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

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March 23, 2022

Redistributing Gains from Trade

- Globalization has aggregate, but unequal, gains
  - It can potentially create winners and losers

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- How do we distribute gains from trade?
- **Obvious answer:** take from winners (lump sum) and give to losers (lump sum)
- **Problems:** Unrealistic, impractical, requires a lot of information
- Need to use distortionary (2nd best) instruments

How? What margins to distort? Are tariffs optimal?

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- Competitive (static) model of trade
  - Roy model of labor supply (sector choice)
  - Labor produces value added
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- **Key friction:**
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- Study the optimal tax system for SOE government that $\leftarrow$ paper: world planner
  - Takes prices as given $\leftarrow$ paper: GE
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- Production must be efficient ⇒ Tariffs are not optimal

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- Optimal policy: Value Added Tax (VAT) differentiated by sector $\leftarrow$ in paper
- Derive formula for optimal VAT system
  - Can be easily computed using moments in data
  - Important: Patterns of comparative/absolute advantage
  - Also important: Elasticity of sector choice

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- Derive formula for optimal VAT system
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  - Important: Patterns of comparative/absolute advantage
  - Also important: Elasticity of sector choice
- Quantitative exercise (preliminary): How should taxes react to the *rise of China*?
  - Main insight: VATs are much more powerful than income taxes

Related Literature

- **Optimal commodity/intermediate good taxation:** Diamond and Mirrlees (1971), Atkinson and Stiglitz (1976), Deaton (1980), Naito (1999)
- **Optimal taxation in trade/spatial models:** Dixit and Norman (1986), Costinot and Werning (2018), Lyon and Waugh (2017), Fajgelbaum and Gaubert (2018), Ales and Sleet (2018)
- **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 Tsyvinsky (2017), Baqaee and Farhi (2017)
- **Measuring gains/loses from trade:** Autor, Dorn, and Hanson (2013), Caliendo, Dvorkin, and Parro (2019), Waugh and Lyon (2019), Carrol and Hur (2019)

Plan of the Talk

- Theory
  - Simple SOE model (GE model in the paper)
  - Optimal VAT and Income Tax (more general policy instruments in the paper)
  - Study the properties of optimal VAT
- Simple examples
  - When there is "pure comparative advantage"
  - When there is "pure absolute advantage"
- Preliminary quantitative results (if there is time)
  - Impact of the *rise of China*
  - Optimal policy response

Theoretical Framework

Production

- There are N sectors, indexed by i or j
- Each produce a differentiated good, using

$$Y_i = L_i$$

- Price of good i is $p_i \leftarrow$ exogenous in the talk
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- L_i is labor input in sector i
- Firms pay wage w_i per unit of labor services

$$w_i = (1 - t_i)\, p_i$$

where t_i is value added tax in sector i

Workers – Preferences

- Continuum of workers

- Have preference over consumption $\mathbf{x} \in \mathbb{R}^N$ and leisure

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- $U(\mathbf{x})$ is homothetic in $\mathbf{x} \Rightarrow$ indirect utility is linear in income

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- Workers have heterogenous type θ, with p.d.f $\mu(\theta)$

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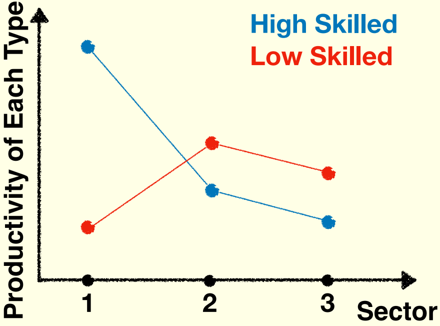

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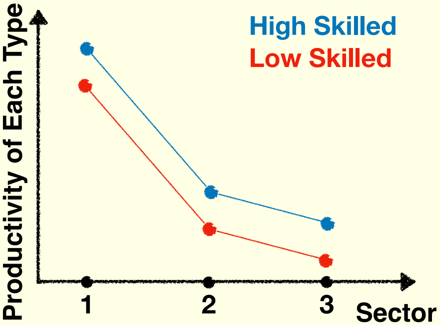
  Example 1: absolute advantage – no specialization

$$a_j(\theta) = a(\theta) \times b_j$$



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  Example 2: perfect specialization

$$a_j(\theta) = \begin{cases} a_j & j = j^*(\theta) \\ 0 & \text{o/w} \end{cases}$$

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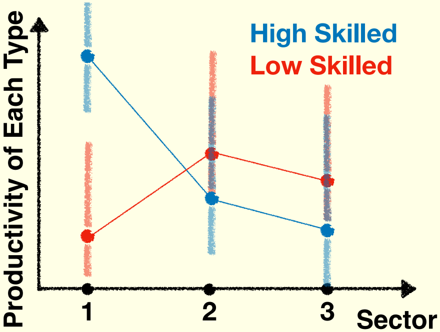

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- Supply of labor services in sector j

$$L_j = \sum_\theta \mu(\theta) \int_{\mathbb{R}_+^N} a_j(\theta)\, \eta_j \ell_j(\theta, \eta)\, \mathbf{1}\left[w_j a_j(\theta)\, \eta_j \geq w_i a_i(\theta)\, \eta_i\right] dF(\eta; \theta)$$

What does the model give us?

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- A general labor supply framework
  (Heterogeneous workers decide where and how much to work)
- A value added tax in sector j, affect wages of workers in sector j
- But workers are heterogenous, i.e. we have different θs
- Question: What role does this tax play in income redistribution (besides income tax)?
- The analysis is analog to commodity taxation framework
  (Heterogenous consumers decide what to buy and how much)

Government Policies

- Value added tax on producers: t_i

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- Nonlinear income tax on workers: $T(y)$
  - Income tax cannot depend on workers' type and/or sectors
- In the paper – GE model with I/O network – we show
  - It is optimal not to tax intermediate inputs (under some conditions)
  - Uniform comm. taxation results hold $\Rightarrow$ can set consumption tax to zero
  - Also WLOG

$$\text{taiff on } i = \text{consumption tax on } i = \text{intermediate input tax on } i = -\text{sales tax on } i$$

$\Rightarrow$ optimal to set tariffs to zero

Government Objective

- Let
  - $\mathbf{p^{SQ}} = \left(p_1^{SQ}, \ldots, p_N^{SQ}\right)$ be status quo vector of prices
  - $\mathbf{w^{SQ}} = \left(w_1^{SQ}, \ldots, w_N^{SQ}\right)$ be status quo vector of wages, and $w_j^{SQ} = p_j^{SQ}$
  - $u^{SQ}(\theta)$ be welfare of worker of type θ under status quo prices and wages
- For any price vector $\mathbf{p}$, government seeks to maximize its surplus subject to
  - Restrictions on policy, i.e. VAT and income tax
  - No type θ is worse off under price vector $\mathbf{p}$, relative to $\mathbf{p^{SQ}}$
- Abstract from any motive for terms of trade manipulation

A useful change of variable

- Let's define effective wage as $z \equiv \max_j w_j a_j(\theta)\eta_j$ and define
  - $h(z,\theta)$: distribution of z among type θ
  - $h_j(z)$: distribution of z in sector j
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- The contribution of a z worker in production of good j is $\frac{y(z)}{w_j}$
- We can write value added in sector j as

$$p_j \int_0^\infty \frac{y(z)}{w_j} h_j(z)\, dz = \int_0^\infty \frac{y(z)}{1-t_j} h_j(z)\, dz$$

Optimal Taxation Problem

$$\max_{t_j, T(y)} \sum_{j=1}^{N} \frac{t_j}{1-t_j} \int_0^\infty y(z)\, h_j(z)\, dz + \int_0^\infty T(y(z))\, h(z)\, dz$$

s.t.

$$U'(z) = \frac{1}{z}\left(\frac{y(z)}{z}\right)^{1+1/\varepsilon}$$

$$U(z) = y(z) - T(y(z)) - \frac{(y(z)/z)^{1+1/\varepsilon}}{1+1/\varepsilon}$$

$$\int_0^\infty U(z)\, h(z;\theta)\, dz \geq u^{SQ}(\theta)$$ ← Pareto Improving (PI) constraint

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Question: where is the vector of price?

Answer: in $h_j(z;\theta)$, via $w_i = (1-t_i) p_i$.

Approximation around status quo

- Instead of full non-linear set of FOC) $\rightarrow$ linear approximation around status quo

- Let

  - δp_j: percent deviation of prices relative to status quo (suppose $\sum_j \frac{\delta p_j}{p_j} = 0$)
  - $\gamma(\theta)$: deviation of multiplier (on PI constraint) from status quo
  - $\tau(z)$: optimal marginal income tax for worker with effective wage z

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- Note: We observe data in status quo $\rightarrow$ can estimate moments/elasticities

Optimal VAT Formula

$$-t_j+\sum_{i=1}^{N}\mathbb{E}_{Y_j}\left[\xi_{j,i}\right]t_i-\varepsilon\sum_{i=1}^{N}\mathbb{E}_{Y_j}\left[\frac{h_i\left(z\right)}{h\left(z\right)}\right]t_i=\sum_{\theta}\left[\mathbb{E}_{Y_j}\left[\left(1+\varepsilon\right)\left(\frac{1-H\left(z;\theta\right)}{zh\left(z\right)}\right)\right]-\frac{Y_j\left(\theta\right)}{Y_j}\right]\gamma\left(\theta\right)$$

- $\xi_{j,i}\left(z\right)$: elasticity of labor supply in sector j w.r.t w_i
- $Y_j\left(\theta\right)$: income earned in sector j by type θ
- Y_j: income earned in sector j
- $\mathbb{E}_{Y_j}\left[g\left(z\right)\right]=\int\frac{z^{1+\varepsilon}h_j(z)}{Y_j}g\left(z\right)dz$: income weighted mean of $g\left(z\right)$ in sector j

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- "inverse elasticity rule" in matrix form: for labor supply elasticity
- The relevant elasticity is the "extensive margin elasticity" $\mathbb{E}_{Y_j}\left[\xi_{j,i}\right]$

Top of Laffer curve: with VAT and income tax

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- Again, standard formula

- Needs to be adjusted for "fiscal externality terms"

Optimal VAT

$$\sum_{i=1}^{N}\left(\mathbb{E}_{Y_i}\left[(1+\varepsilon)\left(\frac{1-H(z;\theta)}{zh(z)}\right)\right]-\frac{Y_i\left(\hat{\theta}\right)}{Y_i}\right)\frac{Y_i}{Y}t_i+$$

$$\sum_{\theta}\mathbb{E}_{Y}\left[\frac{(1+\varepsilon)^2}{\varepsilon}\left(\frac{1-H\left(z;\hat{\theta}\right)}{zh(z)}\right)\left(\frac{1-H(z;\theta)}{zh(z)}\right)\right]\gamma(\theta)+\frac{\delta u_0}{Y}=-\sum_{i=1}^{N}\frac{Y_i\left(\hat{\theta}\right)}{Y}\frac{\delta p_i}{p_i}$$

- In general, optimal taxes depends also on welfare effects
- That is how difficult it is to keep a type θ at their status quo welfare – captured by $\gamma(\theta)$
- Important determinant of $\gamma(\theta)$: correlation between price shock in sector i and income earned by type θ in that sector

Optimal Income Tax Formula

- Once we know t_i and $\gamma(\theta)$ we can find optimal income tax

$$\tau(z) = -\sum_{i=1}^{N} \frac{h_i(z)}{h(z)} t_i - \frac{1+\varepsilon}{\varepsilon} \sum_{\theta} \gamma(\theta) \frac{(1 - H(z;\theta))}{zh(z)}$$

Parametric assumption: Frechet distribution

- Suppose sector productivity shocks are i.i.d and Frechet with shape parameter σ
- Share of type θ who work in sector j is

$$\Lambda_j(\theta) = \frac{(a_j(\theta)\, w_j)^\sigma}{\Phi(\theta)}, \quad \Phi(\theta) = \sum_{i=1}^{N} (a_i(\theta)\, w_i)^\sigma$$

- Distributions of z are also Frechet with shape parameter σ

$$H(z,\theta) = e^{-\Phi(\theta) z^{-\sigma}}, \quad H_j(z,\theta) = \Lambda_j(\theta)\, e^{-\Phi(\theta) z^{-\sigma}}$$

- The extensive margin elasticity becomes

$$\mathbb{E}_{Y_j}[\xi_{j,i}] = \sigma - (\sigma - 1 - \varepsilon) \sum_\theta \mu(\theta) \frac{Y_j(\theta)}{Y_j} \Lambda_i(\theta)$$

Special Case 1: pure absolute advantage

- Suppose

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- Types make identical sector choice

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- Optimal VAT formula collapses to

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$$a_j(\theta) = a(\theta) \times \alpha_j$$

- Types make identical sector choice

$$\Lambda_j(\theta) = \Lambda_j$$

- Optimal VAT formula collapses to

$$\Rightarrow t_i = 0$$

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- Types make identical sector choice
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- Optimal VAT formula collapses to
$$\Rightarrow t_i = 0$$
- Only income tax responds to price shock
$$\tau(z) = -\frac{1+\varepsilon}{\varepsilon} \sum_{\theta} \gamma(\theta) \frac{(1 - H(z;\theta))}{zh(z)}$$

Special Case 2: pure comparative advantage

- Suppose distribution of income is identical across types
- A simple example: two sectors, two types

$$a_1(\theta_1)\,w_1 = a_2(\theta_2)\,w_2$$
$$a_2(\theta_1)\,w_2 = a_1(\theta_2)\,w_1$$

Then

$$\Phi(\theta_1) = \Phi(\theta_2) = \Phi$$
$$Y(\theta_1) = Y(\theta_2) = Y$$
$$H(z,\theta_1) = H(z,\theta_2) = H(z)$$

- Income distribution identical across types, but sector choices are different

Special Case 2: comparative advantage

- Pareto Improving constraint collapses to

$$\sum_{i=1}^{N} \left(\Lambda_i\left(\theta_2\right) - \Lambda_i\left(\theta_1\right)\right) t_i = \sum_{i=1}^{N} \left(\Lambda_i\left(\theta_2\right) - \Lambda_i\left(\theta_1\right)\right) \frac{\delta p_i}{p_i}$$

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- A simple policy can restore status quo welfare

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- A simple policy can restore status quo welfare

$$t_i = \frac{\delta p_i}{p_i}$$

- Since distribution of income is identical across types

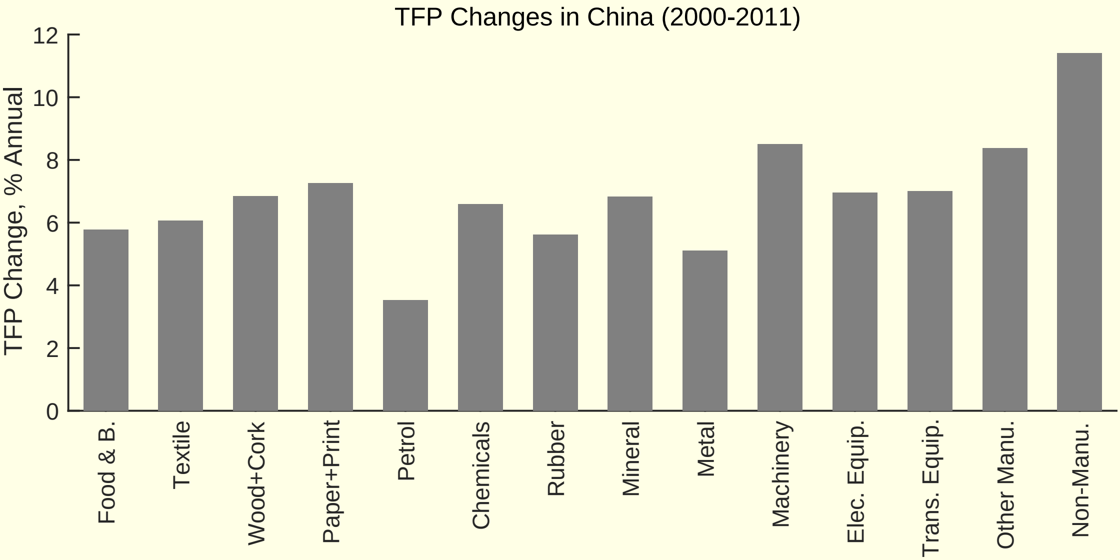
$$\begin{aligned}\tau\left(z\right) &= -\sum_{i=1}^{N} \frac{h_i\left(z\right)}{h\left(z\right)} t_i - \frac{1+\varepsilon}{\varepsilon} \sum_{\theta} \gamma\left(\theta\right) \frac{\left(1 - H\left(z;\theta\right)\right)}{zh\left(z\right)} \\ &= 0\end{aligned}$$

Quantitative Exercise: Optimal Policy Response to *the Rise of China* (Preliminary)

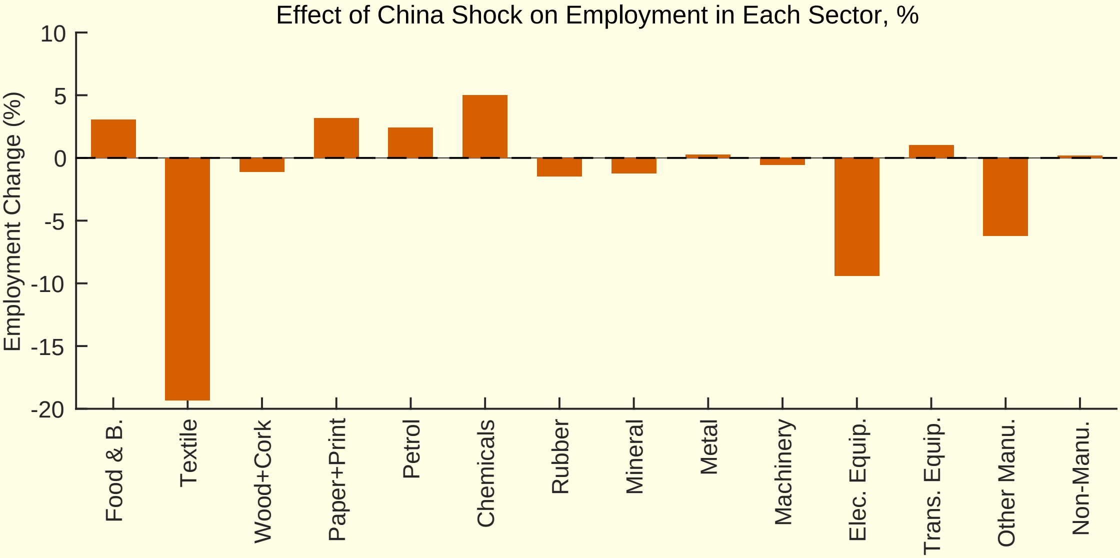
Quantitative Model

- Multi-sector trade model similar to Galle, Rodriguez-Clare, Yi (2020)
- 14 sectors (ISIC Rev 3):
  - 13 manufacturing + an aggregate non-manufacturing
- Types
  - Each type is an education/location in the U.S.
  - Education: No-college vs. some college (associate degrees)
  - Location: 722 Commuting Zones (as in Autor, Dorn and Hanson (2013))
  - $a_j(\theta)$: calibrate to match employment and earning data from 2000 ACS
- China shock: increase in sector TFPs in China (between 2000 and 2011)

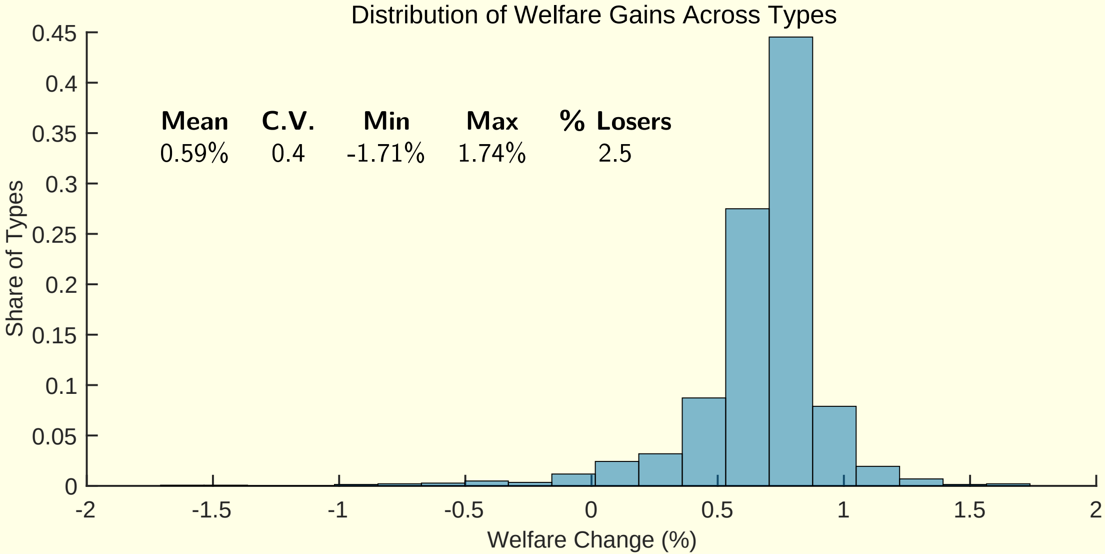
Implied Rise of TFP in China



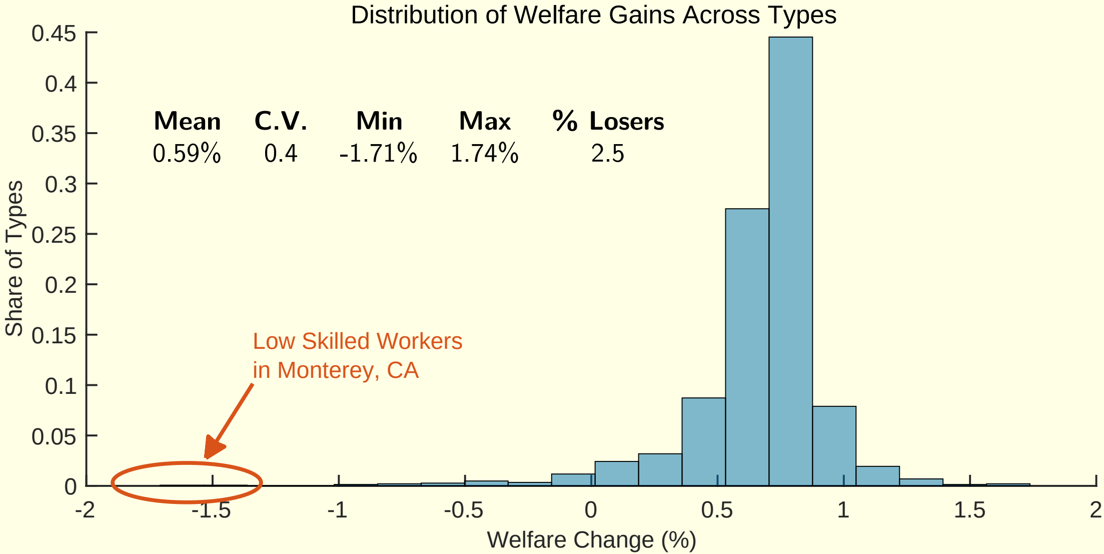
Employment Effect of the Rise of China



Welfare Effect of the Rise of China

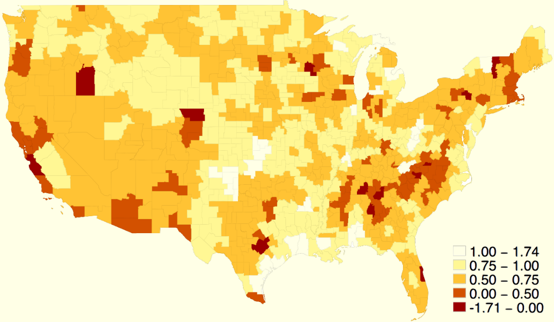


Welfare Effect of the Rise of China

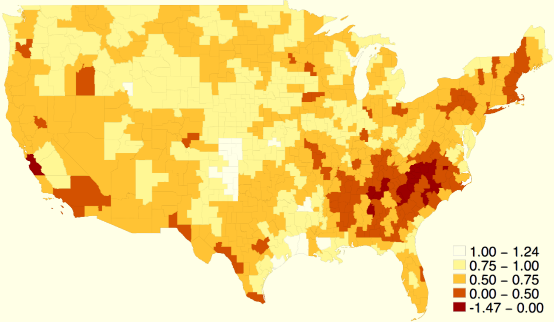


Mean	C.V.	Min	Max	% Losers
0.59%	0.4	-1.71%	1.74%	2.5

Geographic Distribution of Welfare Changes



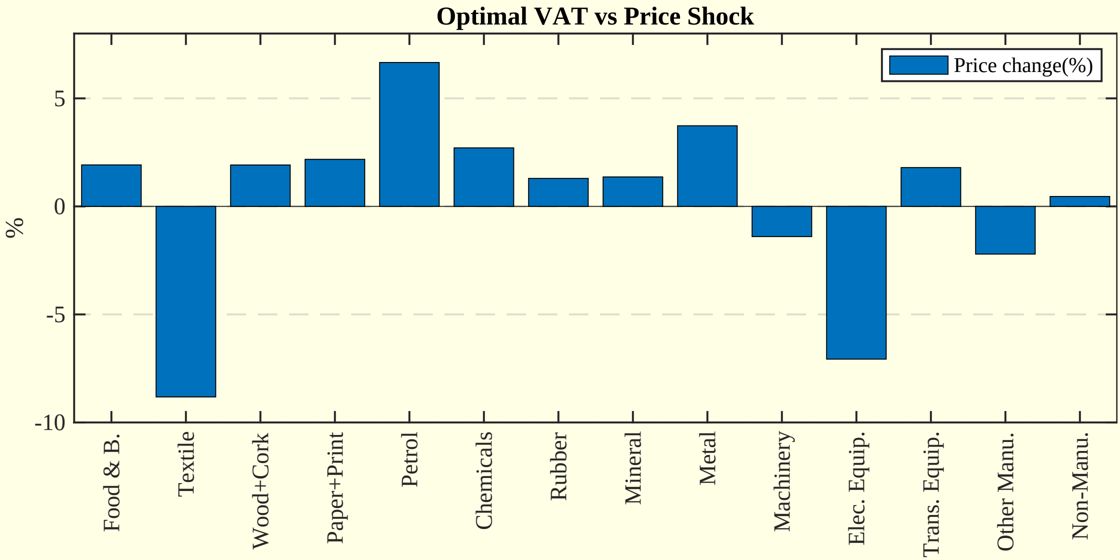
Low Skilled



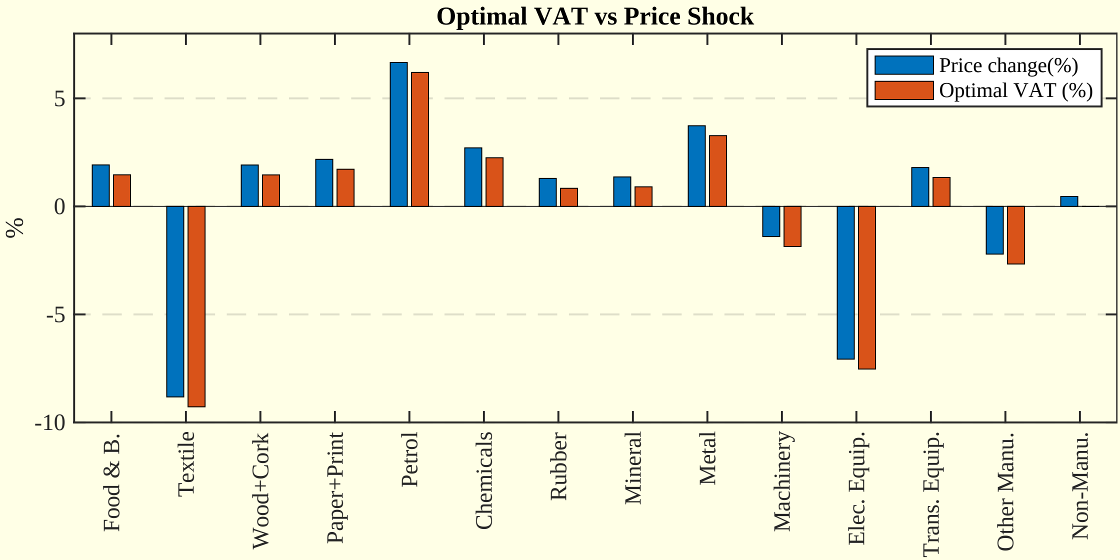
High Skilled

More Results

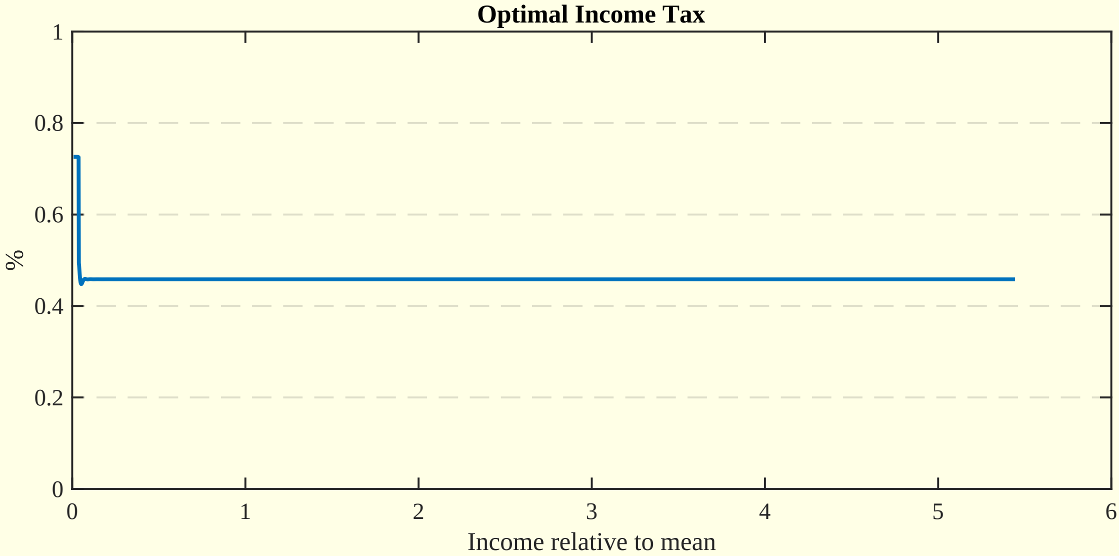
Implied Price Shock



Optimal Policy Response: VAT



Optimal Policy Response: Income Tax



A Difficulty with Frechet

- The discussion above highlights key determinants of optimal tax system
  1. Extensive elasticity of labor supply (sector choice margin)
  2. Tail of the income distribution among each type
  3. Patterns of comparative/absolute advantage
- An issue with Frechet: 1 and 2 are tightly connected
  - Both are determined by shape parameter
- To make tighter connection to data we need a more flexible distribution
  - We have developed a flexible semi-parametric Roy model that can match any income distribution but the extensive elasticity of labor supply is given by a parameter and can be estimated.
  - Not fully done yet.