

# Optimal Redistribution in an Open Economy

Oleg Itskhoki  
Harvard University

Princeton University  
January 8, 2008

How should society respond to increasing inequality?

## How should society respond to increasing inequality?

- Conventional view: more redistribution

# How should society respond to increasing inequality?

- Conventional view: more redistribution
- My answer: depends on the source of inequality
  - ① Skill (increasing dispersion of ability):
    - ▶ increase redistribution
  - ② Globalization (falling trade costs):
    - ▶ increase less or even reduce

# Model of Trade and Inequality

- Melitz-based model:
  - ① Heterogeneity in productivity
  - ② Selection into exporting (fixed costs)

# Model of Trade and Inequality

- Melitz-based model:
  - ① Heterogeneity in productivity
  - ② Selection into exporting (fixed costs)
  
- Stylized model of labor market:
  - One type of heterogeneous agents: **worker-entrepreneurs**

# Model of Trade and Inequality

- Melitz-based model:
  - ① Heterogeneity in productivity
  - ② Selection into exporting (fixed costs)
  
- Stylized model of labor market:
  - One type of heterogeneous agents: **worker-entrepreneurs**
  
- **Data**: more productive firms
  - ... hire more productive workers
  - ... are larger and pay higher wages
  - ... are more likely to export

## Why this model?

- **Conventional framework:** Stolper-Samuelson (HO model)

Challenges:

- Inequality in developing countries
- Within-sector reallocation
- Residual inequality

## Why this model?

- **Conventional framework:** Stolper-Samuelson (HO model)

Challenges:

- Inequality in developing countries
  - Within-sector reallocation
  - Residual inequality
- 
- **Alternative framework:** Helpman-Itskhoki-Redding (2008a,b)
    - Heterogeneous firms and workers
    - Positive assortative matching
    - Rent-sharing

## Why this model?

- **Conventional framework:** Stolper-Samuelson (HO model)

Challenges:

- Inequality in developing countries
  - Within-sector reallocation
  - Residual inequality
- 
- **Alternative framework:** Helpman-Itskhoki-Redding (2008a,b)
    - Heterogeneous firms and workers
    - Positive assortative matching
    - Rent-sharing
- 
- **This paper:** stylized version of HIR

## Results

- Trade increases inequality
  - Participation: only most productive agents export
  - Gains from trade: disproportionately at the top

## Results

- Trade increases inequality
  - Participation: only most productive agents export
  - Gains from trade: disproportionately at the top
- Taxation is more distortive in an open economy
  - Marginal taxes distort intensive margin
  - Distorted scale of production discourages entry

## Results

- Trade increases inequality
  - **Participation**: only most productive agents export
  - **Gains from trade**: disproportionately at the top
- Taxation is more distortive in an open economy
  - Marginal taxes distort intensive margin
  - Distorted scale of production discourages entry
- Extensive margin of trade:
  - ⇒ greater income inequality (**inequality margin**)
  - ⇒ greater efficiency loss from taxation (**efficiency margin**)

## Results

- Trade increases inequality
  - **Participation**: only most productive agents export
  - **Gains from trade**: disproportionately at the top
- Taxation is more distortive in an open economy
  - Marginal taxes distort intensive margin
  - Distorted scale of production discourages entry
- Extensive margin of trade:
  - ⇒ greater income inequality (**inequality margin**)
  - ⇒ greater efficiency loss from taxation (**efficiency margin**)
- Redistribution rationalizes export entry subsidies

## Related Literature

- Recent work on trade and inequality:
  - Verhoogen (2008), Amiti and Davis (2008)
  - Helpman, Itskhoki and Redding (2008a,b)
- Public Finance models with extensive margin:
  - Diamond (1980), Saez (2002)
- Compensation of losers from trade:
  - Dixit and Norman (1980,1986)
  - Spector (2001), Davidson and Matusz (2006), Egger and Kreickemeier (2008)

# Outline

- ① Economic Environment
- ② Closed Economy
- ③ Open Economy
  - Optimal Linear Tax
  - Additional Tax Instruments
- ④ Summary and Discussion

## Economic Environment

- Standard Public Finance Setup:
  - Heterogeneous agents with productivity  $n \sim H(n)$
  - Linear production technology  $y = n\ell$

## Economic Environment

- Standard Public Finance Setup:
  - Heterogeneous agents with productivity  $n \sim H(n)$
  - Linear production technology  $y = n\ell$
- Each **worker-entrepreneur** produces distinct variety:

$$Q = \left[ \int y_n^\beta dH(n) \right]^{1/\beta}, \quad 0 \leq \beta \leq 1$$

## Economic Environment

- Standard Public Finance Setup:
  - Heterogeneous agents with productivity  $n \sim H(n)$
  - Linear production technology  $y = n\ell$
- Each worker-entrepreneur produces distinct variety:

$$Q = \left[ \int y_n^\beta dH(n) \right]^{1/\beta}, \quad 0 \leq \beta \leq 1$$

- Real revenue of agent  $n$ :

$$r_n = Q^{1-\beta} y_n^\beta$$

## Agents and Government

- Agent's problem:

$$U_n \equiv \max_{c, y \geq 0} U \left( c, \frac{y}{n} \right)$$

subject to budget constraint:

$$c = r - T(r), \quad \text{where} \quad r = Q^{1-\beta} y^\beta$$

## Agents and Government

- Agent's problem:

$$\mathcal{U}_n \equiv \max_{c, y \geq 0} \mathcal{U} \left( c, \frac{y}{n} \right)$$

subject to budget constraint:

$$c = r - T(r), \quad \text{where} \quad r = Q^{1-\beta} y^\beta$$

- Government maximizes a **Social Welfare Function**:

$$\max_{T(\cdot)} \int G(\mathcal{U}_n) dH(n)$$

subject to individual optimality and GBC:

$$\int T(r_n) dH(n) \geq 0$$

## Assumptions

- No income effects in labor supply:

$$U(c, \ell) = c - v(\ell)$$

- Constant labor supply elasticity:

$$v(\ell) = \frac{1}{\gamma} \ell^\gamma \quad \Rightarrow \quad \varepsilon \equiv \frac{v'(\ell)}{\ell \cdot v''(\ell)} = \frac{1}{\gamma - 1}$$

- Constant relative inequality aversion:

$$G(U) = \frac{1}{1 - \rho} U^{1 - \rho}, \quad \rho \geq 0$$

- Restricted set of tax instruments:

— Linear tax rate:

$$T(r) = -\Delta + tr, \quad \Delta = tR$$

— Additional tax instruments

## Closed Economy

### Proposition

- i. *Income inequality is determined uniquely by the ability distribution*
- ii. *Optimal linear tax rate increases in income inequality*

# Closed Economy

## Proposition

- i. *Income inequality is determined uniquely by the ability distribution*
- ii. *Optimal linear tax rate increases in income inequality*

## Sketch of the Proof:

- **Lemma:** Distribution of relative revenues:

$$r_n \propto n^{\frac{\beta\gamma}{\gamma-\beta}}$$

- **Lemma:**

Efficiency Margin = Intensive Margin of Labor Supply =  $\varepsilon$

- **Lemma:** Inequality Margin increases in income inequality (variance of relative revenues)

# Open Economy

## Setup

- Source of trade: **love-of-variety** ( $\beta < 1$ )
  - Krugman (1980); Helpman and Krugman (1985)
  - Broda and Weinstein (2006)
- Two symmetric countries
- No tariffs and efficient bargaining about national tax policies
- Variable iceberg trade cost  $\tau > 1$
- Fixed costs of trade  $f_x$  (Melitz, 2003)  $\longrightarrow$  **selection**
  - Evidence: Bernard-Jensen (2004); Das-Roberts-Tybout (2007)
  - Alternatives: BEJK (2003); Melitz-Ottaviano (2008)

# Open Economy

## Agent's Problem

- Revenues:

$$r_n = \begin{cases} Q^{1-\beta} y_n^\beta, & \text{non-exporter,} \\ Y_x^{1-\beta} Q^{1-\beta} y_n^\beta, & \text{exporter} \end{cases} \quad Y_x \equiv 1 + \tau^{-\frac{\beta}{1-\beta}}$$

- Consumption:  $c_n = \Delta + (1 - t)r_n - l_n f_x$
- Utility:  $\mathcal{U}_n = \max_{c, y, l_n} \{c - v(y/n)\}$
- Selection:  $n_x$  is exporting cutoff

## Trade and Inequality

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

## Trade and Inequality

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

$$\frac{r_n}{R} \propto \begin{cases} n^{\frac{\beta\gamma}{\gamma-\beta}}, & n < n_x, \\ Y_x^{\gamma \frac{1-\beta}{\gamma-\beta}} n^{\frac{\beta\gamma}{\gamma-\beta}}, & n \geq n_x, \end{cases} \quad Y_x = 1 + \tau^{\frac{-\beta}{1-\beta}}$$

## Trade and Inequality

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

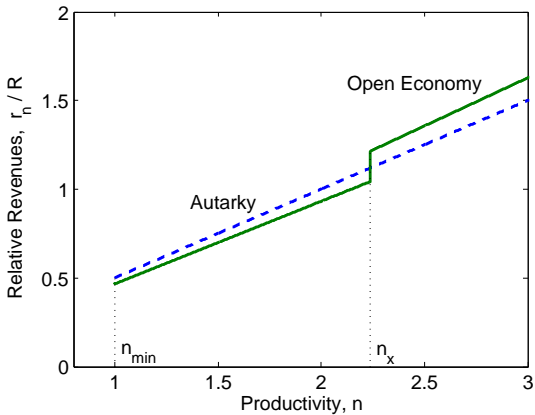
$$\frac{r_n}{R} \propto \begin{cases} n^{\frac{\beta\gamma}{\gamma-\beta}}, & n < n_x, \\ Y_x^{\gamma \frac{1-\beta}{\gamma-\beta}} n^{\frac{\beta\gamma}{\gamma-\beta}}, & n \geq n_x, \end{cases} \quad Y_x = 1 + \tau^{\frac{-\beta}{1-\beta}}$$

- **Two limiting cases:**
  - no agent exports ( $n_x \rightarrow n_{\max}$ )
  - all agents export ( $n_x \rightarrow n_{\min}$ )

$$\frac{r_n}{R} = \frac{r_n^a}{R^a} \propto n^{\frac{\beta\gamma}{\gamma-\beta}}$$

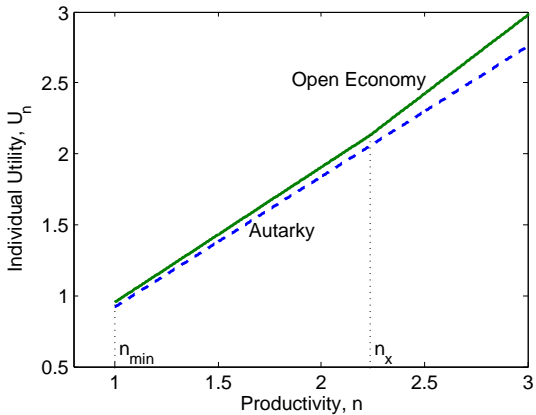
# Relative Revenues

Illustration



# Utilities

## Illustration



# Open Economy

## Equilibrium Properties

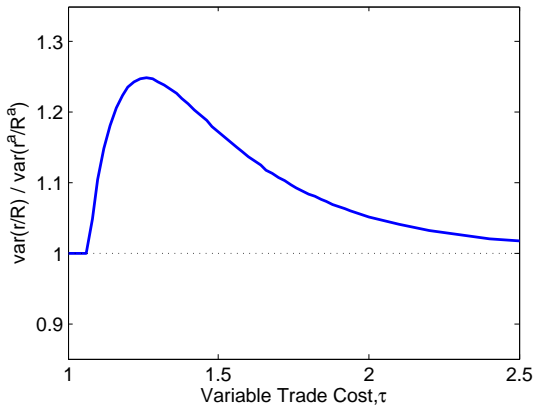
### Proposition

*Holding the tax rate constant:*

- i. All agents gain from trade, although these gains are not proportionally distributed;*
  - ii. Inequality of relative revenues and utilities is higher in an open economy than in autarky given that some agents do not export;*
  - iii. Falling trade costs first increase and then decrease inequality.*
- Replicates Helpman, Itskhoki and Redding (2008):
    - inequality is higher in open economy
    - inequality is non-monotonic with the fraction of exporting agents

# Inequality in Open Economy

Illustration



# Optimal Redistribution

## Proposition

*In response to the same increase in inequality, optimal linear tax rate increases by less (or even falls) in the open economy relative to closed economy.*

# Optimal Redistribution

## Proposition

*In response to the same increase in inequality, optimal linear tax rate increases by less (or even falls) in the open economy relative to closed economy.*

## Intuition:

- Inequality Margin still increases in income inequality (variance of relative revenues)
- Efficiency Margin = Intensive Margin + Extensive Margin  $> \varepsilon$

## Optimal Linear Tax Rate

- General optimality condition:

$$\frac{t}{1-t} = \frac{1}{\tilde{\varepsilon}} \cdot \alpha - (1-\beta)(1-\alpha), \quad 0 \leq \alpha \leq 1$$

$$\underbrace{-\frac{1-\beta}{\beta}}_{\text{efficiency}} \leq t \leq \underbrace{\frac{1}{1+\tilde{\varepsilon}}}_{\text{max revenue}}$$

## Optimal Linear Tax Rate

- General optimality condition:

$$\frac{t}{1-t} = \frac{1}{\tilde{\varepsilon}} \cdot \alpha - (1-\beta)(1-\alpha), \quad 0 \leq \alpha \leq 1$$

- Efficiency Margin:

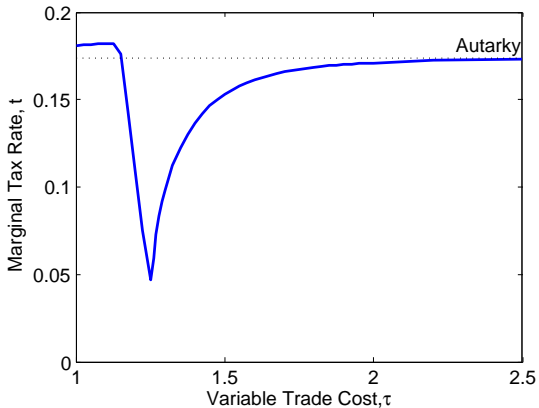
$$\tilde{\varepsilon} \equiv \frac{d \ln Q}{d \ln(1-t)} = \varepsilon \cdot \begin{cases} 1, & \text{no trade/no selection,} \\ 1 + \kappa_x, & \text{trade with selection} \end{cases}$$

- Inequality Margin:

$$\begin{aligned} \alpha &\equiv \int \frac{G'(\mathcal{U}_n)}{\lambda} \frac{r_n - R}{R} dH(n) = -\text{cov} \left( \frac{G'(\mathcal{U})}{\lambda}, \frac{r}{R} \right) \\ &= -\beta_U \cdot \text{var} \left( \frac{r}{R} \right) \end{aligned}$$

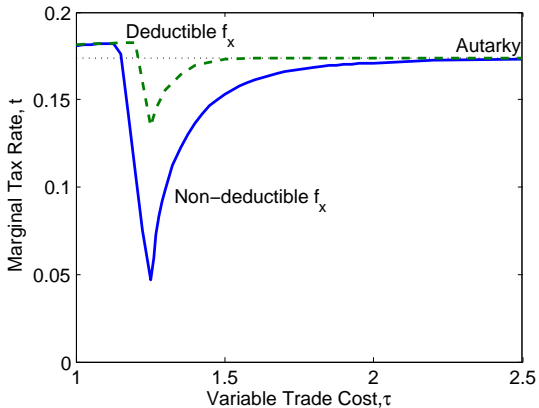
# Policy Response to Inequality

Open Economy



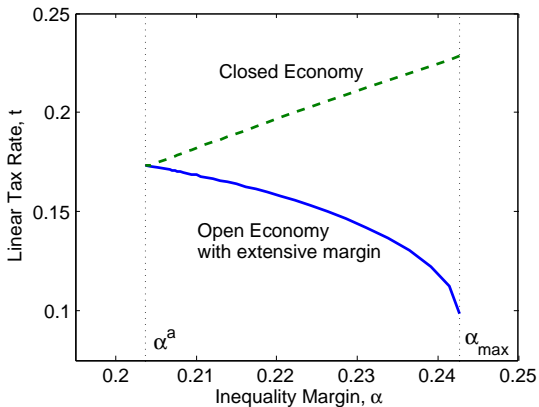
# Policy Response to Inequality

Open Economy



# Policy Response to Inequality

Open versus Closed Economy



## Additional Tax Instruments

- ① Can government target **entry** directly?
- ② **Marginal** vs **Average** tax rates

## Additional Tax Instruments

- ① Can government target **entry** directly?
- ② **Marginal** vs **Average** tax rates
  - Natural candidates for additional tax instruments:
    - export market entry subsidy ( $s$ )
    - differential tax rates on exporters and non-exporters ( $t_d, t_x$ )
  - A type of a two-bracket tax system

# Additional Tax Instruments

- ① Can government target **entry** directly?
- ② **Marginal** vs **Average** tax rates
  - Natural candidates for additional tax instruments:
    - export market entry subsidy ( $s$ )
    - differential tax rates on exporters and non-exporters ( $t_d, t_x$ )
  - A type of a two-bracket tax system
  - Analytical characterization of optimal entry
  - Numerical analysis of optimal tax schedules

## Optimal Entry

- Utilitarian Welfare ( $\rho = 0$ ):

$$W^{\circ} = Q - \pi_x f_x - \int v\left(\frac{y_n}{n}\right) dH(n)$$

## Optimal Entry

- Utilitarian Welfare ( $\rho = 0$ ):

$$W^\circ = Q - \pi_x f_x - \int v\left(\frac{y_n}{n}\right) dH(n)$$

### Proposition

- Entry is efficient when intensive margin is undistorted:*

$$t = -\frac{1-\beta}{\beta} \quad \Rightarrow \quad s^\circ = 0$$

- There is too little entry when intensive margin is distorted:*

$$t > -\frac{1-\beta}{\beta} \quad \Rightarrow \quad 0 < s^\circ / f_x < 1$$

- $ds^\circ / t_d < 0$  and  $ds^\circ / t_x > 0$*

- Optimal entry subsidy for  $\rho > 0$ ,  $s^* < s^\circ$*

# Numerical Analysis

## Parameter Calibration

- Pareto ability distribution with shape parameter 2.2
  - upper end of the empirical ability distribution in Saez (2001)
- Elasticity of substitution = 4 ( $\beta = 3/4$ )
  - BEJK (2003) and Broda and Weinstein (2006)
- Labor supply elasticity  $\varepsilon = 1/2$ 
  - Tuomala (1990) and Saez (2002)
- Inequality aversion  $\rho = 2$ 
  - Saez (2002)
- Fixed trade cost  $f_x$  such that 35% of output is produced by exporting agents and exports accounts for 18% of consumption
  - Bernard and Jensen (1999)

# Average and Marginal Tax Rates

Three Instruments

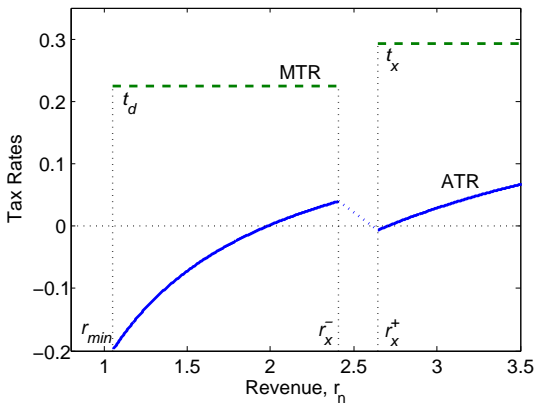


Figure: Average and Marginal Tax Rates for Different Skill Levels ( $\tau = 1.3$ )

# Optimal Entry

## Additional Tax Instruments

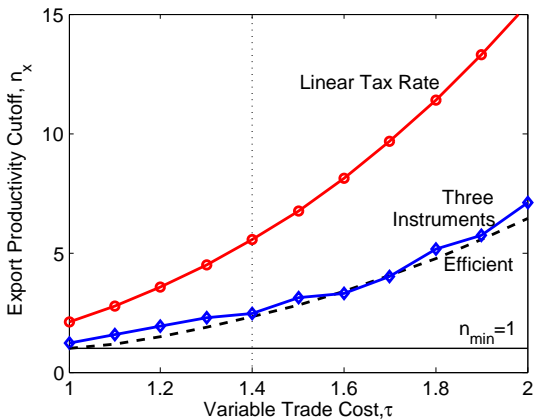


Figure: Optimal Entry,  $n_x$

# Marginal Tax Rates

## Additional Tax Instruments

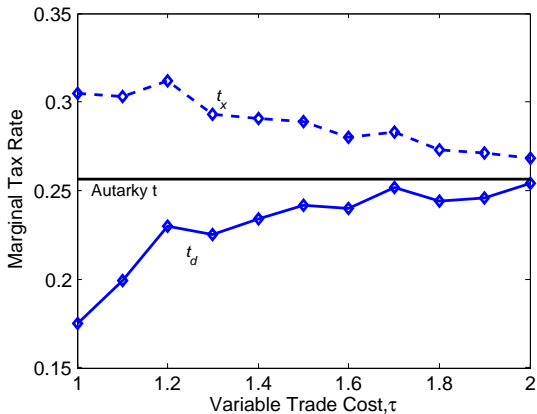


Figure: Optimal Marginal Tax Rates,  $t_d$  and  $t_x$

# Marginal Tax Rates

## Additional Tax Instruments

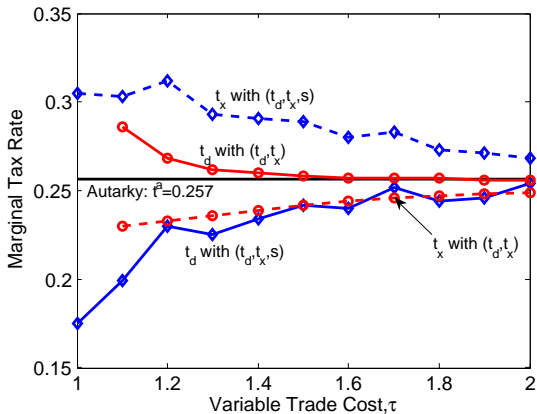


Figure: Optimal Marginal Tax Rates,  $t_d$  and  $t_x$

# Inequality Outcome

## Additional Tax Instruments

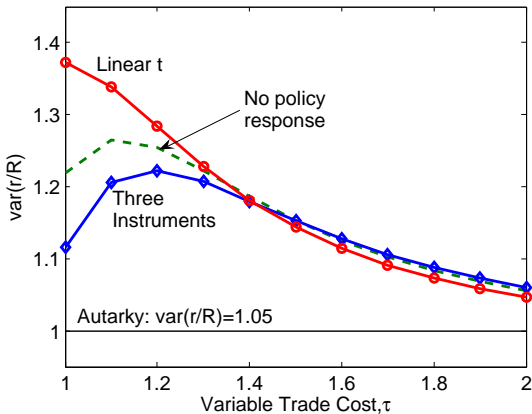


Figure: Inequality of Relative Revenues,  $\text{var}(r/R)$

## Summary

- Trade intensifies both inequality and efficiency margins through selection into exporting (extensive margin of trade)
- An optimal tax system should balance equity, efficiency and, in particular, entry decisions
- Negative marginal tax rates for agents at the threshold
- Greater inequality may be a necessary outcome to reap the most gains from trade

## Discussion

- Second dimension of heterogeneity: fixed costs
- General non-linear taxes in the open economy

## Discussion

- Second dimension of heterogeneity: fixed costs
- General non-linear taxes in the open economy
- Other activities with extensive margin: technology adoption
- The role of free entry condition
- Losers from trade
- Optimal unemployment insurance