Attention Variation and Welfare: Theory and Evidence from a Tax Salience Experiment (REStud 2018)

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Introduction to design

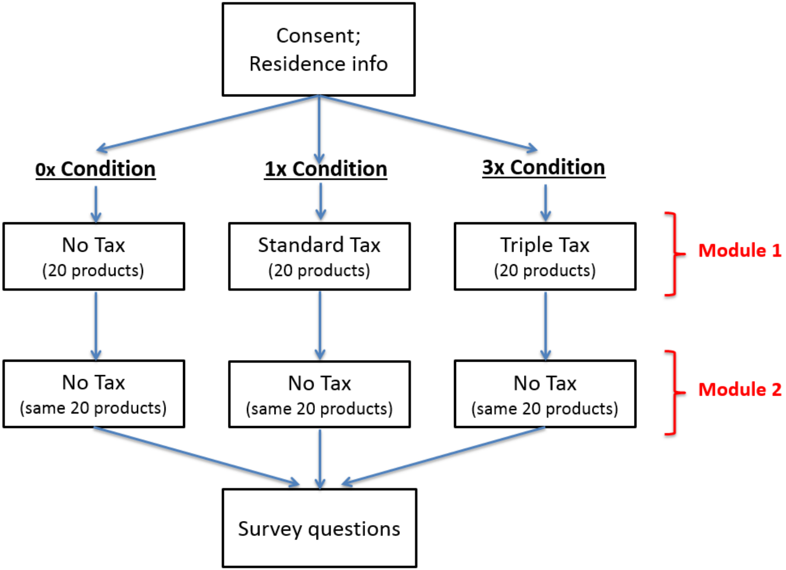
- Online experiment with demographically diverse sample ($N = 2998$) from the 45 states with positive sales taxes
  - Approximates US population on basic demographics
  - Panel provided by *ClearVoice Market Research*
- Series of *real* purchase decisions about common household products
  - 20 products selected from a pretest of 80; not tax-exempt
  - Batteries, bath mat, Febreze, bath towels, laundry hamper, etc.

Caveats

1. Representativeness of sample
2. External validity: Not a completely natural shopping environment
3. Short-run or long-run differences in underreaction?

** Contributions: *Initial* investigation into importance of heterogeneity, proof of concept, some insights into mechanisms

Experimental conditions



Decisions

- For each of twenty household products, use slider to select highest "tag price" (before-tax price) at which would buy the product
  - If product sold to person at tag price p, total amount paid is $p(1+\tau)$, where τ is tax rate

- Incentive compatibility ensured with the Becker-DeGroot-Marschak mechanism (BDM)
  - Product's actual tag price randomly determined
  - Given $20 budget for each decision (only one decision selected at random to count)
  - If respondent was willing to buy product at randomly chosen tag price, price was deducted from budget and product was shipped
  - Unspent portion of $20 budget is kept by the respondent

Subject comprehension tested with quiz questions, and final sample consists only of subjects who pass

BDM slider for tax conditions

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Carnation Home Fashions Hotel Collection 8-Gauge Vinyl Shower Curtain Liner with Metal Grommets, Monaco Blue

Protect your favorite shower curtain with our top-of-the-line Hotel Collection Vinyl Shower Curtain Liner. This standard-sized (72'' x 72'') liner is made with an extra heavy (8 gauge), water repellant vinyl that easily wipes clean. With metal grommets along top of the liner to prevent tearing. Here in Monaco Blue, this liner is available in a variety of fashionable colors. With its wonderful features and fashionable colors, this liner could also make a great shower curtain.

Please enter the highest tag price at which you would buy this product:
(You can drag the slider, or use left and right arrow keys to adjust it by $0.01 increments)

Tag Price: **$10.95**

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

[link to instructions page]

BDM slider for no tax condition

Wharton
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Energizer AA Batteries max Alkaline 20-Pack

Energizer AA max alkaline batteries 20 pack super fresh, Expiration Date: 2024 or better. Packed in original Energizer small box 4 batteries per box x 5 boxes total 20 batteries.

Please enter the highest tag price at which you would buy this product if no sales tax were to be applied at the register:
(You can drag the slider, or use left and right arrow keys to adjust it by $0.01 increments)

Tag Price:

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

[link to instructions page]

Advantages and disadvantages of elicitation method

Advantage: Yields direct, non-parametric estimates of average m

- They call θ the attention parameter — what we call m
- $E\left[\frac{1}{\text{tax rate}} \cdot \frac{p_{\text{2nd stage}} - p_{\text{1st stage}}}{p_{\text{1st stage}}}\right] = E\left[\frac{1}{\tau} \cdot \frac{p - \frac{p}{1+m\tau}}{\frac{p}{1+m\tau}}\right] = E[m]$
  - In actual empirical implementation, also use the "no tax" arm to control for any other possible systematic differences between 1st stage and 2nd stage

Disadvantage: The bidding-like mechanism is weird

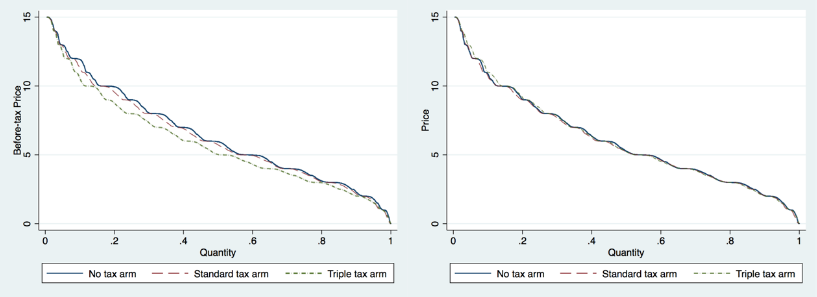
- But Taubinsky (2016) replicates results with "yes/no" buying decisions (multiple price lists) using probit models

Results

Average demand curves as functions of pre-tax price

(a) Stage 1, before-tax price

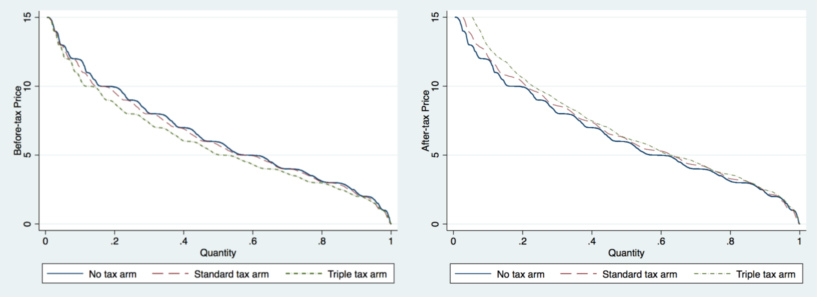
(b) Stage 2



Sample demographics balance

Demand curves as functions of pre- vs. post-tax price

(a) Stage 1, before-tax price (b) Stage 1, after-tax price



Sample demographics balance

Average underreaction for standard and triple taxes

Table: Estimates of average θ by condition

	(1) All	(2) $p_2 \geq 1$	(3) $p_2 \geq 5$
Std. tax avg. θ	0.261**	0.250***	0.226**
	(0.111)	(0.095)	(0.094)
Triple tax avg. θ	0.481***	0.475***	0.535***
	(0.045)	(0.039)	(0.041)
Observations	59960	58478	32810
Difference p-val	0.03	0.01	$<$ 0.001

Notes: Cluster-robust (by subject) standard errors in parentheses. Significance * 0.1 ** 0.05 *** 0.01

Formal econometric model for estimation

Higher attention to taxes on higher priced products?

Table: Estimates of average θ by p_2 bin ($p_2 \leq 5$, $5 < p_2 \leq 10$, $p_2 > 10$)

	(1) Standard	(2) Triple	(3) Pooled	(4) Standard	(5) Triple	(6) Pooled
Middle p_2 bin	–0.097	0.117**	0.123**	–0.077	0.097**	0.104***
	(0.147)	(0.054)	(0.054)	(0.101)	(0.038)	(0.038)
High p_2 bin	0.115	0.147**	0.154**	0.168	0.069	0.072
	(0.185)	(0.074)	(0.074)	(0.152)	(0.053)	(0.053)
Std. tax cons.	0.266*		0.156			
	(0.140)		(0.098)			
Triple tax cons.		0.402***	0.395***			
		(0.054)	(0.054)			
Individual fixed effects	No	No	No	Yes	Yes	Yes
Observations	40651	39378	58478	40651	39378	58478

Notes: All specifications condition on $p_2 \geq 1$. All specifications include order-effect dummies. Cluster-robust standard errors (by subject) in parentheses. Two-step GMM estimator in columns (3) and (6). Significance * 0.1 ** 0.05 *** 0.01

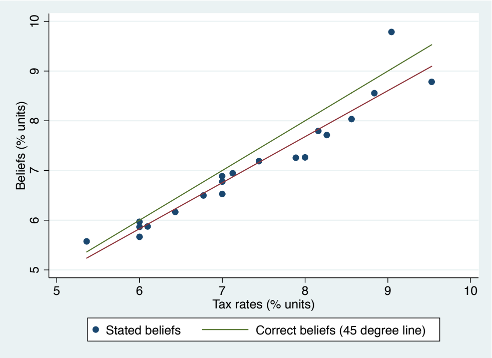
Robustness of previous result

Taubinsky (2016) replicates higher underreaction at lower prices for both standard and triple taxes with greater statistical precision

- Based on results from last slide, pre-specified (AEA RCT registry) a cutoff of $p = \$6$ for "low" vs. "high" prices

Incorrect tax beliefs *not* a major source of error

Figure: Perceived vs. actual tax rates



Notes: This figure divides actual tax rates into 25 quantiles, and plots the average belief against the average tax rate for each quantile

- 73% know tax rate within 0.5 percentage points

How big are individual differences?

Quick theory review:

- Efficiency costs at (p, τ) is $\propto E[\theta|p,\tau]^2 + Var[\theta|p,\tau]$
- Question: How important is the variance compared to the mean?

Main quantity of interest: $E_{p_1,\tau}[Var[\theta|p_1,\tau]]$

- Some differences between subjects may be due to differences in the tax rates or prices at which they buy
- Question: How big is variation after controlling for tax-rates and prices?

Approach

Problems for direct estimation:

1. Second-moment estimation is potentially biased by people anchoring on round-numbers
2. Taxes are small in magnitude $\Rightarrow$ individual-level estimates are very noisy
   - $\Rightarrow$ hard to do variance-decompositions

Instead, combine "self-classifying" survey responses with actual behavior to establish a non-parametric lower bound

- *No* assumptions about truth-telling or metacognition required
- Builds on Hendren (2013), Handel and Kolstad (2015)

Survey instrument: The self-sorting survey question

For standard and triple tax arms: "Think back to part 1 of the study, where there was a tax on any item you might purchase. If there was no tax, would you be willing to buy at higher tag prices in part 1?"

	Standard	Triple
"Yes" (R=H)	0.06	0.11
"Maybe a little" (R=M)	0.56	0.56
"No" (R=L)	0.38	0.32
Ranksum $z = 3.80$, $p < 0.001$		

Self-sorting question highly predictive of behavior

Assumption: Survey responses not correlated with measurement error

$\Rightarrow$ $E[\theta|R]$ can be consistently estimated

Table: Estimates of average θ by survey response

	(1) Standard	(2) Triple
"Yes" average θ	1.103***	0.936***
	(0.277)	(0.103)
"A little" average θ	0.436***	0.622***
	(0.110)	(0.048)
"No" average θ	–0.172	0.047
	(0.139)	(0.056)
Observations	40651	39378

Notes: All specifications condition on $p_2 \geq 1$. All specifications include order-effect dummies. Cluster-robust standard errors (by subject) in parentheses. Significance * 0.1 ** 0.05 *** 0.01

Intuition for variance lower-bound

Consider distribution in which each person is assigned a value of $\hat{\theta}$ equal to...

- $E[\theta|\text{“Yes”}]$ if responds “Yes"
- $E[\theta|\text{“A little”}]$ if responds “A little"
- $E[\theta|\text{“No”}]$ if responds “No"

Simple statistical fact: $Var[\theta] \geq Var[\hat{\theta}]$

- Intuition: $Var[\theta] = Var[\hat{\theta}] +$ variance within bins

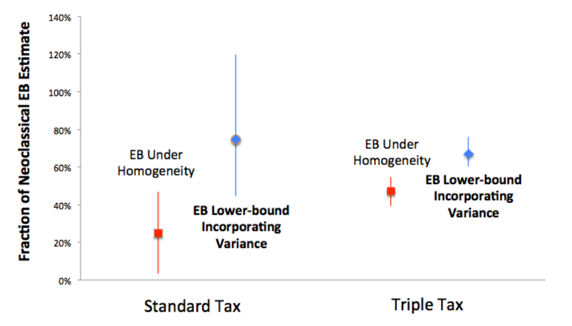
<u>Extra challenge:</u> Want $E_{p_1,\tau}[Var[\theta|p_1,\tau]]$, not $Var[\theta]$

- Similar idea + math trick to take out variation coming from differences in tax rates (and prices)

▸ Formal results on lower-bound estimator

Lower-bound estimates of variance and the implications

Excess burden (EB) estimates as fraction of estimates under "rationality" assumption



Estimates in units of θ

	Standard	Triple
Lower bound estimate	0.132	0.094
Bias (mean)	0.009	0.001
Standard error	0.051	0.019
95% conf. int.	(0.054, 0.251)	(0.063, 0.135)
Bias-corrected conf. int.	(0.049, 0.237)	(0.064, 0.136)

Recap of paper

Theory shows that understanding *variability* of bias is crucial for evaluating the efficiency of policy instruments

1. How does the bias vary across consumers?
   - *Increase efficiency cost estimates by >200% for standard US taxes*
   - *Increase efficiency cost estimates by >40% for large (3x) taxes*

2. How does the bias vary across incentives?
   - *Tripling taxes doubles attentiveness to taxes*
     - *Taxes distort behavior through an additional debiasing channel*
     - *Shown in paper: Inferred cost of tripling taxes would be only 1/4 as high as the the actual cost if endogeneity is not taken into account*
   - *Consumers less attentive to taxes on low-priced items*

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Basic lessons about the importance of heterogeneity apply more broadly