Pigou Creates Losers:
On the Implausibility of Achieving Pareto Improvements from Pigouvian Taxation

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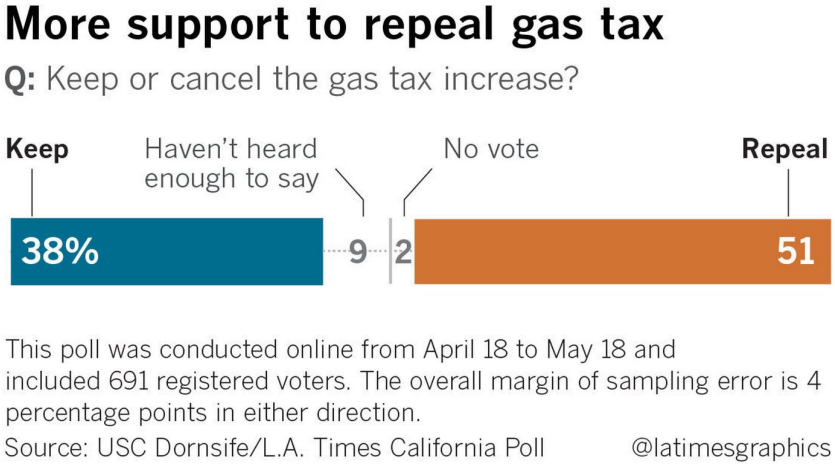

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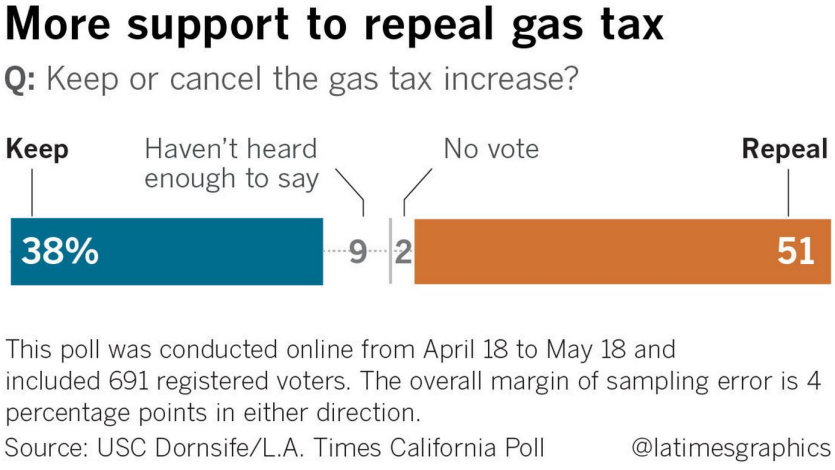

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One answer is distributional implications

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2. Don't need to worry about stakeholders $\Rightarrow$ just compensate them and everyone is better off
3. Conclusion: distributional impacts are not a real concern, or if they are it is due to ignorance, or a failure of politicians to design policies to compensate losers

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- If we cannot make everyone better off, must acknowledge the creation of losers in discussing policies

Theory

Sketch of analytical model

- A good causes a negative externality

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- Tax raises total revenue R
- Generates efficiency gains from reduced externality g_i, with average gain $\bar{g}$

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- Think of $c_i - T(\mathbf{X}_i)$ as targeting error

Main result is a necessary condition

- For any distribution of g_i, a **necessary condition** for a Pareto improvement from marginal tax to be possible is:

$$\frac{1}{N}\sum_i |c_i - T(\mathbf{X}_i)| < 2\bar{g}$$

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- Taking this condition to data requires:
  1. Average efficiency gain (marginal damage, demand derivative)
  2. Distribution of burdens (for marginal tax = distribution of consumption)
  3. Data on covariates

Assumptions

- Focus on marginal tax, starting from zero
- Assume all efficiency gains go to consumers
- Abstract from general equilibrium incidence (only burden is on price effect on consumers)
- Abstract from double dividend issues (return to revenue allocation later)
- Treating $\mathbf{X}$ as exogenous, not responsive to incentives

* These assumptions maintained in empirical application
* They are biased towards finding Pareto improvement or imply that measuring burdens easier

Visual depiction of theory

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σ

$>$ +

Δ

Heterogeneity
>> DWL triangle

Pigou

Pareto

Contributions and relation to literature

A straw man?

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- Some careful authors do note that real policies will create some losers
- This paper provides theoretical framework; derives testable condition; has original empirical estimates

A red herring?

Who cares about creating a Pareto improvement?

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- You can preserve "average" progressivity and have efficient policy—so, who cares if someone loses?

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- Political economy motivation:
- Political systems show a bias towards the status quo
- Small groups may often be able to veto change (Olson 1965, 1982)

Relation to prior literature: progressivity

- Rich literature explores progressivity of gas tax and carbon tax—Poterba (1991), West (2004), Burtraw et al. (2008), Metcalf (2009), Grainger and Kolstad (2010), Hasset, Mathur and Metcalf (2014), Williams et al. (2015), Cronin, Fullerton and Sexton (2019), etc.

- Literature shows revenue can easily be recycled to ensure tax is progressive **on average**

- My argument is that we need to pay attention to variation in winners and losers within income groups

Relation to prior literature: heterogeneity

- A newer literature does pay attention to this heterogeneity—Rausch, Metcalf and Reilly (2011), Cronin, Fullerton and Sexton (2019), Fischer and Pizer (2019), Pizer and Sexton (2019), Davis and Knittel (2019)

- Most closely related is Cronin, Fullerton and Sexton (2019), which similarly documents heterogeneity in losers/winners across revenue recycling schemes

- I add theory and present different prediction thought experiment

Relation to prior literature: compensation

- There is a literature focused on compensating polluters through permit allocations—Bovenberg and Goulder (2011), Bovenberg, Goulder and Gurney (2005), Burtraw and Palmer (2008), Goulder, Hafstead and Dworfsky (2010), etc.
- Most of that literature is focused on industry averages, not individual heterogeneity, and are focused on firms
- I introduce a focus on heterogeneity and consider individual households, not firms

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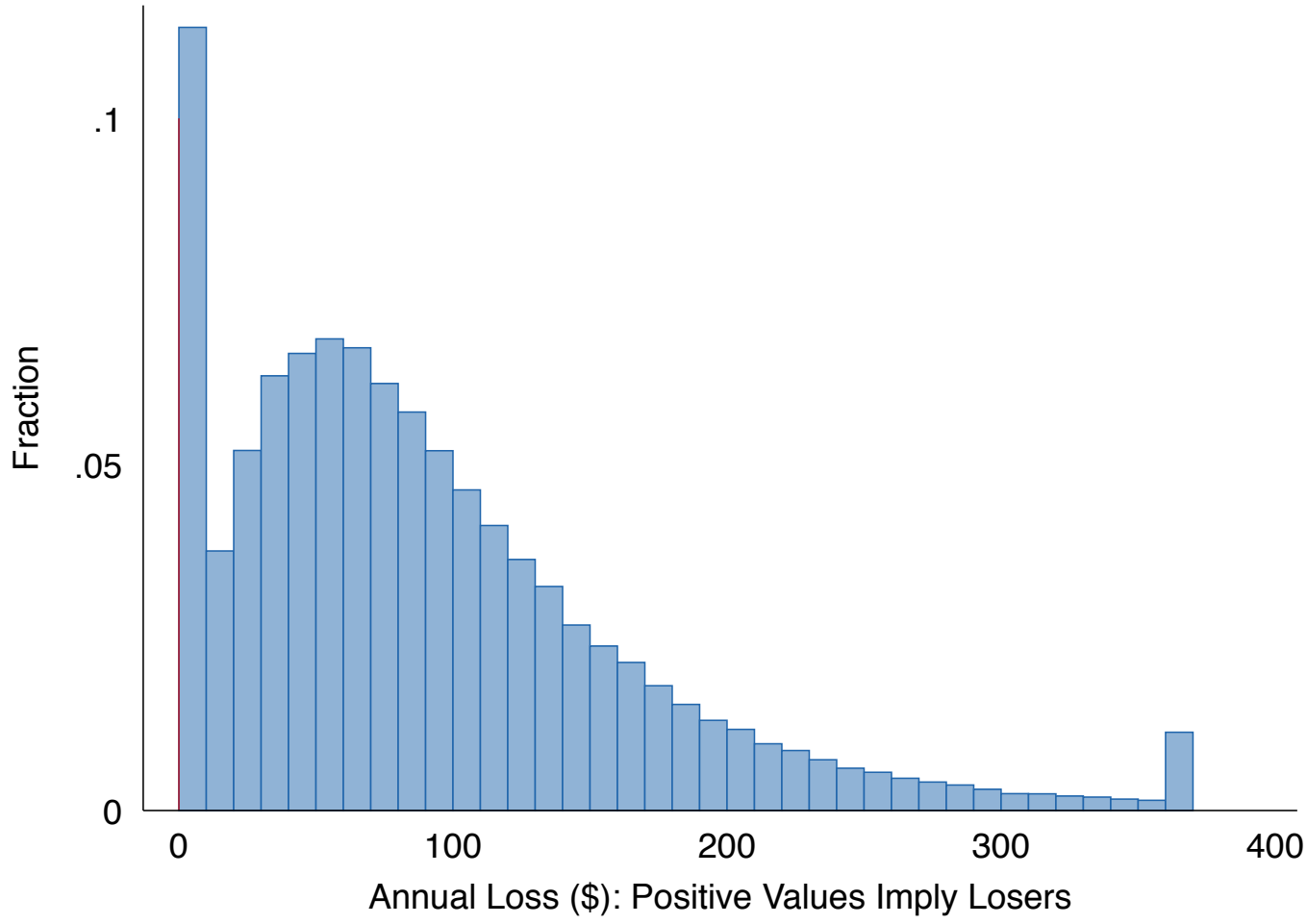
Distribution of initial burdens (c_i) of 10 cent gas tax



- Mean is around \$90/hh/y, but there is a lot of variation

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3. **Predict c_i with covariates $\mathbf{X}_i$**
   - Use CEX covariates that could plausibly be used in transfers
   - Ask how well these covariates predict distribution of burdens

Choosing plausible covariates for a transfer scheme

- "Most exogenous"
  - **Time:** year fixed effects
  - **Demographics:** married indicator, dummies for family size, number of kids, number of elderly
  - **Geography:** state dummies, urban indicator

- Income
  - **Income:** pre-tax family income (linear), binned pre-tax family income ($5k bins)

- "Obviously endogenous"
  - **Vehicle ownership:** dummies for total vehicles, owned vehicles and leased vehicles
  - **Other energy expenditures:** natural gas, electricity, and fuel oil (linear)

OLS regressions predicting impact of gasoline tax

$$c_i = \alpha + \beta \mathbf{X}_i + \epsilon_i$$

	A	B	C	D
Avg. Abs. Error	\$46.6	\$45.0	\$44.2	\$39.9
R^2	.292	.331	.356	.456
N	197,668	197,668	197,668	197,668
Year FE	Y	Y	Y	Y
Demo & geo controls	Y	Y	Y	Y
Linear income		Y	Y	Y
Binned income			Y	Y
Vehicles & energy				Y

- Necessary condition fails: average absolute error $>>$ 2 $\times$ \$8.25
- Pareto improvement not possible. About 40% lose under implied scheme

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  - Counting non-carbon externalities (which are not well targeted by gas tax!) can boost marginal damages enough to meet necessary condition
  - Damages \$2 per gallon with $\varepsilon = -0.8$ yields 6% losers

Other "Sin Goods" even harder to predict

R^2 of regressions on expenditures (not burden)			
Motor Fuels	.336	.381	.403
Electricity	.281	.324	.327
Natural gas	.179	.211	.214
Alcohol	.051	.126	.129
Tobacco	.043	.046	.05
All energy	.393	.469	.486
All sin goods	.362	.438	.455
N	197,668	197,668	197,668
Year FE	Y	Y	Y
Demog. & geog. controls	Y	Y	Y
Linear income		Y	Y
Binned income			Y

- Preliminary: lower predictability $\Rightarrow$ Pareto gain unlikely; less control over final distribution of burdens for other goods

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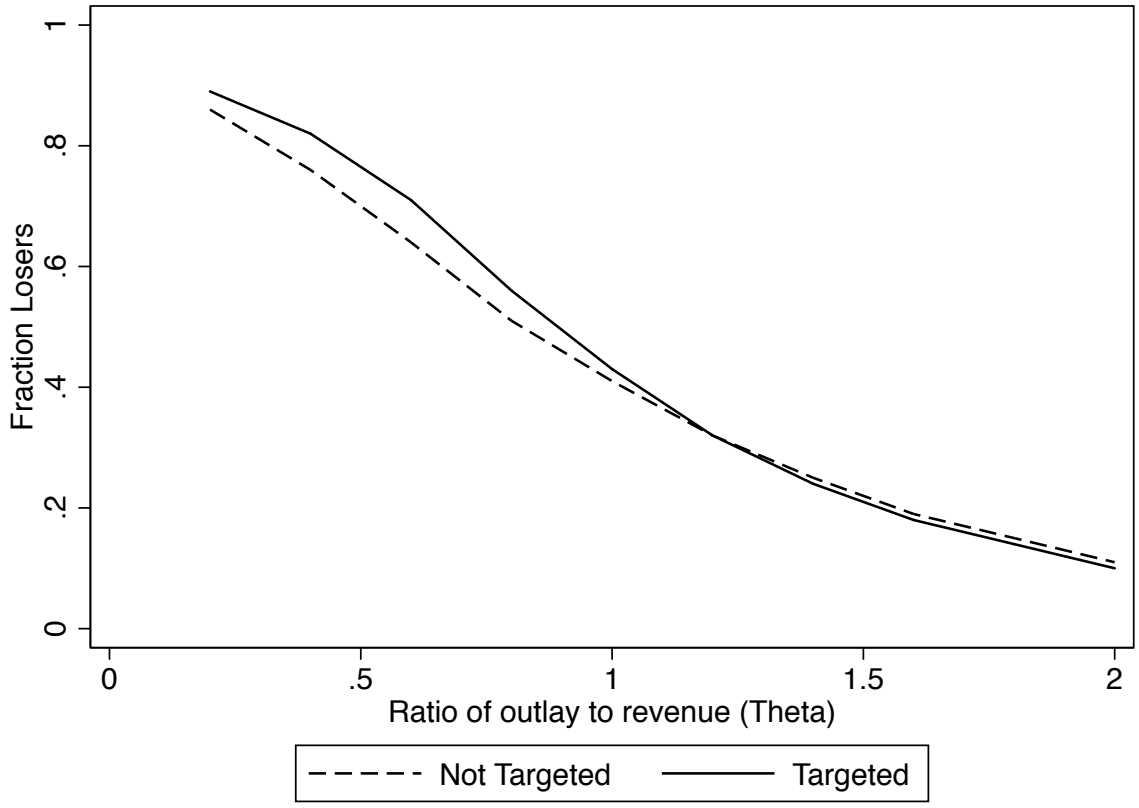
- Compare to NHTS (for gasoline) and RECS (for electricity and natural gas)
- Meta-response: if measuring consumption is difficult, it is hard to design a transfer scheme!

Extensions

Revenue versus compensation trade-offs

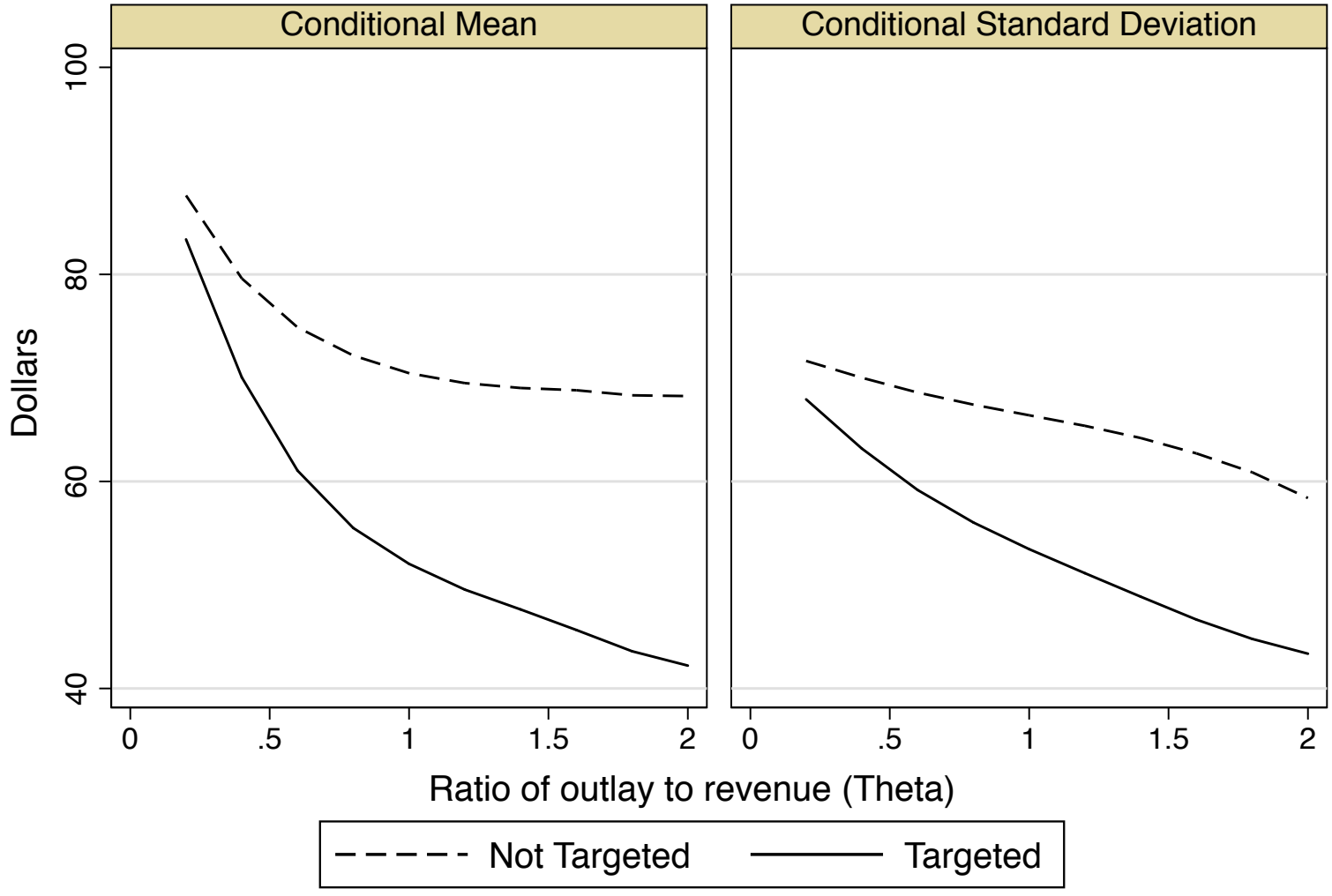
- The preceding assumed that money available for transfers equals revenue raised
- Using revenue for lump-sum rebates is inefficient because it eschews revenue recycling benefits (Goulder 1995, etc.)
- To establish **trade-off between using valuable revenue and compensating losers**, scale baseline transfers up or down to equal $\theta T(\mathbf{X}_i)$ and look at distribution of losses

The fraction of losers as a function of outlays



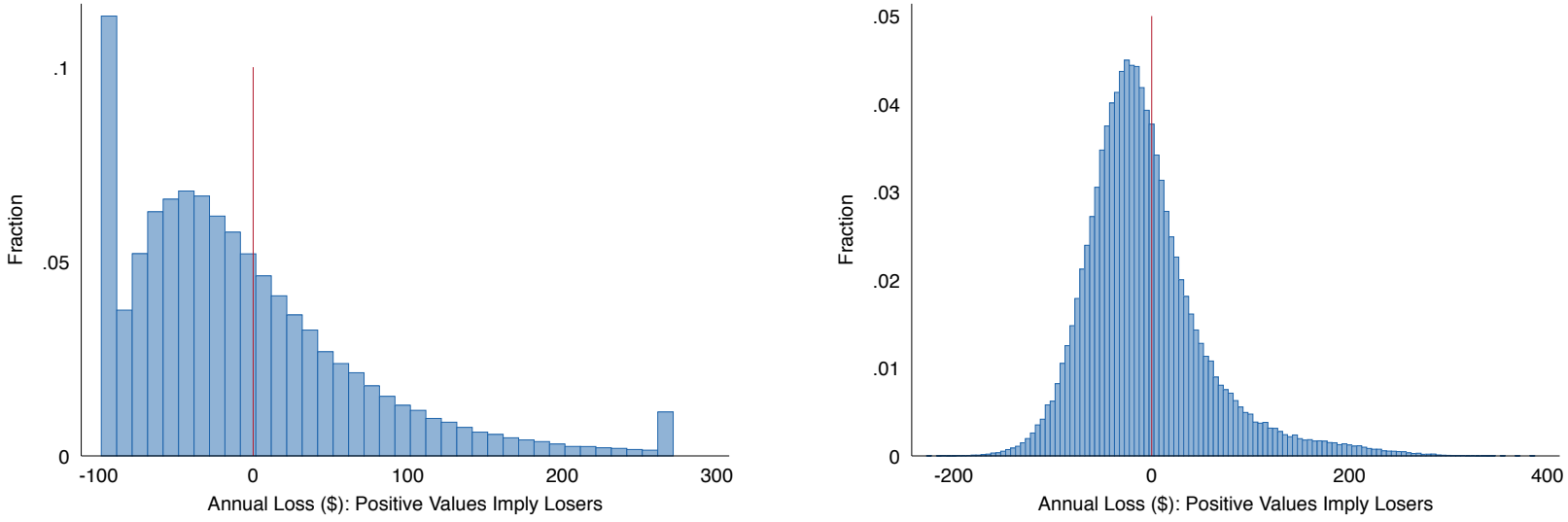
- θ is transfers given / revenue raised from tax ($\theta = 1$ is base case above)
- Targeting has minimal impact on fraction who are losers

Conditional loss statistics as a function of outlays



- Graphs show mean and st. dev. of losses **among losers**
- Targeting shrinks the variance, reduces tail of biggest losers

Which distribution do you prefer?



Distribution of net losses: equal rebate vs targeted

- Targeting has minimal impact on number of losers, but it radically alters the distribution

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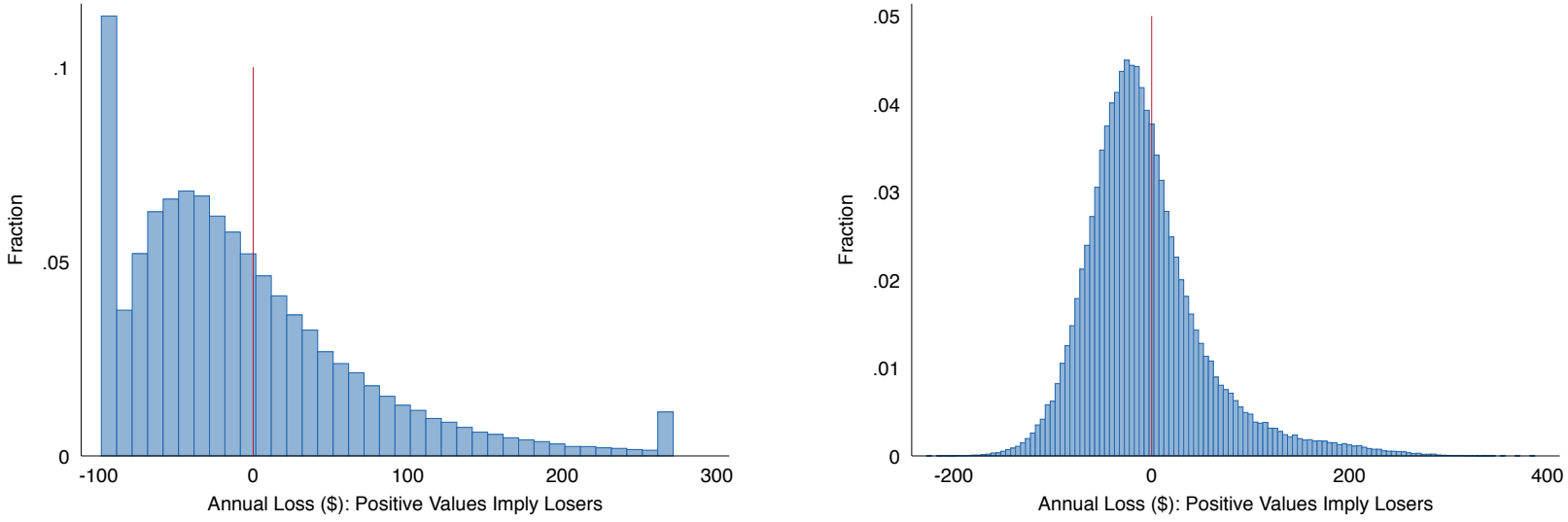

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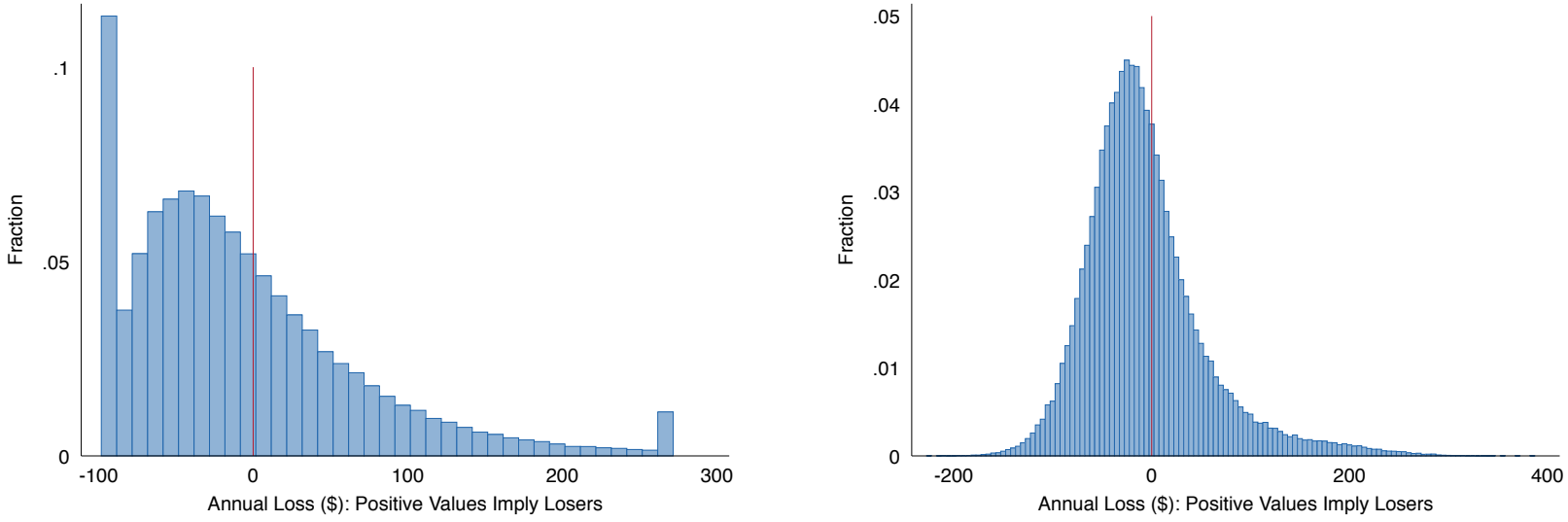

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- Future work: what distribution is **politically optimal**?
- **Broad lesson:** If covariates predict initial burdens more precisely, planner has more control over final distribution

Targeting neutralizes impacts by covariate

- Any covariate included in $\mathbf{X}$ will have zero correlation with final burdens
- Thus, targeting automatically "neutralizes" the burden among any politically relevant group

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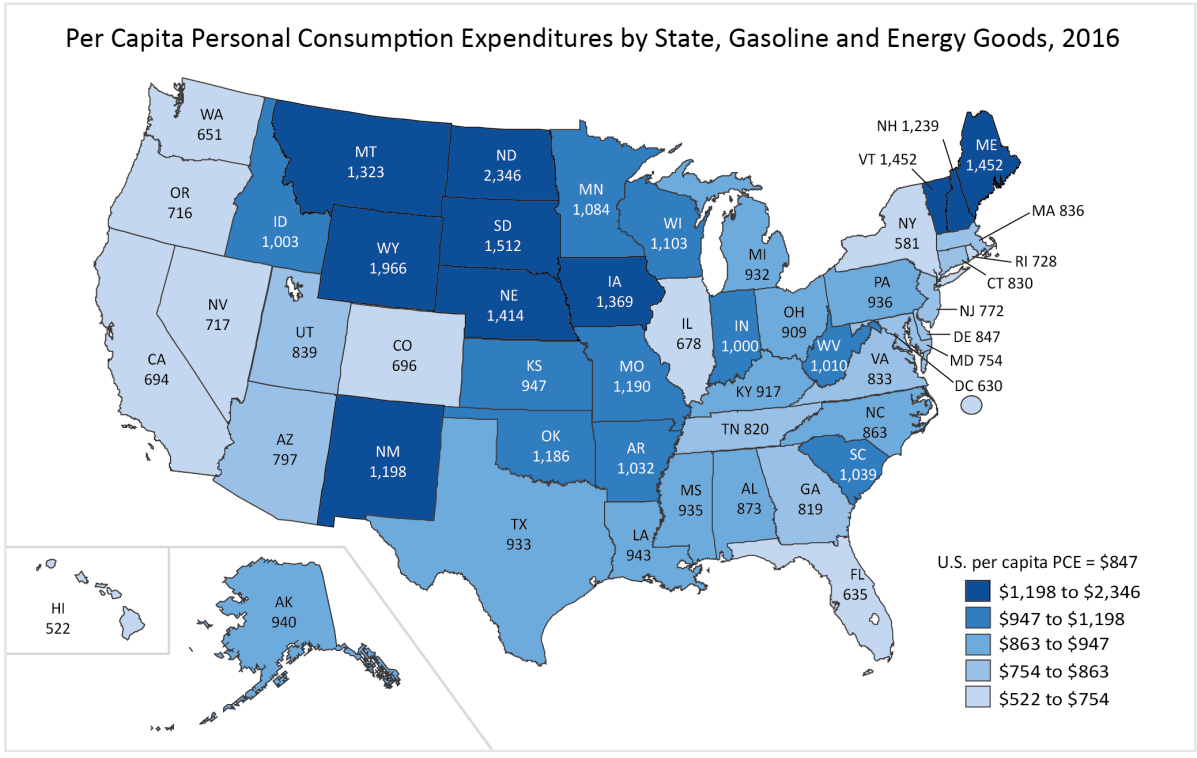


U.S. Bureau of Economic Analysis

- Any covariate included in $\mathbf{X}$ will have zero correlation with final burdens
- Thus, targeting automatically "neutralizes" the burden among any politically relevant group
- Example: including state dummy variables in $\mathbf{X}$ ensures that every state is compensated, on average

Alternative loss 1: minimizing losers

- If a true Pareto improvement is impossible, a planner might wish to minimize the number of losers

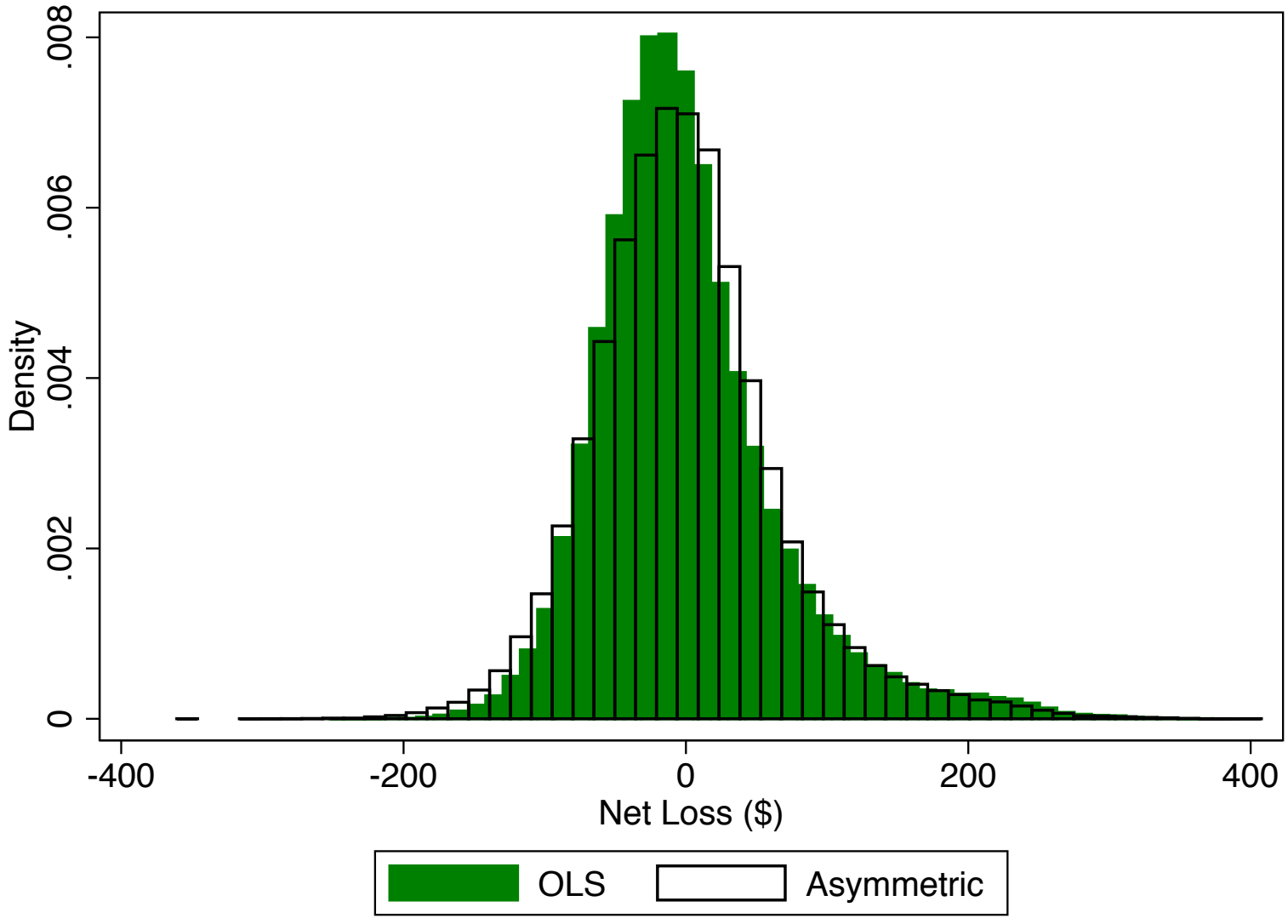
- Caring about the number of losers but not the size of losses will create perverse outcomes
  - e.g., $T(\textit{Bill Gates}) = -\infty$, redistribute, get only 1 loser

- Instead, I propose an asymmetric loss function that ignores winners, but still has quadratic penalties for losers:

$$L = \sum_i (\min\{0, c_i - T(\mathbf{X}_i)\})^2$$

(must impose budget constraint)

Losers only loss function yields similar outcomes



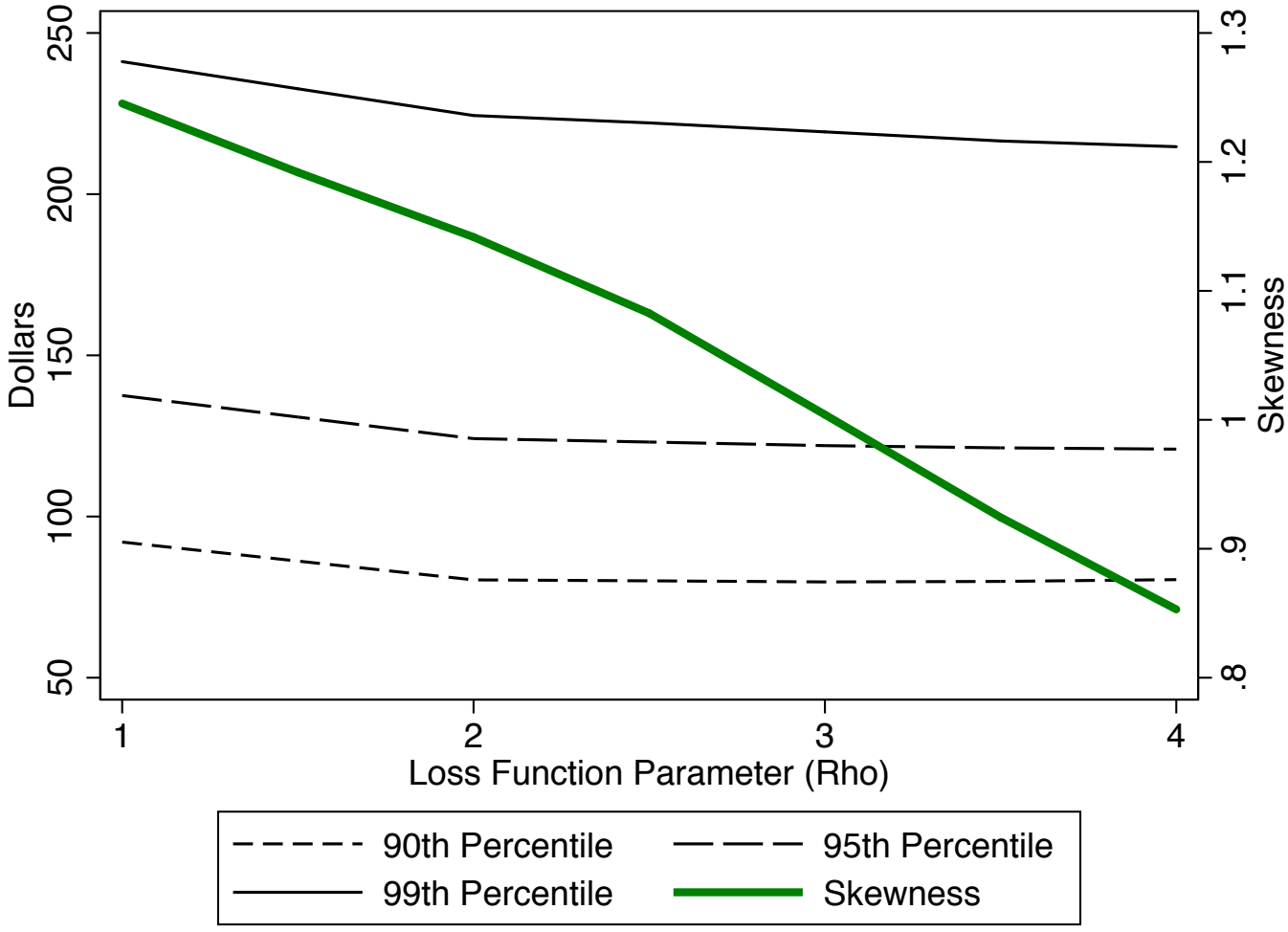
Alternative loss 2: steeper losses

- One might be especially concerned about large losses
- One way of capturing this is to make the loss function steeper than quadratic
- Consider generalized symmetric loss function

$$L = \sum_i |c_i - T(\mathbf{X}_i)|^\rho$$

- $\rho = 1$ is LAD, $\rho = 2$ is OLS, $\rho > 2$ puts more weight on outliers

Steeper symmetric penalty trims tails (slightly)



- Higher ρ does reduce skewness
- Differences seem economically small

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- **Empirics:** gas tax will create substantial fraction of losers
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- **Broad punchline:** efficient policies create losers, which may matter for political feasibility
- Better targeting shrinks number of losers
- Targeting could be designed to improve political feasibility

Bonus material

Table: Fraction of losers under alternative parameters

10 Cent Tax; Transfer targeted based on Specification C

Elasticity	Externality	Pct Windsorized	Pct Losers
-0.4	$0.4	1%	37.0%
-0.4	$2	1%	15.5%
-0.6	$2	1%	9.7%
-0.8	$2	1%	6.2%
-0.8	$2	10%	3.0%

10 Cent Tax; Equal transfer

Elasticity	Externality	Pct Windsorized	Pct Losers
-0.4	$0.4	1%	37.3%
-0.4	$2	1%	20.2%
-0.6	$2	1%	13.9%
-0.8	$2	1%	9.6%
-0.8	$2	10%	12.0%

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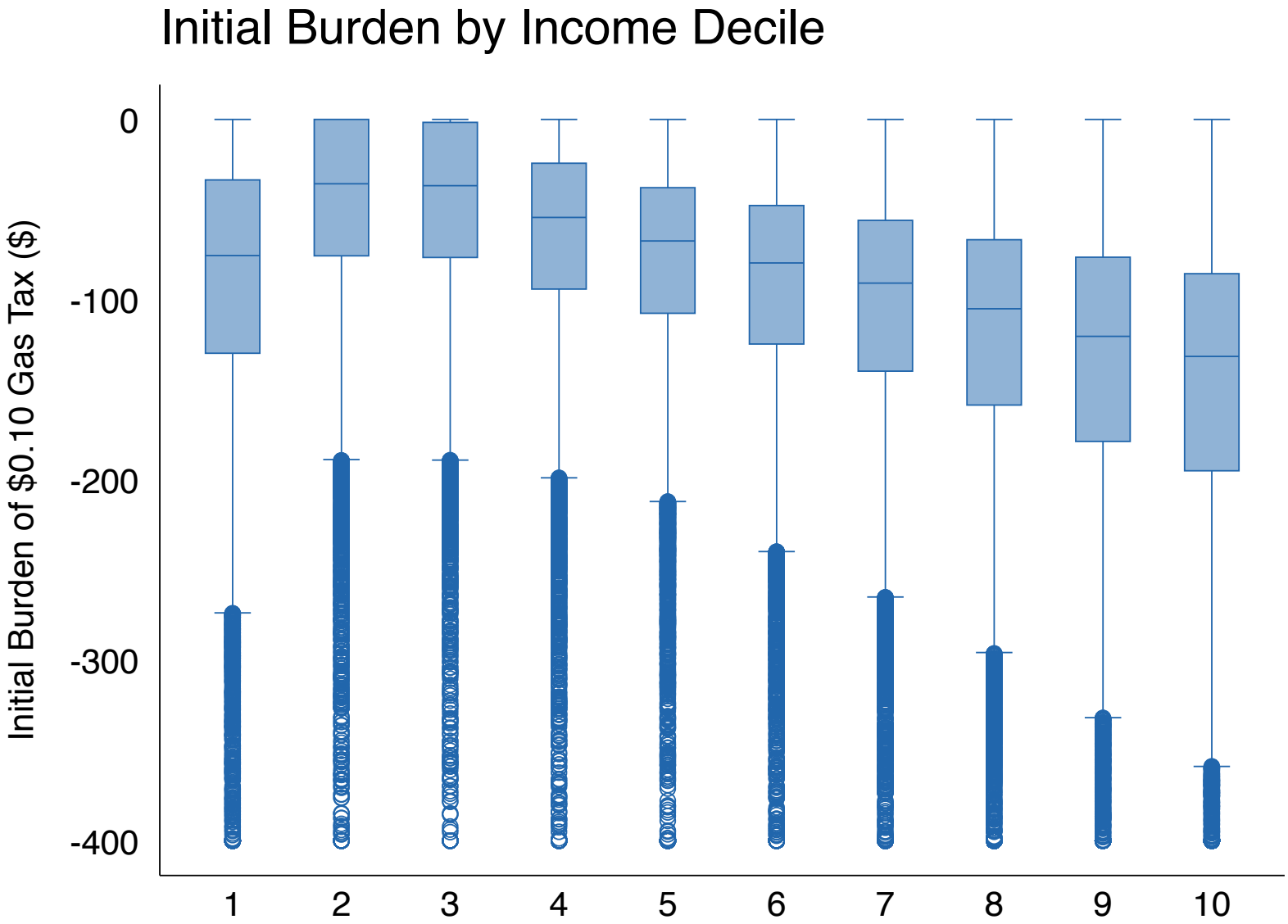
- Concerns: self-reported data, single year per HH, survey data quality (Meyer, Mok and Sullivan 2015)



- Income is correlated with gasoline expenditures
- But within decile heterogeneity dominates across

Net cost, OLS targeted transfer (column C) 37.0% lose