Lecture 10: Welfare Gains from Trade

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New Trade Models, Same Old Gains ?

See Arkolakis, Costinot & Rodríguez-Clare, 2012, "New Trade Models, Same Old Gains?" *American Economic Review*, 102(1) : 94-130 and their online appendix.

New Trade Models, Same Old Gains ?

- ACRC show that, in a large class of trade models (including Armington, Krugman, Eaton-Kortum and Melitz-Chaney), welfare gains from international trade can be summarized by a unified welfare measure.
- Gains from trade depend only on the *share of domestic goods in aggregate expenditure* and the *price elasticity of imports*.

$\Rightarrow$ (Wrong) interpretation : Despite different underlying mechanisms, a given shock to international trade costs has identical aggregate effects.

$\Rightarrow$ (Correct) interpretation : One does not need to take a stand on the driver of trade to evaluate the magnitude of gains from trade.

General assumptions

ACRC's result applies to models that satisfy 4 micro assumptions...

i) Dixit-Stiglitz CES preferences :

$$W_j = \frac{R_j}{P_j} \text{ where } P_j = \left[\int_{\omega \in \Omega} p_j(\omega)^{1-\sigma} d\omega\right]^{1/(1-\sigma)}$$

ii) One factor (labor) in inelastic supply and immobile across countries, L_j

iii) Linear cost functions :

$$C_i(\mathbf{w}, \mathbf{q}, \tau, \varphi) = \sum_{j=1}^{N} \left[\underbrace{c_{ij}(w_i, \tau_{ij}, \varphi)}_{\textit{Cst MC in dom L}} q_j + \underbrace{f_{ij}(w_i, w_j, \xi_{ij}, \varphi)}_{\textit{Fixed cost in dom/for L}} 1(q_j > 0)\right]$$

where φ is the firm's productivity

iv) Perfect or monopolistic competition (with restricted or free entry)

General assumptions (ii)

...and 3 macro restrictions :

i) Balanced trade :

$$\sum_i X_{ij} = \sum_i X_{ji} \text{ where } X_{ij} \equiv \int_{\omega \in \Omega_{ij}} x_{ij}(\omega) d\omega$$

ii) Aggregate profits (gross of entry costs) are a constant share of aggregate revenues : $\Pi_j / R_j = cst$

iii) A CES import demand system :

$$\frac{\partial \ln(X_{ij}/X_{jj})}{\partial \ln \tau_{i'j}} = \begin{cases} \varepsilon < 0 & if \quad i' = i \\ 0 & if \quad i \neq i' \end{cases}$$

Research Question

What is the impact of foreign shocks on aggregate welfare W_j ?

- Foreign shocks are defined as changes in parameters affecting :
  - foreign endowments $\mathbf{L} = \{L_i\}$
  - entry costs $\mathbf{F} = \{F_i\}$
  - variable trade costs $\tau = \{\tau_{ij}\}$
  - fixed trade costs $\xi = \{\xi_{ij}\}$

  while L_j, F_j,τ_{jj} and ξ_{jj} remain constant.
- We will focus on changes in variable trade costs τ.

ACRC's Sufficient Statistic Result

Proposition

In this class of models, the welfare impact of a foreign shock is :

$$\hat{W}_j = \hat{\lambda}_{jj}^{1/\varepsilon}$$

where λ_{jj} *the share of domestically produced goods in consumption and* $\hat{v} = v'/v$ *is the ratio between* v *in the new equilibrium's and the initial* v.

- In the special case of moving to autarky $(\lambda'_{jj} = 1)$: $\hat{W}_j^A = \lambda_{jj}^{-1/\varepsilon}$
- Observed changes in domestic consumption shares and estimated trade elasticities are *sufficient statistics* for evaluating welfare gains !

CES National Product Differentiation (Armington)

- CES utility+Armington assumption :

$$U_j = \left[\sum_{i=1}^{N} q_{ij}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}$$

- Linear cost function ($f_{ij} = 0$) :

$$C_i(\mathbf{w}, \mathbf{q}, \tau, \varphi) = \sum_{j=1}^{N} [w_i \tau_{ij} q_{ij}]$$

- Perfect competition :

$$p_{ij} = w_i \tau_{ij} \Rightarrow P_j = \left[\sum_{i=1}^{N} (w_i \tau_{ij})^{1-\sigma}\right]^{1/(1-\sigma)}$$

- Trade balance :

$$R_j = \sum_{i=1}^{N} X_{ij} = w_j L_j$$

CES National Product Differentiation (Armington)

⇒ Bilateral trade flows :

$$X_{ij} = \underbrace{\left(\frac{w_i \tau_{ij}}{P_j}\right)^{1-\sigma}}_{\lambda_{ij}} w_j L_j$$

⇒ CES Import demand system :

$$\varepsilon \equiv \frac{d \ln X_{ij}/X_{jj}}{d \ln \tau_{ij}} = 1 - \sigma, \quad \frac{d \ln X_{ij}/X_{jj}}{d \ln \tau_{i'j}} = 0$$

- Welfare impact of a foreign shock (with w_j as numeraire) :

$$d \ln W_j = d \ln R_j - d \ln P_j$$
$$\textit{with} \quad d \ln R_j = d \ln w_j + d \ln L_j = 0$$
$$\textit{and} \quad d \ln P_j = \sum_i \lambda_{ij}(d \ln w_i + d \ln \tau_{ij})$$

CES National Product Differentiation (Armington)

- From the demand functions :

$$d \ln \lambda_{ij} - d \ln \lambda_{jj} = (1-\sigma)[d \ln w_i + d \ln \tau_{ij} - d \ln w_j]$$

- By choice of normalization $d \ln w_j = 0$
- By construction : $\sum_{i=1}^{N} \lambda_{ij} = 1$

$$\Rightarrow \quad d \ln W_j = -\frac{1}{1-\sigma} \sum_i \lambda_{ij} (d \ln \lambda_{ij} - d \ln \lambda_{jj}) = \frac{d \ln \lambda_{jj}}{1-\sigma} \Leftrightarrow \quad \hat{W}_j = \hat{\lambda}_{jj}^{1/(1-\sigma)}$$

- Welfare gains only depend on terms-of-trade changes, which can be inferred from changes in the relative demand for domestic and foreign goods
- $\downarrow \tau \rightarrow \downarrow$ relative price of imported goods $\rightarrow \downarrow P_j \rightarrow \uparrow W_j$

CES Monopolistic Competition (Krugman)

- CES utility :

$$U_j = \left[\sum_{i=1}^{N} N_i q_{ij}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}$$

- Linear cost function :

$$C_i(\mathbf{w}, \mathbf{q}, \tau, \varphi) = \sum_{j=1}^{N} [w_i \tau_{ij} q_{ij}] - w_i F \quad (f_{ij} = 0)$$

- Free entry

$$N_i = \frac{L_i}{\sigma F}$$

CES Monopolistic Competition (Krugman)

$\Rightarrow$ CES Import demand system :

$$X_{ij} = N_i \left(\frac{\sigma}{\sigma - 1} \frac{w_i \tau_{ij}}{P_j} \right)^{1-\sigma} R_j \;\Rightarrow\; \varepsilon \equiv \frac{d \ln X_{ij}/X_{jj}}{d \ln \tau_{ij}} = 1-\sigma, \quad \frac{d \ln X_{ij}/X_{jj}}{d \ln \tau_{i'j}} = 0$$

$\Rightarrow$ Welfare gains :

$$\hat{W}_j = \hat{\lambda}_{jj}^{1/(1-\sigma)} = \hat{\lambda}_{jj}^{1/\varepsilon}$$

- $\downarrow \tau \rightarrow \downarrow$ relative price of imported goods $\rightarrow \downarrow P_j \rightarrow \uparrow W_j$

Heterogeneous Industries (EK)

- CES utility across industries :

$$U_j = \left[\int_0^1 q_j(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right]^{\frac{\sigma}{\sigma-1}}$$

- Linear cost function :

$$C_i(\mathbf{w}, \mathbf{q}, \tau, \varphi) = \sum_{j=1}^{N} \frac{w_i \tau_{ij}}{\varphi_i(\omega)}$$

- Perfect competition :

$$\Omega_{ij} = \left\{ \omega \in \Omega \mid \frac{w_i \tau_{ij}}{\varphi_i(\omega)} < \frac{w_{i'} \tau_{i'j}}{\varphi_{i'}(\omega)} \forall i' \neq i \right\}$$

Heterogeneous Industries (EK)

⇒ Bilateral trade :

$$X_{ij} = \frac{\int_0^{+\infty} \left(\frac{w_i \tau_{ij}}{\varphi_i(\omega)}\right)^{1-\sigma} g_i(\varphi_i(\omega)) d\omega}{\sum_{i'=1}^{N} \int_0^{+\infty} \left(\frac{w_{i'} \tau_{i'j}}{\varphi_{i'}(\omega)}\right)^{1-\sigma} g_{i'}(\varphi_{i'}(\omega)) d\omega} R_j$$

with $g_i(\varphi_i(\omega))$ the density of goods with productivity $\varphi_i(\omega)$ in Ω_{ij}

⇒ Trade elasticity :

$$\frac{\partial \ln(X_{ij}/X_{jj})}{\partial \ln \tau_{i'j}} = \begin{cases} \underbrace{1-\sigma}_{Intensive} + \underbrace{\gamma_{i'j}^{i'} - \gamma_{jj}^{i'}}_{Extensive} & for \quad i' = i \\ \gamma_{ij}^{i'} - \gamma_{jj}^{i'} & for \quad i' \neq i \end{cases}$$

with $\gamma_{ij}^{i'} \equiv \partial \ln[\int_0^{+\infty} \varphi_i(\omega)^{\sigma-1} g_i(\varphi_i(\omega)) d\omega] / \partial \ln(w_{i'} \tau_{i'j})$

- Under Fréchet distribution :

$$\frac{\partial \ln(X_{ij}/X_{jj})}{\partial \ln \tau_{i'j}} = \begin{cases} -\theta & for \quad i' = i \\ 0 & for \quad i' \neq i \end{cases}$$

Heterogeneous Industries (EK)

- Under Fréchet :

$$P_j = \left[\Gamma\left(\frac{\theta+1-\sigma}{\theta}\right)\right]^{\frac{1}{1-\sigma}} \left[\sum_{i=1}^{N} T_i(\tau_{ij} w_i)^{-\theta}\right]^{\frac{-1}{\theta}}$$

- Impact of a foreign shock (again, with w_j as numeraire) :

$$\begin{aligned} & d\ln W_j = d\ln R_j - d\ln P_j \\ \textit{with} \quad & d\ln R_j = d\ln w_j + d\ln L_j = 0 \\ \textit{and} \quad & d\ln P_j = \sum_i \lambda_{ij}(d\ln w_i + d\ln \tau_{ij}) \\ \textit{where} \quad & \lambda_{ij} \equiv \frac{X_{ij}}{R_j} \end{aligned}$$

Note that the extensive margin effect is second-order, as consumers are indifferent between the cutoff goods produced by different countries

Heterogeneous Industries (EK)

- From the bilateral trade flows :

$$d \ln \lambda_{ij} - d \ln \lambda_{jj} = (1 - \sigma + \gamma^i_{ij} - \gamma^i_{jj}) d \ln(w_i \tau_{ij}) + \sum_{i' \neq i,j} (\gamma^{i'}_{ij} - \gamma^{i'}_{jj}) d \ln(w_{i'} \tau_{i'j})$$

$$\Rightarrow \quad d \ln W_j = - \sum_{i=1}^{N} \lambda_{ij} \frac{d \ln \lambda_{ij} - d \ln \lambda_{jj}}{-\theta}$$

- Since $\sum_i \lambda_{ij} = 1$, welfare gains become :

$$d \ln W_j = \frac{d \ln \lambda_{jj}}{-\theta} \quad or \quad \hat{W}_j = \hat{\lambda}_{jj}^{1/(-\theta)} = \hat{\lambda}_{jj}^{1/\varepsilon}$$

Extensive margin is now key since it is at the root of the terms-of-trade gains : $\downarrow \tau \rightarrow \downarrow$ relative price of imported goods $\rightarrow$ shift to more competitive suppliers $\rightarrow \downarrow P_j \rightarrow \uparrow W_j$

Heterogeneous Firms (Melitz-Chaney)

- CES utility across firms :

$$U_j = \left[\sum_{i=1}^{N} \int_{\Omega_{ij}} q_{ij}(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right]^{\frac{\sigma}{\sigma-1}}$$

- Linear cost function :

$$C_i(\mathbf{w}, \mathbf{q}, \tau, \varphi) = \sum_{j=1}^{N} \left[\frac{w_i \tau_{ij}}{\varphi} + w_i^{\mu} w_j^{1-\mu} \xi_{ij} 1(q_{ij}(\varphi) > 0) \right]$$

- Selection :

$$\Omega_{ij} = \left\{ \varphi \in \Omega | \varphi > \varphi_{ij}^* = \sigma^{\frac{\sigma}{\sigma-1}} (\sigma - 1) \left(\frac{w_i \tau_{ij}}{P_j} \right) \left(\frac{f_{ij}}{Y_j} \right)^{1/(\sigma-1)} \right\}$$

$$\Rightarrow X_{ij} = \frac{N_i \int_{\varphi_{ij}^*}^{+\infty} \left(\frac{w_i \tau_{ij}}{\varphi} \right)^{1-\sigma} g_i(\varphi) d\varphi}{\sum_{i'=1}^{N} N_{i'} \int_{\varphi_{i'j}^*}^{+\infty} \left(\frac{w_{i'} \tau_{i'j}}{\varphi} \right)^{1-\sigma} g_{i'}(\varphi) d\varphi} R_j$$

where $g_i(\varphi)$ is the marginal density of g.

Heterogeneous Firms (Melitz-Chaney)

- Effect of the foreign shock :

$$\frac{\partial \ln \varphi_{ij}^*}{\partial \ln \tau_{ij}} = \frac{\partial \ln \varphi_{jj}^*}{\partial \ln \tau_{ij}} + 1 \quad \textit{and} \quad \frac{\partial \ln \varphi_{ij}^*}{\partial \ln \tau_{i'j}} = \frac{\partial \ln \varphi_{jj}^*}{\partial \ln \tau_{i'j}} \quad \forall i \neq i'$$

$\Rightarrow$ Trade elasticity :

$$\frac{\partial \ln(X_{ij}/X_{jj})}{\partial \ln \tau_{i'j}} = \begin{cases} 1 - \sigma - \gamma_{ij} - (\gamma_{ij} - \gamma_{jj})\frac{\partial \ln \varphi_{jj}^*}{\partial \ln \tau_{ij}} & \textit{for} \quad i' = i \\ -(\gamma_{ij} - \gamma_{jj})\frac{\partial \ln \varphi_{jj}^*}{\partial \ln \tau_{i'j}} & \textit{for} \quad i' \neq i \end{cases}$$

with $\gamma_{ij} \equiv d \ln[\int_{\varphi_{ij}^*}^{+\infty} \varphi^{\sigma-1} g_i(\varphi) d\varphi] / d \ln \varphi_{ij}^*$

- With a Pareto distribution :

$$\frac{\partial \ln(X_{ij}/X_{jj})}{\partial \ln \tau_{i'j}} = \begin{cases} -\theta & \textit{for} \quad i' = i \\ 0 & \textit{for} \quad i' \neq i \end{cases}$$

Heterogeneous Firms (Melitz-Chaney)

- Welfare under free entry :

$$
\begin{aligned}
& d\ln W_j = d\ln R_j - d\ln P_j \\
\textit{with} \quad & d\ln R_j = d\ln w_j + d\ln L_j = 0 \\
\textit{and} \quad & d\ln P_j = \sum_i \lambda_{ij}\left(d\ln w_i + d\ln \tau_{ij} + \frac{d\ln N_i - \gamma_{ij} d\ln \varphi^*_{ij}}{1-\sigma}\right) \\
& = \sum_i \frac{\lambda_{ij}}{1-\sigma-\lambda_j}\Big[(1-\sigma-\lambda_j)(d\ln w_i + d\ln \tau_{ij}) \\
& + \frac{\gamma_{ij}}{1-\sigma}(d\ln \xi_{ij} + \mu d\ln w_i) + d\ln N_i\Big]
\end{aligned}
$$

where $\gamma_j = \sum_i \gamma_{ij}\lambda_{ij}$

Heterogeneous Firms (Melitz-Chaney)

- From bilateral trade :

$$d\ln\lambda_{ij} - d\ln\lambda_{jj} = (1-\sigma-\gamma_{ij})d\ln(w_i\tau_{ij})$$
$$+\frac{\gamma_{ij}}{1-\sigma}(d\ln\xi_{ij} + \mu d\ln w_i) - (\gamma_{ij}-\gamma_{jj})d\ln\varphi^*_{jj} + d\ln N_i - d\ln N_j$$

- and from the definition of cutoffs :

$$d\ln\varphi^*_{ij} = d\ln\varphi^*_{jj} + d\ln(w_i\tau_{ij}) - \frac{d\ln\xi_{ij} + \mu d\ln w_i}{1-\sigma}$$

Heterogeneous Firms (Melitz-Chaney)

- Finally welfare :

$$d \ln W_j = \frac{d \ln \lambda_{jj} - d \ln N_j}{-\theta}$$

- Under free entry : $\Pi_j = N_j F_j = cst \times Y_j$ (macro-level restriction (ii)) and thus

$$d \ln N_j = 0$$

- Under restricted entry : $d \ln N_j = 0$
- Welfare gains due to terms-of-trade adjustments (through the intensive and extensive margins)

Empirical welfare gains

Empirical welfare gains

- Based on ACRC we only need measures of λ_{jj} and estimates of ε to quantify welfare gains.
- ε can be estimated with a gravity equation.
- Despite different structural interpretations, the gravity equation is consistent with all models and in particular satisfies macro-restriction iii) :

$$\ln X_{ij} = A_i + B_j + \varepsilon \ln \tau_{ij} + \nu_{ij} \Rightarrow \ln X_{ij} - \ln X_{jj} = A_i - A_j + \varepsilon(\ln \tau_{ij} - \ln \tau_{jj}) + \nu_{ij} - \nu_{jj}$$

- Note that for the gravity equation to provide the trade elasticity necessary to quantify welfare gains in all models, it must be true that the orthogonality condition is equally verified in all models

Gains from Trade With Different Trade Elasticity Estimates

Table – Estimated θ parameters and corresponding welfare gains

	$\hat{\theta}$	$\hat{W}^A_{US}$	$\hat{W}^A_{open}$
EK, Method of moments	8.28	.991	.875
EK, 2Stages GLS+OLS	2.84	.975	.677
EK, 2Stages GLS+2SLS	3.60	.980	.735
EK, OLS Trade Eq.	2.44	.971	.635
EK, 2SLS Trade Eq.	12.86	.994	.917
SW, SMM	4.12	.983	.764
CDK, IV	6.53	.989	.844
CP, (mean)	8.22	.991	.874

EK=Eaton & Kortum (2002), CDK=Costinot et al (2011)
SW=Simonovska & Waugh (2011), CP=Caliendo & Parro (2014)
$\hat{W}^A_{US}$ uses $\lambda_{US,US} = .93$ from ACRC and $\hat{W}^A_{US} = \lambda_{US,US}^{-1/\varepsilon}$
$\hat{W}^A_{open}$ uses $\lambda_{open} = .33$, the value for Singapore.

Limits : Melitz & Redding (2014)

- A common interpretation of ACRC is that having different trade models is useless in as much as they "predict" the same welfare gains from trade.
- This is a wrong interpretation : The right interpretation would be that we don't need to know which model is the right one in order to evaluate welfare gains **ex post** since, up to the micro and macro assumptions, they do imply welfare gains that can be summarized by the same aggregate statistics.
- Simple example : In Melitz-Chaney, $\varepsilon = -\gamma < 1 - \sigma$ and thus gains from trade are larger than in Krugman, for a given domestic trade share.

Limits : Melitz & Redding (2014)

- In order to compare different trade models in terms of their predictions for welfare gains, one cannot use ACRC.
- Instead, one needs to compare models keeping structural parameters identical, which can imply different trade shares and/or elasticities.
- Illustration :
  - compare the standard Melitz (2003) model with a variant where the distribution of productivities is a Dirac measure
  - comparing welfare gains of both models helps identify the gains from trade due to selection mechanisms.
- Starting from the same autarkic equilibrium, welfare gains are larger with heterogeneous firms

Assumptions

- Preferences, production and entry as in Melitz
- 2 symmetric countries ($w = w^*$ and $R = R^*$)
- Static version (probability of death is zero)
- cdf of productivities is $G(\varphi)$ in the version with Heterogeneous Firms (Melitz-Chaney) and a degenerate distribution in the homogeneous case where firms either draw zero (probability $G(\bar{\varphi})$) or $\bar{\varphi}$ (probability $1 - G(\bar{\varphi})$)
- A sunk entry cost f_e and a fixed production cost f.
- Homogeneous case is isomorphic to Krugman (1980) in which the representative firm has productivity $\bar{\varphi}$ and pays a fixed cost $F = f + \frac{f_e}{1-G(\bar{\varphi})}$
- In the open economy equilibria, a fixed exporting cost f_{ex} and a variable iceberg trade cost τ

Autarky

- With Heterogeneous Firms (Melitz-Chaney) :
  - ZCP implies φ^* such that $RP^{\sigma-1}p(\varphi^*)^{1-\sigma} = \sigma f$
  - Unique equilibrium under free entry : $(1 - G(\varphi^*))\bar{\pi} = f_e$
  - Mass of entrants : $M_e = \frac{M}{1-G(\varphi^*)} = \frac{R}{\sigma[f_e+(1-G(\varphi^*))f]}$

  $\Rightarrow$ Welfare under autarky :

$$W^A_{het} \equiv \frac{w}{P} = \left(\frac{L}{\sigma f}\right)^{\frac{1}{\sigma-1}} \frac{\sigma-1}{\sigma}\varphi^*$$

- With homogeneous firms :
  - Free entry implies :$RP^{\sigma-1}p(\bar{\varphi})^{1-\sigma} = \sigma F$
  - Labor market equilibrium implies : $M = \frac{L}{\sigma F}$

  $\Rightarrow$ Welfare under autarky :

$$W^A_{hom} \equiv \frac{w}{P} = \left(\frac{L}{\sigma F}\right)^{\frac{1}{\sigma-1}} \frac{\sigma-1}{\sigma}\bar{\varphi}$$

Autarky (ii)

- Choose $\bar{\varphi} = \tilde{\varphi}(\varphi^*)$ and $G(\bar{\varphi}) = G(\tilde{\varphi}(\varphi^*))$ such that autarkic equilibria are isomorphic in the sense of all aggregate variables being the same given the same values for $\{f, f_e, L, \sigma\}$

$\Rightarrow$ Normalize so that welfare under autarky is identical in both models :

$$W^A_{het} = W^A_{hom}$$

Open Economy

- With Heterogeneous Firms (Melitz-Chaney) :
  - Productivity cutoffs defined by the ZCP conditions : ${\varphi^*}^T$ and ${\varphi_x^*}^T$ such that

$$RP^{\sigma-1}p({\varphi^*}^T)^{1-\sigma} = \sigma f \quad and \quad RP^{\sigma-1}p({\varphi_x^*}^T)^{1-\sigma}\tau^{1-\sigma} = \sigma f_{ex}$$

which implies

$${\varphi_x^*}^T = \tau \left(\frac{f_{ex}}{f}\right)^{\frac{1}{\sigma-1}} {\varphi^*}^T$$

  - Free entry implies :

$$[1 - G({\varphi^*}^T)]\bar{\pi} = f_e$$

$$where \quad \bar{\pi} = \pi_d(\tilde{\varphi}({\varphi^*}^T)) + \frac{1 - G({\varphi_x^*}^T)}{1 - G({\varphi^*}^T)}\pi_x(\tilde{\varphi}_x({\varphi_x^*}^T))$$

Note : ${\varphi^*}^T > \varphi^*$ for $f_{ex} > 0$

  - Mass of entrants : $M_e = \frac{M}{1-G({\varphi^*}^T)} = \frac{R}{\sigma[f_e+[1-G({\varphi^*}^T)]f+[1-G({\varphi_x^*}^T)]f_{ex}}$

Open Economy (ii)

- Welfare in open economy :
  - If selection into export ($\varphi_x^{*T} > \varphi^{*T}$) :

$$W_{het}^T \equiv \frac{w}{P} = \left(\frac{L}{\sigma f}\right)^{\frac{1}{\sigma-1}} \frac{\sigma-1}{\sigma} \varphi^{*T} > W_{het}^A$$

  - If all firms export :

$$W_{het}^T \equiv \frac{w}{P} = \left(\frac{(1+\tau^{1-\sigma})L}{\sigma(f+f_{ex})}\right)^{\frac{1}{\sigma-1}} \frac{\sigma-1}{\sigma} \varphi^{*T} > W_{het}^A$$

Open Economy (iii)

- With homogeneous firms :
  - $\bar{\varphi}$ and $G(\bar{\varphi})$ unchanged
  - Representative firm exports if and only if $\frac{\tau^{\sigma-1} f_{ex}}{F} > 1$
  - If $\frac{\tau^{\sigma-1} f_{ex}}{F} < 1$,
$$W^T_{hom} = W^A_{hom} = W^A_{het} < W^T_{het}$$
  - If $\frac{\tau^{\sigma-1} f_{ex}}{F} \geq 1$:
    - ★ Free entry implies : $RP^{\sigma-1} p(\bar{\varphi})^{1-\sigma}(1+\tau^{1-\sigma}) = \sigma(F + f_{ex})$
    - ★ Labor market equilibrium implies : $M = \frac{L}{\sigma(F+f_{ex})}$
    - ⇒ Welfare in open economy :

$$W^T_{Hom} \equiv \frac{w}{P} = \left(\frac{(1+\tau^{1-\sigma})L}{\sigma(F+f_{ex})}\right)^{\frac{1}{\sigma-1}} \frac{\sigma-1}{\sigma}\bar{\varphi}$$

Relative welfare

- The proportional welfare gains from trade are larger in the heterogeneous firm model than in the homogeneous firm model :

$$\frac{W_{Het}^T}{W_{Het}^A} \geq \frac{W_{Hom}^T}{W_{Hom}^A}$$

- The inequality is strict whenever the fixed exporting cost is non zero
- To achieve the same proportional welfare gains from trade requires strictly lower trade costs (f_{ex} and/or τ) in the homogeneous firm model than in the heterogeneous firm model (except with zero fixed exporting cost)
- With an unbounded Pareto distribution of productivities, $\frac{W_{Het}^T}{W_{Het}^A}$ is increasing in the dispersion of productivities (θ)

Conclusion

- ACRC (2012) analyze the sufficient set of assumptions needed for a model to predict gains from trade that can be easily computed in the data.
- Their approach extends to models with several sectors, intermediates trade and variable markups.
- The main result should NOT be interpreted as a negative result. Having welfare gains in different models summarized by the same statistics does not mean the magnitude of those gains is the same in all models.
- Still a lot to do on the empirical side. Under small deviations from the ACRC assumptions the trade elasticity is a combination of structural and endogenous variables, and thus not invariant to the sample.

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