Fiscal Policy and Inequality

Bunching Methods to Estimate Elasticities

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Outline

Intro: Bunching Methods

Bunching at Kinks

- Theory
- Estimating ETI using Kinks
- Income Tax Bunching in Denmark (Chetty et al QJE 2011)
- Heterogeneous Elasticities

Bunching at Notches

- Theory
- Estimating ETI Using Notches
- Applications

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- How can we obtain elasticity estimates from individual responses to kinks and notches?
  - Main reference: overview paper by Kleven (2016)*

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  - **"Kinks"** and **"Notches"**
- How can we obtain elasticity estimates from individual responses to kinks and notches?
  - Main reference: overview paper by Kleven (2016)*
- Potential applications to other contexts in which there are cutoffs in the budget set:
  - Regulations (eg, labor laws)
  - Nonlinear pricing (eg, electricity consumption)

Bunching Method: Kinks

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- Kinks create endogeneity problem in regression analysis, because $\text{cov}(\tau, u) \neq 0$
- We can take advantage for **non-parametric identification**
  - Exploit response to kink to estimate behavioral elasticity

Bunching Method: Notches

- In some cases, taxes or regulations generate discontinuities in the budget set itself
- This creates a "notch":
  - Notch = income threshold at which the **average** tax rate changes discontinuously
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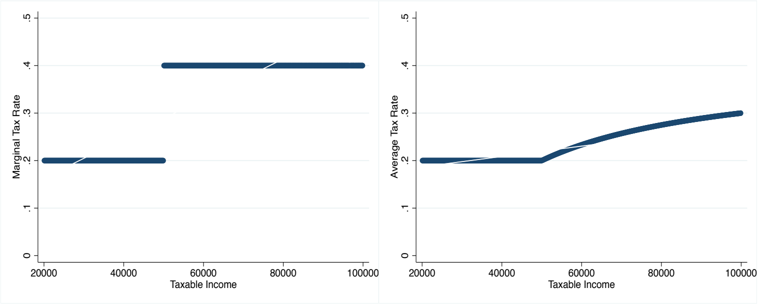
  - Notch = income threshold at which the **average** tax rate changes discontinuously
    - Discrete change in the level of the budget set
    - The *marginal* tax rate may change as well
- Notches generate much stronger incentives than kinks
  - Often, create a "dominated" range where individuals should not locate under any utility function
  - Allows us to estimate the relevance of optimization frictions

Example: Kink in the tax schedule

- Consider a simple tax schedule:

$$\tau \equiv T'(z) = \begin{cases} 0.2 & \text{if } z \leq 50,000 \\ 0.4 & \text{if } z > 50,000 \end{cases}$$



Bunching: Relationship with other Methods

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    - ie, cannot choose what side of the threshold they are on
  - Bunching assumes that there is a response: we use bunching to estimate the underlying elasticity of *that* response

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    - Assume no savings, so that $c \equiv z - T(z)$
    - $u\left(c, \frac{z}{n}\right) = u\left((1-\tau)z, \frac{z}{n}\right)$

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    - $u\left(c, \frac{z}{n}\right) = u\left((1-\tau)z, \frac{z}{n}\right)$
  - Optimal choice determined by:

$$-\frac{u_c\left(c, \frac{z}{n}\right)}{u_z\left(c, \frac{z}{n}\right)} = (1-\tau)$$

Small Kink Analysis

- Tax reform: new marginal tax rate $\tau + \Delta\tau$ (where $\Delta\tau > 0$ is small) for earnings above $z > z^*$, such that

$$T(z) = \tau \cdot z + \Delta\tau \cdot (z - z^*) \cdot \mathbf{I}[z > z^*]$$

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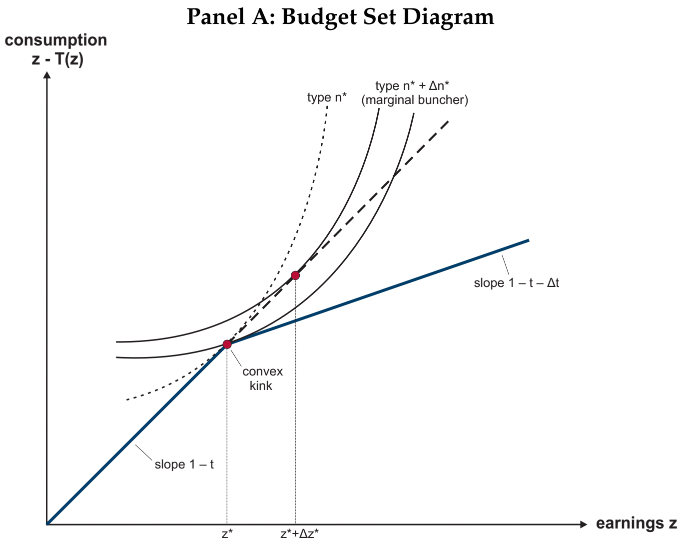
  - where $\mathbf{I}[\cdot]$ is the indicator function
- This creates a kink in the budget set at income level z^*
- Net-of-tax rate goes *down*: $(1 - \tau)$ to $(1 - \tau - \Delta\tau)$

Bunching at Kinks: Budget Set



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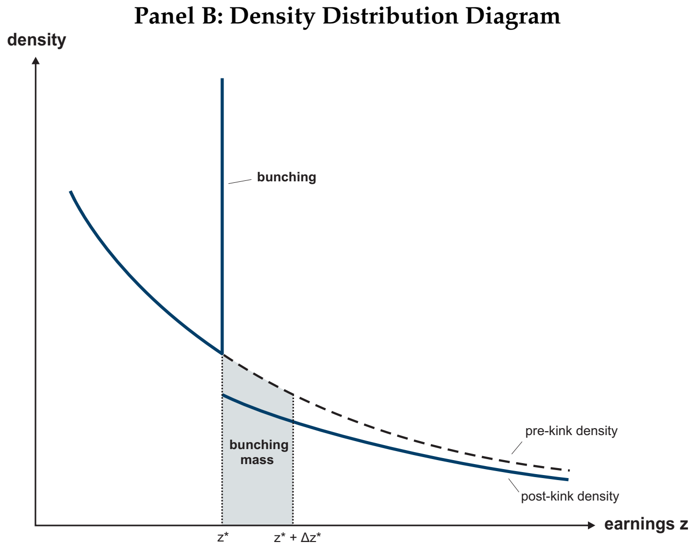
- Individual with ability n^* is unaffected
- Individual with ability $n \in (n^*, n^* + \Delta n^*$ reduces taxable earnings to z^* (ie, bunches at z^*):

Type (n)	Pre-reform	Post-reform
n^*	$z\left(n^*\right) = z^*$	$z\left(n^*\right) = z^*$
$n^* + \Delta n^*$	$z\left(n^* + \Delta n^*\right) = z^* + \Delta z^*$	$z\left(n^* + \Delta n^*\right) = z^*$

Bunching at Kinks: Density Distribution



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    - Individuals with $n \in (n^*, n^* + \Delta n^*)$ will bunch at z^* after the reform
3. Adjusters:
    - Individuals with $n > n^* + \Delta n^*$ will reduce earnings after the reform, but they will locate above the kink (i.e., $z > z^*$)

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  - Individual with type $n^* + \Delta n^*$ is the "marginal buncher"
- Number of **excess bunchers** is given by:

$$\begin{aligned} B &= \int_{z^*}^{z^*+\Delta z^*} h_0(z)\, dz \\ &\simeq h_0(z^*)\, \Delta z^* \end{aligned}$$

  - $h_0(z^*)$ = height of the pre-reform density at the kink
  - Implicit assumption: $h_0(z)$ is smooth around z^*

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Estimating ETI using Kinks

- Definition of elasticity of taxable income (ETI):

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- Use definition of $B \simeq h_0\left(z^*\right)\Delta z^*$, sub for Δz^*:

$$\varepsilon(z^*) = \frac{\left[\frac{B}{h_0(z^*)}\frac{1}{z^*}\right]}{\left[\frac{\Delta(1-\tau)}{(1-\tau)}\right]}$$

Formula for estimating ETI using kink

$$\varepsilon(z^*) = \frac{\left[\frac{b}{z^*}\right]}{\left[\frac{\Delta(1-\tau)}{(1-\tau)}\right]}$$

- $b \equiv \frac{B}{h_0(z^*)}$ = ratio of "excess bunchers" compared to counterfactual (pre-reform) density at the kink

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$\Rightarrow$ Elasticity of Taxable Income (ε) is proportional to b, which can be easily estimated non-parametrically

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- Step 1:
    1. Discretize data into income bins (e.g., bins of \$1,000)
    2. Count taxpayers c_j in each bin j
- In the ETI formula, the value for z^* is the bin including, or just above, the kink

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  - c_j = number of individuals in bin j
  - p = order of the polynomial
  - $[z_-, z_+]$ = excluded range (a few bins above and below the kink)
    - this is equivalent to removing these bins from the data when running the regression.

ETI with kinks: Measure Bunching

- $\hat{c}_j$, predicted count of individuals by bin with fitted polynomial:

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- Then the elasticity estimate is

$$\hat{\varepsilon}(z^*) = \frac{\left[\frac{\hat{b}}{z^*}\right]}{\left[\frac{\Delta(1-\tau)}{(1-\tau)}\right]}$$

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Chetty et al. (QJE, 2011): Bunching in Denmark

- Study taxpayer behavior under Danish income tax
- Marginal income tax rate goes up from **49% to 63%** for earnings above DKr 267,600 (£30,000)
  - Large kink: $(1 - t)$ goes down from 0.51 to 0.37
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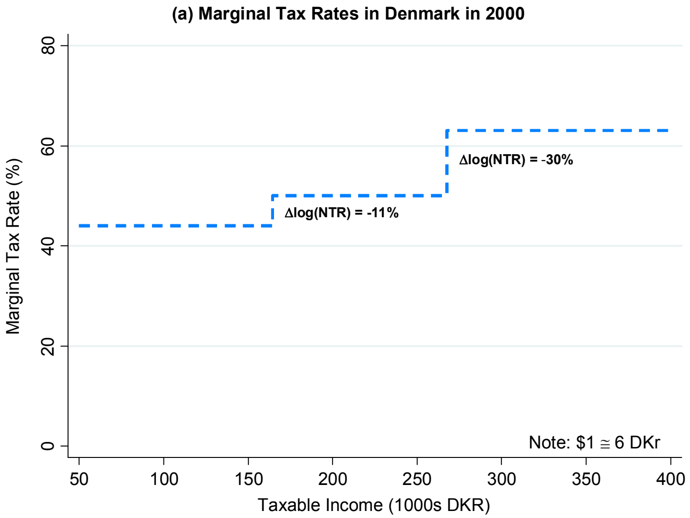
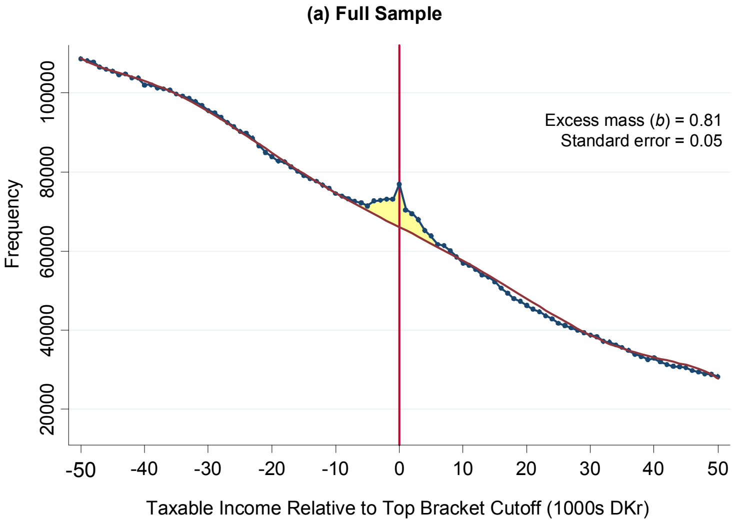
  - 30% fall in net-of-tax rate
- **Administrative Data**: universe of Danish taxpayers, 1994-2001
  - About 4 million taxpayers per year

Danish Income Tax



Chetty et al. (QJE, 2011): Results

Full Sample of Individual Taxpayers



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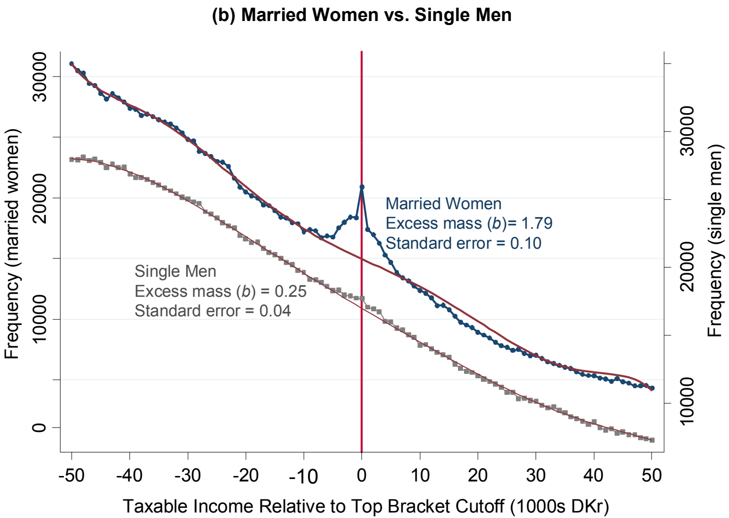
Married women vs. Single Men



Chetty et al. (QJE, 2011): Results

- Bunching response very strong for married women
  - Often second earners in the household
- Weak response for single men
  - Little flexibility in labor supply

Chetty et al. (QJE, 2011): Results

TABLE II
Observed Elasticity Estimates using Small Tax Reforms

	Dependent Variable: Log Change in Wage Earnings					
Subgroup:	All Wage Earners		Married Females	High-Experience Married Female Professionals	Wage Earners 100-300K	Wage Earners > 200K
	(1)	(2)	(3)	(4)	(5)	(6)
log change in net-of-tax rate (Δ log (1-t))	-0.001 (0.003)	-0.004 (0.003)	0.006 (0.005)	0.000 (0.011)	-0.006 (0.003)	-0.001 (0.003)

Source: Chetty, Friedman, Olsen & Pistaferri (QJE, 2011)

Chetty et al. (QJE, 2011): Results

- Very small elasticities for wage earners: $\varepsilon \approx 0$
- Overall, surprisingly small elasticity estimates
  - Compare with Kleven and Schultz (2014) estimates, obtained using DD methods with exactly the same data and similar tax reforms

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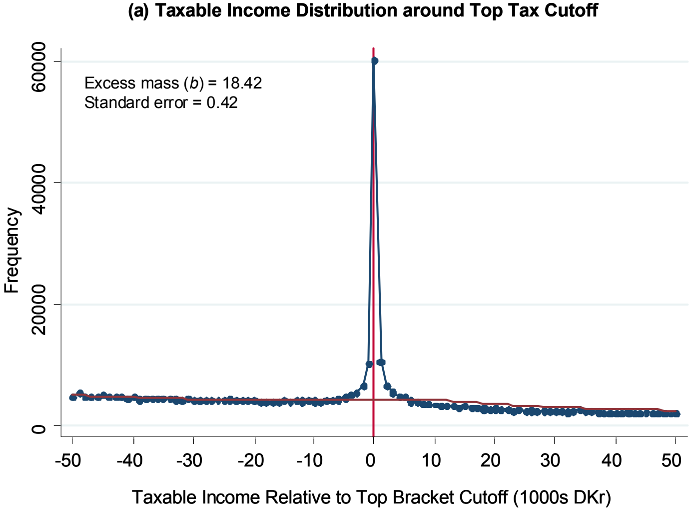
Bunching among Self-Employed



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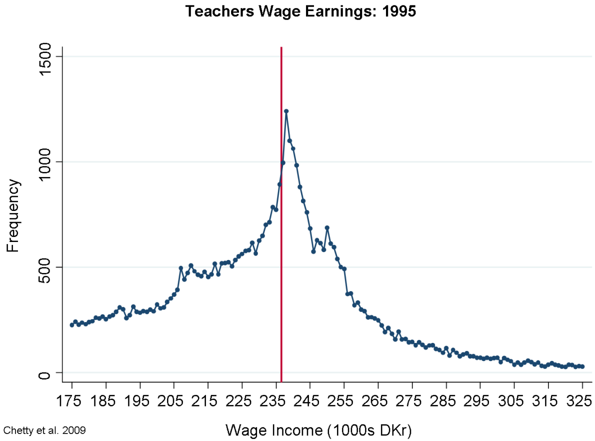
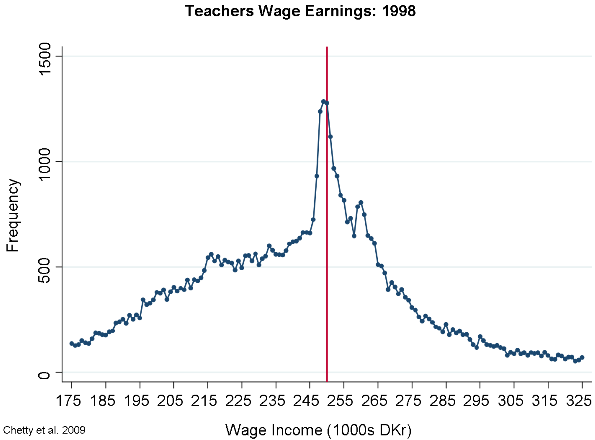
1. More flexible labor supply (**real** response)
   - Can adjust hours much more easily
2. Higher ability to manipulate reported income (**avoidance/evasion**)
   - Harder to track payments because there is no third-party reporting

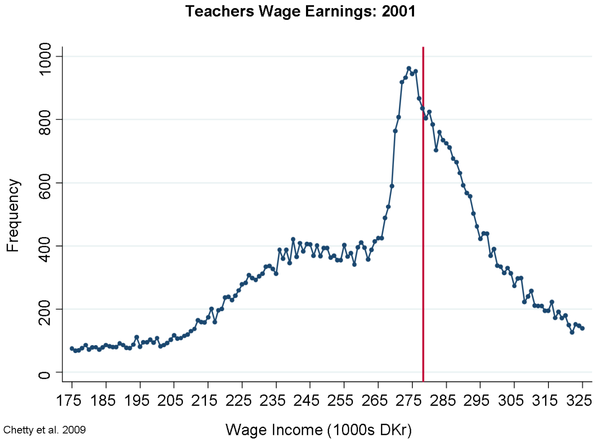
Bunching among Teachers, 1995



Bunching among Teachers, 1998



Bunching among Teachers, 2001



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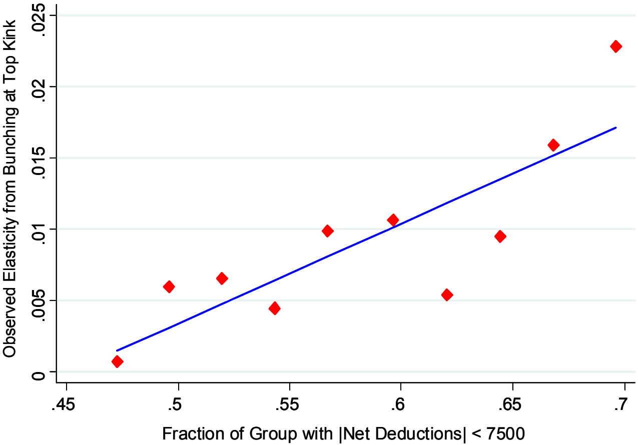
  - Little flexibility in labor supply
  - Unlikely to know details of tax system
- But: Strong teachers' unions negotiate salaries every year!
  - They follow changes in tax system
  - Everyone in the union benefits

Chetty et al. (QJE, 2011): Results

Elasticity correlated with Number of Available Deductions

FIGURE X
Observed Elasticities vs. Scope of Tax Changes



Chetty et al. (QJE, 2011): Results

- Overall, surprisingly small elasticity estimates. Why?

1. Adjustment costs
   1.1 Cost of re-optimizing may be higher than benefit
2. Constraints on hours of work per week
3. Inattention?

Outline

Notched Income Tax Schedule in Pakistan

Average tax rates

Source: Kleven and Waseem (QJE, 2013)

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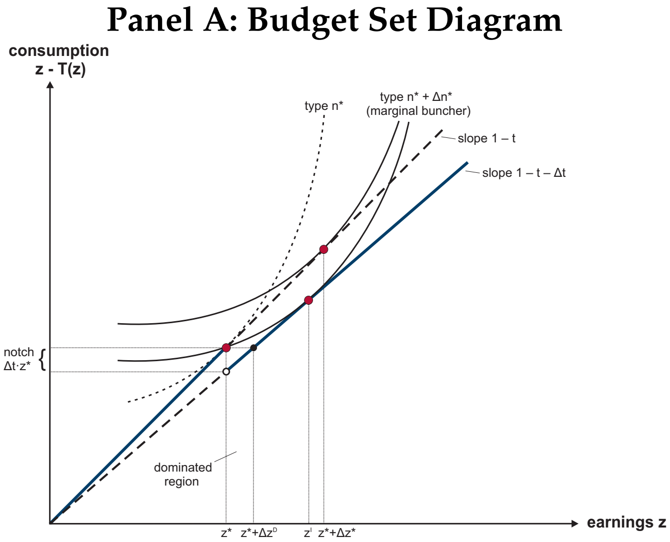
Notched Budget Set



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- With notches, bunching should be observed to the left of the notch
  - With kinks, bunching *around* the threshold. Why?

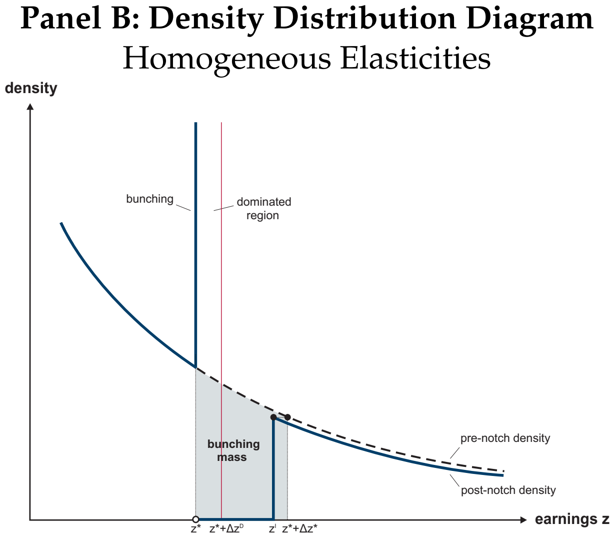
Bunching at Notches: Dominated Range

- Notches create a "dominated range":
  - Irrational to locate in $\left(z^*, z^* + \Delta z^D\right)$ under *any* preferences

Bunching at Notches: Dominated Range

- Notches create a "dominated range":
  - Irrational to locate in $\left(z^*, z^* + \Delta z^D\right)$ under *any* preferences
  - We should expect a "hole" in the distribution above the notch...
  - ...unless there are optimization frictions

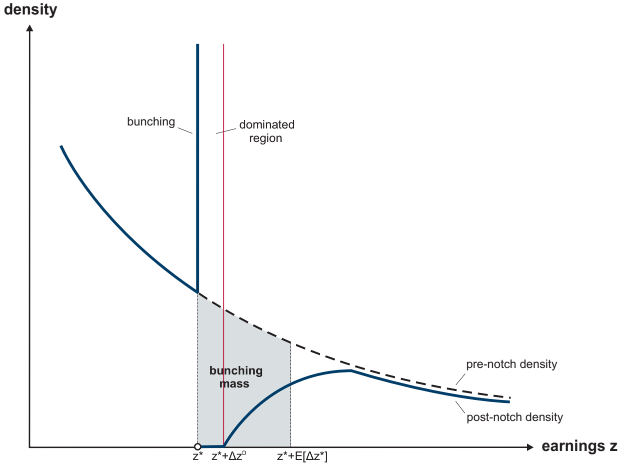
Bunching at Notches: Homogeneous Elasticities



Source: Kleven (2015)

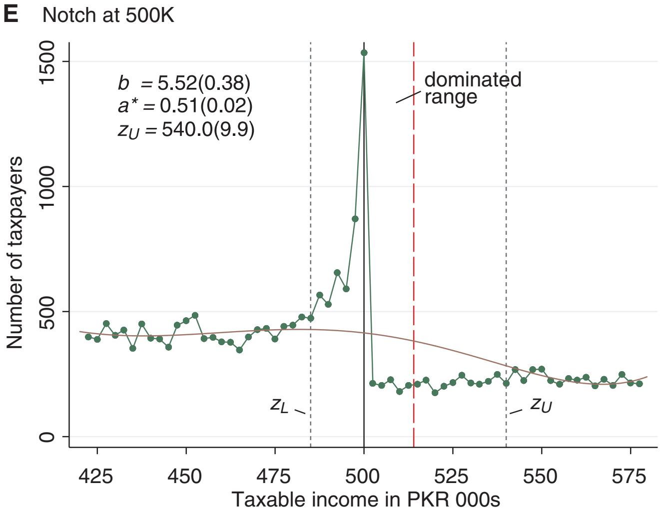
Bunching at Notches: Heterogeneous Elasticities

Panel C: Density Distribution Diagram
Heterogeneous Elasticities



Source: Kleven (2015)

Kleven & Waseem (QJE, 2013): Bunching at a Notch



Outline

Quantifying Frictions with notches

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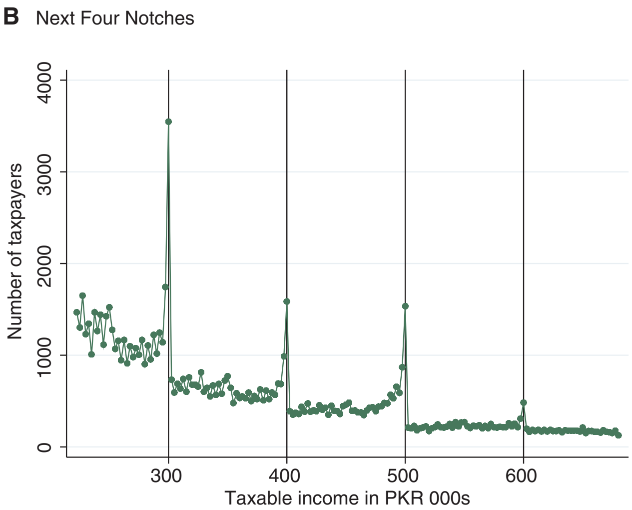
- Let a proportion a^* of individuals be in the dominated range, we interpret that $a^*\%$ of individuals are affected by frictions
- Then, we reweight our bunching estimates by a factor $(1 - a^*)$
  - Similar to treatment-effect-on-the-treated (ToT) estimates

Outline

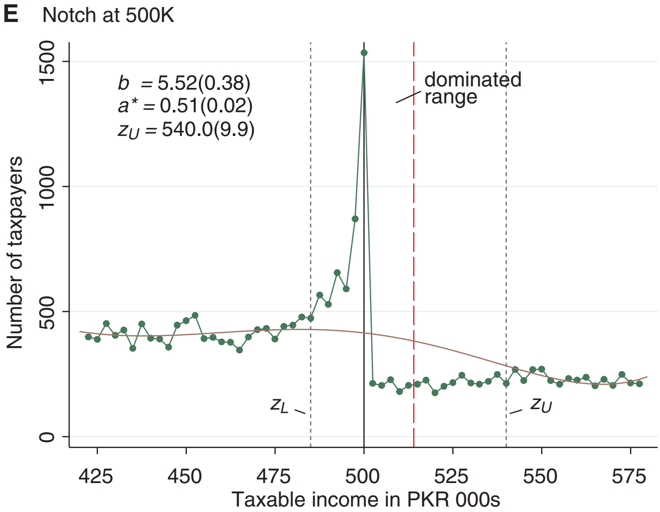
Kleven & Waseem (QJE, 2013): Income Tax in Pakistan

Average tax rates

Kleven & Waseem (QJE, 2013): Income Distribution



Kleven & Waseem (QJE, 2013): Bunching at a Notch



Kleven & Waseem (QJE, 2013): Results

- Taxpayers bunch strongly at each notch
- But there are some taxpayers in the dominated range. Why?
  - Optimization frictions: adjustment costs and inattention
  - Career concerns: current earnings may affect future earnings

Kleven & Waseem (QJE, 2013): Results

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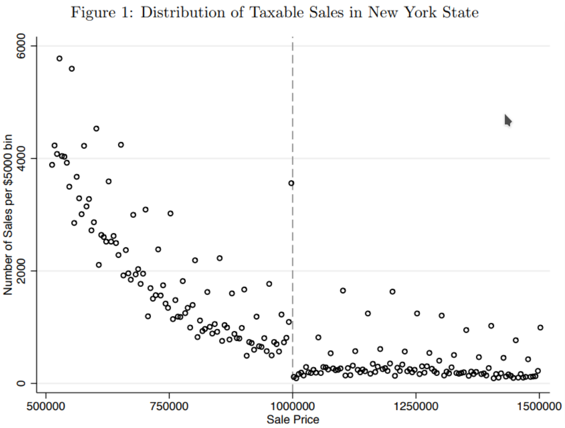
- Generally low elasticities ($\epsilon \approx .02$), despite large bunching response
- Elasticities larger for self-employed ($\epsilon \approx .15$), as in other contexts
- Optimization frictions are very important:
  - Despite strong incentives created by notches, many people do not modify their economic decisions

Distribution of Housing Sale Prices, New York State



- Kopcuk and Munroe (2014)