International Economics I

Lecture 1: International Trade

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- Homothetic and identical consumption preference in both countries
  - constant expenditure share, b_z on commodity z

$$
\begin{aligned}
b(z) &= P(z)\, C(z) / Y > 0 \\
b(z) &= b^*(z) \\
\int_0^1 b(z)\, dz &= 1
\end{aligned}
$$

- Fraction of income spent on commodities produced in the Home

$$\begin{aligned} \vartheta(\tilde{z}) &\equiv \int_0^{\tilde{z}} b(z)\,dz > 0 \\ \vartheta'(\tilde{z}) &= b(\tilde{z}) > 0 \end{aligned}$$

- Fraction of income spent on commodities produced in the Foreign

$$1 - \vartheta(\tilde{z}) \equiv \int_{\tilde{z}}^{1} b(z)\,dz$$

- Many-commodity Ricardian model
  - unit labor requirement for n commodities in the Home country: $(a_1, ..., a_n)$
  - unit labor requirement for n commodities in the Foreign country: $(a_1^*, ..., a_n^*)$
  - without loss of generality, it is assumed

$$a_1^*/a_1 > ... > a_i^*/a_i > ... > a_n^*/a_n$$

- Continuum of goods setting
  - $z \in [0, 1]$ index commodities
  - unit labor requirement for Home and Foreign countries: $a(z)$ and $a^*(z)$
  - relative unit labor requirement

$$A(z) \equiv \frac{a^*(z)}{a(z)}, A'(z) < 0$$

- Which goods are produced in the Home country?
  - perfect competition market with free trade $\Rightarrow$ comparison of the marginal cost

$$a(z)w \leq a^*(z)w^*$$

$\Rightarrow$

$$\omega \equiv \frac{w}{w^*} \leq A(z)$$

$\Rightarrow$

$$\tilde{z}(\omega) = A^{-1}(\omega)$$

  - Home country produces $0 \leq z \leq \tilde{z}(\omega)$
  - Foreign country produces $\tilde{z}(\omega) \leq z \leq 1$

- Relative price of two commodities
  - if both produced in the Home country, i.e., $z, z' \in [0, \tilde{z}]$

$$P(z)/P(z') = wa(z)/wa(z') = a(z)/a(z')$$

  - one produced in the Home and the other produced in foreign, i.e., $z \in [0, \tilde{z}]$, $z'' \in [\tilde{z}, 1]$

$$P(z)/P(z') = wa(z)/w^{*}a^{*}(z'') = \omega a(z)/a^{*}(z'')$$

- Market clearing condition

$$wL = \vartheta\left(\tilde{z}\right)\left(wL + w^{*}L^{*}\right)$$

$\Rightarrow$

$$\omega = \frac{\vartheta\left(\tilde{z}\right)}{1-\vartheta\left(\tilde{z}\right)}\frac{L^{*}}{L} = B\left(\tilde{z}; L^{*}/L\right)$$

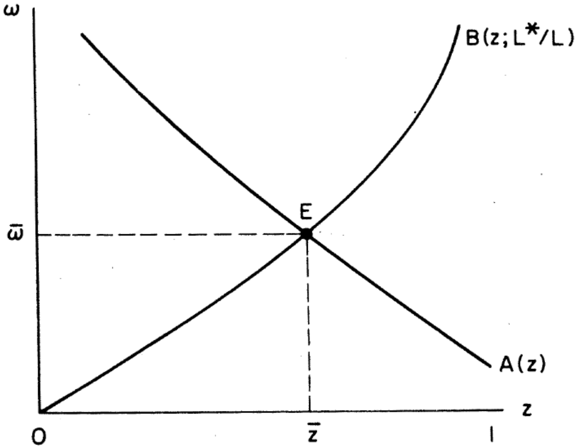

FIGURE 1

- Increase of L^*/L: $\frac{\partial B}{\partial (L^*/L)} > 0$

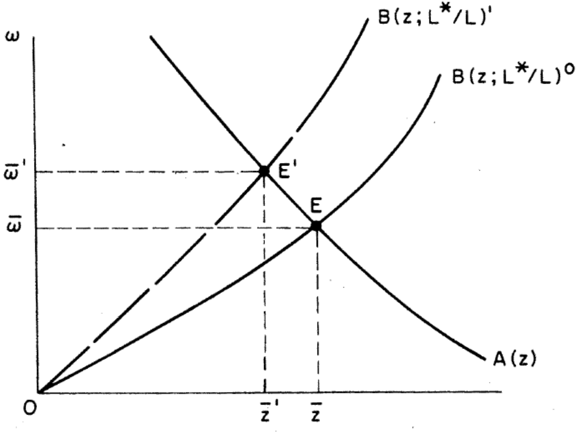

FIGURE 2

- Intuition
  - $L^*/L \uparrow$: Foreign has extra labor supply, which creates extra demand for Home goods if nothing changes
  - hence, wage in the Home increases and that in the Foreign decrease, which means $\bar{\omega} \uparrow$
  - this erodes the comparative advantage in the Home, which causes the shrinkage of commodities set it produces $\bar{z} \downarrow$
- Gains
  - unambiguous gains for the Home

$$
\begin{aligned}
C(z) &= \frac{b(z)\,wL}{wa(z)} = \frac{b(z)\,L}{a(z)} \forall z \in [0, \bar{z}] \\
C(z) &= \frac{b(z)\,wL}{w^* a^*(z)} = \omega \frac{b(z)\,L}{a^*(z)} \forall z \in [\bar{z}, 1]
\end{aligned}
$$

  - loss for the Foreign

- Uniform technical progress
  - uniform proportional reduction in foreign unit labor requirement, i.e., $a^* (z) \downarrow$ by same proportion
  - shift the curve of $A(z)$ downward
  - causes $\bar{\omega}$ and $\bar{z}$ both fall
- Intuition
  - $a^* (z) \downarrow \Rightarrow$ increases in foreign comparative advantage (i.e., $A(z) \downarrow$)
  - which means commodities shifted production from the Home to the Foreign country
  - causes demand for labor decrease in the Home and increase in the Foreignt, which falls ω

- Welfare gains
  - improvement of the terms of trade in the Home

$$\hat{P}(z) - \hat{P}(z'') = \hat{\bar{\omega}} - \hat{a}^*(z'') > 0$$

  - gains for the Home, losses for the Foreign

- Shift of demand from high z to low z commodities, i.e., $\vartheta\left(\tilde{z}\right)=\int_0^{\tilde{z}} b\left(z\right)dz\uparrow$
  - $B\left(.\right)\uparrow$ shifts up and left
  - $\bar{\omega}\uparrow$and $\bar{z}\downarrow$
- Intuition
  - similar to case I
- Welfare gains
  - undetermined as the consumption preference changed

- Transfers of money from the Foreign to the Home
  - nothing changes in the equilibrium
  - because the consumption preference is the same
  - but there is no balanced trade: trade deficit for the Home, which equals the international transfer

- Assume a fraction $(1-k)$ is spent on nontraded goods in each country

$$0 < k \equiv \int_0^1 b(z)\, dz < 1$$

- Market clearing condition becomes

$$[1-\vartheta(\tilde{z}) - (1-k)]\, wL = \vartheta(\tilde{z})\, w^* L^*$$

$\Rightarrow$

$$\omega = \frac{\vartheta(\tilde{z})}{k - \vartheta(\tilde{z})} \frac{L^*}{L}$$

- In the equilibrium

$$\bar{\omega} = \frac{\vartheta(\bar{z})}{k - \vartheta(\bar{z})} \frac{L^*}{L} = A(\bar{z})$$

- Shift in demand toward nontraded goods
  - if the remaining demand shift from high z toward low z commodities, then $\bar{\omega}\uparrow$
  - if balanced shift, then nothing changes
- International transfer T in terms of foreign labor

$$T=(k-\vartheta)\left[\omega L+T\right]-\vartheta\left(L^{*}-T\right)$$

$\Rightarrow$

$$\bar{\omega}=\frac{1-k}{k-\vartheta\left(\bar{z}\right)}\frac{T}{L}+\frac{\vartheta\left(\bar{z}\right)}{k-\vartheta\left(\bar{z}\right)}\frac{L^{*}}{L}$$

  - $B\left(.\right)$ shift upward $\Rightarrow\bar{\omega}\uparrow$and $\bar{z}\downarrow$

- Iceberg transport cost
  - a fraction $g(z)$ of commodity z shipped actually arrives
- Comparision of prices

$$\begin{aligned} wa(z) &\leq (1/g)\, w^* a^*(z) \\ w^* a^*(z) &\leq (1/g)\, wa(z) \end{aligned}$$

$\Rightarrow$

$$A(z)\, g \leq \omega \leq A(z)/g$$

Dornbusch, Fischer and Samuelson (1977)

Extension II: Transport Costs

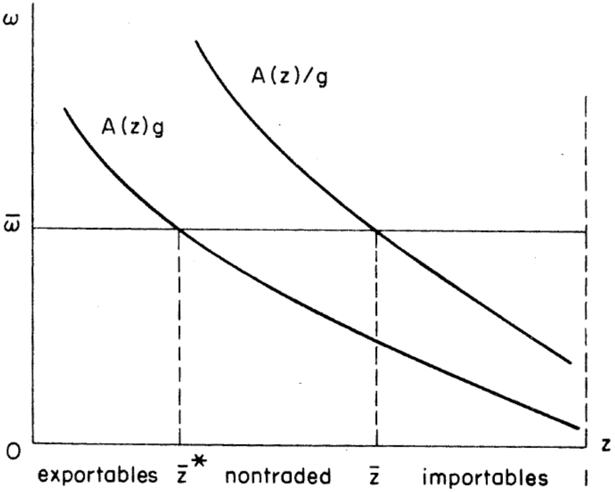

FIGURE 3

- Market clearing condition

$$(1-\lambda)\, wL = (1-\lambda^*)\, w^* L^*$$

  - where λ is the share of home country expenditure on domestically produced goods (i.e., $z \leq \bar{z}$)
  - λ^* is the share of foreign country expenditure on foreign produced goods (i.e., $z \geq \bar{z}^*$)

$$\begin{aligned} \lambda(g\omega) &\equiv \int_0^{\bar{z}} b(z)\, dz \\ \lambda^*(\omega/g) &\equiv \int_{\bar{z}^*}^1 b(z)\, dz \end{aligned}$$

and

$$\begin{aligned} \bar{z} &= A^{-1}(g\omega) \\ \bar{z}^* &= A^{-1}(\omega/g) \end{aligned}$$

- In equilibrium

$$\bar{\omega} = \frac{1 - \lambda^* \left(\bar{\omega}/g\right)}{1 - \lambda \left(g\bar{\omega}\right)} \frac{L^*}{L}$$

  - three equations, three unknowns $\left(\bar{z}, \bar{z}^*, \bar{\omega}\right)$

- Uniform tariffs on imports: t and t^*
  - similar to the case of transport costs
- Comparison of prices

$$\begin{aligned}\bar{z} &= A^{-1}\left(\frac{\omega}{1+t}\right) \\ \bar{z}^* &= A^{-1}\left(\omega\left(1+t^*\right)\right)\end{aligned}$$

- Market clearing condition

$$(1-\lambda)\, Y/(1+t) = (1-\lambda^*)\, Y^*/(1+t^*)$$

$\Rightarrow$

$$\bar{\omega} = \left(\frac{1-\lambda^*}{1-\lambda}\right)\frac{1+t\lambda}{1+t^*\lambda^*}\frac{L^*}{L}$$

  - three equations, three unknowns $(\bar{z}, \bar{z}^*, \bar{\omega})$, which are functions of $\left(t, t^*, \frac{L^*}{L}\right)$

- Welfare
  - $t \uparrow \Rightarrow \bar{\omega} \uparrow \Rightarrow$ terms of trade improves
  - the rationale why countries have the incentives to impose trade tariffs
  - Beggar-My-Neighbor argument for free trade agreement

Eaton and Kortum (2002)

- Extend Dornbusch, Fischer and Samuelson (1977) to the multi-countries and multi-products setting
  - no nice predictions about which country produces which goods as in DFS (1977)
  - link bi-lateral trade to underlying fundamentals like technology and geographic features
  - flexible to add new elements to the platform and conduct counterfactual analysis

- N countries
  - $i, n = 1, ..., N$
- A continuum of products
  - $j \in [0, 1]$ represents product
- Homogenous consumer preference across countries

$$U = \left[\int_0^1 Q(j)^{(\sigma-1)/\sigma} dj \right]^{\sigma/(\sigma-1)} \tag{1}$$

where σ is the elasticity of substitution

- Production efficiency $z_i(j)$
- One production factor (a same bundle of production factors)
  - free mobility of inputs across products within a country
  - assume the cost is c_i ($= w_i$ if labor)
- Constant returns to scale production technology
  - the cost of producing one unit of product j in country i is $c_i / z_i(j)$

- Iceberg transport cost
  - d_{ni}: the amount needed to ship one unit of product from country i to country n
  - $d_{ii} = 1 \ \forall \ i$; $d_{ni} > 1$ for $n \neq i$; $d_{ni} \leq d_{nk} d_{ki}$
- The cost (and hence the price) of product j produced in country i and sold in country n is

$$p_{ni}(j) = \left(\frac{c_i}{z_i(j)} \right) d_{ni} \tag{2}$$

- Perfect competition market
  - the price of product j in country n is

$$p_n(j) = \min \{ p_{ni}(j); i = 1, ..., N \}, \tag{3}$$

- A probabilistic representation of technologies
  - $z_i(j)$ is the realization of a random variable Z_i drawn from its country-specific probability distribution $F_i(z) = \Pr[Z_i \leq z]$
  - by the law of large number, $F_i(z)$ also represents the fraction of products for which $z_i(j) < z$
- Specifically, $F_i(.)$ is assumed to be independent across countries and takes a Fréchet distribution, i.e.,

$$F_i(z) = e^{-T_i z^{-\theta}}, \tag{4}$$

  - T_i: reflects a country's absolute advantage as a higher value indicates more likely a draw of high efficiency
  - θ: captures a country's comparative advantage as a lower value indicates more heterogeneity

- The distribution of prices country i could sell in country n is

$$\begin{aligned} G_{ni}(p) &= \Pr\left[P_{ni} \leq p\right] = \Pr\left[\frac{c_i d_{ni}}{Z_i} \leq p\right] \\ &= 1 - F_i\left[\frac{c_i d_{ni}}{p}\right] = 1 - e^{-\left[T_i (c_i d_{ni})^{-\theta}\right] p^{\theta}} \qquad (5) \end{aligned}$$

- The distribution of prices in country n is

$$\begin{aligned} G_n(p) &= \Pr\left[P_n \leq p\right] = \Pr\left[\min\left\{P_{ni}\ \forall\ i\right\} \leq p\right] \\ &= 1 - \prod_{i=1}^{N}\left[1 - G_{ni}(p)\right] \\ &= 1 - \prod_{i=1}^{N} e^{-\left[T_i(c_i d_{ni})^{-\theta}\right]p^{\theta}} \\ &= 1 - e^{-\Phi_n p^{\theta}} \qquad (6) \end{aligned}$$

  - where $\Phi_n \equiv \sum_{i=1}^{N} T_i(c_i d_{ni})^{-\theta}$: contains the states of technology and input costs as well as bi-lateral geographic barriers

Lemma (1)

The probability that country i provides a good at the lowest price in country n is $\pi_{ni} = \frac{T_i(c_i d_{ni})^{-\theta}}{\Phi_n}$.

Proof.

$$
\begin{aligned}
\pi_{ni} &= \Pr\left[P_{ni} \leq P_{nk} \ \forall \ k \neq i\right] \\
&= \int_0^\infty \prod_{k \neq i} \left[1 - G_{nk}(p)\right] dG_{ni}(p) \\
&= \int_0^\infty e^{-\left(\sum\limits_{k \neq i} T_i(c_i d_{ni})^{-\theta}\right) p^\theta} e^{-T_i(c_i d_{ni})^{-\theta} p^\theta} \left(T_i(c_i d_{ni})^{-\theta}\right) p^{\theta-1}\theta dp \\
&= \int_0^\infty e^{-\Phi_n p^\theta} \left(T_i(c_i d_{ni})^{-\theta}\right) dp^\theta.
\end{aligned}
$$

Proof.

Let $-\Phi_n p^\theta = x$. Hence, when $p = 0$, $x = 0$; when $p = \infty$, $x = -\infty$. And $dp^\theta = -\frac{dx}{\Phi_n}$.

$$\begin{aligned}
\pi_{ni} &= -\int_0^{-\infty} \left[\frac{T_i (c_i d_{ni})^{-\theta}}{\Phi_n} \right] e^x dx \\
&= \left[\frac{T_i (c_i d_{ni})^{-\theta}}{\Phi_n} \right] e^x \Big|_{-\infty}^0 = \frac{T_i (c_i d_{ni})^{-\theta}}{\Phi_n}.
\end{aligned}$$

□

Lemma (2)

The price of a good that country n actually buys from country i has the distribution $G_n(p)$.

Proof.

$$
\begin{aligned}
G_{ni}(p) &= \Pr\left[P_{ni} \le p \middle| P_{ni} \le P_{nk} \ \forall \ k \ne i\right] \\
&= \frac{\Pr\left[P_{ni} \le p \ \& \ P_{ni} \le P_{nk} \ \forall \ k \ne i\right]}{\Pr\left[P_{ni} \le P_{nk} \ \forall \ k \ne i\right]} \\
&= \frac{1}{\pi_{ni}} \int_0^p \prod_{k \ne i} \left[1 - G_{nk}(p)\right] dG_{ni}(p) \\
&= G_n(p).
\end{aligned}
$$

$\square$

- All the adjustment is at the extensive margin
  - *better* countries sell more with the same average price charged
- The share of expenditure in country n on goods from country i is the same as π_{ni}

Lemma (3)

The price index in country n is $p_n = \gamma \Phi_n^{-1/\theta}$, *where* $\gamma \equiv \left[\Gamma\left(\frac{\theta+1-\sigma}{\theta}\right)\right]^{1/(1-\sigma)}$ *and* Γ *is the Gamma function.*

Proof.

$$p_n = E\left[p^{1-\sigma}\right]^{1/(1-\sigma)}.$$

Let $x = -\ln p$. Hence, when $p = 0$, $x = 0$; when $p = \infty$, $x = \infty$.

$$\begin{aligned} dG_n(p) &= e^{-\Phi_n p^\theta}\left(\Phi_n \theta\right) p^\theta dp \\ &= -e^{-\Phi_n p^\theta}\left(\Phi_n \theta\right) p^\theta dx. \end{aligned}$$

$\square$

Proof.

$\Rightarrow$

$$
\begin{aligned}
E\left[e^{tx}\right] &= \int_0^\infty e^{tx} dG_n(p) \\
&= \int_0^\infty e^{tx} e^{-\Phi_n p^\theta} \left(\Phi_n \theta\right) p^\theta dx \\
&= \left(\Phi_n \theta\right) \int_0^\infty e^{(t-\theta)x} e^{-\Phi_n e^{-\theta x}} dx.
\end{aligned}
$$

Then let $y = \Phi_n e^{-\theta x}$. Hence, when $x = 0$, $y = \infty$; when $x = \infty$, $y = 0$.

$$
\begin{cases}
dx = -\frac{1}{\theta y} dy \\
e^{(t-\theta)x} = \left(\frac{y}{\Phi_n}\right)^{1-\frac{t}{\theta}}
\end{cases}
$$

$\square$

Proof.

$\Rightarrow$

$$
\begin{aligned}
E\left[e^{tx}\right] &= \Phi_n^{\frac{t}{\theta}} \int_0^\infty y^{\left(1-\frac{t}{\theta}\right)-1} e^{-y}\, dy \\
&= \Phi_n^{\frac{t}{\theta}} \Gamma\left(1-\frac{t}{\theta}\right).
\end{aligned}
$$

Finally, let $t = \sigma - 1$.

$$
\begin{aligned}
p_n &= E\left[p^{-t}\right]^{-1/t} = \left[\Phi_n^{\frac{t}{\theta}} \Gamma\left(1-\frac{t}{\theta}\right)\right]^{-1/t} \\
&= \gamma \Phi_n^{-1/\theta}.
\end{aligned}
$$

□

- The fraction of country n's expenditure on goods from country i is

$$\frac{X_{ni}}{X_n} = \pi_{ni} = \frac{T_i (c_i d_{ni})^{-\theta}}{\Phi_n}, \tag{7}$$

  - given that country n's expenditure structure on products from different countries is the same

- Country i's total sales are

$$Q_i = \sum_{m=1}^{N} X_{mi} = T_i c_i^{-\theta} \sum_{m=1}^{N} \frac{d_{mi}^{-\theta} X_m}{\Phi_m}$$

$\Rightarrow$

$$\begin{aligned} T_i c_i^{-\theta} &= Q_i / \left(\sum_{m=1}^{N} \frac{d_{mi}^{-\theta} X_m}{\Phi_m} \right) \\ &= Q_i / \left(\sum_{m=1}^{N} \frac{d_{mi}^{-\theta} X_m}{p_n^{-\theta}} \gamma^{\theta} \right) \end{aligned}$$

- $\Rightarrow$

$$\begin{aligned} X_{ni} &= \frac{T_i (c_i d_{ni})^{-\theta}}{\Phi_n} X_n \qquad (8) \\ &= \frac{Q_i d_{ni}^{-\theta}}{\sum_{m=1}^{N} \frac{d_{mi}^{-\theta} X_m}{p_m^{-\theta}} \gamma^{\theta}} \frac{\gamma^{\theta}}{p_n^{-\theta}} X_n \\ &= \frac{Q_i}{\sum_{m=1}^{N} \left(\frac{d_{mi}}{p_m}\right)^{-\theta} X_m} \left(\frac{d_{ni}}{p_n}\right)^{-\theta} X_n \qquad (9) \end{aligned}$$

- Equation (9) resembles the conventional gravity model
  - the exporter's GDP (Q_i) and importer's GDP (X_n) enter with unit elasticity
  - bi-lateral geographic barriers (d_{ni}) has a negative impact;
  - the denominator represents sort of multi-lateral resistence term as in Anderson and van Wincoop (2003)

- Total income equals to total cost

$$w_i L_i = \sum_n X_{ni}$$

- Total income equals to total expenditure

$$w_n L_n = \sum_i X_{ni} = X_n$$

$\Rightarrow$

$$w_i L_i = \sum_n \frac{T_i (c_i d_{ni})^{-\theta}}{\Phi_n} w_n L_n \tag{10}$$

- $N-1$ equations to solve N unknowns $(w_1, ..., w_N)$
  - need a normalization (a numeraire)
  - the solution is unique: Scarf and Wilson (2003); Alvarez and Lucas (2007), Allen and Arkolakis (2015)

- Normalized import share

$$S_{ni} \equiv \frac{X_{ni}/X_n}{X_{ii}/X_i} = \frac{\Phi_i}{\Phi_n} d_{ni}^{-\theta} = \left(\frac{p_i d_{ni}}{p_n}\right)^{-\theta} \tag{11}$$

  - $d_{ni} \uparrow \Rightarrow S_{ni} \downarrow$
  - $\theta \uparrow \Rightarrow S_{ni}$ more responsive to $\frac{p_i}{p_n}$ and d_{ni}, as comparative advantage falls

- Head and Ries index of trade costs
  - let $B_{ni} \equiv \left(\frac{X_{ni}}{X_{ii}} \frac{X_{in}}{X_{nn}}\right)^{1/2}$

$$B_{ni} = (S_{ni} S_{in})^{1/2} = \left(d_{ni}^{-\theta} d_{in}^{-\theta}\right)^{1/2} = d_{ni}^{-\theta}$$

  - the last equality comes with the symmetric trade costs assumption

- θ is the key structural parameter
    - trade elasticity
    - needed for welfare and counterfactual analysis
    - can be estimated from equation (11) with the price information and geographic barriers
- Data
    - retail prices of 50 manufacturing products in 19 OECD countries in 1990

- For good j
  - if country n imports from country i, then $p_n(j)/p_i(j) = d_{ni}$
  - if country n does not, then $p_n(j)/p_i(j) \leq d_{ni}$
  - $p_n(j)/p_i(j)$ bounds at d_{ni}
- Given that every country in the sample imports manufacturing goods from every other

$$\max_j \{p_n(j)/p_i(j)\} = d_{ni}$$

  - to reduce measurement error, the second highest is used

- Let $r_{ni}(j) \equiv \ln p_n(j) - \ln p_i(j) \Rightarrow d_{ni} = \max 2_j \{r_{ni}(j)\}$
- Measure $p_n(j) / p_i(j)$ as the mean value: $p_n(j) / p_i(j) = \sum_j r_{ni}(j)/50$
- Hence,

$$D_{ni} \equiv \ln\left(\frac{p_i d_{ni}}{p_n}\right) = \frac{\max 2_j \{r_{ni}(j)\}}{\sum_j r_{ni}(j)/50}$$

- Given equation (11), we can estimate θ from

$$\ln(S_{ni}) = -\theta D_{ni}$$

  - Method of moment: $\theta = 8.28$; OLS without intercept: $\theta = 8.03$

- One production factor, i.e., labor: $c_i = w_i$

$$\pi_{nn} = \frac{X_{nn}}{X_n} = \frac{T_n w_n^{-\theta}}{\Phi_n}$$

- As $p_n = \gamma \Phi_n^{-1/\theta}$, we have

$$\omega_n \equiv \frac{w_n}{p_n} = \gamma^{-1} T_n^{1/\theta} \pi_{nn}^{-1/\theta}$$

- At autarky, we have

$$\omega_n^A = \gamma^{-1} T_n^{1/\theta}$$

$\Rightarrow$

$$GT_n \equiv \omega_n / \omega_n^A = \pi_{nn}^{-1/\theta}$$

  - two sufficient statistics: θ and π_{nn}

- Production uses two inputs: labor and intermediates (consisted of all products)

$$c_i = w_i^{\beta} p_i^{1-\beta}$$

$\Rightarrow$

$$\left(\frac{w_i}{p_i}\right)^{\beta} = \frac{c_i}{p_i} = \frac{c_i}{\gamma \Phi_i^{-1/\theta}}$$

As $\pi_{ii} = \frac{T_i (c_i d_{ii})^{-\theta}}{\Phi_i} = \frac{T_i c_i^{-\theta}}{\Phi_i}$, $c_i = \left(\frac{T_i}{\Phi_i \pi_{ii}}\right)^{1/\theta}$; hence,

$$\begin{aligned}
\left(\frac{w_i}{p_i}\right)^{\beta} &= \frac{c_i}{\gamma \Phi_i^{-1/\theta}} = \frac{\left(\frac{T_i}{\Phi_i \pi_{ii}}\right)^{1/\theta}}{\gamma \Phi_i^{-1/\theta}} \\
&= \left(\frac{T_i}{\pi_{ii}}\right)^{1/\theta} \frac{1}{\gamma}
\end{aligned}$$

- $\Rightarrow$

$$\frac{w_i}{p_i} = \gamma^{-1/\beta} \left(\frac{T_i}{\pi_{ii}} \right)^{1/\theta\beta} \tag{12}$$

- Gains from trade then become

$$\omega_i / \omega_i^A = \pi_{ii}^{-1/\theta\beta}$$

- Total labor income equals labor costs

$$w_i L_i = \beta Q_i = \beta \sum_{n=1}^{N} X_{ni} = \beta \sum_{n=1}^{N} \pi_{ni} X_n, \tag{13}$$

- Total expenditure on manufacturing goods

$$X_n = \frac{1-\beta}{\beta} w_n L_n + \alpha Y_n, \tag{14}$$

  - where Y_n is the total final expenditure, equal to $Y_n^M = w_n L_n$ (value added in manufacturing) plus income from non-manufacturing activities Y_n^O

- Case of free mobile labor
  - w is determined by nonmanufacturing sector

$$w_i L_i = \sum_{n=1}^{N} \pi_{ni} \left[(1-\beta) w_n L_n + \alpha \beta Y_n \right]$$

  - determines L_i
  - prices are determined by

$$p_n = \gamma \Phi_n^{-1/\theta} = \gamma \left[\sum_{i=1}^{N} T_i \left(d_{ni} w_i^{\beta} p_i^{1-\beta} \right)^{-\theta} \right]^{-1/\theta}$$

  - trade shares are determined by

$$\pi_{ni} = T_i \left(\frac{\gamma d_{ni} w_i^{\beta} p_i^{1-\beta}}{p_n} \right)^{-\theta}$$

- Case of immobile labor
  - L_i is fixed

$$w_i L_i = \sum_{n=1}^{N} \pi_{ni} \left[(1 - \beta + \alpha\beta)\, w_n L_n + \alpha\beta Y_n^O \right]$$

  - $\{w_i, \pi_{ni}, p_i\}$ are determined simultaneously

- Estimation of the model

$$\frac{X_{ni}/X_n}{X_{nn}/X_n} = \frac{T_i \left(\frac{\gamma d_{ni} w_i^{\beta} p_i^{1-\beta}}{p_n} \right)^{-\theta}}{T_n \left(\frac{\gamma w_n^{\beta} p_n^{1-\beta}}{p_n} \right)^{-\theta}}$$

$\Rightarrow$

$$\frac{X_{ni}}{X_{nn}} = \frac{T_i}{T_n} \left(\frac{w_i}{w_n} \right)^{-\theta\beta} \left(\frac{p_i}{p_n} \right)^{-\theta(1-\beta)} d_{ni}^{-\theta}.$$

- As

$$\begin{cases} \frac{X_{ii}}{X_i} = \pi_{ii} = T_i \left(\frac{\gamma w_i^{\beta} p_i^{1-\beta}}{p_i} \right)^{-\theta} \\ \frac{X_{nn}}{X_n} = \pi_{nn} = T_n \left(\frac{\gamma w_n^{\beta} p_n^{1-\beta}}{p_n} \right)^{-\theta} \end{cases}$$

$\Rightarrow$

$$\frac{X_{ii}/X_i}{X_{nn}/X_n} = \frac{T_i}{T_n} \left(\frac{w_i}{w_n} \right)^{-\beta\theta} \left(\frac{p_i}{p_n} \right)^{\beta\theta}$$

$\Rightarrow$

$$\frac{p_i}{p_n} = \left(\frac{T_i}{T_n} \right)^{-1/\beta\theta} \frac{w_i}{w_n} \left(\frac{X_{ii}/X_i}{X_{nn}/X_n} \right)^{-1/\beta\theta}$$

- $\Rightarrow$

$$\frac{X_{ni}}{X_{nn}} = \frac{T_i}{T_n}\left(\frac{w_i}{w_n}\right)^{-\theta\beta}\left[\left(\frac{T_i}{T_n}\right)^{1/\beta\theta}\frac{w_i}{w_n}\left(\frac{X_{ii}/X_i}{X_{nn}/X_n}\right)^{-1/\beta\theta}\right]^{-\theta(1-\beta)} d_{ni}^{-\theta}$$

$$= \left(\frac{T_i}{T_n}\right)^{1+(1-\beta)/\beta}\left(\frac{w_i}{w_n}\right)^{-\theta\beta-\theta(1-\beta)}\left(\frac{X_{ii}/X_i}{X_{nn}/X_n}\right)^{(1-\beta)/\beta} d_{ni}^{-\theta}$$

$\Rightarrow$

$$\ln\frac{X_{ni}}{X_{nn}} = \frac{1}{\beta}\ln\frac{T_i}{T_n} - \theta\ln\frac{w_i}{w_n} - \theta\ln d_{ni} + \frac{1-\beta}{\beta}\ln\frac{X_{ii}/X_i}{X_{nn}/X_n}$$

$\Rightarrow$

$$\ln\frac{X'_{ni}}{X'_{nn}} = \frac{1}{\beta}\ln\frac{T_i}{T_n} - \theta\ln\frac{w_i}{w_n} - \theta\ln d_{ni},$$

  - where $\ln X'_{ni} \equiv \ln X_{ni} - \frac{1-\beta}{\beta}\ln\left(X_{ii}/X_i\right)$

- Denote $S_i \equiv \frac{1}{\beta} \ln T_i - \theta \ln w_i$ as a measure of source country i's competitiveness

$$\begin{aligned} \ln \frac{X'_{ni}}{X'_{nn}} &= -\theta \ln d_{ni} + S_i - S_n \\ &= -\theta \left[d_k + b + l + e_h + m_n + \delta_{ni} \right] + S_i - S_n \end{aligned}$$

  - d_k: the effect of distance between n and i in the kth interval
  - b: border
  - l: common language
  - e_h: trading area h; the European Community and the European Free-Trade Area
  - m_n: overall destination effect
  - δ_{ni}: error term; other factors

- To capture potential reciprocity in geographic barriers, it is assumed that

$$\delta_{ni} = \delta_{ni}^{2} + \delta_{ni}^{1},$$

  - where δ_{ni}^{2} (with variance σ_2^2) affects two-way trade (hence, $\delta_{ni}^{2} = \delta_{in}^{2}$)
  - δ_{ni}^{1} (with variance σ_1^2) affects one-way trade
  - this implies that the variance-covariance matrix of δ has diagonal elements

$$\begin{cases} E\left(\delta_{ni}\delta_{ni}\right) = \sigma_1^2 + \sigma_2^2 \\ E\left(\delta_{ni}\delta_{in}\right) = \sigma_2^2 \end{cases}$$

- The final estimation equation becomes

$$\ln \frac{X'_{ni}}{X'_{nn}} = -\theta \left[d_k + b + l + e_h + m_n\right] + S_i - S_n + \theta\delta^2_{ni} + \theta\delta^1_{ni}$$

  - estimated by the GLS
  - first-step: OLS estimation generates residue $\hat{\varepsilon}_{ni}$
  - then in the second-step, $\theta^2\sigma_2^2$ is estimated by averaging $\hat{\varepsilon}_{ni}\hat{\varepsilon}_{in}$ while $\theta^2\left(\sigma_1^2 + \sigma_2^2\right)$ is estimated by averaging $\left(\hat{\varepsilon}_{ni}\right)^2$

- Shocks that affect the fundamentals, such as L_i, d_{ni}, T_i
- Eaton and Kortum (2002) approach
  - given the estimated parameters $(\theta,\ \alpha,\ \beta)$ and known variables $(L_i,\ d_{ni},\ T_i,\ L_i^{'},\ d_{ni}^{'},\ T_i^{'})$
  - solve the endogeneous variables at the old and new equilibriums
- Dekle, Eaton and Kortum (2008) approach
  - directly look at the changes in the endogeneous variables

- Trade shares are

$$
\begin{aligned}
\pi_{ni} &= \frac{T_i (w_i d_{ni})^{-\theta}}{\sum_m T_m (w_m d_{nm})^{-\theta}} \\
\pi'_{ni} &= \frac{T'_i (w'_i d'_{ni})^{-\theta}}{\sum_m T'_m (w'_m d'_{nm})^{-\theta}}
\end{aligned}
$$

- Define $\hat{x} \equiv x'/x$; then we have

$$
\begin{aligned}
\hat{\pi}_{ni} &= \frac{\hat{T}_i (\hat{w}_i \hat{d}_{ni})^{-\theta}}{\sum_m T_m (w_m d_{nm})^{-\theta} / \sum_m T'_m (w'_m d'_{nm})^{-\theta}} \\
&= \frac{\hat{T}_i (\hat{w}_i \hat{d}_{ni})^{-\theta}}{\sum_m \pi_{nm} \hat{T}_m (\hat{w}_m \hat{d}_{nm})^{-\theta}}
\end{aligned}
$$

- At equilibrium, we have

$$w_i' L_i' = \sum_n \pi_{ni}' w_n' L_n' = \sum_n \hat{\pi}_{ni} \pi_{ni} w_n' L_n'$$

$\Rightarrow$

$$\hat{w}_i \hat{L}_i Y_i = \sum_n \frac{\pi_{ni} \hat{T}_i (\hat{w}_i \hat{d}_{ni})^{-\theta}}{\sum_m \pi_{nm} \hat{T}_m (\hat{w}_m \hat{d}_{nm})^{-\theta}} \hat{w}_n \hat{L}_n Y_n$$

  - where $Y_n \equiv w_n T_n$
- N equations and N unknowns $\{\hat{w}_i\}$ as functions of shocks and initial conditions

Eaton and Kortum (2002)

Extensions

- Bertrand competition: Bernard, Eaton, Jensen, and Kortum (2003)
  - variable firm markups
  - firm heterogeneity
- Multiple sectors: Costinot, Donaldson, and Komunjer (2012)
  - technology endowment differs across country and sector: T_i^k
  - predictions of trade patterns
- Nonhomothetic preferences: Fieler (2011)
  - consumption bundle changes with income level
  - θ^k differs across sectors

Competition and Gains from Trade: A Quantitative Analysis of China Between 1995 and 2004?

By Wentai Hsu, Yi Lu and Guiying Wu

Competition and Gains from Trade

- In the event of trade liberalization, potential entry of foreign firms may bring at least four different gains from trade:
  - Better productivity (lower costs and hence lower price) – Ricardian effect
  - Lower markups (domestic firms may lower their prices to deter foreign entry and successful foreign entry may also bring lower markup)
  - Higher profits – there are more chances for firms to earn profits from foreign countries
  - Less dispersion of markup distribution – allocative efficiency
- Competition and markups matter in the latter three above-mentioned forces – pro-competitive effects.

Allocative Efficiency

- When some goods are monopolized and others are not, the resource allocation across goods is distorted.
- When mark-ups are the same across all goods, first-best allocative efficiency is attained. The condition that the price ratio equals the marginal cost ratio, for any pair of goods, holds because of constant mark-ups.
- Trade liberalization "tends" to depress markups both in mean and its dispersion (Holmes, Hsu, and Lee 2014).
- Despite the economics of pro-competitive effects of trade being well-understood, its quantitative magnitudes are still under-studied.
- By incorporating allocative efficiency, this paper is also linked to the literature on resource misallocation, e.g., Hsieh and Klenow (2009).

This Paper

- This paper utilizes China's Economic Census Data at 1995 and 2004 to quantitatively examine welfare gains from trade.
    - Decomposition: a Ricardian component and two pro-competitive components
    - Separate the effect of tariff reduction from non-tariff trade costs.
- Using Economic Census Data at 1995 and 2004 avoids the trunction problem in the commonly used annual survey of manufacturing firms ($\geq$ 5 million RMB).
- Why China?
    - China entered WTO in 2001.
    - Average import tariff drops from 25.5% to 6.3%, whereas average export tariff drops from 6.4% to 3.2%.
    - SOE reforms, improvement in infrastructure,.......
    - Import share increases from 0.13 to 0.22, and export intensity also

Quantitative Framework

- Our quantitative framework is a variant of the canonical trade model in Bernard, Eaton, Jensen, and Kortum (2003; henceforth BEJK).
    - Productivity (Frechét distribution) differ across firms and countries
    - Firms compete in Bertrand fashion
    - Markups are generated by productivity differences – lowest cost firm charges the price at the second lowest marginal cost
- The distribution of markup is invariant to changes in trade costs....no pro-competitive effect of trade.

Quantitative Framework

- Holmes, Hsu, and Lee (2014) develop a model that deviate from BEJK in allowing a general distribution of productivity and assuming there are "finite" number of firms per product to draw from the distribution.
- Their result is that pro-competitive effects of trade will emerge when the tail of the productivity distribution is not too fat.
- We adopt the model framework in Holmes, Hsu, and Lee (2014) and assume
  - Productivity draws is from log-normal
  - Number of firms per product is drawn from Poisson
- Log-normal distribution has a kind-of fat-tail, but is less fat than Pareto/Frechét, and it matches the entire distribution better than

Preview of Main Results

- Counter-factual analysis reveals that pro-competitive effects account for 25.6% of the total welfare gains during 1995-2004.

- Comparison with symmetric-country estimation indicates that the asymmetry between countries may be an important source of gains from trade, whereas the relative contribution of pro-competitive effects remains similar.

- Tariff reduction accounts for 17.6% of the reduction in trade cost, and in terms of welfare,

    - In 1995, $\tau^{\text{nontariff}} = 2.154$ is relatively large, and tariff reduction accounts for only 12.3% of the total welfare gains.

    - In 2004, $\tau^{\text{nontariff}} = 1.621$ is relatively small, and tariff reduction accounts for 23.4% of the total welfare gains.

Context in the Literature

- CES + monopolistic competition/perfect competition: constant markup and hence no pro-competitive effects (Krugman 1980 and countless models following this)
- Arkolakis, Costinot, Donaldson and Rodriguez-Clare (2015) deviate from CES by allowing a flexible specification of non-homothetic preference, but they continue to assume monopolistic competition and a fat-tailed distribution (Pareto). Result: Welfare is lower with markup dispersion, but there is little pro-competitive effect of trade.
- Feentra (2014) proposes a monopolistic competitive model with a non-homothetic preference and a "bounded" productivity distribution that allows pro-competitive effects.

Context in the Literature

- Oligopoly Approach by Edmond, Midrigan, and Xu (2014):
  - quantitatively evaluate pro-competitive effects using the model of Atkeson and Burstein (2008) - heterogeneous-product Cournot competition.
  - Got estimate from 11% to 38%.
  - Markups are directly linked to **market shares** of firms.
  - Taiwanese data work for their oligopoly environment because they can go down to very fine product level to look at with a few firms.

- In large countries, due to numerous firms in a given "industry", market share per firm is typically small, and the market structure looks less concentrated and appears to be more monopolistic competitive than oligopolistic.

- Difficult to apply Edmond et al.'s approach to large countries.

- Our approach allows an oligopoly structure to work even in the

- A continuum of goods, and each good indexed by $\omega \in [0, \gamma]$:
  - γ is exogenous
  - Only $\bar{\omega} \leq \gamma$ measure of goods will be actually produced, $\bar{\omega}$ is endogenous.
- Assume CES utility.

$$U = \left(\int_0^{\bar{\omega}} q_\omega^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}}, \text{ for } \sigma > 1.$$

- There are two countries, $i = 1$ (China), 2 (ROW).

Model: Consumption

- The standard CES price index in country j:

$$P_j \equiv \left(\int_0^{\bar{\omega}} p_{j\omega}^{1-\sigma} d\omega \right)^{\frac{1}{1-\sigma}}.$$

- Country j's total consumption expenditure of good ω is given by

$$E_{j\omega} = R_j \left(\frac{p_{j\omega}}{P_j} \right)^{1-\sigma},$$

where $\left(\frac{p_{j\omega}}{P_j} \right)^{1-\sigma}$ is expenditure share on good ω, and R_j is the total revenue, as well as total income, of country j.

Number of Firms and Measure of Goods

- The number of firms for each good $\omega \in [0, \gamma]$ in country i is a random realization from Poisson distribution with parameter λ_i:

$$f_i(n) = \frac{e^{-\lambda_i} \lambda_i^n}{n!}.$$

- The actual number of goods produced $\bar{\omega} < \gamma$ is the complement set of the event $(n_1, n_2) = (0, 0)$. Formally,

$$\bar{\omega} = \gamma (1 - f_1(0) f_2(0)) = \gamma \left[1 - e^{-(\lambda_1 + \lambda_2)} \right]. \tag{15}$$

- In the event $(n_1, n_2) = (0, 1)$ or $(1, 0)$: monopoly.

- If $n_1 + n_2 \geq 2$, then firms engages in **Bertrand competition**.

Productivity, Marginal Cost, and Pricing

- Production features constant returns to scale.
- Labor is the only input.
- Each potential competitor draws a productivity $\varphi_{\omega,ik}$ from a log-normal distribution so that for $k \in \{1, 2, ..., n_{\omega,i}\}$,

$$\ln\left(\varphi_{\omega,ik}\right) \sim N\left(\mu_i, \eta_i\right).$$

- In $n_{\omega,i}$ draws, let $\varphi^{*}_{\omega,i}$ and $\varphi^{**}_{\omega,i}$ be the first and second highest.

Productivity, Marginal Cost, and Pricing

- Shipping domestically is free, but shipping to foreign countries requires an iceberg cost $\tau > 1$.

$$\tau_{ij} = 1 \text{ if } i = j, \text{ and } \tau_{ij} = \tau > 1 \text{ if } i \neq j.$$

- For each ω, the relevant marginal costs to deliver to country j are

$$\left\{ \frac{\tau_{1j} w_1}{\varphi^{*}_{s\omega,1}}, \frac{\tau_{1j} w_1}{\varphi^{**}_{s\omega,1}}, \frac{\tau_{2j} w_2}{\varphi^{*}_{s\omega,2}}, \frac{\tau_{2j} w_2}{\varphi^{**}_{\omega,2}} \right\}.$$

- Let $a^{*}_{j\omega}$ and $a^{**}_{j\omega}$ be the lowest and second lowest elements of this set.

Productivity, Marginal Cost, and Pricing

- Monopoly pricing: $\bar{p}_{j\omega} = \frac{\sigma}{\sigma-1} a^*_{j\omega}$.
- Pricing:

$$p_{j\omega} = \min\left(\bar{p}_{j\omega}, a^{**}_{j\omega}\right) = \min\left\{\frac{\sigma}{\sigma-1} a^*_{j\omega}, a^{**}_{j\omega}\right\}.$$

- The markup of good ω at j is therefore

$$m_{j\omega} = \frac{p_{j\omega}}{a^*_{j\omega}} = \min\left\{\frac{\sigma}{\sigma-1}, \frac{a^{**}_{j\omega}}{a^*_{j\omega}}\right\},$$

General Equilibrium

- There are three conditions that pins down total revenues R_1, R_2, and equilibrium wage ratio $w \equiv w_2 / w_1 = w_2$:
  - The labor market clearing condition in both countries.
  - Balanced trade condition, which is implied by the market clearing of commodities.

Aggregate Markups

- From the firms' viewpoint, if it is a nonexporter, then its markup is $m^f_{j\omega} = m_{\omega,j}$.
- For an exporter, constant returns to scale implies that its markup is a revenue-weighted average of markups in both countries.
- Welfare depends on the markups from both consumers' and producers' points of view, but the former is not directly observable.
- What we observe is firms' markups, which are useful for inferring structural parameters.
- **Consumers' aggregate markup** is the revenue-weighted harmonic mean across goods with *destination* at i.

$$M_i^{buy} = \left(\int_0^{\bar{\omega}} m_{\omega,i}^{-1} \phi_{\omega,i} d\omega \right)^{-1}.$$

Welfare Decomposition

Let A_i be the price index under marginal cost pricing,

$$A_i = \int_0^1 a^*_{i\omega} \tilde{q}^m_{i\omega} d\omega,$$

where $\tilde{\mathbf{q}}^m_i = \{\tilde{q}_{\omega,i} : \omega \in [0,1]\}$ is the expenditure-minimizing consumption bundle that delivers one unit of utility. We can then write

$$\begin{aligned} W_i^{Total} &= \frac{R_i}{P_i} = w_i L_i \times M_i^{sell} \times \frac{1}{P_i} && (16) \\ &= w_i L_i \times \frac{1}{A_i} \times \frac{M_i^{sell}}{M_i^{buy}} \times \frac{A_i \times M_i^{buy}}{P_i} \\ &\equiv w_i L_i \times W_i^{Prod} \times \frac{M_i^{sell}}{M_i^{buy}} \times W_i^A, && (17) \end{aligned}$$

where W_i^{Prod} is *productive efficiency* index, and W_i^A is *allocative efficiency* index.

Welfare Decomposition

$$W_i^{Total} = w_i L_i \times \frac{1}{A_i} \times \frac{M_i^{sell}}{M_i^{buy}} \times W_i^A.$$

- We focus on country 1, and we will set $w_1 = 1$. As the labor supply L_i is, the first term can be ignored.
- $W^{Prod} \equiv \frac{1}{A_i}$ is what the welfare index would be with constant mark-up. The index varies with **technological changes** (μ_i, η) or when **trade cost** (τ) changes declines. Terms of trade effects also show up in W^{Prod}, as **wages** also enter the marginal costs.
- It can be shown that this term traces the ACR statistics very closely in terms of elasticity with respect to trade costs.

Welfare Decomposition

$$W_i^{Total} = w_i L_i \times \frac{1}{A_i} \times \frac{M_i^{sell}}{M_i^{buy}} \times W_i^A.$$

- When markups are a constant, the third and fourth terms drop out.
- The third term is a "terms of trade" effect on mark-ups.
  - The higher the producers' aggregate markups, or the lower the consumers' aggregate markup, the higher the welfare.
  - This term drops out under autarky.
  - It also drops out under symmetric countries.

Welfare Decomposition

$$W_i^A \equiv \frac{A_i \times M_i^{buy}}{P_i} = \frac{\int_0^1 a_{i\omega}^* \tilde{q}_{i\omega}^a d\omega}{\int_0^1 a_{i\omega}^* \tilde{q}_{i\omega} d\omega} \leq 1.$$

- Under marginal cost pricing, $\tilde{q}_{\omega,i}^a$ is the optimal bundle, and hence $\int_0^1 a_{i\omega}^* \tilde{q}_{i\omega}^a d\omega \leq \int_0^1 a_{i\omega}^* \tilde{q}_{i\omega} d\omega$.
- Under constant markups, for any pair of goods, the ratio of actual prices equals the ratio of marginal cost, and hence, $W_i^A = 1$.
- Those with higher markups produce/employ less than optimal, and those with low markups produce/employ more than optimal.

Data

- Economic census from China's NBS (National Bureau of Statistics) data (1995 and 2004).
- From World Bank's WDI (World Development Indicators), obtain world manufacturing GDP and GDP per capita.
- The aggregate Chinese trade data is from UN comtrade.
- Combine data of GDP per capita and labor income share to calculate $w = w_2 / w_1$.
- Tariff data from WITS.

Estimation of Markups

- We estimate markups using De Loecker and Warzynski's (2012) approach , which calculate markups as

$$m_\omega^{\text{DLW}} = \frac{\theta_\omega^X}{\alpha_\omega^X},$$

where θ_ω^X is the input elasticity of output of input X, and α_ω^X is the share of expenditure on input X in total sales.

Inference of the Elasticity of Substitution

- The model implies that

$$m \in \left[1, \frac{\sigma}{\sigma - 1}\right].$$

- When the second marginal cost is high, the markup is bounded by the monopoly one because the firm profits is still subject to the substitutibility between products. The higher the substitutibility (σ), the lower the bound.

- Considering the possibility of measurement error and outliers, we equate $\frac{\sigma}{\sigma-1}$ to the 99-percentile of estimated markup distribution.

- Result: $\sigma = 1.4$.

- This is quite different estimates from the literature which typically estimate/calibrate σ under monopolistic competition models, which often feature constant markup.

Simulated Method of Moments

- We use SMM to estimate the remaining parameters

τ :	trade cost
γ :	measure of goods
λ_i :	mean number of firms per product
μ_i :	mean parameter of log-normal productivity draw
η_i :	standard deviation parameter of log-normal productivity draw

- For productivity, we normalize $\mu_2 = 0$ (when $\ln \varphi$ is zero, $\varphi = 1$). This is because only the relative magnitude of μ_1 to μ_2 matter. Choosing μ_2 amounts to choosing unit.

- Given data moments of R_1, R_2, w and the inferred σ from markup distribution, we simulate 12 moments for each set of parameter $(\tau, \gamma, \lambda_1, \lambda_2, \mu_1, \eta_1, \eta_2)$.

- Table 2.

Counter-Factual Analysis

- We conduct counter-factuals under 2004 parameter values, and take τ to the 1995 value and to autarky (Table 4).
- The welfare gains from 1995's openness to 2004's level is 9.4%, in which the pro-competitive effect account for 25.6%.
- Allocative efficiency W^A alone accounts for 22.2% of these gains.
- $W^{TOT} = \frac{M^{\text{sell}}}{M^{\text{buy}}}$ accounts for 3.4%
  - decreases in both M^{sell} and M^{buy}, but that of M^{buy} is larger.
  - More trade openness benefits Chinese consumers by lowering the markups, but it also hurts Chinese firms' profits.
- Gains from trade from autarky is about 33%, but the relative contributions of pro-competitive effects are similar (23.4% overall,

Comparing with the Literature

- In Edmond et al., diminishing returns in allocative efficiency

	%Δ in Edmond et al.		
Import share	Total Welfare	Ricardian	allocative efficiency
0 to 10%	3.1	1.9	1.2
10% to 20%	2.8	2.5	0.3

- We do a similar exercise, and our corresponding table is

	%Δ in this paper		
Import share	Total Welfare	Ricardian	allocative efficiency
0 to 10%	22.8	16.4	5.5
10% to 20%	5.7	4.0	1.4

- A similar diminishing returns pattern in allocative efficiency.
- Overall welfare and Ricardian components exhibit diminishing returns as well.

Symmetric Countries

- For the purpose of comparison, we also estimate a symmetric country case. Table 5 & 6.
- The gains from trade, as well as its components, are smaller in symmetric-country case (2.7%).
  - $W^{TOT} = 1$ always in this case
  - As productivity draws between the two countries become the same, the Ricardian gains are reduced.
  - When two countries are the same in their productivity draws and entries, not only the distribution of markups becomes more similar, but the dispersion of markups becomes smaller.

Robustness

- The relative contribution of pro-competitive effects remains similar to the following robustness checks
  - Based on 1995 estimates and taking τ to 2004 level or autarky.
  - Using a raw measure of markups:

$$m = \frac{\text{revenue}}{\text{total costs}}.$$

  - Using 97.5%-tile to infer σ.

The Effect of Tariff

- Decompose trade cost by

$$\tau = (1 + t)\tau^{\text{nontariff}}.$$

- Using tariff data from WITS and calculate weighted average using weights by trade volumes,

  - Average import tariff droped from 25.5% to 6.3%

  - Average export tariff droped from 6.4% to 3.2%
  - Weightee average droped from 15.7% to 4.3%
  - Relative importance of tariff reduction in overall reduction of trade cost$\Delta \ln(1 + t) / \Delta \ln \tau = 31.6\%$

The Effect of Tariff

- Keep $\tau^{\text{nontariff}}$ at the 2004 level
  - tariff reduction accounts for only 3.7% of the total welfare gains, where the pro-competitive effects accounts for 20.3% of these gains
  - the relative tariff contribution is then 39.6% (comparing with and without $\tau^{\text{nontariff}}$ change)
- Keep $\tau^{\text{nontariff}}$ at the 1995 level
  - tariff reduction accounts for 23.4% of the total welfare gains
  - the relative tariff contribution is then 35.2%

Conclusion

- The quantitative framework is useful for examining pro-competitive effects and applicable to both small and large countries.
- The key is that the assumed market structure allows the number of competitors of a firm to be inferred rather than to be tied with the number of firms of an industry or product category.
- The overall welfare gains from trade in China during 1995-2004 is about 9.4%.
- Pro-competitive effects account for 25.6% of the total gains, and allocative efficiency alone account for 22.2%.
- This is substantial comparing with results from monopolistic competition models. Our results highlight the importance of an oligopoly approach in studying pro-competitive effects.