A Presentation on ‘Slicing the Pie: Quantifying the Aggregate Distributional Effects of Trade’, by Galle, Rodriguez-Clare, and Yi (2017)

Nicholas A Potter

November 4, 2018

- **Galle, Simon, Andres Rodriguez-Clare, and Moises Yi**. Slicing the pie: Quantifying the aggregate and distributional effects of trade. Working Paper No. w23737. National Bureau of Economic Research, 2017.

Research Question

What are the welfare effects of trade: who gains, who loses, by how much, and under what conditions? - Autor, Dorn, and Hanson (2013)

Model Background

The model combines:

- A multi-sector gravity model based on Eaton and Kortum (2002) as in Costinot, Donaldson, and Komunjer (2012).
- Heterogenous labor as in Lagakos and Waugh (2013).
- Different labor groups that differ in their comparative advantage across sectors.

Multi-sector gravity model

There are $i = \{1 \dots N\}$ countries and $s = \{1 \dots S\}$ sectors, with each sector modeled as in Eaton and Kortum (2002):

- iceberg costs τ_{ijs}.
- sector-specific productivity $y_{ijs} = a_{is}(x) l_{ijs} / \tau_{ijs}$.
- a_{is} is drawn from a Fr$\acute{e}$chet distribution with shape parameter θ_s and scale parameter T_{is}.

$$a_{is} \sim F_{is}(a|\theta_s, T_{is}) = e^{-\theta_s a^{-T_{is}}}$$

Heterogeneous labor

- Each country has G_i groups of labor.
- Workers in group ig draw efficiency units z_s for each sector s from a Fr$\acute{e}$chet distribution with shape parameter $\kappa_{ig} > 1$ and scale parameter A_{igs}.
- Workers choose to work in the sector that maximizes income, i.e. they choose s such that $w_{is}z_{is} \geq w_{ik}z_{ik} \; \forall \; k$.

$$z_{is} \sim F_{ig}(z|\kappa_{ig}, A_{igs}) = e^{-\kappa_{ig} z^{-A_{igs}}}$$

Wages

- Workers are hereogeneous within groups due to efficiency draw, but also between groups due to drawing from different distributions.
- Wages can differ across sectors due to heterogeneity of z_s.
- Wages cannot differ across groups because production technologies and goods prices are national.

Model

Preferences *across goods within a sector* are CES. Preferences *across sectors* are Cobb-Douglass with shares β_{is}, so that the worker in country i working for industry s chooses $c_i(x)$ to solve

$$\max \prod_{s=1}^{S} \left(\int_0^1 c_{is}(x)^{\rho_{is}} dx \right)^{\frac{\beta_{is}}{\rho_{is}}}$$

$$\sum_{s=1}^{S} \int_0^1 \hat{p}(x) c_i(x) dx = \hat{w}_{is} z_{is},$$

where $\sum_{s=1}^{S} \beta_{is} = 1 \ \forall \ i$.

Model: Technology

$$\hat{y}_{ijs}(x) = a_{is}(x)\hat{l}_{ijs}/\tau_{ijs},$$

where τ_{ijs} is the iceberg cost of exporting from country i to country j for sector s.

Model: Profit maximizing conditions

$\hat{p}_{js} \leq \hat{w}_{is}\tau_{ijs}/a_{is}(x)$, with equality if $\hat{y}_{ijs}(x) > 0$.

Model equilibrium: Gravity

In Galle et al.:

$$\lambda_{ijs} = \frac{T_{is}(\tau_{ijs} w_{is})^{-\theta_s}}{\sum_{m=1}^{n} T_{ms}(\tau_{ms} w_{ms})^{-\theta_s}}$$

In Eaton Kortum:

$$X_{ij} = \frac{Y_i Y_j \left(\frac{\tau_{ij}}{P_j}\right)^{-\theta}}{\sum_{m=1}^{n} Y_m \left(\frac{\tau_{im}}{P_m}\right)^{-\theta}}$$

- λ_{ijs} is the share of expenditures by country i on goods from sector s from country j.
- X_{ij} is expenditures by country i for goods from country j.

Model equilibrium: Labor

Share of workers in group ig choosing to work in sector s:

$$\pi_{igs} \equiv \int_{\Omega_{is}} dF_{ig}(z) = \frac{A_{igs} w_{is}^{\kappa_{ig}}}{\Phi_{ig}^{\kappa_{ig}}},$$

where $\Phi_{ig}^{\kappa_{ig}} = \sum_k A_{igk} w_{ik}^{\kappa_{ig}}$.

Model equilibrium: Labor

Supply from group ig to sector s is

$$E_{igs} \equiv L_{ig} \int_{\Omega_{is}} z_s dF_{ig}(z) = \eta_{ig} \frac{\Phi_{ig}}{w_{is}} \pi_{igs} L_{ig},$$

where $\eta_{ig} \equiv \Gamma(1 - 1/\kappa_{ig})$.

Model equilibrium: Labor

- Income levels per worker are equalized between sectors:

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

- Income of group ig is $Y_{ig} \equiv \sum_s w_{is}E_{igs} = \eta_{ig}L_{ig}\Phi_{ig}$
- Income of country i is $Y_i \equiv \sum_{g \in G_i} Y_{ig}$

Trade imbalances

As in Dekle, Eaton, and Kortum (2008):

$$X_j = Y_j + D_j, \text{ with } \sum_j D_j = 0,$$

where

- X_j is expenditure in sector j.
- Y_j is income in sector j.
- D_j is a trade imbalance transer.

Equilibrium

Excess demand for efficiency units in sector s of country i:

$$ELD_{is} \equiv \frac{1}{w_{is}} \sum_{j} \lambda_{ijs} \beta_{js} X_j - \sum_{g \in G_i} E_{igs} = 0$$

Group-level welfare effects

Proposition 1: Given a shock to trade costs or foreign technology levels, the ex-ante percentage change in real wage of group ig is

$$\hat{W}_{ig} = \prod_s \hat{\lambda}_{iis}^{-\beta_{is}/\theta_s} \cdot \prod_s \hat{\pi}_{igs}^{-\beta_{is}/\kappa_{ig}}.$$

- The first term is the change in real income given wages.
- The second term is the change for a specific group given changes in specific sectors, i.e. the distribution of labor from group ig to sectors $s \in S$.

Group-level welfare effects

The effect of a trade shock on a particular group ig is determined by the degree of specialization by that group.

- A group specialized in textiles would become less specialized and gain less from trade if a trade shock leads to importing relatively more textiles.

Aggregate welfare effects

$$\hat{W}_i = \prod_s \hat{\lambda}_{iis}^{-\beta_{is}/\theta_s} \cdot \sum_{g \in G_i} \left(\frac{Y_{ig}}{Y_i} \right) \prod_s \hat{\pi}_{igs}^{-\beta_{is}/\kappa_{ig}}$$

- Aggregate welfare is dependent on income and sector-level prices.

Gains from trade

Define gains from trade as

$$GT_i \equiv 1 - \hat{W}_i^A \text{ and } GT_{ig} \equiv 1 - \hat{W}_{ig}^A$$

Inequality-adjusted welfare effects

Let $\rho > 0$ be the degree of inequality aversion, then social welfare in country i is

$$\hat{U}_i = \left(\sum_g w_{ig} \hat{W}_{ig}^{1-\rho} \right)^{\frac{1}{1-\rho}}.$$

Data

- 1,444 groups in the U.S. are defined by commuting zone and whether or not workers have at least an associates degree.
- Groups are assumed fixed, which is reasonable given little evidence of migration or education in response to trade exposure.
- 13 manufacturing sectors and 1 non-manufacturing sector (excluding public administration and non-profit).
- Time period is 2000-2011.

Empirical approach

- Instrument China import penetration shock as changes in sector-level exports from China to countries similar to the U.S.
- This captures the rise of China manufacturing but not U.S.-specific endogeneity.
- Estimate the effect of the China shock on group-level income

China shock instrument as

$$\Delta IP_{st}^{China \to Other} \equiv \frac{\Delta M_{st}^{China \to Other}}{L_{st_0}^{US}}$$

.

Empirical approach

$$\ln \hat{y}_g = \alpha + \beta \sum_{s \in M} \pi_{gs}^{M} \Delta IP_s^{China \to Other} + \varepsilon_g,$$

where:

- $y_g \equiv Y_g / L_g$ is average labor income in group g.
- $\pi_{gs}^{M} \equiv \pi_{gs} / \pi_{gM}$ is the share of labor employed in manufacturing sector s relative to total manufacturing employment.

The rise of China

Table 1: Reduced-form impact of the rise of China

(a) Dependent variable: $\ln \hat{y}_g$

	(1)	(2)	(3)
Definition of π_{gs}	Workers	Hours	Earnings
$\sum_{s\in M} \pi_{gs}^{M} \Delta IP_{st}^{China\to Other}$	-0.00248	-0.00548	-0.000976
	(0.00116)	(0.00251)	(0.000474)
Observations	1444	1444	1444

(b) Dependent variable: $\ln \hat{\pi}_{gNM}$

	(1)	(2)	(3)
	Workers	Hours	Earnings
$\sum_{s\in M} \pi_{gs}^{M} \Delta IP_{st}^{China\to Other}$	0.00532	0.0111	0.00191
	(0.00110)	(0.00245)	(0.000606)
Observations	1444	1444	1444

$\ln \hat{y}_g$ is log change in average earnings per worker and $\ln \hat{\pi}_{gNM}$ is the log change in the labor share of the non-manufacturing sector.

Estimation of

- As $\kappa \to 1$, labor becomes increasingly sector-specific.
- As $\kappa \to \infty$, labor is perfectly mobile between sectors.
- Empirical estimation is $\kappa \sim 2$ (see Table 2 of Galle, Rodríguez-Clare, and Yi (2017)), implying that **labor is not very mobile between sectors**.

The rise of China: Calibration

Galle, Rodríguez-Clare, and Yi (2017) model the China shock as sector-specific technology shocks, $\hat{T}_{China,s}$.

where $\hat{T}_{China,s}$ is determined by the change in U.S. expenditure shares on Chinese goods

Recall that T is the shape parameter for the distribution of productivities.

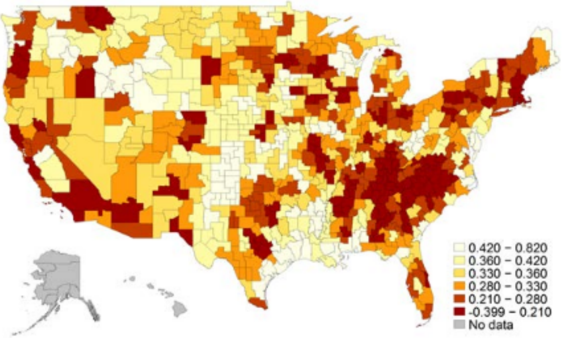
The rise of China: Welfare effects

Table 3: The Welfare Effects of the China Shock on the US

κ	$\widehat{W}_{US}$	Mean	CV	Min.	Max.	$\prod_s \widehat{\lambda}_s^{-\beta_s/\theta_s}$
$\to 1$	0.29	0.38	0.87	-2.24	2.56	0.20
2	0.25	0.32	0.56	-1.64	1.34	0.20
4	0.23	0.28	0.36	-1.01	0.76	0.21
$\to \infty$	0.24	0.24	0.00	0.24	0.24	0.24

The rise of China: Welfare effects

Figure 1: Geographical distribution of the welfare gains from the rise of China



(a) Low-educated workers

Impacts: The rise of China

Table 4: The rise of China and the Bartik measure for import competition

(a) First Stage: $\ln \sum_s \pi_{gs}\hat{r}_s = \alpha + \beta \sum_{s\in M} \pi_{gs}^M \Delta IP_{st}^{China\to Other} + \varepsilon_g$

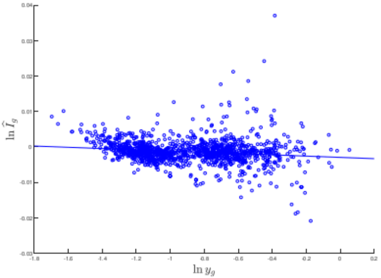
	(1)	(2)	(3)
Definition of π_{gs}	Workers	Hours	Earnings
$\sum_{s\in M} \pi_{gs}^M \Delta IP_{st}^{China\to Other}$	-0.00348	-0.00779	-0.00151
	(0.000982)	(0.00218)	(0.000505)
F Statistic	12.52	12.71	8.924

(b) Second Stage: $\ln \hat{y}_g = \alpha + \beta \ln \sum_s \pi_{gs}\hat{r}_s + \varepsilon_g$

	(1)	(2)	(3)
$\ln \sum_s \pi_{gs}\hat{r}_s$	0.712	0.703	0.648
	(0.228)	(0.221)	(0.212)
Observations	1444	1444	1444

Impacts: The rise of China

Figure 4: Initial group-level income and our Bartik measure of import competition



Impacts: Gains from trade

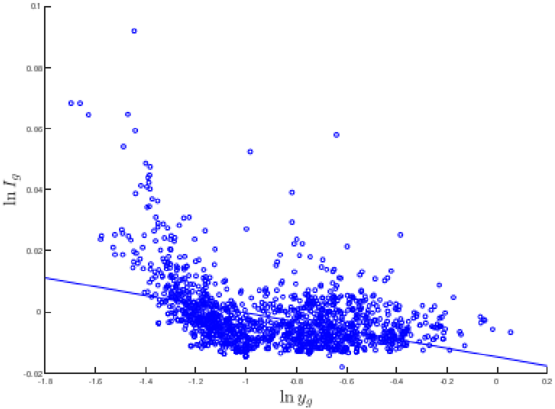
- Negative of the impact of a counterfactual move back to Autarky.

Table 5: Aggregate and Group-level Gains from Trade

κ	$\widehat{W}_{US}$	Mean	CV	Min.	Max.	$\prod_s \widehat{\lambda}_s^{-\beta_s/\theta_s}$
$\to 1$	1.60	1.80	0.59	-7.86	3.36	1.45
2	1.52	1.63	0.33	-3.19	2.41	1.45
4	1.48	1.54	0.18	-0.87	1.93	1.45
$\to \infty$	1.45	1.45	0.00	1.45	1.45	1.45

Impacts: Gains from trade

Figure 6: Group-level Import Competition and Income



Extension: Intermediate goods

- Allow wages to vary by sector (w_i becomes w_{is}).
- Gains from the China shock are 0.34%.
- Gains from trade are 2.98%.
- The distribution effects are mitigated, with lower CV and more compressed group-level welfare effects.

Extension: Within-US trade costs

- Trade costs between states are non-zero.
- Overall welfare gains are smaller than in the baseline model (0.23% versus 0.32%).
- Distribution of gains is more dispersed. CV is 0.44 versus 0.33 and the range of group-level gains from trade is [-4.24, 2.90] versus [-3.19, 2.41].

Extension: Employment effects

- Current model does not allow for mobility across groups or regions.
- Since literature suggests only a weak relationship between mobility and trade, employment effects are likely minimal.

"To us, this suggests the need to entertain some kind of labor market friction that can generate involuntary unemployment in response to a negative trade shock." –Galle, Rodríguez-Clare, and Yi (2017)

References

Autor, David H, David Dorn, and Gordon H Hanson. 2013. "The China Syndrome: Local Labor Market Effects of Import Competition in the United States." *American Economic Review* 103 (6). American Economic Association:2121–68. https://doi.org/10.1257/aer.103.6.2121.

Costinot, A., D. Donaldson, and I. Komunjer. 2012. "What Goods Do Countries Trade? A Quantitative Exploration of Ricardo's Ideas." *The Review of Economic Studies* 79 (2). Oxford University Press (OUP):581–608. https://doi.org/10.1093/restud/rdr033.

Dekle, Robert, Jonathan Eaton, and Samuel Kortum. 2008. "Global Rebalancing with Gravity: Measuring the Burden of Adjustment." *IMF Staff Papers* 55 (3). Springer Nature:511–40. https://doi.org/10.1057/imfsp.2008.17.

Eaton, Jonathan, and Samuel Kortum. 2002. "Technology, Geography, and Trade." *Econometrica* 70 (5). The Econometric Society:1741–79. https://doi.org/10.1111/1468-0262.00352.

Galle, Simon, Andrés Rodríguez-Clare, and Moises Yi. 2017. "Slicing the Pie: Quantifying the Aggregate and Distributional Effects of Trade." National Bureau of Economic Research. https://doi.org/10.3386/w23737.

Lagakos, David, and Michael E Waugh. 2013. "Selection, Agriculture, and Cross-Country Productivity Differences." *American Economic Review* 103 (2). American Economic Association:948–80. https://doi.org/10.1257/aer.103.2.948.