

Inequality, Costly Redistribution and Welfare in an Open Economy

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 - ▶ How much compensation/redistribution **actually** takes place?
 - ▶ Is this redistribution **costless**, as the Kaldor-Hicks approach assumes?
- ▶ These issues are relevant not just for trade, but also for any policy with redistributive effects

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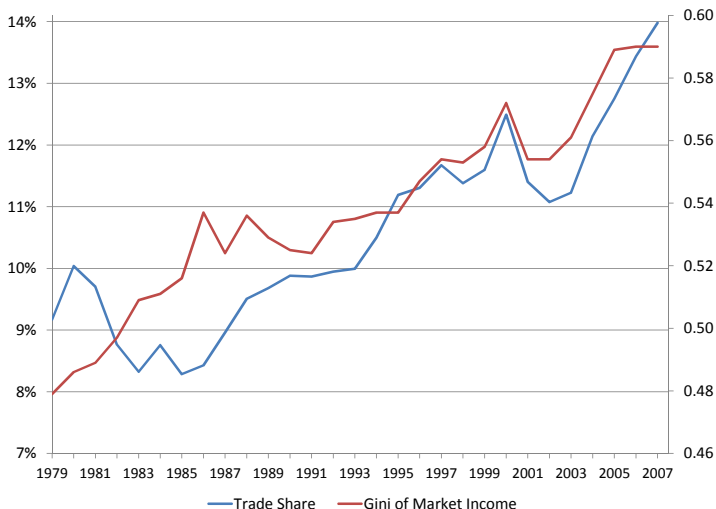
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 1. A 'welfarist' correction reflecting the preferences of an inequality-averse social planner

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 1. A 'welfarist' correction reflecting the preferences of an inequality-averse social planner
 2. A 'costly-redistribution' correction capturing behavioral responses to *trade-induced* shifts across marginal tax rates

A Motivating Graph

Openness and Inequality in the United States (1979-2007)



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Hicks (1939, p. 712)

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- ▶ Welfarist correction: constant degree of inequality- (or risk-) aversion
 - ▶ widely used in Public Finance (veil of ignorance rationale)
- ▶ 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 U.S. trade share

Related Literature

- ▶ Trade models with heterogeneous workers: Itskhoki (2008) but also
 - ▶ matching/sorting models (see Grossman, and Costinot and Vogel for surveys)
 - ▶ models with imperfect labor markets (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 more recently
- ▶ Costly-redistribution: Kaplow (2008), Hendren (2014)

Road Map

1. A Motivating Example
2. Economic Model
3. Calibration
4. Counterfactuals: Inequality and the Gains from Trade

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where $\tau(r)$ is a nonlinear income tax and $T(\varphi)$ a lump-sum transfer

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- ▶ The cumulative distribution of φ in the population is $H(\varphi)$, while the associated income distribution for real earnings is $F(r)$
- ▶ Society is evaluating the consequences of a trade liberalization that would shift $F(r)$ from some initial $F_0(r)$ to $F_1(r)$.
- ▶ What are the welfare consequences of the move from $F_0(r)$ to $F_1(r)$?

The Kaldor-Hicks Principle: An Illustration

- ▶ Suppose only lump-sum transfers are used and government budget is balanced so $\int T(\varphi) dH(\varphi) = 0$ and $\int r^d(\varphi) d\varphi = \int r dF(r)$
- ▶ The compensating variation for individual of type φ associated with trade opening is:

$$v(r_1^d(\varphi) + CV(\varphi)) = v(r_0^d(\varphi))$$

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$$\begin{aligned} - \int CV(\varphi) dH(\varphi) &= \int r_1^d(\varphi) dH(\varphi) - \int r_0^d(\varphi) dH(\varphi) \\ &= \int r dF_1(r) - \int r dF_0(r) = R_1 - R_0 \end{aligned}$$

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- ▶ Gains from trade = Aggregate Real Income Growth

$$\left. \frac{W_1}{W_0} \right|_{\text{Kaldor-Hicks}} = 1 + \mu \equiv \frac{R_1}{R_0}$$

Pros and Cons of the Kaldor-Hicks Principle

- ▶ Principle does not rely on interpersonal comparisons of utility
 - ▶ indirect utility can be heterogeneous across agents
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 - ▶ 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 W_1/W_0 reflect those costs?
 - ▶ Dixit and Norman (1986) showed that $W_1/W_0 > 1$ using a course set of tax policies - but how large is W_1/W_0 ?

A Welfarist Correction

- ▶ Consider an original position in which individuals evaluate policies under a veil of ignorance (not knowing φ)
- ▶ Ex-ante symmetry implies that individual/social welfare is

$$V = \int g(r^d(\varphi)) dH(\varphi), \quad (1)$$

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$$g(r^d) = \frac{(r^d)^{1-\rho} - 1}{1-\rho} \text{ for } \rho \geq 0 \quad (2)$$

- ▶ With simple transformation, we have

$$W = \frac{[\mathbb{E}((r^d)^{1-\rho})]^{1/(1-\rho)}}{\mathbb{E}(r^d)} \times \mathbb{E}(r^d) = \Delta \times R$$

where $\Delta \leq 1$ by Jensen's inequality

Welfarist Correction: Two Special Cases

- ▶ Suppose $H(\varphi)$ is such that the distribution of **disposable** income is

$$\text{Pareto: } \Delta = \left(\frac{1+G}{1-G(1-2\rho)} \right)^{1/(1-\rho)} \frac{1-G}{1+G}$$

$$\text{Lognormal: } \Delta = \exp \left\{ -\rho \left[\Phi^{-1} \left(\frac{1+G}{2} \right) \right]^2 \right\}$$

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- ▶ W increases in mean income R but decreases in inequality G
- ▶ Notice that in both cases

$$\left. \frac{W_1}{W_0} \right|_{\text{Welfarist}} = \frac{\Delta(G_1; \rho)}{\Delta(G_0; \rho)} \times (1 + \mu), \quad (3)$$

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for some constant k which can be set to ensure that the government budget is balanced

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- ▶ Average net-of-tax rates decrease in reported income at a constant rate ϕ , which captures the degree of progressivity of the tax system
- ▶ Behavioral response to taxation: positive, constant elasticity of reported income to the net-of-marginal-tax rate:

$$\varepsilon \equiv \frac{\partial r}{\partial (1 - \tau_m(r))} \frac{1 - \tau_m(r)}{r} > 0 \quad (5)$$

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- ▶ In such a case, we find that aggregate income can be written as

$$R = (1 - \phi)^\varepsilon \frac{(\mathbb{E}r)^{1+\varepsilon}}{(\mathbb{E}r^{1-\phi})^\varepsilon \cdot \mathbb{E}(r^{1+\varepsilon\phi})} \times \mathbb{E}(r) = \Theta \times \tilde{R}$$

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- ▶ Two parametric examples

$$\text{Pareto: } \Theta = (1 - \phi)^\varepsilon \frac{(1-\phi)(1+G) - (1+\varepsilon\phi)2G}{(1-\phi)(1+G) - 2G} \left(\frac{(1-\phi)(1-G)}{(1-\phi)(1+G) - 2G} \right)^\varepsilon$$

$$\text{Lognormal: } \Theta = (1 - \phi)^\varepsilon \exp \left\{ -\frac{\phi^2 \varepsilon (\varepsilon + 1)}{(1-\phi)^2} \left[\Phi^{-1} \left(\frac{1+G}{2} \right) \right]^2 \right\}$$

where G is the Gini of the distribution of **disposable income**

A Constant Elasticity Model

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- ▶ Consumption equals after-tax income:

$$r(\varphi) - T(r(\varphi)) = k r(\varphi)^{1-\phi}, \quad (8)$$

and government runs balanced budget

Equilibrium

- ▶ Distribution of disposable income (and utility) is shaped by underlying distribution of ability and by parameters β , γ and ϕ :

$$c(\varphi) \propto \varphi^{\frac{\beta(1+\varepsilon)(1-\phi)}{1+\varepsilon\phi}}$$

where

$$\varepsilon \equiv \frac{\beta}{\gamma - \beta}$$

governs the elasticity of market income to marginal tax rates

- ▶ Higher after-tax income inequality when
 - ▶ income is more elastic to taxes (higher ε)
 - ▶ taxes are less progressive (higher ϕ)
 - ▶ tasks are more substitutable (higher β)

Social Welfare

- ▶ With a constant degree of inequality aversion ρ , we can write

$$W = \Delta \times \hat{\Theta} \times \tilde{W}$$

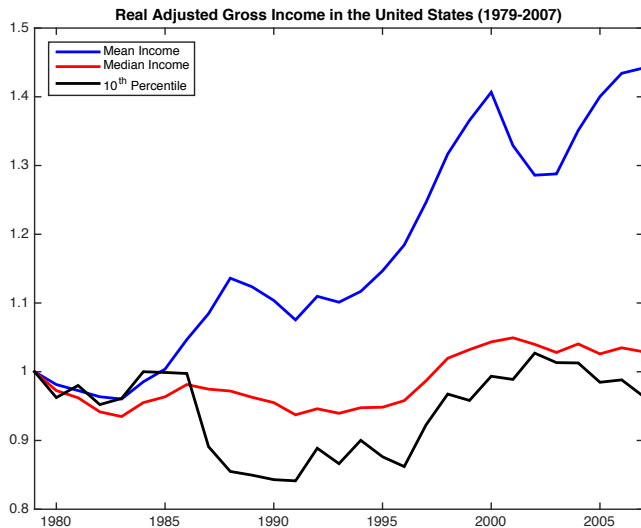
where

$$\Delta = \frac{\left[\mathbb{E} \left((r^d)^{1-\rho} \right) \right]^{1/(1-\rho)}}{\mathbb{E} (r^d)}$$
$$\hat{\Theta} = (1 + \varepsilon\phi) (1 - \phi)^{\varepsilon\kappa} \left[\frac{(\mathbb{E}r)^{1+\varepsilon}}{(\mathbb{E}r^{1-\phi})^\varepsilon \cdot \mathbb{E}(r^{1+\varepsilon\phi})} \right]^{\kappa}$$

and $\kappa = 1 / (1 - (1 - \beta)(1 + \varepsilon)) > 1$.

- ▶ Δ is the same welfarist correction as in our example
- ▶ $\hat{\Theta}$ is a slightly modified costly-redistribution correction
- ▶ \tilde{W} is welfare in a hypothetical 'Kaldor-Hicks' economy

A 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

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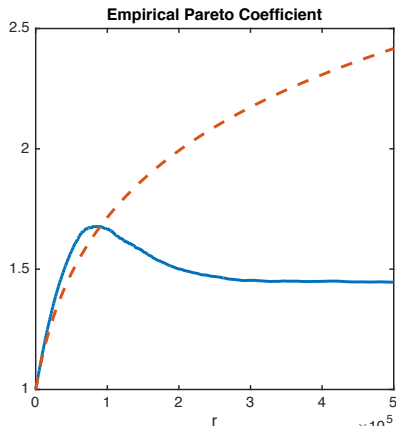
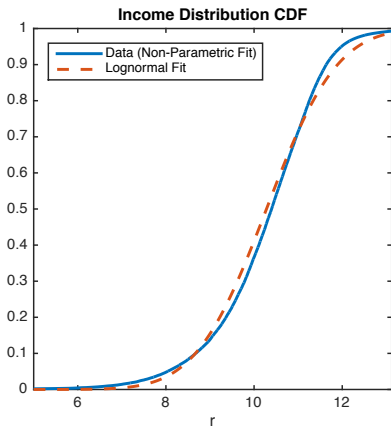
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- ▶ Use CBO data on before-tax and after-tax/transfer income to calibrate the degree of tax progressivity ϕ
- ▶ Elasticity of substitution = 4 ($\beta = 3/4$)
 - ▶ BEJK (2003), Broda and Weinstein (2006)
- ▶ Experiment with various values of ε and ρ
 - ▶ Benchmark $\varepsilon = 0.5$ and $\rho = 1$

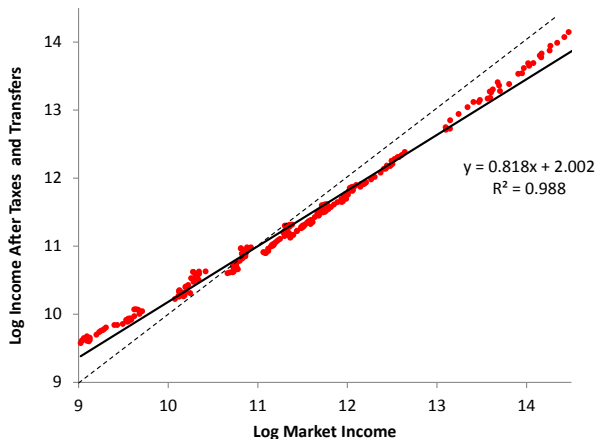
Calibrating the Income Distribution

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

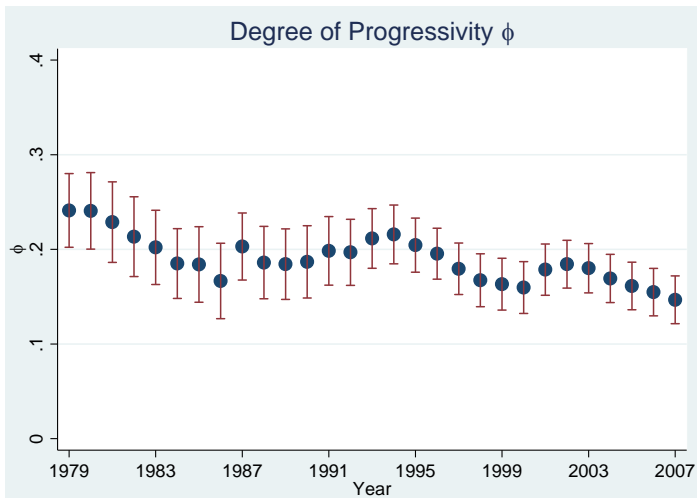


Calibrating Tax Progressivity

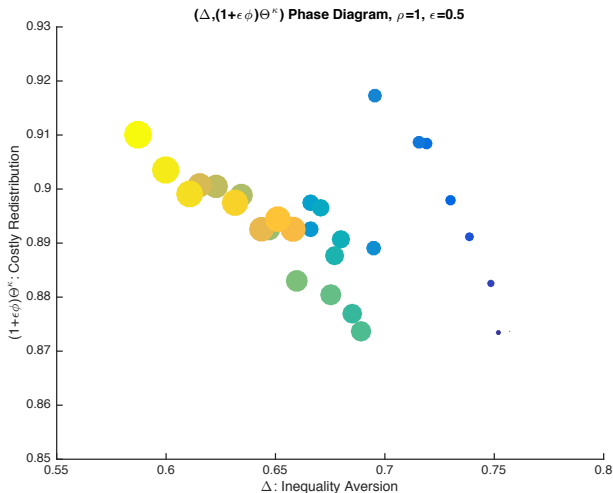
- ▶ Equation (4) may seem ad hoc, but it fits U.S. data remarkably well (similar fit with PSID data)



U.S. Progressivity Over Time



Evolution of Δ and $\hat{\Theta}$ Over Time



Social Welfare and Counterfactuals

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 1. Symmetric iceberg cost τ (reduces revenue per unit shipped)
 2. Fixed cost of exporting $f(n)$ increasing in the number n of foreign markets served $f(n) = f_x n^\alpha$ (in terms of final output)
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 - ▶ helps smooth effect of trade integration on the income distribution
- ▶ Sale revenue is now

$$r(\varphi) = \Upsilon_{n(\varphi)}^{1-\beta} Q^{1-\beta} y(\varphi)^\beta, \quad (9)$$

where

$$\Upsilon_{n(\varphi)} = 1 + n(\varphi) \tau^{-\frac{\beta}{1-\beta}}$$

and $y(\varphi) = \varphi l(\varphi)$ is total output

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- ▶ Disposable income or consumption is thus

$$c(\varphi) = r(\varphi) - T(r(\varphi)) - f_x n(\varphi)^\alpha. \quad (10)$$

- ▶ Agents now choose labor input $\ell(\varphi)$ and market access investment $n(\varphi)$ to maximize utility (7) given the revenue function (6) and budget constraint (10)
- ▶ Given symmetry, goods market clearing imposes

$$Q = \left(\int_0^1 \tau_{n(\varphi)}^{1-\beta} y(\varphi)^\beta \right)^{1/\beta} \quad (11)$$

Trade and Inequality

- ▶ **Result:** Trade increases inequality of revenues and utilities

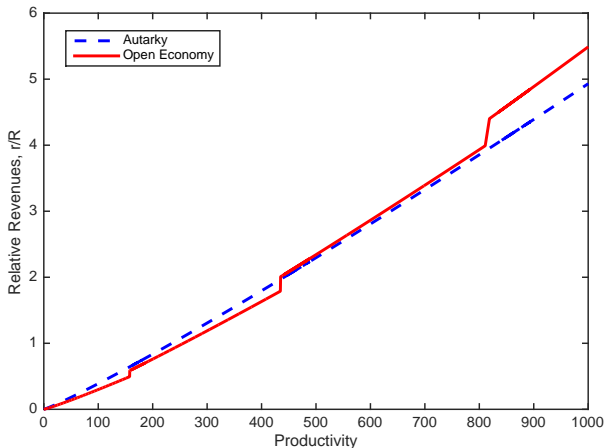
$$\frac{c(\varphi)}{Q} \propto \left\{ \begin{array}{ll} \varphi^{\frac{\beta(1+\varepsilon)(1-\phi)}{1+\varepsilon\phi}}, & \varphi < \varphi_{x1}, \\ \tau_1^{\frac{(1-\beta)(1+\varepsilon)(1-\phi)}{1+\varepsilon\phi}} \varphi^{\frac{\beta(1+\varepsilon)(1-\phi)}{1+\varepsilon\phi}}, & \varphi < \varphi_{x2}, \\ \vdots & \vdots \\ \tau_N^{\frac{(1-\beta)(1+\varepsilon)(1-\phi)}{1+\varepsilon\phi}} \varphi^{\frac{\beta(1+\varepsilon)(1-\phi)}{1+\varepsilon\phi}} & \varphi \geq \varphi_{xN} \end{array} \right. \quad \tau_n = 1 + n\tau^{-\frac{\beta}{1-\beta}}$$

- ▶ Two limiting cases:
 - ▶ no agent exports ($\varphi_{x1} \rightarrow \infty$)
 - ▶ all agents export ($\varphi_{xN} \rightarrow \varphi_{\min}$)

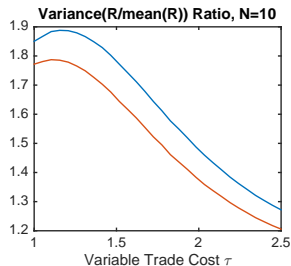
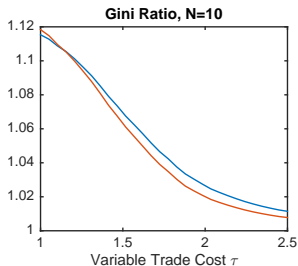
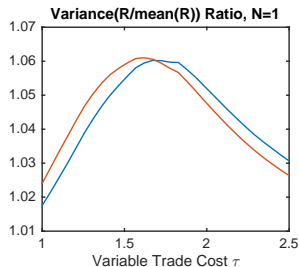
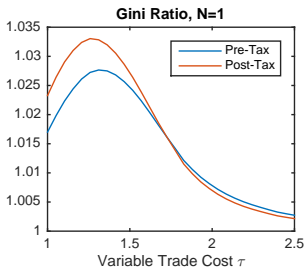
$$\frac{c(\varphi)}{Q} = \frac{c_{aut}(\varphi)}{Q_{aut}} \propto \varphi^{\frac{\beta(1+\varepsilon)(1-\phi)}{1+\varepsilon\phi}}$$

Trade and Inequality (cont.)

- ▶ Trade increases relative sale revenue of high-ability households but reduces that of low-ability households



Trade and Inequality (cont.)



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
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 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

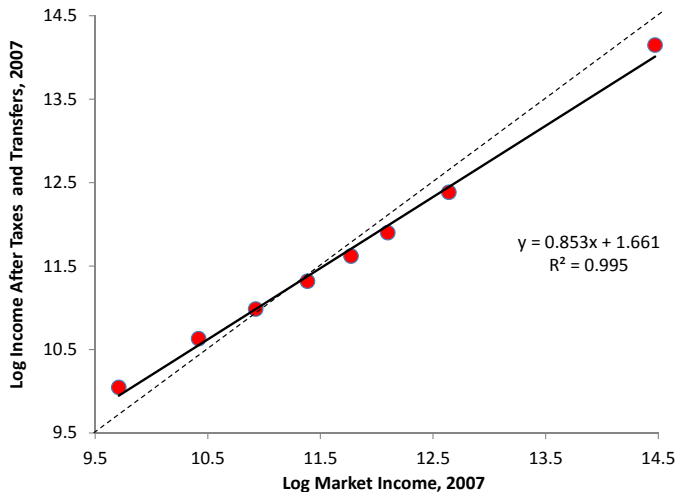
- ▶ Hold the following parameters fixed
 1. Elasticity of substitution = 4 ($\beta = 3/4$) as before
 2. Iceberg trade costs ($\tau = 1.83$)
 - ▶ Melitz and Redding (2014), Anderson and Van Wincoop (2004)
 3. Number of countries ($N = 10$)
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- ▶ Set baseline fixed cost f_x 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 exploiting cross-section of U.S. exports)

Calibration: Progressivity

- ▶ Note from (4) that $\ln r^d = \ln k + (1 - \phi) \ln r(\varphi) \implies \phi = 0.147$



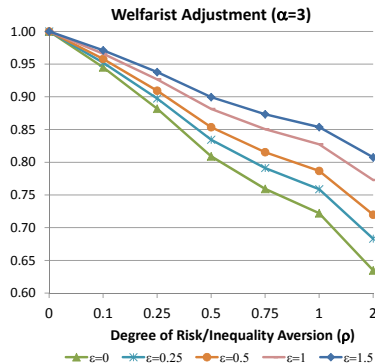
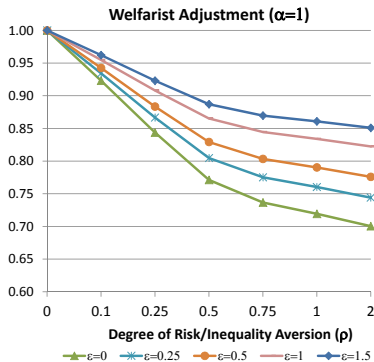
Calibrated Welfare Gains from Trade and Inequality

- ▶ 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

Labor supply elasticity	Gains from Trade		Increase in Gini Coefficient	
	$\alpha = 1$	$\alpha = 3$	$\alpha = 1$	$\alpha = 3$
$\varepsilon = 0$	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%

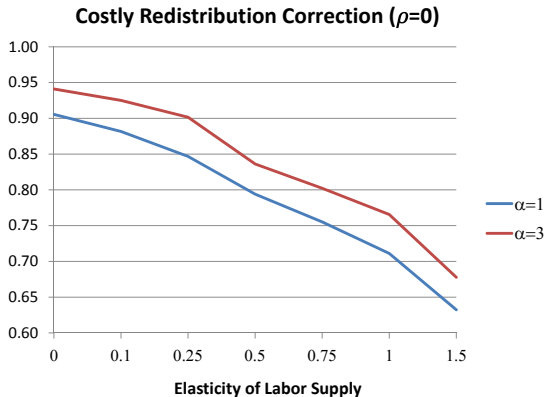
Welfarist Correction

- 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 21% lower for both $\alpha = 1$ and $\alpha = 3$



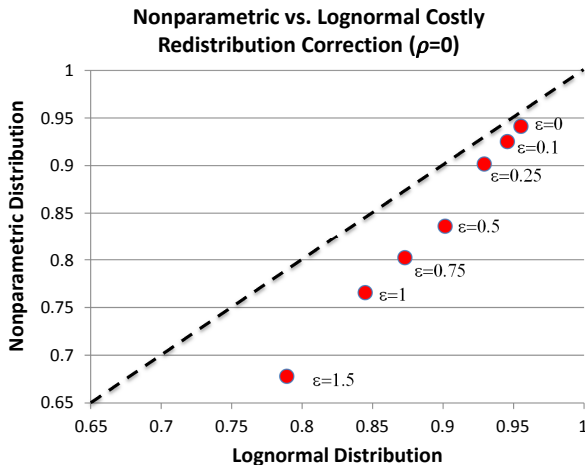
Costly Redistribution Correction

- ▶ Costly redistribution correction is higher, the higher is the labor supply elasticity ε
- ▶ When $\varepsilon = 0.5$, welfare gains are 21% lower for $\alpha = 1$ and 16% lower for $\alpha = 3$



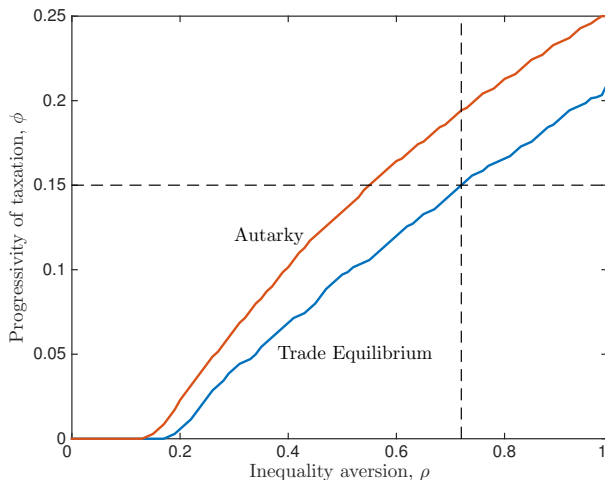
Nonparametric versus Lognormal Case

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



Optimal Progressivity and Implied Inequality Aversion

- ▶ The observed degree of progressivity in 2007 is optimal if ρ is around 0.7



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- ▶ In this paper, we have developed welfarist and costly redistribution corrections to standard measures of the gains from trade integration
- ▶ Under plausible parameter values, these corrections are nonnegligible and eliminate about one-fifth of the (static) gains from trade