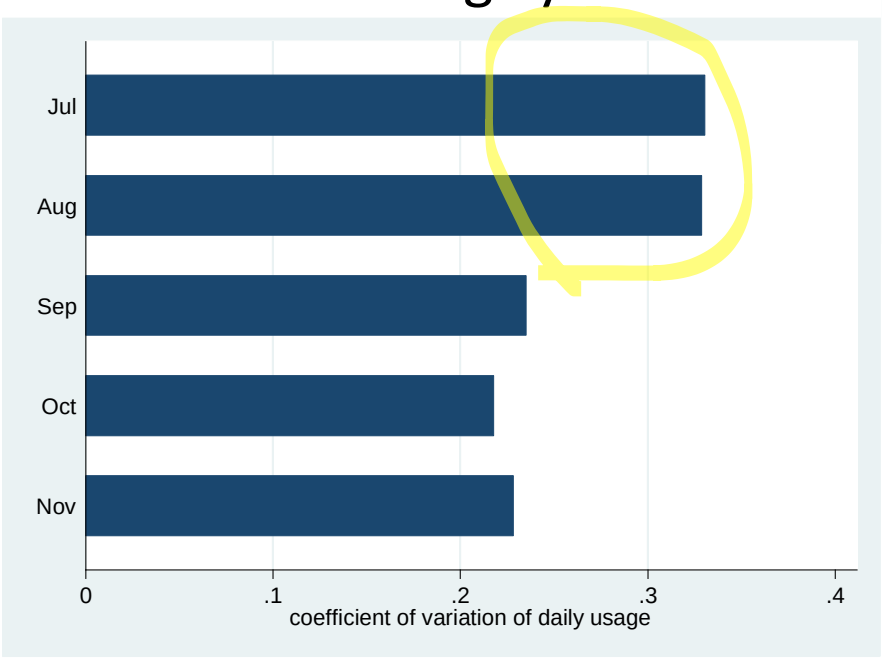
- ~1300 electricity customers (AC owners) in Vinh Phuc
- Intervention
  - conservation bonus vs. baseline IBT
  - cross-randomized with fortnightly text messages providing usage info
- Five months of daily consumption data, including hot/cool months



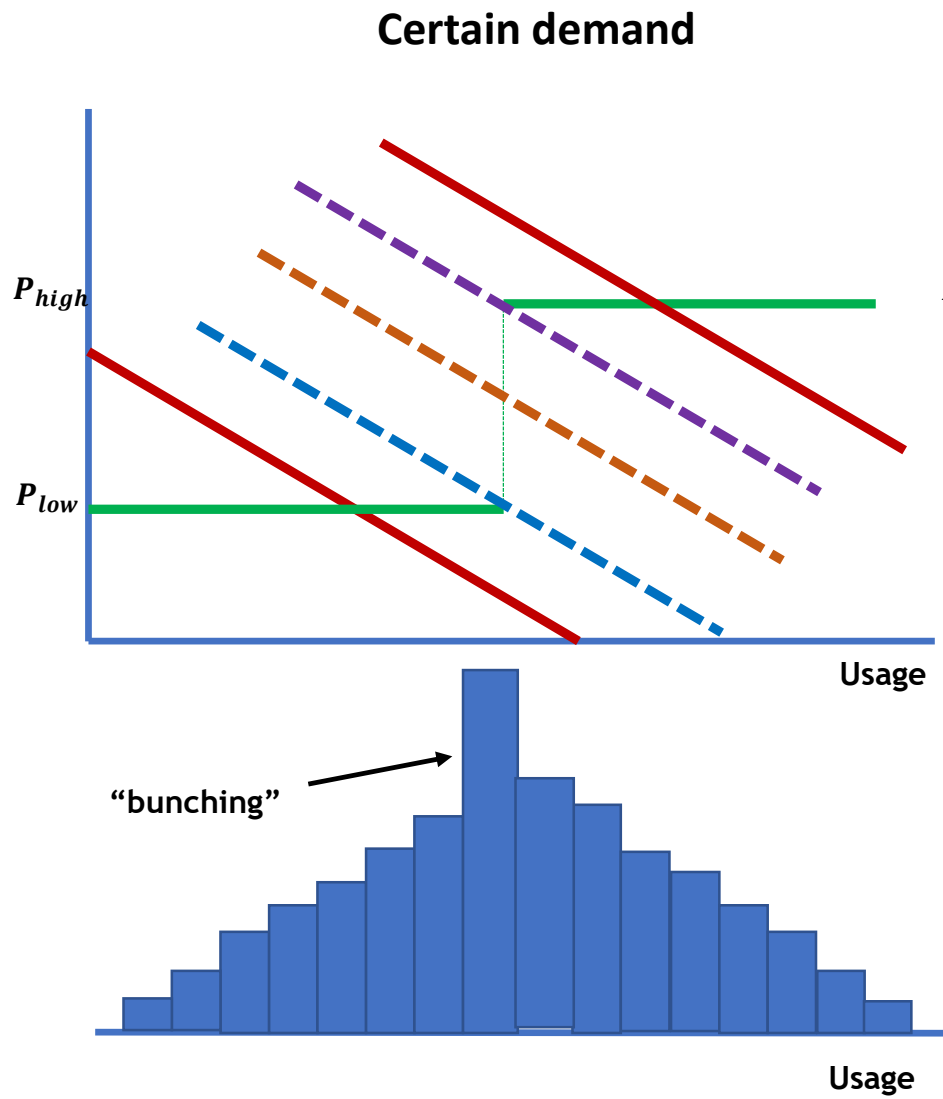
Role of air conditioning

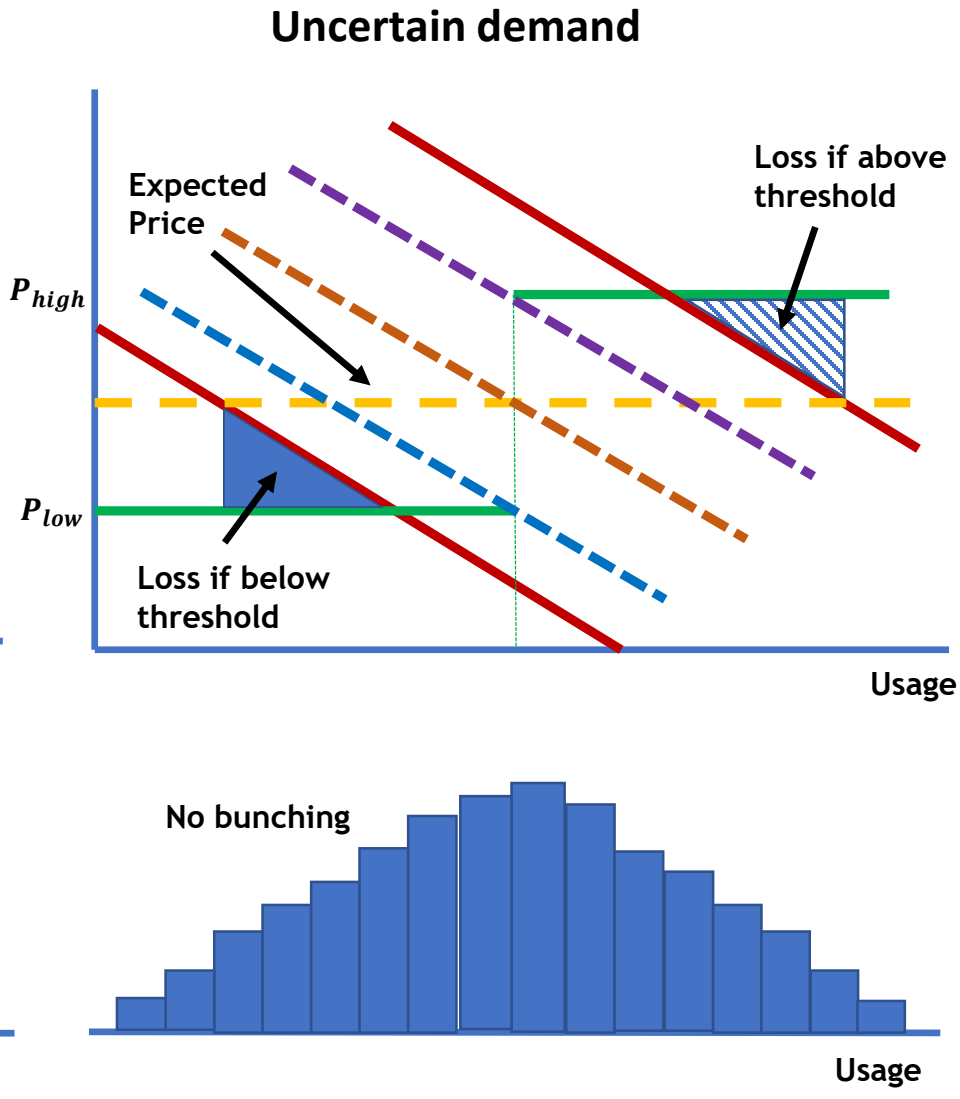
- 80% of day-to-day variation in usage due to heat index
- Demand uncertainty within billing cycle



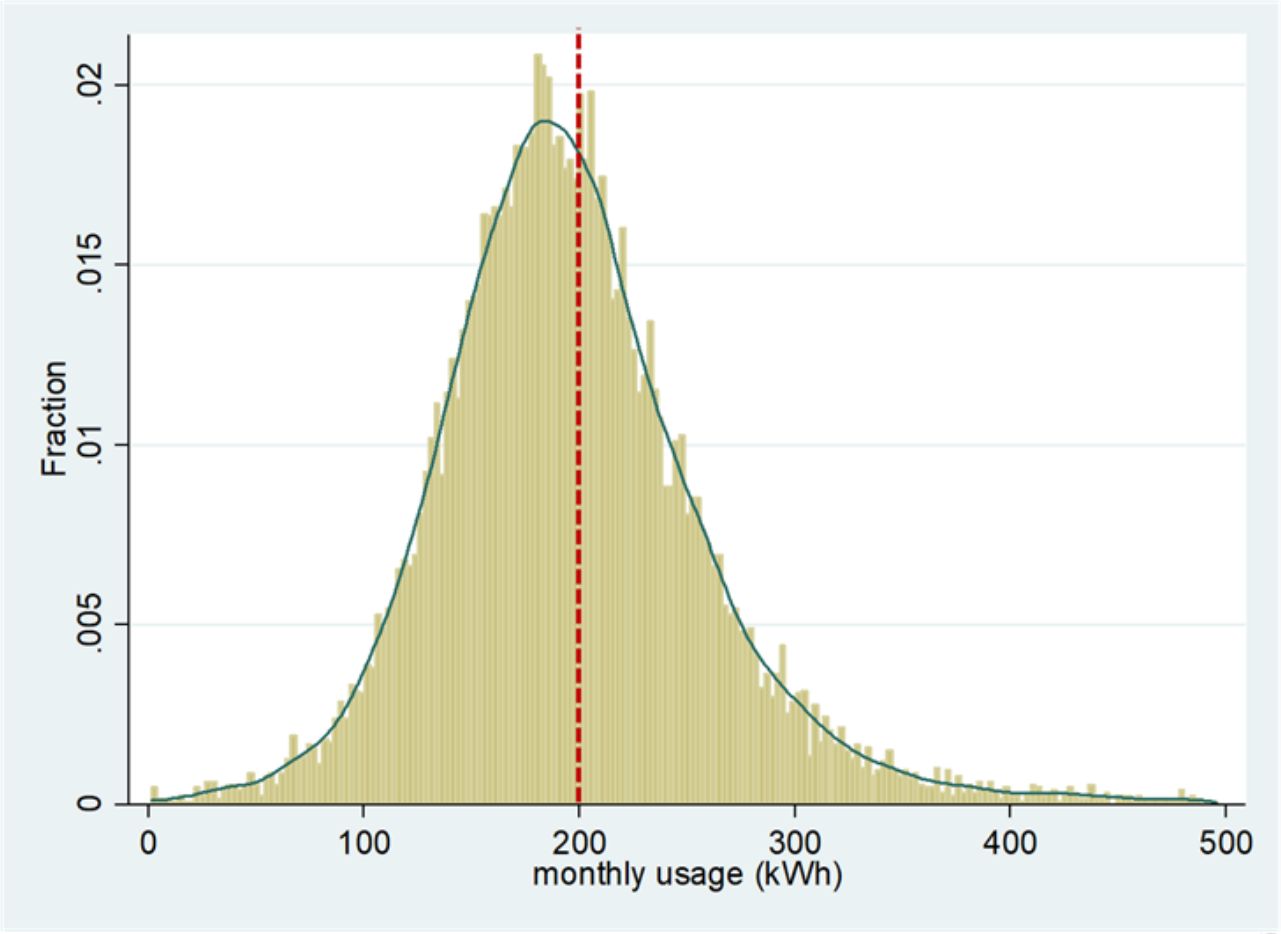


Why is demand uncertainty important?





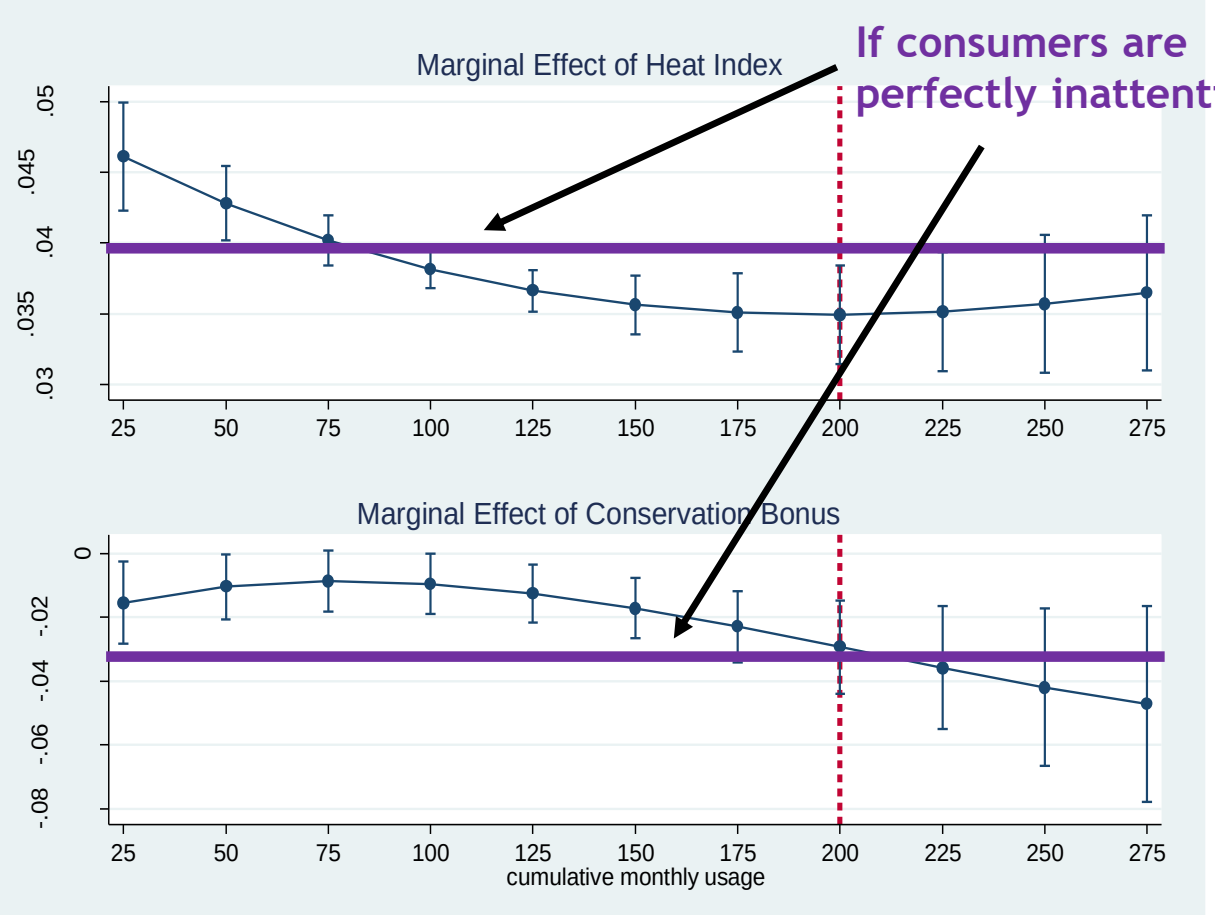
No bunching ➔ uncertainty is important



Are electricity consumers attentive to usage?

- As cumulative usage for the billing month → 200 kWh threshold
  - Daily usage response (+) to higher heat index ***attenuated***
  - Daily usage response (-) to conservation bonus ***increases***

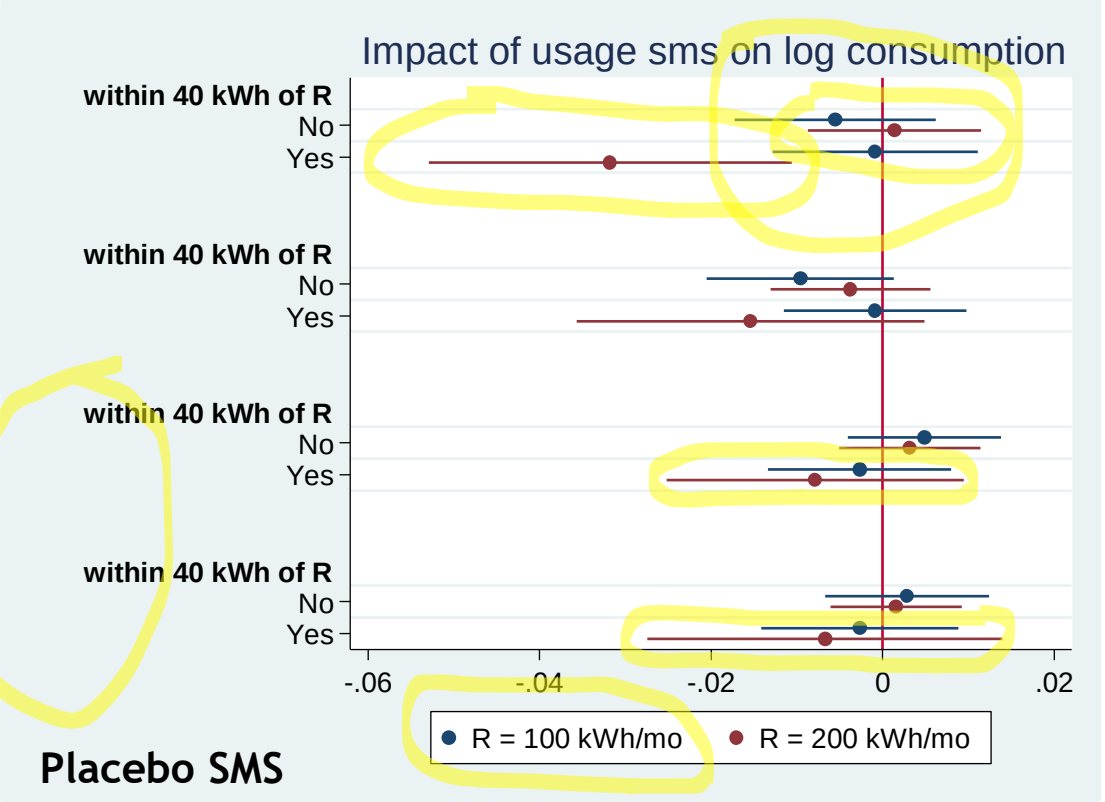
- Conclusion: Some attentiveness – how much? Need a ***quantitative*** model



Do consumers respond to real-time usage info?

Usage text (SMS) reduces consumption by 3% on day after it is received, but only when close to 200 kWh usage threshold

- SMS increases attention (for a day)
- What is $ benefit?



Identifying inattention

- ***Perceived*** usage (the behavioral part)
  - a weighted average of actual usage and "default" (heuristic) usage
  - default: cumulative usage $\propto$ billing day
  - SMS: increases attention-weight
- Estimating attention-weight
  - expected price varies over billing cycle with perceived usage
  - quantitative model relates daily cons. to expected price ***each day*** of billing cycle

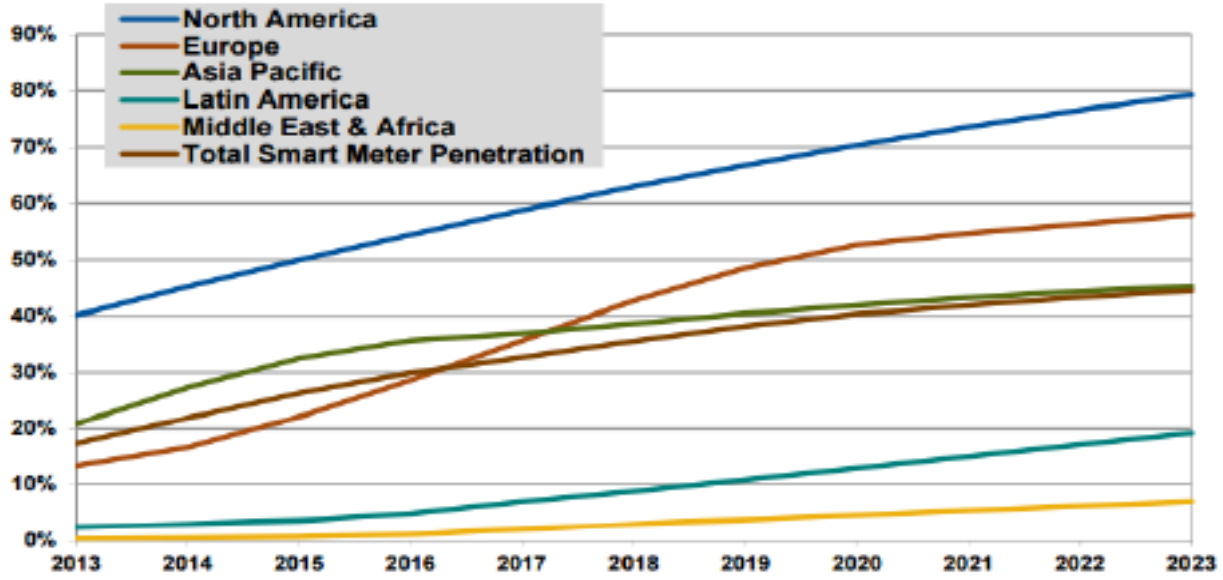
Benefits of usage info

- Estimated attention weight = **0.6 << 1.0**
- Value of electricity – actual expenditures (preliminary):
  - imperfect attention (actual) = **USD 7.0 /month**
  - perfect attention (counterfactual) = **USD 7.1 /month**
- Benefit of attentiveness = **7.1 - 7.0 = USD 0.1 /month**

- In summary
  - IBTs create distortions, partly due to inattention
  - Cost of inattention appears to be small =>
  - Welfare gains from providing usage info also small
  - TBD: estimate how much SMS increases attention weight

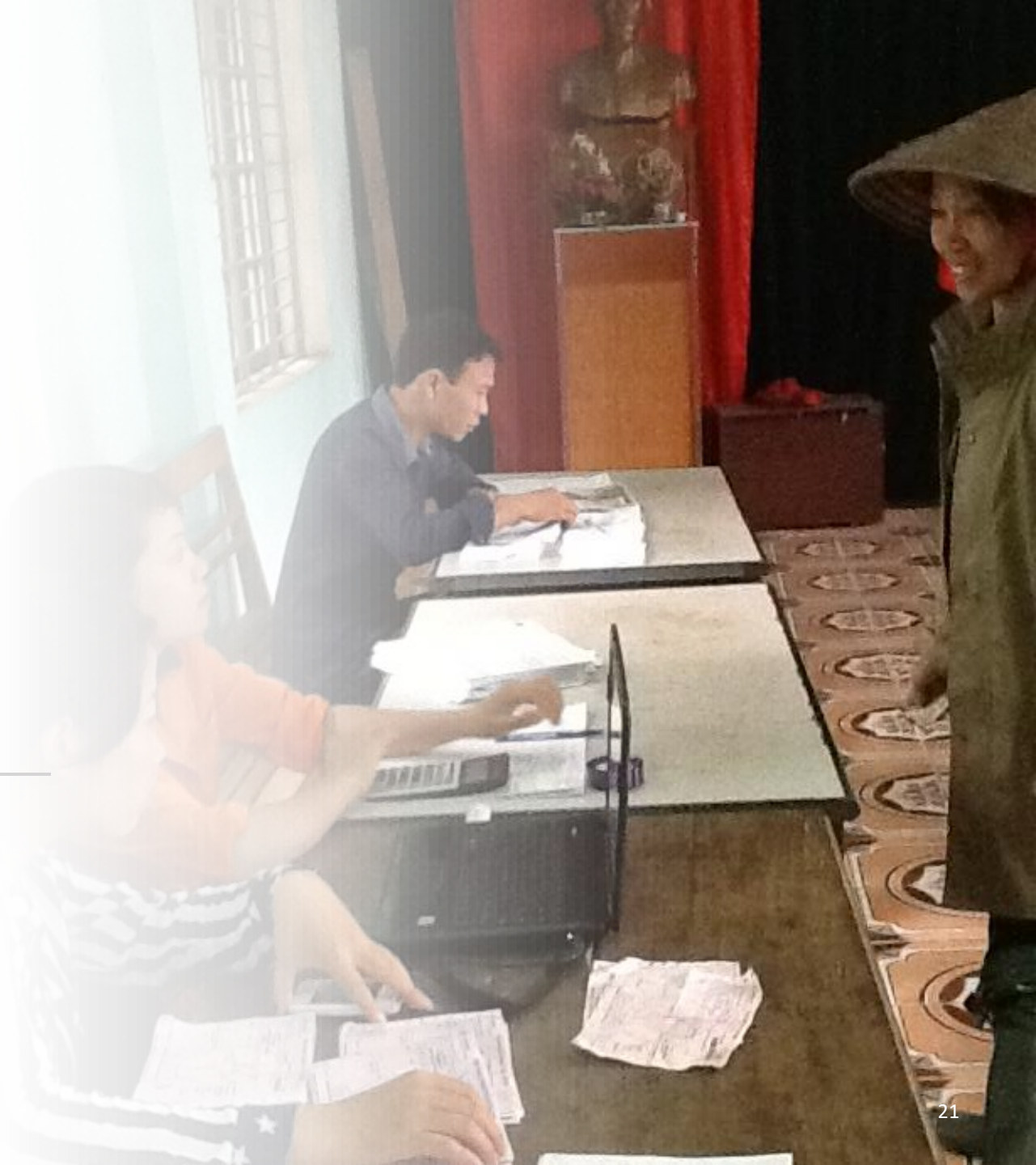
Looking forward – research opportunities

- New metering technologies
  - Pre-paid (Jack and Smith 2020) – reduce default
  - Smart-Grid and RTP (Jessoe & Rapson 2014; Ito et al. 2018)



Smart meter penetration by region (Uribe-Pérez et al 2016)

The water pricing experiment

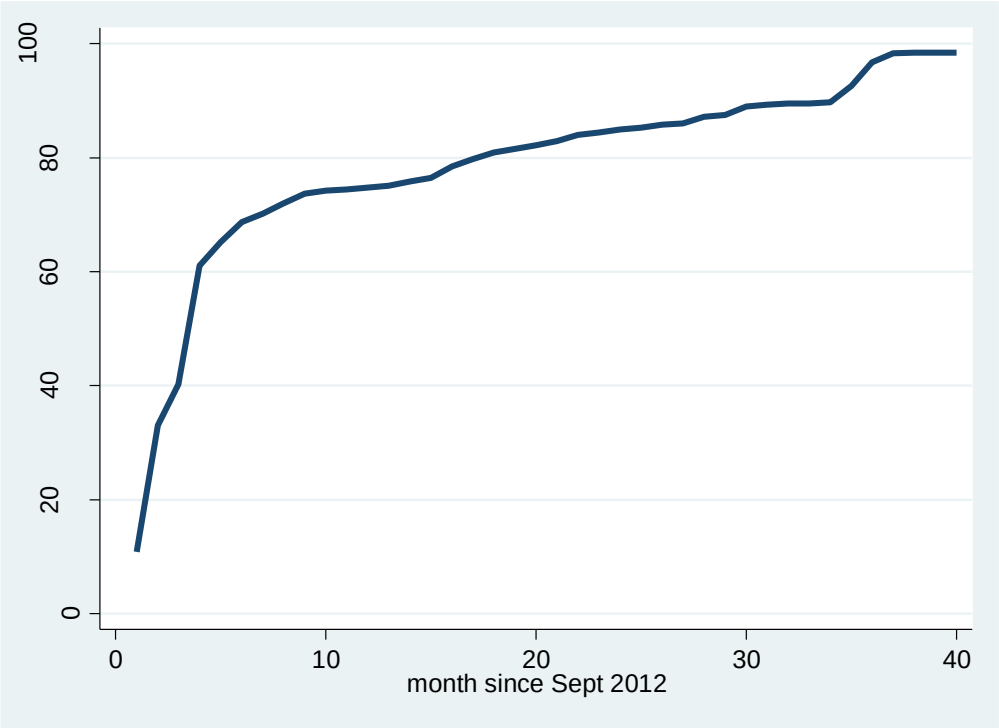


Big Picture: Access & cost recovery

- Provide utility services if WTP > cost of connection
- Optimal two-part tariff (Auerbach & Pellechio 1978)
  - price > marginal cost ➔ use proceeds to
  - reduce connection fee ➔ increase take-up of poor (low WTP)
- What if preferences are not fixed? i.e., habit formation
- ***Which*** WTP to use? Before or after habits are formed?

Research setting

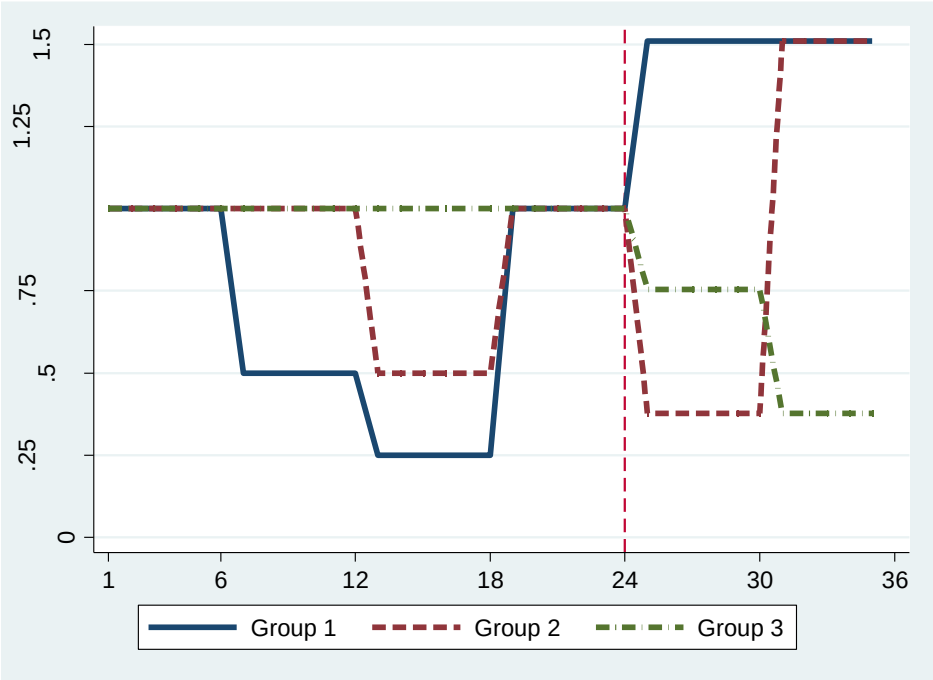
- Relatively prosperous rural commune in the Red River delta of Vietnam
- Prior to piped water, rainwater collected in tanks for drinking, cooking, and showers
- Piped water ➔
  - higher pressure (e.g., for showers)
  - convenience (no collecting/pumping)
  - But has not fully displaced rainwater
- Private water utility
  - Subject to govt. rate regulation
  - Provided cost info



A recent introduction: Median household connected 37 months prior to experiment

Experiment and data

- About 1500 water customers were followed for 3 years
- Intervention: 29 mos of alternating price discounts for 3 randomized groups
- Price information campaign to inform participants of discounts
- Monthly metered consumption data

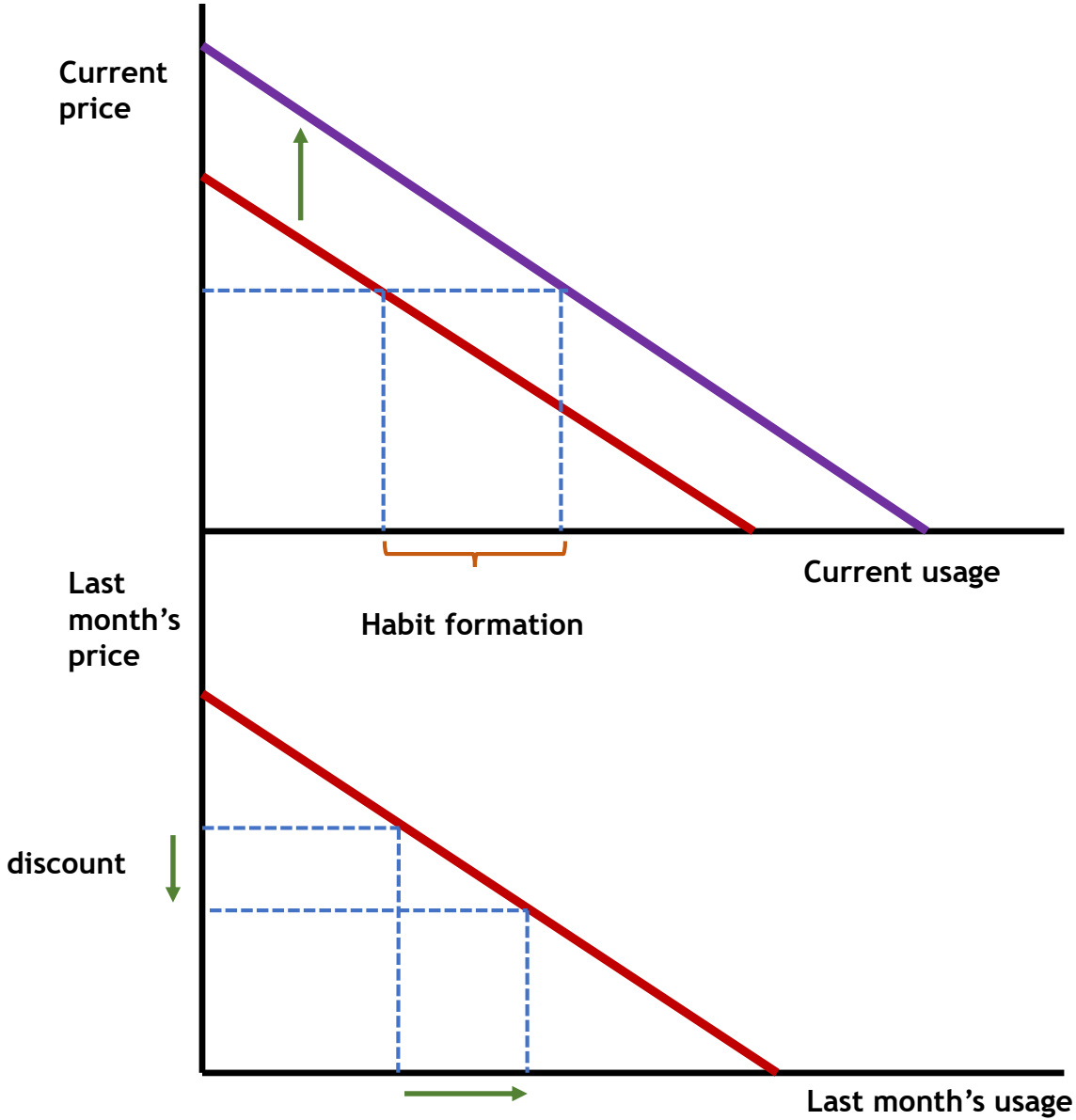


Habit formation in utility services: Evidence from energy usage

- Persistent responses to price changes/conservation programs
  - Jessoe and Rapson (2014), Allcott and Rogers (2014) - USA
  - Ito et al. (2018) - Japan
  - Ito and Zhang (2020) - China
  - Costa and Gerard (2018) – Brazil

Do piped water customers form habits?

Price	log monthly usage
Current mo.	-0.0420
	(0.0187)
Past (3 mo. ave)	-0.0480
	(0.0202)
Observations	42,398
R-squared	0.666

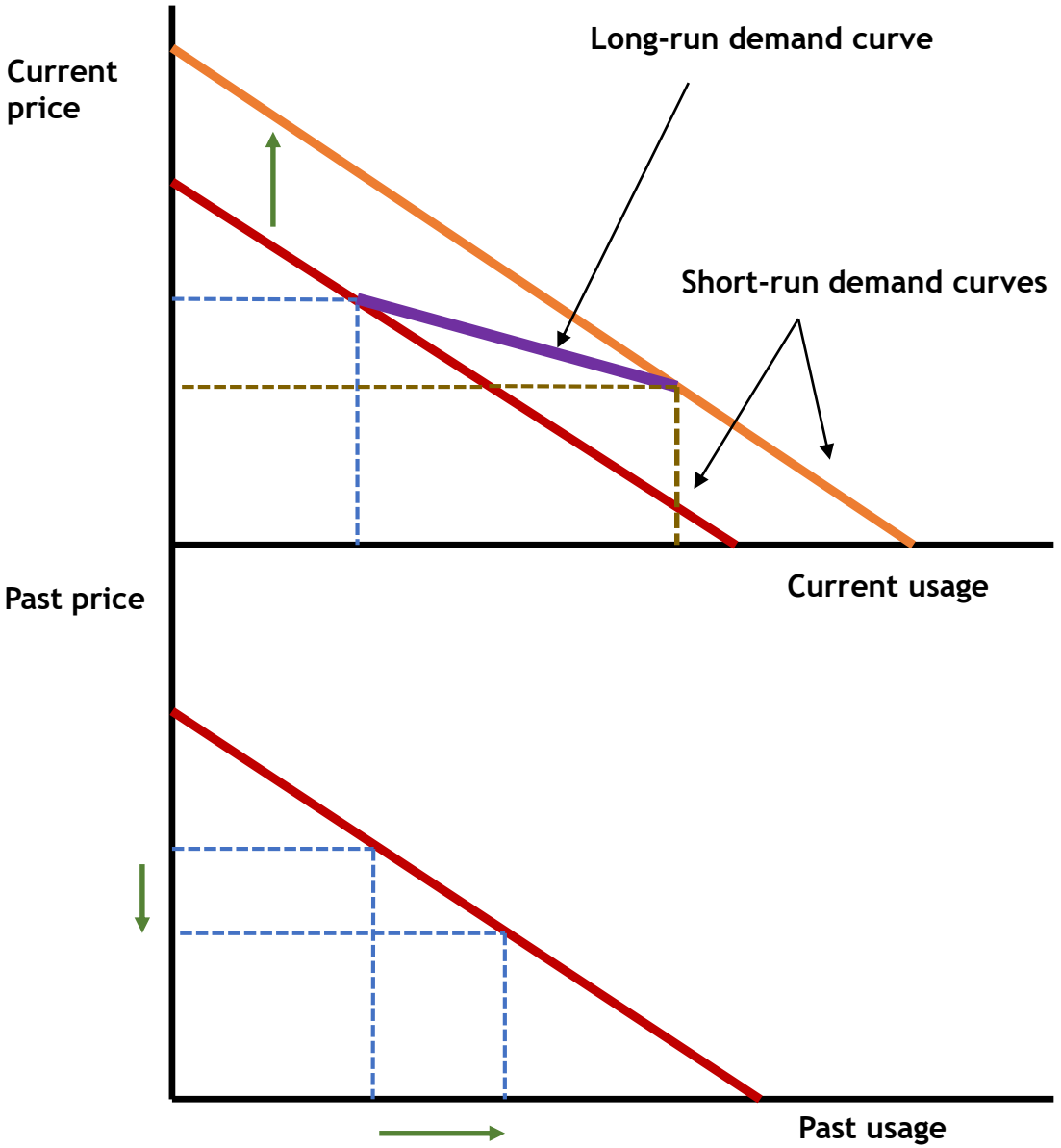


Are consumers aware of habit formation?

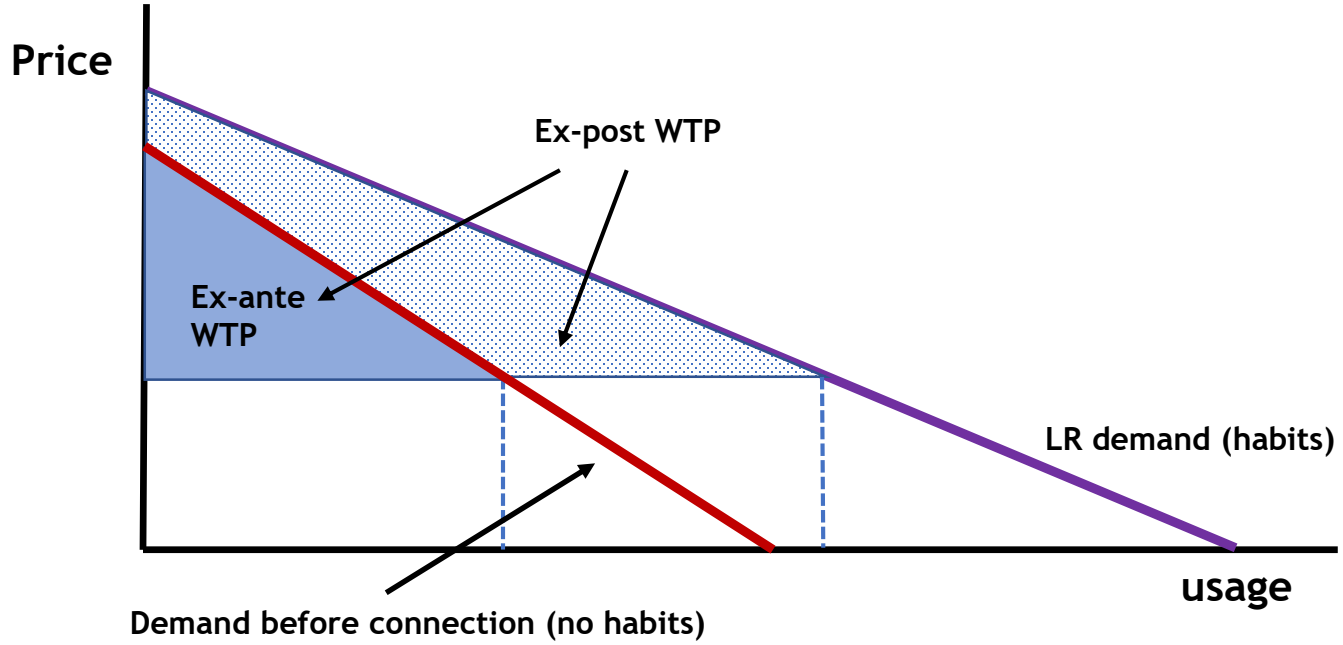
- Do consumers internalize the future effect of today's consumption?
- Or do they form habits unwittingly, naively assuming unchanging future preferences?
- Lack of awareness is consistent with
  - Evidence of ***projection bias*** summarized in Loewenstein et al. (2003)
  - Recent experiments: Augenblick & Rabin (2019); Acland & Levy (2015)
  - consumption dynamics in our pricing experiment
    - Current usage not "explained" by expected future usage
- Let's assume projection bias: what are the implications?

Projection bias: Implication one

- There is a “long-run” demand curve incorporating habit formation
- as distinct from “short-run” demand, which fixes habits
- LR price elasticity > SR price elasticity
- Estimates ➔ LR = 2.7 × SR
- Need to know LR demand to design pricing policy



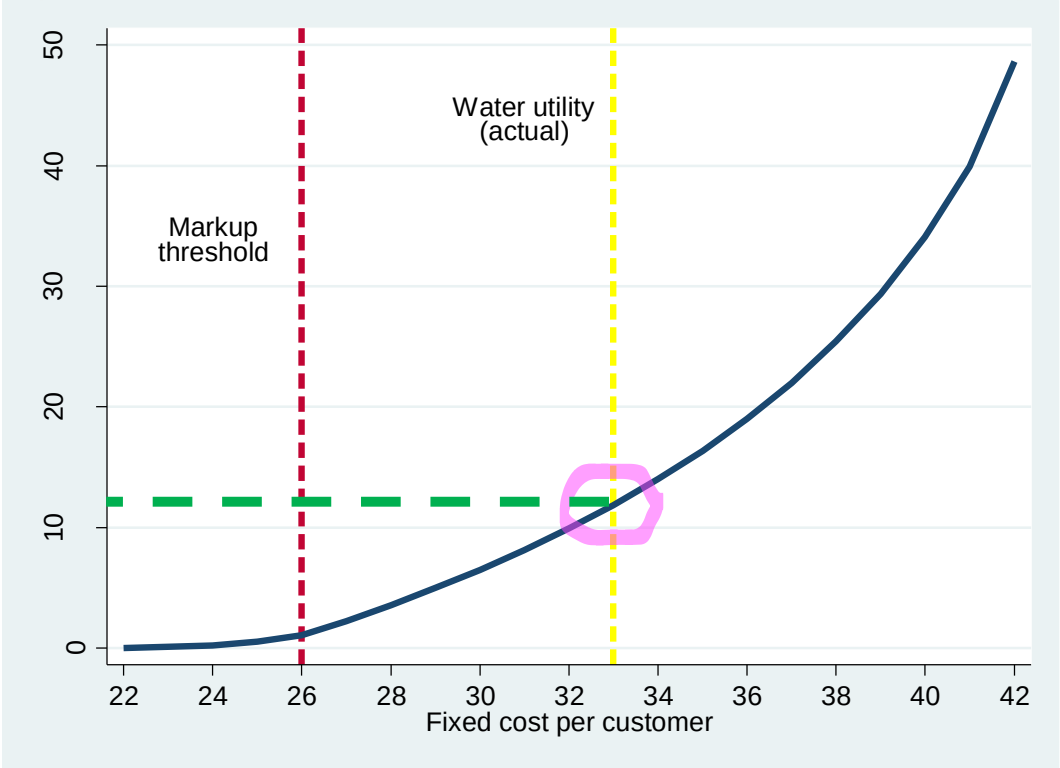
Projection bias: Implication two



- Ex-post willingness-to-pay > ex-ante willingness-to-pay
- Estimate: ex-post = 3.25 × ex-ante (median consumer)
- Decision to connect is based on ***ex-ante*** WTP

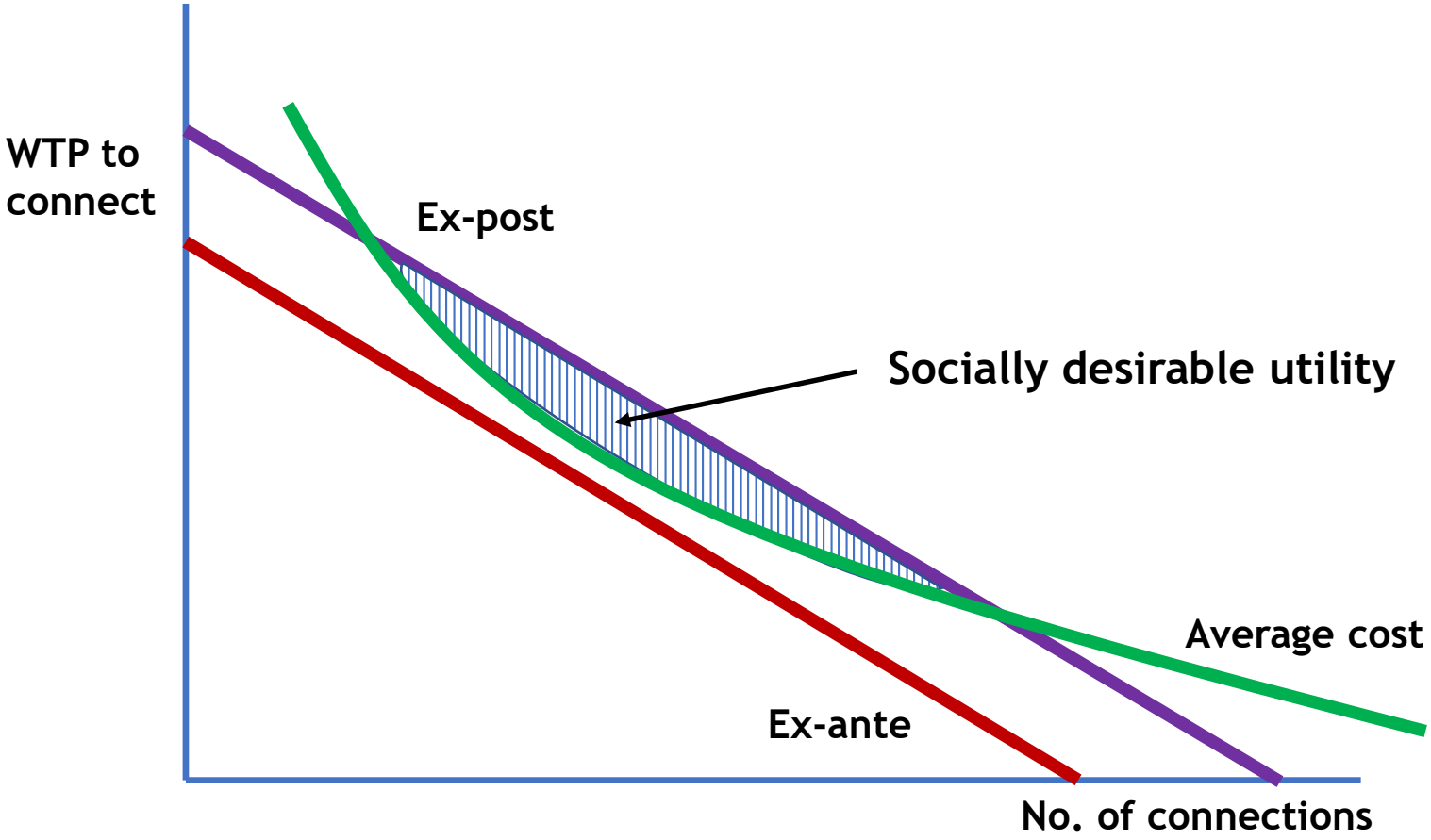
Two-part tariff redux

- How to best recover costs when consumers form habits?
- Defer payment till habits form
  - tax consumers' future 'selves'
  - subsidize present 'selves'
- Two ways to do this
  - low connection fee + markup
  - recurrent fee + zero markup
    - e.g., mobile-phone plans
- In our setting: recurrent fee yields 12% gain vs. markup



Main takeaway

- Behavioral economics says it matters ***when*** WTP is elicited
- CBA based on ex-ante WTP may reject socially desirable projects!



Conclusion

Two examples of behavioral economics

enriching ECON 101 toolkit

providing insights that allow better policy-making

A formula for progress =

economic theory +

behavioral science +

experimental methods!

THANK YOU

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