Complementarity between firm exporting and firm importing on industry productivity and welfare

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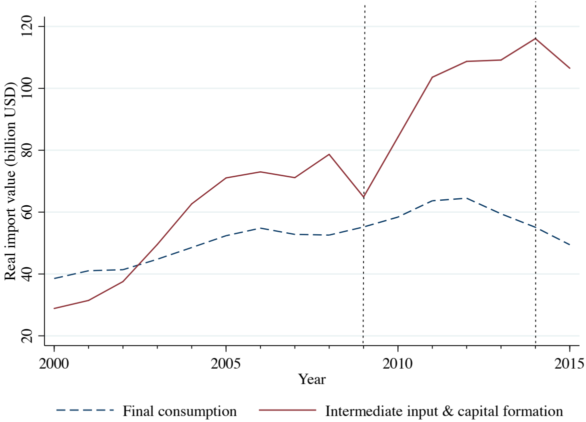
Motivation

- Intermediate inputs have a large and growing share of international trade relative to final goods:
  - "Offshoring"
  - "Outsourcing"
  - "Vertical specialization"
  - "Fragmentation of production processes"

- **Hypotheses**:
  - Trade flows of inputs and outputs may be differently affected by trade costs
  - Welfare gains may be different between input trade and output trade

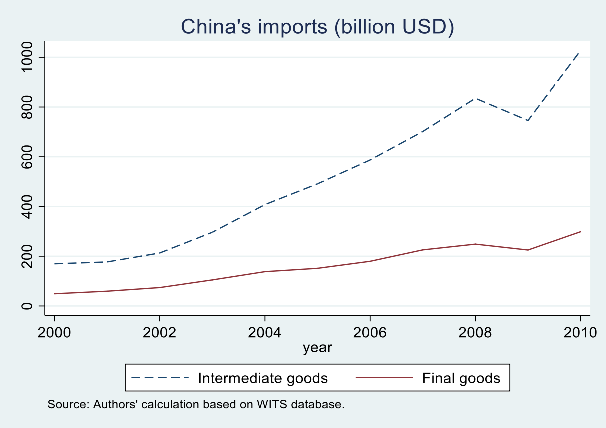
Motivation (cont.)



Japan's imports from China in 2000–2015

Source: Ito (2018)

Motivation (cont.)



China's imports from the world in 2000-2009

Source: Ara et al. (2018)

Questions and results

- How different are the impacts of trade barriers on trade flows between intermediate inputs and final goods?:
  - The gravity equation for final-good trade ($i = F$) or input trade ($i = I$) is

    $$Exports^i_{AB} = Constant^i \times \frac{GDP_A^{\alpha} \times GDP_B^{\beta}}{(Trade\ \ barriers_{AB})^{\epsilon^i}}$$

    where ϵ^i is the trade elasticity with respect to trade barriers

  - The trade elasticity is *endogenously* greater for inputs than final goods

    $$|\epsilon^I| > |\epsilon^F|$$

Questions and results (cont.)

- How large are the welfare gains from trade for intermediate inputs relative to final goods?:
    - Changes in welfare are expressed in terms of the domestic share λ^i and ϵ^i:

      $$\widehat{W}^i = \left(\widehat{\lambda}^i\right)^{-\frac{1}{\epsilon^i}}$$

      where $\widehat{\lambda}^i \equiv (\lambda^i)'/\lambda^i$ is changes in the domestic share for $i \in \{F, I\}$

    - The welfare gains from trade are *smaller* for input trade in bounded Pareto distributions (e.g., Helpman et al., 2008)

      $$\widehat{W}^I < \widehat{W}^F$$

Outline

- Related literature
- Basic model:
  - Intermediate-input firms in the upstream sector
  - Final-good firms in the downstream sector
- Equilibrium:
  - The gravity equation of intermediate inputs
  - The impact of variable trade costs
- Summary

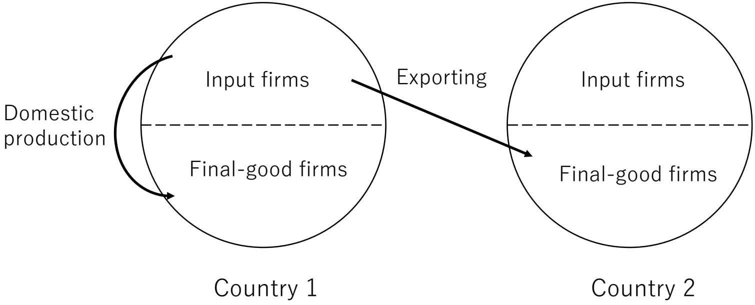
Related literature

- Antràs et al. (2017):
  - Global sourcing in a multiple-country setting
  - E-K framework for intermediate-input firms
- Bernard et al. (2018):
  - Two-sided heterogeneity
  - Matching between downstream and upstream sectors
- Melitz and Redding (2014b):
  - Final-good production by a sequence of traded intermediate inputs
  - Perfectly competitive markets in every production sector

Model

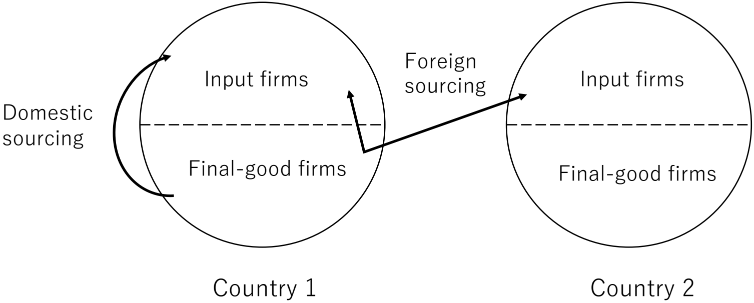
- Setup:
  - Two symmetric countries
  - Only intermediate inputs are tradable and final goods are non-tradable
  - Labor is only a factor of production
  - Input firms (final-good firms) draw productivity φ (ϕ) from $G(\varphi)$ ($G(\phi)$)
  - Fixed production cost f + variable trade cost τ, fixed trade cost f_t where $\tau^{\sigma-1}f_t > f$

Model (cont.)



Firm exporting

Model (cont.)



Firm importing

Consumers

- Consumers' preferences:

$$U = \left[\int_{v \in V} q(v)^{\frac{\sigma-1}{\sigma}} dv + \int_{v \in \tilde{V}} \tilde{q}(v)^{\frac{\sigma-1}{\sigma}} dv \right]^{\frac{\sigma}{\sigma-1}}, \qquad \sigma > 1$$

- Final-good demands:

$$q(v) = R^F P^{\sigma-1} p(v)^{-\sigma}$$
$$\tilde{q}(v) = R^F P^{\sigma-1} \tilde{p}(v)^{-\sigma}$$
$$P = \left[\int_{v \in V} p(v)^{1-\sigma} dv + \int_{v \in \tilde{V}} \tilde{p}(v)^{1-\sigma} dv \right]^{\frac{1}{1-\sigma}}$$

Final-good firms

- Final-good firms' technology:

$$q(\phi) = \phi \left[\int_{\omega \in \Omega} x(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right]^{\frac{\sigma}{\sigma-1}}$$

$$\tilde{q}(\phi) = \phi \left[\int_{\omega \in \tilde{\Omega}} \tilde{x}(\omega)^{\frac{\sigma-1}{\sigma}} d\omega + \int_{\omega \in \tilde{\Omega}} \tilde{x}_t(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right]^{\frac{\sigma}{\sigma-1}}$$

- Expenditure of final-good firms:

$$e(\phi) = \int_{\omega \in \Omega} \gamma(\omega) x(\omega) d\omega$$

$$\tilde{e}(\phi) = \int_{\omega \in \tilde{\Omega}} \tilde{\gamma}(\omega) \tilde{x}(\omega) d\omega + \int_{\omega \in \tilde{\Omega}} \tilde{\gamma}_t(\omega) \tilde{x}_t(\omega) d\omega$$

Final-good firms (cont.)

- Input demands:

$$x(\omega) = e(\phi)\Gamma^{\sigma-1}\gamma(\omega)^{-\sigma}$$

$$\Gamma = \left[\int_{\omega\in\Omega} \gamma(\omega)^{1-\sigma} d\omega\right]^{\frac{1}{1-\sigma}}$$

and

$$\tilde{x}(\omega) = \tilde{e}(\phi)\tilde{\Gamma}^{\sigma-1}\tilde{\gamma}(\omega)^{-\sigma}$$

$$\tilde{\Gamma} = \left[\int_{\omega\in\tilde{\Omega}} \tilde{\gamma}(\omega)^{1-\sigma} d\omega + \int_{\omega\in\tilde{\Omega}} \tilde{\gamma}_t(\omega)^{1-\sigma} d\omega\right]^{\frac{1}{1-\sigma}}$$

where

$$\Gamma > \tilde{\Gamma}$$

Final-good firms (cont.)

- Pricing rules:

$$p(\phi) = \frac{\sigma}{\sigma - 1} \frac{\Gamma}{\phi}$$

$$\tilde{p}(\phi) = \frac{\sigma}{\sigma - 1} \frac{\tilde{\Gamma}}{\phi}$$

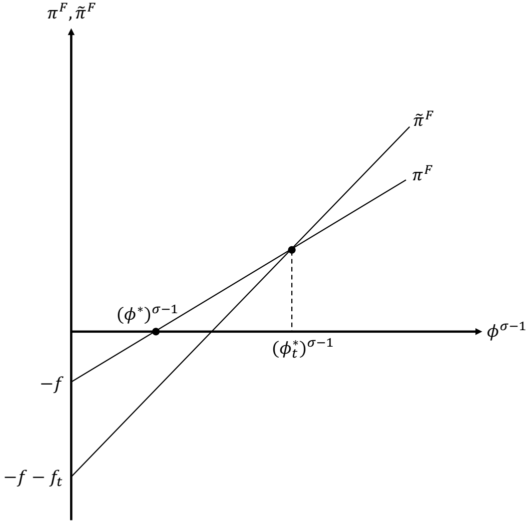
$$\tilde{\Gamma} < \Gamma \quad \Longrightarrow \quad \tilde{p}(\phi) < p(\phi)$$

- Optimal profits:

$$\pi^F(\phi) = \frac{r^F(\phi)}{\sigma} - f = \Gamma^{1-\sigma} B^F \phi^{\sigma-1} - f$$

$$\tilde{\pi}^F(\phi) = \frac{\tilde{r}^F(\phi)}{\sigma} - f - f_t = \tilde{\Gamma}^{1-\sigma} B^F \phi^{\sigma-1} - f - f_t$$

Final-good firms (cont.)



Only more productive firms can **import** inputs (Bernard et al., 2007, 2012, 2018a)

Final-good firms (cont.)

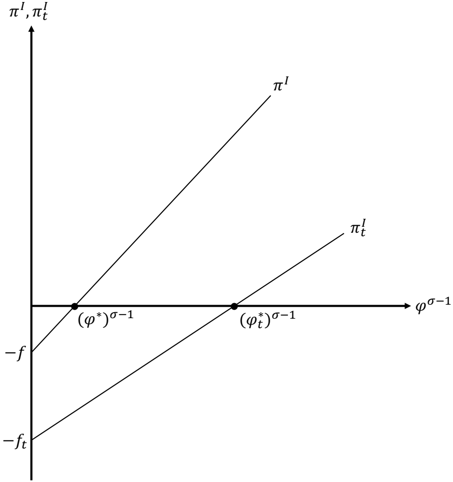
- Free entry condition:

$$\int_{\phi^*}^{\phi_t^*} \pi^F(\phi) dG(\phi) + \int_{\phi_t^*}^{\infty} \tilde{\pi}^F(\phi) dG(\phi) = f_e$$

- Labor market clearing condition:

$$N_e f_e + N_e \int_{\phi^*}^{\phi_t^*} f dG(\phi) + N_e \int_{\phi_t^*}^{\infty} (f + f_t)\, dG(\phi) = L^F$$

Intermediate-input firms



Only more productive firms can **export** inputs (Bernard et al., 2007, 2012, 2018a)

Equilibrium

- Four ZCP and two FE conditions have the following unknowns:

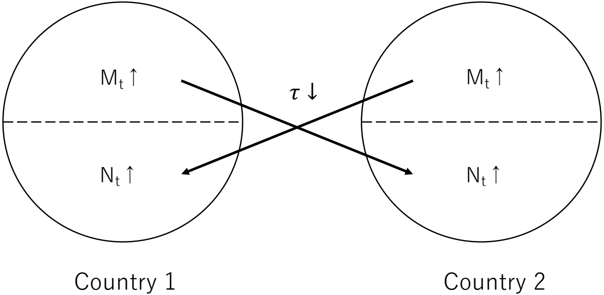
$$\phi^*,\ \phi_t^*,\ B^F,\ \varphi^*,\ \ \varphi_t^*,\ B^I$$

- Impact of variable trade costs on the productivity cutoffs:

$$\frac{d\phi^*}{d\tau} < 0, \quad \frac{d\phi_t^*}{d\tau} > 0, \quad \frac{d\varphi^*}{d\tau} < 0, \quad \frac{d\varphi_t^*}{d\tau} > 0$$

$\Longrightarrow$ co-movement between two production sectors

Equilibrium (cont.)



Less productive firms enter into the foreign market in both sectors

Equilibrium (cont.)

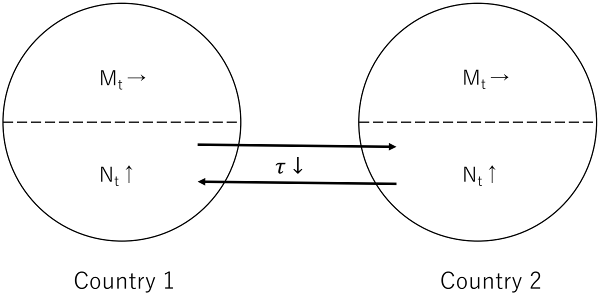
- Aggregate input exports:

$$
\begin{aligned}
R_t^I &= M_e \int_{\varphi_t^*}^{\infty} r_t^I(\varphi) dG(\varphi) \\
&= \psi^I L(B^I)^{\frac{k}{\sigma-1}} \tau^{-\frac{k(\sigma-1)}{2(\sigma-1)-k}} f_t^{1-\frac{k}{2(\sigma-1)-k}}
\end{aligned}
$$

- Trade elasticity of intermediate inputs:

$$
\begin{aligned}
\zeta_o^I &\equiv -\frac{\partial \ln R_t^I}{\partial \ln \tau} \\
&= \underbrace{(\sigma-1)}_{\text{Intensive margin elasticity}} + \underbrace{\frac{(\sigma-1)[k-(\sigma-1)]}{2(\sigma-1)-k}}_{\text{Input extensive margin elasticity}} + \underbrace{\frac{(\sigma-1)[k-(\sigma-1)]}{2(\sigma-1)-k}}_{\text{Output extensive margin elasticity}} \\
&= \frac{k(\sigma-1)}{2(\sigma-1)-k} > k
\end{aligned}
$$

Equilibrium (cont.)



Resource reallocations arise only in the downstream sector

Summary

- We show that:
  - Trade elasticity is greater in intermediate inputs than final goods
  - Ara and Zhang (2019) provide evidence in the China Customs data
- We also compare the welfare gains in the two types of trade:
  - Welfare gains from trade are the same under the Pareto distribution
  - Identify the condition under which welfare gains are greater for input trade