Pareto-improving tax reforms and the Earned Income Tax Credit

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ESEM conference

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Introduction

- Starting point:
  - Take an income tax-transfer system in place.
  - Is there a tax reform that makes every citizen better off?
  - If yes: Which tax reform does the job?
- We provide
  - empirically applicable Pareto conditions,
  - a test for whether any specific reform is Pareto-improving,
  - a measure of the size of inefficiencies,
  - a tool to identify the "best" Pareto-improving reform.
- We apply these tools to study the 1975 EITC introduction in the US.

What we do

- **Generic formal framework:**
  - Static utility-maximizing choice of earnings.
  - Budget set defined by some non-linear tax schedule.
  - Tax reforms vary the marginal tax in m income brackets (flexibly located).

Figure

- **Perturbation approach:** Identify small Pareto-improving reforms.
- **Necessary and sufficient conditions** for Pareto efficiency.
- **Test function** for historical tax reforms.
- **Application** to 1975 EITC introduction in the US.

What we find

- **Two is more than one:**

  If the tax system cannot be Pareto-improved by a one-bracket reform, then there can still be Pareto-improving two-bracket reforms.

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- **Express results** using **revenue function** $y \mapsto \mathcal{R}(y)$: revenue gain from a small one-bracket reform at income level $y > 0$.

- **Application:**
  - 1974 pre-EITC tax system was Pareto-inefficient.
  - 1975 EITC introduction was not Pareto-improving (but close to).
  - Best reform was a larger version of the EITC reform.

Model

- Continuum of individuals.
- Utility function $u : (c, y, \theta) \mapsto u(c, y, \theta)$, continuously differentiable in c.
- Atomless distribution of individual characteristics $\theta \in \Theta \subset \mathbb{R}^n$, single-crossing condition.
- Simplest case: Diamond (1998)

$$u(c, y, \theta) = c - \frac{1}{1 + \frac{1}{\varepsilon}} \left(\frac{y}{\theta} \right)^{1+\frac{1}{\varepsilon}}$$

- Below: Fixed and variable effort costs as in Jacquet et al. (2002)

$$u(c, y, \theta_1, \theta_2) = c - \frac{1}{1 + \frac{1}{\varepsilon}} \left(\frac{y}{\theta_1} \right)^{1+\frac{1}{\varepsilon}} - \theta_2 \; \mathbb{1}_{y>0}$$

Tax reforms

- Status quo budget set: $C_0(y) = c_0 + y - T_0(y)$, where
  - $T_0 : y \mapsto T_0(y)$ is continuous tax schedule with $T_0(0) = 0$,
  - c_0 is base transfer to non-working agents.
- Reform introduces new tax function $T_1 = T_0 + \tau\, h$, where
  - τ is magnitude of reform,
  - $h : y \mapsto h(y)$ is direction of reform.
- Revenue gain used to increase base transfer, $c_1 = c_0 + R(\tau, h)$.

Pareto-improving tax reforms

- Denote by $v(\tau, h, \theta)$ the indirect utility of type θ after tax reform (τ, h).
- By envelope theorem, the utility effect of a small reform is

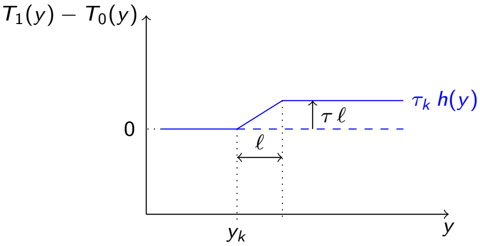
$$\frac{d}{d\tau}\, v(0, h, \theta) = u_{c0}(\theta)\ \left[R_\tau(0, h) - h\left(y_0(\theta)\right)\right]\ .$$

- Small reform is Pareto-improving if

$$R_\tau(0, h) > \max_{y \in y_0(\theta)} h(y)\ .$$

Tax reforms with one bracket

- Consider a reform (τ, h) that varies $T'(y)$ by τ in one interval $(y_k, y_k + \ell)$.



- Saez (2001) perturbation: $\tau \to 0$, $\ell \to 0$
- Denote marginal revenue gain by $\mathcal{R}(y_k) \;\Rightarrow\;$ **Revenue function**

  (Note: $\mathcal{R}$ differs across models, contains mechanical and behavioral effects)

First main result: Necessary conditions

Theorem 1

If T_0 is a Pareto-efficient tax system, then the revenue function $y \mapsto \mathcal{R}(y)$ is

- bounded from below by 0,
- bounded from above by 1,
- non-increasing.

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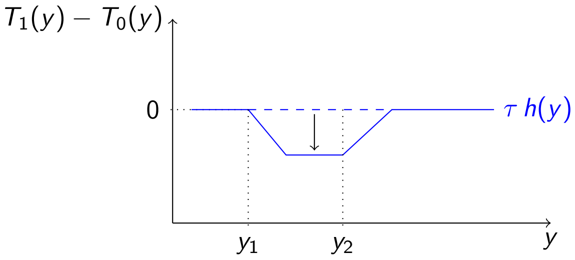
- If $\mathcal{R}(y_k) > 1$, a one-bracket tax increase at income y_k raises enough revenue to compensate the direct losers.
- If $\mathcal{R}(y_1) < \mathcal{R}(y_2)$, a two-bracket tax cut between incomes y_1 and $y_2 > y_2$ is self-financing.

$\Rightarrow$ **Two is more than one!**

Two-bracket tax cuts



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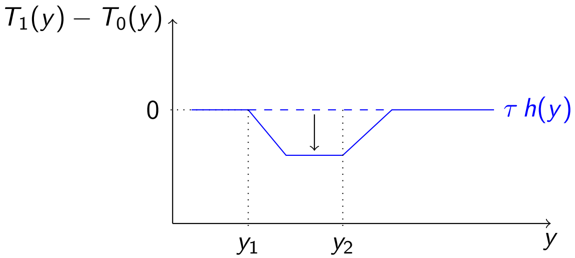

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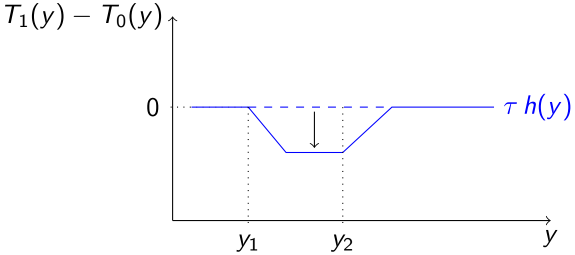

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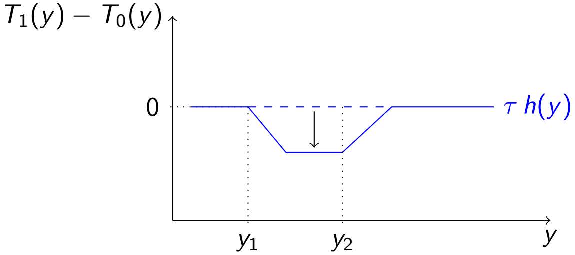

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$\Rightarrow$ If $\mathcal{R}(y_1) < \mathcal{R}(y_2)$: Two-bracket tax cut is self-financing!

Second main result: Sufficient conditions

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Theorem 2

If the revenue function $y \mapsto \mathcal{R}(y)$ is

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$\Rightarrow$ **By Theorem 2: Two is enough.**

Pareto test Intuition Relation

Sufficient-statistics formula

- Model with labor supply responses at intensive and extensive margins, no income effects.
- Jacquet, Lehmann, Van der Linden (2013): Revenue effect $\mathcal{R}(y)$ is

$$\begin{aligned}\mathcal{R}(y) &= 1 - F_y(y_k) - \varepsilon_0(y)\, y_k\, f_y(y_k)\, \frac{T_0'(y_k)}{1 - T_0'(y_k)} \\ &\quad - \int_{y_k}^{\infty} f_y(y_k)\, \pi_0(y)\, \frac{T_0(y)}{y - T_0(y)}\, dy\end{aligned}$$

- F_y, f_y: cdf/pdf of income distribution
- $\varepsilon_0(y), \pi_0(y)$: Intensive- and extensive-margin elasticities
- $T_0(y)$, $T_0'(y)$: Participation tax, marginal tax

1974 EITC introduction: Background

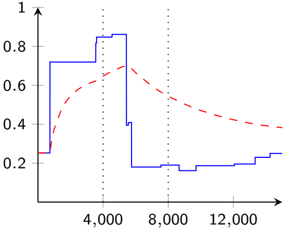
- 1975 EITC introduction was response to increased welfare dependency and a widely discussed “poverty trap”.
- EITC provided pro-work incentives
- Phased in at marginal rate of -10% from 0 to $4,000$ USD.
- Phased out at marginal rate of $+10\%$ from $4,000$ to $8,000$ USD.
- Initially, the EITC was restricted to taxpayers with dependent children.

$\Rightarrow$ Calibrate test function $\mathcal{R}(y)$ for single parents and childless singles

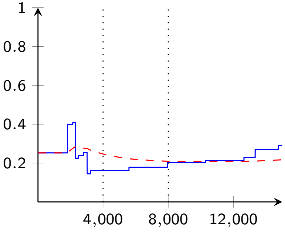
Calibration

- Data on tax schedule and welfare programs (AFDC, SNAP) for 1974.
- Taxes and transfers varied by family size ⇒ Focus on families with two kids.
- US income distributions: March CPS 1975.
- Benchmark assumptions on behavioral responses:
  - intensive-margin elasticity 0.33;
  - average extensive-margin elasticities 0.58 (single parents) and 0.25 (childless singles).

1974 Tax-Transfer Schedules



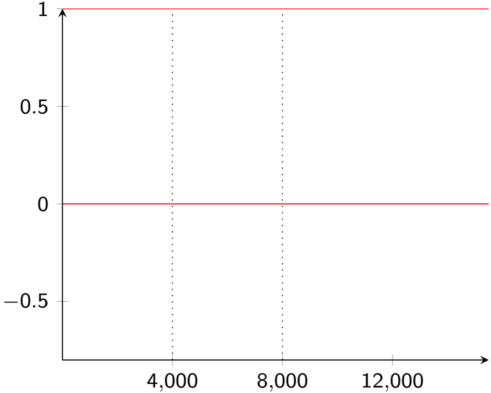
(a) Single parents



(b) Childless singles

- Solid blue lines: Effective marginal tax rate $T_0'(y)$
- Dashed red lines: Participation tax rate $T_0(y)/y$

Pareto test of 1974 tax-transfer system



1975 tax system

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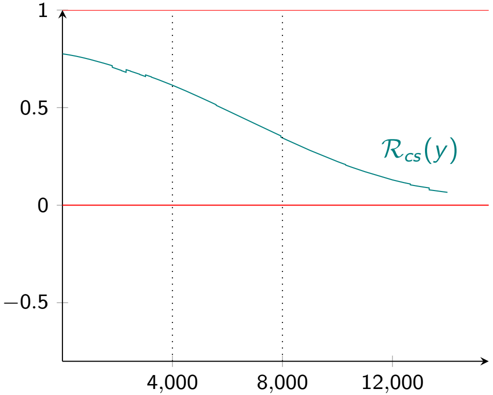

- Childless singles (teal): Minor inefficiencies around $3,000$ USD!

1975 tax system

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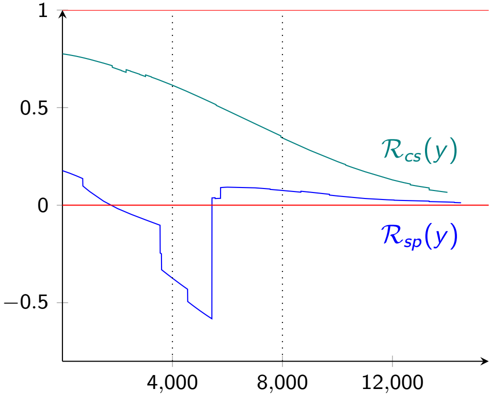

- Single parents (blue): Substantial inefficiencies in EITC range!

1975 tax system

Pareto test: Sensitivity analysis

- In alternative scenarios, we consider
  - smaller or larger participation elasticities,
  - smaller or larger intensive elasticities,
  - heterogeneous elasticities,
  - income effects at both margins,
  - estimates of F_y based on other samples or PSID data,
  - assets tests for AFDC and SNAP,
  - other representations of tax-transfer schedule,
  - tax-transfer schedules for other US states,
  - single parents with 1, 2, or 3 children

⇒ Robust finding: 1974 tax-transfer system was Pareto-inefficient

Figures

Conclusion

- We provide necessary and sufficient conditions for Pareto-efficiency of income taxes.
- Key lesson: Two-bracket reforms deserve particular attention.
- Two-bracket reforms can make every one better off, even if no one-bracket reform can.
- If there are no Pareto-improving reforms with one and two brackets, then there is no Pareto improvement at all.
- Sufficient-statistics formulas allow to identify Pareto-improving reforms.
- Application: 1975 EITC introduction was two-bracket tax cut that tackled inefficiency.
- Pareto test should be first step in the analysis of tax systems.

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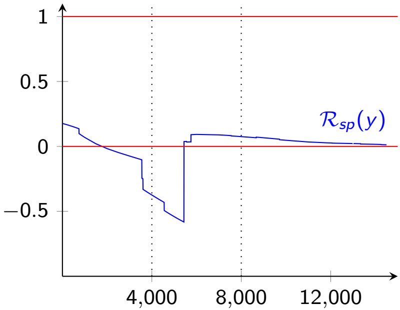
Evaluation of 1975 EITC reform



- 1975 EITC reform Pareto-improving if

$$-\int_0^{4000} \mathcal{R}(y)dy + \int_{4000}^{8000} \mathcal{R}(y)dy \geq 0 \ .$$

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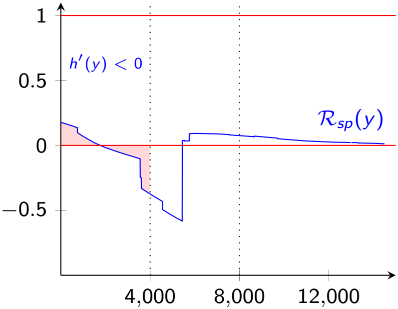

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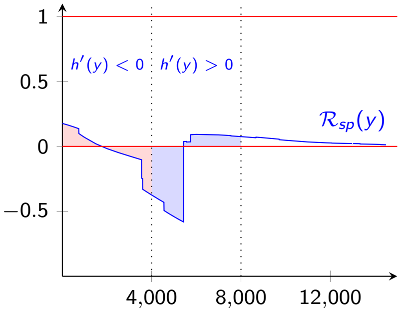

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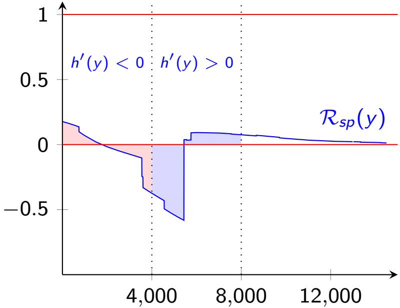

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$\Rightarrow$ Result: Not Pareto-improving for benchmark scenario.

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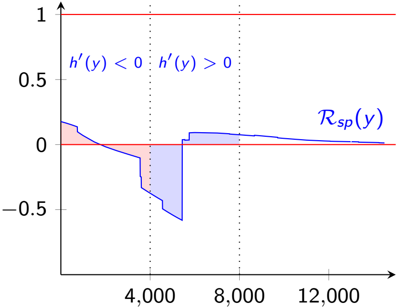

- 1975 EITC reform Pareto-improving if

$$-\int_0^{4000} \mathcal{R}(y)dy + \int_{4000}^{8000} \mathcal{R}(y)dy \geq 0 \ .$$

$\Rightarrow$ Result: Pareto-improving if $\bar{\pi} > 0.84$.

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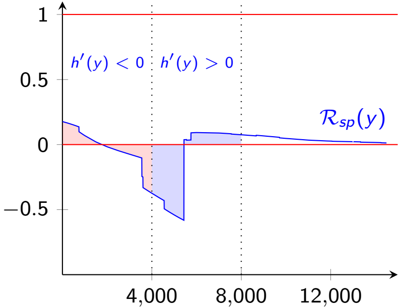

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$$-\int_0^{4000} \mathcal{R}(y)dy + \int_{4000}^{8000} \mathcal{R}(y)dy \geq 0 \ .$$

$\Rightarrow$ Result: Pareto-improving for single parents with one child.

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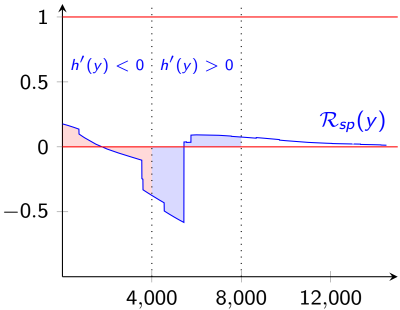
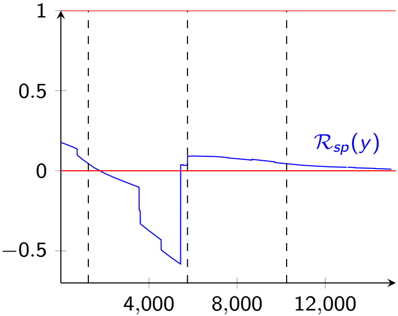


- 1975 EITC reform Pareto-improving if

$$-\int_0^{4000} \mathcal{R}(y)dy + \int_{4000}^{8000} \mathcal{R}(y)dy \geq 0 \ .$$

⇒ Result: Pareto-improving for single parents in Illinois.

Best alternative reform?



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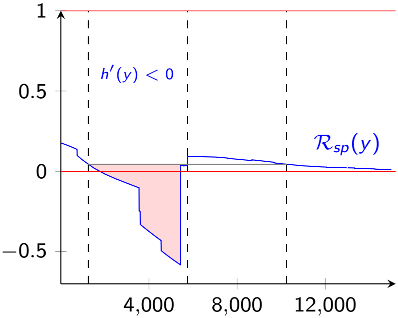

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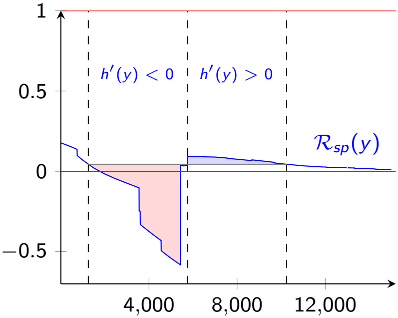

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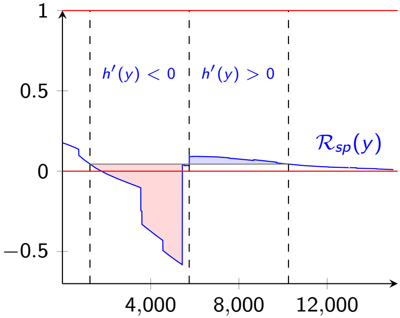

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$\Rightarrow$ Revenue gain per family: 12.6 USD (vs. < 0.01 USD for childless singles).

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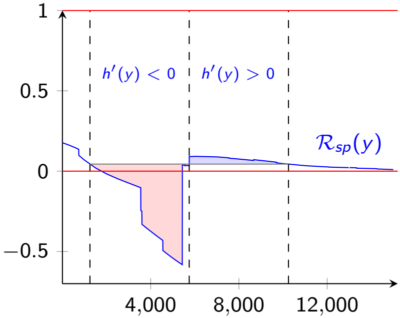

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Subsequent EITC reforms

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- Conditioning of EITC schedules on family size?
  - Size of inefficiency increasing in family size.
  - Conditional tax cuts can raise 25% more revenue than unconditional tax cut.
  - 1991/2009 reforms: Larger EITC for families with $2/3+$ children.

Concluding Remarks

Conclusion

- We provide necessary and sufficient conditions for Pareto-efficiency of income taxes.
- Key lesson: Two-bracket reforms deserve particular attention.
- Two-bracket reforms can make every one better off, even if no one-bracket reform can.
- If there are no Pareto-improving reforms with one and two brackets, then there is no Pareto improvement at all.
- Sufficient-statistics formulas allow to identify Pareto-improving reforms.
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Figure: Tax reform with one bracket

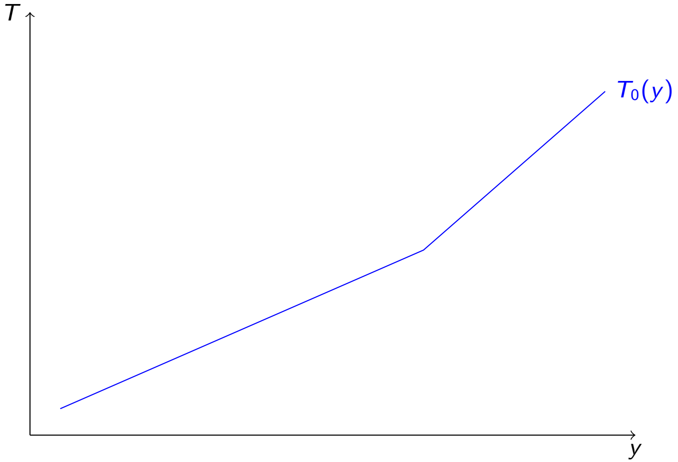


Figure: Tax reform with one bracket

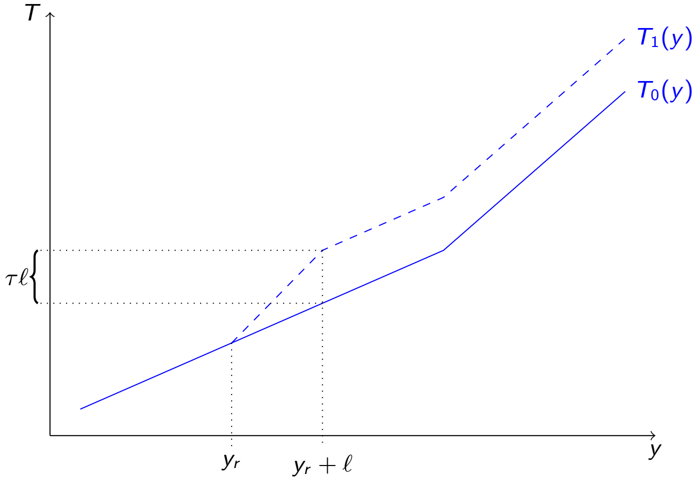
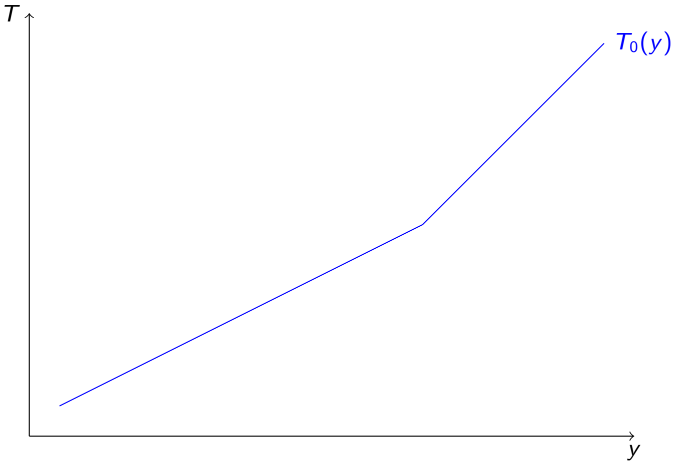


Figure: Tax reform with two brackets



Intro

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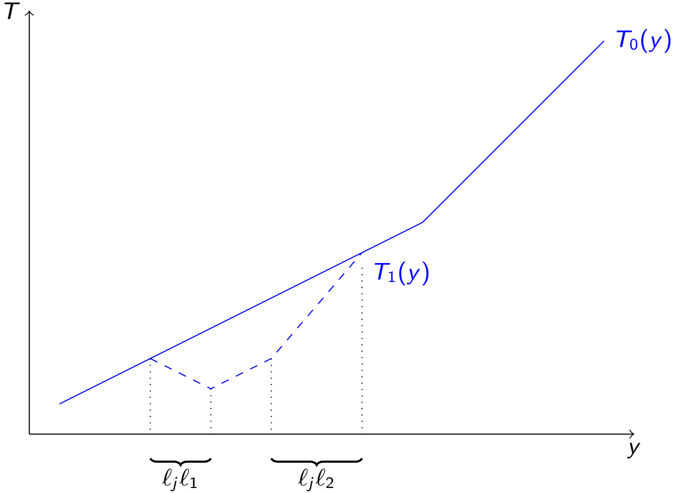

Intro

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  - Focus on simple reform such that

$$T_1(y) = \begin{cases} T_0(y_k) - \varepsilon & \text{for} \quad y = y_k \, , \\ T_0(y) & \text{for} \quad y \neq y_k \, . \end{cases}$$

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⇒ We provide sufficient conditions and results for *all* non-linear reforms!

Related literature

- Inverse optimum approach: Bourguignon & Spadaro (2012), Jacobs, Jongens & Zoutman (2017).

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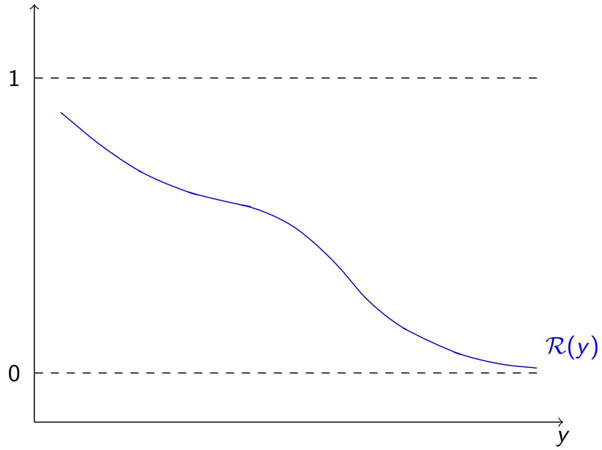
- No general results on how to tackle inefficiencies.

$\Rightarrow$ We provide direct Pareto test, and show which reforms help!

Model Relation inverse approach

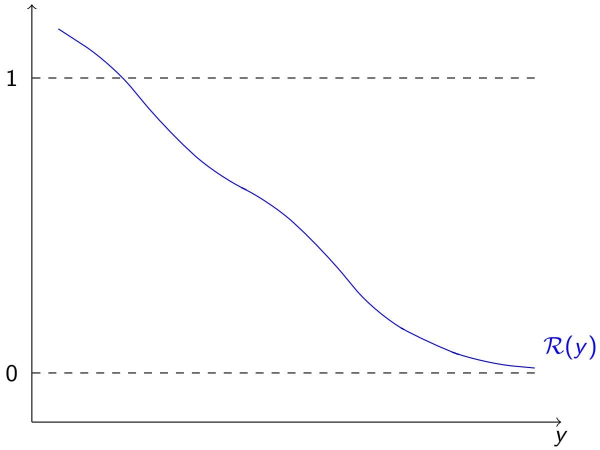
Graphical Pareto test



$\Rightarrow$ Case 1: T_0 is Pareto-efficient!

Intuition

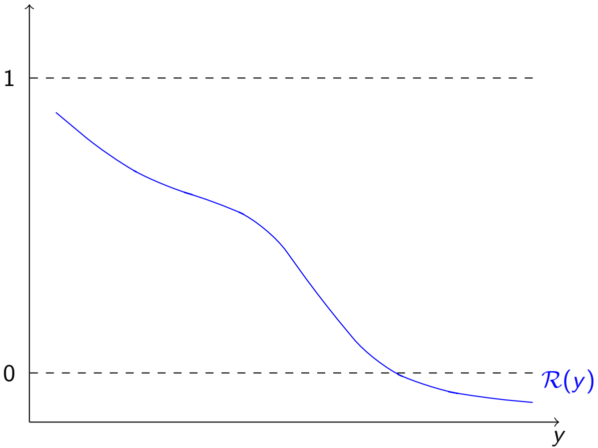
Graphical Pareto test



$\Rightarrow$ Case 2: One-bracket tax increase is Pareto-improving!

Intuition

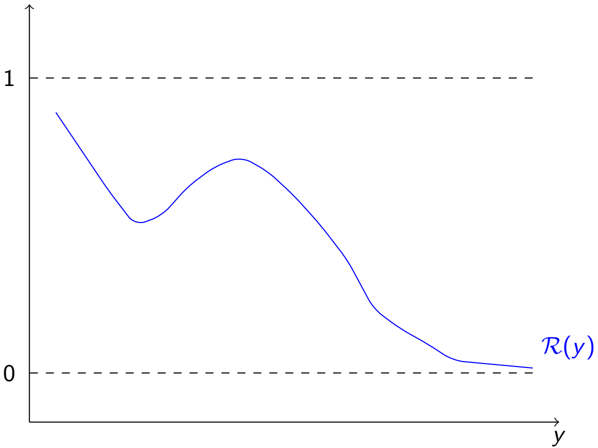
Graphical Pareto test



$\Rightarrow$ Case 3: One-bracket tax cut is Pareto-improving!

Intuition

Graphical Pareto test

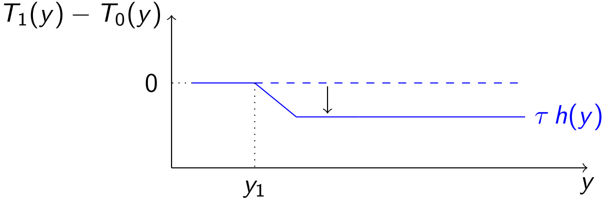


$\Rightarrow$ Case 4: Two-bracket tax cut is Pareto-improving!

Intuition

Intuition: Why is two enough?

- Consider reform with tax cut $\tau_1 < 0$ in lowest bracket 1



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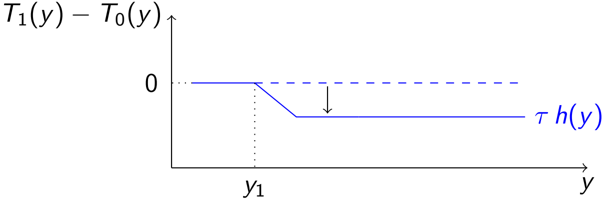

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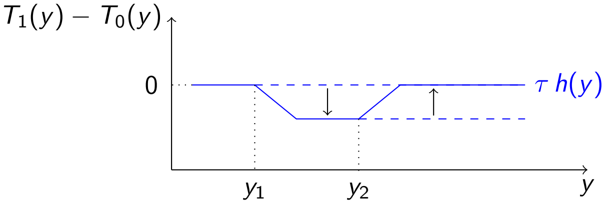

- Revenue loss, cut in base transfers $\Rightarrow$ Agents below y_1 lose.
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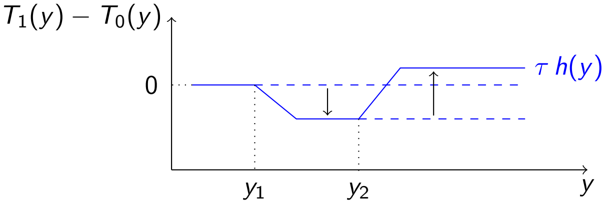

- Revenue loss, cut in base transfers $\Rightarrow$ Agents below y_1 lose.
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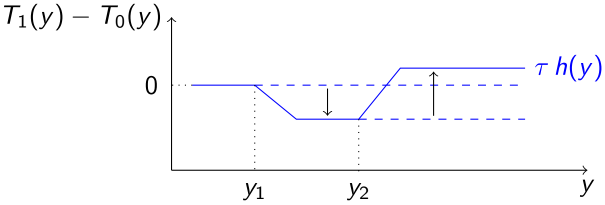

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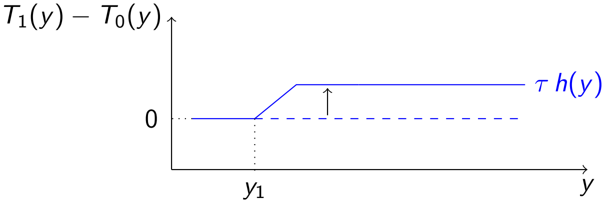
  $\Rightarrow$ Agents above bracket 2 lose.

  $\Rightarrow$ Compensation requires further tax increase.

Sufficient condition

Intuition: Why is two enough?

- Consider reform with tax increase $\tau_1 > 0$ in lowest bracket



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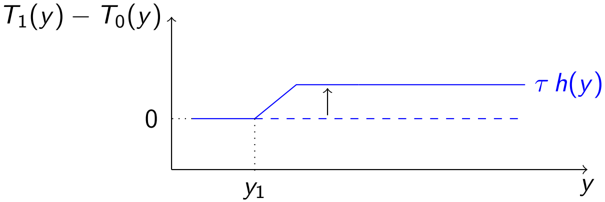

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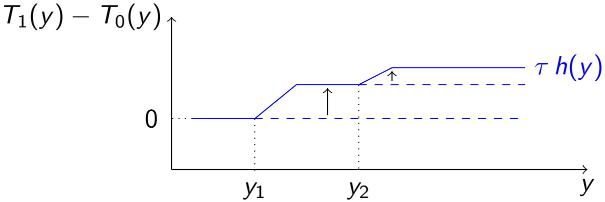

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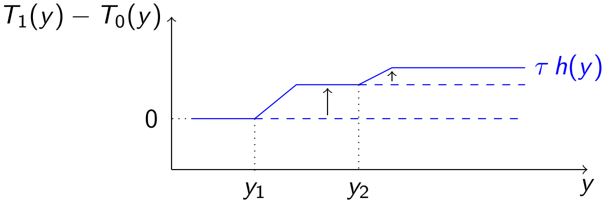

- Revenue gain, but agents above y_1 lose.
- Compensation requires to raise taxes at higher income $y_2 > y_1$.

  $\Rightarrow$ Agents above y_2 lose even more.

  $\Rightarrow$ Biggest loser cannot be compensated.

Comment: Simplify sufficient conditions

- Assume that
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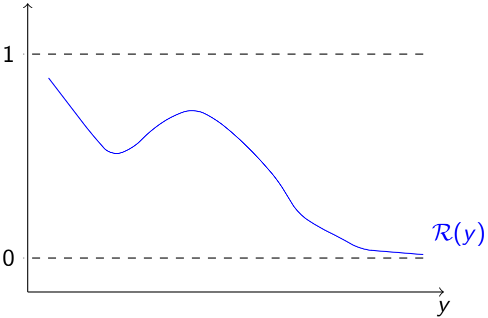
- Hence, we can focus on two-bracket tax cuts only.
- In some cases, two-bracket reforms are equivalent to one-bracket reforms: No agent is affected by one of the brackets.

Illustration: Best Pareto-improving reform



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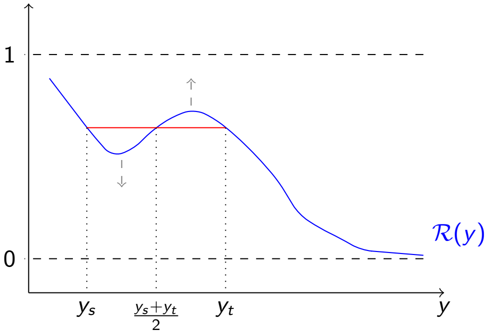

- Revenue-maximizing reform: Two-bracket tax cut!

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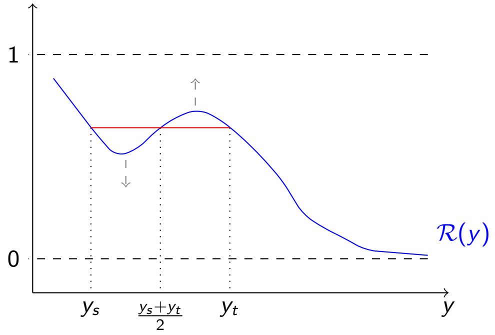

- Revenue-maximizing reform: Two-bracket tax cut!
- Maximum revenue gain:

$$R(\tau, h^*) \approx \tau a \left[\int_{\frac{y_s+y_t}{2}}^{y_t} \mathcal{R}(y) dy - \int_{y_s}^{\frac{y_s+y_t}{2}} \mathcal{R}(y) dy \right]$$

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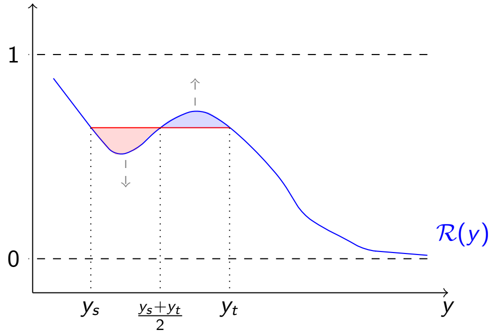

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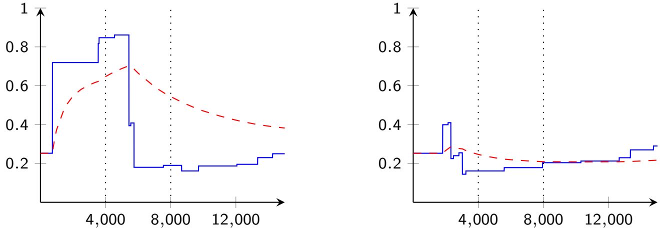
Sufficient statistics

1974 Tax-Transfer Schedules

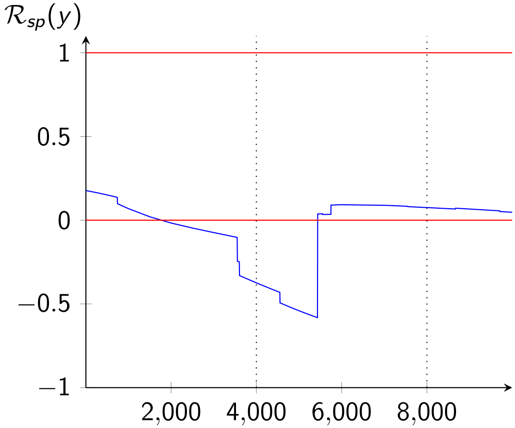


(a) Single parents (b) Childless singles

- Solid blue lines: Effective marginal tax rate $T_0'(y)$
- Dashed red lines: Participation tax rate $T_0(y)/y$

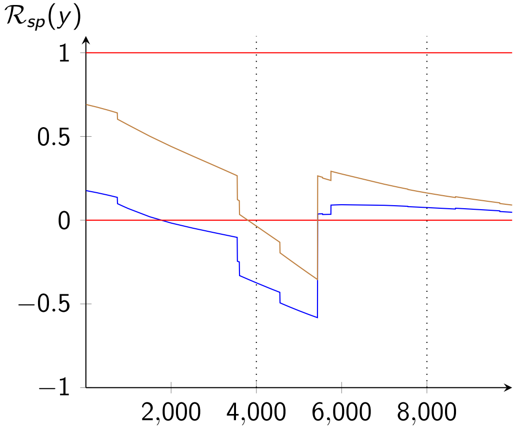
Calibration

Sensitivity analysis



- Blue: Benchmark

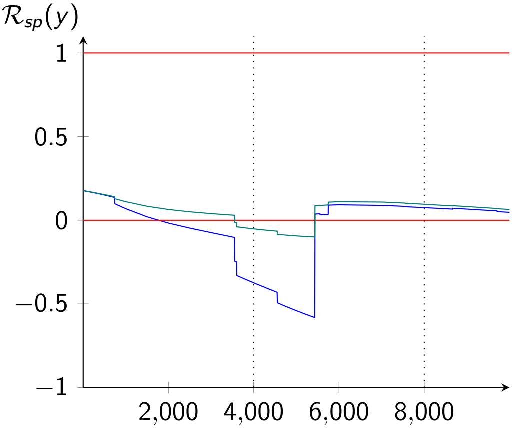
Sensitivity analysis



- Brown: No extensive-margin responses $\pi = 0$

EITC reform

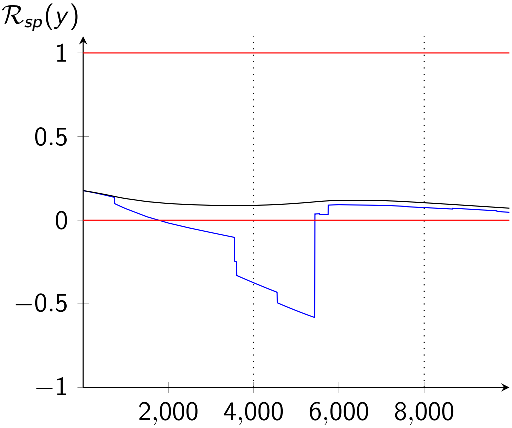
Sensitivity analysis



- Teal: Less intensive-margin responses $\varepsilon = 0.1$

EITC reform

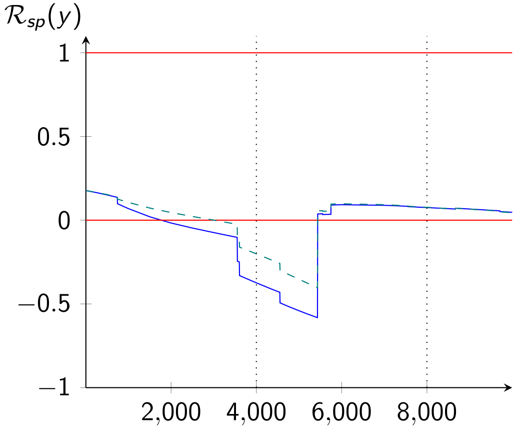
Sensitivity analysis



- Black: No intensive-margin responses $\varepsilon = 0$

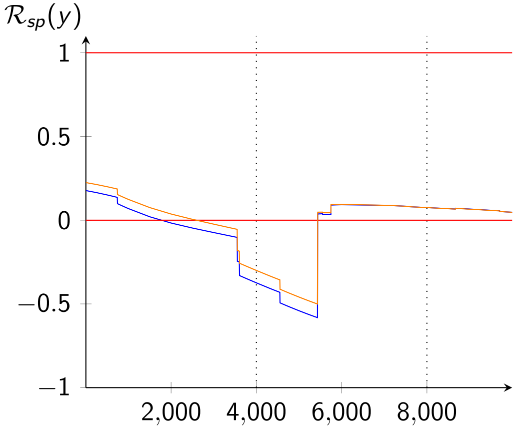
EITC reform

Sensitivity analysis



- Dashed teal: Elasticity ε increasing with income

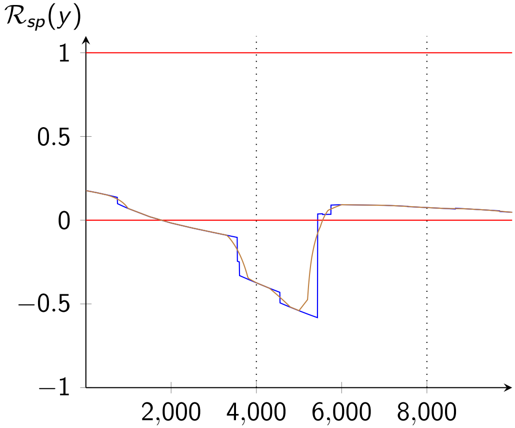
Sensitivity analysis



- Orange: With income effects, $MPE = 0.3$

EITC reform

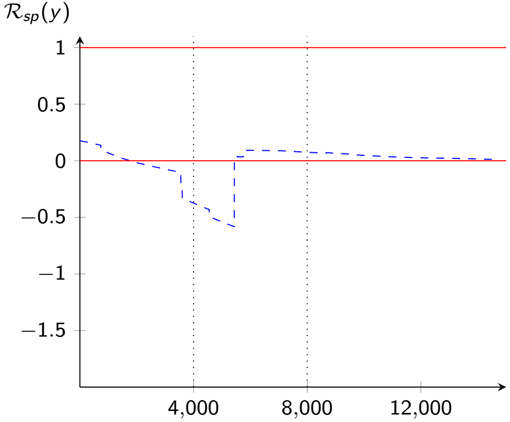
Sensitivity analysis



- Brown: Smoothed tax schedule

EITC reform

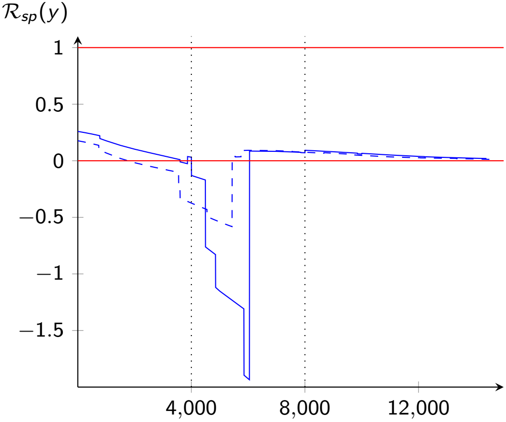
Pareto test of 1975 tax-transfer system



- 1974: Potential revenue gain 12.6 USD per family

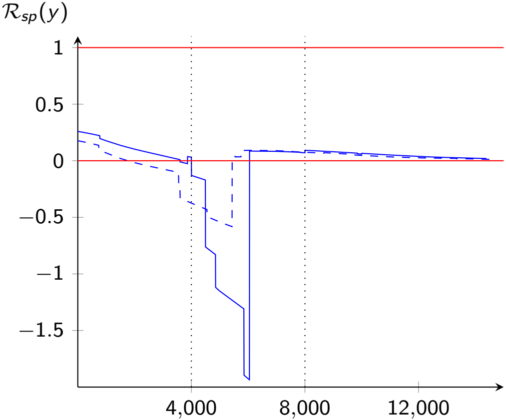
Conclusion

Pareto test of 1975 tax-transfer system



- 1975: Potential revenue gain 21.8 USD per family

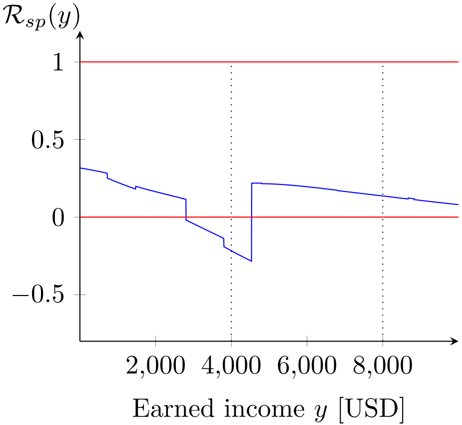
Pareto test of 1975 tax-transfer system



- 1979: EITC expansion between $4k$ and $10k$ USD.

Conclusion

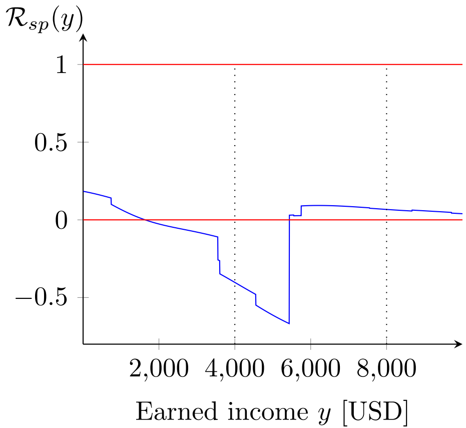
Heterogeneity: Family size



Single parents with 1 child

- Optimal tax cut between $2,000$ and $7,000$ USD.
- Revenue gain 6.4 USD per family.

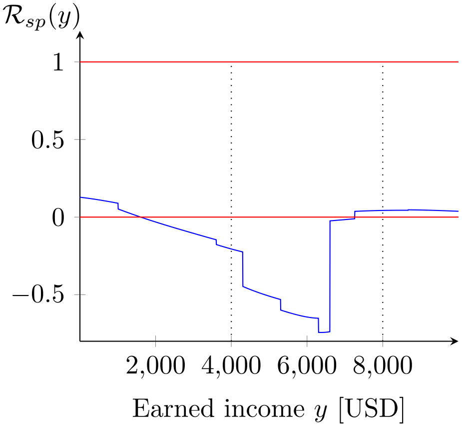
Heterogeneity: Family size



Single parents with 2 children

- Tax cut between $1,200$ and $10,200$ USD.
- Revenue gain 13.5 USD per family.

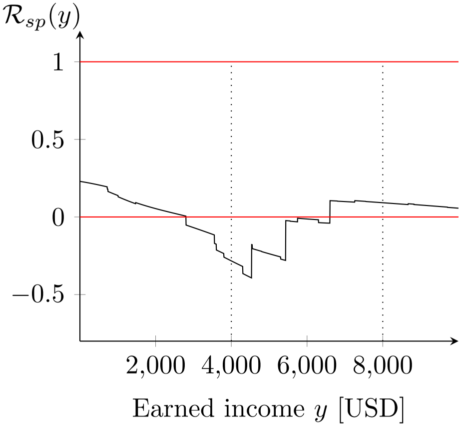
Heterogeneity: Family size



Single parents with 3 children

- Optimal tax cut between $1,300$ and $13,200$ USD.
- Revenue gain 18.5 USD per family.

Heterogeneity: Family size

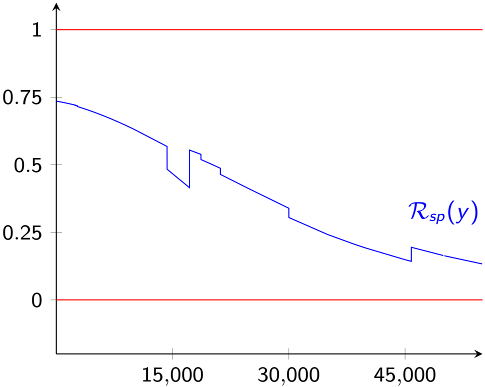


Unconditional reform for all single parents:

- Optimal tax cut between $2,200$ and $11,000$ USD.
- Revenue gain about 20% lower than for best conditional reforms.

Conclusion

Current US tax-transfer system



- Minor inefficiency around $15,000$ USD

Conclusion

Relation to inverse optimum approach

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- Consider small two-bracket tax cut between incomes y_1 and $y_2 > y_1$.
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$$E\left[g(y) \mid y \in (y_1, y_2)\right] = \frac{\mathcal{R}(y_1) - \mathcal{R}(y_2)}{F(y_2) - F(y_1)} .$$

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Relation to inverse optimum approach II

- Consider small one-bracket tax cut at income y_k.
- For $\mathcal{R}(y_k) < 0$: Welfare effect of zero requires that

$$E\left[g(y) \mid y > y_k\right] < 0 \, .$$

Relation to inverse optimum approach II

- Consider small one-bracket tax cut at income y_k.
- For $\mathcal{R}(y_k) < 0$: Welfare effect of zero requires that

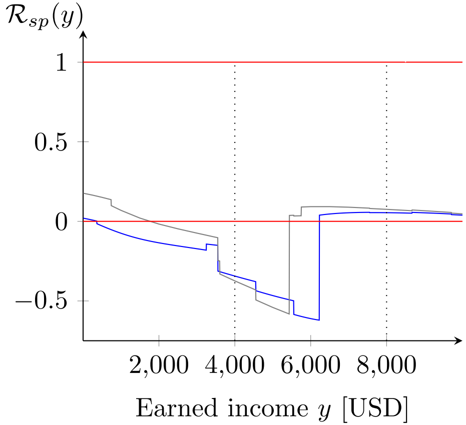
$$E\left[g(y) \mid y > y_k\right] < 0 .$$

- Consider small one-bracket tax increase at income y_k.
- For $\mathcal{R}(y_k) > 1$, welfare effect of zero requires that

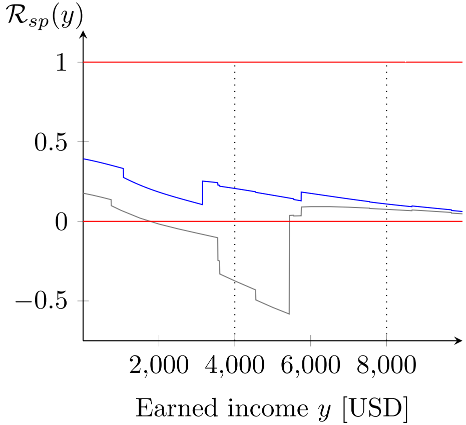
$$E\left[g(y) \mid y < y_k\right] < 0 .$$

Model Reform test

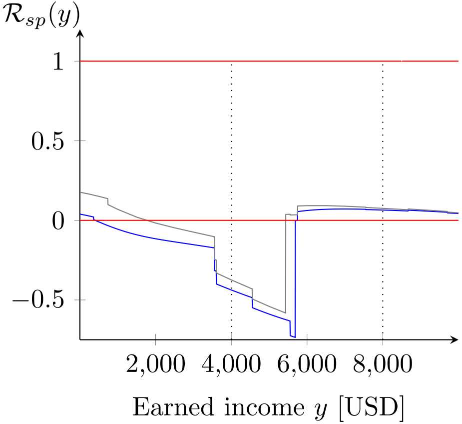
Other states: New York



Other states: Texas



Other states: Pennsylvania



Other states: Illinois