MIT 14.662 Spring 2026 – Lecture Slides 11
Trade and (Local) Labor Markets

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Lecture roadmap

1. **Why trade is a labor topic**
   - Place-based questions; China shock as motivating example
2. **Building the Ricardian-Gravity framework**
   - Ricardo $\rightarrow$ DFS $\rightarrow$ Eaton-Kortum: deriving gravity
3. **The China Shock and local labor markets**
   - From E-K to ADH; empirical results on employment, wages, transfers
4. **Welfare and distributional effects**
   - Aggregate gains (small) vs. variance across places (large)

Agenda

1. **Why trade is a labor topic**

2. **Building the Ricardian-Gravity Framework**
   - Ricardo's model of comparative advantage—and its limitations (Ricardo 1817)
   - Adding a continuum of goods + trade costs (Dornbusch, Fischer, Samuelson *AER* '77
   - Adding many countries and stochastic productivity (Eaton-Kortum *ECTA* '02)
   - Who buys what from whom? Trade flows & expendiuture shares
   - Closing the model
   - Explaining stylized/motivating fact patterns

3. **The China Shock and Local Labor Markets**
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   - Aggregate gains and local losses

Trade and (local) labor markets: Why is this a labor topic?

Many labor market questions are about 'place'

1. How does an external shock—trade shock, immigration shock, tax subsidy—affect employment and wages of people in a location?
2. Why are U.S. state and city-level GDP per capita levels failing to converge in the post-1980 era after converging rapidly in the first three post-War decades?
3. Why are jobless rates persistently higher in some locations than others?
4. What are the effects of places on people? Large influential literature most associated with Chetty, Hendren, and Katz (though that is not our topic here)

Trade and (local) labor markets: Why is this a labor topic?

Many labor market questions are about 'place'

These 'placial economics' questions encompass

- Trade
- Immigration
- Spatial equilibrium
- Zillions of public policies

Trade and (local) labor markets: Why this is a labor topic

- **Many labor market questions are about 'place'**
- **These 'placial economics' questions encompass**
  - Trade
  - Immigration
  - Spatial equilibrium
  - Zillions of public policies
- **What makes them challenging**
  1. They are not person-level treatments: SUTVA clearly violated
  2. They involve some notion of local equilibrium
  3. But we can't think of local equilibrium without its relationship to external (general) equilibrium since most 'places' are not closed economies—trade, migration, etc

Trade and (local) labor markets: What we need and where we're going

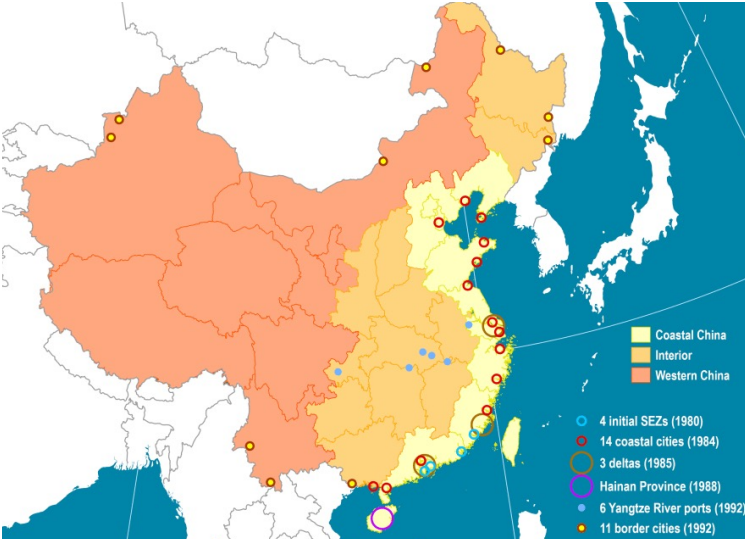
- **To study these questions, we need**
  1. Models that guide thinking on how product markets are linked to labor markets (AKA, trade models)
  2. Models of spatial equilibrium that explore why places might differ, why these differences may persist, and whether or not these differences are 'efficient' vs. a market or coordination failure

- **Agenda**
  1. **Start** by linking trade $\rightarrow$ comparative advantage of countries/places $\rightarrow$ local labor demand
  2. **Next** consider how places are linked by geography as well as by trade
  3. Develop **evidence**: trade shocks and local labor markets; immigration, wages, and tradability

The motivating case: China's spectacular rise

Deng Xiaoping, led PRC 1978–1989

Right panel: Special Economic Zones

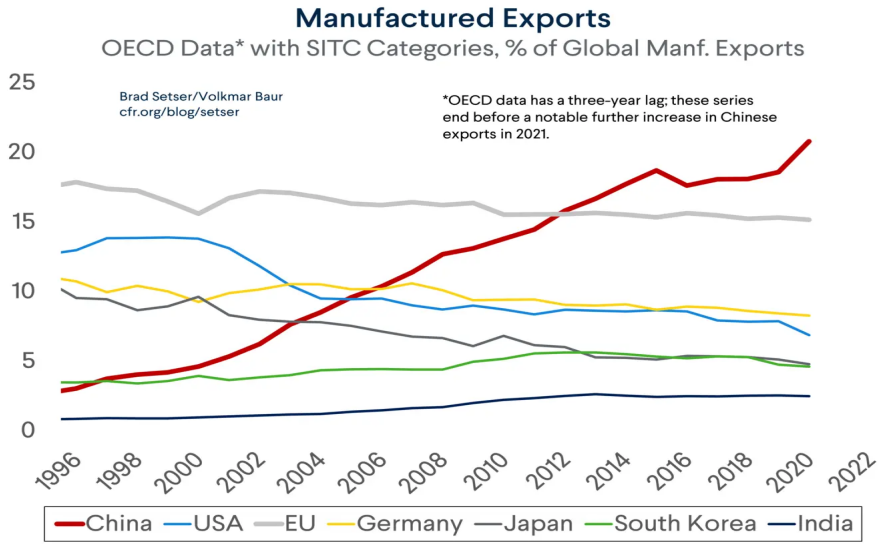


The rise of China since the early 1990s

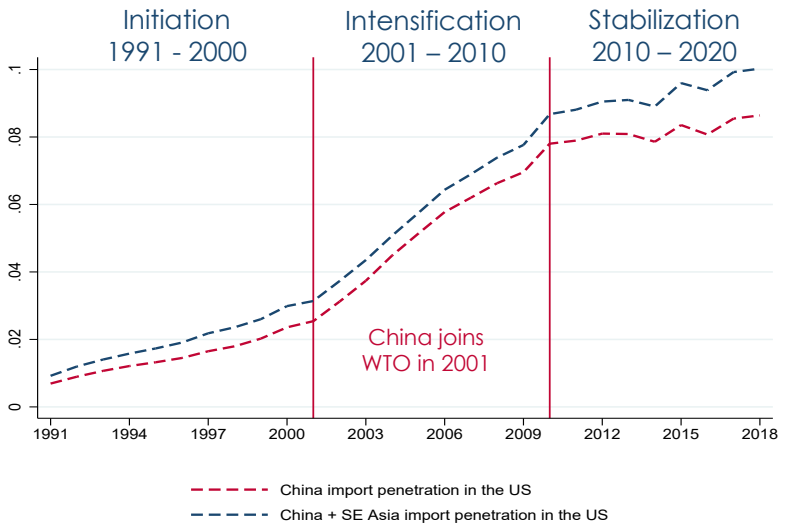
"Reform and Opening" → Surge in Chinese manufacturing

- 1984: Opening to trade and Foreign Direction Investment
- 1991–1994: Inward FDI in China grew from 1% to 6% of GDP
- 1992: Marketization, privatization, easing controls on labor mobility
- 1998 to 2007: Average manufacturing TFP growth 8.0% per year (Brandt, van Biesebroeck and Zhang '12)

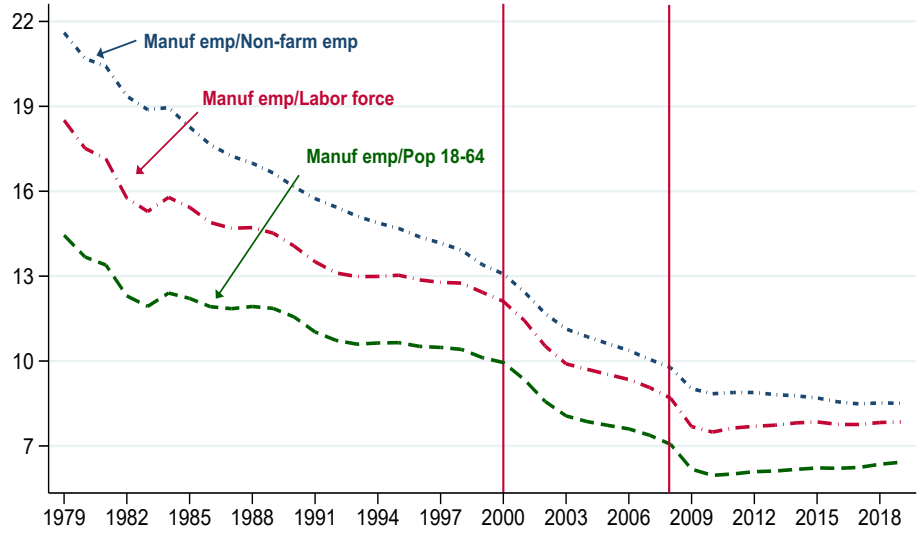
China's share of world manufacturing exports, 1996 – 2022



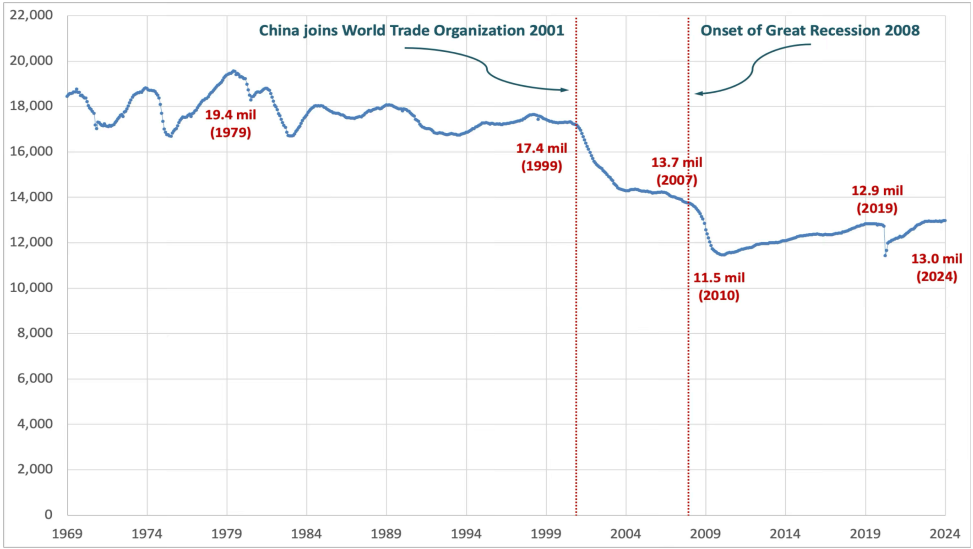
China's penetration of US market (share of manufacturing absorption): three eras



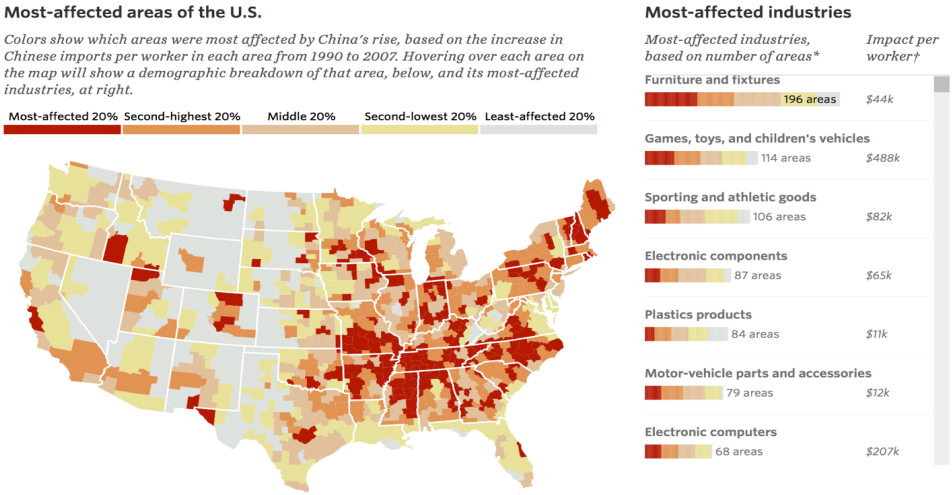
The share of US employment in manufacturing, 1939 – 2014



U.S. manufacturing employment fell by 20% during 1999-2007, and by 32% during 1999-2016



Unequal gains: Parts of US most affected by China's rising manufacturing prowess, 1990 – 2007



Autor, Dorn, Hanson & *Wall Street Journal*, 2016

Connecting trade flows to labor markets

How do trade flows affect (or reflect) domestic labor demand?

1. What do trade *flows* tell us about labor demand?
2. How does productivity growth in one country affects labor markets in others?
3. Are trade deficits relevant/irrelevant for labor markets?

Evidence

- Do workers suffer earnings or employment losses?
- Do they change employers, change industries, or change sectors?
- Which workers adjust most or least successfully—and why?
- How do aggregate impacts differ from individual impacts?
- See Autor Dorn Hanson '13 '14 '25, Pierce and Schott '16, many recent papers
- Can policy help workers adjust? (see Hyman, Kovak, Leive '24)

Where we're headed

To understand how trade affects labor markets, we need a framework for:

1. Understanding why countries trade
2. Predicting who trades what with whom
3. Explaining how trade patterns change with productivity and costs
4. Connecting trade flows to labor demand

The Ricardian-Gravity framework provides these foundations

- Start with Ricardo's 2×2 insight
- Add DFS continuum of goods, then E-K stochastic productivity
- Result: gravity equation linking trade to labor demand

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Some key stylized facts about trade: True across and within countries

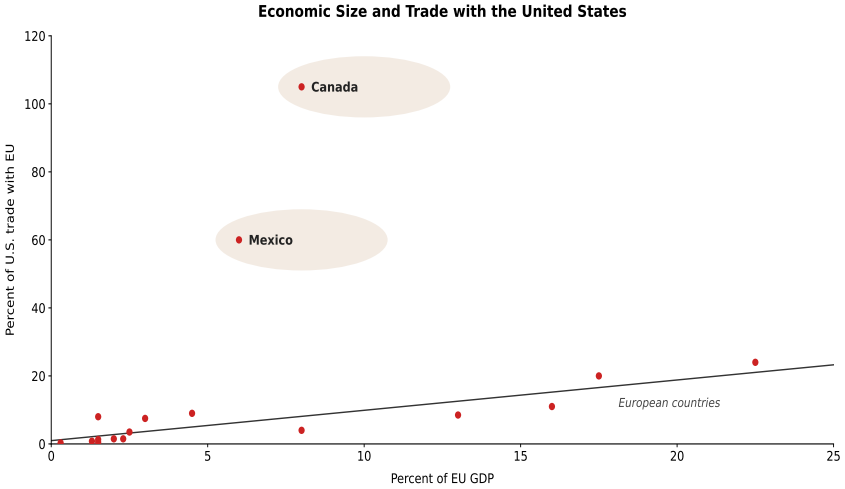
Some fact patterns that were recognized long before they were understood

1. Trade between countries diminish with distance (doh!)
2. Prices vary across locations, with greater price differences between countries that are further apart (doh!)
3. All countries import more from larger countries
4. Large countries trade *less* relative to GDP

We'll return to explain each of these once we've developed the Eaton-Kortum framework

Countries trade more with their neighbors

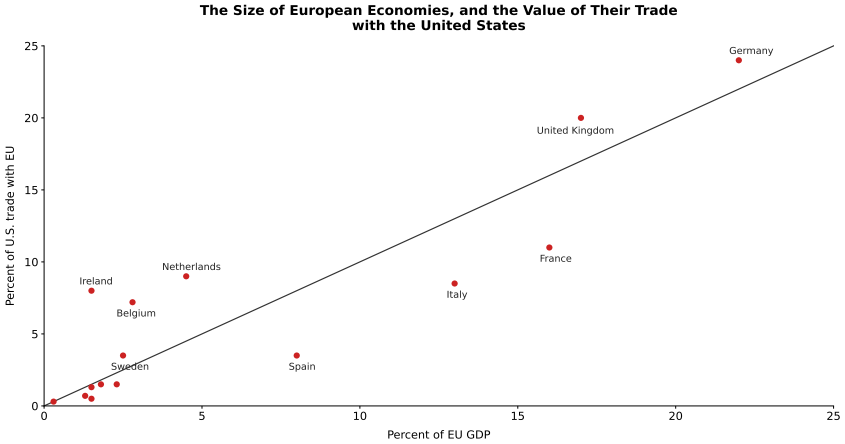
The United States does markedly more trade with its neighbors than it does with European economies of the same size.



Source: U.S. Department of Commerce, European Commission.

Countries import more from larger countries

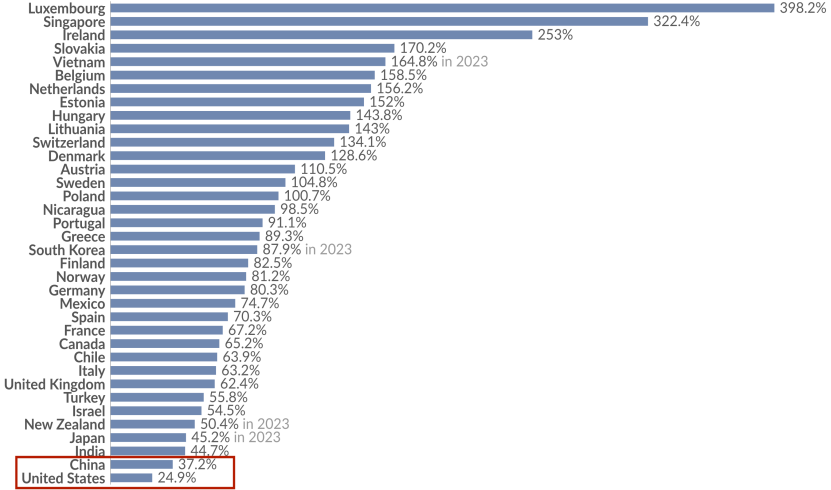
Countries' Percent of U.S. Trade with EU versus Countries' Percent of EU GDP



Source: U.S. Department of Commerce, European Commission.

Large countries trade less as a share of GDP (2024 data)

Sum of exports and imports of goods and services, divided by gross domestic product, expressed as a percentage. This is also known as the "trade openness index".



Data source: National statistical organizations and central banks, OECD national accounts, and World Bank staff estimates (2025)

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Ricardian model of comparative advantage (1817)

Key ingredients

- Two countries: England and Portugal
- Two goods: Wine and cloth
- Ricardo showed both countries could be made better off by trading if their relative productivity in wine and cloth differed

Limitations of the Ricardian model

1. Cannot be readily extended to multiple goods
2. Cannot be readily extended to multiple countries
3. No role for transportation costs in affecting trading patterns or prices
4. Partial equilibrium: not clear how exchange rate is set between England and Portugal

Ricardo's brilliant insight produced a framework that was an analytic nightmare

- Highly recommend Eaton and Kortum. 2012. *Journal of Econ Perspectives* "Putting Ricardo to Work"

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Adding many goods: Dornbusch, Fischer, Samuelson AER '77

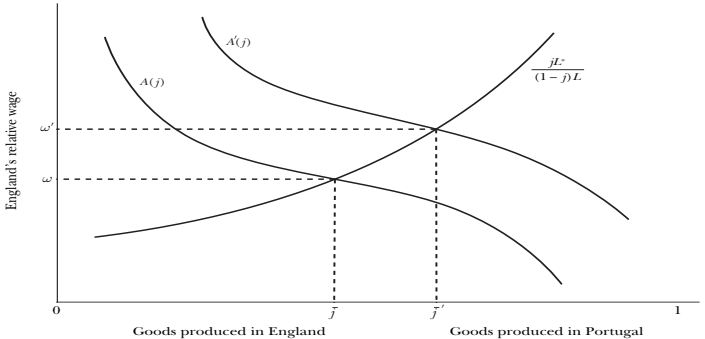
- Idea: a *continuum* of goods
- Goods j arrayed on the unit interval $j \in [0,1]$ where
  - Let $a_K(j)$ equal the productivity (inverse of labor requirements) of country k in good j
  - The ratio $A(j) = a_E(j)/a_P(j)$ is non-increasing in j
  - $A(j)$ is smooth and strictly decreasing
  - Thus, England's comparative advantage is *falling* in the index j
- In this formulation, chain of comparative advantage has no flat spots—always a *marginal good* that is equally costly to produce in both countries.
- If $w_P = 1$, the marginal good $\bar{j}$ satisfies

$$w_E \cdot a_E(\bar{j}) = w_P a_P(\bar{j}) = a_P(\bar{j})$$
$$w_E = a_P(\bar{j})/a_E(\bar{j})$$

(where E is England and P is Portugal)

Wage determination with a continuum of goods

Figure 2
Wage Determination with a Continuum of Goods



Source: Authors.
Notes: On the *x*-axis is a continuum of goods from 0 to 1 with England having the strongest comparative advantage in goods nearer 0 and Portugal in goods nearer 1. England produces the goods from 0 to $\bar{j}$. Portugal produces the goods from $\bar{j}$ through 1. The figure illustrates how a shift up in the productivity curve $A(j)$, meaning that England gets relatively more productive at making every good, raises England's relative wage ω and expands the share of goods it produces. A partial derivation for the equation describing the upward-sloping curve is provided in footnote 2.

If England becomes more productive, England's share of goods produced rises, **wage in England rises**. If English labor supply expands without an increase in productivity, England produces larger share of goods but **English wage falls**

Step 2: Adding trade costs

How do we know that trade costs matter?

1. Most countries consume a disproportionate share of their own output
2. Distant countries trade less with one another
3. Remote countries trade less with everyone

Trade costs imply

- 'Perfect' competition does *not* imply law of one price across markets
- Same good can have different prices in different markets.
- Low-cost producer of a good for one country may not be the low-cost producer for another country

Step 2: Adding trade costs

DFS modeled trade costs as 'iceberg' transportation costs

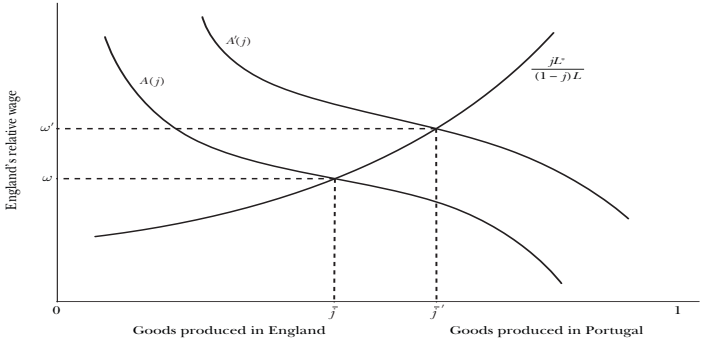
- A fraction of cargo decays (melts) in transit
- Amount of decay is proportional to transit time or distance

Formally, DFS assume

- Delivering one unit of a good from country i to k requires shipping $d_{ik} > 1$ units of the good
- d_{ik} differs among country pairs
- Usually assumed that d does not differ among goods *within* a country pair, but this can be relaxed
- Triangle inequality: $d_{ik} \times d_{km} \geq d_{im}$ (a no-arbitrage condition)

Trade costs introduce a non-traded region in Dornbusch-Fischer-Samuelson diagram

Figure 2
Wage Determination with a Continuum of Goods



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Rather than each good being produced in only one country (England for $j < \bar{j}$, Portugal for $j > \bar{j}$), trade costs allow for a region $\underline{j} - \bar{j}$ on the continuum of goods where both countries produce domestic consumption

Taking stock: what we have so far

Ricardo + DFS:

- Comparative (not absolute) advantage drives trade
- Trade costs create non-traded goods and price differentials
- Continuum of goods $\rightarrow$ tractable analysis

But we need more:

- Two countries isn't realistic for empirical work
- You can't just assume a 'continuum' of countries
- See https://www.youtube.com/watch?v=3q_iqrvnC_4 (minute 1:48): "There are probably *hundreds* of countries in the world..."

$\Rightarrow$ **Eaton-Kortum (2002):** Probabilistic productivity solves the many-countries problem

How do we add more countries?

We need to add more countries—two is not going to cut it

- Imagine many goods and many countries
- *You wouldn't expect the continuity/ranking assumptions to hold for many countries*
- (See Jones 1961, *IER* for formal proof)

Adding more countries with with no chain of comparative advantage...

- This is a guess-and-check world
- Not gonna work

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Key inputs to Eaton-Kortum model

- Productivity diffs across all countries / regions
- Diffs in comparative advantage across all industries
- Diffs in labor costs
- Distances among countries
- Trade deficits (exogenous)

Step 3: Including > 2 countries

Here's the idea (Eaton-Kortum '02 Ecta)

- As per Dornbusch, Fischer, Samuelson, assume a **continuum** of goods $j \in [0, 1]$
- Assume an **integer** number of countries $i = 1, 2, ..., I$ (not new, but had always been a mess)
- Allow the productivity of each industry j in each country i to be a *probabilistic* draw (this is the 'big idea')
- With well-chosen functional forms, this reintroduces smoothness to many-goods, many-country setting
- *So it's like the DFS trick (continuum of goods) for the 21st century*

Outputs

1. Overall utility / consumption / real wage levels in each location
2. Who buys what from whom
   - What that tells us about comparative advantage
   - What this tells us about gains from trade
   - How this changes with productivity and trade frictions
3. How productivity $\Delta's$ in one country affect welfare of others
4. How trade flows (and deficits) affect labor demand, both in levels and comparative statics

Basics

1. Countries $i = 1, 2, ..., I$ (integer count)
2. Goods $j \in [0, 1]$ (continuum)
3. Iceberg transport costs
   - $d_{ii'} > 1$ and $d_{ii} = 1$ and $d_{ii''} < d_{ii'} \times d_{i'i''}$
4. Unit labor requirements for good i in country j are $a_i(j)$
5. Additionally, each country has national level TFP term $A_i > 0$, affecting productivity in all goods
   - This reflects **absolute advantage**

Why Fréchet? The key distributional assumption

The problem: With N countries and a continuum of goods, we need to determine:

- Who is the low-cost producer of each good for each destination?
- What share of goods does each country supply to each market?

E-K's insight: Make productivity a *random* draw from a specific distribution

- Each country-good pair gets an independent productivity draw
- Fréchet (Type II extreme value) distribution has a key property:
  - Prices $\propto 1/z$ follow a Weibull distribution, and *the minimum of independent Weibull draws is also Weibull*
  - So the cheapest source price for each good stays in a tractable family, giving closed-form trade shares

Economic intuition: Countries are like lottery tickets

- Some win big (very high productivity in certain goods)
- The dispersion parameter θ controls how "lumpy" comparative advantage is

The productivity distribution: stochastic country-by-product draws

Unit labor requirements $a_i(j)$ are Weibull (the cost-side dual of Fréchet)

$$\Pr\left[a_i\left(j\right) < x\right] = 1 - e^{-(A_i x)^{\theta}}$$

- Vertical differentiation: A_i governs country $i's$ **absolute advantage** — higher $A_i \rightarrow$ lower unit labor costs on average
- Horizontal differentiation: $\theta > 1$ reflects **comparative advantage** via the *dispersion of draws*
  - Low $\theta \rightarrow$ high dispersion $\rightarrow$ large role for *comparative advantage*
  - High $\theta \rightarrow$ low dispersion $\rightarrow$ large role for *price competition*
- **Comparative advantage and price competition are effectively inverses**
  - High dispersion of $a's$ means some $a_i\left(j\right)'s$ *much lower* than others
  - If so, small price $\Delta's$ have little effect on $ij's$ market share
  - Conversely, if dispersion of $a's$ minimal, small price $\Delta's$ have large effects on $ij's$ market share
  - Thus dispersion and elasticity are inverses
  - (Akin to task model where greater relative steepness of the comparative advantage schedule between two skill groups implies a lower elasticity of substitution)

The price distribution: what price do countries pay for each good?

What price do countries pay for each good j, as seen from perspective of a purchasing country n?

- Let w_i equal the labor cost in country i
- The cost of producing good j in country i and delivering it country n is

$$c_{ni}(j) = a_i(j) w_i d_{ni}$$

- The price that country n pays for j is of course the **minimum** of all prices available to it

$$c_n(j) = \min\{c_{ni}(j)\}$$

- With non-zero trade costs that differ among country pairs, *the price of identical goods j will vary across countries n*

The price distribution: what price do countries pay for each good?

Seen from the perspective of country n

1. Cumulative distribution of cost of good j produced in country i and offered in country n is

$$\Pr\left[c_{ni}(j) < c\right] = 1 - e^{-\left(cA_i / w_i d_{ni}\right)^{\theta}}$$

2. The cumulative distribution of prices for good j that country n faces across all supplier countries is

$$\begin{aligned}\Pr\left[p_n(j) < p\right] &= 1 - \prod_i \Pr\left[c_{ni}(j) > p\right] \\ &= 1 - e^{-\left(\bar{A}_n p\right)^{\theta}}\end{aligned}$$

$$\text{where } \bar{A}_n = \left[\sum_{i=1}^{I} \left(\frac{A_i}{w_i d_{ni}}\right)^{\theta}\right]^{\frac{1}{\theta}}$$

(multiplicative structure reflects independent draws—one per country)

The price distribution

$\bar{A}_n$ is a country specific purchase price parameter

$$\bar{A}_n = \left[\sum_{i=1}^{I} \left(\frac{A_i}{w_i d_{ni}} \right)^{\theta} \right]^{\frac{1}{\theta}}$$

- $\bar{A}_n$ related to but distinct from A_n since it depends on $A's$, $w's$, and $d's$ in every country
- It differs across countries due only to differences in trade costs ($\approx$ distance)

Higher $\bar{A}_n$ corresponds to a lower price index

- A country's PPP is rising in its $\bar{A}_n$

$\bar{A}_n$ shows how four forces govern prices in each country n

1. States of technology around the world: $A's$
2. Input costs around the world: $w's$
3. Trade barriers (including distance) between each country: $d's$
4. Underlying strength of comparative versus, θ (lower θ, more comp. adv). **Why?**

Trade enlarges each country's effective technology frontier

$$\bar{A}_n = \left[\sum_{i=1}^{I} \left(\frac{A_i}{w_i d_{ni}} \right)^{\theta} \right]^{\frac{1}{\theta}}$$

As seen from the perspective of each country n, $\bar{A}_n$ reflects technology available from all other countries discounted by input costs and geographic barriers

1. In a world with no geographic barriers ($d_{ni} = 1$ for all n and i), $\bar{A}_n$ is the same everywhere $\rightarrow$ law of one price holds for each good
2. At the other extreme of autarky ($d_{ni} \rightarrow \infty$ for $n \neq i$), $\bar{A}_n$ reduces to A_n / w_n, country n's own state of technology, down-weighted by its input cost

Simplest case

- Preferences are symmetric Cobb-Douglas, with equal shares on all goods (simple to generalize to CES, etc)
- Ideal price index for each country n is geometric mean of price distribution

$$\rho_n = \frac{\gamma}{\bar{A}_n} \text{ with } \bar{A}_n = \left[\sum_{i=1}^{I} \left(\frac{A_i}{w_i d_{ni}} \right)^{\theta} \right]^{\frac{1}{\theta}}$$

  where $\gamma = e^{-\epsilon/\theta}$ and ϵ is Euler's constant

- *Lower* values of ρ_n mean *higher* purchasing power
- A higher value of $\bar{A}_n$ corresponds to *higher* purchasing power (lower price)

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Who buys what from whom?

- Probability π_{ni} that country i is the lowest cost supplier of any specific good j to country n is

$$\pi_{ni} = \Pr\left[c_{ni}(j) = p_n(j)\right] = \left(\frac{A_i / w_i d_{ni}}{\bar{A}_n}\right)^{\theta}$$

  not subscripted by j because probability does not differ across goods

- With a continuum of goods, π_{ni} is also the *share* of all goods consumed in n that are supplied by i
- Higher *world* productivity (higher $\bar{A}_n$) lowers probability that country i is low cost producer of j for country n
- Conversely, higher *own* productivity A_i raises probability that country i is low cost producer of j for country n

Who buys what from whom? (Recall: n is importing country, i supplying country)

Who buys what from whom?

- As above, probability π_{ni} that country i is the lowest cost supplier of any specific good j to country n is

$$\pi_{ni} = \Pr\left[c_{ni}(j) = p_n(j)\right] = \left(\frac{A_i / w_i d_{ni}}{\bar{A}_n}\right)^{\theta}$$

  not subscripted by j because probability does not differ across goods

Observe the critical role of θ

- θ is trade elasticity with respect to w_i or d_{ni}

$$\frac{\partial \ln \pi_{ni}}{\partial \ln d_{ni}} = -\theta$$

- Recall that larger θ implies lower dispersion of productivity draws.
- **What's the intuition?**

What a country buys (again, from perspective of n, importing country)

With a continuum of goods, π_{ni} is also the share of all goods consumed in n that are supplied by i

- Due to Fréchet distribution, quantity and price selection exactly offset one another. This is the **Roy-Fréchet** property at work
- Expected price of goods purchase by country n from country i does not vary across countries i conditional on purchase
- If price $i's$ goods fell, n would purchase a broader range from i *and* reduce purchases from i' until the average price of purchases across all countries was again equated

Implication: Country $n's$ share of total expenditure on goods produced in i is (X is expenditure)

$$\pi_{ni} = \frac{X_{ni}}{X_n} = \left(\frac{A_i / w_i d_{ni}}{\bar{A}_n} \right)^{\theta}$$

What makes this non-Roy like?

- The conditional mean is invariant to the point of selection
- All selection is reflected in *quantities* not *prices*
- We saw this before in Hsieh, Hurst, Jones, and Klenow '19

Expenditure, imports, and exports: seen from perspective of exporting country i

- **As above, country $n's$ share of total expenditure on goods from country i (imports to n from i) is:**

$$\pi_{ni} = \frac{X_{ni}}{X_n} = \left(\frac{A_i / w_i d_{ni}}{\bar{A}_n} \right)^{\theta}$$

- **Now consider sales from the perspective of country i**
  - Country $i's$ sales to *all* countries m (exports) *including itself* is

$$\begin{aligned} X_i &= \sum_M X_m \pi_{mi} \\ &= \sum_M X_m \left(\frac{A_i / w_i d_{mi}}{\bar{A}_m} \right)^{\theta} \\ &= \left(\frac{A_i}{w_i} \right)^{\theta} \sum_M \frac{X_m d_{mi}^{-\theta}}{\bar{A}_m^{\theta}} \end{aligned}$$

Finally: rearrange to get exports from each country i to each country n

- Now use expression above for import shares to eliminate $\left(\frac{A_i}{w_i}\right)^{\theta}$ in X_i:

$$\pi_{ni} = \frac{X_{ni}}{X_n} = \left(\frac{A_i / w_i d_{ni}}{\bar{A}_n}\right)^{\theta} \Rightarrow \left(\frac{A_i}{w_i}\right)^{\theta} = \left(\frac{X_{ni}}{X_n}\right) \times \left(\bar{A}_n d_{ni}\right)^{\theta}$$

- Recalling that $X_i = \sum_M X_m \pi_{mi}$:

$$X_i = \sum_M \frac{X_m d_{mi}^{-\theta}}{\bar{A}_m^{\theta}} \times \left(\frac{X_{ni}}{X_n}\right) \times \left(\bar{A}_n d_{ni}\right)^{\theta}$$

- Finally, rearranging to solve for X_{ni} **exports from** i **to** n

$$X_{ni} = \frac{X_n X_i \left(\bar{A}_n d_{ni}\right)^{-\theta}}{\sum_M \left(\bar{A}_m d_{mi}\right)^{-\theta} X_m} = \frac{X_i X_n \left(\frac{d_{ni}}{\rho_n}\right)^{-\theta}}{\sum_M \left(\frac{d_{mi}}{\rho_m}\right)^{-\theta} X_m}$$

here, we used the fact that $\rho_n = \gamma / \bar{A}_n$

Unpacking the expression for exports

Exports from i to n

$$X_{ni} = \frac{X_i X_n \left(\frac{d_{ni}}{\rho_n}\right)^{-\theta}}{\sum_M \left(\frac{d_{mi}}{\rho_m}\right)^{-\theta} X_m}$$

- Increasing in exporter i's total economic size, X_i
- Increasing in importer $n's$ total economic size X_n. Higher X_n means a larger market into which to sell
- Declining in bilateral trade costs d_{ni}
  - d_{ni} is deflated by the importer's price level ρ_n
  - Import costs matter more when the destination market is more competitive
- Denominator $\left(\frac{d_{mi}}{\rho_m}\right)^{-\theta} X_m$, is the size of each destination market m as perceived by i

Why do they call it the gravity model?

Traditional gravity regression for trade btwn country pairs

$$\ln(X_{ni}) = \beta_0 + \underset{(+)}{\beta_1} \ln(M_n) + \underset{(+)}{\beta_2} \ln(M_i) + \underset{(-)}{\beta_3} \ln(d_{ni}) + e_{ni}$$

- X_{ni} is exports from i from n, M_n, M_i are economic "masses" of n and i, d_{ni} is trade cost/distance
- Substitute X_n for M_n and X_i for M_i and take logs

$$\ln X_{ni} = \ln \left[X_{ni} = \frac{X_i X_n \left(\frac{d_{ni}}{\rho_n} \right)^{-\theta}}{\sum_M \left(\frac{d_{mi}}{\rho_m} \right)^{-\theta} X_m} \right]$$

$$\ln X_{ni} = \ln X_i + \ln X_n - \theta \ln d_{ni} + \theta \ln p_n - \ln \left[\sum_M \left(\frac{d_{mi}}{\rho_m} \right)^{-\theta} X_m \right]$$

Voilá, gravity!

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Closing the model: worldwide market clearing

Straightforward to close model if all income is labor income

- Let L_i be the labor endowment of country i
- Then country $i's$ total income is

$$w_i L_i = \sum_{n=1}^{I} \pi_{ni} \left(w_n L_n + D_n \right)$$

- π_{ni} is the share $n's$ consumption purchased from i
- As above $\pi_{ni} = \frac{X_{ni}}{X_n} = \left(\frac{A_i / w_i d_{ni}}{A_n} \right)^{\theta}$
- D_n is the trade deficit in county n, equal to what it spends in excess of its labor income
- This is a system of I linear equations, will have to be solved numerically
- Trade deficits are exogenous here (outside of model), but they matter. See Dix-Carneiro, Pessoa, Reyes-Heroles, and Traiberman, *QJE* 2023

What we've got: a general equilibrium, multi-sector, multi-country Roy-'ish' model

Inputs

- Productivity diffs across all countries / regions
- Diffs in comparative advantage across all industries
- Diffs in labor costs
- Distances among countries
- Trade deficits (exogenous)

Outputs

1. Overall utility / consumption / real wage levels in each location
2. Who buys what from whom
   - What that tells us about comparative advantage
   - How this changes with productivity and trade frictions
   - What this tells us about gains from trade
3. How productivity $\Delta's$ in one country affect welfare of others
4. How trade flows (and deficits) affect labor demand, both in levels and comparative statics

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Explaining key regularities

Recall our motivating facts from earlier—E-K now explains them:

1. Why does trade between countries diminish with distance?
2. Why do prices for identical goods vary across locations?
3. Why do countries exhibit home bias in consumption?
4. Why does every country buy more from large countries—so large countries have greater home bias?
5. Why do trade deficits (loans between countries) affect what countries produce *and* distribution of economic activity within countries?
6. How can we see the gains from trade?

$$\frac{w_i}{\rho_i} = \gamma^{-1} A_i \pi_{ii}^{-1/\theta} \quad \Rightarrow \quad \ln\left(w_i/\rho_i\right) = -\ln\gamma + \ln A_i - \frac{1}{\theta}\ln\pi_{ii}$$

Gains from trade: $\hat{W}_n = \hat{\pi}_{nn}^{-1/\theta}$ (Arkolakis-Costinot-Rodriguez-Clare *AER* 2012)

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Eaton-Kortum provides conceptual/empirical framework for linking goods trade to local labor demand

- **Guides analysis:** how observed changes in *quantities* of goods imported are related to changes in the demand for the output of a local economy (e.g., a Commuting Zone)
- **Illuminates two missing mechanisms** in partial equilibrium analysis
  1. Trade affects labor demand not just through its impact on imports but also through changes in export demand due to rising competitive pressure in third-country markets
  2. Trade deficits, normally ignored by trade economists, have non-neutral implications for sectoral allocation of labor demand. Empirically, this now appears much more important than was appreciated

From theory to measurement

We now have a theoretical framework. Next:

- How do we *measure* trade shocks at the local labor market level?
- How do we identify *causal* effects of trade on labor outcomes?
- What do the data tell us about adjustment costs and welfare?

The "China Shock" literature

- Autor, Dorn, Hanson (2013): Local labor market exposure to import competition
- Uses variation across commuting zones in industry composition
- Instruments with other countries' exposure to Chinese imports

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Connecting trade flows to labor markets

Let the demand for labor in industry j by region i be given by

$$L_{ij} = L^d(w_{ij}, Q_{ij})$$

- where w_{ij} is unit production costs and Q_{ij} is output
- Think of an industry as containing a continuum of goods
- All reasoning above about "shares" by countries applies to shares by industries within and across countries

Connecting trade flows to labor markets

Using the E-K model, region i's sales in industry j to destination market n can be written as

$$X_{nij} = \frac{A_{ij}(w_{ij}d_{nij})^{-\theta}}{\sum_h A_{hj}(w_{hj}d_{nhj})^{-\theta}},$$

- where θ describes the dispersion in productivity among firms
- A_{ij}, determines mean of firm productivities in an industry and region
- $\sum_h A_{hj}(w_{hj}d_{nhj})^{-\theta}$ describes the extent of competition in destination market n in industry j. Reflects production and trade costs in the locations that supply products to market n

Region i will capture a larger share of market n's purchases in industry j when it has high productivity, low production costs, and low trade costs relative to other suppliers

Connecting trade flows to labor markets

- Define

$$\tilde{A}_{ij} \equiv A_{ij} w_{ij}^{-\theta}$$

as cost-adjusted productivity of region i in industry j

- Summing over destination markets for region i, its total output in industry j is

$$Q_{ij} = \tilde{A}_{ij} \sum_{n} \frac{X_{nj} d_{nij}^{-\theta}}{\bar{A}_{nj}}$$

China is among the countries that each U.S. region competes in serving destination markets

- When China's productivity expands or its foreign trade costs fall, this increases the value of $\bar{A}_{nj}$ in each destination market, diverting product demand from U.S. regions that also serve these markets
- *Crucial point*: A rise in the productivity (or fall in the trade costs) of one country affects output in other nations not only by displacing domestic production (through imports) but also by displacing exports that these other countries would have made
- As a country becomes more productive or faces lower trade barriers, its probability of becoming the low cost producer of each good for every other country rises
- Thus, exports from this 'rising' country displace exports to other countries from their prior suppliers

Consider effect on Q_{ij} of a rise in China's competitive position

1. An increase in A_{cj}, where c indexes China
2. *or* a reduction in trade costs d_{ncj}, e.g., due to China's accession to the WTO

Direct effect of $\Delta's$ in China's productivity and trade costs on Q_{ij}

$$\hat{Q}_{ij} = -\sum_n \frac{X_{nij}}{Q_{ij}} \frac{X_{ncj}}{X_{nj}} (\hat{A}_{cj} - \theta \hat{d}_{ncj})$$

- where $\hat{x} \equiv d \ln x$, X_{nij}/Q_{ij} is the share of exports to destination market n in region i's output in industry j
- X_{ncj}/X_{nj} is the share of imports from China in spending by destination market n in industry j

The fall in region i's output in industry j is larger

$$\hat{Q}_{ij} = -\sum_n \frac{X_{nij}}{Q_{ij}} \frac{X_{ncj}}{X_{nj}} (\hat{A}_{cj} - \theta \hat{d}_{ncj})$$

1. the greater is the cost-adjusted productivity growth in China $\hat{A}_{cj}$
2. the larger is the reduction in trade costs facing China $\hat{d}_{ncj}$
3. the more dependent region i is on market n (X_{nij})
4. the more important China is as a source of supply to market n (X_{ncj})

Connecting trade flows to labor markets

In applying expression for $\hat{Q}_{ij}$, ADH focus on competition that CZs face from China in the U.S. market

- Limit the summation above to $n = u$, that is, to outputs produced and consumed in the United States
- Includes only the *direct* effect of shocks to Chinese productivity and trade costs on the demand for output in region i
- It ignores indirect effects of these changes on factor prices and spending in region i and in other regions and countries
- Changes in factor prices may cause changes in aggregate spending by countries—reverberating through global economy
- In general equilibrium, $\Delta's$ in China's productivity + trade costs affect wages + factor prices in countries where China competes

Applying EK framework to U.S. labor markets using 'China Shock'

- Measure of import exposure at the CZ-level

$$\Delta IPW_{uit} = \sum_j \frac{L_{ijt}}{L_{ujt}} \frac{\Delta M_{ucjt}}{L_{it}}$$

- Instrumented by

$$\Delta IPW_{oit} = \sum_j \frac{L_{ijt-1}}{L_{ujt-1}} \cdot \frac{\Delta M_{ocjt}}{L_{it-1}}$$

- Estimating equation (2SLS)

$$\Delta L_{it}^m = \gamma_t + \beta_1 \Delta IPW_{uit} + \mathbf{X}_{\mathbf{it}}' \beta_2 + e_{ct}$$

Autor-Dorn-Hanson '13: setup

Empirical proxy for ΔCZ's import exposure

$$\Delta IPW_{uit} = \sum_j \frac{L_{ijt}}{L_{ujt}} \frac{\Delta M_{ucjt}}{L_{it}}$$

- Trade-induced demand shock to CZ's goods output
- Allocates to each CZ a share of national import growth
- Divides this value by a CZ's total employment
- Yields measure of "import growth per worker" in $\$1K$ units

Note two sources of variation in this measure

1. Variation in CZ's manufacturing *mix*
2. Overall CZ manufacturing share, so ID comes from industry mix conditional on share

Empirical target of ADH

- How CZ-level demand shock affects employment, wages, etc. in manufacturing and non-manufacturing

This work also spurred methodological 'neo-Bartik' literature (ADH '13 as reference case)

- Goldsmith-Pinkham, Sorkin, Swift. 2018. "Bartik Instruments: What, When, Why, and How"
- Borsuyak, Hull, Jaravel. 2022. "Quasi-Experimental Shift-Share Research Designs"
- Adão, Kolesár, Morales. 2018. "Shift-Share Designs: Theory and Inference"

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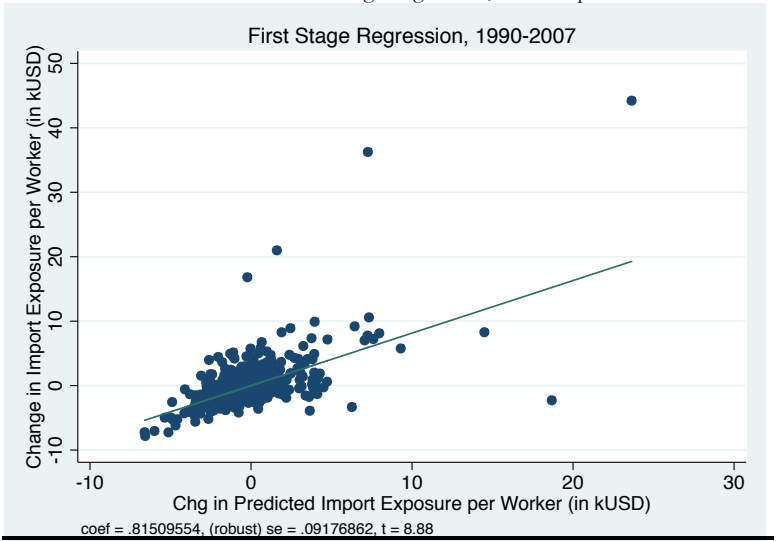
First stage: commuting zone (CZ) level changes in potential Chinese import exposure

Panel A: 2SLS 1st Stage Regression, Full Sample



Notes: N=722. The added variable plots control for the start of period share of employment in

Reduced form: CZ-level Δ's in Chinese import exposure vs. Δ's manufacturing emp/pop

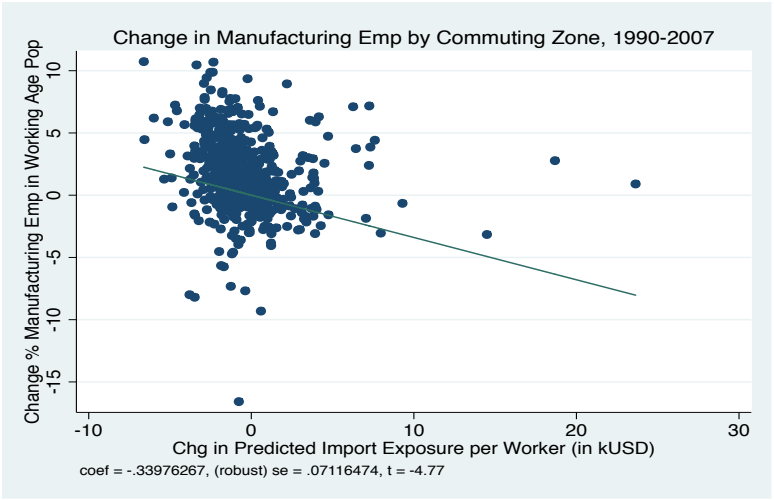
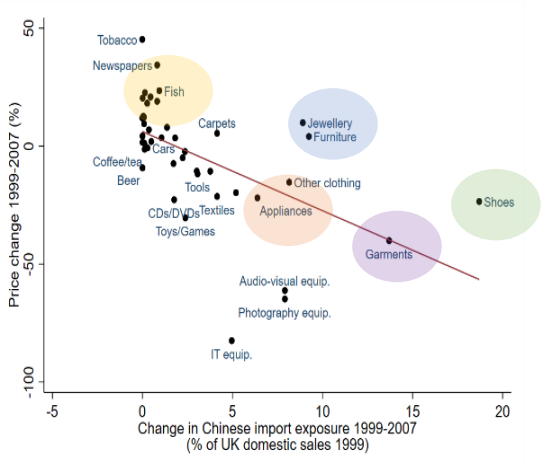


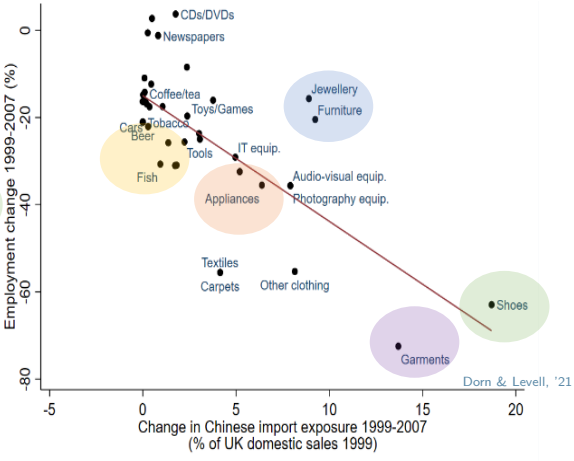
Figure 2.
Change in Import Exposure per Worker and Decline of Manufacturing Employment: Added Variable Plots 2SLS and Reduced Form Estimates

Change in goods prices vs. changes in employment: it works just like the theory says!

Δ Goods Prices

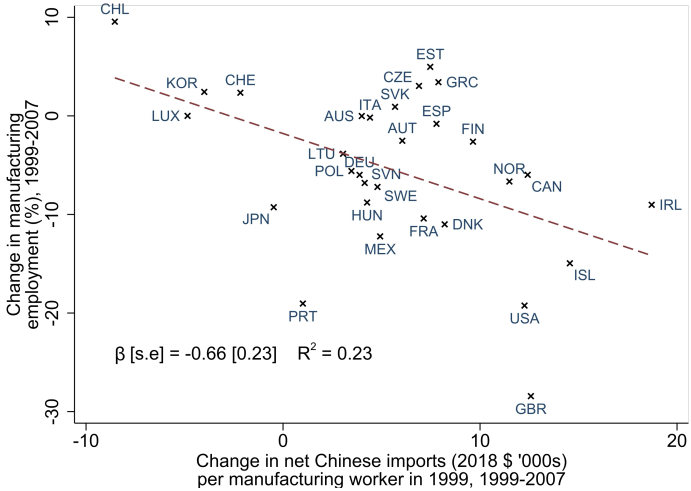


Δ Emp in Goods-Producing Sectors



Goods prices & goods employment dropped in tandem

Cross-country correlation: China shock, manufacturing decline



Dorn and Levell 2024

2SLS estimates by decade: import exposure and manufacturing emp/pop

TABLE 2—IMPORTS FROM CHINA AND CHANGE OF MANUFACTURING EMPLOYMENT IN CZS, 1970–2007: 2SLS ESTIMATES

Dependent variable: 10 × annual change in manufacturing emp/working-age pop (in % pts)

	I. 1990–2007			II. 1970–1990 (pre-exposure)		
	1990–2000 (1)	2000–2007 (2)	1990–2007 (3)	1970–1980 (4)	1980–1990 (5)	1970–1990 (6)
(Δ current period imports from China to US)/worker	−0.89*** (0.18)	−0.72*** (0.06)	−0.75*** (0.07)			
(Δ future period imports from China to US)/worker				0.43*** (0.15)	−0.13 (0.13)	0.15 (0.09)

Notes: $N = 722$, except $N = 1{,}444$ in stacked first difference models of columns 3 and 6. The variable "future period imports" is defined as the average of the growth of a CZ's import exposure during the periods 1990–2000 and 2000–2007. All regressions include a constant and the models in columns 3 and 6 include a time dummy. Robust standard errors in parentheses are clustered on state. Models are weighted by start of period CZ share of national population.

Autor-Dorn-Hanson, 2013

Pooled 2SLS estimates 1990–2007: import exposure and manufacturing emp/pop

TABLE 3—IMPORTS FROM CHINA AND CHANGE OF MANUFACTURING EMPLOYMENT IN CZS, 1990–2007: 2SLS ESTIMATES

Dependent variable: 10 × annual change in manufacturing emp/working-age pop (in % pts)

	I. 1990–2007 stacked first differences					
	(1)	(2)	(3)	(4)	(5)	(6)
(Δ imports from China to US)/ worker	−0.746*** (0.068)	−0.610*** (0.094)	−0.538*** (0.091)	−0.508*** (0.081)	−0.562*** (0.096)	−0.596*** (0.099)
Percentage of employment in manufacturing$_{-1}$		−0.035 (0.022)	−0.052*** (0.020)	−0.061*** (0.017)	−0.056*** (0.016)	−0.040*** (0.013)
Percentage of college-educated population$_{-1}$				−0.008 (0.016)		0.013 (0.012)
Percentage of foreign-born population$_{-1}$				−0.007 (0.008)		0.030*** (0.011)
Percentage of employment among women$_{-1}$				−0.054** (0.025)		−0.006 (0.024)
Percentage of employment in routine occupations$_{-1}$					−0.230*** (0.063)	−0.245*** (0.064)
Average offshorability index of occupations$_{-1}$					0.244 (0.252)	−0.059 (0.237)
Census division dummies	No	No	Yes	Yes	Yes	Yes
	II. 2SLS first stage estimates					
(Δ imports from China to OTH)/ worker	0.792*** (0.079)	0.664*** (0.086)	0.652*** (0.090)	0.635*** (0.090)	0.638*** (0.087)	0.631*** (0.087)
R^2	0.54	0.57	0.58	0.58	0.58	0.58

Autor-Dorn-Hanson, 2013

Import exposure and changes in manufacturing and non-manufacturing Emp/Pop by Education

TABLE 5—IMPORTS FROM CHINA AND EMPLOYMENT STATUS OF WORKING-AGE POPULATION WITHIN CZs, 1990–2007: 2SLS ESTIMATES

Dependent variables: Ten-year equivalent changes in log population counts and population shares by employment status

	Mfg emp (1)	Non-mfg emp (2)	Unemp (3)	NILF (4)	SSDI receipt (5)
Panel A. 100 × log change in population counts					
(Δ imports from China to US)/worker	−4.231***	−0.274	4.921***	2.058*	1.466***
	(1.047)	(0.651)	(1.128)	(1.080)	(0.557)
Panel B. Change in population shares					
All education levels					
(Δ imports from China to US)/worker	−0.596***	−0.178	0.221***	0.553***	0.076***
	(0.099)	(0.137)	(0.058)	(0.150)	(0.028)
College education					
(Δ imports from China to US)/worker	−0.592***	0.168	0.119***	0.304***	—
	(0.125)	(0.122)	(0.039)	(0.113)	
No college education					
(Δ imports from China to US)/worker	−0.581***	−0.531***	0.282***	0.831***	—
	(0.095)	(0.203)	(0.085)	(0.211)	

Notes: N = 1,444 (722 CZs × two time periods). All statistics are based on working age individuals (age 16 to 64).

Possible violations of identifying assumptions

1. **Common industry positive demand shocks in high-income countries?**
   - Industry demand shocks differenced out of gravity measure (which is an alternative specification of the trade shock)
2. **Common industry negative supply shocks in high-income countries?**
   - Would imply common increase in import penetration across LDCs (whereas in fact China's penetration increased by much more)
3. **US industry negative supply shocks?**
   - US and China are not primarily exporting the same goods to non-US high income countries

Alternative measures of trade exposure

- **What about?**
  - Imports from other countries, competition in foreign markets, US exports to China, imported intermediate inputs?
- **In alternative specifications, ADH do many things...**
  1. Use gravity model to estimate China export supply shock
  2. Add to imports from China imports from other low-wage countries
  3. Include changes in import penetration in other US destination markets
  4. Replace gross imports with net imports (in dollars or factor units)
  5. Adjust for imports of intermediate inputs

Pooled 2SLS estimates 1990–2007: import exposure and Δ population

Table 4—Imports from China and Change of Working-Age Population in CZ, 1990–2007: 2SLS Estimates

Dependent variables: Ten-year equivalent changes in log population counts (in log pts)

	I. By education level			II. By age group		
	All (1)	College (2)	Noncollege (3)	Age 16–34 (4)	Age 35–49 (5)	Age 50–64 (6)
Panel A. No census division dummies or other controls						
(Δ imports from China to US)/worker	−1.031**	−0.360	−1.097**	−1.299	−0.615	−1.127***
	(0.503)	(0.660)	(0.488)	(0.826)	(0.572)	(0.422)
R^2	—	0.03	0.00	0.17	0.59	0.22
Panel B. Controlling for census division dummies						
(Δ imports from China to US)/worker	−0.355	0.147	−0.240	−0.408	−0.045	−0.549
	(0.513)	(0.619)	(0.519)	(0.953)	(0.474)	(0.450)
R^2	0.36	0.29	0.45	0.42	0.68	0.46
Panel C. Full controls						
(Δ imports from China to US)/worker	−0.050	−0.026	−0.047	−0.138	0.367	−0.138
	(0.746)	(0.685)	(0.823)	(1.190)	(0.560)	(0.651)
R^2	0.42	0.35	0.52	0.44	0.75	0.60

Autor-Dorn-Hanson, 2013

Pooled 2SLS estimates 1990–2007: import exposure and Δ ln Emp and Δ ln Wage

TABLE 7—COMPARING EMPLOYMENT AND WAGE CHANGES IN MANUFACTURING AND OUTSIDE MANUFACTURING, 1990–2007: 2SLS ESTIMATES

Dependent variables: Ten-year equivalent changes in log workers and average log weekly wages

	I. Manufacturing sector			II. Nonmanufacturing		
	All workers (1)	College (2)	Noncollege (3)	All workers (4)	College (5)	Noncollege (6)
Panel A. Log change in number of workers						
(Δ imports from China to US)/worker	−4.231***	−3.992***	−4.493***	−0.274	0.291	−1.037
	(1.047)	(1.181)	(1.243)	(0.651)	(0.590)	(0.764)
R^2	0.31	0.30	0.34	0.35	0.29	0.53
Panel B. Change in average log wage						
(Δ imports from China to US)/worker	0.150	0.458	−0.101	−0.761***	−0.743**	−0.822***
	(0.482)	(0.340)	(0.369)	(0.260)	(0.297)	(0.246)
R^2	0.22	0.21	0.33	0.60	0.54	0.51

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Pooled 2SLS estimates 1990–2007: import exposure and transfer payments

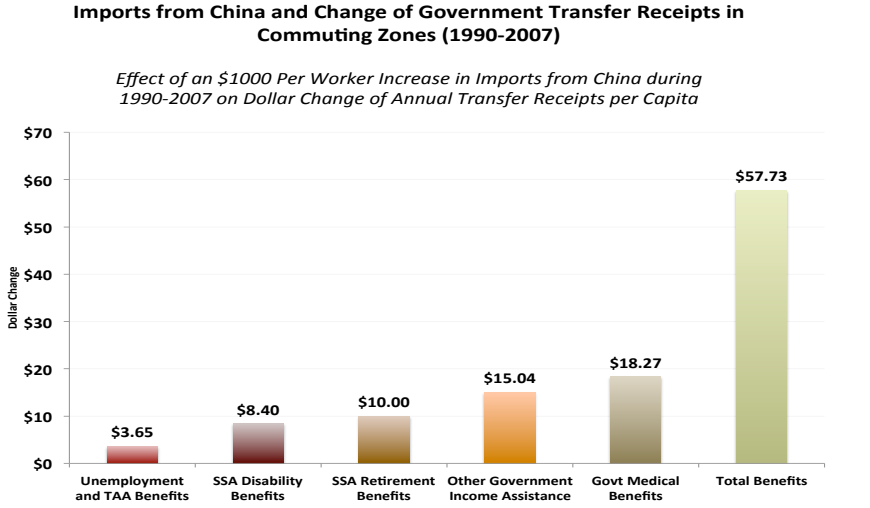
TABLE 8—IMPORTS FROM CHINA AND CHANGE OF GOVERNMENT TRANSFER RECEIPTS IN CZs, 1990–2007: 2SLS ESTIMATES

Dep vars: Ten-year equivalent log and dollar change of annual transfer receipts per capita (in log pts and US$)

	Total individual transfers (1)	TAA benefits (2)	Unemployment benefits (3)	SSA retirement benefits (4)	SSA disability benefits (5)	Medical benefits (6)	Federal income assist (7)	Educ/ training assist (8)
Panel A. Log change of transfer receipts per capita								
(Δ imports from China to US)/worker	1.01***	14.41*	3.46*	0.72*	1.96***	0.54	3.04***	2.78**
	(0.33)	(7.59)	(1.87)	(0.38)	(0.69)	(0.49)	(0.96)	(1.32)
R^2	0.57	0.28	0.48	0.36	0.32	0.27	0.54	0.33
Panel B. Dollar change of transfer receipts per capita								
(Δ imports from China to US)/worker	57.73***	0.23	3.42	10.00*	8.40***	18.27	7.20***	3.71***
	(18.41)	(0.17)	(2.26)	(5.45)	(2.21)	(11.84)	(2.35)	(1.44)
R^2	0.75	0.28	0.41	0.47	0.63	0.66	0.53	0.37

Autor-Dorn-Hanson, 2013

Pooled 2SLS estimates 1990–2007: import exposure and transfer payments



Connected: Trade flows ⇔ Labor Markets

How do trade flows affect (or reflect) domestic labor demand?

1. What do trade *flows* tell us about labor demand?
2. How does productivity growth in one country affects labor markets in others?
3. Are trade deficits relevant/irrelevant for labor markets?

Evidence:

- Do workers suffer earnings or employment losses?
- Do they change employers, change industries, or change sectors?
- Which workers adjust most or least successfully—and why?
- How do aggregate impacts differ from individual impacts?
- See Autor Dorn Hanson '13, Pierce and Schott '16, many recent papers
- Can policy help workers adjust? (see Hyman, Kovak, Leive '24)

Agenda

1. **Why trade is a labor topic**
2. **Building the Ricardian-Gravity Framework**
   - Ricardo's model of comparative advantage—and its limitations (Ricardo 1817)
   - Adding a continuum of goods + trade costs (Dornbusch, Fischer, Samuelson *AER* '77
   - Adding many countries and stochastic productivity (Eaton-Kortum *ECTA* '02)
   - Who buys what from whom? Trade flows & expendiuture shares
   - Closing the model
   - Explaining stylized/motivating fact patterns
3. **The China Shock and Local Labor Markets**
   - From E-K to ADH: Deriving the import exposure measure
   - Empirical results: Employment, wages, and transfers
4. **Welfare and Distributional Effects**
   - Aggregate gains and local losses

From local effects to welfare

We've documented large, persistent local labor market effects. But:

- Are these *welfare losses* or just reshuffling?
- How do local losses compare to aggregate gains from trade?
- What fraction of the population actually lost from China trade?

Key tension:

- Aggregate gains from trade are *positive but small*
- Cross-place variance in impacts is *large*
- $\Rightarrow$ Substantial share of population in net-losing regions

Agenda

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Estimating and interpreting welfare effects

- **Challenge: Assessing welfare effects using evidence from local labor markets**
  - Missing intercept problem (Wolf '19): We're learning only about relative effects across regions
  - If labor is fully mobile across regions and sectors, change in welfare is common across regions
  - *But* we see persistent, local labor market effects
  - To rationalize these differences, theory requires adjustment *frictions*
  - Most models assume *labor market frictions*

- **To quantify these welfare effects, we need two things**
  1. An estimate of the **mean** gain from trade ('the intercept')
  2. An estimate of the **diversity** of these gains ('the variance')

Trade models produce modest estimates of the variance of localized impacts

- **Caliendo et al '19: costly labor mobility**
  - Estimate mobility elasticity υ from $\mathsf{E}\left[\ln \mu_t^{j,k}/\mu_t^{j,j} \,|\, \ln w_{t+1}^k/w_{t+1}^j\right]$
  - $\%\Delta\bar{\mathbf{W}}$ **(std. dev.)** $=$ **0.20 (0.09) in long run (12 years)**

- **Galle et al '20: specific factors**
  - Estimate labor specificity κ from $\mathsf{E}\left[\ln \hat{y}_j \,|\, \ln \hat{\pi}_{jNM}\right]$
  - $\%\Delta\bar{\mathbf{W}}$ **(std. dev.)** $=$ **0.22 (0.25), similar w/ home prod., unemploy.**

- **Adão et al '20: agglomeration effects**
  - Estimate agglom, employ elasticities ψ, ϕ from $\mathsf{E}\left[\ln \hat{w}_j, \ln \hat{L}_j | \hat{\eta}_j^P, \hat{\eta}_j^C\right]$
  - $\%\Delta\bar{\mathbf{W}}$ **(std. dev.)** $=$ **0.16 (1.75)**

- **Related work**
  - Rodriguez-Clare et al '20: Downward nominal wage rigidities
  - Kim & Vogel '20: Non-pecuniary losses from unemployment

Relative changes in CZ welfare

Trade-shock induced change in welfare for CZ i (conditional on controls) relative to the population-weighted US mean (ADH '21):

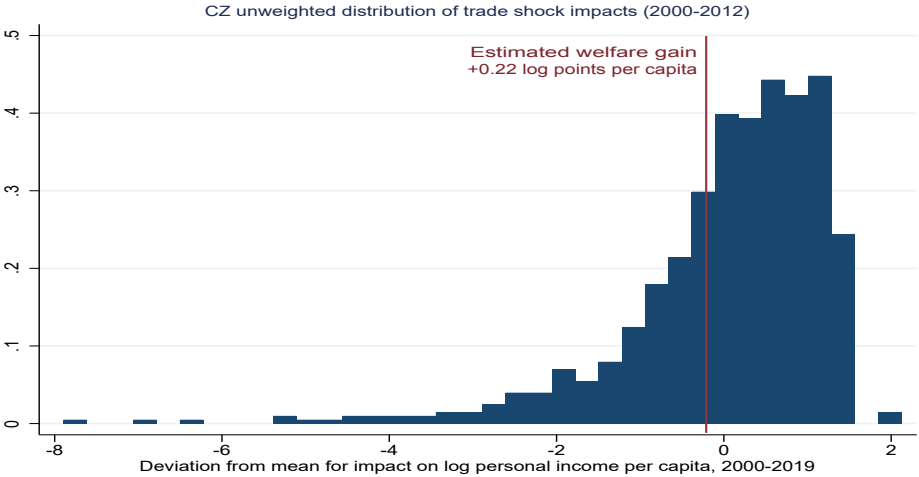
$$\ln \hat{W}_i - \sum_h s_h \ln \hat{W}_h = \ln \hat{y}_i - \sum_h s_h \ln \hat{y}_h$$

$$= \tilde{\beta}_{y\tau} \Delta \widetilde{IP}^{cu}_{i\tau} - \sum_h s_h \tilde{\beta}_{y\tau} \Delta \widetilde{IP}^{cu}_{h\tau}$$

- s_i = initial share of CZ i in US population
- $\hat{y}_i$ = trade-shock induced change in income per capita in CZ i
- $\tilde{\beta}_{y\tau}$ = estimated impact coefficient for $\ln y$ over time interval τ
- $\Delta \widetilde{IP}^{cu}_{i\tau}$ = exogenous component of trade shock for CZ i (observed trade shock $\times$ $\hat{\beta}$ $\times$ adj. R^2 in 1^{st} stage regression)

Trade-shock-induced variance in △ income per capita: $\hat{\sigma} = 1.35$

Unweighted distribution of CZ changes (deviation from pop.-weighted mean)



Note: Wted (unwted) std. dev. of shock impact: 1.35 (0.89); $N = 722$, 36 bins.

Autor, Dorn, Hanson '21

What fraction of CZs/residents experienced net welfare losses?

- **Aggregate gains from trade — the intercept**
  - In Caliendo et al '19, Galle et al '20, aggregate gains from trade are $\leq 0.22\%$
- **Adding in gross losses ($\hat{\sigma} = 1.35$) – the variance**
  1. Adding in gross losses above, 223 CZs suffered net losses (32.8% of U.S. pop)
  2. If we double gains to 0.44%, 173 commuting zones lost (15.9% of U.S. pop)
  3. Alternatively: Jaravel and Sager '19 imply induced price falls of 1.25%. If so, 82 CZs suffered welfare losses (7% of U.S. pop)
- **Hard to escape the conclusion that there are losers as well as winners**
  - Note that house prices fall after China Shock—but so do public goods (Feler & Senses '17)

Key takeaways

1. Theory: From Ricardo to Eaton-Kortum

- Comparative advantage drives trade; absolute advantage determines wages
- Fréchet productivity draws $\rightarrow$ tractable gravity equation
- Trade elasticity θ governs responsiveness to costs and gains from trade

2. Measurement: The China Shock

- Import exposure varies dramatically across local labor markets
- Shift-share design identifies local labor demand effects
- Large, persistent effects on employment, wages, and transfers

3. Welfare: Winners and losers

- Aggregate gains from trade are positive but modest
- Cross-CZ variance in impacts is large $\rightarrow$ substantial share of population in losing regions
- Adjustment is slow—standard models miss this persistence