Trade, Inequality and Costly Redistribution

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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 technology adoption etc.

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

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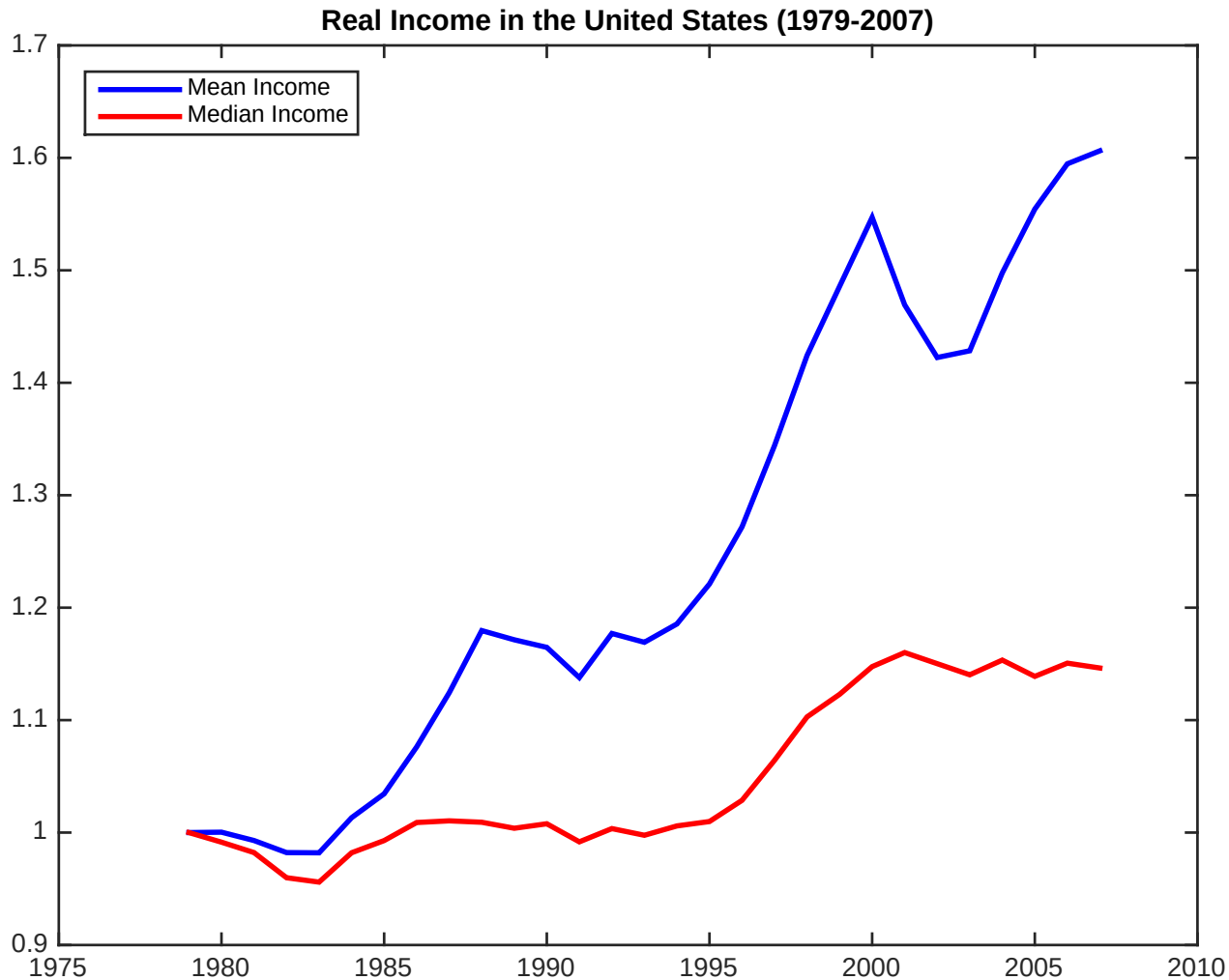
  3. despite progressive tax system, trade still increases inequality in after-tax incomes

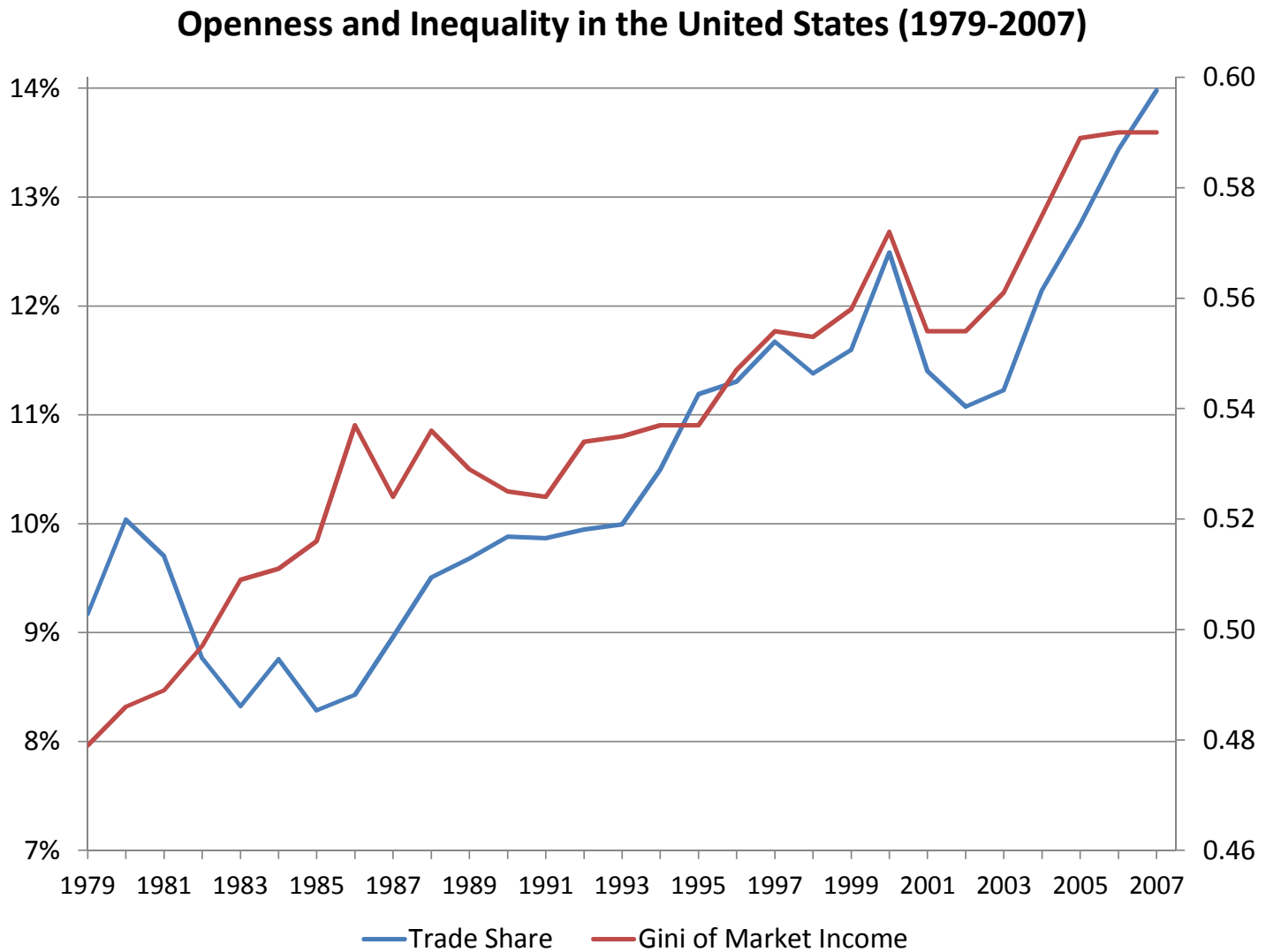
- We propose two types of adjustment to standard welfare measures:
  1. **Welfarist correction**: taking into account inequality-aversion of society (or risk-adjustment under the veil of ignorance)
  2. **Costly-redistribution correction**: capturing behavioral responses to *trade-induced* shifts across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

Motivating Figure



1.74% versus 0.47% annualized annual growth

Motivating Figure



Building Blocks and Related Literature

- Trade models with heterogeneous workers
  - Itskhoki (2008)
  - matching/sorting models (see Grossman, and Costinot and Vogel for surveys)
  - models with imperfect labor markets (Helpman, Itskhoki, Redding, and others)
- Gains from trade and costly redistribution: Dixit and Norman (1986), Rodrik (1992), Spector (2001), Naito (2006)
- Welfarist approach: Bergson (1938), Samuelson (1947), Diamond & Mirlees (1971), Saez more recently
- Costly-redistribution:
  - Kaplow (2008), Hendren (2014)
  - Nonlinear tax system as in Heathcote, Storesletten and Violante (2014)
  - Model calibrated to fit 2007 U.S. data on income distribution from IRS public records

Road Map

1. A Motivating Example
2. Open Economy Model
3. Calibration
4. 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:

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

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- 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?

A Constant-Elasticity Model

Closed Economy

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

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

- Each individual produces a task according to $y = \varphi\ell$, $\varphi \sim H_{\varphi}$
- This translates into market income $r = Q^{1-\beta}y^{\beta}$, $Q = \int r_{\varphi}\mathrm{d}H_{\varphi}$
- Consumption equals after-tax income: ▸ show data

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

- Government runs balanced budget $g = \frac{G}{Q} = 1 - k\frac{\int r_{\varphi}^{1-\phi}\mathrm{d}H_{\varphi}}{\int r_{\varphi}\mathrm{d}H_{\varphi}}$

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- Government runs balanced budget $g = \frac{G}{Q} = 1 - k\frac{\int r_{\varphi}^{1-\phi}\mathrm{d}H_{\varphi}}{\int r_{\varphi}\mathrm{d}H_{\varphi}}$
- In constant-elasticity model, $r_{\varphi} \propto \varphi^{\frac{\beta(1+\varepsilon)}{1+\varepsilon\phi}}$, where $\varepsilon \equiv \frac{\beta}{\gamma-\beta}$

Welfare Corrections

- Welfare:

$$\tilde{W}_0 = \frac{1}{1+\varepsilon}(1-g)\tilde{Q},$$

$$W_\rho = \frac{1+\varepsilon\phi}{1+\varepsilon}(1-g)Q \cdot \Delta = \tilde{W}_0 \cdot \Theta \cdot \Delta,$$

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- **Welfarist Correction** (Atkison, 1970):

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

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- **Costly Redistribution Correction**:

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

Properties of the Correction Terms

- **General properties**:
  1. $\Delta, \Theta \in [0, 1]$ and independent of μ.
  2. $\Delta = 1$ if either $\rho = 0$ or F_r is degenerate.
     $\Delta < 1$ otherwise, and monotonically decreasing in ρ
  3. $\Theta = 1$ iff $\phi = 0$.
     If F_r is degenerate, $\tilde{\Theta} = 1$ and $\Theta = \bar{\Theta} \leq 1$.
     $\bar{\Theta}$ is monotonically decreasing in ϕ and ε.

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- Special-case: **log-normal** ability distribution

$$\Delta = \exp\left\{-\rho(1-\phi)^2 \frac{\sigma_r^2}{2}\right\},$$

$$\tilde{\Theta} = \exp\left\{-\kappa\varepsilon(1+\varepsilon)\phi^2 \frac{\sigma_r^2}{2}\right\}.$$

  — both Δ and Θ decrease in dispersion of income (σ_r, Gini, etc.)

  — yet, Δ increases and Θ decreases in $\phi \rightarrow$ policy tradeoff

Corrections for Welfare Gains

- GDP growth rates:

$$\mu = \frac{Q' - Q}{Q},$$

$$\tilde{\mu} = \frac{\tilde{Q}' - \tilde{Q}}{\tilde{Q}} = \tilde{G}$$

- Welfarist correction:

$$G^W \equiv \frac{\Delta W_\rho}{W_\rho} = (1 + \mu)\frac{\Delta'}{\Delta} - 1$$

- Costly redistribution correction:

$$\mu = (1 + \tilde{\mu})\frac{\Theta'}{\Theta} - 1$$

Look at the data

Growth corrections for US, 1979–2007

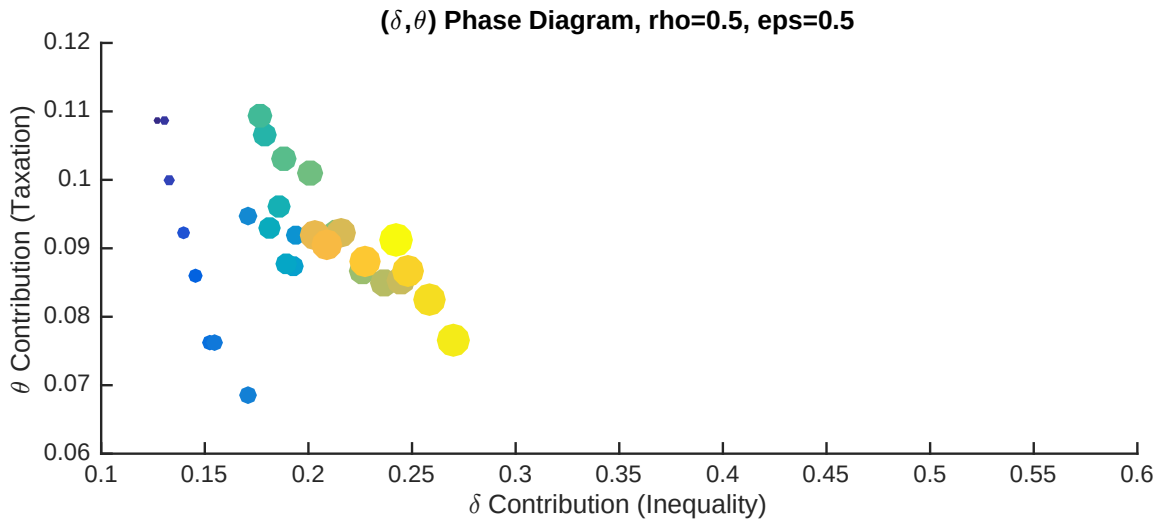
	Welfare correction: $G^W/\mu \sim \Delta'/\Delta$		
	$\rho = 0.5$	1	2
Non-parametric	0.89	0.80	−0.08
Log-normal	0.90	0.80	0.60

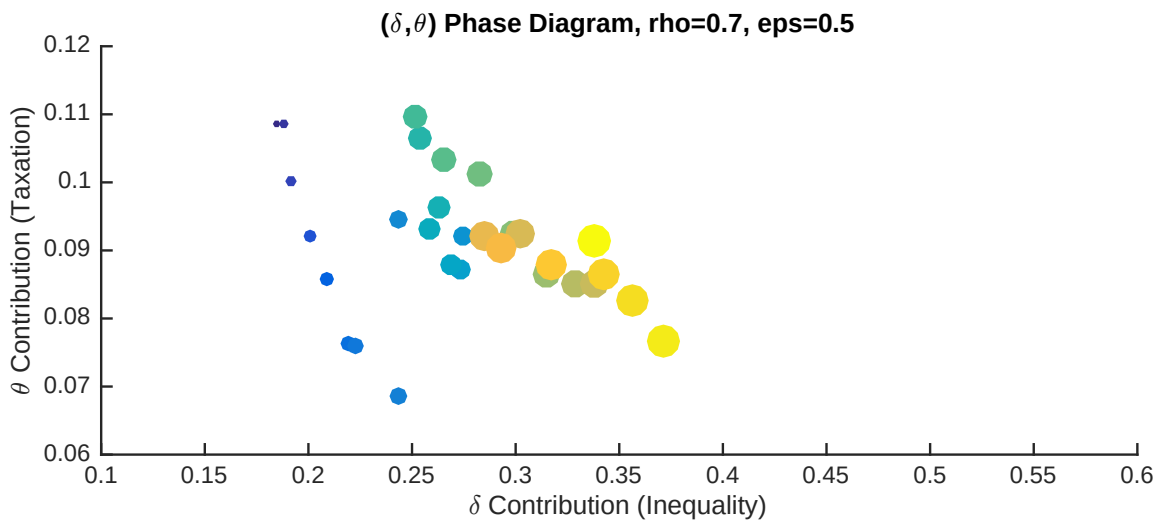
	CR correction: $\mu/\tilde{\mu} \sim \Theta'/\Theta$		
	$\varepsilon = 0.5$	1	2
Non-parametric	1.04	1.14	1.98
Log-normal	1.06	1.27	$(\tilde{\mu} < 0)$

- Recall that annualized $\mu = 1.74\%$ over 1979–2007,
- inequality increased
- but progressively (ϕ) decreased

Policy Tradeoff for US, 1979–2007

- In logs: $\log W_\rho = \log \tilde{W}_0 + \overbrace{\log \Theta}^{\equiv -\theta} + \overbrace{\log \Delta}^{\equiv -\delta}$





Trade and Welfarist Correction

A Preliminary Quantitative Assessment

- How large is the negative correction to social welfare associated with trade-induced inequality?
- Consider U.S. during the period 1979–2007:

	1979	2007
Trade Share	0.092	0.140
Gini Coefficient	0.367	0.489

- Two crucial questions:
  1. How much did the rise in the trade share increase aggregate disposable income?
  2. Which share s of the 0.122 increase in the Gini is caused by that trade opening?
- Trade model will answer these questions, but suppose $\mu = 3\%$ and $s = 5\%$, 10%, and 20%

Welfarist Correction

A Preliminary Quantitative Assessment

- It does not take an awful lot of inequality aversion to generate significant downward corrections to gains from trade

Table 1. Social Welfarist Inequality Correction to Welfare Effects of Trade Integration

	Pareto Correction			Lognormal Correction		
	Contribution of Trade to Inequality			Contribution of Trade to Inequality		
	$s = 5\%$	$s = 10\%$	$s = 20\%$	$s = 5\%$	$s = 10\%$	$s = 20\%$
Inequality Aversion	(1)	(2)	(3)	(4)	(5)	(6)
$\rho = 0$	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
$\rho = 0.1$	2.85%	2.69%	2.36%	2.91%	2.83%	2.65%
$\rho = 0.25$	2.67%	2.33%	1.64%	2.79%	2.57%	2.12%
$\rho = 0.5$	2.46%	1.92%	0.80%	2.57%	2.14%	1.25%
$\rho = 0.75$	2.32%	1.63%	0.23%	2.36%	1.72%	0.39%
$\rho = 1$	2.22%	1.43%	-0.18%	2.15%	1.29%	-0.46%
$\rho = 2$	1.98%	0.96%	-1.08%	1.31%	-0.39%	-3.81%

ECONOMIC MODEL

Open Economy

Environment

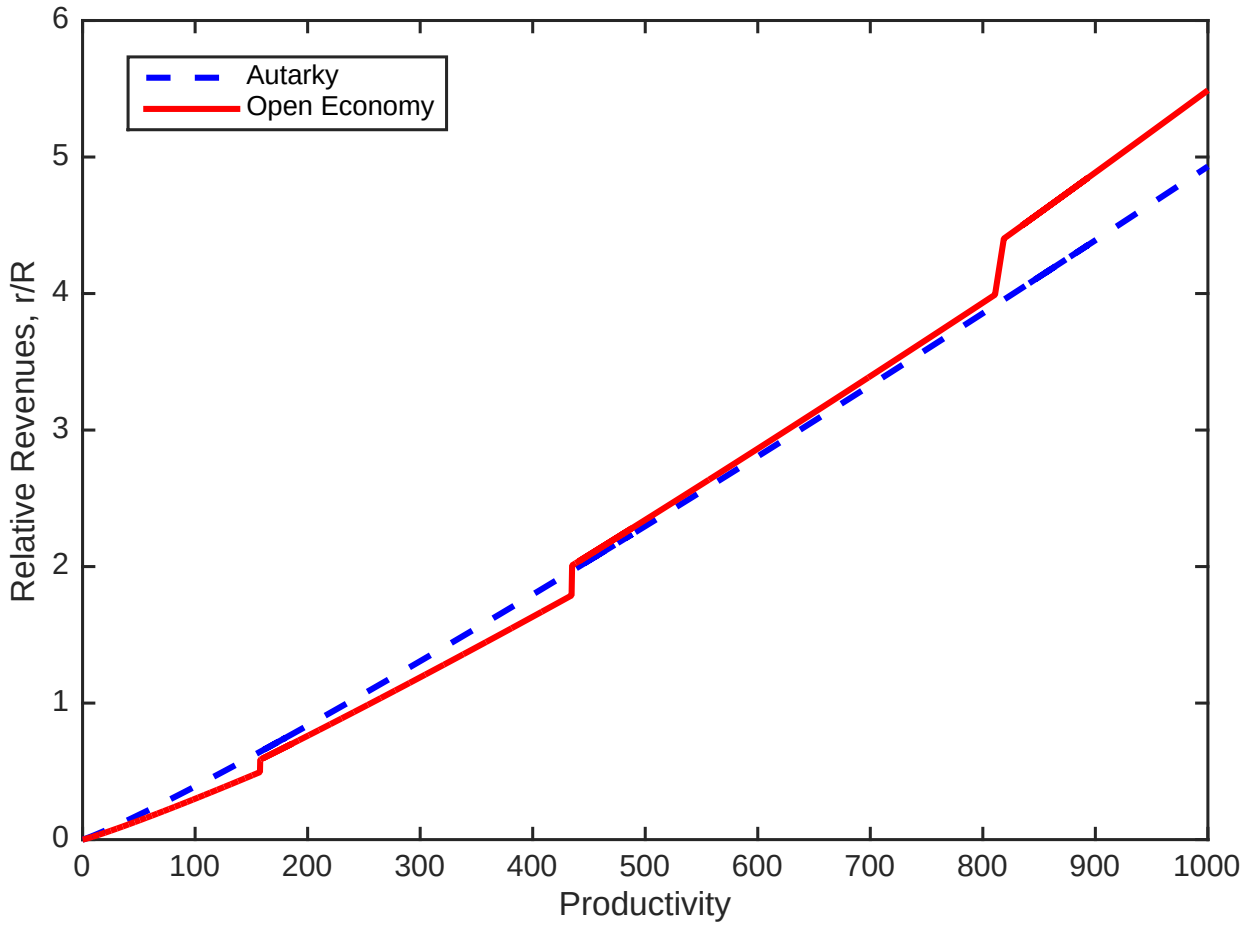
- Consider a world economy with $N+1$ symmetric regions
- Households can market their output locally or in any of the other N regions
- Trade/Offshoring involves two types of additional costs
  1. Variable iceberg trade cost τ
  2. Fixed cost of market access $f(n)$ increasing in the number n of foreign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

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

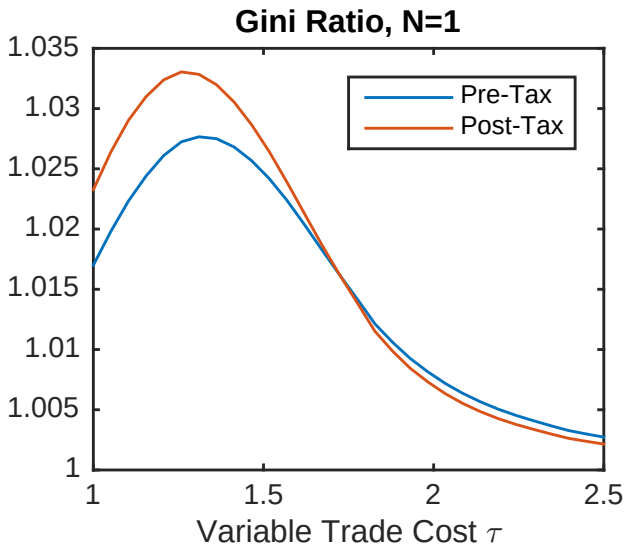
- Taxation: the government does not observe export decisions and $f(n)$ is not tax deductible: $c_{\varphi} = k r_{\varphi}^{1-\phi} - f n_{\varphi}^{\alpha}$

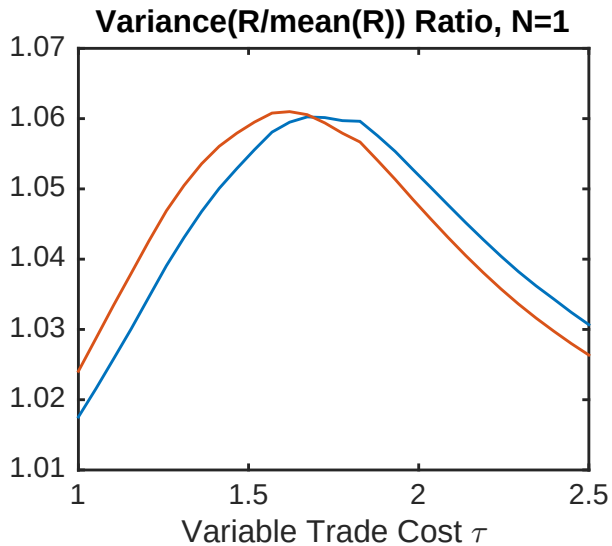
Trade and Inequality

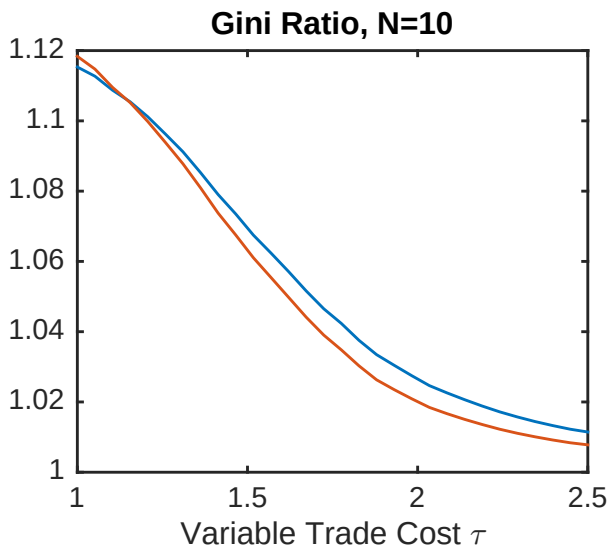
- Trade increases relative revenues of high-ability households (due to market access), but reduces that of low-ability households (due to foreign competition)

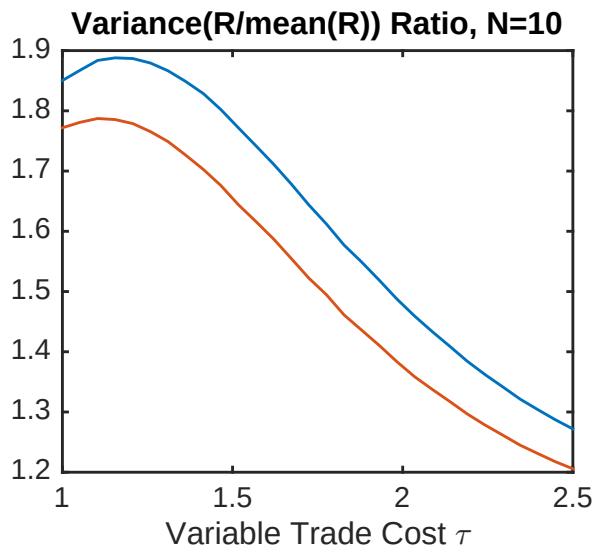


Trade and Inequality









CALIBRATION AND COUNTERFACTUALS

Calibration and Counterfactuals

Road Map

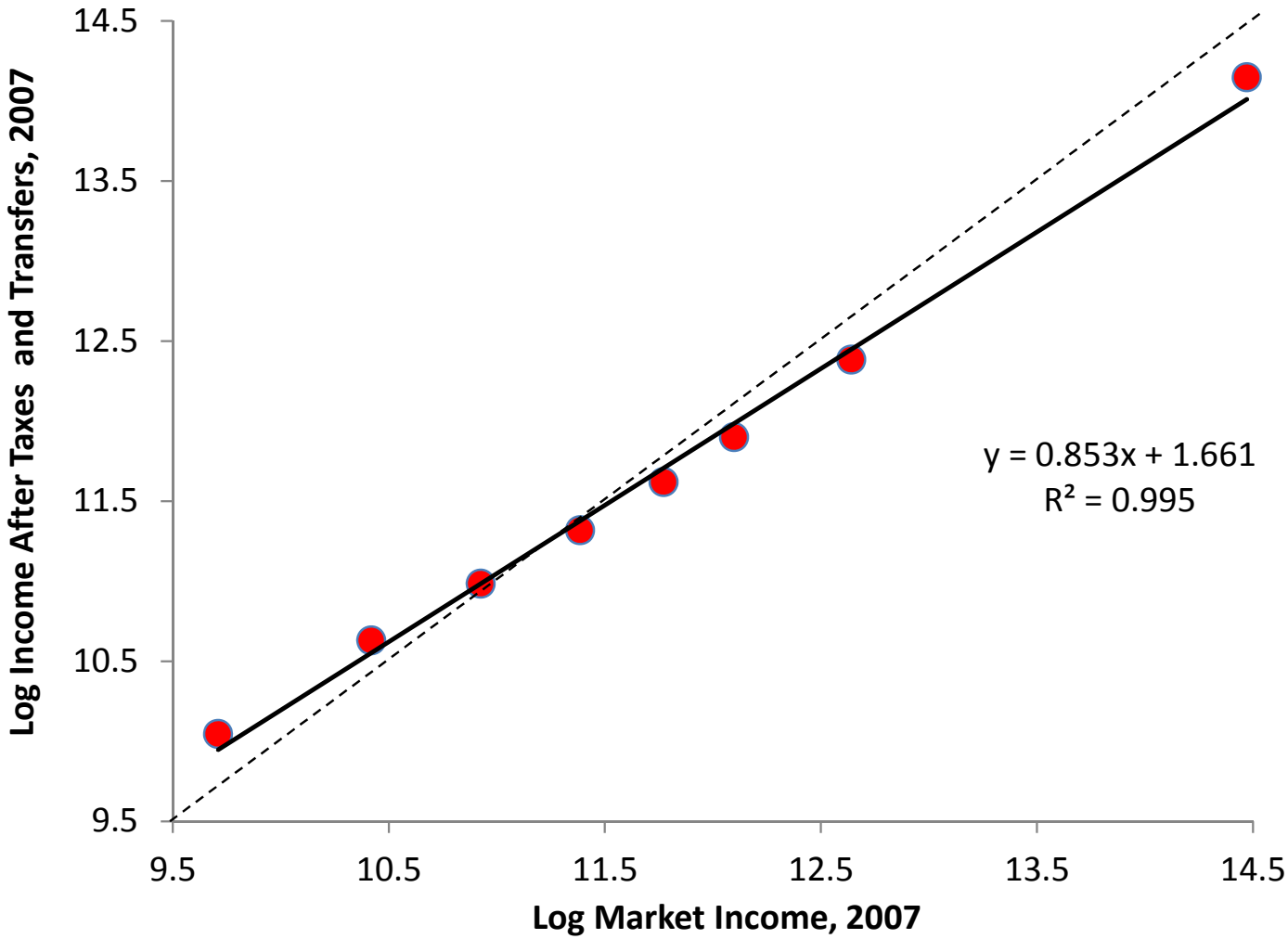
- We first calibrate the model to 2007 U.S. data (trade share, income distribution, tax progressivity)
- We then explore the implication of a move to autarky on
  1. Aggregate Income
  2. Income Inequality
- We use the model to gauge the quantitative importance of the two corrections developed above
  1. How large are the gains from trade for different degrees of inequality aversion?
  2. How large would the gains from trade be in the absence of costly redistribution (i.e., $\phi = 0$)?

Calibration

- Hold the following parameters fixed
  1. Elasticity of substitution $= 4$ ($\beta = 3/4$)
     - BEJK (2003), Broda and Weinstein (2006), Antràs, Fort and Tintelnot (2014)
  2. Iceberg trade costs ($\tau = 1.83$)
     - Anderson and Van Wincoop (2004), Melitz and Redding (2014)
  3. Number of countries ($N = 10$)
     - U.S. roughly 10-15% of world manufacturing; results not too sensitive to N above 5
- Set baseline fixed cost f to match a U.S. trade share of 0.14
- Set convexity of fixed costs to either $\alpha = 1$ or $\alpha = 3$ (consistent with preliminary estimates using U.S. exports)
- Labor supply elasticity: experiment with various values for γ between $\gamma = 10000$ (or $\varepsilon \simeq 0$) and $\gamma = 5/3$ (or $\varepsilon = 1.5$)

Calibration: Progressivity

- We set $\phi = 0.147$, consistent with 2007 income data:

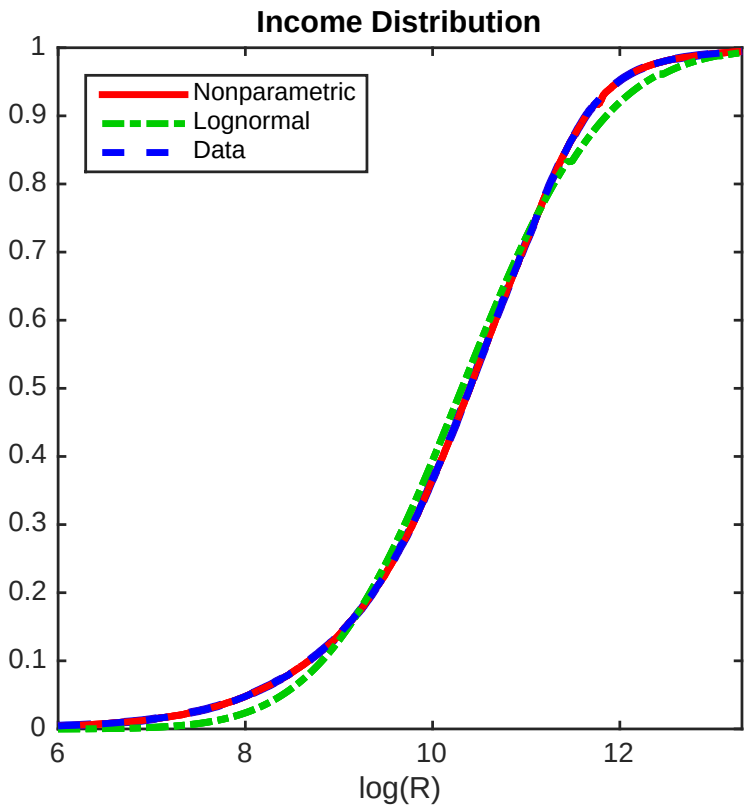


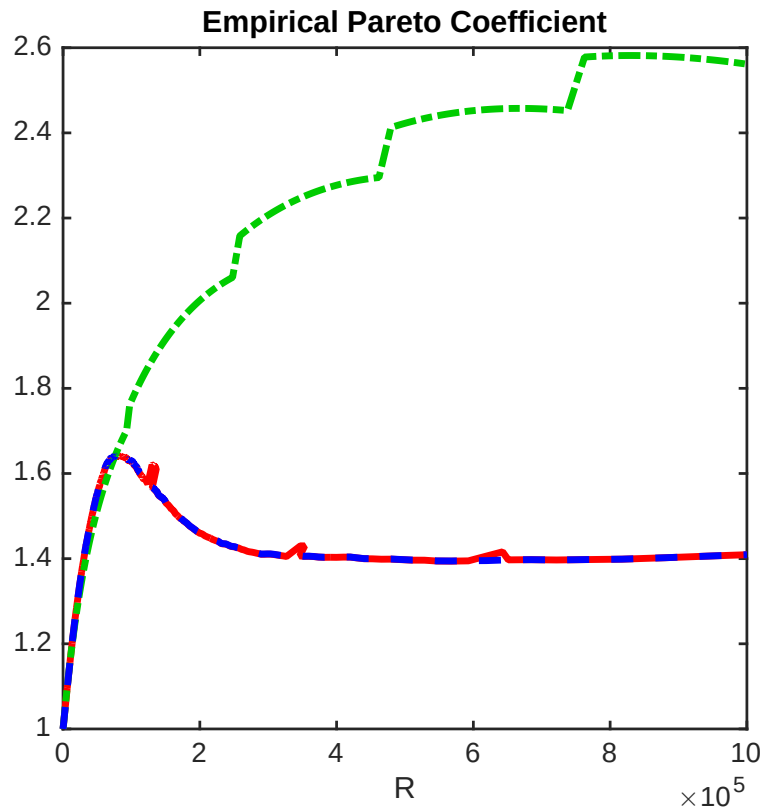
Calibration: Distribution of Ability

- Use 2007 U.S. Individual Income Tax Public Use Sample
  - approximately 2.5 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
- We follow two types of approaches:
  1. Nonparametric approach: given other parameter values, one can recover the φ's from the observed distribution of adjusted gross income
  2. Parametric approach: assume that $\varphi \sim \mathit{LogNormal}(\mu, \sigma)$ and calibrate μ and σ to match the mean and the Gini coefficient of adjusted gross income

Parametric vs. Non-Parametric Approach

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





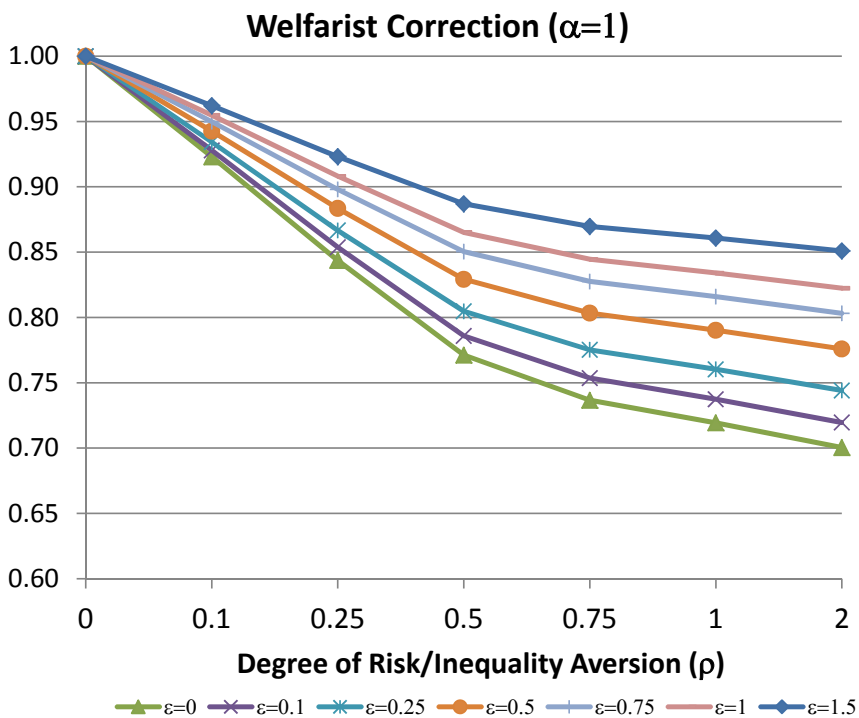
Gains from Trade and Inequality

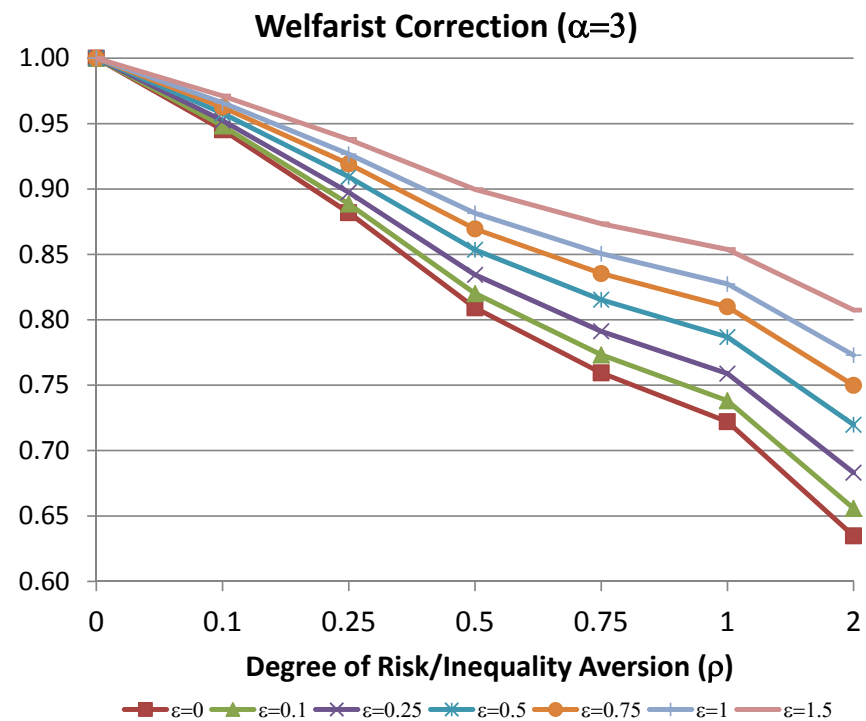
- Calibrated welfare gains from trade are higher, the higher is the labor supply elasticity ε
- But relative to autarky trade induces more inequality when ε is high

	Gains from Trade		Increase in Gini Coefficient	
Labor supply elasticity	$\alpha = 1$	$\alpha = 3$	$\alpha = 1$	$\alpha = 3$
$\varepsilon = 0$	4.86%	4.02%	2.31%	1.70%
$\varepsilon = 0.1$	5.52%	4.54%	2.44%	1.81%
$\varepsilon = 0.25$	6.54%	5.36%	2.64%	1.95%
$\varepsilon = 0.5$	8.31%	6.77%	2.92%	2.17%
$\varepsilon = 0.75$	10.40%	8.32%	3.16%	2.35%
$\varepsilon = 1$	12.41%	9.89%	3.36%	2.51%
$\varepsilon = 1.5$	16.72%	13.21%	3.72%	2.78%

Welfarist Correction

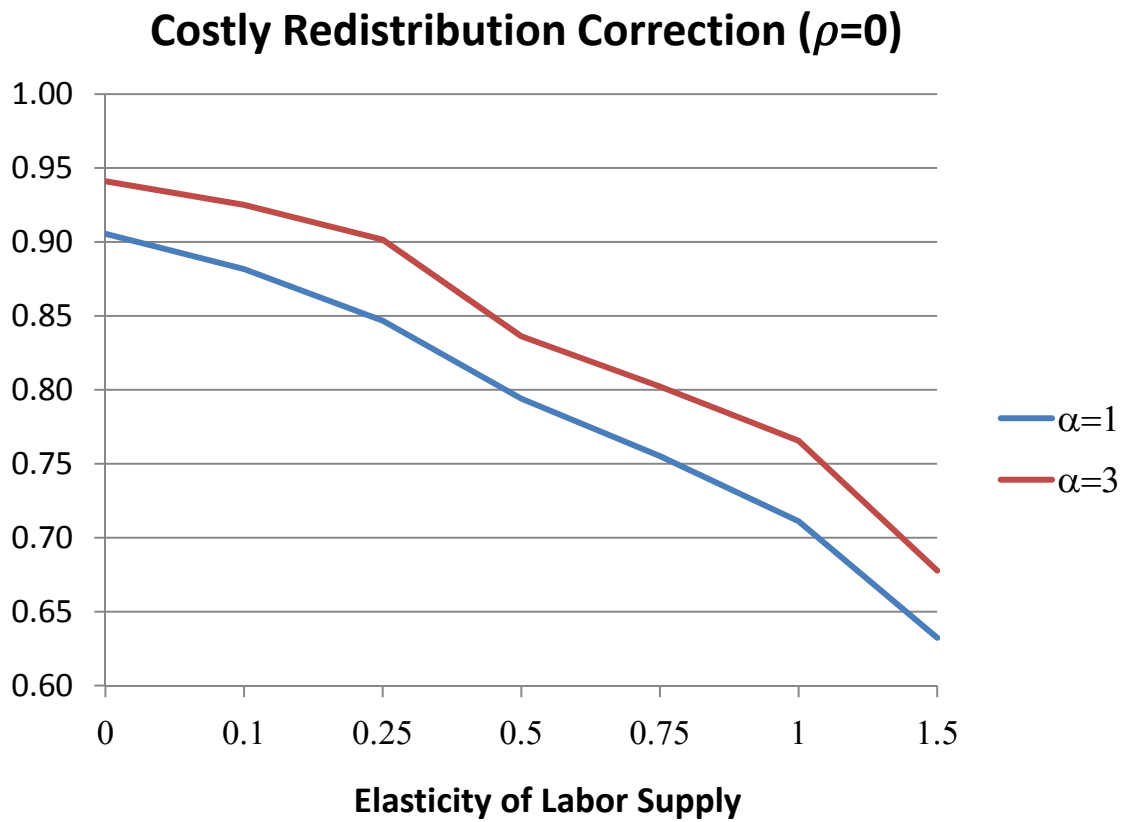
- Welfarist correction is higher, the higher is risk/inequality aversion ρ and the lower is the labor supply elasticity ε
- With log utility ($\rho = 1$) and a labor supply elasticity of $\varepsilon = 0.5$, welfare gains are 20–25% lower



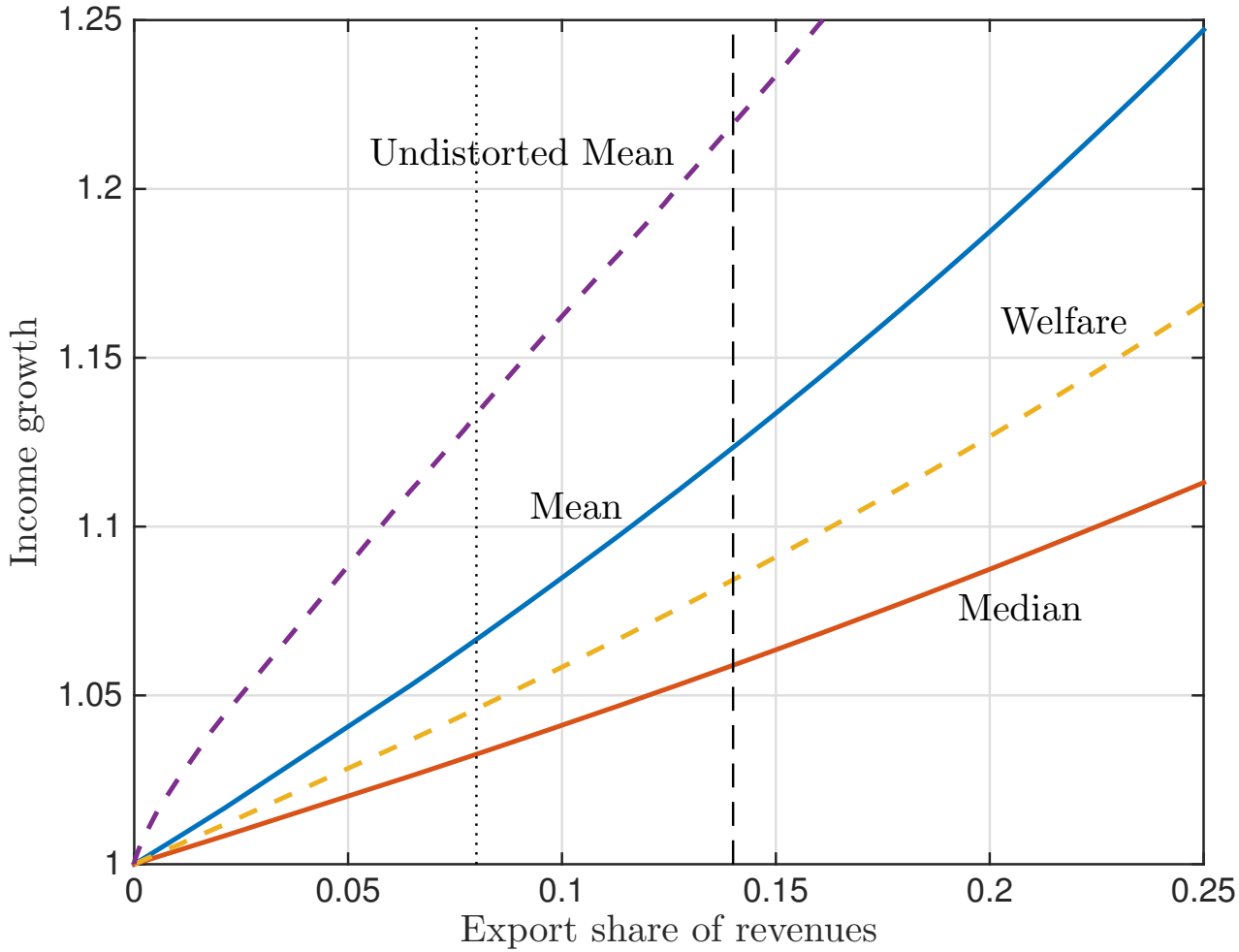


Costly Redistribution Correction

- Costly redistribution correction is higher, the higher is the labor supply elasticity ε
- When $\varepsilon = 0.5$, welfare gains are 15–20% lower



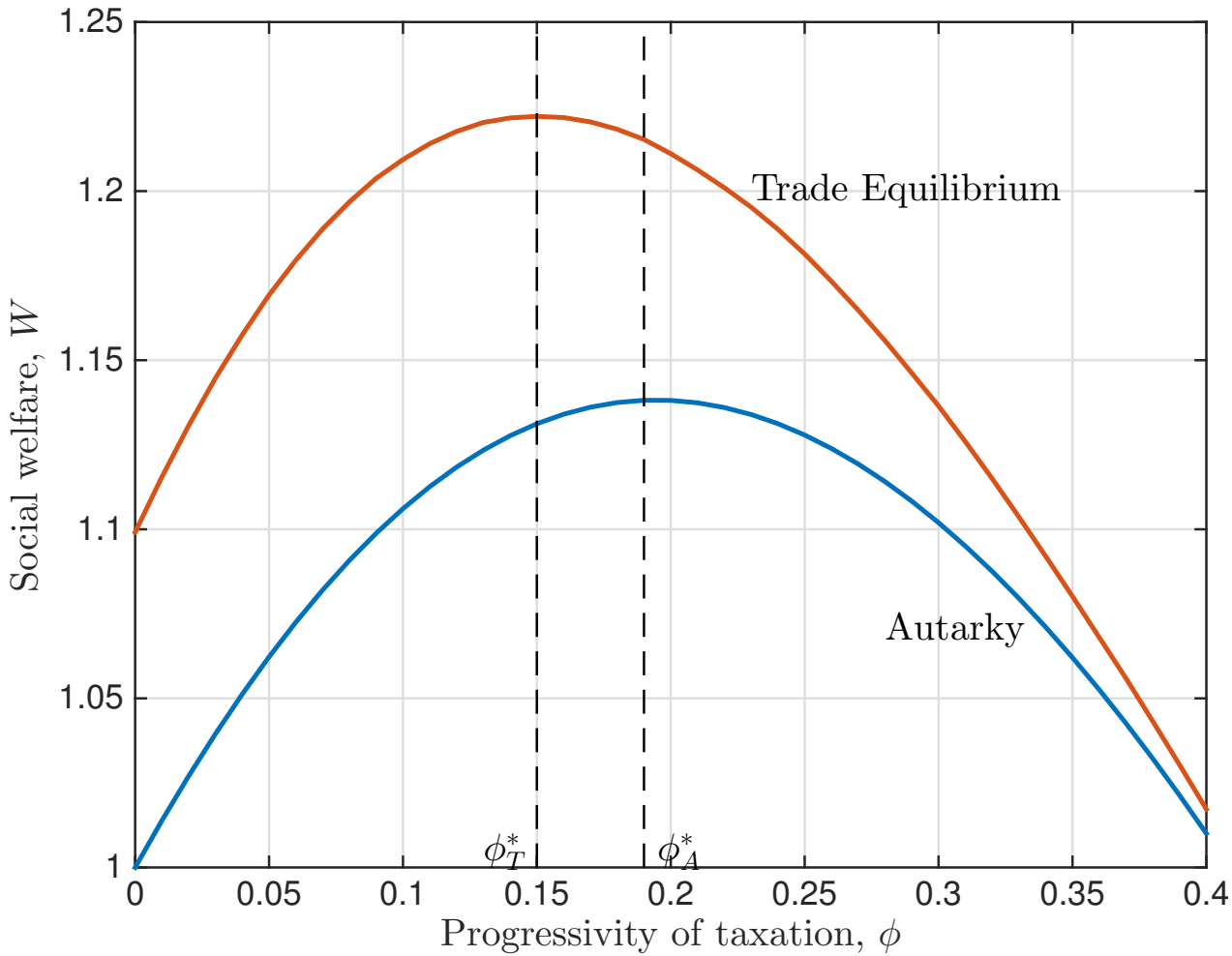
Welfare gains from trade



OPTIMAL PROGRESSIVITY

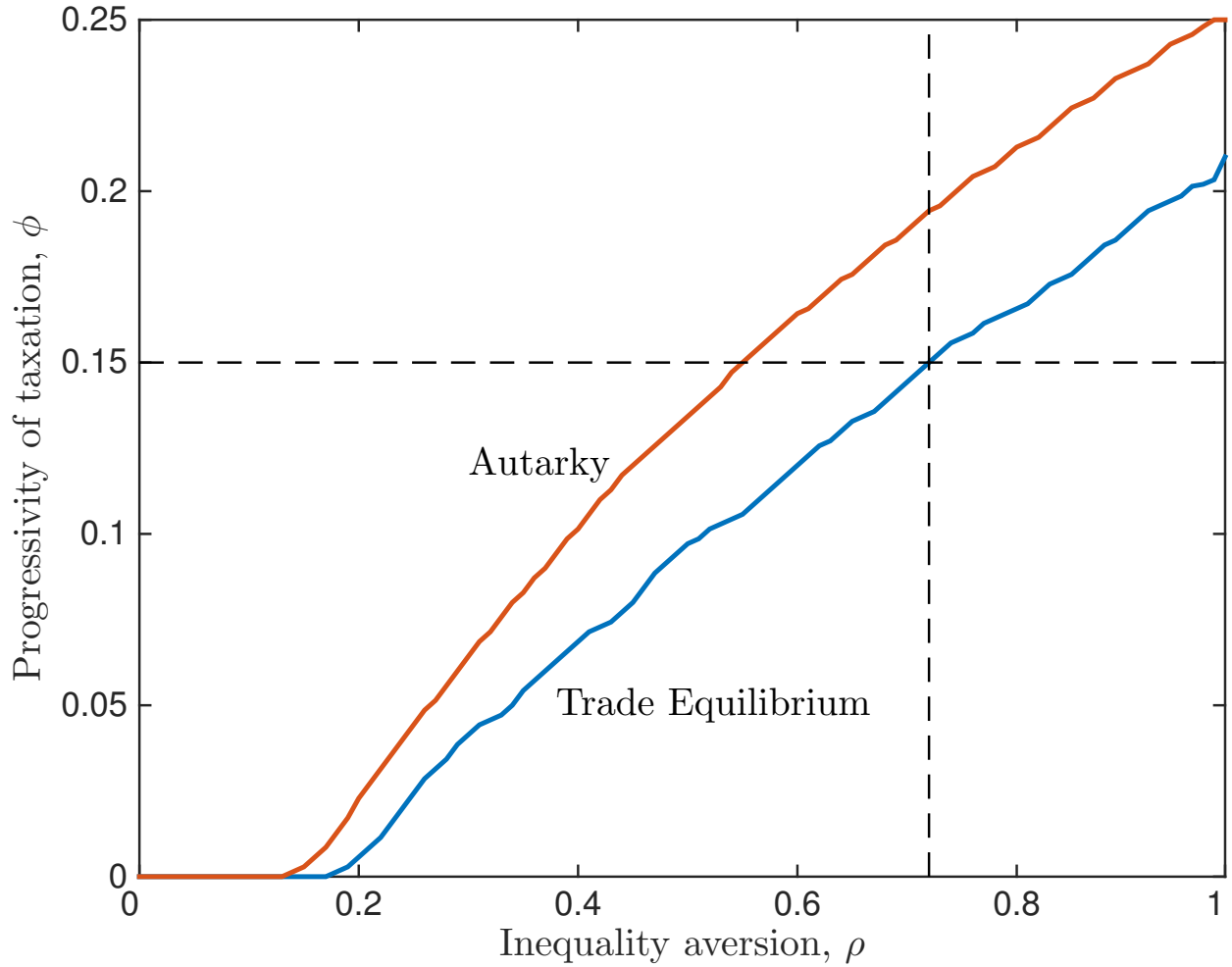
Progressivity and Inequality Aversion

- Optimal progressively is lower in open economy $\Rightarrow$ greater inequality increase if ϕ is adjusted



Progressivity and Inequality Aversion

- Observed progressivity $\phi \approx 0.15$ in 2007 is optimal if $\rho \approx 0.7$



Progressivity and Inequality Aversion

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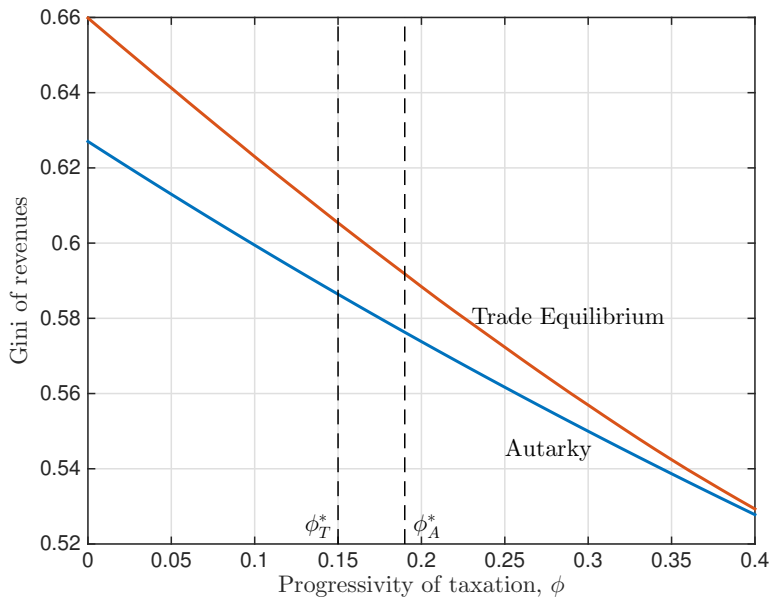
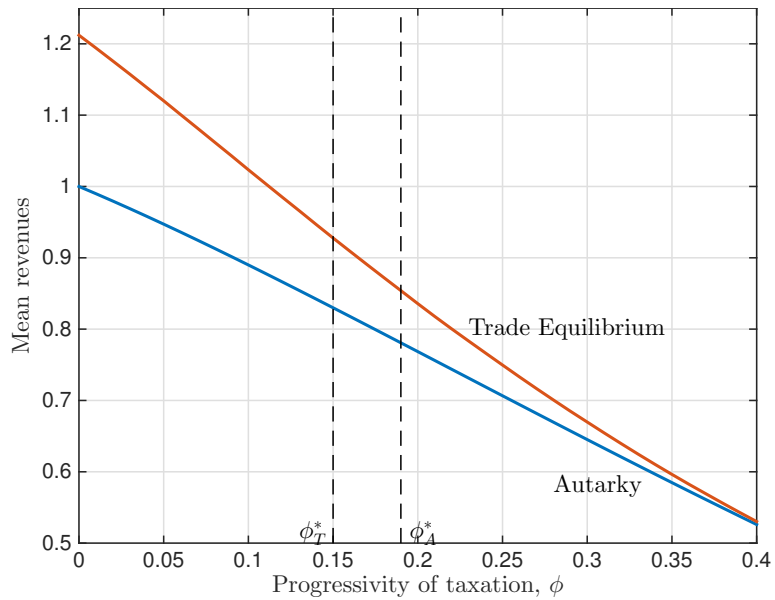




Conclusions

- 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

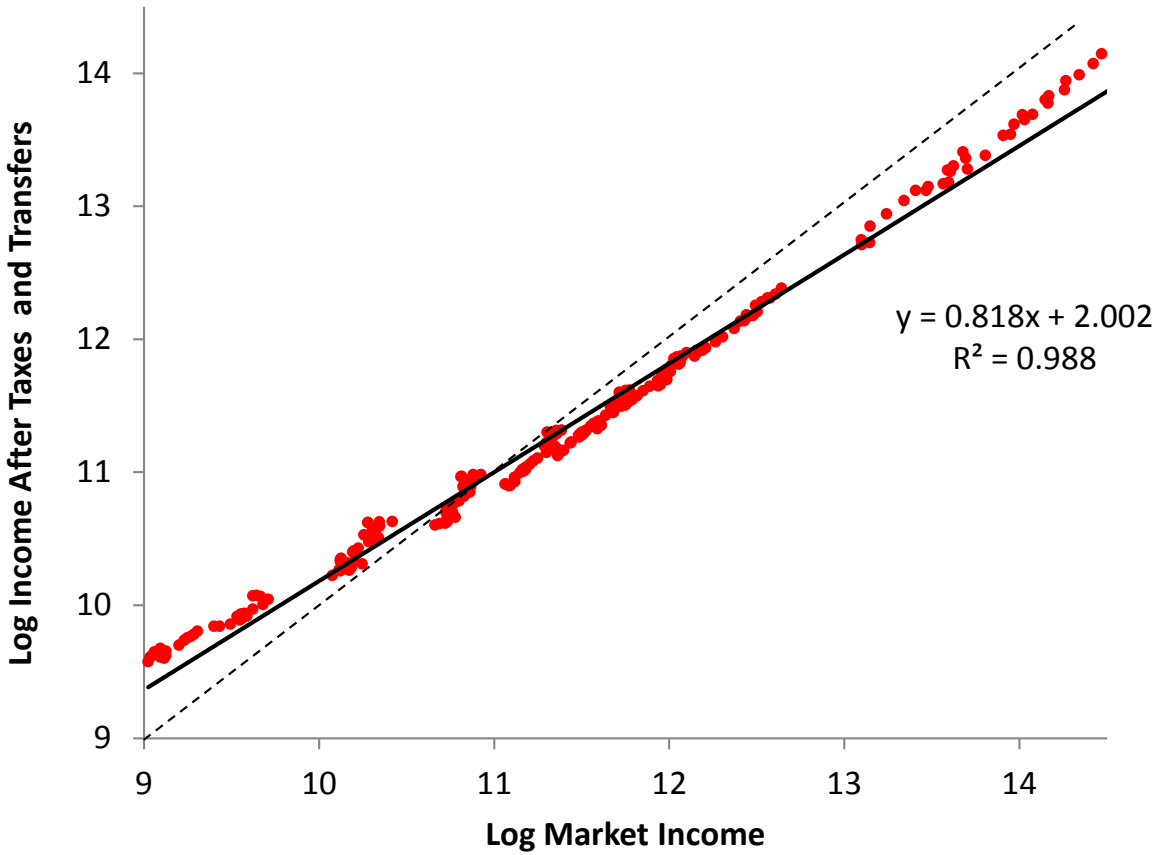
  $\longrightarrow$ should we measure gains using average income or adjust for inequality?
- Income taxation induces behavioral responses that affect the aggregate income response to trade integration

  $\longrightarrow$ 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

On the Shape of the Tax Schedule

- The tax schedule might seem *ad hoc*, but it fits U.S. data remarkably well: $\log r_{\varphi}^{d} = \log k + (1 - \phi) \log r_{\varphi}$

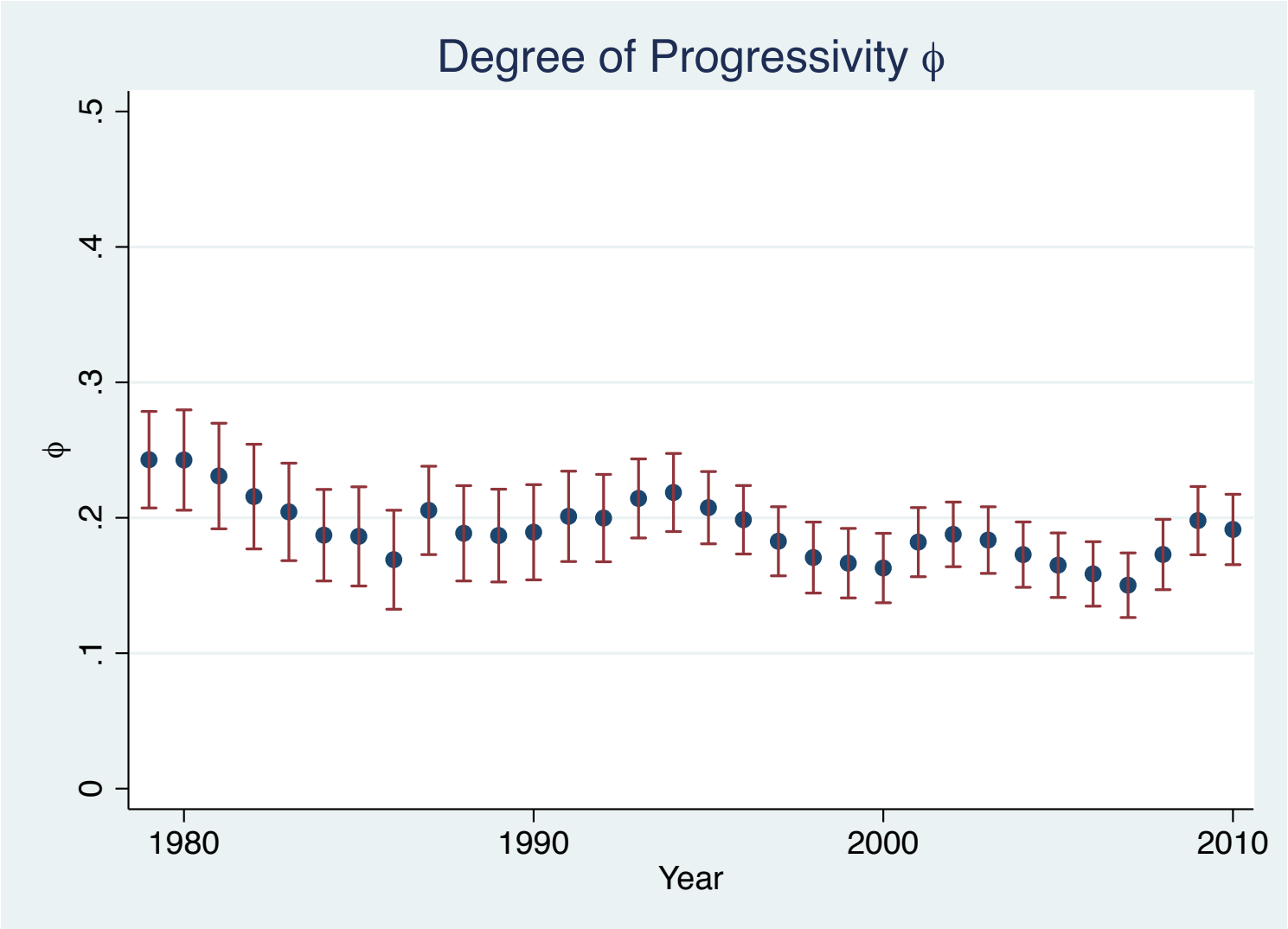


CBO data, percentiles of income distribution 1979–2010 (similar fit with PSID)

back to slides

On the Shape of the Tax Schedule

Over Time



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