Trade with Search Frictions: Identifying New Gains from Trade

Tomohiro Ara

Fukushima University

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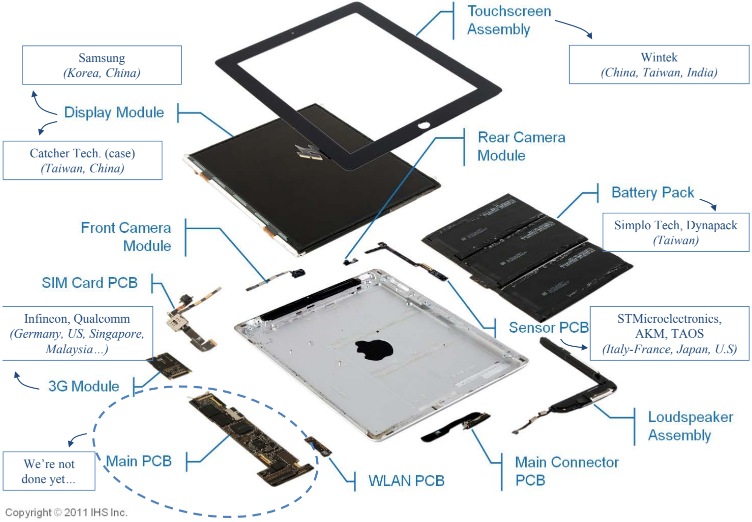
Motivation

- Firms often search for suppliers to procure specialized inputs:
  1. While a few core inputs are made in-house, other non-core inputs are largely purchased from the outside
  2. Transactions of such outsourced inputs involve a substantial investment in customizing inputs for the needs of firms
  3. Recent advances of information technology make it easier to search for suppliers not only within borders but also across borders

$\Rightarrow$ Consider Apple's sourcing strategy

Example: smartphones



"Non-market" transaction

Example: smartphones (cont.)

Online Marketplace | Trade Shows | Smart Sourcing | Other Services

globalsources
Reliable exporters: find them and meet them

Products | Enter English keyword to search products

Path: All Categories >> Mobile Electronics >> Mobile Phone Accessories & Parts >> Mobile Phone Parts >> Mobile phone LCDs – Update me on new products

Smartphone parts LCD screen module for Moto E3

US$ 9.5 / Piece Get Freight Cost

50 Pieces Minimum Order

1 - 3 days Lead Time

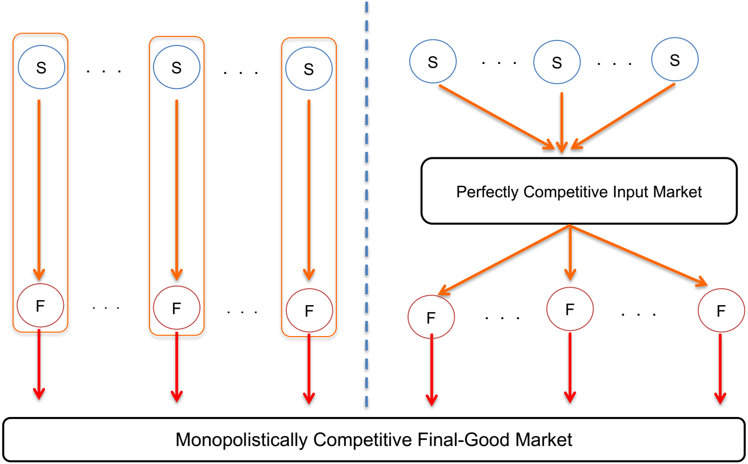
Small Orders:	Accepted
Sample Price (USD):	$15.00 Request Sample

Inquire Now

Request Latest Price | Add to Basket

"Market" transaction

Two types of input transactions



Main findings

- Sources of welfare gains:
  1. Resource reallocation between firms (Melitz, 2003)
  2. Matching improvement of firms

- New impact of trade:
  - The number of suppliers rises relative to the number of firms, thereby thickening the market of intermediate inputs
  - Gains from trade $\Rightarrow$ 0.9% without search but 3.1% with search

Related literature

1. Search frictions and trade:
   - Grossman and Helpman (2002, 2005), Antràs and Costinot (2011), Felbermayr et al. (2011)
   - This paper $\Rightarrow$ Economic integration in goods/matching markets in monopolistic competition
2. Contractual frictions and offshoring:
   - Antràs (2003), Antràs and Helpman (2004), Ornelas and Turner (2008, 2012)
   - This paper $\Rightarrow$ Possibility of welfare losses associated with offshoring

Setup

- Consumer preferences:

$$U = \left(\int_0^{N^F} y(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}}, \quad \sigma > 1$$

where N^F is the number (measure) of varieties in the industry

- Demand and expenditure for variety ω:

$$y(\omega) = Ap(\omega)^{-\sigma}$$
$$r(\omega) = Ap(\omega)^{1-\sigma}$$

where A is the index of industry demand

Setup (cont.)

- Firm technology:

$$y(\alpha) = \alpha \left(\frac{x^F}{\eta}\right)^{\eta} \left(\frac{x^S}{1-\eta}\right)^{1-\eta}, \quad 0 < \eta < 1$$

where α is the industry-specific parameter

	Unmatched	Matched
Input transaction	Market	Non-market
Input type	Generic	Customized
Input quality	$\alpha = 1$	$\alpha > 1$
Variable profit	$r(1)/\sigma$	$r(\alpha)/\sigma$
Firm profit	$r(1)/\sigma$	$r^F(\alpha)/\sigma$
Supplier profit	0	$r^S(\alpha)/\sigma$

Setup (cont.)

- Equilibrium output and revenue:

$$y(\alpha) = A\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}\alpha^{\sigma}$$

$$r(\alpha) = A\left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1}\alpha^{\sigma-1}$$

- The ratio of equilibrium revenue of matched firms to unmatched firms:

$$\frac{r(\alpha)}{r} = \alpha^{\sigma-1}$$

where $r \equiv r(1)$

Setup (cont.)

- Number of matches:

$$m(u^F, u^S)$$

which satisfies CRS in matching

- Probability of matches:

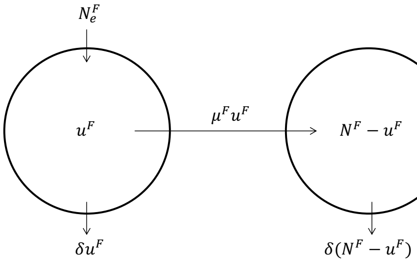
$$\mu^F \equiv m(u^F, u^S)/u^F = m(1, \theta)$$
$$\mu^S \equiv m(u^F, u^S)/u^S = m(1/\theta, 1) = \mu^F/\theta$$

where $\theta \equiv u^S/u^F$

- Probability of a bad shock: δ

Setup (cont.)

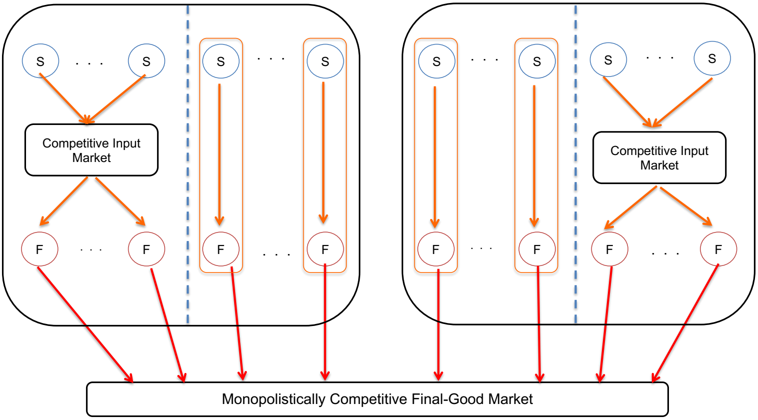
- Search process for firms:



- The law of motion:

$$
\begin{aligned}
\dot{N}^F &= \delta N^F - N_e^F \\
\dot{N}_e^F &= (\delta + \mu^F) u^F - N_e^F \\
\dot{u}^F &= \delta(N^F - u^F) - \mu^F u^F
\end{aligned}
$$

Costly trade: X-integration



Costly trade: X-integration

- When only matched firms export, the Bellman equations are given by

$$\begin{aligned}
\gamma V^F &= \frac{r}{\sigma} + \mu^F\left(V^F(\alpha) - F_x - V^F\right) - \delta V^F + \dot{V}^F \\
\gamma V^F(\alpha) &= \frac{r^F(\alpha)}{\sigma} - \delta V^F(\alpha) + \dot{V}^F(\alpha) \\
\gamma V^S &= \mu^S\left(V^S(\alpha) - F_d - V^S\right) - \delta V^S + \dot{V}^S \\
\gamma V^S(\alpha) &= \frac{r^S(\alpha)}{\sigma} - \delta V^S(\alpha) + \dot{V}^S(\alpha)
\end{aligned}$$

where F_d and F_x are a one-time investment cost

Costly trade: X-integration (cont.)

- Assuming that $\gamma = 0$ and setting $\dot{V}^F = \dot{V}^F(\alpha) = 0$:

$$V^F = \frac{r}{\delta\sigma} + \left(\frac{\mu^F}{\delta + \mu^F}\right)\left(\frac{r^F(\alpha)}{\delta\sigma} - \frac{r}{\delta\sigma} - F_x\right)$$
$$V^F(\alpha) = \frac{r^F(\alpha)}{\delta\sigma}$$

  where the probability δ introduces an effect similar to time discounting

- Similarly, setting $\dot{N}^F = \dot{N}^F_e = \dot{u}^F = 0$:

$$n = \left(\frac{\mu^F}{\delta + \mu^F}\right) N^F$$

  where $n \equiv N^F - u^F$

Costly trade: X-integration (cont.)

- Bargaining within matched agents:

$$\max_{\frac{r^F(\alpha)}{\sigma},\frac{r^S(\alpha)}{\sigma}} \left(V^F(\alpha) - F_x - V^F\right)\left(V^S(\alpha) - F_d - V^S\right)$$

subject to $r^F(\alpha)/\sigma + r^S(\alpha)/\sigma = r(\alpha)/\sigma$

- Optimal sharing rule:

$$\frac{r^F(\alpha)}{\delta\sigma} - \frac{r}{\delta\sigma} - F_x = \beta\left(\frac{r(\alpha)}{\delta\sigma} - \frac{r}{\delta\sigma} - F_d - F_x\right)$$

$$\frac{r^S(\alpha)}{\delta\sigma} - F_d = (1-\beta)\left(\frac{r(\alpha)}{\delta\sigma} - \frac{r}{\delta\sigma} - F_d - F_x\right)$$

where $\beta \equiv (\delta + \mu^F)/(2\delta + \mu^F + \mu^S)$

Costly trade: X-integration (cont.)

- FE conditions:

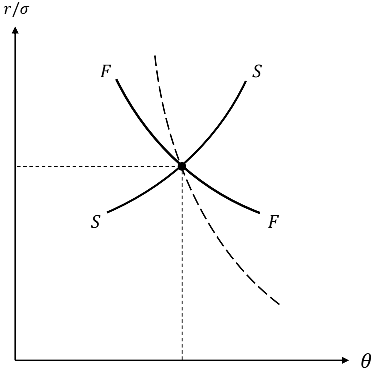
$$V_e^F \equiv V^F - F_e^F = 0$$
$$V_e^S \equiv V^S - F_e^S = 0$$

- From the steady-state relationships, this can be written as

$$\frac{r}{\sigma} + \frac{n}{N^F}\beta\left(\frac{r(\alpha)}{\sigma} - \frac{r}{\sigma} - f_d - f_x\right) - f_e^F = 0$$
$$\frac{n}{N^S}(1-\beta)\left(\frac{r(\alpha)}{\sigma} - \frac{r}{\sigma} - f_d - f_x\right) - f_e^S = 0$$

where $f_d \equiv \delta F_d$, $f_x \equiv \delta F_x$, $f_e^F \equiv \delta F_e^F$ and $f_e^S \equiv \delta F_e^S$

Costly trade: X-integration (cont.)



$$\theta = u^S/u^F = (N^S - n)/(N^F - n)$$

- *FF* curve

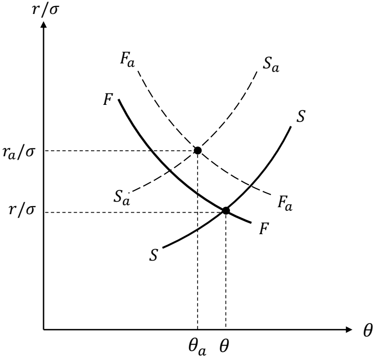
  $\theta \uparrow \Rightarrow \mu^F \uparrow \Rightarrow r/\sigma \downarrow$

- *SS* curve

  $\theta \uparrow \Rightarrow \mu^S \downarrow \Rightarrow r/\sigma \uparrow$

- θ and r/σ are consistent with free entry in X-integration equilibrium

Costly trade: X-integration (cont.)



- Impact of X-integration

$$r/\sigma < r_a/\sigma$$

$$\theta > \theta_a$$

- Matched firms get a larger rent by reductions in trade costs ($\tau_x, f_x \downarrow$)

$$\frac{r(\alpha)}{\sigma} - \frac{r}{\sigma} - f_d - f_x \quad \uparrow$$

which induces new entry of agents

Costly trade: X-integration (cont.)

- Gains from trade (GFT) in X-integration:
  1. $r/\sigma < r_a/\sigma \implies$ Resources are reallocated from (less efficient) unmatched firms to (more efficient) matched firms
  2. $\theta > \theta_a \implies$ Firms have the higher probability to meet suppliers ($n/N^F > n_a/N_a^F$), enhancing overall production efficiency of the industry

Costly trade: X-integration (cont.)

- GFT are expressed as

$$\frac{W}{W_a} = \left[\left(\frac{N_a^F + (\alpha^{\sigma-1} - 1)n_a}{N^F + (\alpha^{\sigma-1} - 1)n}\right)\lambda\right]^{-\frac{1}{\sigma-1}}$$

where λ is the expenditure share on domestic goods

1. In Krugman (1980) where $N^F = N_a^F$ and $n = n_a = 0$, this ratio is simply given as $W/W_a = \lambda^{-1/(\sigma-1)}$ (Arkolakis et al., 2012)
2. In our model where $n/N^F > n_a/N_a^F$, the values in the brackets (endogenous firm matches) matter for welfare
3. Numerical solutions $\Longrightarrow$ GFT are 0.9% without search but 3.1% with search

Summary

- Main findings:
  - Search in standard workhorse models of trade can amplify welfare gains
  - Such gains are important not only qualitatively but also quantitatively
- Extensions:
  - Economic integration in matching markets
  - Trade liberalization facilitating this integration may cause welfare losses from trade