The Inequality Deflator:
Interpersonal Comparisons without a Social Welfare Function

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     - Subjective choice of researcher or policy-maker

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    - Existing literature: Hylland and Zeckhauser (1979), Coate (2000), Kaplow (1996, 2004, 2006, 2008)
- What's missing is a simple (yet general) empirical method of accounting for these distortions (Coate 2000)

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  - **Implementable by weighting surplus by the "inequality deflator"**
    - Marginal cost of providing $1 of welfare to an income level
    - Differs from $1 because of how behavioral response affects government budget

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  - $1 to poor is more valuable even if you like the rich

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2. Pareto-based welfare framework
   - Motivates simple “cost” vs. ”benefit” framework
   - Apply to several economic policies (e.g. merger policy / producer vs. consumer surplus; Medicaid, food stamps, etc.)

1. Model

2. Relation to SWF

3. The Shape of the Inequality Deflator

4. Comparing Income Distributions

5. Pareto-based Welfare Analysis of Policies

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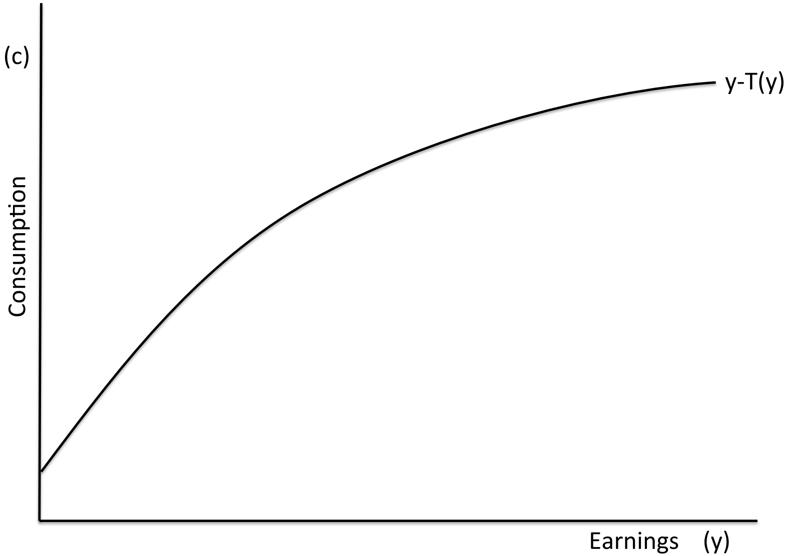
- Why are transfers through the income tax schedule costly?
- Suppose we want to provide a transfer to people earning near y^*...

Modifications to Income Tax Schedule



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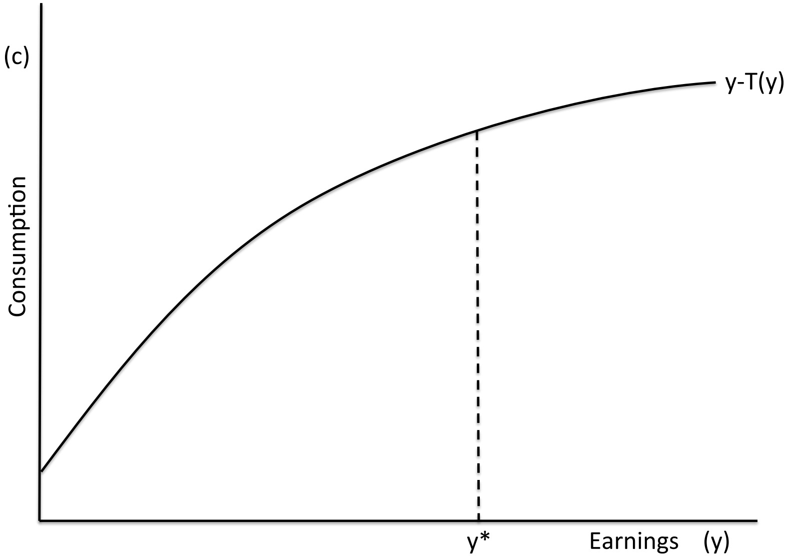

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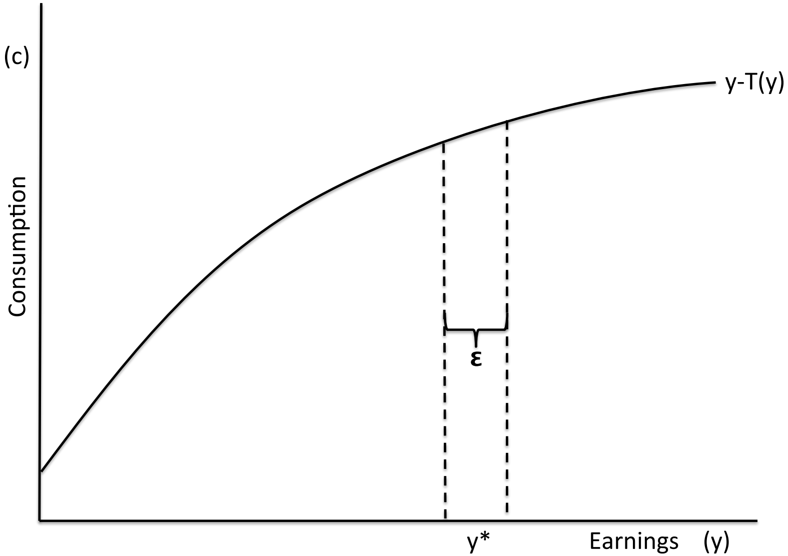

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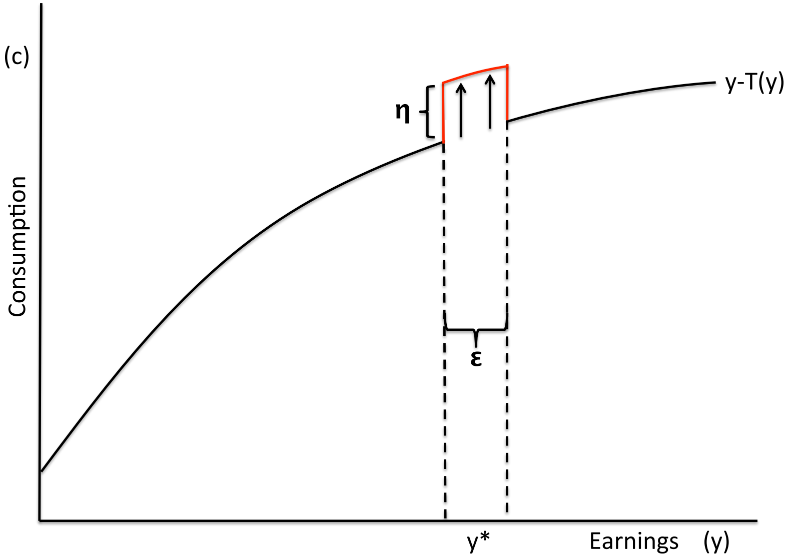

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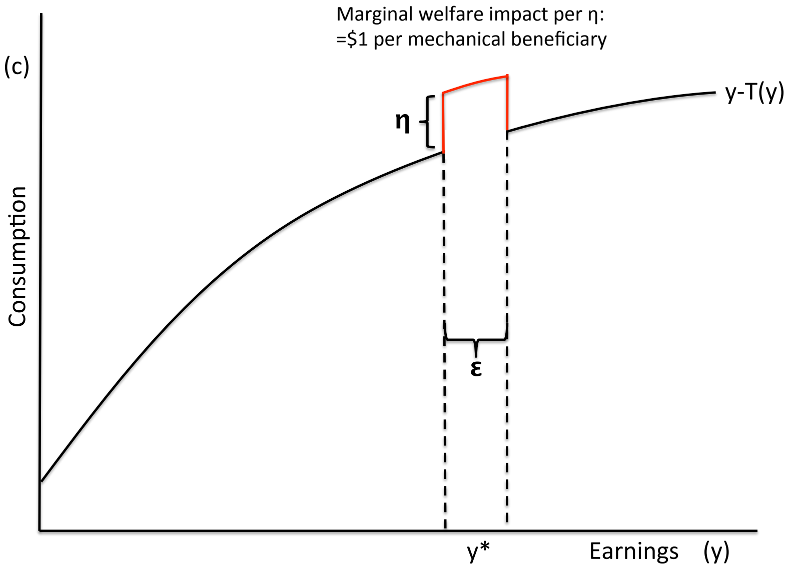

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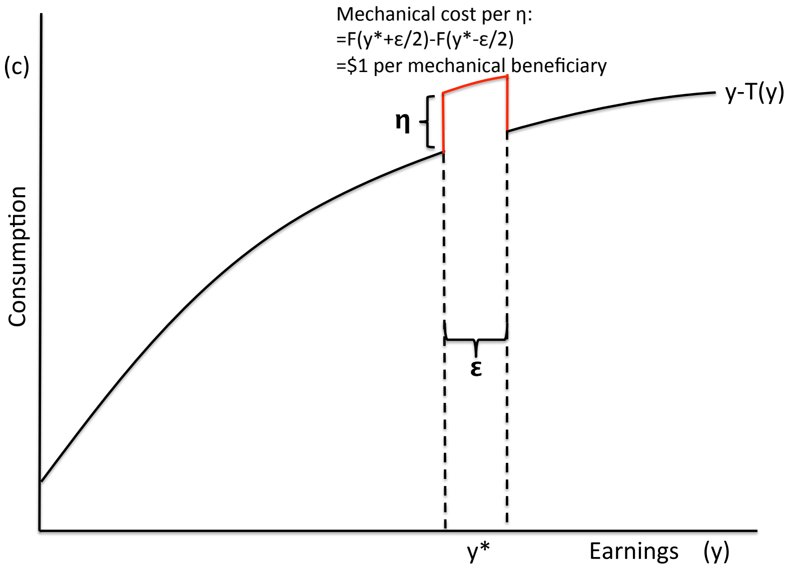

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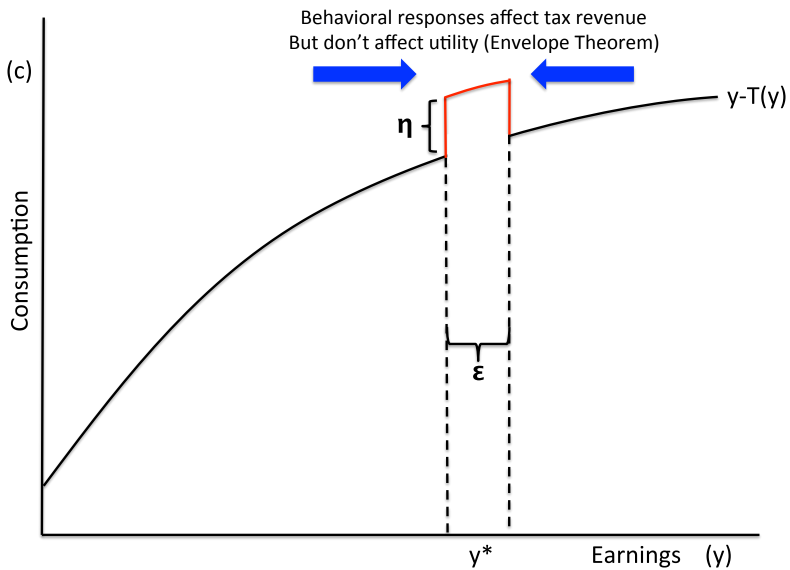

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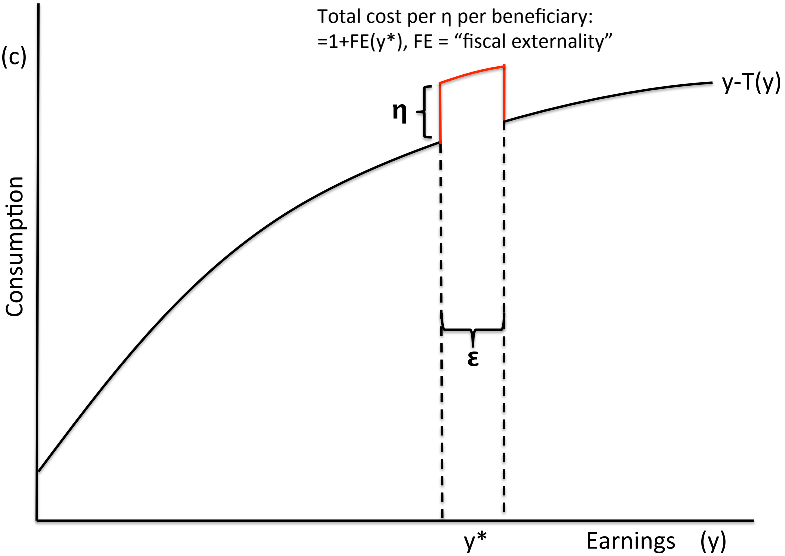

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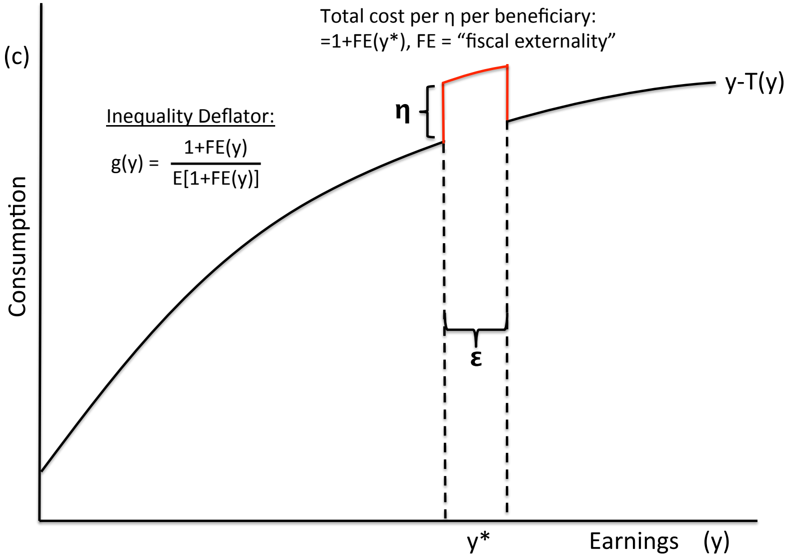

Formal Model

- Paper defines inequality deflator in general model Formal Model

$$g\left(y\right)=\frac{1+FE\left(y\right)}{E\left[1+FE\left(y\right)\right]}$$

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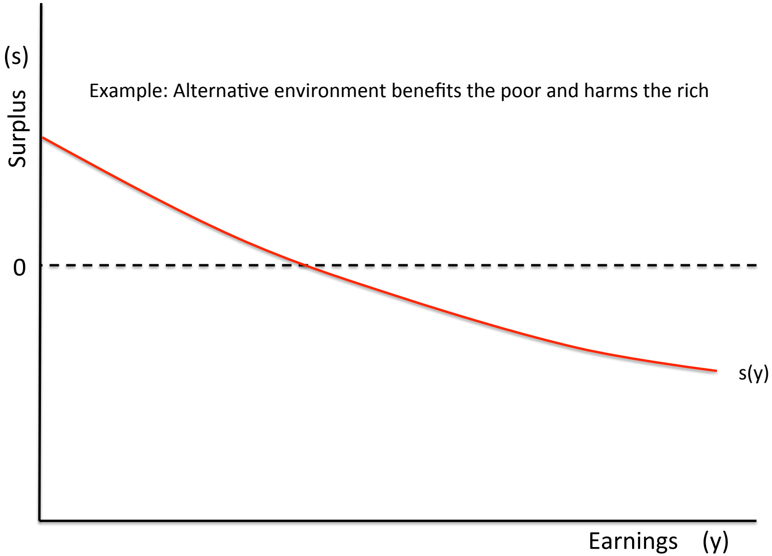
- Inequality Deflator can be used to neutralize distributional comparisons

Example: Alternative Environment Benefits Poor



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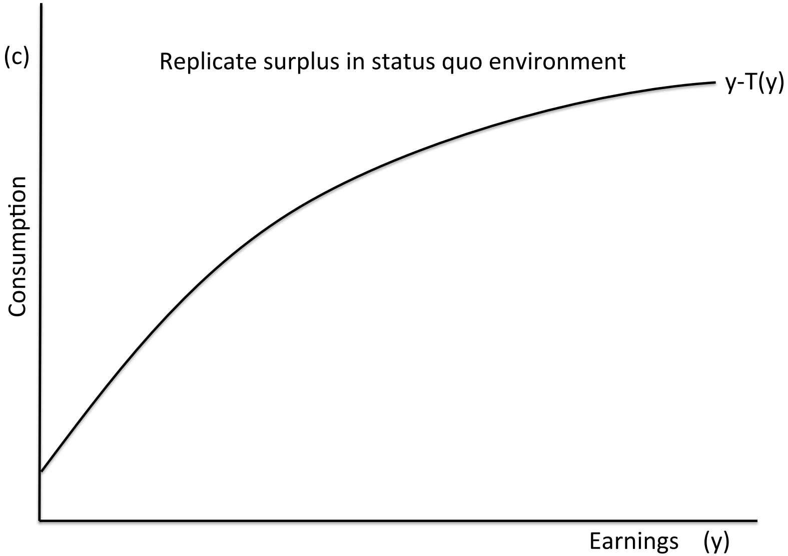

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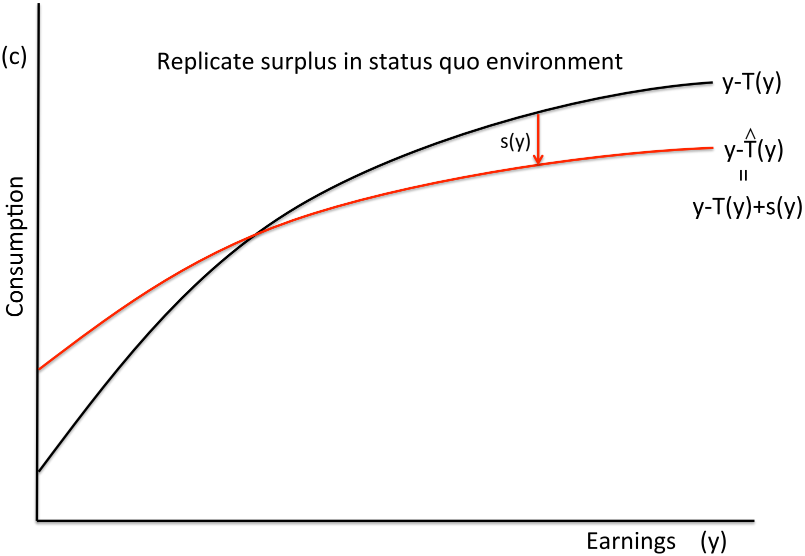

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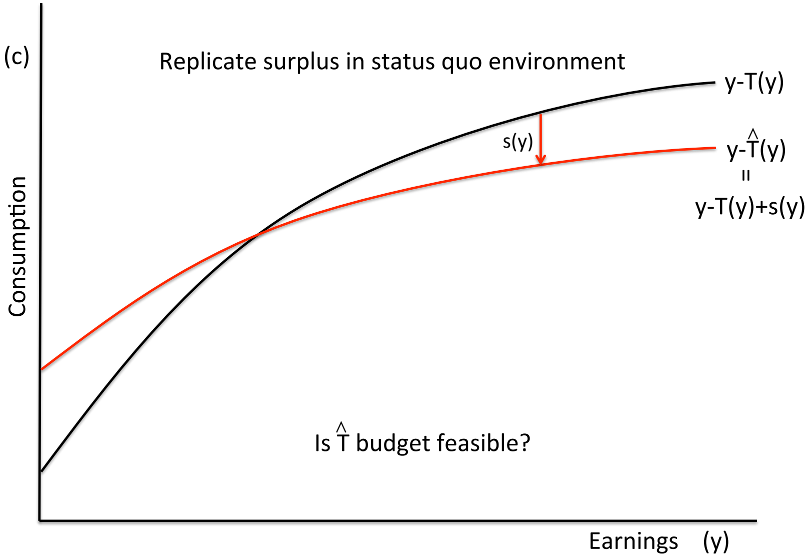

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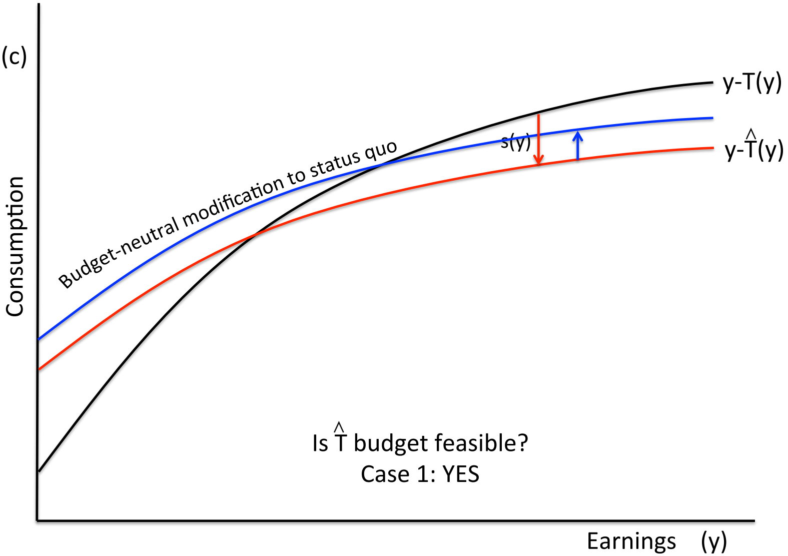

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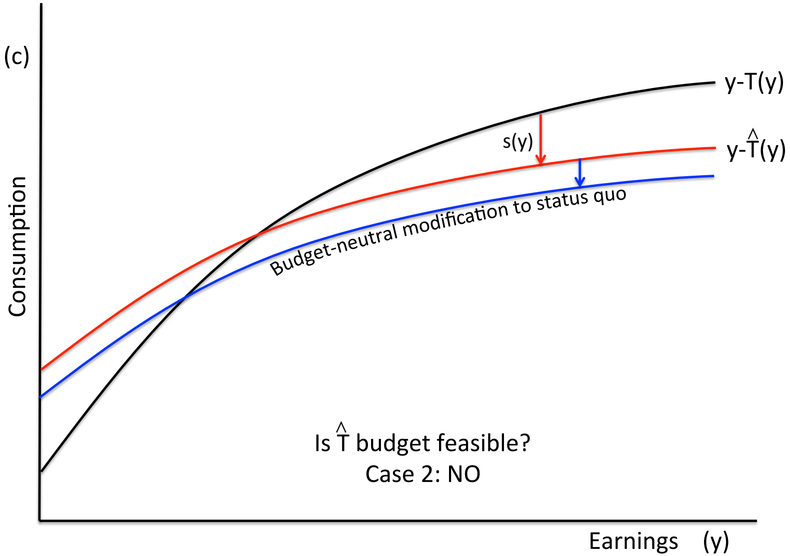

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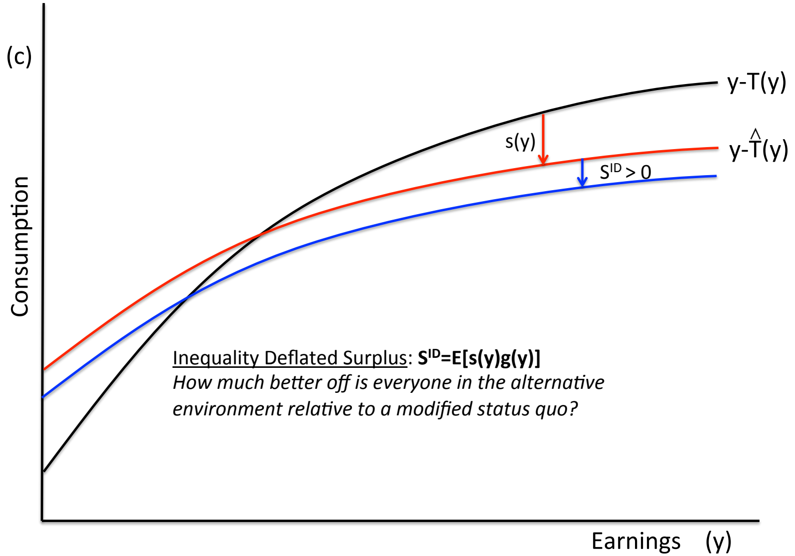

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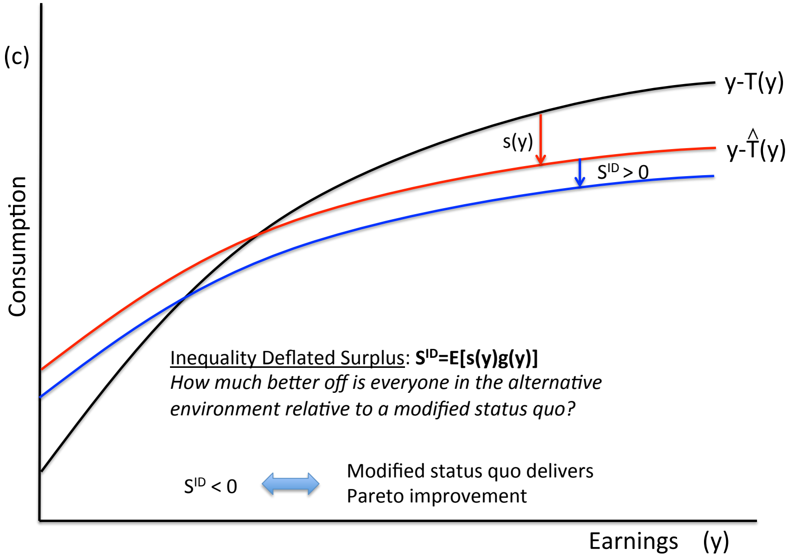
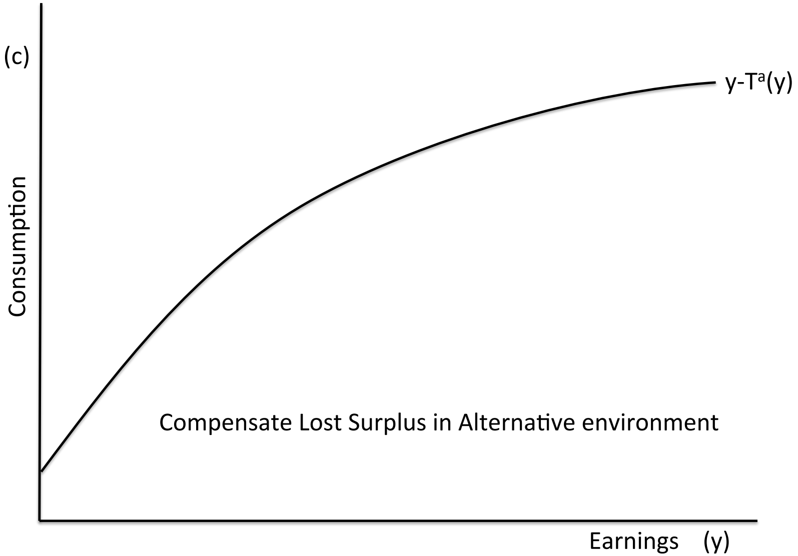


EV and CV

- Given $s(y)$, two ways of neutralizing distributional comparisons
- "EV": modify status quo tax schedule
  - By how much can everyone be made better off in modified status quo world relative alternative environment? Formal "First Order" Statement
- "CV": modify alternative environment tax schedule
  - By how much can everyone be made better off in modified alternative environment relative to status quo?

Inequality Deflator: "CV" Example



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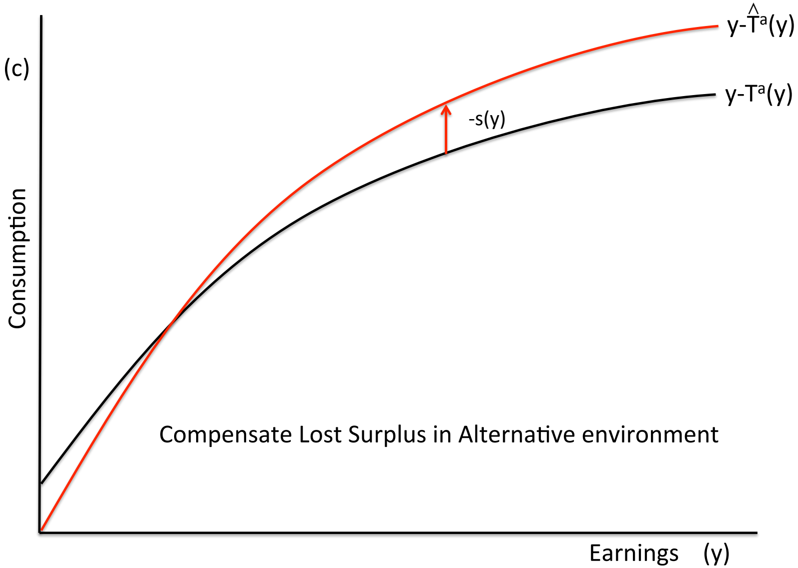

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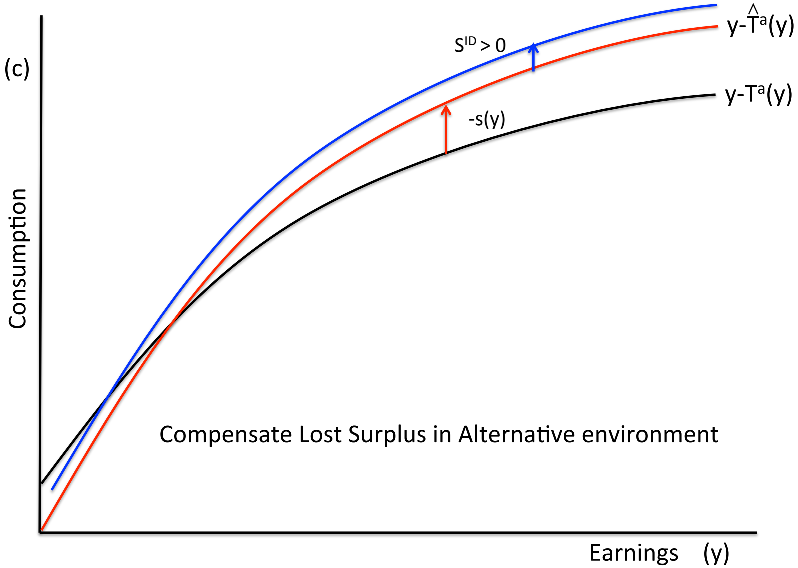

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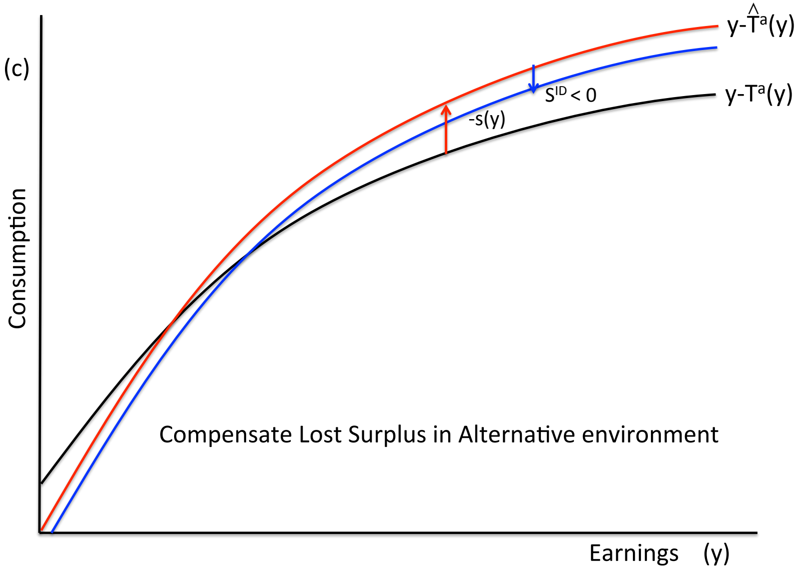

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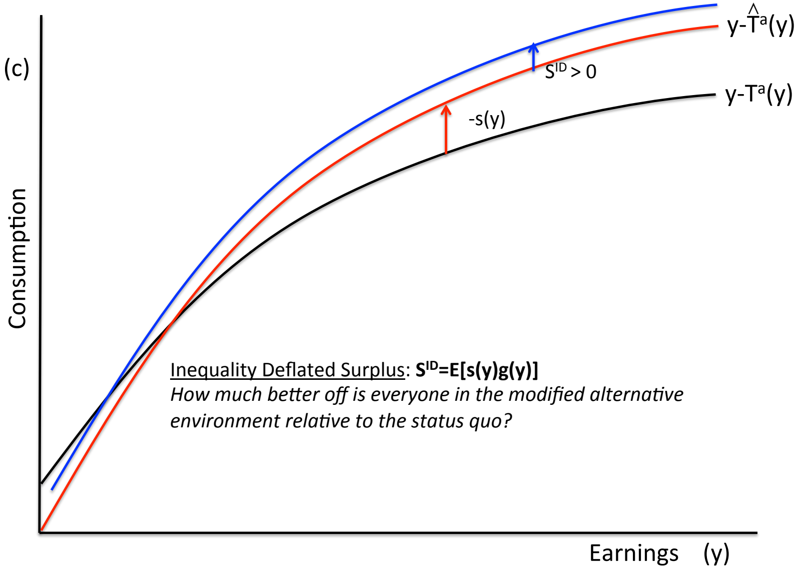

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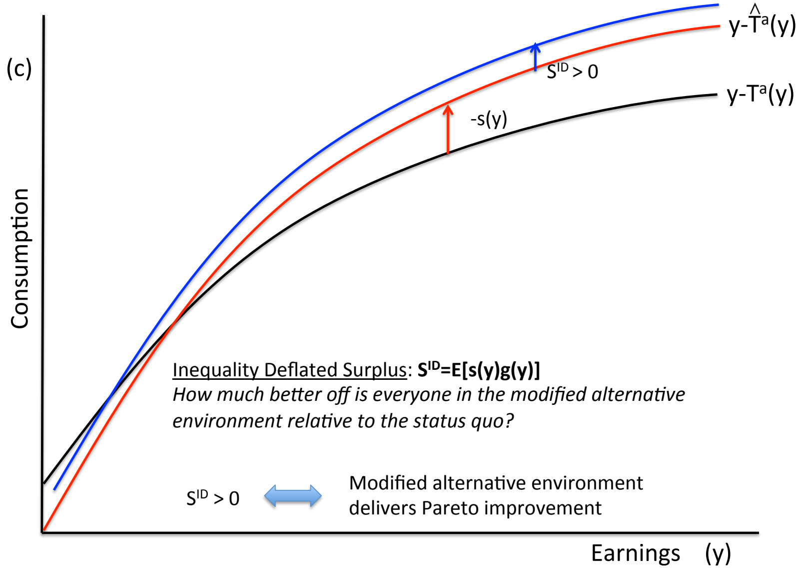

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    - By how much is *everyone* better off?

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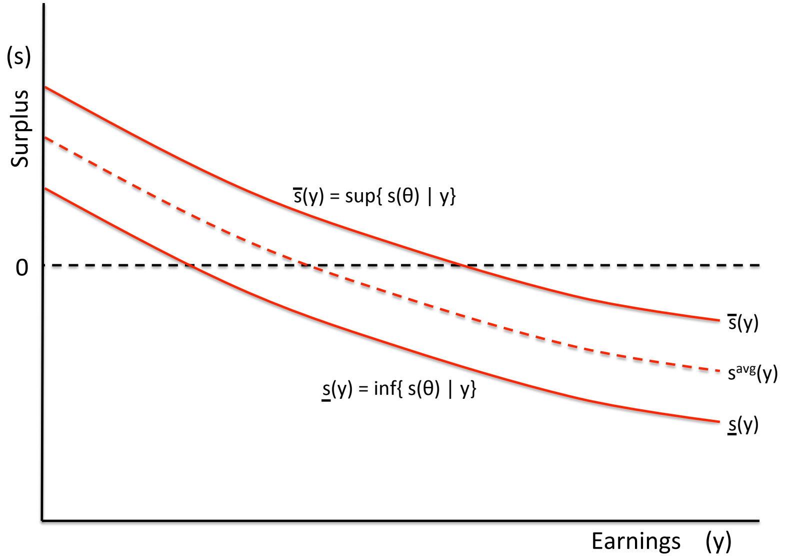
  - Let $s(\theta)$ denote individual θ's WTP for alternative environment

Detailed Model

Heterogeneous Surplus



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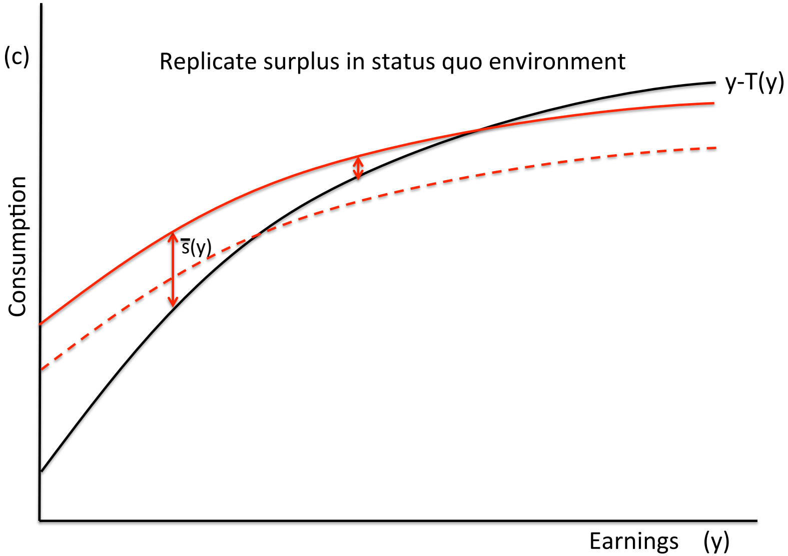

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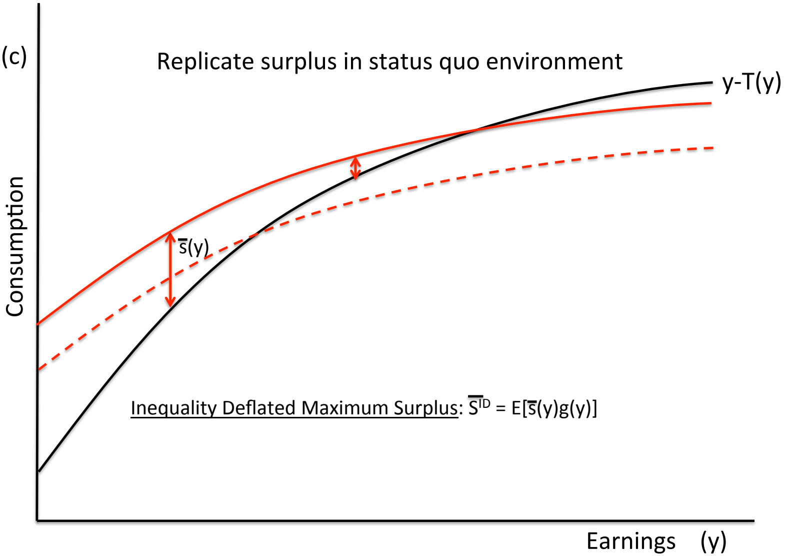

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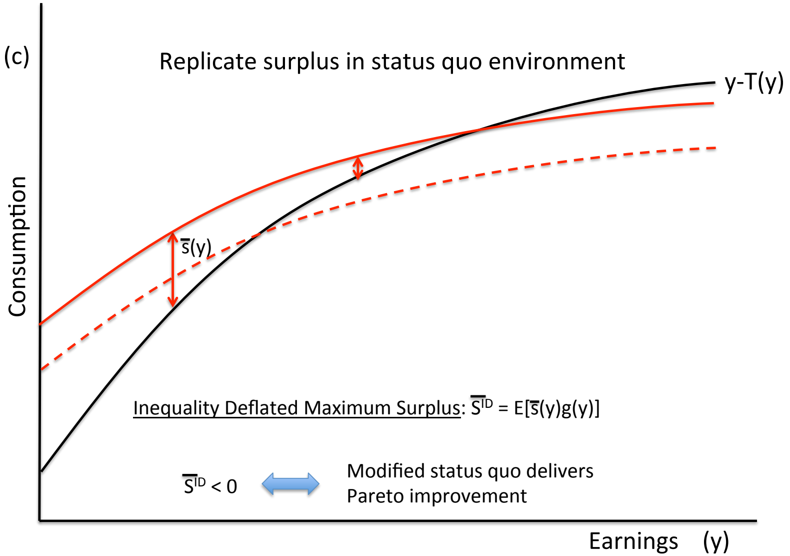
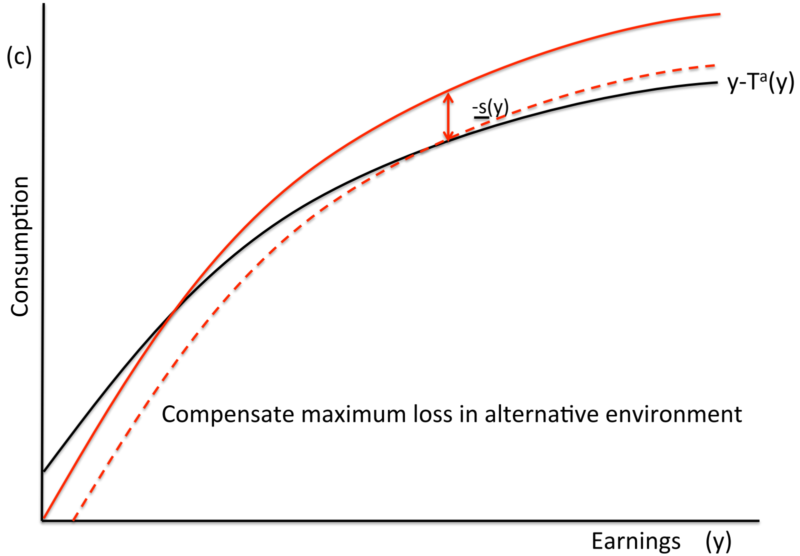


Compensate Minimum Surplus in Alternative Environment



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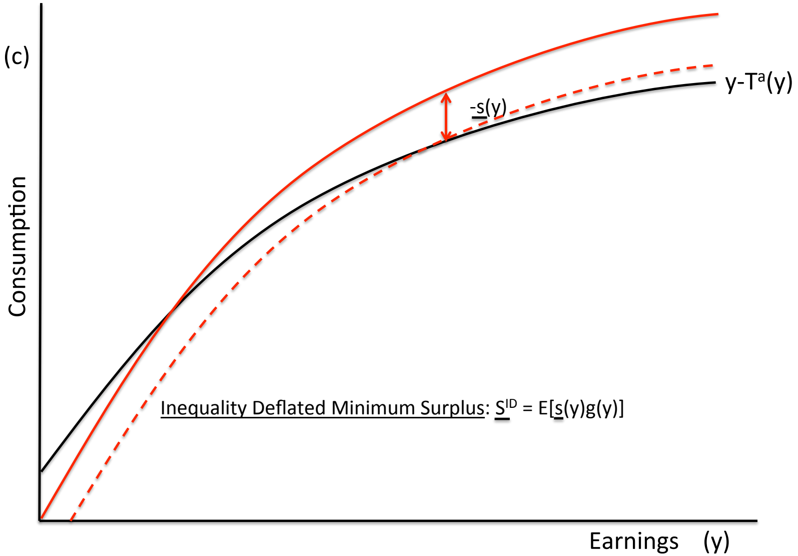

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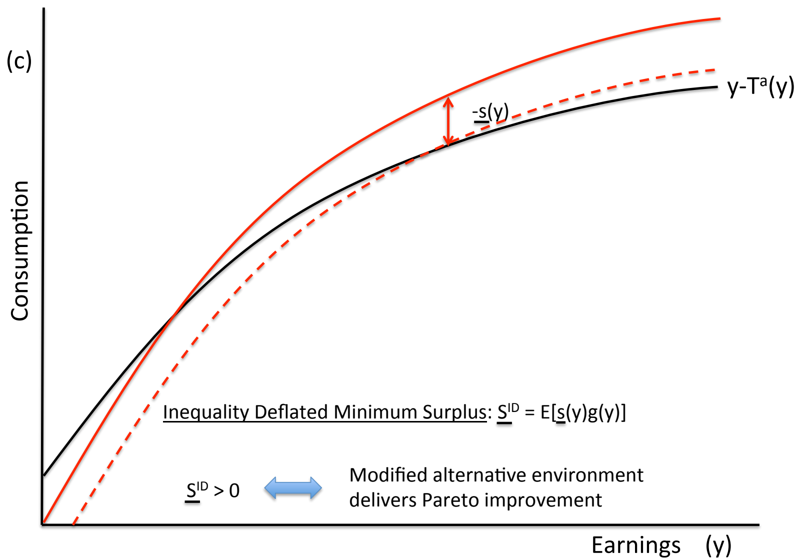

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  - $\underline{S}^{ID} = E\left[\underline{s}\left(y\right)g\left(y\right)\right] > 0$ characterizes potential Pareto improvements of modified alternative environment relative to status quo
- Note $\underline{S}^{ID} \leq \overline{S}^{ID}$ with equality iff $var\left(s\left(\theta\right)|y\left(\theta\right)=y\right)=0$

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- Inequality deflator well-suited for comparisons in which surplus does not vary conditional on income, so that $\underline{S}^{ID} = S^{ID} = \overline{S}^{ID}$

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    - Kaldor Hicks logic rationalizes using $g(y)$ to value surplus regardless of own social preferences

Covariance Bias

- SWF interpretation breaks down with heterogeneity conditional on income

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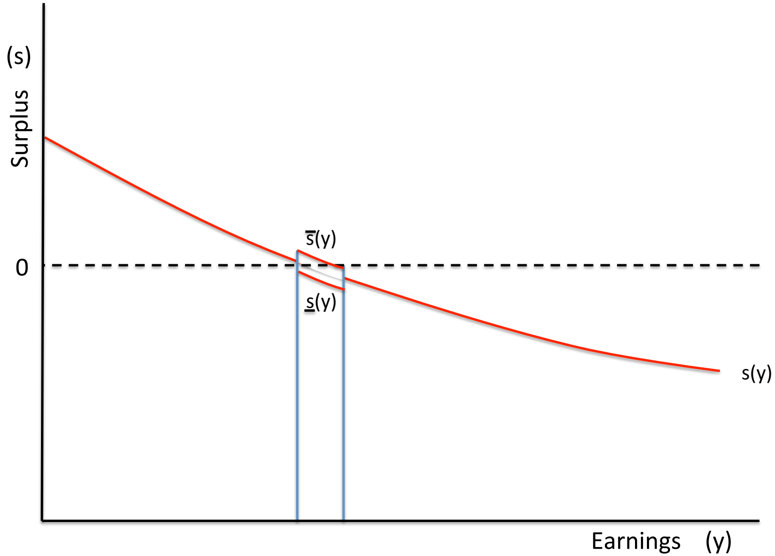
- Can the bias be bounded? Maybe $\underline{S}^{ID}$ and $\overline{S}^{ID}$ provide some bounds?

Surplus with Minimal Heterogeneity



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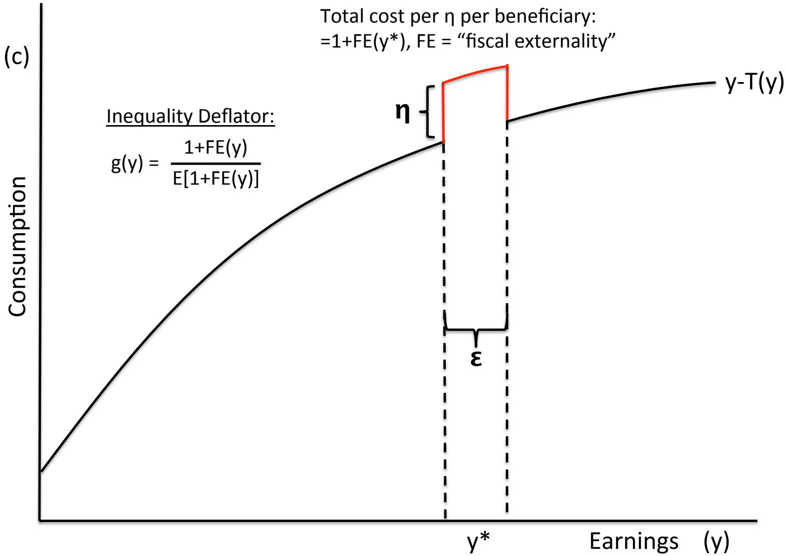
  - In general, inequality deflator is a cost function that adjusts for the unequal distribution of surplus

Limitations

- Inequality deflator has several clear limitations:
  - Only consider changes to the income tax schedule
    - Other policy manipulations could help in cases where $\underline{S}^{ID} < 0 < \overline{S}^{ID}$
  - Ignore political constraints
    - Could by added analogously to the IC constraints?
  - GE effects/Spillovers
    - Assumed $u(c, y; \theta)$. More generally, $u(c, y, y_{others}; \theta)$
  - Tax evasion and avoidance (Slemrod and Yhitzaki, 2002)
  - No explicit account of dynamics
  - Only consider first order properties
    - Exploit envelope theorem

Modifications to Income Tax Schedule



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- **Reduced form empirical evidence suggests deflator values poor more so than the rich**
  - Despite evidence that taxable income elasticities may be quite stable across the income distribution (e.g. Chetty 2012)

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- Let

$$\epsilon^c(y) = \text{avg comp. elasticity for those earning } y$$

$$\zeta(y) = \text{avg inc. effect for those earning } y$$

$$\epsilon^P(y) = \text{avg LFP rate elasticity for those earning } y$$

Formal Definitions

Optimal Tax Expression

Proposition 1 For every point, y^*, such that $T'(y)$ and $\epsilon^c(y^*)$ are locally constant and the distribution of income is continuous:

$$FE(y^*) = \underbrace{-\epsilon^P(y^*)\frac{T(y)-T(0)}{y-T(y)}}_{\text{Participation Effect}} \underbrace{-\zeta(y^*)\frac{\tau(y^*)}{1-\frac{T(y^*)}{y^*}}}_{\text{Income Effect}} \underbrace{-\epsilon^c(y^*)\frac{\tau(y^*)}{1-\tau(y^*)}\alpha(y^*)}_{\text{Substitution Effect}}$$

where $\alpha(y) = -\left(1+\frac{yf'(y)}{f(y)}\right)$ is the local Pareto parameter of the income distribution General Formula

- Heterogeneity in $FE(y)$ depends on:
    1. Shape of income distribution, $\alpha(y)$
    2. Shape and size of behavioral elasticities
    3. Shape of tax rates

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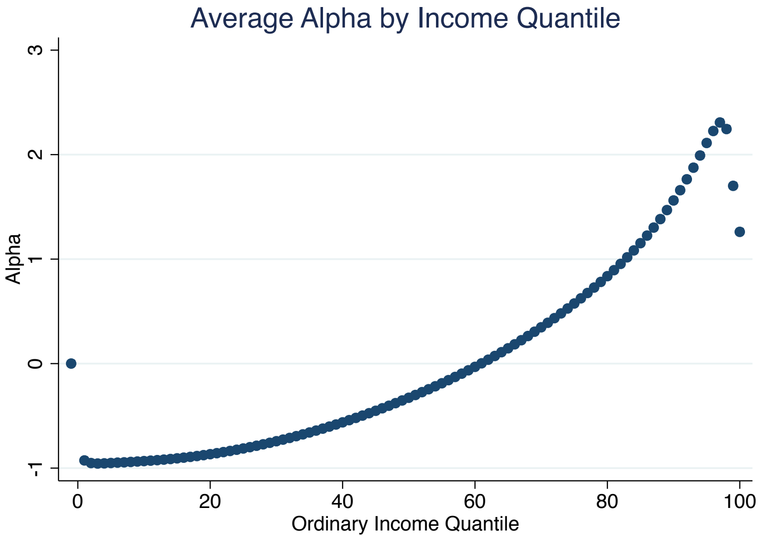
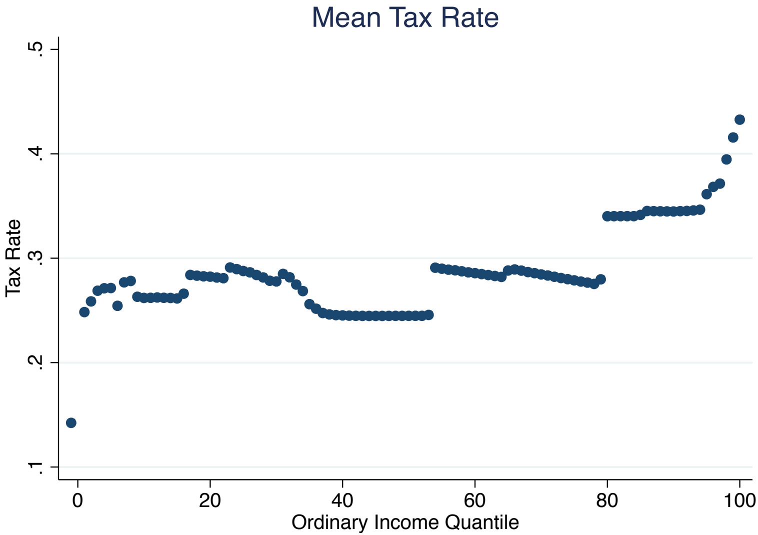
  - Account for covariance between elasticity of income distribution and marginal tax rate Estimation Details

Average Alpha



Mean Tax Rate (Fed + State + SS + Medicare)



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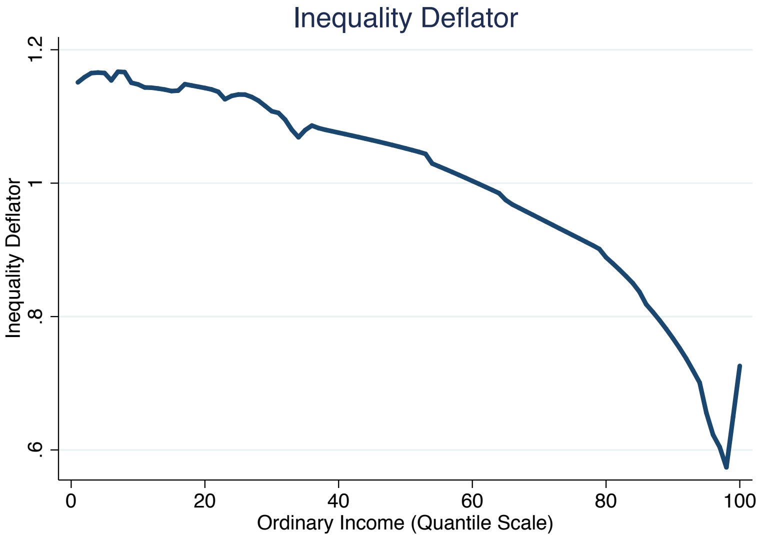
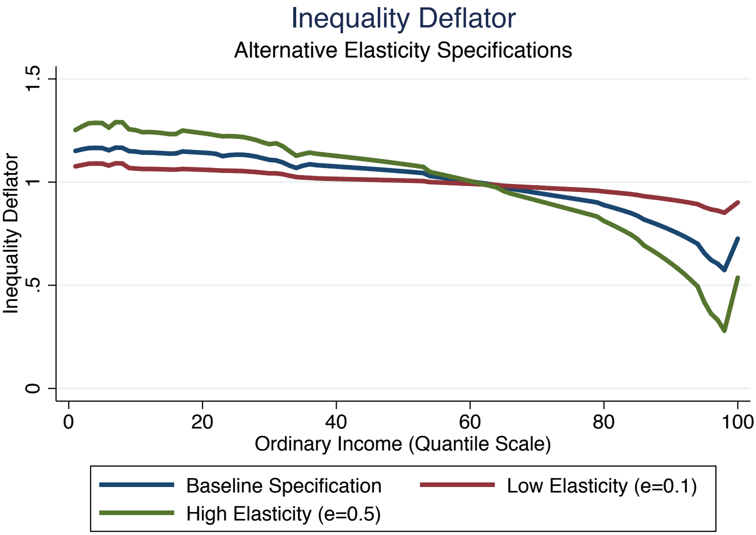


Estimation Details / Components
Income Scale

Inequality Deflator



Household Income

Measuring Income Distributions / Purchasing Power

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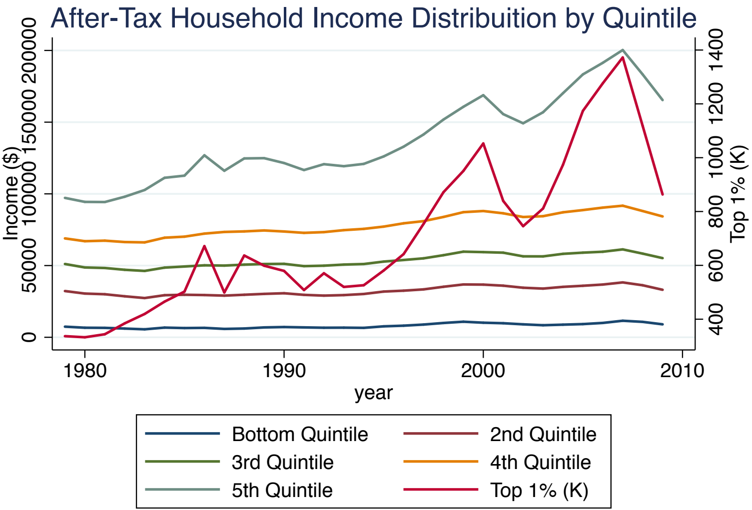
2. Cross-country ordering of income distributions

1. Income Inequality



Source: CBO; Supplemental Tables 43373, Table 7

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    - Search for Pareto comparisons using particular counterfactuals (e.g. SBTC vs no SBTC)
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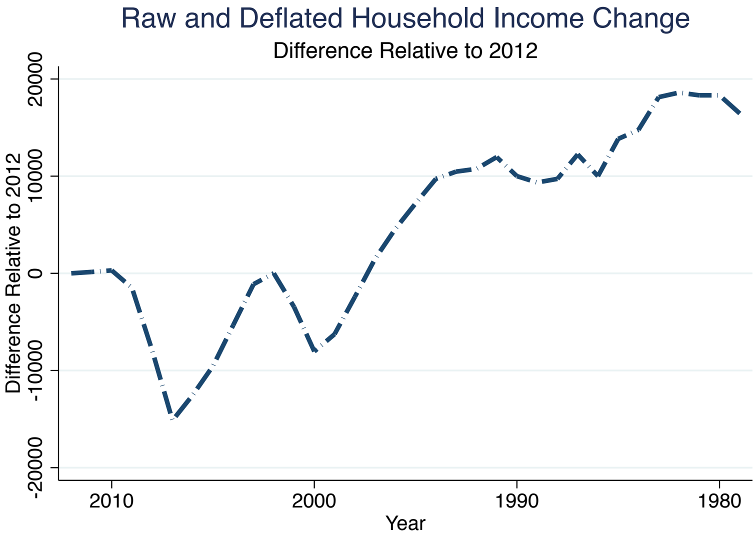
  - More costly to make the rich poor and the poor rich than to keep everyone rich and poor

1. Deflated Growth



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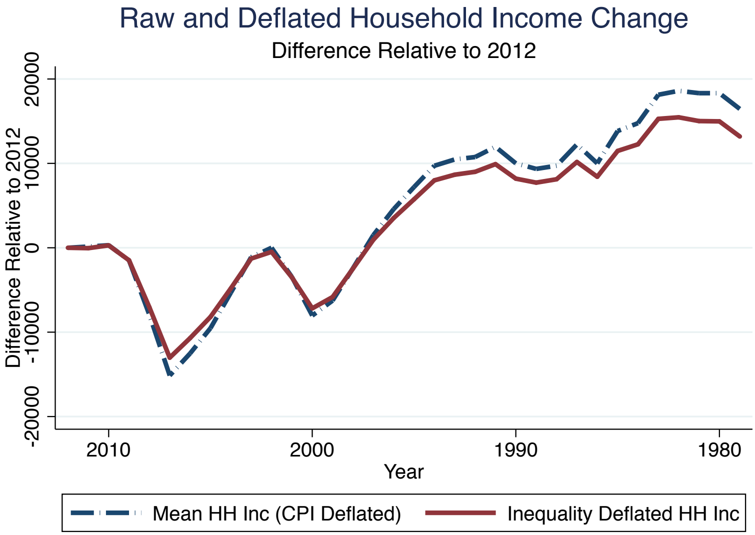

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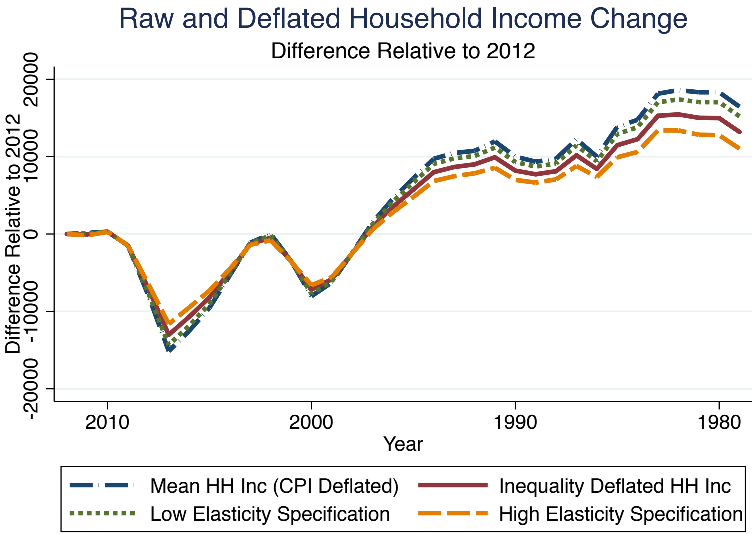
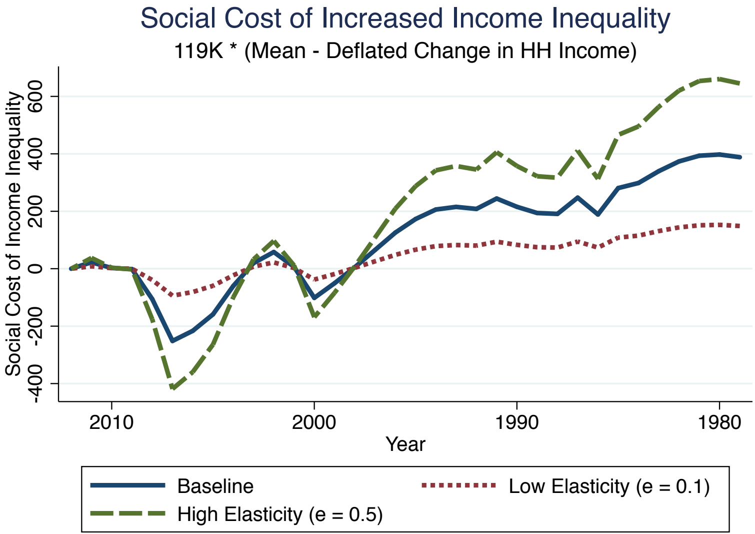


1. Social Cost of Increased Income Inequality



2. Comparisons Across Countries

- Define surplus of country a relative to US:

$$s(\theta) = Q_a(\alpha(\theta)) - Q_0(\alpha(\theta))$$

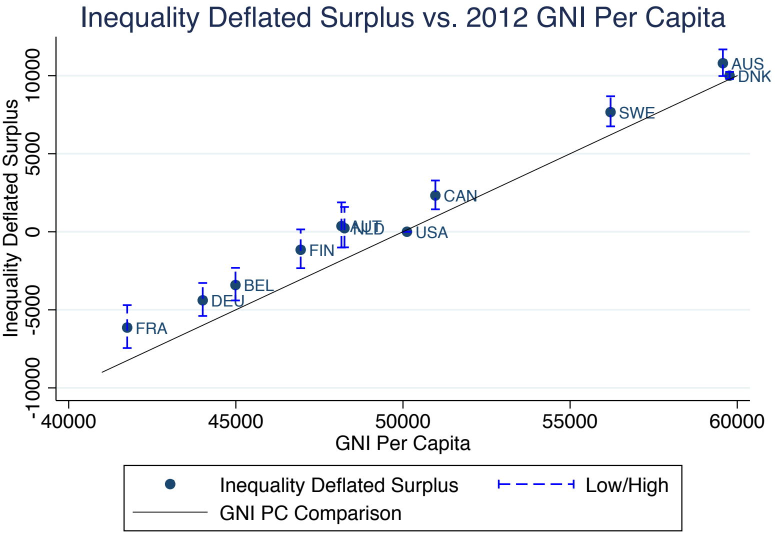
  - Ignores differences in leisure / public goods / life expectancy / etc. across countries
  - Could extend to incorporate heterogeneous value of lifespans (Becker et al, 2003)

- "How much richer would the US be than country a if it had same income distribution"

$$Q_a(\alpha) - Q_0(\alpha) = S^{ID} \quad \forall \alpha$$

Implementation Details

2. Country Comparison to US



Welfare Analysis

- Preference for “pro poor” policies?

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- Budget neutral policies: weight surplus by inequality deflator

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- What about non-budget neutral policies?

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- Total cost to government $1 + FE^G$ where FE^G is the aggregate fiscal externality

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- If neither inequality holds, then more or less G does not yield a Pareto comparison
  - But can use $s(\theta)$ for this G for future comparisons of other Gs!
    - e.g. augment tax schedule + Medicaid for other health policies?

Properties

- **Property 1**: Indifference to changes in the current tax schedule
  - No potential Pareto improvements
- **Property 2** If G has same fiscal externalities as change in tax schedule, then G desirable iff

$$\int s(y)\, dF(y) \geq 1$$

  - (Hylland and Zeckhauser 1979; Kaplow 1996, 2004, 2008)
    Detailed Statements
- **Property 3**: If G does not induce a fiscal externality, $FE^G(y) = 0$, then weight poor surplus more:

$$\int s(y)\,(1 + FE(y)) \geq 1$$

  - Expenditures on rich without a positive FE are "distortionary"!

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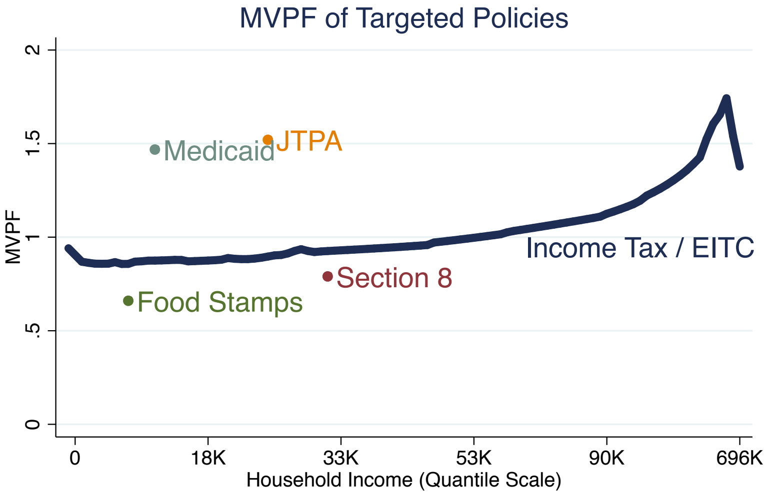
- Additional spending on G desirable iff

$$\underbrace{MVPF_G}_{\text{Value of } G} \geq \underbrace{\frac{1}{1 + FE(y)}}_{\text{Value of } T(y)}$$

MVPFs

- Hendren (2013) uses causal effects calculates MVPF for several policies:
  - Job Training Partnership Act (Bloom 1997)
  - Food Stamps (Hoynes and Schanzenbach 2012)
  - Section 8 Housing Vouchers (Jacob and Ludwig 2012)
- Finkelstein, Hendren, Luttmer (2014) studies Medicaid expansion in Oregon
- Compare MVPF for these policies to $\frac{1}{1+FE(y)}$

Welfare Impact



Source: MVPF for Medicaid from Finkelstein, Hendren, and Luttmer (2014); Other MVPFs compiled in Hendren (2013) drawing on existing estimates from Bloom et al (1997), Hoynes and Schanzenbach (2012), and Jacob and Ludwig (2012)
Income is average income of policy beneficiaries normalized to 2012 income using CPI-U

Conclusion

- Inequality deflator implements modified Kaldor Hicks criteria for searching for potential Pareto improvements
- Weights surplus to poor more so than to the rich
  - Applies regardless of personal preferences
- Inequality Deflator holds distribution of purchasing power constant
  - Quantify cost of rising U.S. income inequality
  - Cross-country income distribution comparisons
- Policy implications
  - Tractable cost-benefit analysis using Pareto principle
  - Compare policies to the efficiency of the tax schedule
- **General idea: use marginal costs of feasible redistribution + envelope theorem + Pareto principle instead of a SWF**

6 Appendix

Model

Return

- Individuals indexed by $\theta \in \Theta$, where (Θ, μ) is measure space
- Status quo environment:
  - Choose consumption $c(\theta)$ and earnings $y(\theta)$ to maximize utility

$$u(c, y; \theta)$$

subject to a budget constraint

$$c \leq y - T(y) + m$$

where T is a nonlinear income tax schedule and m is non-taxable income

Cost of Taxation

Return

- Provide η transfer to those within ϵ of y^*

$$\hat{T}(y; y^*, \epsilon, \eta) = \begin{cases} T(y) & \textit{if } y \notin \left(y^* - \frac{\epsilon}{2}, y^* + \frac{\epsilon}{2}\right) \\ T(y) - \eta & \textit{if } y \in \left(y^* - \frac{\epsilon}{2}, y^* + \frac{\epsilon}{2}\right) \end{cases}$$

- Let $\hat{y}(\theta; y^*, \epsilon, \eta)$ denote type θ's choice of y facing $\hat{T}$
- Let $\hat{q}(y^* \epsilon, \eta)$ denote the per-beneficiary budget impact of tax schedule $\hat{T}(y; y^*, \epsilon, \eta)$

$$\hat{q}(y^*, \epsilon, \eta) = \frac{-\int \left[\hat{T}(\hat{y}(\theta; y^*, \epsilon, \eta); y^*, \epsilon, \eta)\right] d\mu(\theta)}{F\left(y^* + \frac{\epsilon}{2}\right) - F\left(y^* - \frac{\epsilon}{2}\right)}$$

The Inequality Deflator

Return

- Taking limit as $\epsilon \to 0$,

$$\lim_{\epsilon \to 0} \frac{d\hat{q}\left(y,\epsilon,\eta\right)}{d\eta}|_{\eta=0} = 1 + FE\left(y\right)$$

where 1 is the mechanical cost and $FE\left(y\right)$ is the causal impact of the behavioral response to the policy on the government budget

- **Inequality deflator** is given by

$$g\left(y\right) = \frac{1 + FE\left(y\right)}{E\left[1 + FE\left(y\right)\right]}$$

- Main idea: $g\left(y\right)$ can be used to provide first order characterization of potential Pareto comparisons

Define Surplus

Return

- Individual's indirect utility:

$$v^0(\theta) = \max_y u(y - T(y) + m, y; \theta)$$

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    - Lower inequality, greater productivity, free trade, etc.

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- Expenditure function, $e(v; \theta)$
- Alternative environment generates utility $v^a(\theta)$ for type θ
  - Lower inequality, greater productivity, free trade, etc.
- **Surplus** (Equivalent Variation):

$$s(\theta) = e(v^a(\theta); \theta) - e\left(v^0(\theta); \theta\right)$$

Define Surplus Conditional on Income

Return

- Define surplus functions:

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  - **Average surplus** to those earning y:

$$s^{avg}(y) = E\left[s(\theta) \mid y(\theta) = y\right]$$

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  - Note $\underline{s}(y) \leq s^{avg}(y) \leq \overline{s}(y)$ with equality if $var\left(s(\theta)\,|y(\theta)\right) = 0$

Inequality Deflated Surplus

Return

- Inequality Deflated Surplus:

$$S^{ID} = E\left[s^{avg}\left(y\left(\theta\right)\right)g\left(y\left(\theta\right)\right)\right]$$

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Formal Statements

Return to Surplus Return to EV/CV

- "First order" statements
- Given $s(\theta)$, define set of alternative environments with surplus

$$s_\epsilon(\theta) = \epsilon s(\theta)$$

- Define inequality deflated surplus

$$S_\epsilon^{ID} = \int s_\epsilon(\theta)\, g(y(\theta))\, d\mu(\theta) = \epsilon S^{ID}$$

- **Assumption 1**: Revenue function is differentiable in modifications to the tax schedule

Formal Equivalent Variation Statement

Proposition 1: *If* $S^{ID} < 0$*, there exists an* $\tilde{\epsilon} > 0$ *such that for any* $\epsilon < \tilde{\epsilon}$ *there exists an augmentation to the tax schedule in the status quo environment that generates surplus,* $s_{\epsilon}^{t}(\theta)$*, that is higher at all points of the income distribution:* $E\left[s_{\epsilon}^{t}(\theta)\,|y(\theta) = y\right] > E\left[s_{\epsilon}(\theta)\,|y(\theta) = y\right]$ *for all* y*. Conversely, if* $S^{ID} > 0$*, no such* $\tilde{\epsilon}$ *exists.*

Return to Surplus Return to EV/CV

Marginal cost

- Let $g_{\epsilon}(y)$ denote the inequality deflator in the ϵ-alternative environment.
- Let $y^{\epsilon}(\theta)$ denote the choice of type θ's income in the ϵ-alternative environment
- **Assumption 2:** For sufficiently small ϵ, $g_{\epsilon}(y)$ captures the marginal cost of taxation
  - $y^{\epsilon}(\theta) = y^{\epsilon}(\theta')$ iff $y(\theta) = y(\theta')$ for all θ
  - $g(y(\theta)) = g(y^{\epsilon}(\theta))$ for all θ

Return to Surplus Return to EV/CV

Formal Compensating Variation Statement

Proposition 2: *Suppose Assumption 2 holds. If* $S^{ID} > 0$*, there exists* $\tilde{\epsilon} > 0$ *such that for any* $\epsilon < \tilde{\epsilon}$*, there exists an augmentation to the tax schedule in the alternative environment that delivers surplus* $s^t_\epsilon(\theta)$ *that is on average positive at all points along the income distribution:* $E\left[s^t_\epsilon(\theta)\,|y(\theta) = y\right] > 0$ for all y. Conversely, if $S^{ID} < 0$, then no such $\tilde{\epsilon}$ exists.

Return to Surplus Return to EV/CV

Potential Pareto Improvement in Status Quo

Proposition 3: *Suppose* $\overline{S}^{ID} < 0$*. Then, there exists an* $\tilde{\epsilon} > 0$ *such that, for each* $\epsilon < \tilde{\epsilon}$ *there exists a modification to the income tax schedule that delivers a Pareto improvement relative to* $s_{\epsilon}(\theta)$*. Conversely, if* $\overline{S}^{ID} > 0$*, there exists an* $\tilde{\epsilon} > 0$ *such that for each* $\epsilon < \tilde{\epsilon}$ *any budget-neutral modification to the tax schedule results in lower surplus for some* θ *relative to* $s_{\epsilon}(\theta)$*.*

Return | Return to Surplus | Return to EV/CV

Potential Pareto Improvement in Alternative Environment

Suppose Assumption 2 holds. Suppose $\underline{S}^{ID} > 0$. Then, there exists an $\tilde{\epsilon} > 0$ such that, for each $\epsilon < \tilde{\epsilon}$ there exists a modification to the income tax schedule in the alternative environment such that the modified alternative environment delivers positive surplus to all types relative to the status quo, $s_{\epsilon}^{t}(\theta) > 0$ for all θ.

Return Return to Surplus Return to EV/CV

Assumptions

Return

- Define $c(y; w, \theta)$ to be type θ's indifference curve:

$$u(c(y; w, \theta), y; \theta) = w$$

- **Assumption 3:** Each type θ's indifference curve, $c(y; w, \theta)$, satisfies the following conditions:
  1. (Continuously differentiable in utility) For each $y \geq 0$, there exists $\kappa > 0$ such that $c(y; w, \theta)$ is continuously differentiable in w for all $w \in [u(y(\theta) - T(y(\theta)), y(\theta); \theta) - \kappa, u(y(\theta) - T(y(\theta)), y(\theta); \theta) + \kappa]$
  2. (Convex in y for positive earnings, but arbitrary participation decision) For each $y > 0$, there exists $\kappa > 0$ such that $c(y; w, \theta)$ is twice continuously differentiable in y for all $w \in [u(y(\theta) - T(y(\theta)), y(\theta); \theta) - \kappa, u(y(\theta) - T(y(\theta)), y(\theta); \theta) + \kappa]$ and $c_y > 0$ and $c_{yy} > 0$.
  3. (Continuous distribution of earnings) $y(\theta)$ is continuously distributed on the positive region $y > 0$ (but may have a mass point at $y = 0$).

Elasticities

$$\epsilon^c(y) = E\left[\frac{1-\tau(y(\theta))}{y(\theta)} \frac{dy}{d(1-\tau)}|_{u=u(c,y;\theta)} | y(\theta) = y\right]$$

$$\zeta(y) = E\left[\frac{dy(\theta)}{dm} \frac{y(\theta) - T(y(\theta))}{y(\theta)} | y(\theta) = y\right]$$

$$\epsilon^P(y) = \frac{d[f(y)]}{d[y - T(y)]} \frac{y - T(y)}{f(y)}$$

Return

Assumptions

Return

$$FE(y^*) = \underbrace{-\epsilon_c^P\left(y^*\right)\frac{T(y^*) - T(0)}{y^* - T(y^*)}}_{\text{Participation Effect}} \underbrace{-\zeta(y^*)\frac{\tau(y^*)}{1 - \frac{T(y^*)}{y^*}}}_{\text{Income Effect}} + \underbrace{\frac{d}{dy}|_{y=y^*}\left[\epsilon^c(y)\frac{\tau(y)}{1-\tau(y)}\frac{yf(y)}{f(y^*)}\right]}_{\text{Substitution Effect}}$$

Households versus Filers

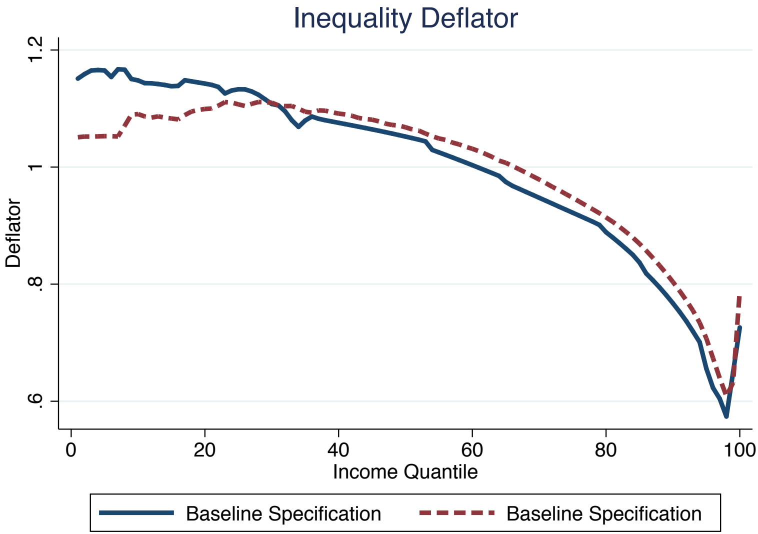
Return

- IRS definition of y is perfect for mapping to taxable income elasticities and capturing costs from distortions
- Many datasets (e.g. Census) measure income at the household level
- How different would the analysis be if we used households, not tax filings, as the unit of analysis?
  - For many conceptual experiments, surplus, $s(\theta)$, may depend on household income, not taxable income
- Construct household income analogue $h(\theta)$ following Chetty, Hendren, Kline, and Saez (2014)
  - Adjusted gross income plus tax-exempt interest and the non-taxable portion of social security benefits.
- Construct average cost at each household

$$g^H(h) = E\left[g(y(\theta))\,|h(\theta) = h\right]$$

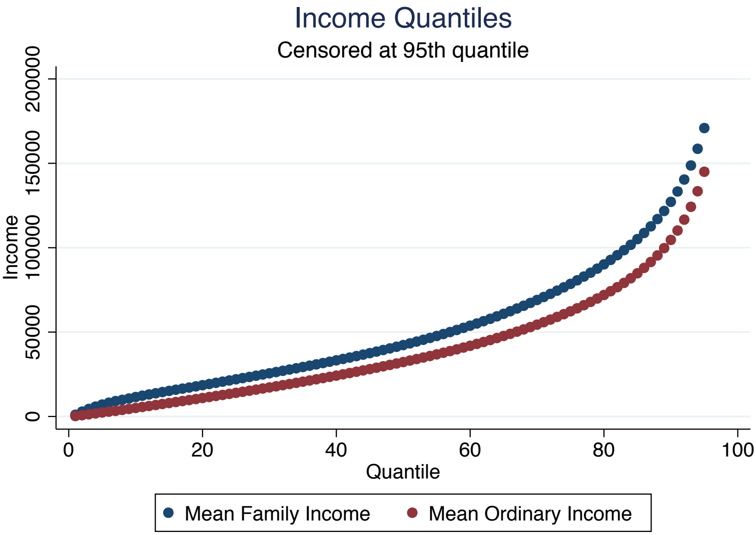
- Average marginal cost of providing \$1 to families earning h

Inequality Deflator: Household versus Individual Income



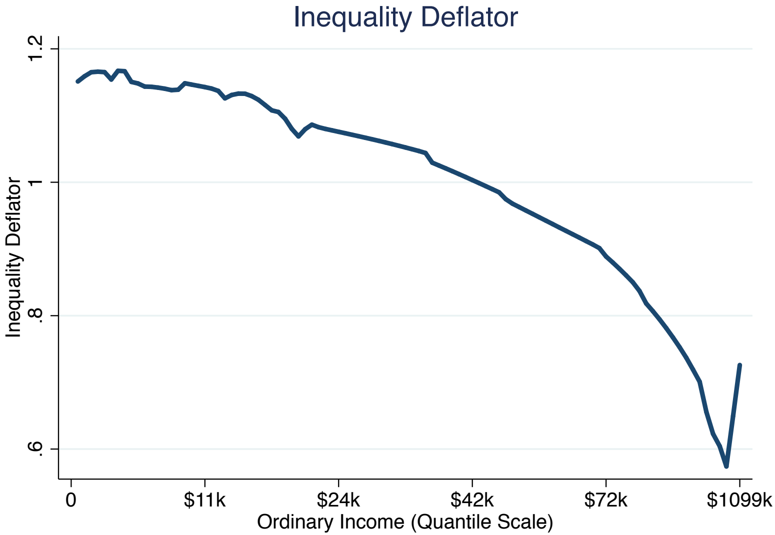
Return

Income Quantiles



Return

Income Scale



Return

Multiple Tax Schedules

Return

- U.S. tax schedule is complex
  - Two people with the same earnings, y, can face different tax schedules, $T(y)$
  - Filing status (married, single, etc.), # of children, EITC eligibility, AMT, etc.
- Suppose filers with earnings y face tax schedule $T_j(y)$ (j fixed). Can show:

$$FE(y^*) = E_j\left[FE_j(y^*)\right]$$

where

$$FE_j(y^*) = -\epsilon_j^P(y^*)\frac{T_j(y) - T_j(0)}{y - T_j(y)} - \zeta_j(y^*)\frac{\tau_j(y^*)}{1 - \frac{T_j(y^*)}{y^*}} + \epsilon_j^c(y^*)\frac{\tau_j(y^*)}{1 - \tau_j(y^*)}\alpha_j(y^*)$$

- Can average over fiscal externalities
  - Need to account for how shape of income distribution, $\alpha_j(y)$, varies with the marginal tax rate $\tau_j(y)$

Estimation Requirements

Return

- Dataset: 2012 IRS Databank
  - De-identified information derived from the population of US income tax returns
  - Sample: primary filers aged 25-65 and their married spouses (~95 million filers)
- Income definition
  - y is taxable ordinary income of a filer
    - Taxable income (f1040, line 43) minus income not subject to the ordinary income tax (long-term capital income (line 13) and qualified dividends (line 9b))
  - $T_j'(y)$ computed directly for each filer
    - Account for EITC filing, AMT, Dependents, etc.
- Compute $\alpha_j(y)$ non-parametrically for each $T_j'(y)$

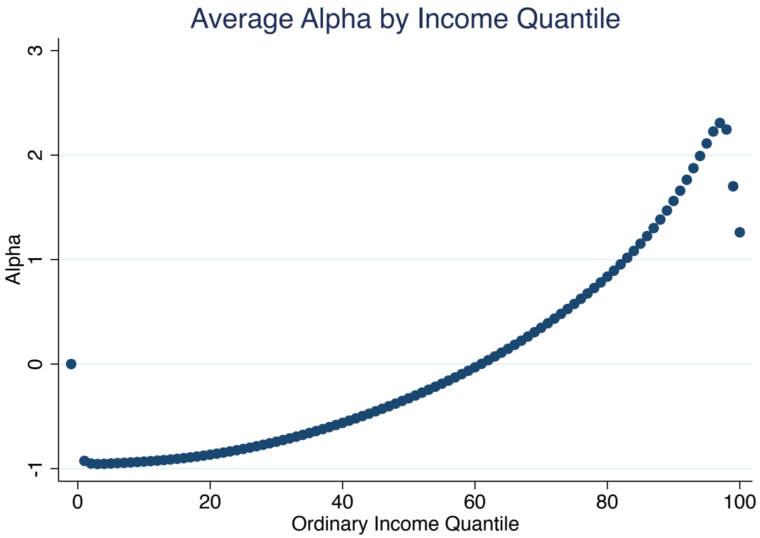
Elasticity Specifications

Return

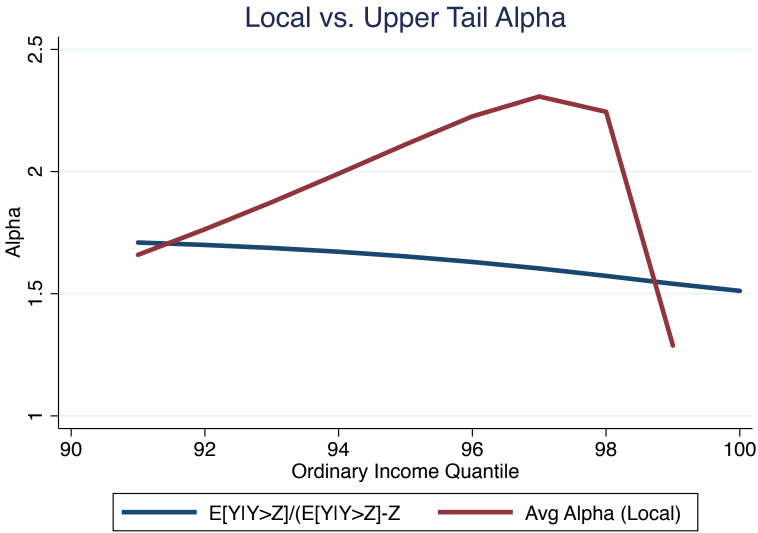
- Construct baseline specification and two alternative specifications
- Baseline specification
  - Assume no income effects, $\zeta_j(y) = 0$ (Gruber and Saez 2002)
  - Participation effects
    - EITC Filers: $-\epsilon_j^P(y^*)\frac{T_j(y)-T_j(0)}{y-T_j(y)} \approx 0.09$ (Hotz and Scholz 2003; Hendren 2013)
    - Non-EITC filers: $\epsilon_j^P(y^*) = 0$ (Leibman and Saez 2006)
  - Compensated elasticity, $\epsilon_j^c(y)$
    - EITC filers: 0.31 in phase-in; 0.14 in phase-out region (Chetty et al. 2013)
    - Top tax rate: 0.3 (Saez et al. 2012)
    - All others 0.3 (Chetty 2012)
- Alternative specifications of ϵ^c of 0.1 and 0.5
  - General pattern similar, but redistribution more costly with higher ϵ^c

Alpha

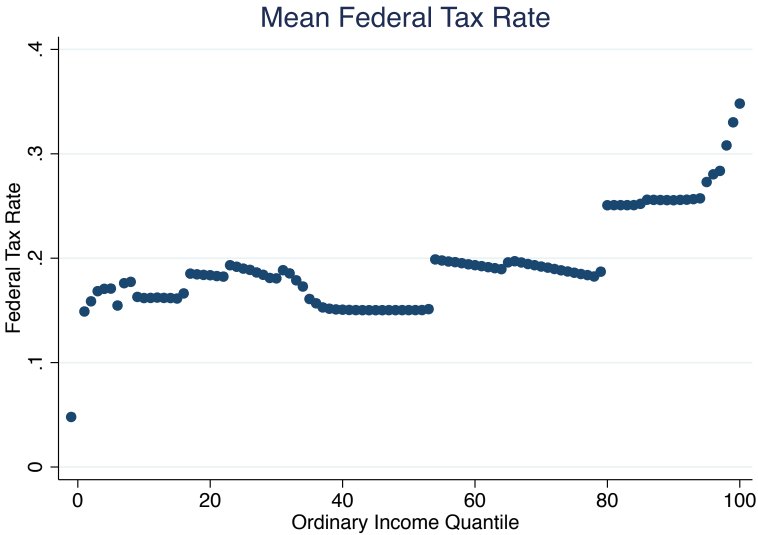
Return



Alpha: Upper Tail



Mean Federal Tax Rate

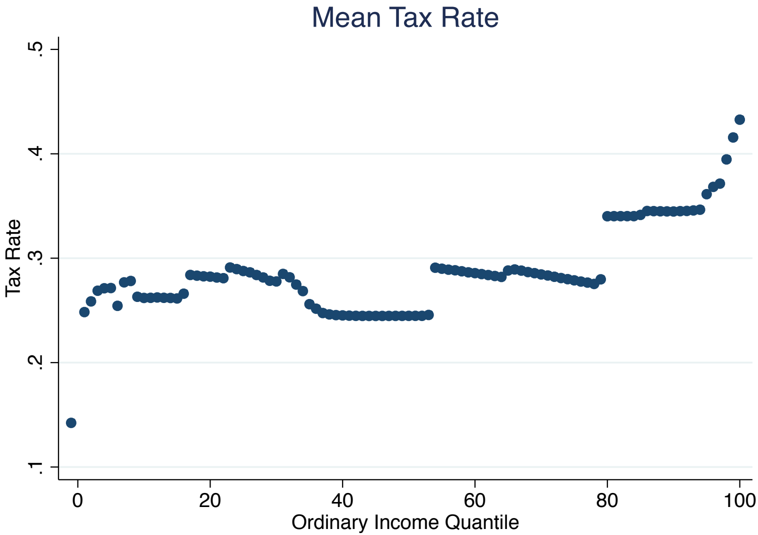


Tax Rate Assumptions

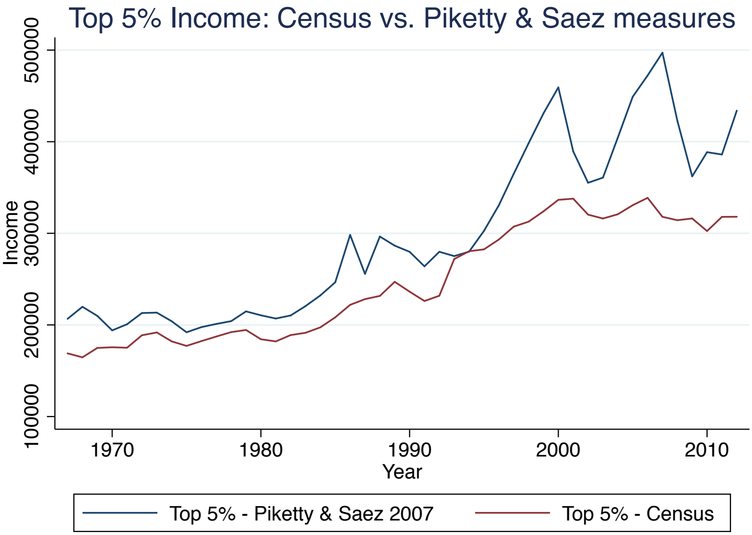
- State Taxes: 5%
- Medicare 2.9% (Saez et al 2012)
- Sales tax: 2.3% (Saez et al 2012)
- EITC "top-up": 10%

Return

Mean Tax Rate (Fed + State + SS + Medicare)



Top 5% Robustness



Implementation Details

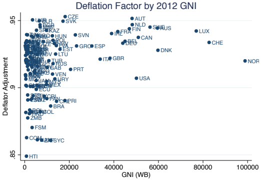
- Use household income inequality data from two sources:
- UN World Income Inequality Database
  - World Bank World Development Indicators
  - 130 countries in total with household surveys post 2000
- Data provide shares of income accruing to quintiles or deciles of the income distribution
  - e.g. Lorentz curves
- Let Y_a denote gross national income per capita

$$S_a^{ID} = Y^a \int_0^1 \frac{Q_a(\alpha)}{Y^a} g^H(Q_0(\alpha))\, d\alpha - Y^0 \int_0^1 \frac{Q_0(\alpha)}{Y^0} g^H(Q_0(\alpha))\, d\alpha$$

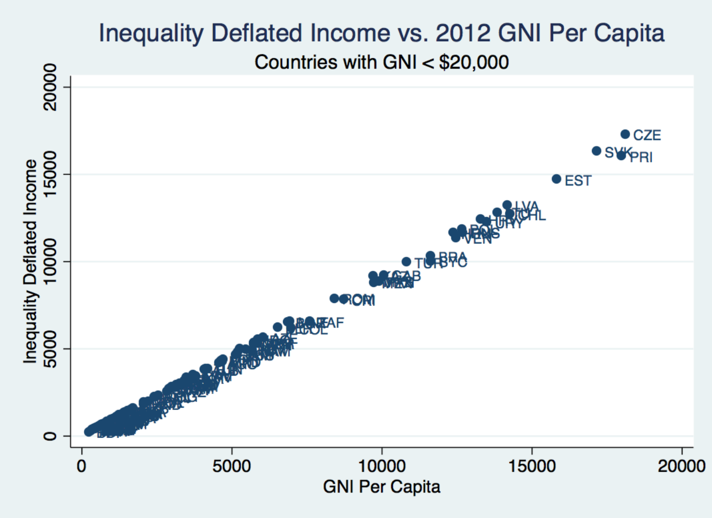
- Approximation for groups g (e.g. quintiles, deciles)
  - $s_g = \frac{\% Income}{\% Population}$
  - $g_g =$ average deflator value in group g

$$\int_0^1 \frac{Q_a(\alpha)}{Y^a} g^H(Q_0(\alpha))\, d\alpha \approx \sum_g s_g g_g$$

3. Deflation Factors



Country Orderings: $<$ 20K Income



Return

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- Total cost to government $1 + FE^G$ where FE^G is the aggregate fiscal externality

Characterizing Potential Pareto Improvements

- **If $s(\theta)$ does not vary conditional on income, additional spending on G provides (local) potential Pareto improvement if and only if**

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Kaplow

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  - Suggests public expenditures to the rich that have no distortionary impact on taxable behavior are highly "distortionary"