

Slicing the Pie: Quantifying the Aggregate and Distributional Effects of Trade

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Motivation

- Gravity models → quantify *aggregate* welfare effects of trade
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- This paper:
 - ▶ Bridge the two literatures
 - ▶ Quantify aggregate and distributional effects of “China Shock” on US

Gravity and Welfare

- Gravity model: tractable structural framework to predict trade flows
 - ▶ Eaton-Kortum, Melitz-Pareto, ACR,...
- Trade data + trade elasticity \rightarrow counterfactual analysis
 - ▶ Gains from trade
 - ▶ Aggregate gains from China shock
- Stylized model with reasonable empirical performance (Donaldson '18)

The China Syndrome

- Autor, Dorn and Hanson (2013)
- Focus on local labor markets (commuting zones - CZs)
- Major finding: relative decline in earnings and employment for CZs most exposed to competition from ↑ US imports from China
- Other findings: ↑ federal transfers, ↓ marriage, ↑ suicide and drug overdose, electoral polarization...

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- Back to a general equilibrium model: Gravity + Roy-Fr chet.
 - ▶ Roy-Fr chet: standard discrete choice model of labor (re)allocation across sectors.

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- Other extreme: workers are stuck in their sector (specific factors).
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 - ▶ Roy model: workers self-select into sectors based on comparative advantage.
 - ▶ Fréchet parameter κ determines scope for reallocation:
 - $\kappa \rightarrow \infty$: perfectly mobile workers
 - $\kappa \rightarrow 1$: specific factors in terms of effective labor units

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 - ▶ Fréchet parameter κ determines scope for reallocation:
 - $\kappa \rightarrow \infty$: perfectly mobile workers
 - $\kappa \rightarrow 1$: specific factors in terms of effective labor units
- Generalizes specific-factors intuition to a setting with labor mobility.
- Examine *between-group* distributional effects of trade.

Extensions and limitations of baseline model

- Extensions:
 1. Intermediate goods
 2. Trade costs within countries
 3. Imperfect substitutability between different types of labor (H-O)
 4. Endogenous labor force participation and unemployment
 5. Labor mobility across CZs (no quantification)
- Limitations:
 1. Strong parametric assumptions
 2. No implications for within-group inequality
 3. No transitional dynamics

Literature

- **Aggregate gains from trade**, with gravity: Costinot et al. (2012 - CDK)
 - ▶ Eaton & Kortum (2002 - EK), Arkolakis et al. (2012 - ACR), ...
- **Distributional effects of trade:**
 - ▶ With gravity: Burstein & Vogel (2016), Fajgelbaum & Khandelwal (2016)
 - ▶ Between regions: Autor et al. (2013), Dauth et al. (2014), Dix-Carneiro & Kovak (2016), Hakobyan & McLaren (2016), Kovak (2013), Topalova (2010)
 - ▶ At individual level: Adao et. al. (2020)
- **Trade and sectoral reallocation:**
 - ▶ Adao (2016), Artuç et al. (2010), Caliendo et al. (2019), Coşar (2013), Dix-Carneiro (2014), Goldberg & Pavcnik (2007), Lee (2020), Menezes-Filho & Muendler (2011), Wacziarg & Seddon-Wallack (2004)
- **Roy-type labor markets:**
 - ▶ Burstein et al. (2019), Hsieh et al. (2019), Lagakos & Waugh (2013 - LW), Young (2014)

Model

Model

- N countries, index i, j
- S sectors, index s, k
- G_i groups, index ig

Model: Trade Side

- Each sector is modeled as in EK:
 - ▶ CES preferences over continuum of goods,
 - ▶ National CRS technologies drawn iid-Fréchet with T_{is} and θ_s ,
 - ▶ Iceberg trade costs $\tau_{ijs} \geq 1$.
- Preferences across sectors are Cobb-Douglas with shares β_{is} .

Model: Labor Side

- Exogeneous mass L_{ig} of workers of type g in country i .
- A worker from g in country i has efficiency units z_s drawn iid-Fréchet with $\kappa > 1$ and A_{igs} .
- w_{is} is the wage per efficiency unit in sector s of country i :
 - ▶ w_{is} identical across g : no trade costs, national technologies,
 - ▶ w_{is} can differ across s : upward sloping labor supply to each s .
- Workers work in sector that maximizes $w_{is}z_s$.

Equilibrium: Labor Demand

- Determined by trade side.
- Demand for efficiency units in sector s in country i is

$$\frac{1}{w_{is}} \sum_j \lambda_{ijs} \beta_{js} Y_j,$$

where

$$\lambda_{ijs} = \frac{T_{is} (\tau_{ijs} w_{is})^{-\theta_s}}{\sum_l T_{ls} (\tau_{ljs} w_{ls})^{-\theta_s}} = \frac{T_{is} (\tau_{ijs} w_{is})^{-\theta_s}}{\gamma^{-\theta_s} P_{js}^{-\theta_s}}.$$

- Only difference with EK: w_{is} rather than w_j .

Equilibrium: Labor Supply

- Share of workers in group g who choose to work in sector s is

$$\pi_{igs} = \frac{A_{igs} w_{is}^\kappa}{\Phi_{ig}^\kappa} \text{ with } \Phi_{ig} \equiv \left(\sum_k A_{igk} w_{ik}^\kappa \right)^{1/\kappa} .$$

Equilibrium: Labor Supply

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- Let E_{igs} be total efficiency units supplied by group g in sector s .
- Average income that workers from g get in s is

$$\frac{w_{is} E_{igs}}{\pi_{igs} L_{ig}} = \zeta \Phi_{ig}.$$

- Group-level income is

$$Y_{ig} \equiv \sum_s w_{is} E_{igs} = \zeta L_{ig} \Phi_{ig}.$$

Equilibrium: Labor Market

- Excess demand for efficiency units in sector s of country i is

$$ELD_{is} \equiv \frac{1}{w_{is}} \sum_j \lambda_{ijs} \beta_{js} Y_j - \sum_g E_{igs}.$$

- λ_{ijs} , Y_j and E_{igs} are functions of the whole matrix of wages $\mathbf{w} \equiv \{w_{is}\}$, so system $ELD_{is} = 0$ for all i, s determines all wages \mathbf{w} .

Comparative Statics: Wages

- Foreign shock: $\hat{T}_{is}, \hat{\tau}_{ijs} \neq 1$ for $i \neq j$ ($\hat{x} \equiv x'/x$)
- Using $ELD_{is} = 0$, we can write $ELD'_{is} = 0$ as

$$\sum_g \hat{\pi}_{igs} \hat{\Phi}_{ig} \pi_{igs} Y_{ig} = \sum_j \hat{\lambda}_{ijs} \lambda_{ijs} \beta_{js} \sum_g \hat{\Phi}_{jg} Y_{jg}$$

with

$$\hat{\Phi}_{ig} = \left(\sum_k \pi_{igk} \hat{w}_{ik}^\kappa \right)^{1/\kappa},$$

$$\hat{\lambda}_{ijs} = \frac{\hat{T}_{is} (\hat{\tau}_{ijs} \hat{w}_{is})^{-\theta_s}}{\sum_k \lambda_{kjs} \hat{T}_{ks} (\hat{\tau}_{kjs} \hat{w}_{ks})^{-\theta_s}},$$

$$\hat{\pi}_{igs} = \frac{\hat{w}_{is}^\kappa}{\sum_k \pi_{igk} \hat{w}_{ik}^\kappa}$$

Comparative Statics: Real Income

- Define $y_{ig} = \frac{Y_{ig}}{L_{ig}}$. Given all \hat{w}_{is} we can get $\hat{\lambda}_{iis}$ and $\hat{\pi}_{igs}$ and then

$$\begin{aligned}\widehat{W}_{ig} \equiv \hat{y}_{ig} / \hat{P}_i &= \hat{\Phi}_{ig} / \hat{P}_i \text{ (from } y_{ig} = \zeta \Phi_{ig} \text{)} \\ &= \hat{\Phi}_{ig} / \prod_s \hat{P}_{is}^{\beta_{is}} \text{ (Cobb-Douglas preferences)}\end{aligned}$$

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Comparative Statics: Real Income

$$\widehat{W}_{ig} = \underbrace{\prod_s \widehat{\lambda}_{iis}^{-\beta_{is}/\theta_s}}_{\text{A country's consumer gains}} \cdot \underbrace{\prod_s \widehat{\pi}_{igs}^{-\beta_{is}/\kappa}}_{\text{A group's labor-income gains}}$$

- Consumer gains measure gains from specialization at the country level.
 - ▶ Valid for a broad class of gravity models (ACR).
- Labor-income gains measure gains from specialization at the group level.
 - ▶ Workers in group g gain more if sectors of their comparative advantage can expand.

A Bartik Approximation

- A Bartik-style measure of group-level import competition:

$$I_g \equiv \sum_s \pi_{gs} \frac{\beta_s}{r_s},$$

with $r_s \equiv \sum_g \pi_{gs} Y_g / Y$.

- For any trade shock:

$$\ln \hat{Y}_g / \hat{Y} \approx \frac{1}{\kappa} \ln \sum_s \pi_{gs} \hat{r}_s = -\frac{1}{\kappa} \ln \hat{I}_g$$

- ▶ This approximate sufficient statistic is exact for $\kappa \rightarrow 1$, and almost exact for $\kappa > 1$ in our simulations.

- If the shock is back to autarky, then

$$\ln \hat{Y}_g^A / \hat{Y}^A \approx \frac{1}{\kappa} \ln I_g.$$

Inequality-Adjusted Welfare Effects

- Let $W_g \equiv Y_g/P$. Utility for agent behind the veil of ignorance

$$U \equiv \left(\sum_g \frac{L_g}{L} W_g^{1-\rho} \right)^{1/(1-\rho)}.$$

- The higher ρ , the more inequality averse,
 - ▶ For $\rho = 0$, $U = W$, with $W \equiv \sum_g \frac{L_g}{L} W_g$.

- Inequality-adjusted welfare effects:

$$\hat{U} = \left(\sum_g \omega_g \hat{W}_g^{1-\rho} \right)^{\frac{1}{1-\rho}} \quad \text{with} \quad \omega_g \equiv \frac{L_g (Y_g/L_g)^{1-\rho}}{\sum_h L_h (Y_h/L_h)^{1-\rho}}.$$

Empirical Analysis

Data

- For $i = \text{US}$, sector s
- US Labor Market:
 - ▶ $G = 722$ Commuting Zones (CZs)
 - ▶ Labor income: Census and American Community Survey
 - ▶ Employment shares at the Commuting Zone (CZ) level
- Estimation closely follows ADH:
 - ▶ Trade data from UN Comtrade
 - ▶ Time period: 1990-2007
- Simulations:
 - ▶ Trade data from WIOD
 - ▶ Time period: 2000 - 2007
 - ▶ $S = 14$, with 13 manufacturing sectors and 1 non-manufacturing sector

Estimation

- Two key elasticities: θ and κ :
 - ▶ Estimation of θ is standard in the literature - gravity equation.
 - ▶ Key challenge here is estimation of κ .
- Combine empirical and theoretical elements to estimate κ :
 - ▶ Empirical: higher exposure to China shock \rightarrow \downarrow manuf. employment.
 - ▶ Theoretical: \downarrow manuf. employment \rightarrow \downarrow relative income depending on κ .

Estimation

- Formally, for $i = US$ and suppressing subindex, model implies

$$\ln \hat{y}_g = \ln \hat{w}_{NM} - \frac{1}{\kappa} \ln \hat{\pi}_{gNM} + \varepsilon_g,$$

where $\varepsilon_g = (1/\kappa) \ln \hat{A}_{gNM}$. [Derivation and discussion](#)

- Use China shock

$$Z_{gt} \equiv \sum_{s \in M} \pi_{gst} \Delta IP_{st}^{China \rightarrow Other}$$

as instrument for $\ln \hat{\pi}_{gNM}$ building on ADH.

- Exclusion restriction: $E(Z_g \varepsilon_g) = 0$ [Discussion](#)
- Identical set of control variables as ADH.

Table: IV estimation of κ

	(1)	(2)	(3)	(4)
	$\ln \hat{y}_g$	$\ln \hat{y}_g$	$\ln \hat{y}_g$	$\ln \hat{y}_g$
$\ln \hat{\pi}_{NM}$	-0.358*	-0.639**	-0.704**	-0.487**
	(0.211)	(0.303)	(0.295)	(0.183)
Implied κ	2.79	1.56	1.42	2.05
F-First Stage	58.46	24.02	29.52	67.87
Observations	1444	1444	1444	1444
R^2	0.683	0.667	0.662	0.677
Import Penetration	Other (π_{gst-10})	Other	US	US Bartik

Variable y_g is average earnings per worker, and π_{gNM} is the labor share employed in non-manufacturing. The columns differ in the construction of the instrument: column (1) uses $Z_{gt} \equiv \sum_{s \in M} \pi_{gst-10} \Delta IP_{st}^{China \rightarrow Other}$, column (2) uses $Z_{gt} \equiv \sum_{s \in M} \pi_{gst} \Delta IP_{st}^{China \rightarrow Other}$, column (3) uses $Z_{gt} \equiv \sum_{s \in M} \pi_{gst} \Delta IP_{st}^{China \rightarrow US}$, and column (4) uses our Bartik measure for the US: $Z_{gt} \equiv \ln \sum_s \pi_{gst} \hat{f}_{st}$. Standard errors are clustered at the state level and reported in parentheses.

Counterfactual Analysis

China-shock calibration

- China shock = sector-level productivity shocks in the model, $\widehat{T}_{China,s}$.
- Calibration of $\widehat{T}_{China,s}$
 - ▶ Inspired by Caliendo, Dvorkin & Parro (2016).
- Run a variation on ADH's first-stage regression for our data

$$\widehat{\lambda}_{China,US,s} = \alpha + \beta \widehat{\lambda}_{China,Other,s} + \varepsilon_s$$

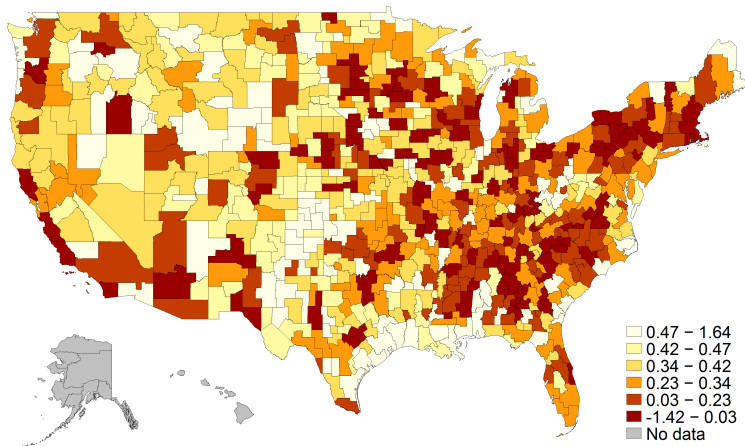
- ▶ Obtain $\widehat{\lambda}_{China,US,s} \equiv \widehat{\beta} \widehat{\lambda}_{China,Other,s}$.
- ▶ Calibrate $\widehat{T}_{China,s}$ to $\widehat{\lambda}_{China,US,s}$.

Simulated China shock and groups' income changes

κ	\widehat{W}_{US}	Mean	CV	Min.	Max.	$\prod_s \widehat{\lambda}_s^{-\beta_s/\theta_s}$
$\rightarrow 1$	0.24	0.32	1.24	-1.44	2.30	0.14
1.5	0.22	0.29	1.01	-1.18	1.65	0.15
	(0.02)	(0.03)	(0.23)	(0.3)	(0.6)	(0.01)
3.0	0.20	0.26	0.70	-0.74	0.96	0.16
$\rightarrow \infty$	0.20	0.20	0	0.20	0.20	0.20

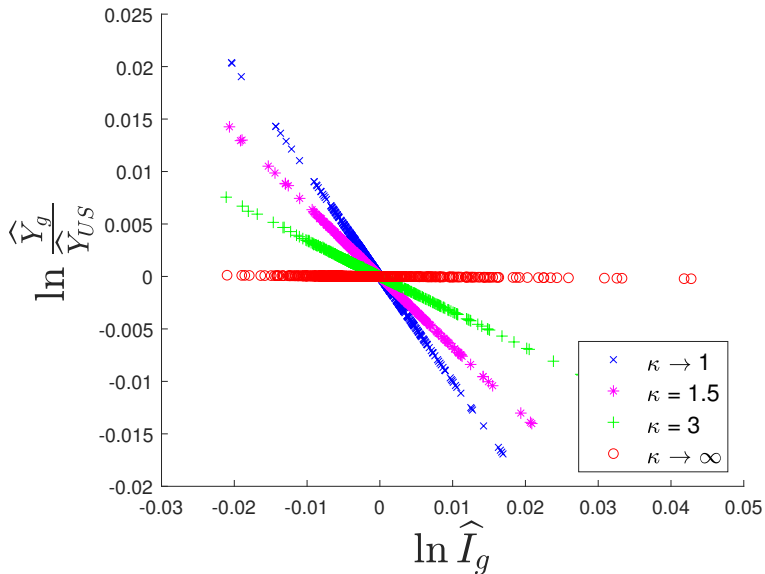
The first column displays the aggregate welfare effect of the China shock for the US, in percentage terms $100(\widehat{W}_{US} - 1)$, and the second column shows the mean welfare effect: $100(\frac{1}{G} \sum_g \widehat{W}_{US,g} - 1)$. The third column shows the coefficient of variation (CV), and for the fourth and fifth column we have $\text{Min.} \equiv \min_g 100(\widehat{W}_{US,g} - 1)$ and $\text{Max.} \equiv \max_g 100(\widehat{W}_{US,g} - 1)$, respectively. The final column displays the multi-sector ACR term $100 \left(\prod_s \widehat{\lambda}_{US,US,s}^{-\beta_{US,s}/\theta_s} - 1 \right)$. The values for $\hat{T}_{China,s}$ are calibrated for $\kappa = 1.5$. The third row has standard errors in parentheses, computed using the delta method and numerical derivatives with respect to $\hat{\beta} = 1/\hat{\kappa}$, for each statistic when $\kappa = 1.5$.

Figure: Geographical distribution of the welfare gains from the rise of China

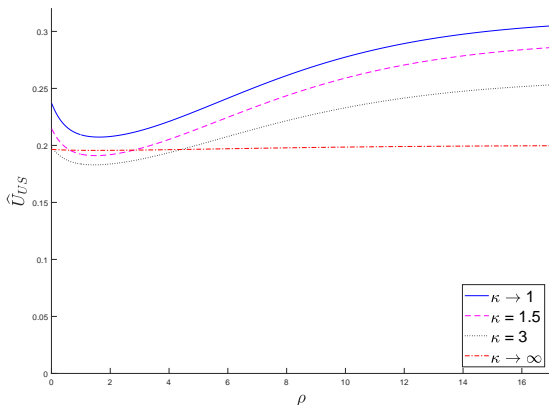


This figure plots the geographic distribution of $100(\hat{W}_g - 1)$, where \hat{W}_g are the welfare effects for group g in the US from the counterfactual rise of China, for our preferred value of $\kappa = 1.5$.

Import competition and relative income

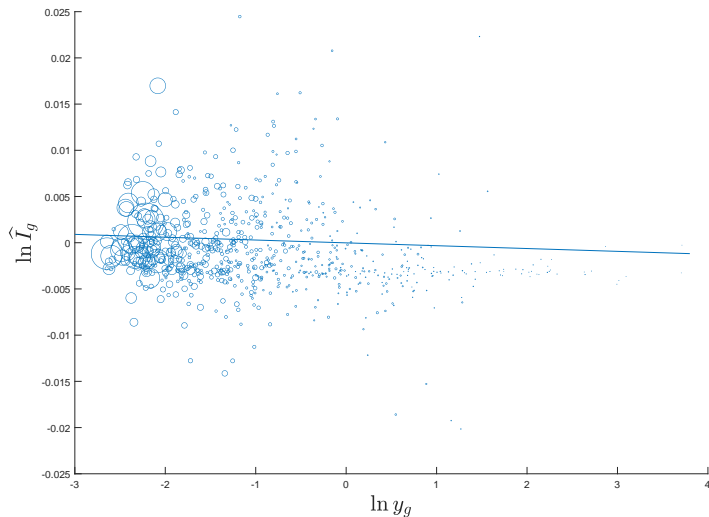


Inequality-adjusted welfare effects



The figure plots the relationship between \hat{U} , the inequality-adjusted welfare effects of the rise of China, with $U \equiv \left(\sum_g l_g W_g^{1-\rho} \right)^{1/(1-\rho)}$, and ρ which is the coefficient of relative risk aversion for the agent behind the veil of ignorance.

Initial income and changes in import competition

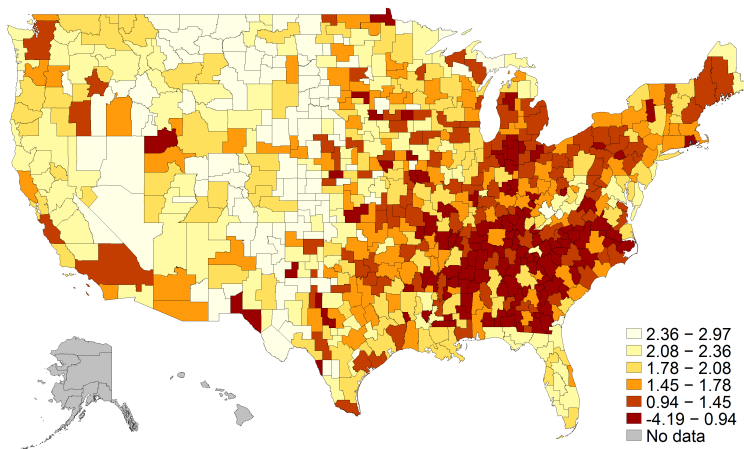


Counterfactual return to autarky

- The gains from trade are 1.56% for the US, with a CV of 63%.
- Losses from trade are particularly concentrated in Central and Southern Appalachia.
- The inequality-adjusted gains from trade are higher than the standard gains from trade.

Full results

Figure: Geographical distribution of the gains from trade



This figure plots the geographic distribution of $100(1 - \hat{W}_g)$, where \hat{W}_g are the welfare effects for group g in the US from a return to autarky for our preferred value of $\kappa = 1.5$.

Extensions

Introducing a Heckscher-Ohlin-type mechanism

- Differentiate between two types m of workers: college and non-college.
- Imperfect substitutes in production, with elasticity η .
- Sector-specific wages and employment shares now differ by worker type.
- χ_{ims} is the cost share of labor type m in sector is .
- Updated welfare expression:

$$\widehat{W}_{img} = \prod_s \hat{\lambda}_{iis}^{-\frac{\beta_{is}}{\theta_s}} \cdot \prod_s \hat{\tau}_{img_s}^{-\frac{\beta_{is}}{\kappa}} \cdot \prod_s \hat{\chi}_{ims}^{-\frac{\beta_{is}}{\eta-1}}$$

- $\prod_s \hat{\chi}_{ims}^{-\frac{\beta_{is}}{\eta-1}}$ captures the average change in the college-premium across sectors.

Roy-Fréchet + Heckscher-Ohlin

Table: Welfare effects of the China shock

	\widehat{W}_{US}	Mean	CV	Roy gains	College premium
$\kappa \rightarrow \infty; \eta = 1.6$	0.15	0.15	0.15	0.00	-0.03
$\kappa = 1.5; \eta = 1.6$	0.22	0.31	0.77	0.07	-0.01
	(0.02)	(0.04)	(0.17)	(0.03)	(0.02)
$\kappa = 1.5; \eta \rightarrow \infty$	0.22	0.32	0.73	0.07	0.00

Table: Gains from trade

	\widehat{W}_{US}	Mean	CV	Roy gains	College premium
$\kappa \rightarrow \infty; \eta = 1.6$	1.45	1.48	0.14	0.00	1.00
$\kappa = 1.5; \eta = 1.6$	1.56	1.60	0.47	0.11	0.10
	(0.05)	(0.06)	(0.18)	(0.05)	(0.09)
$\kappa = 1.5; \eta \rightarrow \infty$	1.56	1.49	0.59	0.11	0.00

Involuntary unemployment and voluntary non-employment

- Three stage model:
 - ▶ 1st stage: home production (HP) vs employment (Fréchet μ)
 - ▶ 2nd stage: choose which sector to seek employment (Fréchet κ)
 - ▶ 3rd stage: employed or unemployed in sector chosen
- Frictional matching leads to involuntary unemployment (Kim-Vogel '21)
 - ▶ The match probability increases with the real wage
 - ▶ Unemployment adjustment amplifies the impact of a shock

Unemployment and non-employment

- Updated welfare expression:

$$\widehat{W}_{ig} = \left(\pi_{igHP} + (1 - \pi_{igHP}) \hat{e}_{ig}^{\mu} \hat{\Phi}_{ig}^{\mu} \right)^{(1/\mu)},$$

- $\hat{\Phi}_{ig}$ captures country and group-level gains from specialization

$$\hat{\Phi}_{ig} = \prod_{s \in F} \hat{\lambda}_{iis}^{-\frac{\beta_{is}}{\theta}} \prod_{s \in F} \hat{\pi}_{igs}^{-\frac{\beta_{is}}{\kappa}},$$

- \hat{e}_{ig} comes from the solution to

$$\hat{e}_{ig}^{\mu/\alpha} = \pi_{igHP} + (1 - \pi_{igHP}) \hat{e}_{ig}^{\mu} \hat{\Phi}_{ig}^{\mu}.$$

Table: GMM Estimation of the Model with Unemployment and Non-employment

	(1)	(2)	(3)	(4)
$\ln \hat{E}$	0.985* (0.563)	2.398* (1.456)	4.389 (3.199)	1.002** (0.408)
$\ln \hat{\pi}_{HP}$	-0.312** (0.122)	-0.519 (0.369)	-0.760 (0.708)	-0.362*** (0.104)
$\ln \hat{\pi}_{NM}$	-0.633** (0.291)	-0.972** (0.409)	-1.001** (0.409)	-0.834** (0.258)
Implied α	0.504	0.294	0.186	0.499
Implied μ	3.209	1.927	1.316	2.759
Implied κ	1.579	1.029	0.999	1.199
Observations	1444	1444	1444	1444
Import Penetration	Other (lagged)	Other (no lag)	US (no lag)	US Bartik

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors are clustered at the state level, and we weight by 1990 commuting zone populations.

All log changes for the 2000–2007 period are multiplied by (10/7) to obtain decade-equivalent changes. Home production defined as not in the labor force (NiLF).

Table: Welfare effects with and without frictional unemployment and home production

	The rise of China			Gains from trade		
	\widehat{W}_{US}	Mean	CV	\widehat{W}_{US}	Mean	CV
no SAM, no HP	0.2150	0.294	1.010	1.556	1.556	0.626
with SAM, no HP	0.3240	0.443	1.001	2.325	2.327	0.616
with SAM & HP, $\mu = 1$	0.2116	0.288	1.022	1.531	1.529	0.626
with SAM & HP, $\mu = 2.5$	0.2121	0.288	1.011	1.521	1.520	0.618

The first three columns display the welfare effects for the counterfactual rise of China, while the final three columns show the gains from trade. Columns 1 and 4 displays, for the relevant worker type, the aggregate welfare effect in percentage terms $100(\widehat{W}_{US} - 1)$, and columns 2 and 5 show the mean welfare effect: $100(\frac{1}{G} \sum_g \widehat{W}_{US,g} - 1)$. The third column shows the coefficient of variation (CV). For the gains from trade, we simulate the return to autarky, and for that simulation report the negative of the above statistics.

Conclusion

- Framework to study aggregate and distributional effects of trade.
- Welfare effects are summarized in a parsimonious equation that nests the multi-sector ACR result.
- Key additional parameter κ governs strength of distributional effects.
- Estimate κ combining ADH Bartik strategy with structural equation from model, $\kappa \approx 1.5$.
- Counterfactual analysis reveals that China shock increases average welfare, but some groups experience losses more than six times the average gain.
- Adjusted for plausible measures of inequality aversion, gains in social welfare remain positive, and deviate only slightly from the standard aggregation.

Improving model fit

- This model appears to understate the distributional effects compared to the data.
- Four complementary approaches to address this:
 - ▶ Amplification on intensive and extensive margin (Galle-Lorentzen 2023)
 - ▶ Account for decline in the labor share in manufacturing through automation (Galle-Lorentzen 2023)
 - ▶ Introduce downward nominal wage rigidity (Rodríguez-Clare - Ulate - Vasquez 2022)
 - ▶ Agglomeration forces and spatial spillovers (Adao-Arkolakis-Esposito 2022)

Background

Equilibrium

- Excess demand for efficiency units in sector s of country i is

$$ELD_{is} \equiv \frac{1}{w_{is}} \sum_j \lambda_{ijs} \beta_{js} Y_j - \sum_g E_{igs}$$

▶ Effective labor units: $E_{igs} = \eta_{ig} \frac{\Phi_{ig}}{w_{is}} \pi_{igs} L_{ig}$

- λ_{ijs} , Y_j and E_{igs} are functions of the whole matrix of wages $\mathbf{w} \equiv \{w_{is}\}$, so system $ELD_{is} = 0$ for all i, s determines all wages \mathbf{w}

▶ Graphically

▶ Comparative Statics

▶ Back

Comparative Statics: Wages

- Foreign shock: $\hat{T}_{is}, \hat{\tau}_{ijs} \neq 1$ for $i \neq j$ ($\hat{x} \equiv x'/x$)
- Using $ELD_{is} = 0$, we can write $ELD'_{is} = 0$ as

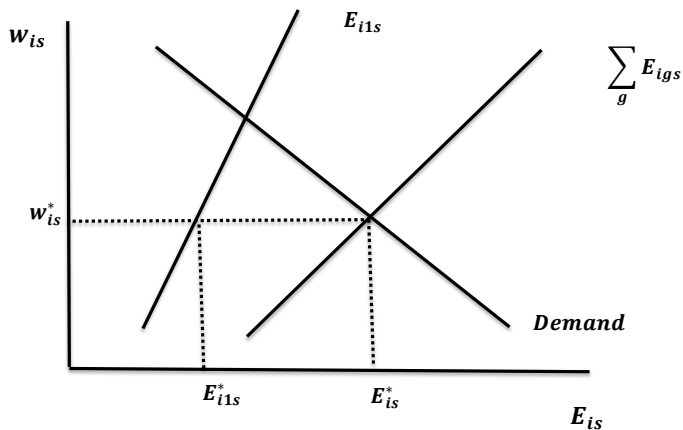
$$\sum_g \hat{\pi}_{igs} \hat{\Phi}_{ig} \pi_{igs} Y_{ig} = \sum_j \hat{\lambda}_{ijs} \lambda_{ijs} \beta_{js} \sum_g \hat{\Phi}_{jg} Y_{jg}$$

with

$$\hat{\Phi}_{ig} = \left(\sum_k \pi_{igk} \hat{w}_{ik}^\kappa \right)^{1/\kappa},$$

$$\hat{\lambda}_{ijs} = \frac{\hat{T}_{is} (\hat{\tau}_{ijs} \hat{w}_{is})^{-\theta_s}}{\sum_k \lambda_{kjs} \hat{T}_{ks} (\hat{\tau}_{kjs} \hat{w}_{ks})^{-\theta_s}},$$

$$\hat{\pi}_{igs} = \frac{\hat{w}_{is}^\kappa}{\sum_k \pi_{igk} \hat{w}_{ik}^\kappa}$$

Supply and Demand of E_{is} 

Derivation of estimation equation

- Labor Share: $\pi_{gs} = \frac{A_{gs} w_s^\kappa}{\Phi_g^\kappa}$
- Hat algebra and rearranging: $\hat{\Phi}_g^\kappa = \frac{\hat{A}_{gs} \hat{w}_s^\kappa}{\hat{\pi}_{gs}}$
- Taking logs, noting that $\hat{y}_g = \hat{\Phi}_g$ and applying to sector *NM*:

$$\ln \hat{y}_g = \ln \hat{w}_{NM} - \frac{1}{\kappa} \ln \hat{\pi}_{gNM} + \varepsilon_{gNM},$$

- Focus on non-manufacturing since it is the only sector with sufficiently strong first stage
- Alternative estimation equation: $\ln \hat{y}_g = \alpha - \frac{1}{\kappa} \ln \Pi_s \hat{\pi}_{gs} + \varepsilon_g$
 - ▶ yields somewhat higher estimates of κ

[Back](#)

Exclusion restriction

- Control for observables: $\varepsilon_{gt} = X'_{gt}\Theta + \epsilon_{gt}$
- Updated exclusion restriction:

$$\text{cov}(Z_{gt}, \epsilon_{gt}) = \sum_{s \in M} \Delta IP_{st}^{China \rightarrow Other} \mathbb{E} [\pi_{gst-10} \mathbb{E}[\epsilon_{gt} | \boldsymbol{\pi}_{gt-10}]] = 0,$$

- Two ways of satisfying this restriction:
 - ▶ $\mathbb{E} [\pi_{gst-10} \mathbb{E}[\epsilon_{gt} | \boldsymbol{\pi}_{gt-10}]] = 0$ for all s (Goldsmith-Pinkham et al. 2018)
 - ▶ $\text{cov}(Z_{gt}, \epsilon_{gt}) = \sum_{s \in M} \Delta IP_{st}^{China \rightarrow Other} \mathbb{E} [\pi_{gst-10} \epsilon_{gt}] \rightarrow 0$ (Borusyak et al. 2018)
 - This restriction relates to the ADH argument on the exogeneity of the China shock

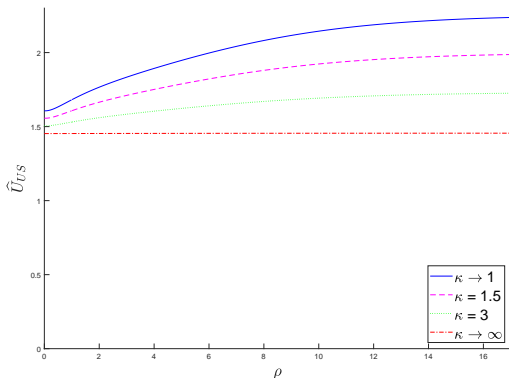
Counterfactual return to autarky

Table: Aggregate and Group-level Gains from Trade

→ 1	1.61	1.61	0.90	-7.95	3.81	1.45
1.5	1.56	1.56	0.63	-4.82	3.03	1.45
	(0.05)	(0.05)	(0.26)	(2.85)	(0.71)	(0)
3.0	1.50	1.50	0.33	-1.68	2.24	1.45
→ ∞	1.45	1.45	0	1.45	1.45	1.45

The first column displays the aggregate gains from trade for the US, in percentage terms ($100(1 - \widehat{W}_{US})$) and the second column shows the mean welfare effect: $100(\frac{1}{G} \sum_g 1 - \widehat{W}_{US,g})$. Here, \widehat{W}_{US} and $\widehat{W}_{US,g}$ are the aggregate and group-level welfare change from a return to autarky for the US. The third column shows the coefficient of variation (CV), and for the fourth and fifth column we have $\text{Min.} = \min_g 100(1 - \widehat{W}_{US,g})$ and $\text{Max.} = \max_g 100(1 - \widehat{W}_{US,g})$, respectively. The final column displays the multi-sector ACR term $100 \left(1 - \prod_s \widehat{\lambda}_{US,US,s}^{-\beta_{US,s}/\theta_s} \right)$. [Back](#)

Inequality-adjusted Gains from Trade



The figure plots the relationship between the inequality-adjusted gains from trade $\hat{U}_{US} \equiv \left(\sum_g \omega_g \hat{W}_g^{1-\rho} \right)^{\frac{1}{1-\rho}}$ and ρ . Here, ρ is the coefficient of relative risk aversion for the agent behind the veil of ignorance and $\omega_g \equiv \frac{l_g (Y_g/L_g)^{1-\rho}}{\sum_h l_h (Y_h/L_h)^{1-\rho}}$ a modified weight for group g . The vertical axis displays $100(1 - \hat{U}_{US})$. [Back](#)

Income and import competition

