Relation Specificity, Market Thickness, and International Trade

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International trade and offshoring

- Volume of international trade has been rising
  - Components trade
  - Offshoring
- Has an increase in final goods trade stimulate offshoring, and hence stimulate components trade?
  - Relation specificity
- Interaction and feedback effects
  - Market thickness
  - Matching between upstream and downstream firms
  - Negotiation within matched pairs on profit shares
- Quality of products (or productivity) is affected by such environment

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Related literature

- McLaren (AER 2000)
- Grossman and Helpman (QJE 2002)
- Nunn (QJE 2007)

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Outline

- Basic model
- Autarkic equilibrium
  - Relation specificity of industry and market thickness
- Final-good trade equilibrium
  - Reduction of trade cost and market thickness
- Conclusion

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Framework

- Two symmetric countries
- L individuals in each country
- Labor is the only production factor
  - Each individual has one unit of labor
  - Labor is the numeraire: $w = 1$
- Several monopolistically-competitive industries
  - We focus on one industry in this talk
- Continuous time

Industry and consumer preferences

- A representative industry
  - Upstream and downstream sectors
    - U: c units of labor → 1 unit of component
    - D: 1 unit of component → 1 unit of the final good
  - Free entry in both sectors
- A representative consumer's preferences

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

Relation specific investment

- M upstream firms and N downstream firms match
- If matched: n pairs
  - Nash bargaining about profit sharing
  - Upstream firm invests $K(\gamma)$
  - Quality of the final good = 1
- If unmatched
  - U: Sell components in the market (perfect competition)
  - D: Buy components in the market
    - Quality of the good = $1/\gamma$
- Degree of relation specificity γ

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Matching technology

- Constant-returns-to-scale matching function
- Probability of matching
  - D: $\mu^D = \frac{\nu(M-n,N-n)}{N-n} = \nu\left(\frac{M-n}{N-n}, 1\right) \equiv s(z)$

    where $z \equiv \frac{M-n}{N-n}$
  - U: $\mu^U = \frac{\nu(M-n,N-n)}{M-n} = \frac{s(z)}{z}$
- Relationship breaks down at a rate of λ

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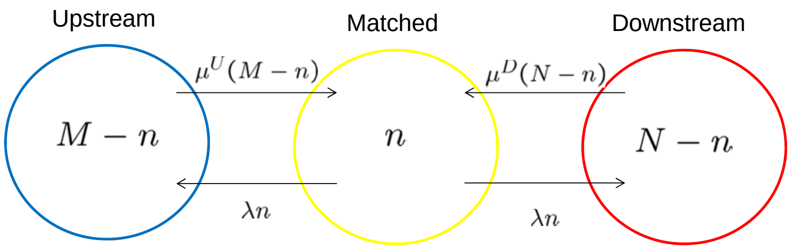
Matching in the steady state



$$\mu^U = \left(\frac{n}{M-n}\right)\lambda$$
$$\mu^D = \left(\frac{n}{N-n}\right)\lambda$$

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Bellman equations

- Downstream firms
  - Matched: $r\tilde{V}^D = \tilde{\pi}^D + \lambda\left(V^D - \tilde{V}^D\right) + \dot{\tilde{V}}^D$
  - Unmatched: $rV^D = \pi^D + \mu^D\left(\tilde{V}^D - V^D\right) + \dot{V}^D$
- Upstream firms
  - Matched: $r\tilde{V}^U = \tilde{\pi}^U + \lambda\left(V^U - \tilde{V}^U\right) + \dot{\tilde{V}}^U$
  - Unmatched: $rV^U = \mu^U\left(\tilde{V}^U - K - V^U\right) + \dot{V}^U$

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Steady state value functions

- Downstream firms
  - Matched: $r\tilde{V}^D = \frac{(r+\mu^D)\tilde{\pi}^D}{r+\lambda+\mu^D} + \frac{\lambda\pi^D}{r+\lambda+\mu^D}$
  - Unmatched: $rV^D = \frac{(r+\lambda)\pi^D}{r+\lambda+\mu^D} + \frac{\mu^D\tilde{\pi}^D}{r+\lambda+\mu^D}$
- Upstream firms
  - Matched: $r\tilde{V}^U = \frac{(r+\mu^U)\tilde{\pi}^U}{r+\lambda+\mu^U} - \frac{\lambda\mu^U}{r+\lambda+\mu^U}K$
  - Unmatched: $rV^U = \frac{\mu^U\tilde{\pi}^U}{r+\lambda+\mu^U} - \frac{\mu^U(r+\lambda)}{r+\lambda+\mu^U}K$

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Nash bargaining

- Problem

$$\begin{array}{ll} \max_{\tilde{\pi}^D,\, \tilde{\pi}^U} & \left(\tilde{V}^D - V^D\right)\left(\tilde{V}^U - K - V^U\right) \\ \text{s.t.} & \tilde{\pi}^U + \tilde{\pi}^D = \tilde{\pi} \end{array}$$

- Payoffs

$$\begin{aligned} \tilde{\pi}^D &= \frac{1}{2(r+\lambda)+\mu^D+\mu^U}\left[(r+\lambda+\mu^D)\tilde{\pi} + (r+\lambda+\mu^U)\pi^D - (r+\lambda)(r+\lambda+\mu^D)K\right] \\ \tilde{\pi}^U &= \frac{1}{2(r+\lambda)+\mu^D+\mu^U}\left[(r+\lambda+\mu^U)\tilde{\pi} - (r+\lambda+\mu^U)\pi^D + (r+\lambda)(r+\lambda+\mu^D)K\right] \end{aligned}$$

  - Profits from the final good market

$$\tilde{\pi} = \gamma\pi^D = \frac{L}{\sigma\left(n + \frac{N-n}{\gamma}\right)}$$

Value functions

- Value functions, $\tilde{V}^D$, V^D, $\tilde{V}^U$, V^U can be written as functions of $\tilde{\pi}$ and $z = \frac{M-n}{N-n}$
- Value functions of unmatched firms

$$\begin{aligned} rV^D &= \phi^D\left[\tilde{\pi} - (r+\lambda)K\right] + (1-\phi^D)\frac{\tilde{\pi}}{\gamma} \\ rV^U &= \phi^U\left[(\gamma-1)\frac{\tilde{\pi}}{\gamma} - (r+\lambda)K\right] \end{aligned}$$

  - $\phi^D = \frac{\mu^D}{2(r+\lambda)+\mu^U+\mu^D} = \frac{zs(z)}{2(r+\lambda)z+zs(z)+s(z)}$
  - $\phi^U = \frac{\mu^U}{2(r+\lambda)+\mu^U+\mu^D} = \frac{s(z)}{2(r+\lambda)z+zs(z)+s(z)}$

Free entry conditions

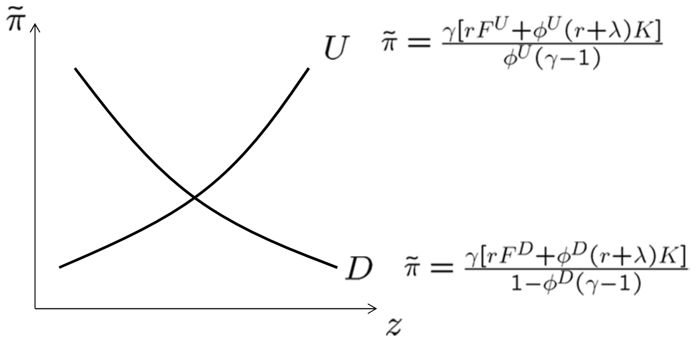
- Downstream sector

$$V^D = F^D$$
$$\Rightarrow \quad \tilde{\pi} = \frac{\gamma[rF^D + \phi^D(r+\lambda)K]}{1-\phi^D(\gamma-1)}$$

- Upstream sector

$$V^U = F^U$$
$$\Rightarrow \quad \tilde{\pi} = \frac{\gamma[rF^U + \phi^U(r+\lambda)K]}{\phi^U(\gamma-1)}$$

Equilibrium



$$\tilde{\pi} = \frac{L}{n\sigma\left(1+\frac{\lambda}{\gamma s(z)}\right)} \rightarrow n$$
$$s(z) = \left(\frac{n}{N-n}\right)\lambda \rightarrow N$$
$$\frac{s(z)}{z} = \left(\frac{n}{M-n}\right)\lambda \rightarrow M$$

Market thickness

- Total outputs of components

$$X = \frac{\sigma - 1}{\sigma c} \frac{L}{1 + \frac{\gamma S(z)}{\lambda}}$$
$$\tilde{X} = \frac{\sigma - 1}{\sigma c} \frac{L}{1 + \frac{\lambda}{\gamma S(z)}}$$

- Market thickness
  - Components traded in the market relative to components traded directly inside pairs

$$\frac{X}{\tilde{X}} = \frac{(N-n)x}{n\tilde{x}} = \frac{\lambda}{s(z)} \frac{1}{\gamma}$$

  - Number of unmatched upstream firms relative to that of unmatched downstream firms

$$z = \frac{M-n}{N-n}$$

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Relation specificity and market thickness

- $$\begin{aligned} \gamma \uparrow \quad & (R'(\gamma) = 0) \\ \Rightarrow \quad & \tilde{\pi} \uparrow, \; \pi^D \downarrow, \; n \uparrow, \; \tilde{X} \uparrow, \; X \downarrow, \; M \uparrow, \; N? \\ & z \uparrow, \; \frac{X}{\tilde{X}} \downarrow \end{aligned}$$
- The higher the relation specificity
  - the lower the market thickness
  - the more favorable to downstream firms in matching
  - $M \uparrow$ but $X \downarrow$

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Trade costs and trade pattern

- Trade costs
  - Fixed costs: F_X
  - Variable iceberg costs: τ
- Fixed costs → Only matched downstream firms export

Free entry conditions

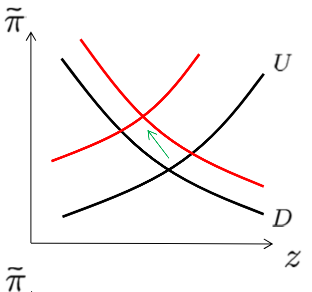
- Downstream sector

$$V^D = F^D$$
$$\Rightarrow \quad \tilde{\pi} = \frac{(1+\tau^{1-\sigma})\gamma[rF^D + \phi^D(r+\lambda)(K+F_x)]}{1-\phi^D[(1+\tau^{1-\sigma})\gamma - 1]}$$

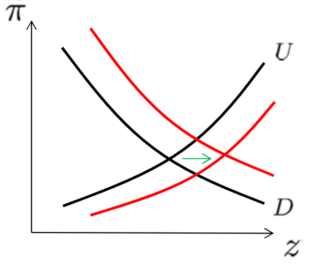
- Upstream sector

$$V^U = F^U$$
$$\Rightarrow \quad \tilde{\pi} = \frac{(1+\tau^{1-\sigma})\gamma[rF^U + \phi^U(r+\lambda)(K+F_X)]}{\phi^U[(1+\tau^{1-\sigma})\gamma - 1]}$$

Equilibrium



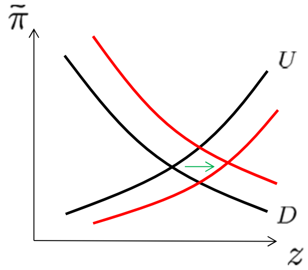
$F_X \uparrow$



$\tau \downarrow$

Reduction of trade costs and market thickness

$\tau \downarrow$



- $\frac{X}{\tilde{X}} = \frac{(N-n)x}{n\tilde{x}} = \frac{\lambda}{s(z)}\frac{1}{(1+\tau^{-\sigma})\gamma}$
- $\tau \downarrow \rightarrow \frac{X}{\tilde{X}} \downarrow$
  - This effect is large, the larger is γ

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Preliminary conclusion

- Trade affects market thickness; size of the effect varies with relation specificity of component traded in the industry
- Extension
  - Offshoring