Inequality, Redistribution, and Optimal Trade Policy: A Public Finance Approach

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UNEQUAL GAINS FROM TRADE

- Gains from globalization are unequally distributed
  - Often benefits productive workers and firms
- China shock: import competition from China
- Possible cause: large relocation costs and low elasticity of sectoral/location choice:
  - Artuc, Chaudhuri, McLaren (2010)
**Redistributing Gains from Trade**

- **Second Welfare Theorem Logic:** Aggregate gains from trade are positive; redistribute them using lump-sum taxes and transfers

- **Public Finance:** Lump-sum taxes are unavailable/unrealistic
  - What policy instruments to use? What margins to distort?

- If lump-sum taxes are unavailable: trade policy cannot be separated from fiscal policy

- How should we design optimal tax/trade policy to balance:
  - Efficiency gains from trade
  - Costs associated with increased inequality
General and tractable competitive model of trade

- Input-Output linkages in production
- Imperfect worker mobility
- Government policy:
  - Direct taxes: Income taxes
  - Indirect taxes: Taxes on consumption and production

Study the optimal cooperative tax system across countries

- Abstract from strategic interactions

Key friction:

- Income taxes cannot depend on workers’ characteristics and sector
WHAT WE FIND

- Production must be taxed differently across sectors

- Its determinants:
  - Only income and employment distribution as well as labor supply elasticities in each country

- VAT taxes are optimal

- Quantitative implication: explore how taxes must react to China shock
**Related Literature**


- **Optimal non-cooperative trade policy:** Bagwell and Staiger (1999), Costinot, Donaldson, Vogel, and Werning (2015), Beshkar and Lashkaripour (2017)

- **Interplay between distortions and production networks:** Caliendo, Parro and Tsivinsky (2017), Baqae and Farhi (2017)
Simple Model
No labor mobility
PRODUCTION
PRODUCTION

- $N_c$ countries, indexed by $c$
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$$Y_i^c = G_i^c \left( L_i^c, \{Q_{ij}^c\}_{j=1}^{N} \right), \forall i = 1, \ldots, N$$
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Labor  Intermediate Inputs
Workers
WORKERS

- Continuum of workers in each country
  - Have preferences over consumption $x \in \mathbb{R}^N$ and leisure
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  - For now: each worker works for $j^c(\theta)$; relax later
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- Preferences:
  $$ v = U^c(\mathbf{x}) - v^c(\ell) $$
WORKERS
Assumption. Workers preferences satisfy

\[ U^c(x) : \text{Homothetic in } x, \text{ linear in income} \]

\[ v^c(\ell) = \frac{1}{1 + \frac{1}{\varepsilon c}} \ell^{1 + \frac{1}{\varepsilon c}} \]
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- Useful benchmark: uniform commodity taxation applies
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- Useful benchmark: uniform commodity taxation applies
- More general results in the paper
GOVERNMENT AND POLICIES
Government and Policies

- Consumption tax
Consumption tax

\[ t^x_i : \text{ad-valorem tax on consumption of } i \]
Government and Policies

• Consumption tax
  ★ $t_{i}^{x,c}$ : ad-valorem tax on consumption of $i$

• Production taxes
**GOVERNMENT AND POLICIES**

- Consumption tax
  - $t_{i}^{x,c}$: ad-valorem tax on consumption of $i$

- Production taxes
  - $t_{i}^{p,c}$: sales
Government and Policies

• Consumption tax
  - $t^x_{i,c}$: ad-valorem tax on consumption of $i$

• Production taxes
  - $t^p_{i,c}$: sales
  - $t^p_{ij,c}$: intermediate inputs
Consumption tax

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Production taxes

- $t^p_{i,c}$: sales
- $t^p_{ij,c}$: intermediate inputs

Special case:
Government and Policies

- Consumption tax
  - $t_{i,c}^{x} \quad \text{ad-valorem tax on consumption of } i$

- Production taxes
  - $t_{i,c}^{p} \quad \text{sales}$
  - $t_{ij,c}^{p} \quad \text{intermediate inputs}$

- Special case:
  - tariffs: $t_{i,c}^{x} = -t_{i,c}^{p} = t_{ji,c}^{p}$
TAXES AND MARKETS
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Income tax:

- Linear in income: $T^c (z) = \tau^c z - T^c$
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- Goods: international competitive markets

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TAXES AND MARKETS

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- Labor: domestic competitive markets

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Optimal Policy Problem
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- Objective in country $c$

$$W^c \left( \{v^c(\theta)\}_{\theta \in \Theta} \right)$$
**Optimal Policy Problem**

- **Objective in country** \( c \)
  \[ W^c \left( \left\{ v^c(\theta) \right\}_{\theta \in \Theta} \right) \]

- **Policy determined under cooperation**
  \[
  \max_{c=1}^{N_c} \sum_{c=1}^{N_c} \lambda^c W^c \left( \left\{ v^c(\theta) \right\}_{\theta \in \Theta} \right)
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★ No strategic motives for terms of trade manipulation
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  - No strategic motives for terms of trade manipulation
  - Trade agreement; efficient negotiation
OPTIMAL TAXES

- Indeterminacy: set $\tau^c = 0$
**Optimal Taxes**

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---

**Optimal Producer Taxes**

\[
\frac{\epsilon^c_{j}}{1 - \tau^p_{j}} = 1 - \overline{W}^c_{j}
\]

\[
\tau^p_{j} = -\tau^p_{j}
\]
**Optimal Taxes**

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Social value of 1% increase in income of workers in $j$

### Optimal Producer Taxes

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\varepsilon^c \frac{t_{j}^{p,c}}{1 - t_{j}^{p,c}} = 1 - \overline{W}_j^c
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Social value of 1% increase in income of workers in $j$

VAT tax is optimal
Optimal Producer Taxes

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Optimal Producer Taxes

\[ \varepsilon^c \frac{t_{pj}^{p,c}}{1 - t_{pj}^{p,c}} = 1 - \overline{W}_j \]

where \( t_{pj}^{p,c} = -t_{pj}^{p,c} \)
**Optimal Taxes**

Optimal Producer Taxes

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\varepsilon^c \frac{t^{p,c}_j}{1 - t^{p,c}_j} = 1 - \bar{W}^c_j
\]

\[
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\]

- LHS: percentage behavioral decrease in government revenue from a small increase in VAT tax
**Optimal Taxes**

**Optimal Producer Taxes**

\[
\epsilon^c \left\{ \frac{t_{ij}^{p,c}}{1 - t_{ij}^{p,c}} \right\} = 1 - \overline{W}_j^c \\
\]

\[
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- LHS: percentage behavioral decrease in government revenue from a small increase in VAT tax
- RHS: percentage mechanical increase in revenue less welfare effect
Optimal Producer Taxes

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Where are the G.E. effects?
**Optimal Taxes**

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- **Where are the G.E. effects?**

  * Changes in supply of \( j \) potentially changes prices, revenue and welfare
Optimal Producer Taxes

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- LHS: percentage behavioral decrease in government revenue from a small increase in VAT tax
- RHS: percentage mechanical increase in revenue less welfare effect
- Where are the G.E. effects?
  - Changes in supply of \( j \) potentially changes prices, revenue and welfare
  - At the optimum: G.E. welfare effect cancels G.E. revenue effect
Main Implications
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- Trade/technological shocks affect optimal taxes only through distribution of income
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- Trade is undistorted if $\bar{W}_j^c$ the same for all $j$

$$
\bar{W}_j^c = \frac{\int 1 \left[ j^c(\theta) = j \right] \frac{\partial W^c}{\partial v(\theta)} z^c(\theta) \mu^c(\theta) d\theta}{\int 1 \left[ j^c(\theta) = j \right] z^c(\theta) \mu^c(\theta) d\theta}
$$
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  - $\overline{W}_j^c$ depends on inequality within and across sectors
Main Implications
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- Sector-specific VAT taxes are optimal:
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  - Border-adjustments are distortionary and not optimal
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- Sector-specific VAT taxes are optimal:
  - Border-adjustments are distortionary and not optimal
- Alternative way of implementing: sector-specific payroll taxes
Model with Mobility
WORKERS - SECTORAL CHOICE
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- If $\theta$ works in $j$, labor productivity $\alpha^c_j(\theta)\eta_j$
WORKERS - SECTORAL CHOICE

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\[
L_j^c = \int_{\Theta} \int_{\mathbb{R}^N} a_j^c(\theta)\eta_j \ell_j(\theta, \eta) 1 \left[ w_j^c a_j^c(\theta)\eta_j \geq w_j^c a_j^c(\theta)\eta_j' \right] dH(\eta) \mu^c(\theta) d\theta
\]
WORKERS - SECTORAL CHOICE
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Workers - sectoral choice

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  - \( \sigma > 1 + \varepsilon^c \) to ensure integrals exist
WORKERS - SECTORAL CHOICE
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- Frechet distribution:
WORKERS - SECTORAL CHOICE

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    \[
    \overline{z}^c(\theta) = \kappa \left[ \sum_i (w_i^c a_i^c(\theta))^\sigma \right]^{\frac{1+\varepsilon^c}{\sigma}}
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WORKERS - SECTORAL CHOICE

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  - Distribution of labor productivity of type $\theta$ in each sector is the same
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    \[
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    \]
  - Fraction of workers of type $\theta$ in sector $j$
    \[
    \Lambda_j^c(\theta) = \frac{(w_j^c a_j^c(\theta))^{\sigma}}{\sum_i (w_i^c a_i^c(\theta))^{\sigma}}
    \]
Optimal Producer Taxes

\[
(\sigma - 1) \frac{t^p,c_j}{1 - t^p,c_j} = 1 - \overline{W}^c_j
\]

\[
+ (\sigma - 1 - \varepsilon^c) \left[ \sum_i \frac{\int \Lambda_i \Lambda_j \tilde{z} \mu^c d\theta}{(1 - t^p,c_i) \int \Lambda_j \tilde{z} \mu^c d\theta} - 1 \right]
\]
Optimal Taxes

Optimal Producer Taxes

\[(\sigma - 1) \frac{t_{j}^{p,c}}{1 - t_{j}^{p,c}} = 1 - \bar{W}_{j}^{c}\]

\[+ (\sigma - 1 - \varepsilon^{c}) \left[ \sum_{i} \frac{\int \Lambda_{i} \Lambda_{j} \bar{z} \mu_{i}^{c} d\theta}{(1 - t_{i}^{p,c}) \int \Lambda_{j} \bar{z} \mu_{i}^{c} d\theta} - 1 \right]\]

Elasticity of labor supply in \( j \) to wage in \( j \)
**Optimal Taxes**

**Optimal Producer Taxes**

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Relocation effect
Optimal Taxes with Absolute Advantage
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- Absolute advantage, i.e., no specialization
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Optimal Taxes with Absolute Advantage

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**Proposition.** Under absolute advantage, optimal VAT taxes are uniform, i.e., no need for VAT taxes
Optimal Taxes with Absolute Advantage

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Optimal Taxes with Absolute Advantage

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**Proposition.** Under absolute advantage, optimal VAT taxes are uniform, i.e., no need for VAT taxes

- Intuition: taxes cannot affect inequality across types
  \[ \frac{\zeta^c(\theta)}{\zeta^c(\theta')} = \left( \frac{\beta^c(\theta)}{\beta^c(\theta')} \right)^{1+\varepsilon^c} \]
Optimal VAT producer taxes can be used to redistribute gains from trade across sectors

Taxes are fully determined by employment and income distribution

Optimal taxes depend on the specialization in the labor force

★ Absent specialization
QUANTITATIVE EXERCISE
Main Question: How should a trade agreement involving U.S. and China be designed? What should be the VAT taxes?

Closely follow Galle, Rodriguez-Clare, Yi (2017) and Caliendo, Dvorkin, Parro (2017)

Two layers of production: final and intermediate goods

- Intermediate goods: using labor and final goods; tradable
- Final goods are produced with intermediate goods; non-tradable
- Production of intermediate goods: Eaton and Kortum (2002)
**CALIBRATION**

- Key assumption: data comes from Laissez-Faire version of the model; in line with trade literature

- Parameters chosen independently

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Values</th>
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<tbody>
<tr>
<td>$\varepsilon^c$</td>
<td>Frisch elasticity of hours</td>
<td>0.5</td>
</tr>
<tr>
<td>$\nu$</td>
<td>Trade elasticity</td>
<td>4</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>Elasticity of Labor Mobility</td>
<td>2</td>
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<tr>
<td>$\gamma$</td>
<td>Elasticity of substitution (preferences)</td>
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CALIBRATION

- Parameters of production functions
  - Use WIOT to determine expenditure, factor shares

- Trade costs:
  - Price data from Groningen Growth and Development Center
  - trade shares from WIOT

- Sectoral productivity
  - Use price and bilateral trade share data
CALIBRATION

- Following Galle, Rodriguez-Clare and Yi (2017), each type is an education/location in the U.S.
  - Education: No-college vs. some college
  - Location: 722 Commuting Zones as in Autor, Dorn and Hanson (2013)
  - All other countries have one type
  - Use employment and earning data from 2000 American Community Survey to calculate labor productivities
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CHINA SHOCK

- Model China shock as an increase in TFP in China - estimated by Caliendo, Dvorkin, Parro (2017); time horizon 2000-2007
China Shock: Employment Change
CHANGES IN WELFARE
## Changes in Welfare

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Skilled in Monterey, CA
OPTIMAL POLICY EXERCISE

- Assume post China shock technology

- Maximize weighted average of welfare in other countries subject to delivering at least pre-shock welfare to all types in the U.S.
  
  ★ Tax reform that is Pareto improving

- Notice: Laissez-Faire is efficient
  
  ★ Pareto optimal taxation: without the China shock do nothing
Optimal Taxes

![Optimal Tax Rate Graph]

- Agriculture
- Mining
- Food
- Textile
- Leather
- Wood
- Paper
- Coke & Petrol
- Chemicals
- Rubber & Plastic
- Mineral Prod.
- Metal
- Machinery
- Electrical Equip.
- Transport Equip.
- Other Muni.
- Utilities
- Construction
- Trade
- Hotels
- Transportation
- Fin. Services
Optimal Taxes
Optimal Taxes

Employment Change
Optimal Taxes - Decomposition
Conclusion

- Developed a framework to analyze optimal taxation when trade creates winners and losers

- Optimal producer taxes:
  - VAT
  - Depend on degree of specialization of the labor force

- China shock: significant variation in across sectors; distortionary to trade

- Important question: dynamic effects
ADDITIONAL SLIDES
Quantitative Model: Details

- Two types of goods in each sector:
  - Tradable intermediate goods and non-tradable final goods
- Continuum of varieties of intermediate goods in each sector
- Final goods can be used for consumption or in production
- Workers problem is the same as before
Quantitative Model: Details

- Continuum of varieties in intermediate goods

\[ q_j^c (\omega_j) = a_j^c (\omega_j) \left( L_j^c (\omega_j) \right) \chi_j^c \prod_{k=1}^{N_j} \left( M_{j,k}^c (\omega_j) \right)^{\gamma_{j,k}^c}, \quad \sum_{k=1}^{N_j} \gamma_{j,k}^c = 1 - \chi_j^c. \]

Variety: \( \omega_j \in [0, 1] \)

- Assume \( a_j^c \) has a Frechet distribution

\[ F_j^c (a) = e^{-\lambda_j^c a^{-\nu}} \]

Sectoral TFP and Trade elasticity
Unit cost in sector $j$ in country $c$: 

$$\psi_j^c = \left( \frac{w_j^c}{(1 - t_{j,p}^c)} \chi_j^c \right) \chi_j^c \prod_{k=1}^{N_J} \left( \frac{P_k^c}{\gamma_{j,k}^c} \right)$$

- **Wage of $j$ in $c$**
- **Price of $k$ in $c$**
Trade cost:

\( \tau_{j}^{c,c'} \): cost of shipping \( j \) from \( c' \) to \( c \)

\( X_{j}^{c,c'} \): expenditure in \( c \) on \( j \) produced in \( c' \); \( X_{j}^{c} \): expenditure on \( j \) in \( c \)

\[
\pi_{j}^{c,c'} \equiv \frac{X_{j}^{c,c'}}{X_{j}^{c}} = \frac{\lambda_{j}^{c'} \left( \tau_{j}^{c,c'} \psi_{j}^{c'} \right)^{-\nu}}{\sum_{c''} \lambda_{j}^{c''} \left( \tau_{j}^{c,c''} \psi_{j}^{c''} \right)^{-\nu}}
\]