Measuring
Fiscal Impoverishment

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Motivation: Debate about taxing the poor
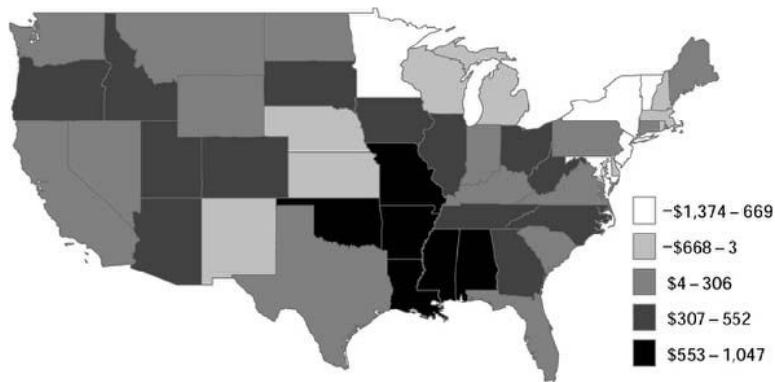
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State and local tax burden for a family of three at the poverty line

☐	−$1,374 − 669
☐	−$668 − 3
☐	$4 − 306
☐	$307 − 552
■	$553 − 1,047

Source: Newmann and O'Brien (2011)

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- Example: southern states of US
    - Letter from Louisiana clergy to Governer Jindal:

        "We are concerned that Louisiana already has one of the most regressive tax systems in the nation, putting a disproportionately high burden on low income families. [. . .] That is unacceptable."

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- Example: Brazil
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  - Poorest 10% spends about a quarter of its income on consumption taxes (Baer and Galvão, 2008)

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    - Politicians (e.g., Rodrigues, 2011)
    - Academics (Siqueira and Nogueira, 2013)
    - Multilateral organizations (Afonso et al., 2013)
    - National and international media (*O Globo*, *Le Monde*, *Washington Post*)

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- World Bank recommendation to developing countries: "avoid taxing the poor"

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- Current measures of tax and transfer system inadequate

Brazil

Post-tax and transfer income groups

	< $2.50	$2.50 –4.00	$4.00 –10.00	> $10.00	% of Pop.
< $2.50	85%	10%	4%	1%	15%
$2.50 –4.00	14%	75%	10%	1%	11%
$4.00 –10.00	0%	13%	84%	3%	33%
> $10.00	0%	0%	16%	84%	40%
% of Pop.	14%	14%	36%	36%	100%

Pre-tax and transfer income groups

Outline

1. Show that standard measures of the effect of taxes and benefits on the poor
   – Poverty indicators (including squared poverty gap)
   – Stochastic dominance tests
   – Measures of horizontal inequity and progressivity

   do not tell us whether some of the poor are made poorer by the tax and transfer system ("fiscal impoverishment")

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3. Axiomatically derive measures that *do* capture FI
   - FI headcount, gap, and log gap
   - FI curve and dominance criteria

Defining Fiscal Impoverishment

- Income space $\Omega \subset \mathbb{R}_+$ and $\sup \Omega < \infty$
- Income before taxes and transfers $y_i^0 \in \Omega$ and after taxes and transfers $y_i^1 \in \Omega$ for $i = 1, \ldots, n$
- Cumulative distribution functions $F_0 : \Omega \to [0, 1]$ and $F_1 : \Omega \to [0, 1]$
- Poverty line $z \in \Omega$
- There is **fiscal impoverishment** if $y_i^1 < y_i^0$ and $y_i^1 < z$ for some i

Review of Stochastic Dominance

- Let F and G be the cumulative distribution functions for two income distributions.
- F (weakly) first order stochastic dominates G

$$\text{if } F(y) \leq G(y) \ \forall \ y$$

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- *F* first order stochastically dominates *G* on $[0, z]$
  - $\Leftrightarrow$ Lower poverty under distribution *F* for broad class of poverty measures, any poverty line
    (Atkinson 1987; Foster and Shorroks 1988)

Review of Horizontal Inequity and Progressivity

- **Horizontal inequity** occurs when pre-tax and transfer equals are treated *unequally* by the fiscal system
  - or individuals are reranked by the fiscal system

- There is **classical horizontal inequity** if $y_i^0 = y_j^0$ and $y_i^1 \neq y_j^1$ for some (i,j) pair

- There is **reranking** if $y_i^0 \geq y_j^0$ and $y_i^1 < y_j^1$ for some (i,j) pair

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- The tax and transfer system is **progressive** if net taxes—i.e., taxes minus benefits—as a proportion of income increase with income

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If there is no reranking among the poor,
F_1 FOSD F_0 on $[0, z] \Leftrightarrow$ no FI
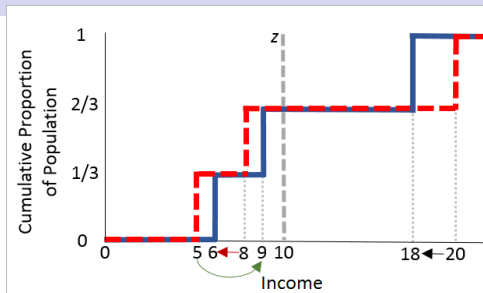
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Propositions: FI and FOSD

Proposition

If there is reranking among the poor, F_1 FOSD F_0 on $[0, z]$ is ***not a sufficient condition*** *for no FI*

Proof.

$\boldsymbol{y^0} = (5, 8, 20), \boldsymbol{y^1} = (9, 6, 18), z = 10$. F_1 FOSD F_0 among the poor and there is FI $\qquad\square$

Proposition

*Horizontal inequity is **neither a necessary nor sufficient condition** for FI.*

Proof.

$\square$

FI, Horizontal Inequity, and Progressivity

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Proof.

Not sufficient: $y^0 = (5, 5, 6, 20)$, $y^1 = (5, 7, 6, 18)$, $z = 10$.
Horizontal inequity (classical and reranking) has occurred but FI has not.

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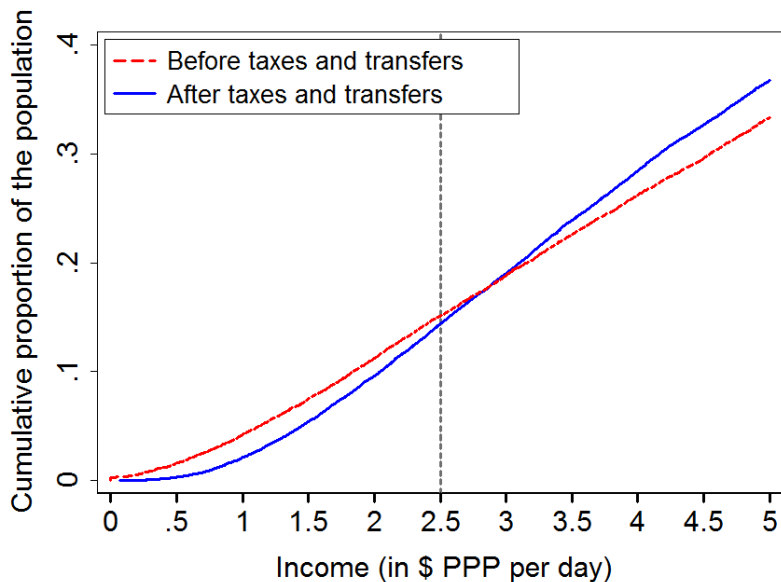Not sufficient: $\boldsymbol{y^0} = (5, 5, 6, 20), \boldsymbol{y^1} = (5, 7, 6, 18), z = 10$.
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Proposition

*A globally progressive tax and transfer system is **neither a necessary nor sufficient condition** for no FI.*

An Illustration: Brazil

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- Closely connected to economic mobility literature
  - See Fields (2010) for an overview

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- FI gap

$$g(\mathbf{y^0}, \mathbf{y^1}) = n^{-1} \sum_{i=1}^{n} \left(\min\{y_i^0, z\} - \min\{y_i^0, y_i^1, z\} \right)$$

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- FI log gap (restrict $\Omega \subset \mathbb{R}_{++}$)

$$\ell(\boldsymbol{y^0}, \boldsymbol{y^1}) = n^{-1} \sum_{i=1}^{n} \big(\ln(\min\{y_i^0, z\}) - \ln(\min\{y_i^0, y_i^1, z\})\big)$$

FI in Brazil

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- $g(\boldsymbol{y^0}, \boldsymbol{y^1}) = \$0.01$ per capita per day
  - $\Rightarrow$ If policy could by perfectly targeted to those who are impoverished, its elimination would not be particularly costly
- However, average amount an impoverished person is impoverished $= g(\boldsymbol{y^0}, \boldsymbol{y^1})/h(\boldsymbol{y^0}, \boldsymbol{y^1}) = \$0.19$ per day
  - 10% of their income on average

Measuring FI

- FI headcount ratio, gap, and log gap can be sensitive to choice of poverty line z
- FI curve
  - For a given cut-off, proportion of total population that was fiscally impoverished

  $$h(z, \cdot) = n^{-1} \sum_{i=1}^{n} \mathbb{1}(y_i^1 < y_i^0) \mathbb{1}(y_i^1 < z)$$

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- Downward mobility curve (Foster and Rothbaum, 2013)
  - For a given cut-off, proportion of total population that experiences downward mobility across that cut-off

$$m(z, \cdot) = n^{-1} \sum_{i=1}^{n} \mathbb{1}(y_i^1 < z < y_i^0)$$

Dominance Propositions

- Comparing two post-fisc situations A and B with same pre-fisc distribution
  - e.g., actual situation vs. proposed reform

Proposition

A has an unambiguously lower FI headcount ratio than B for all poverty lines $z \in [z^-, z^+] \Leftrightarrow$
FI curve of A first order dominates that of B on $[z^-, z^+]$

Proposition

A has unambiguously lower FI gap than B $\Leftrightarrow$
downward mobility curve of A second order dominates that of B on $[0, z^+]$