Inequality, Costly Redistribution and Welfare in an Open Economy

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Introduction

- International trade raises real income but also increases inequality and makes some worse off
- Standard approach to demonstrating and quantifying the gains from trade largely ignore trade-induced inequality
  - Kaldor-Hicks compensation principle
- Two issues with this approach:
  1. How much compensation/redistribution **actually** takes place?
  2. Is this redistribution **costless**, as the Kaldor-Hicks approach assumes?
- These issue are relevant not just for trade, but also for any change with redistributive effects (e.g., technological change)

This Paper

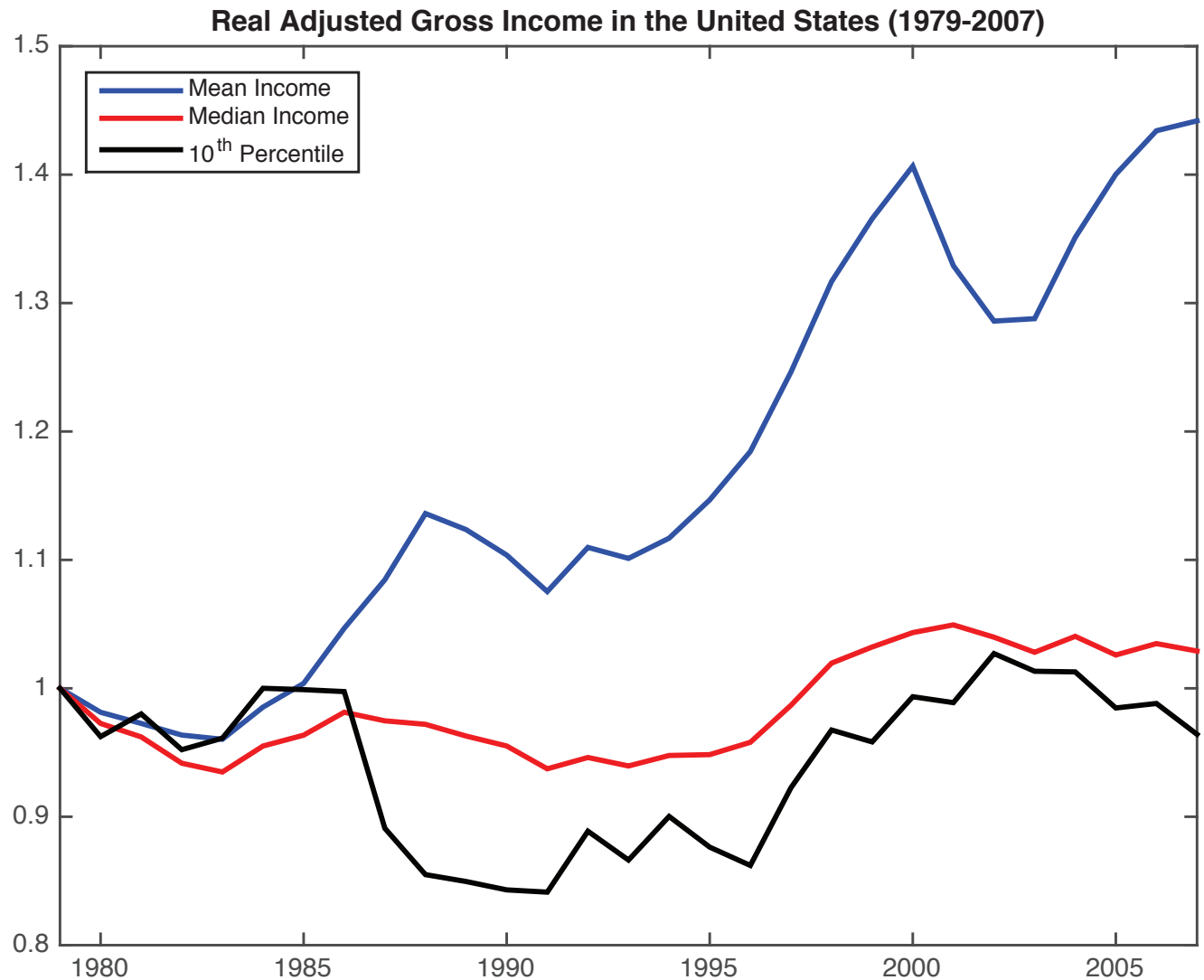
- We study quantitatively welfare implications of trade in a model where:
  1. trade leads to an increase in inequality
  2. redistribution requires distortionary taxation (e.g., due to informational constraints, as in Mirrlees)
  3. despite progressive tax system, trade still increases inequality in after-tax incomes

This Paper

- We study quantitatively welfare implications of trade in a model where:
  1. trade leads to an increase in inequality
  2. redistribution requires distortionary taxation (e.g., due to informational constraints, as in Mirrlees)
  3. despite progressive tax system, trade still increases inequality in after-tax incomes

- We propose two types of adjustment to standard welfare measures:
  1. **Welfarist correction**: taking into account inequality-aversion of society (or risk-adjustment under the veil of ignorance)
  2. **Costly-redistribution correction**: capturing behavioral responses to *trade-induced* shifts across marginal tax rates

Two Motivating Figures



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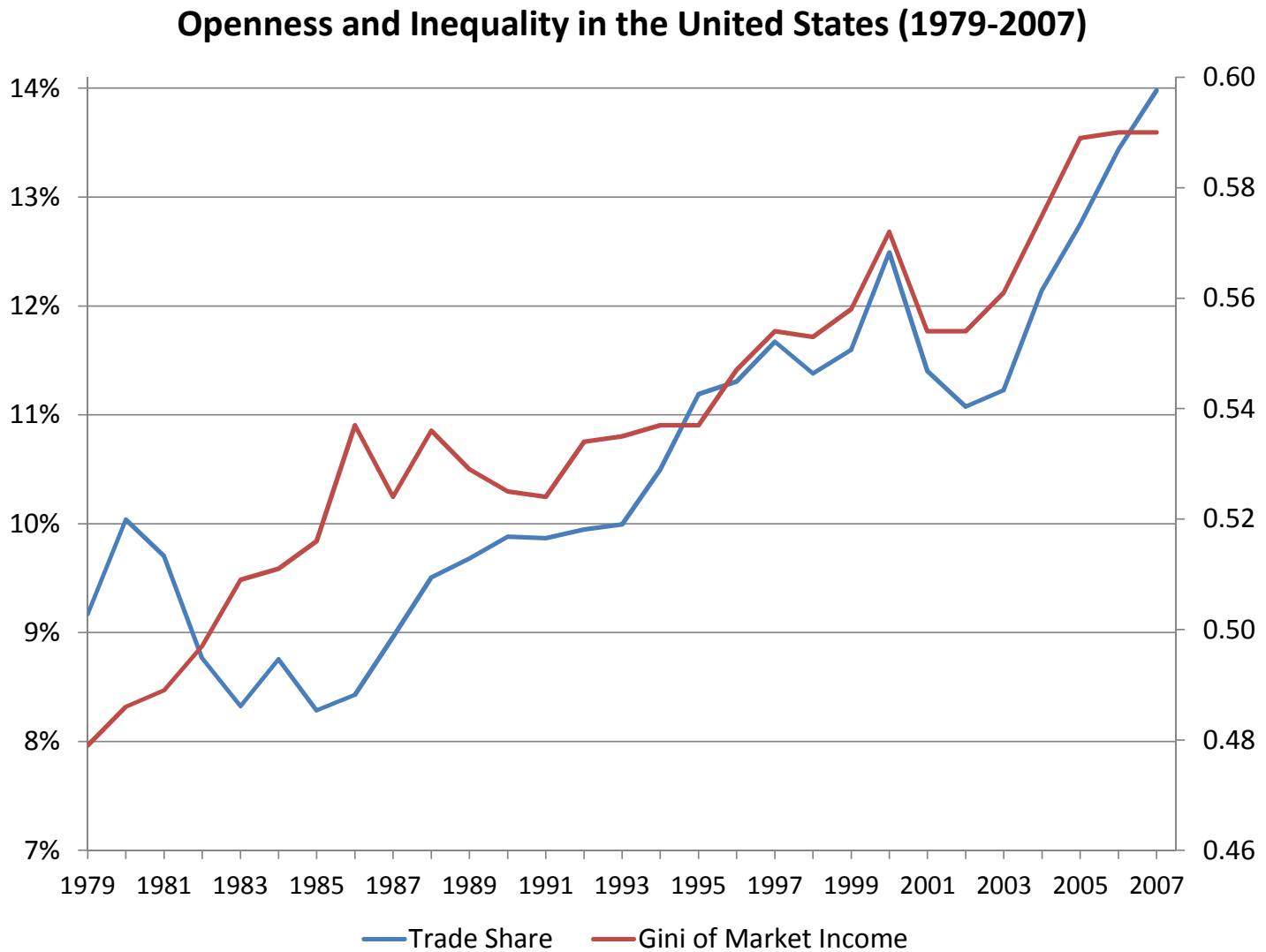

Building Blocks

- Skeleton of Trade Model: Itskhoki (2009)
  - Melitz (2003) with heterogeneous worker-entrepeneurs
  - endogenous labor supply decision with a constant elasticity
- Costly Redistribution: nonlinear progressive tax system
  - after-tax income is log-linear function of pre-tax income
  - Benabou (2002), Heathcote, Storesletten and Violante (2014)
- Constant degree of inequality-aversion
  - widely used in Public Finance (Atkison 1970)
  - equivalent to risk-aversion behind the veil of ignorance
- Model calibrated to fit 2007 U.S. data:
  - distribution of skills calibrated to match U.S. distribution of (adjusted gross) income from IRS public records
  - trade costs calibrated to match the key U.S. trade moments

Other Related Literature

- Trade models with heterogeneous workers:
  - matching/sorting models (see Grossman and Costinot and Vogel for surveys)
  - models with imperfect labor markets (e.g., Helpman, Itskhoki, Redding, and earlier Davidson and Matusz)
- Gains from trade and costly redistribution:
  - Dixit and Norman (1986)
  - Rodrik (1992), Spector (2001), Naito (2006)
- Old literature on Kaldor-Hicks:
  - Kaldor (1939), Hicks (1939), Scitovszky (1941)
- Welfarist approach:
  - Bergson (1938), Samuelson (1947)
  - Diamond & Mirlees (1971), Saez (2003, 2004)
- Costly-redistribution: Kaplow (2008), Hendren (2014)

Road Map

1. Motivating Example
   - Kaldor-Hicks
   - Welfarist correction
   - Costly-redistribution correction
2. Constant-Elasticity Model
   - A preliminary look at the data
3. Open Economy Model
   - Calibration
   - Counterfactuals: inequality and the gains from trade

MOTIVATING EXAMPLE

The Kaldor-Hicks Principle

- Consider an economy with a unit measure of individuals with ability $\varphi \sim H_\varphi$ earning market income $r_\varphi \sim F_r$
- We want to evaluate a **shift of income distribution** $F_r \to F_r'$

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- The compensating variation v_φ for each individual:

$$u(r_\varphi) = u(r_\varphi' + v_\varphi) \qquad \Rightarrow \qquad v_\varphi = r_\varphi - r_\varphi'$$

The Kaldor-Hicks Principle

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- We want to evaluate a **shift of income distribution** $F_r \to F'_r$
- The compensating variation v_φ for each individual:

$$u(r_\varphi) = u(r'_\varphi + v_\varphi) \qquad \Rightarrow \qquad v_\varphi = r_\varphi - r'_\varphi$$

- Hence:

$$\begin{aligned} -\int v_\varphi \mathrm{d}H_\varphi &= \int r'_\varphi \mathrm{d}H_\varphi - \int r_\varphi \mathrm{d}H_\varphi \\ &= \int r \mathrm{d}F'_r - \int r \mathrm{d}F_r = R' - R \end{aligned}$$

- Kaldor-Hicks Gains = Aggregate Real Income Growth

$$G^{KH} = \frac{R' - R}{R} \equiv \mu$$

The Kaldor-Hicks Principle

Pros and Cons

- Principle does not rely on interpersonal comparisons of utility:
  - indirect utility can be heterogeneous across agents
  - result relies on ordinal rather than cardinal preferences
  - notion of efficiency argued to be free of value judgements

- What if redistribution does not take place?
  - under the veil of ignorance, agents see a probability distribution over potential outcomes (need cardinal preferences)
  - risk aversion $\approx$ inequality aversion

- Even if some redistribution takes place, whenever it is costly, shouldn't $\Delta W/W$ reflect those costs?
  - Dixit and Norman (1986) showed that $\Delta W/W > 0$ using a course set of taxes, but by how much is $\Delta W/W$ diminished?

Welfarist Correction

- Social Welfare Function: $V = \int g(r_\varphi^d) \mathrm{d}H_\varphi$
- Constant inequality aversion: $g(r) = \frac{r^{1-\rho}-1}{1-\rho}$
- Convenient transformation: $W = \left[1 + (1-\rho)V\right]^{\frac{1}{1-\rho}}$

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- Convenient transformation: $W = \left[1 + (1-\rho)V\right]^{\frac{1}{1-\rho}}$
- Welfare can be represented:

$$W = \Delta \times R, \qquad \Delta \equiv \Delta(F_r^d; \rho) = \frac{\left[\mathbb{E}\left(r_\varphi^d\right)^{1-\rho}\right]^{\frac{1}{1-\rho}}}{\mathbb{E} r_\varphi^d} \leq 1$$

- Welfare gains: $G^W = (1+\mu)\frac{\Delta'}{\Delta} - 1$

Costly-Redistribution Correction

- Disposable after-tax income: $r_\varphi^d = \left[1 - \tau(r_\varphi)\right] r_\varphi + T_\varphi$
- No lump-sum taxes and tax schedule: $r_\varphi^d = k r_\varphi^{1-\phi}$
- Marginal tax rate: $\tau_m(r_\varphi) = 1 - k(1-\phi) r_\varphi^{-\phi}$
- Constant behavioral elasticity: $\varepsilon \equiv \frac{\partial \log r_\varphi}{\partial \log\left(1-\tau_m(r_\varphi)\right)} \geq 0$
- Counterfactual no-tax income: $\tilde{r}_\varphi = (1-\phi)^{-\varepsilon} r_\varphi^{1+\varepsilon\phi}$

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- Counterfactual no-tax income: $\tilde{r}_\varphi = (1-\phi)^{-\varepsilon} r_\varphi^{1+\varepsilon\phi}$
- Aggregate income loss:

$$R = \Theta \times \tilde{R}, \qquad \Theta \equiv \Theta(F_r; \varepsilon, \phi) = (1-\phi)^{\varepsilon} \frac{\left(\mathbb{E} r_\varphi\right)^{1+\varepsilon}}{\left(\mathbb{E} r_\varphi^{1-\phi}\right)^{\varepsilon} \cdot \left(\mathbb{E} r_\varphi^{1+\varepsilon\phi}\right)}$$

- Aggregate income gains: $\mu = (1+\tilde{\mu}) \dfrac{\Theta'}{\Theta} - 1$

Two Correction Together

- We have:

$$W = \Delta(F_r^d; \rho) \times R \qquad \text{and} \qquad R = \Theta(F_r; \varepsilon, \phi) \times \tilde{R},$$

and $r_\varphi^d = k r_\varphi^{1-\phi}$

- Comparative statics:
  1. Δ declines with ρ; Θ declines with ϕ and ε
  2. Δ and Θ decline with the dispersion of r_φ^d and r_φ, respectively
  3. Higher ϕ reduces dispersion in $r_\varphi^d \longrightarrow$ policy tradeoff

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- Parametric Example (log-normal):

$$\Delta = e^{-\rho(1-\phi)^2 \frac{\sigma^2}{2}} \quad \text{and} \quad \Theta = (1-\phi)^\varepsilon e^{-\varepsilon(1+\varepsilon)\phi^2 \frac{\sigma^2}{2}}$$

where $\sigma^2 = \frac{1}{(1+\varepsilon\phi)^2}\tilde{\sigma}^2$ and $\text{Gini} = 2\Phi(\sigma/\sqrt{2}) - 1$

— similar results with Pareto

CONSTANT-ELASTICITY MODEL

A Constant-Elasticity Model

Closed Economy

- A unit measure of individuals with CRRA-GHH utility:

$$U(c,\ell) = \tfrac{1}{1-\rho}\left(c - \tfrac{1}{\gamma}\ell^{\gamma}\right)^{1-\rho}$$

- Each individual produces a task according to $y = \varphi\ell$, $\varphi \sim H_{\varphi}$
- This translates into market income

$$r = Q^{1-\beta}y^{\beta}, \qquad Q = R = \int r_{\varphi}\mathrm{d}H_{\varphi}$$

- Consumption equals after-tax income:

$$c = r - T(r) = kr^{1-\phi},$$

government runs balanced budget (finances expenditure gQ)

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- In constant-elasticity model: $r_{\varphi} \propto \varphi^{\frac{\beta(1+\varepsilon)}{1+\varepsilon\phi}}$
  - two auxiliary parameters: $\varepsilon \equiv \frac{\beta}{\gamma-\beta}$ and $\kappa \equiv \frac{1}{1-(1-\beta)(1+\varepsilon)}$

Theoretical Welfare Corrections

- **Welfare**:

$$W = \Delta \times \hat{\Theta} \times \tilde{W}, \qquad \text{where} \qquad \tilde{W} = \frac{1-g}{1+\varepsilon}\tilde{R}$$

- **Welfarist Correction**:

$$\Delta \equiv \frac{\left(\int r_\varphi^{(1-\phi)(1-\rho)} \mathrm{d}H_\varphi\right)^{\frac{1}{1-\rho}}}{\int r_\varphi^{1-\phi} \mathrm{d}H_\varphi}$$

- **Costly Redistribution Correction**:

$$\hat{\Theta} \equiv (1+\varepsilon\phi)\frac{R}{\tilde{R}} = \underbrace{(1+\varepsilon\phi)(1-\phi)^{\kappa\varepsilon}}_{\equiv\bar{\Theta}} \left[\underbrace{\frac{\left(\int r_\varphi \mathrm{d}H_\varphi\right)^{1+\varepsilon}}{\left(\int r_\varphi^{1-\phi}\mathrm{d}H_\varphi\right)^{\varepsilon}\int r_\varphi^{1+\varepsilon\phi}\mathrm{d}H_\varphi}}_{\equiv\tilde{\Theta}}\right]^{\kappa}$$

FIRST LOOK AT THE DATA

Calibration

U.S. Income Growth (1979-2007)

- Use U.S. Individual Income Tax Public Use Sample to calibrate distribution of market income
  - approximately 3.5 million anonymized tax returns
  - use NBER weights to ensure this is a representative sample
  - we map market income to adjusted gross income in line 37 of IRS Form 1040

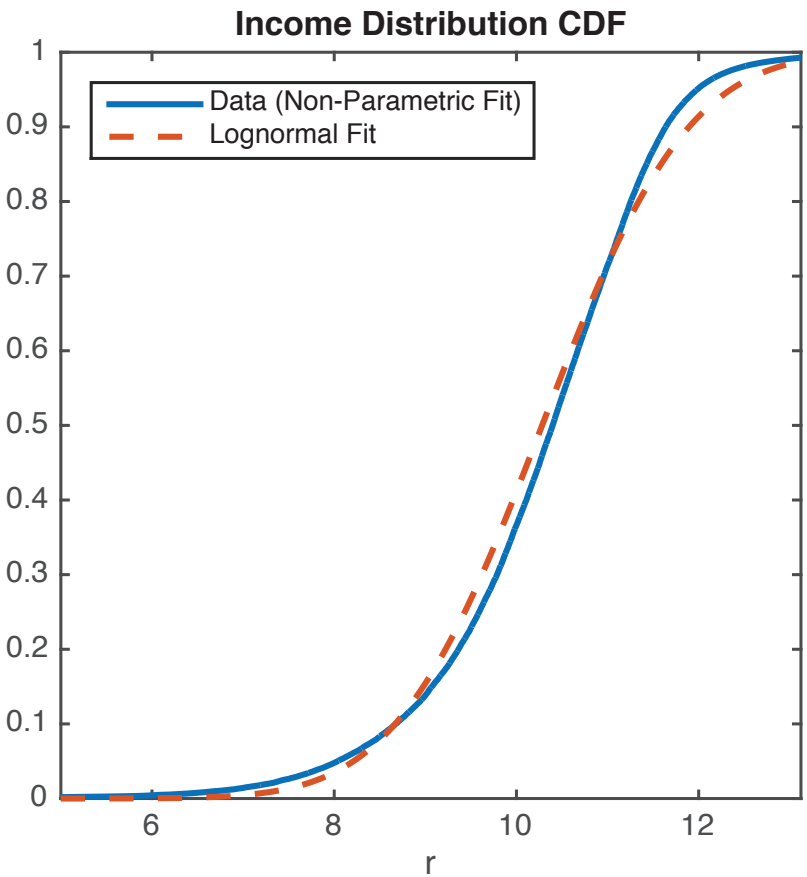
- Use CBO data on before-tax and after-tax/transfer income to calibrate the degree of tax progressivity ϕ

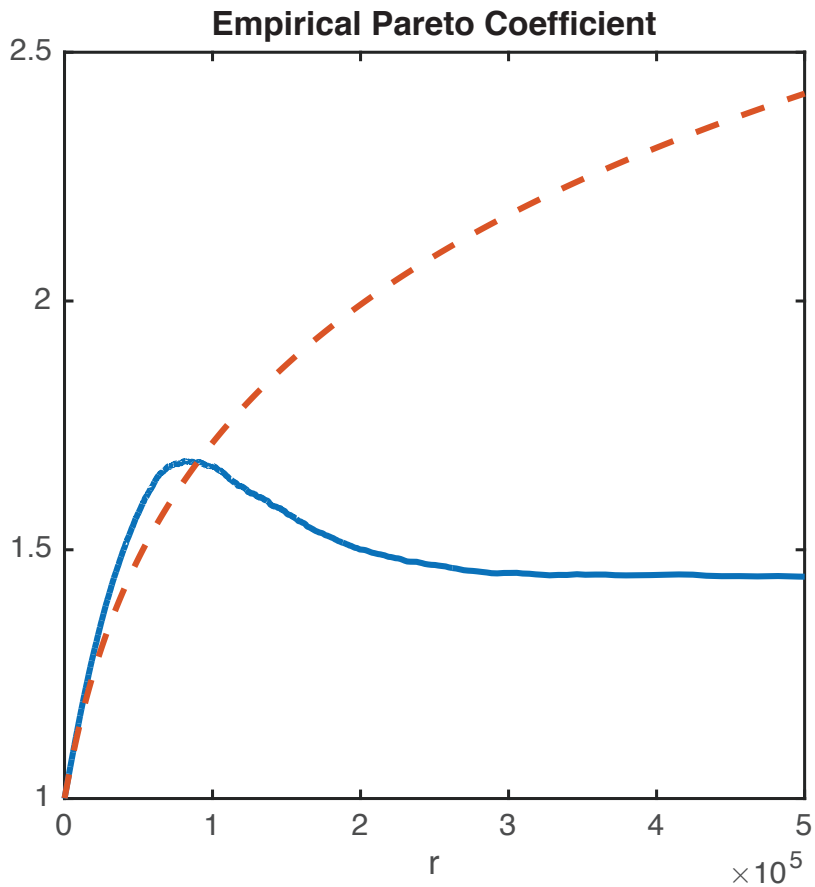
- Elasticity of substitution $= 5$ ($\beta = 4/5$)

- Experiment with various values of ε and ρ
  - benchmark $\varepsilon = 0.5$ and $\rho = 1$

Income Distribution

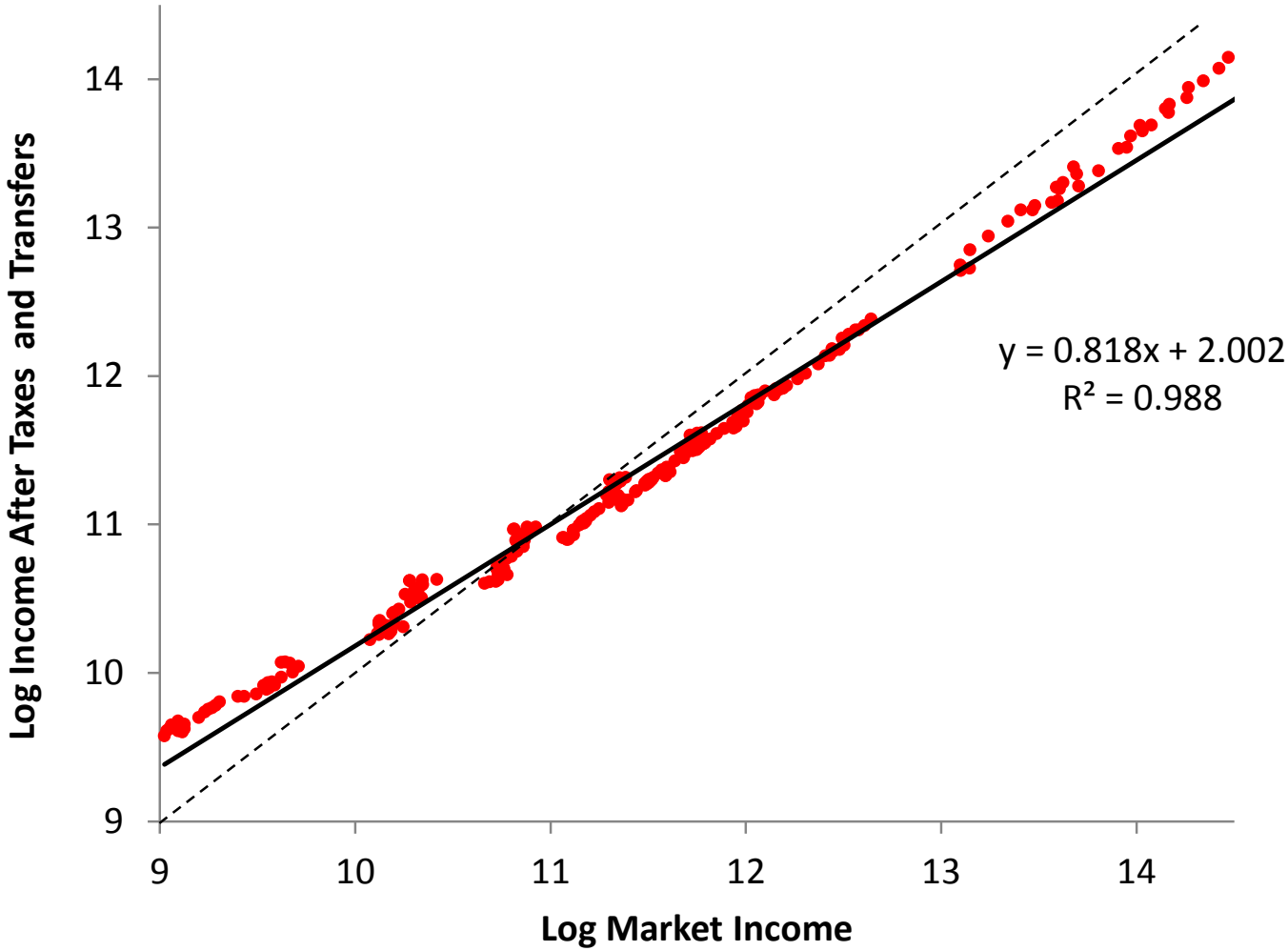
- Log-normal provides a good approximation, but it does a poor fit for the right-tail of the distribution, which looks Pareto





Tax Progressivity

- Tax schedule $r^d = kr^{1-\phi}$ may seem ad hoc, but it fits U.S. data remarkably well (similar fit with PSID data)



Tax Progressivity Over Time

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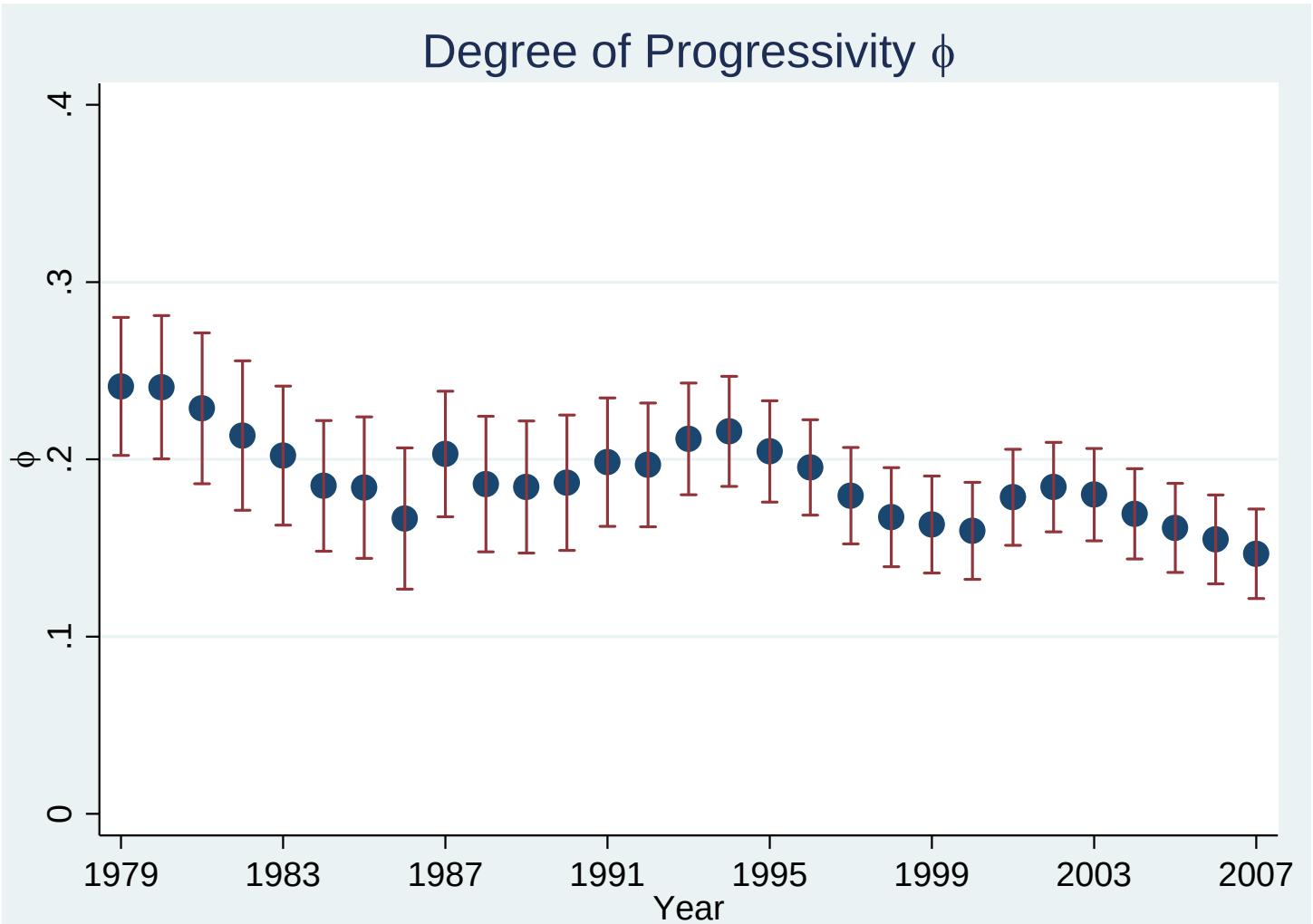

Counterfactuals: 1979–2007

- Mean real income grew 44.2%, or **1.32%** per year
- For the logarithmic case ($\rho = 1$), the implied annual growth rate in social welfare is only **0.31%**
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- *By how much would real income and social welfare have increased if ϕ had been held constant at its 1979 level?*

  For $\rho = 1$ and $\varepsilon = 0.5$:
  - — mean real income by **0.90%** per year
  - — social welfare by **0.52%** per year

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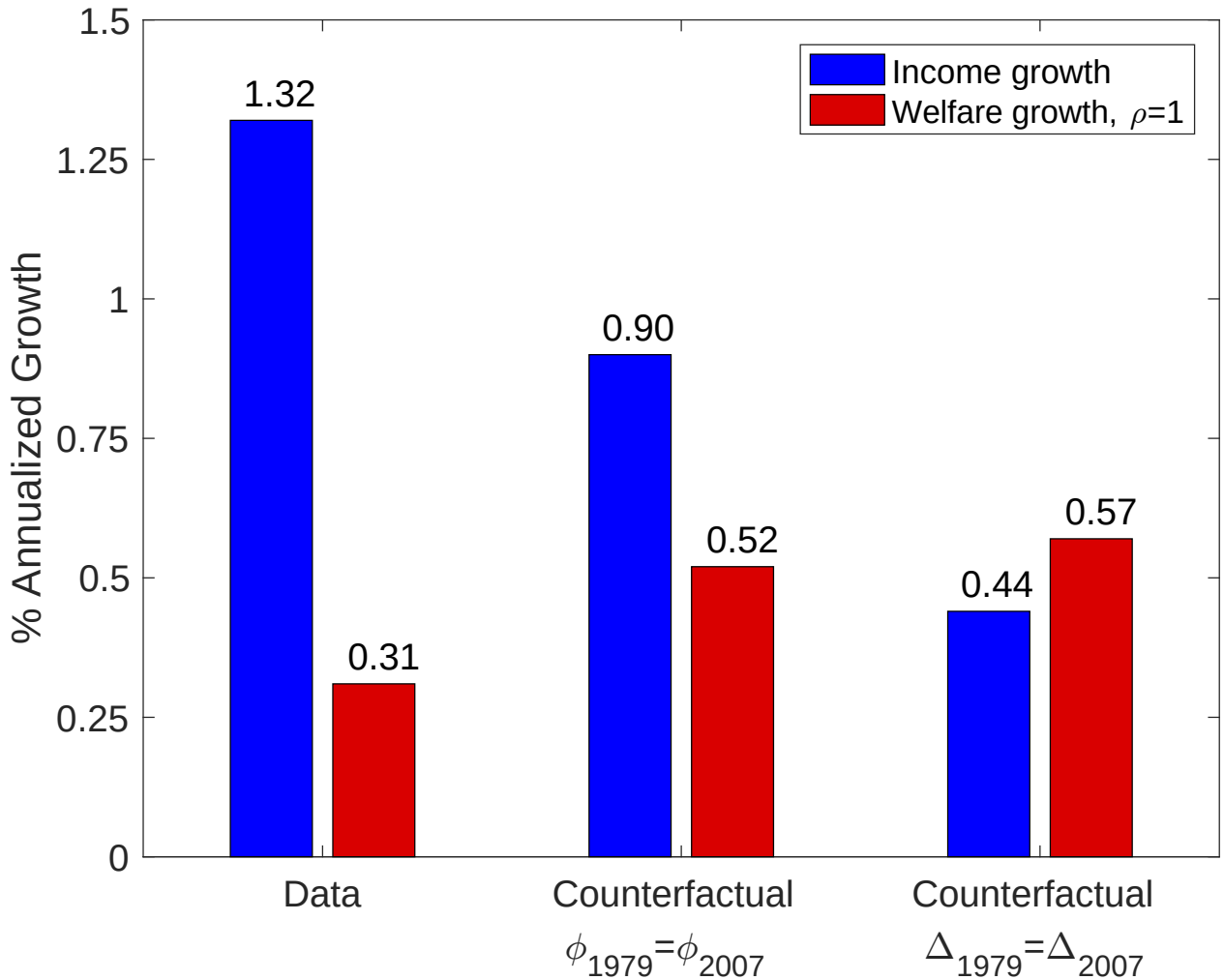
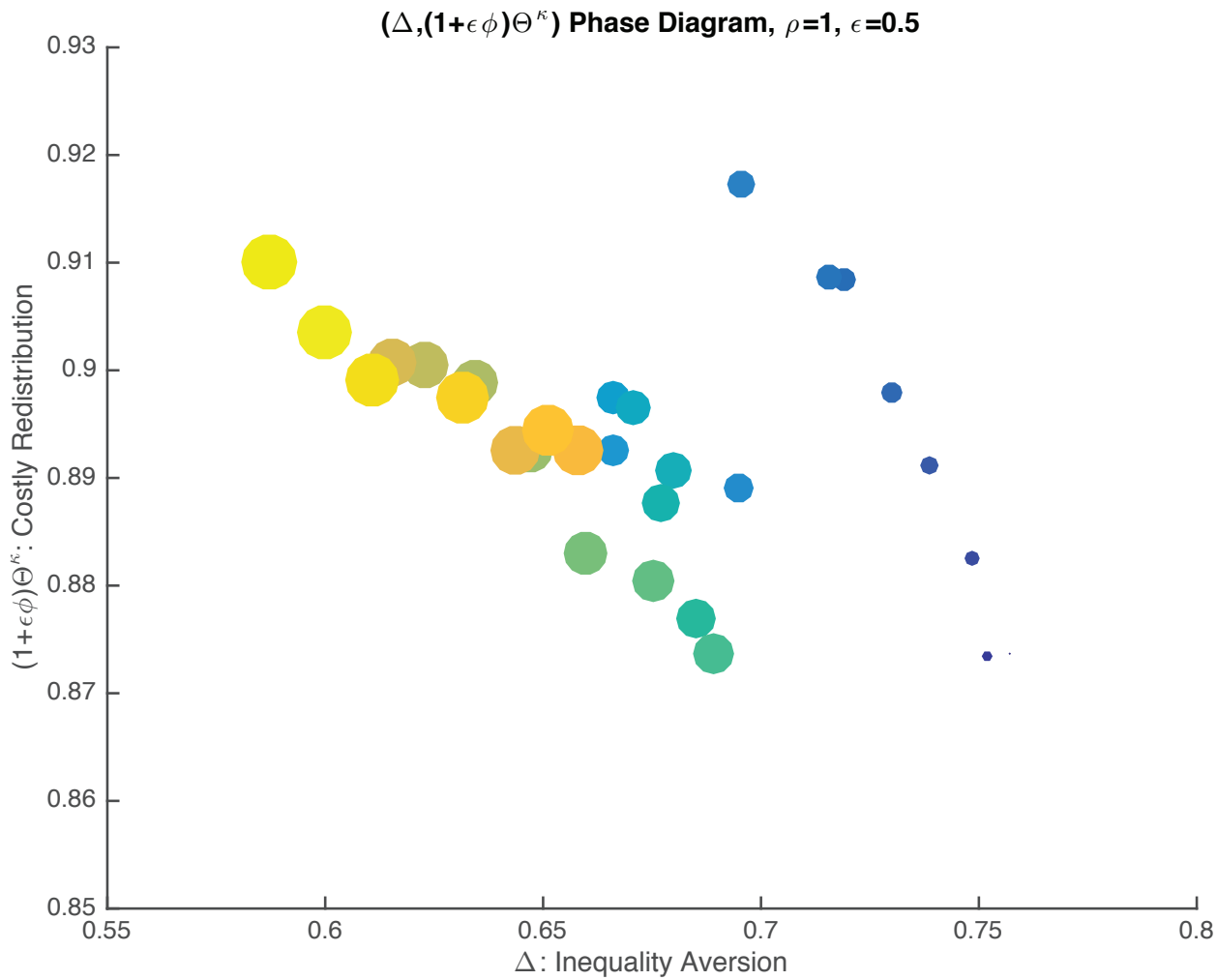
  - — social welfare by **0.52%** per year
- *By how much would real income and social welfare have increased if ϕ had kept Δ at its 1979 level?*
  - — mean real income by **0.44%** per year
  - — social welfare by **0.57%** per year

Social Welfare and Counterfactuals



▸ show $\rho = 0.5$

Evolution of Welfare Corrections



OPEN ECONOMIC MODEL

Open Economy

Environment

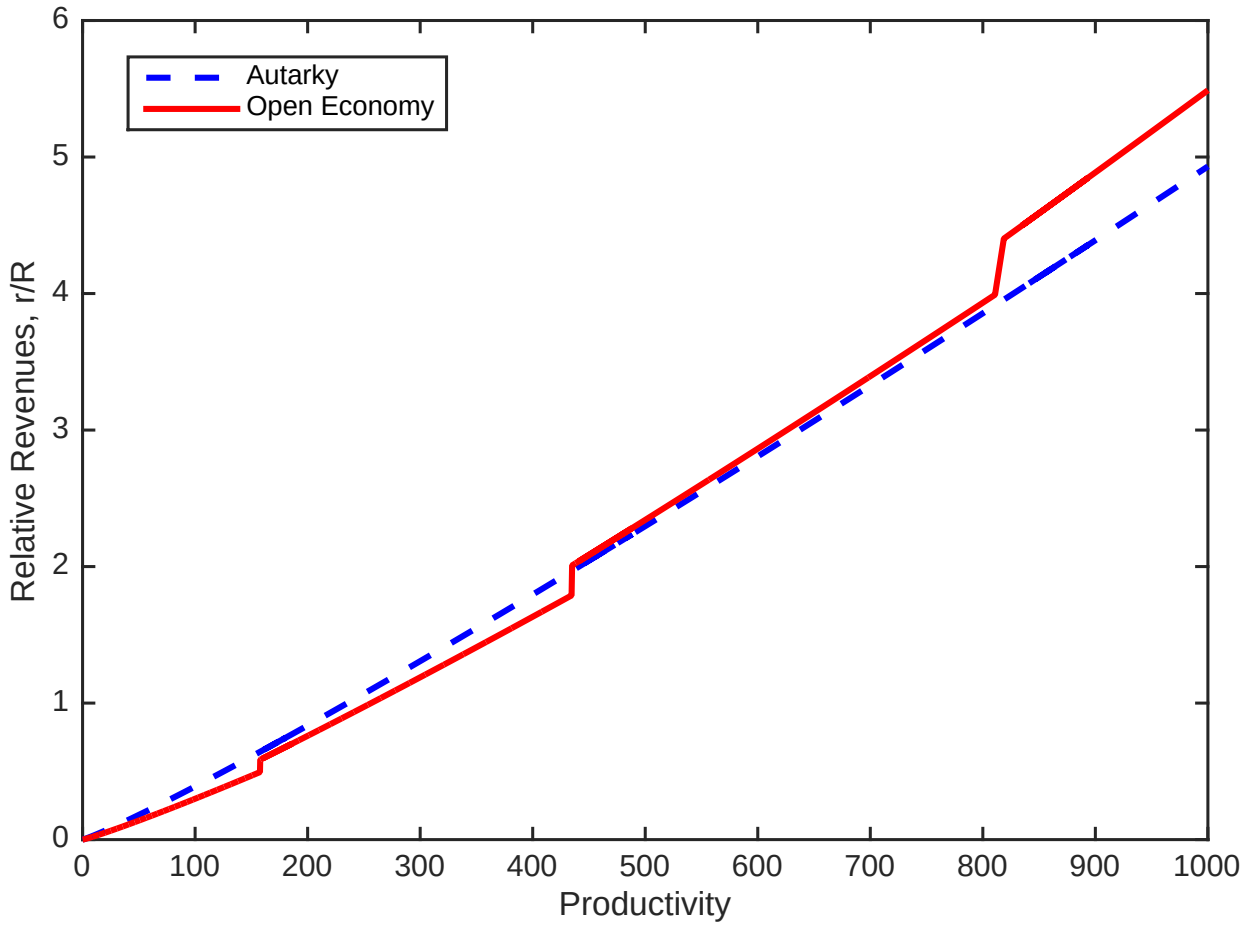
- Consider a world economy with $N+1$ symmetric regions
- Households can market their output (task) locally or in any of the other N regions
- Trade/Offshoring involves two types of additional costs
  1. Variable iceberg trade cost τ
  2. Fixed cost of market access $f(n)$ increasing in the number n of foreign markets served. We adopt $f(n) = fn^{\alpha}$
- Household income

$$r_{\varphi} = \Upsilon_{n_{\varphi}}^{1-\beta} Q^{1-\beta} y_{\varphi}^{\beta}, \qquad \text{where} \qquad \Upsilon_{n_{\varphi}} = 1 + n_{\varphi} \tau^{-\frac{\beta}{1-\beta}}$$

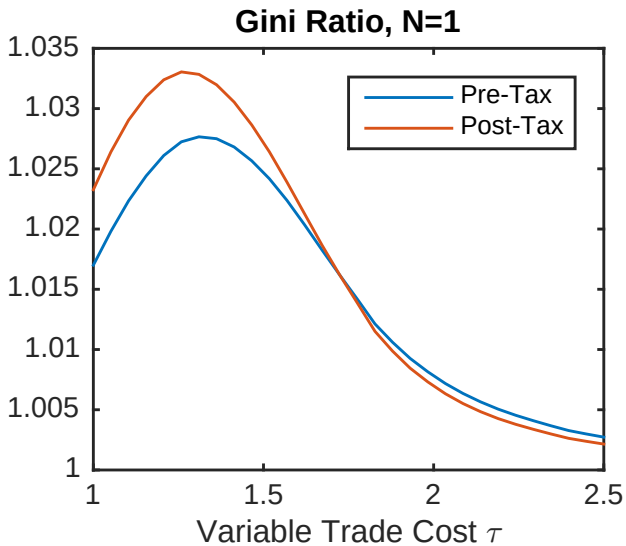
- Taxation: the government does not observe export decisions and $f(n)$ is not tax deductible: $c_{\varphi} = k r_{\varphi}^{1-\phi} - \sum_{n=1}^{n_{\varphi}} f n^{\alpha}$

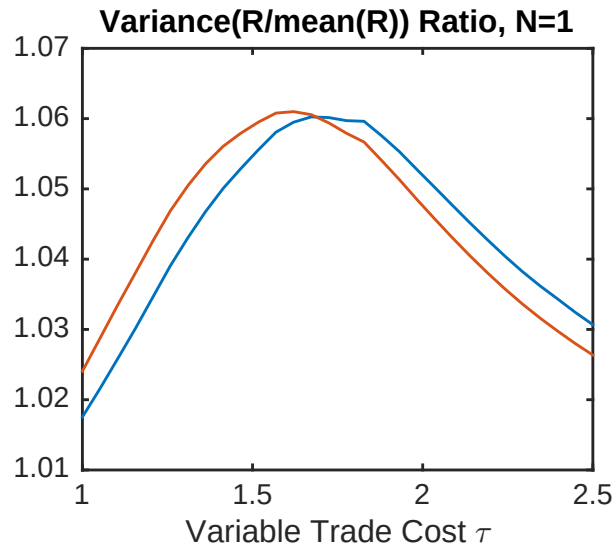
Trade and Inequality

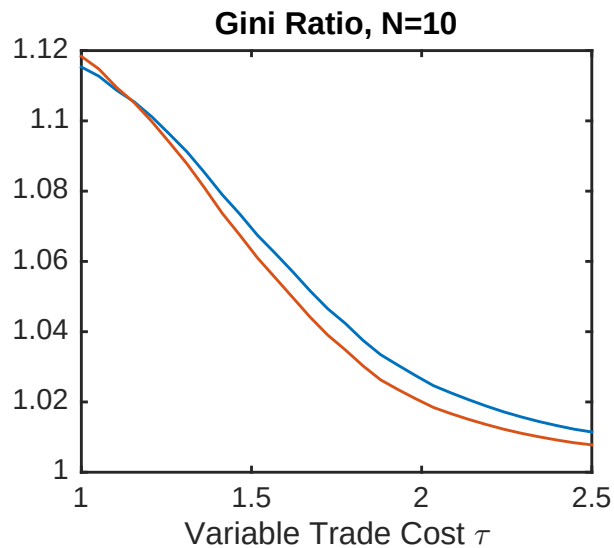
- Trade increases relative revenues of high-ability households (due to market access), but reduces that of low-ability households (due to foreign competition)

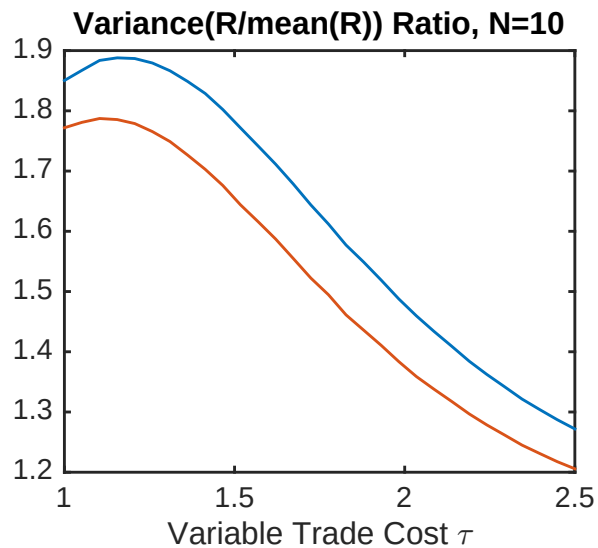


Trade and Inequality









CALIBRATION AND COUNTERFACTUALS

Calibration and Counterfactuals

- We first calibrate the model to 2007 U.S. data
  - — as in the closed economy but with additional trade moments
- We then explore the implication of a move to the 1979 level of trade openness (and to autarky) on:
  1. Aggregate Income
  2. Income Inequality
- We use the model to gauge the quantitative importance of the two corrections developed above

$$W = \frac{\left[\mathbb{E}\left(u_\varphi\right)^{1-\rho}\right]^{\frac{1}{1-\rho}}}{\mathbb{E}u_\varphi} \times \frac{\mathbb{E}u_\varphi}{\tilde{W}} \times \tilde{W} = \Delta_T \times \Theta_T \times \tilde{W}.$$

  1. How large is W'/W for different degrees of inequality aversion?
  2. How large would W'/W be in the absence of costly redistribution?

Calibration

- For our benchmark results, hold the following primitives constant:
  1. As in closed economy, set $\beta = 4/5$ and $\gamma = 2.4 \Rightarrow \varepsilon = 0.5$
  2. Tax progressively $\phi = 0.147$ for 2007
  3. Number of countries $N = 5$ (i.e., US roughly 15% of the world)

- Jointly calibrate trade parameters (τ, f_x, α) and the ability distribution H_φ to match:
  1. 2007 trade share of 7.8% from NIPA $\Rightarrow \tau = 2.11$
  2. Share of exporter sales in total sales $= 60\% \Rightarrow f_x =$\$750
  3. Skewness of export sales: firms that export to $n > 1$ dest. account for 89% of total exporters' sales $\Rightarrow \alpha = 0.53$
  4. The 2007 distribution of market income from the IRS data

  ▸ Implied H_φ

- In the counterfactuals, we then set $\tau_{1979} = 2.25$ to match 1979 trade share of 5.2% (holding all else equal); also $\tau_A = \infty$

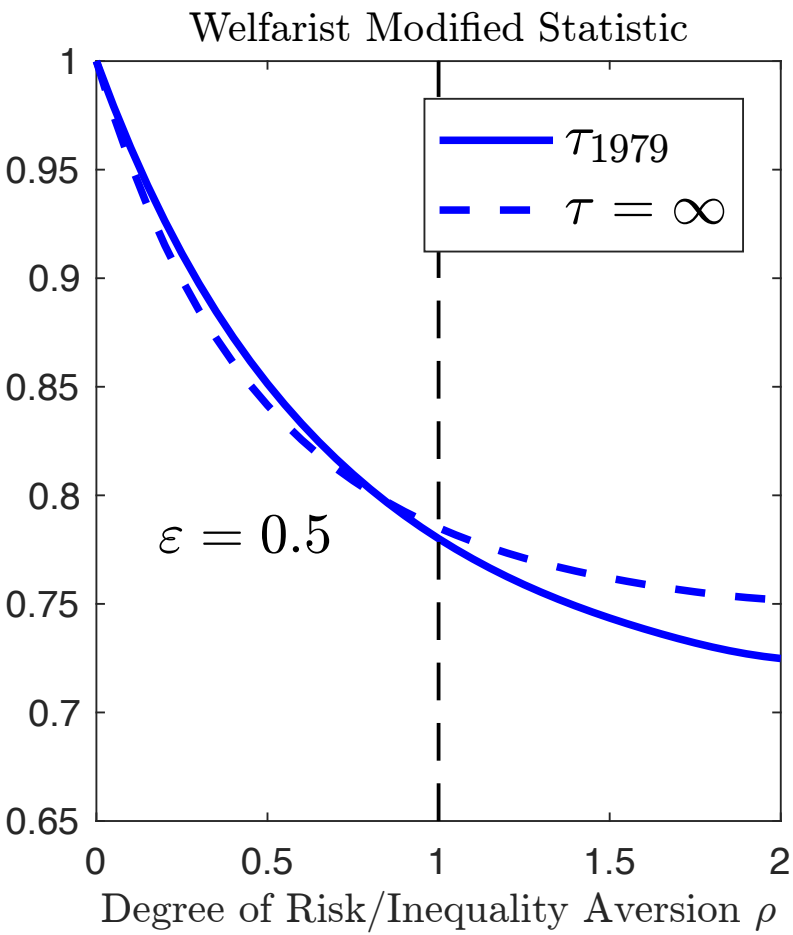
Calibrated Welfare Gains from Trade and Inequality

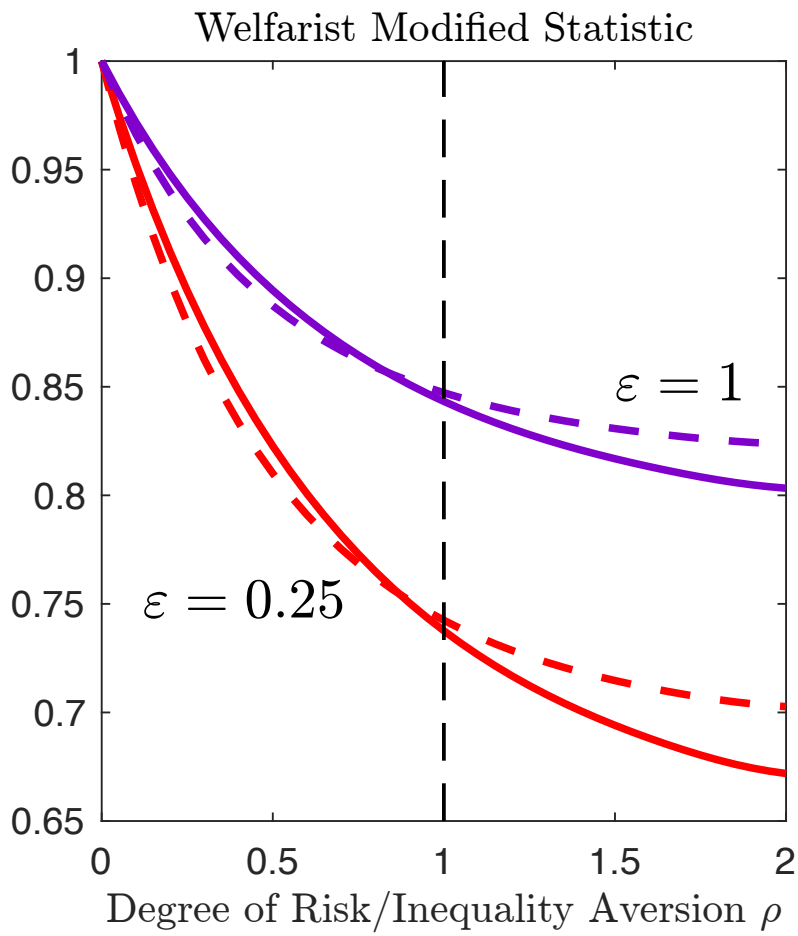
- Calibrated welfare gains from trade are higher, the higher is the labor supply elasticity ε (Arkolakis and Esposito, 2014)
- But relative to autarky trade induces more inequality when ε is high

	% Consumption Gains		% Welfare Gains ($\rho = 0$)		% Increase in Gini	
	τ_{1979}	$\tau = \infty$	τ_{1979}	$\tau = \infty$	τ_{1979}	$\tau = \infty$
$\varepsilon = 0.25$	0.8	2.5	0.8	2.4	0.4	1.1
$\varepsilon = 0.5$	1.2	3.5	1.1	3.3	0.5	1.3
$\varepsilon = 1$	2.0	6.3	1.8	5.9	0.6	1.7

Welfarist Correction

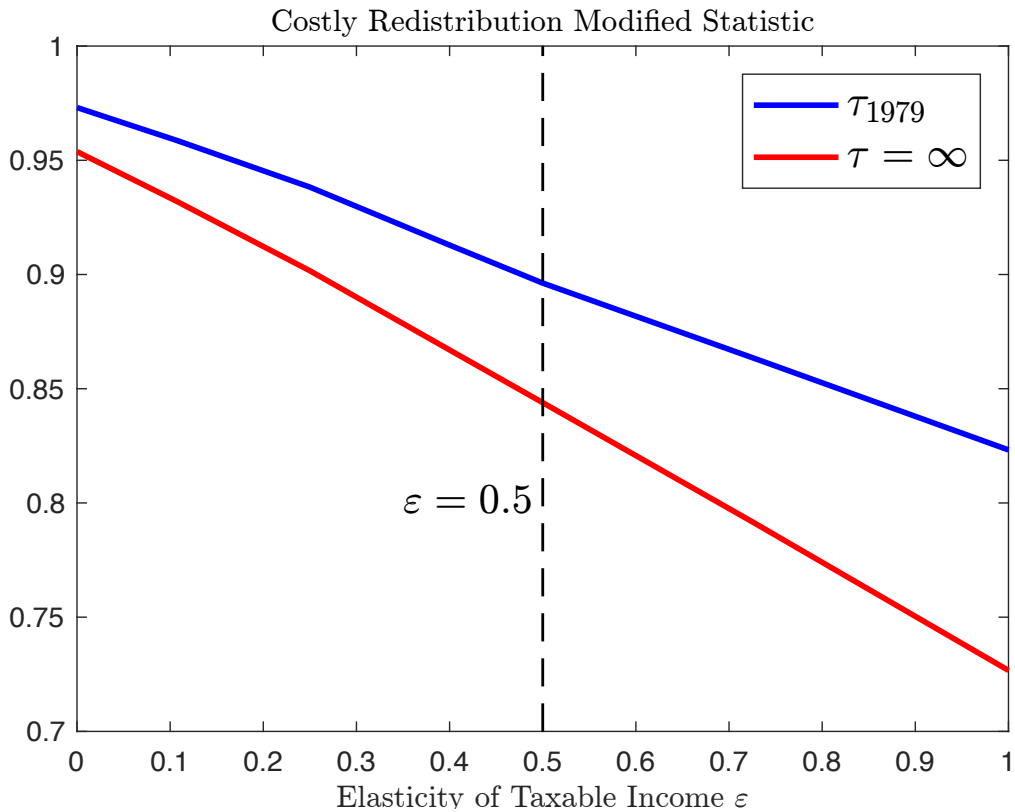
- Welfarist correction is higher, the higher is ρ and the lower is ε
- With log utility ($\rho = 1$) and a labor supply elasticity of $\varepsilon = 0.5$, welfare gains are 21% lower





Costly Redistribution Correction

- Costly redistribution correction is higher, the higher is ε
- When $\varepsilon = 0.5$, welfare gains are 10% lower (when moving to τ_{1979}) and 16% lower (when moving to autarky)



Robustness and Additional Exercises

- Imposing a lognormal distribution of income **underpredicts** costly redistribution correction ▸ Lognormal
- Allowing for progressivity to endogenously adjust to trade opening makes little difference ▸ Endogenous ϕ
- The size of the corrections is fairly robust to:
  - Alternative values of β, holding constant ε ▸ Different β
  - Alternative values of the share of exporter sales in total sales
  - Setting $\alpha = 0$ as in Melitz (2003)
  - Calibrating trade costs (τ, F, α) to the manufacturing sector

Conclusions

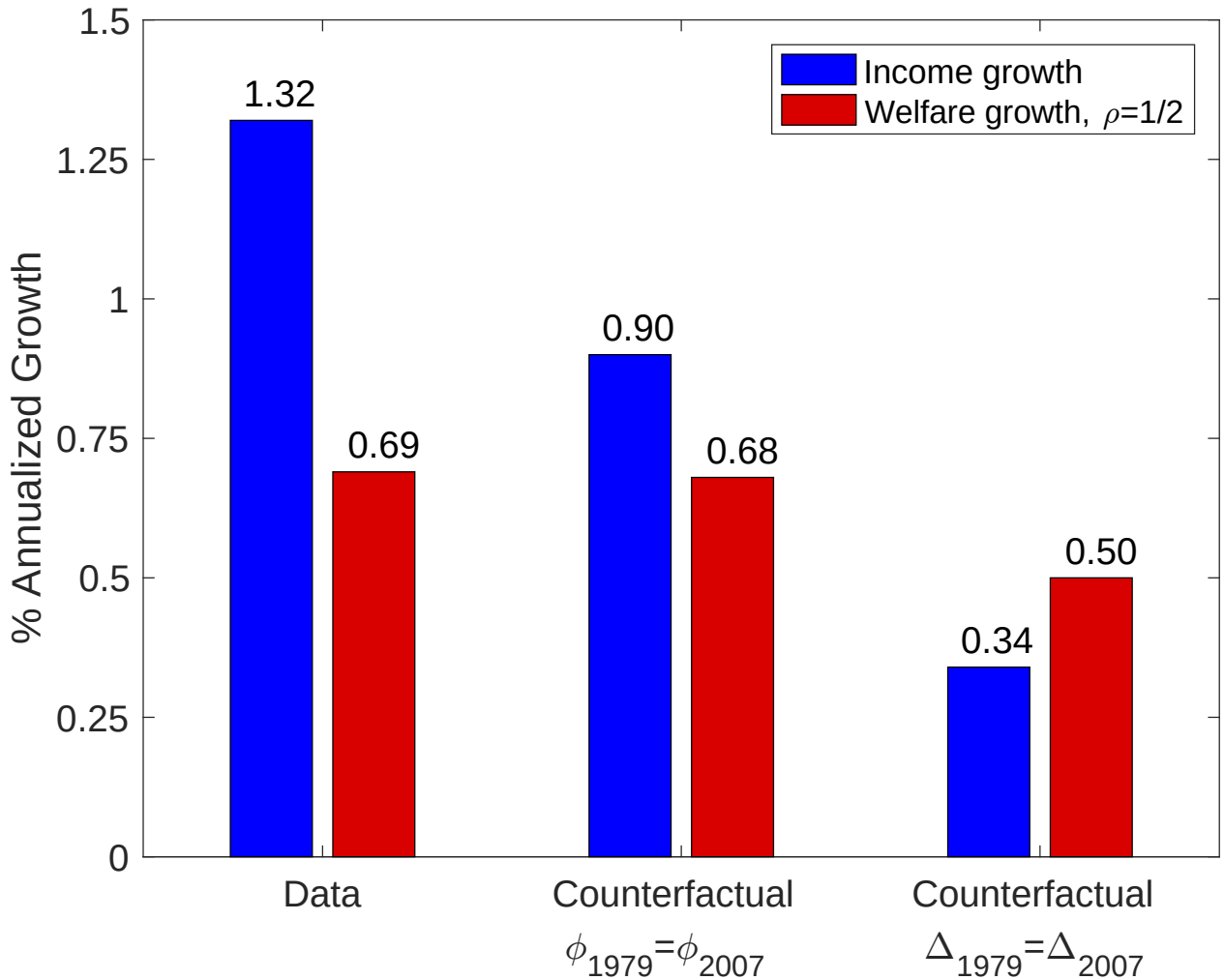
- Trade-induced inequality is partly mitigated via a progressive income tax system
- Still, compensation is not full so trade induces an increase in the inequality of disposable income

  $\longrightarrow$ should we measure gains using average income or adjust for inequality?
- Income taxation induces behavioral responses that affect the aggregate income response to trade integration

  $\longrightarrow$ should we adjust for this "leaky bucket" effect?
- We developed welfarist and costly redistribution corrections to standard measures of the gains from trade
- Under plausible parameter values, these corrections are nonneglible and eliminate about one-fifth of the gains

APPENDIX

Social Welfare and Counterfactuals



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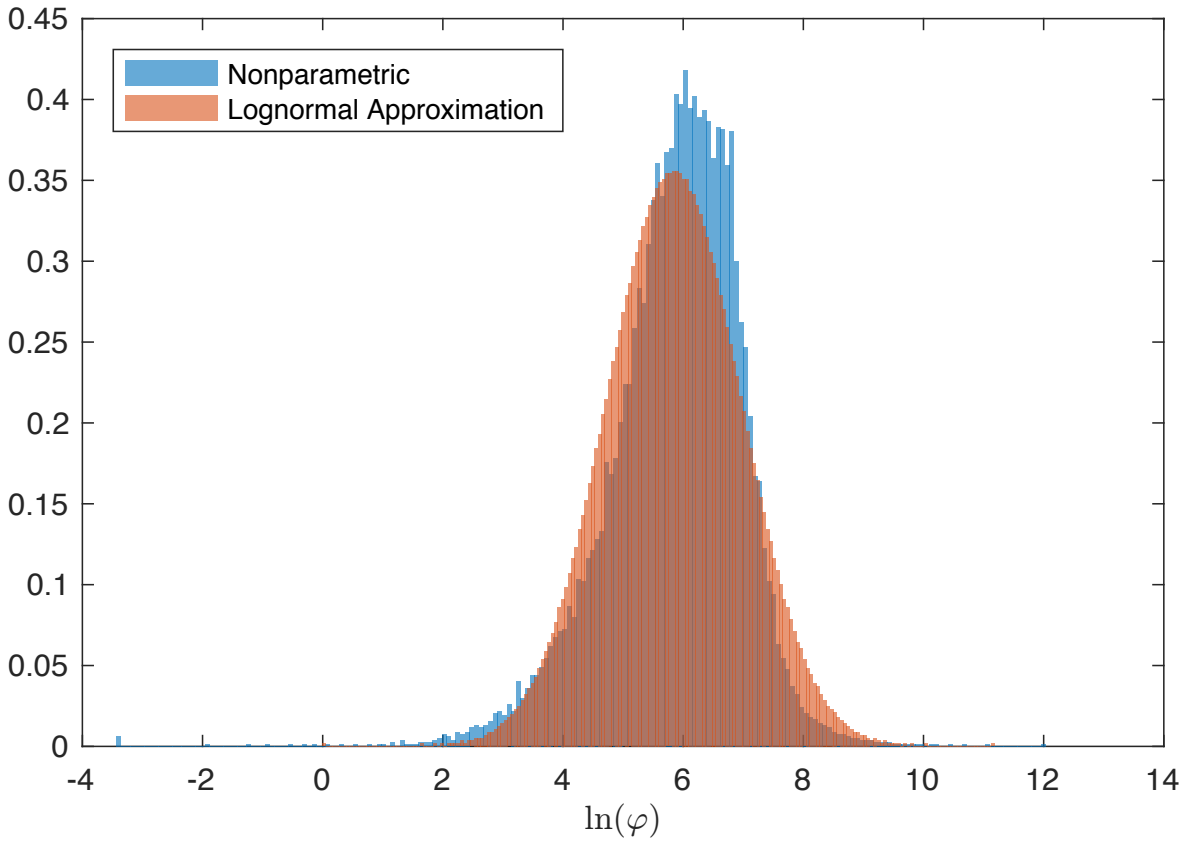
Implied 2007 Ability Distribution H_φ



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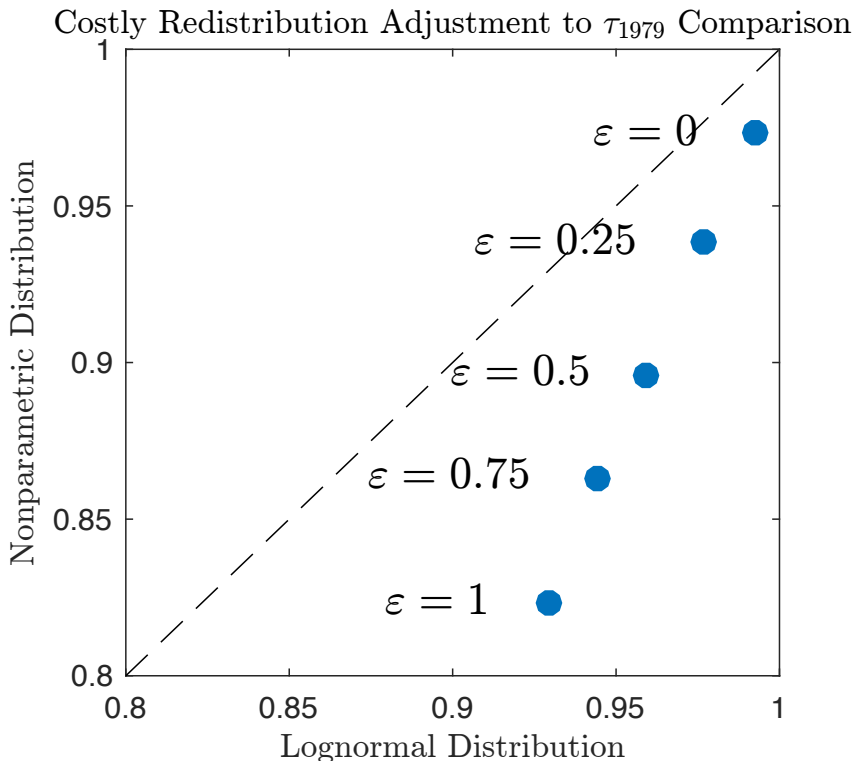
Nonparametric versus Lognormal Case

- Lognormal **underpredicts** costly redistribution correction, esp. for high ε (underpredicts the behavior of the right tail)



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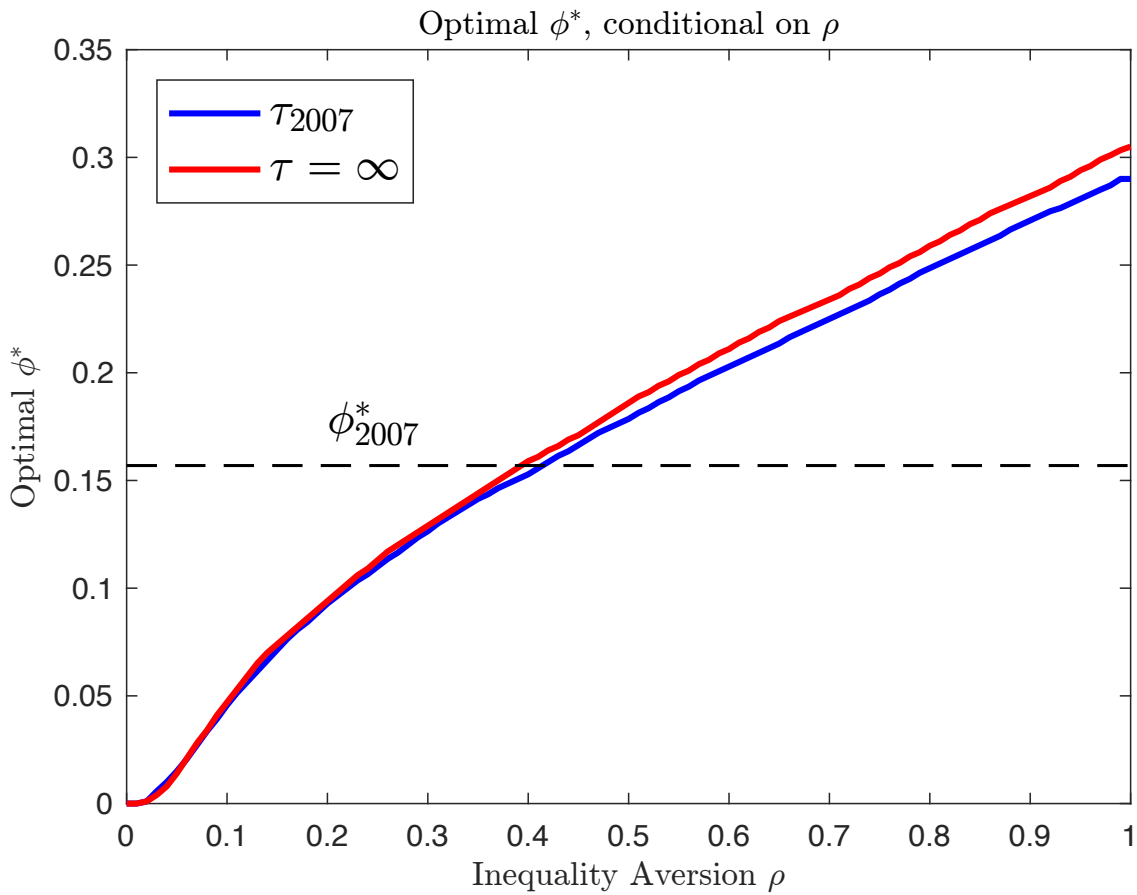
Optimal Progressivity

(and Implied Inequality Aversion)

- Observed degree of progressivity in 2007 is optimal if ρ is relatively low; optimal ϕ with trade is very similar



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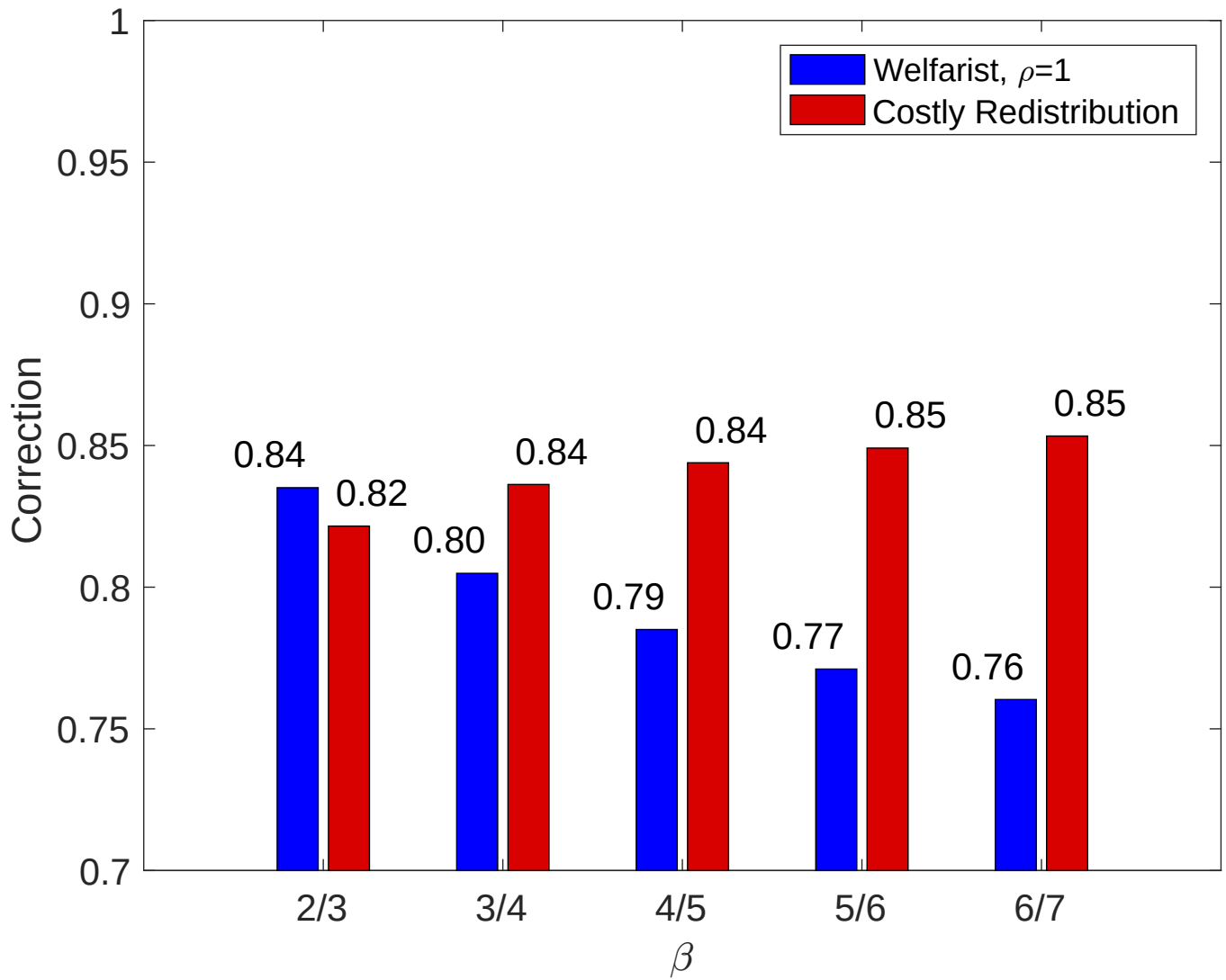
Alternative Values of β (constant ε)



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