ECON 357

Lecture 3: measuring the welfare gains from trade

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Road Map

- Generalization of Chaney (2008):

Arkolakis, Demidova, Klenow and Rodriguez-Clare (2008)

- Equivalence result:

Chaney (2008), Arkolakis et al. (2008 and 2010), Hsieh and Ossa (2010)

- Minimum statistic to measure welfare gains:

Donaldson (2010), Arkolakis et al. (2008 and 2010)

Generalization of Melitz/Chaney

- Free entry
- Flexible wages
- CES, iceberg costs, fixed costs + constant marginal cost
- Pareto distributed productivity shocks

Free entry and zero profit cutoff conditions

$$w_i f_i^E = \sum_j \int_{\varphi_{ij}^*} \left(\frac{\frac{\sigma}{\sigma-1} \frac{\tau_{ij} w_i}{\varphi}}{P_j} \right)^{1-\sigma} \frac{w_j L_j}{\sigma} dG_i(\varphi) - \sum_j \int_{\varphi_{ij}^*} w_j f_{ij} dG_i(\varphi) \quad (FE_i)$$

$$w_j f_{ij} = \left(\frac{\frac{\sigma}{\sigma-1} \frac{\tau_{ij} w_i}{\varphi_{ij}^*}}{P_j} \right)^{1-\sigma} \frac{w_j L_j}{\sigma} \quad (ZCP_{ij})$$

Labor market clearing condition

$$\begin{aligned}
& M_i^E \sum_j \int_{\varphi_{ij}^*} \left(\frac{\frac{\sigma}{\sigma-1} \frac{\tau_{ij} w_i}{\varphi}}{P_j} \right)^{1-\sigma} \frac{(\sigma-1) w_j L_j}{\sigma} dG_i(\varphi) \\
& + M_i^E f_i^E \\
& + \sum_j M_j^E \int_{\varphi_{ji}^*} f_{ji} dG_i(\varphi) \\
& = L_i \qquad (ZCP_{ij})
\end{aligned}$$

a little bit of ugly algebra...

$$(FE_i) + (ZCP_{ij})_j$$

$$\Rightarrow \quad \sum_j w_j f_{ij} \frac{\theta}{\theta-\sigma-1} \left(\frac{b_i}{\varphi^*_{ij}}\right)^\theta - \sum_j w_j f_{ij} \left(\frac{b_i}{\varphi^*_{ij}}\right)^\theta = w_i f_i^E$$

$$\Leftrightarrow \quad \sum_j \frac{w_j}{w_i} f_{ij} \frac{\sigma-1}{\theta-\sigma-1} \left(\frac{b_i}{\varphi^*_{ij}}\right)^\theta = f_i^E$$

$$(LMC_i) + \left((FE_i) + (ZCP_{ij})_j\right)$$

$$\Rightarrow \quad M_i^E \left(\sum_j \theta \frac{w_j}{w_i} f_{ij} \frac{\sigma-1}{\theta-\sigma-1} \left(\frac{b_i}{\varphi^*_{ij}}\right)^\theta + f_i^E\right) + \sum_j M_j^E f_{ji} \left(\frac{b_j}{\varphi^*_{ji}}\right)^\theta = L_i$$

$$\Leftrightarrow \quad M_i^E (1+\theta) f_i^E + \sum_j M_j^E f_{ji} \left(\frac{b_j}{\varphi^*_{ji}}\right)^\theta = L_i$$

...a bit more of ugly algebra

price index in $i (P_i)$

$$\Rightarrow \quad \sum_j M_j^E \int_{\varphi_{ji}^*} \left(\frac{\sigma}{\sigma-1} \frac{\tau_{ji} w_j}{\varphi} \right)^{1-\sigma} dG_j(\varphi) \quad = P_i^{1-\sigma}$$

$$\Leftrightarrow \quad \sum_j M_j^E \frac{\theta}{\theta-\sigma-1} \left(\frac{\frac{\sigma}{\sigma-1} \frac{\tau_{ji} w_j}{\varphi_{ji}^*}}{P_i} \right)^{1-\sigma} \left(\frac{b_j}{\varphi_{ji}^*} \right)^{\theta} \quad = 1$$

$$(P_i) + (ZCP_{ji})_i$$

$$\Rightarrow \quad \sum_j M_j^E \frac{\theta\sigma}{\theta-\sigma-1} \frac{w_i f_{ji}}{w_i L_i} P_i^{1-\sigma} \left(\frac{b_j}{\varphi_{ji}^*} \right)^{\theta} \quad = 1$$

$$\Rightarrow \quad \frac{\theta\sigma}{\theta-\sigma-1} \sum_j M_j^E f_{ji} \left(\frac{b_j}{\varphi_{ji}^*} \right)^{\theta} \quad = L_i$$

Deus ex machina!

$$
\begin{aligned}
& (LMC_i) + (FE_i) + (ZCP_{ij})_{ij} + (P_i) \\
\Rightarrow \quad & M_i^E = \frac{\sigma - 1}{\sigma\theta} \frac{L_i}{f_i^E}
\end{aligned}
$$

- As (assumed) in Chaney (2008), entry is proportional to country size.

Free entry in Melitz versus Krugman

$$\begin{cases} \text{Melitz/Chaney:} & M_i^E = \frac{\sigma-1}{\sigma\theta}\frac{L_i}{f_i^E} \\ \text{Krugman:} & M_i^E = \frac{1}{\sigma}\frac{L_i}{f_i^E} \end{cases}$$

- In Krugman and Melitz, a constant fraction $\frac{1}{\sigma}$ of sales go to profits.
- In Melitz, a fraction of those profits $\left(\frac{\sigma-1}{\theta} < 1\right)$ covers various fixed entry costs.

Welfare gains from trade

Question

- How much welfare would a representative consumer in i lose if country i were to move to complete autarky?
- Can we use only aggregate trade data to compute this amount?

Answer

YES, in surprisingly many seemingly different models!

Litterature

- Arkolakis, Demidova, Klenow and Rodriguez-Clare (AER P&P 2008)
- Donaldson (2010)
- Arkolakis, Costinot and Rodriguez-Clare (2010)
- Hsieh and Ossa (2010)

Equivalence between “many” models

	Symmetric firms/sectors	Heterogeneous firms/sectors
Perfect competition	Anderson van Wincoop (2004)	Eaton Kortum (2002)
Imperfect competition	Krugman (1980)	Melitz (2003) BEJK (2003)

Step 1: gravity equations

- All those models generate gravity equations,

$$X_{ij} = \frac{s_i \rho_{ij}^{-\epsilon}}{\sum_k s_k \rho_{kj}^{-\epsilon}} X_j$$

	ρ_{ij}: trade frictions	ϵ: trade elasticity
Krugman, Armington	$w_i \tau_{ij}$	$\sigma - 1$
Melitz/Chaney	$(w_j f_{ij})^{\frac{\theta-(\sigma-1)}{\theta(\sigma-1)}} w_i \tau_{ij}$	θ
Eaton Kortum, BEJK	$T_i^{-1/\theta} w_i \tau_{ij}$	θ

- With data on trade flows and trade frictions, easy to estimate ϵ,

$$\ln (X_{ij}) = A_i + A_j - \epsilon \ln \tau_{ij} + \eta_{ij}$$

Step 2: welfare and consumption of domestic goods

- All those models generate same welfare function,

$$\frac{w_i}{P_i} = \text{constant} \times \left(\frac{X_{ii}}{X_i}\right)^{-1/\epsilon}$$

- In autarky, trivially, $X_{ii} = X_i$, so that welfare gain from trade are,

$$\frac{(w_i/P_i)_{\text{trade}}}{(w_i/P_i)_{\text{autarky}}} = \left(\frac{X_{ii}}{X_i}\right)^{-1/\epsilon}$$

- The more a country trades with the rest of the world (X_{ii}/X_i small) and the less sensitive trade is to trade frictions (ϵ small), the more it gains from trade.

Note: fixed versus variable costs

- di Giovanni and Levchenko (2010).

$$\frac{w_i}{P_i} = \text{constant} \times L_i^{\frac{1}{\sigma-1}} \times f_{ii}^{-\frac{\theta-(\sigma-1)}{\theta(\sigma-1)}} \times \left(\frac{X_{ii}}{X_i}\right)^{-\frac{1}{\theta}}$$

- Firm size distribution is governed by σ and θ,

$$\Pr\left(\text{Size}_i > S\right) = \text{constant} \times S^{-\frac{\theta}{\sigma-1}}$$

$$\ln\left(\text{Rank}_i - 1/2\right) = \text{constant} - \frac{\theta}{\sigma-1} \ln\left(\text{Size}_i\right)$$

- If firm size distribution is Zipf $(\theta \approx \sigma - 1)$, then fixed costs have a negligible impact on welfare.

Note: welfare gains beyond CES

- **CES:** Broda and Weinstein (QJE 2005) estimate micro-elasticity of substitution and gains from foreign varieties.
- **Translog:** Feenstra and Weinstein (NBER WP 2010) estimate gains from foreign varieties and from falling markups.
- Same numbers roughly (+ .8% per year for U.S.):
  1. More gains from variety in CES (no change in markups)
  2. 1/3 less gains from variety in translog, but reduction in markups too.