Rules of Thumb and Attention Elasticities: Evidence from Over- and Under-Reaction to Taxes

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This paper

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- Unaware / simply don't notice
- Just forget
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This paper: Theoretical and econometric toolkit for answering the research question, applied to sales taxes

Conceptual framework

Physical setting

- Product with salient price component p_s and opaque price component p_o
- Consumer i on choice occasion j values the product at $v_{ij} \sim F_i$
- We observe if individual buys or not on each choice occasion

Rational inattention model

Boundedly rational consumers can only figure out total price at some cost

- Set $p_o = k * q$, where $q \in \mathbb{R}$ and $k \in \mathbb{R}$ is transparent
  - E.g., price of taxed good or "we increase taxes by $3\times$"
- Prior beliefs about q are G_i
  - $G_i(x) = G(x - d_i)$, $\int x dG(x) = 0$
  - Prior mean given by d_i
- Info acquisition about q: Distribution F over signals $s \in \mathbb{R}$ and q
- Cost of info: $c_i(F) = \lambda_i \left(H(G_i) - E_s[H(F(\cdot|s)]\right)$
  - $\lambda_i \geq 0$: unit cost of information (varies by individual)
  - $H(B)$: uncertainty of belief B given by its entropy
  - Assumption: $\lambda_i \perp d_i$
- Buy if $v_{ij} >$ expected price post info acquisition

Reduced form representation

The *revealed attention weight (RAW)* representation:

$$Pr_i(buy) = Pr_i(v_{ij} > p_s + \theta_{ij} p_o)$$

- θ_i is the degree to which i underweights p_o relative to p_s
  - $\theta_{ij} = \theta_i + \delta_{ij}$, with $E[\delta_{ij}] = 0$. We focus on θ_i
- Revealed attention *weight* interpretation: if eliminating p_o impacts demand as much as decreasing p_s by Δ, then $\theta = \Delta / p_o$
  - $\theta > 1$: Over-reaction
  - $\theta = 1$: Correct perception
  - $\theta < 1$: Under-reaction

Proposition 0: Behavior from the rational inattention model can be represented by the RAW model.

Testable Predictions

Can test RI predictions using RAW representation, absent state-dependent stochastic choice data

Suppose attention weights are measured for two different stakes, k^H and k^L, with $k^H > k^L$

- Proposition 1 Average θ_i's closer to 1 at higher stakes
- Proposition 2 Persistent individual differences across stakes (i.e., attention weights are positively correlated as stakes vary)
- Proposition 3 High θ_i^L individuals (sufficiently close to 1 on average) should have lower than average degree of adjustment as stakes increase (i.e., lower than average $\theta_i^H - \theta_i^L$) .
- Proposition 4 Individuals whose θ_i^L and θ_i^H are sufficiently close to each other (i.e., little adjustment as stakes increase) should have (strictly) higher than average θ_i^L and (weakly) higher than average θ_i^H.

Experimental design

Sample and decisions overview

- Online experiment with demographically diverse sample ($N = 1545$) from the 45 states with positive sales taxes
  - Approximates US population on basic demographics
  - Panel provided by *ClearVoice Market Research*

- Series of *real* purchase decisions about common household products
  - 9 products selected from a pretest of 80; not tax-exempt
    - Batteries, bath mat, Febreze, bath towels, laundry hamper, etc.
    - Each person went through a random subset of 3

Decisions

3 "stores" and 3 different items for each individual

- Store A: No sales tax
- Store B: "The standard sales tax that you pay in your city of residence on standard, non-tax-exempt items."
- Store C: "Triple the standard sales tax that you pay in your city of residence on standard, non-tax-exempt items."

Randomization:

- All within-person
- The 3×3 store-item screens presented in completely random order
- All prices completely random on screen
  - But if all "yes" or all "no" selected on screen, then participant prompted with hypothetical price question

Incentive compatible: Subjects given budget and one decision randomly selected to be implemented

Intro screen

You are now entering Store B to shop for: *Glad OdorShield Tall Kitchen Drawstring Trash Bags.*

Continue

Shopping screen

Glad OdorShield Tall Kitchen Drawstring Trash Bags, Fresh Clean, 13 Gallon, 80 Count

Product Description: Glad OdorShield Tall Kitchen Drawstring Trash Bags backed by the power of Febreze are tough, reliable trash bags that neutralize strong and offensive odors for lasting freshness. These durable bags are great for use in the kitchen, home office, garage, and laundry room.

	Yes	No
Would you buy the Glad OdorShield Trash Bags for $8.05?	○	○
Would you buy the Glad OdorShield Trash Bags for $5.29?	○	○
Would you buy the Glad OdorShield Trash Bags for $7.00?	○	○
Would you buy the Glad OdorShield Trash Bags for $4.00?	○	○
Would you buy the Glad OdorShield Trash Bags for $10.64?	○	○
Would you buy the Glad OdorShield Trash Bags for $9.25?	○	○
Would you buy the Glad OdorShield Trash Bags for $12.24?	○	○
Would you buy the Glad OdorShield Trash Bags for $4.60?	○	○
Would you buy the Glad OdorShield Trash Bags for $6.08?	○	○
Would you buy the Glad OdorShield Trash Bags for $14.07?	○	○

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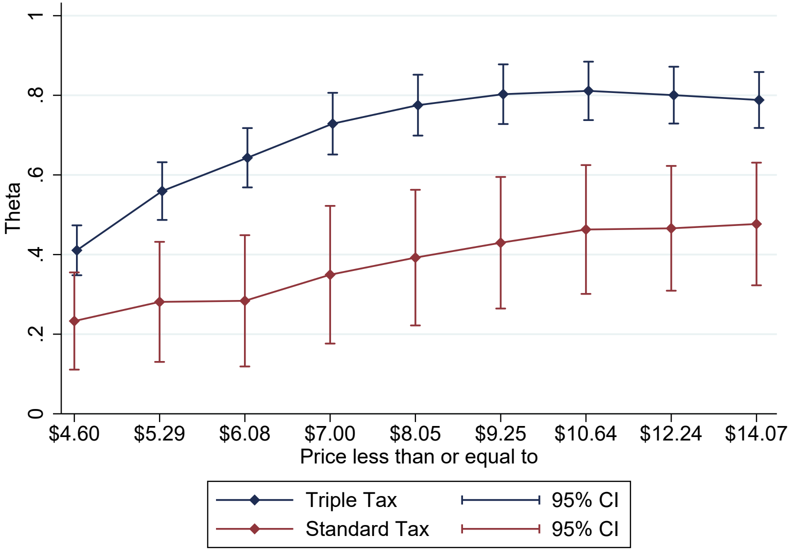
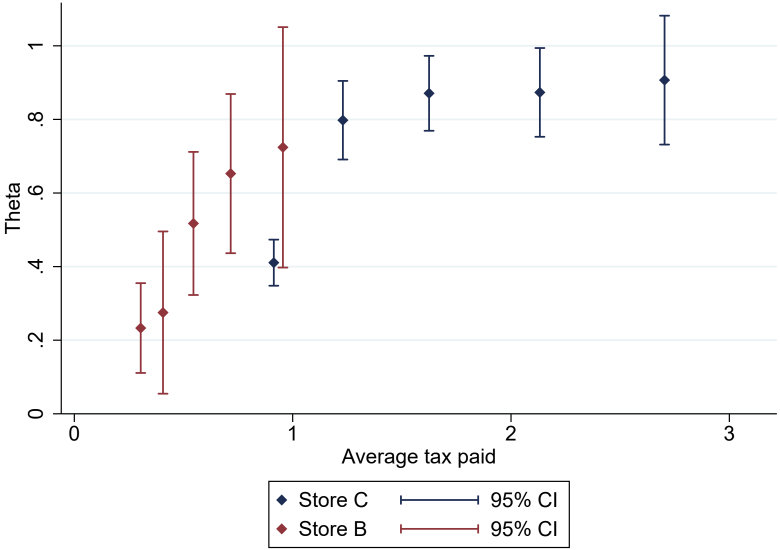
Results

θ for prices at or below a cutoff



θ as a function of absolute value of tax



Use of θ at the individual level: Motivation

Goal: Test propositions and make claims on the distribution of θ_is in the population (e.g., fraction with $\theta_i > 1$)

- Available information: individual estimates of θ_{ij} for each product/store combination ($\hat{\theta}_{ij}$) (6 total)

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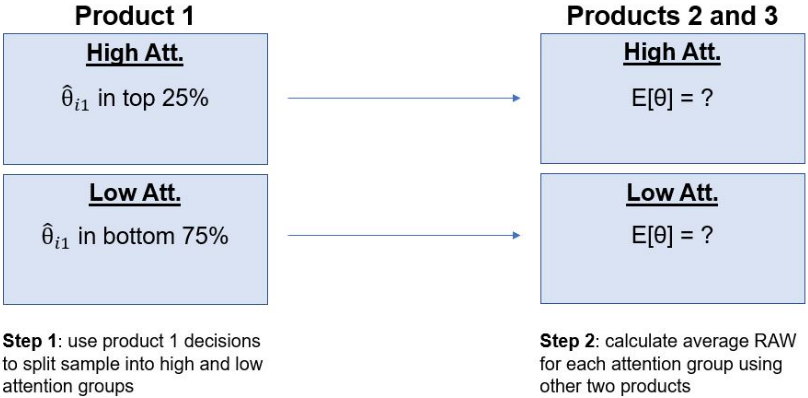
- However, under (very weak) assumptions, these $\hat{\theta}_{ij}$ can still be used to learn information by proxying for high or low attention individuals.

Use of θ at the individual level: Procedure



Later: Repeat procedure to divide individuals into high or low adjustment types, and use this to derive a lower bound on heterogeneity

Results for high vs. low attention types

	Store B	Store C	Store C - Store B
(1): High att.	1.04	1.20	0.16
	[0.84, 1.25]	[1.10, 1.30]	[-0.01, 0.33]
(2): Low att.	0.25	0.64	0.39
	[0.08, 0.43]	[0.57, 0.72]	[0.26, 0.52]
(3): (1) - (2)	0.79	0.56	-0.23
	[0.54, 1.04]	[0.45, 0.67]	[-0.43, -0.04]

Notes: Reported estimates are the average across all products.

Fact 1: The procedure predicts high/low attention types

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Fact 2: Persistent individual differences acros stakes (*Prop 2*)

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Fact 3: Adjustment by high types is significantly lower than average (*Prop 3*)

Results for high vs. low adjustment types

	Store B	Store C	Store C - Store B
(1): Low adj.	0.85	0.86	0.01
	[0.64, 1.07]	[0.77, 0.96]	[-0.15, 0.17]
(2): High adj.	0.34	0.76	0.43
	[0.17, 0.51]	[0.69, 0.84]	[0.30, 0.55]
(3): (1) - (2)	0.52	0.10	-0.42
	[0.28, 0.75]	[-0.01, 0.20]	[-0.60, -0.24]

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Fact 2: θ^B is above average for low adjustment types! (*Prop 4, part 1*)

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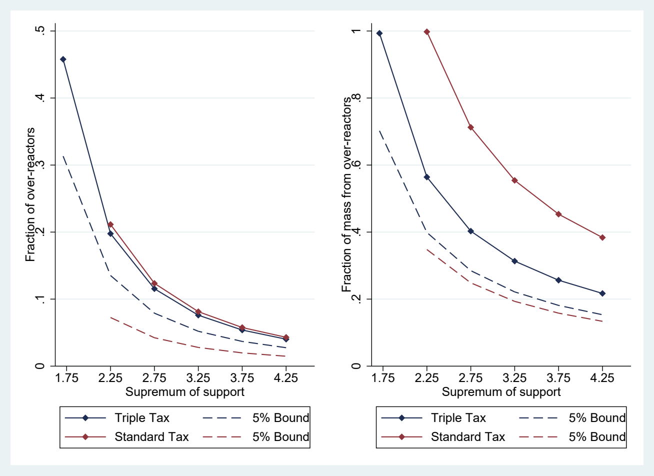
Fact 3: θ^C is also **above** average for low adjustment types! (*Prop 4, part 2*)

Bounds on overreaction and mass of overreaction

After some econometrics...



Conclusion: Takeaways and contributions

(I) Empirics: Have shown that (in this economic setting)

1. Inattention to opaque incentives is deliberate and elastic to stakes
2. "See it or ignore it" is not what's going on: Not thinking means relying on highly heterogeneous rules of thumb (priors)

(II) Economic implications: Beyond "theory-testing," implications for

1. Efficiency and welfare
2. Market structure in shrouded attribute models

(III) Methods: Econometric methods can be generalized for applications to

1. Within-subject experiments (e.g., are people risk-loving, loss-loving, or future-biased?)
2. Quantification of private information with multiple noisy proxies