# Offshoring, Relationship Specificity, and Domestic Production Networks

Taiji Furusawa (Hitotsubashi University)

Tomohiko Inui (Gakushuin University)

Keiko Ito (Senshu University)

Heiwai Tang (Johns Hopkins University)

# Goal of the paper

- Examine the impact of offshoring (importing inputs) on domestic production network
  - Data on domestic production network in 2005 and 2010
    - Active offshoring by Japanese firms partly due to yen appreciation
  - Offshoring → Dropping and Adding of input suppliers
    - What are the characteristics of dropped suppliers and added suppliers?
- Also examine characteristics of buyer-supplier relationships
  - Distance
  - Productivity
  - Relationship specificity
- Hope to assess macro impacts from micro impacts

# Data

- TSR (Tokyo Shoko Research) data for 2006 and 2011
  - Firm-level transaction relationship data
    - List of suppliers (max 24), customers (max 24）
  - Firm-level data on employment, sales, location, establishment year, and others
- Basic Survey on Business Structure and Activities (BSBSA) collected annually by METI
  - All the firms with 50+ employees and 30+ million yen of paid-in capital for mining, manufacturing, wholesale and retail trade, and other services sectors.
  - Firm-level exports, imports, FDI, and other detailed firm-level information available

**Table 2: Characteristics of Downstream Firms (Buyers) in the Basic Business Survey**

| All industries | 2005 | 2010 |
|---|---|---|
| No. of firms in the BSBSA | **22,939** | **24,892** |
| Nb. of importers | **5,344** | **5,659** |
| Nb. of importers from Asia | **4,315** | **4,786** |
| Fraction of firms that import | 0.233 | 0.227 |
| Fraction of firms that import from Asia | 0.188 | 0.192 |
| | | |
| Average importer's import intensity (imports/ total purchases) | 0.183 | 0.212 |
| Aveage firms' shares of imports from Asia (imports from Asia / total imports) | 0.795 | 0.821 |
| | | |
| Manufacturing industries | | |
| Nb. of firms in the BSBSA | **11,021** | **11,361** |
| Nb. of importers | **3,270** | **3,494** |
| Nb. of importers from Asia | **2,747** | **3,082** |
| Fraction of firms that import | 0.297 | 0.308 |
| Fraction of firms that import from Asia | 0.249 | 0.271 |
| | | |
| Average importer's import intensity (imports/ total purchases) | 0.163 | 0.192 |
| Aveage firms' shares of imports from Asia (imports from Asia / total imports) | 0.824 | 0.846 |

Sample: BSBSA (2005, 2010)

**Table 3: Summary Statistics (Number of Buyers and Sellers)**

| Sample: | All mfg. buyers in 2005 | Existing Importers in 2005 | Non-importers in 2003-2005 | Import starters between 2005-2010 | Non-importers 2005-2010 | Continuous importers 2005-2010 |
|---|---|---|---|---|---|---|
| **Panel A: Number of buyers (2005)** | | | | | | |
| | 8,404 | 2,117 | 5,611 | 341 | 4,179 | 1,436 |
| **Panel B: Number of sellers per buyer (2005)** | | | | | | |
| Mean | 19.33 | 34.78 | 13.40 | 20.67 | 13.53 | 38.34 |
| Median | 8 | 11 | 7 | 9 | 7 | 12 |
| Min. | 1 | 1 | 1 | 1 | 1 | 1 |
| Max. | 3,552 | 3,004 | 3,552 | 1,056 | 3,552 | 3,004 |
| **Panel C: Number of sellers' prefectures per buyer (2005)** | | | | | | |
| Mean | 4.84 | 6.79 | 4.01 | 5.25 | 3.99 | 7.00 |
| Median | 4 | 5 | 3 | 4 | 3 | 5 |
| Min. | 1 | 1 | 1 | 1 | 1 | 1 |
| Max. | 47 | 47 | 46 | 38 | 46 | 47 |

# Theory

- Simple extension of Antràs, Fort, and Tintelnot (2014) and Bernard, Moxnes, and Saito (2015)
- Features of the model
  - Eaton-Kortum framework
  - 1 final good, K input types (different in terms of relationship specificity)
  - Two-sided firm heterogeneity in productivity
  - M domestic and M* foreign regions
  - Relationship specificity capture by
    - Elasticity of trade costs in distance $t_k$
    - Variability of input producer's productivity $\theta_k$

# Production of final good

- Production
  1. Produce K composite inputs each from inputs of [0,1]

$$x_{ik} = \left[ \int_0^1 x_{ik}(j)^{\frac{\rho-1}{\rho}} dj \right]^{\frac{\rho}{\rho-1}}$$

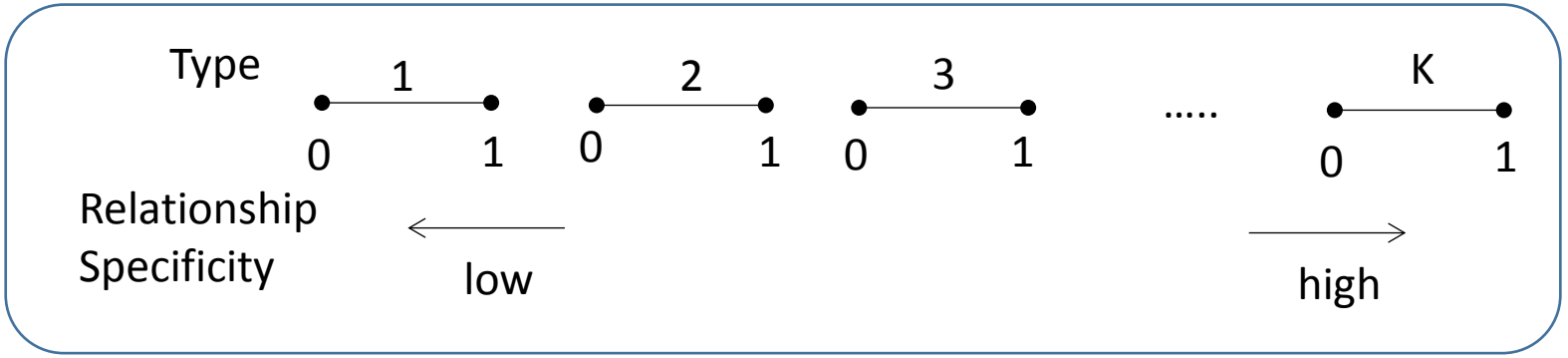
  2. Produce a final good from K composite inputs

$$y_i = \varphi_i \Pi_{k=1}^{K} \left( \frac{x_{ik}}{\beta_k} \right)^{\beta_k}$$

     - $\varphi_i$ : Core productivity of final good producer i
- Monopolistic competition (without entry and exit)

# Inputs for final good production

- K different types of input with different relationship specificity (with final good producers)




- Inputs are either
  - Insourced: $r = 0$
  - Domestically outsourced: $r = 1, \cdots, M$
  - offshored: $r = M + 1, \cdots, M + M^*$

# Equilibrium sourcing given $\{\Omega_{ik}\}_{k=1}^{K}$ : Eaton and Kortum (2002)

- Price parameters for final good producer i

$$\Phi_{ikr} = \begin{cases} T_{k0}(w_r c_k)^{-\theta_k} & \text{if } r = 0 \\ n_{kr} T_{kr}(w_r c_k \tau_k(d_{ir}))^{-\theta_k} = n_{kr} T_{kr} w_r^{-\theta_k} e^{-\theta_k t_k d_{ir}} & \text{if } r = 1, \cdots, M + M^* \end{cases}$$

- Price parameter for type k inputs for firm i

$$\Phi_{ik} = \Phi_{ik0} + \sum_{r \in \Omega_{ik}} \Phi_{ikr}$$

- Region r's share of input sourcing

$$s_{ikr} = \frac{\Phi_{ikr}}{\Phi_{ik}}$$

# Sourcing strategy

- Profit function for buyer i

$$\pi_i(\varphi_i) = B\phi_i^{\sigma-1}\Pi_{k=1}^{K}\gamma_k^{\beta_k(1-\sigma)}\Phi_{ik}^{\frac{\beta_k(\sigma-1)}{\theta_k}} - \sum_{k=1}^{K}\sum_{r\in\Omega_{ik}} f_k$$

- Condition to search region

$$\pi_i(\varphi_i)|_{\Omega_{ik}\cup\{r_1\}} - \pi_i(\varphi_i)|_{\Omega_{ik}} \approx \frac{\beta_k(\sigma-1)}{\theta_k}\tilde{\pi}_i(\varphi_i)\frac{\Phi_{ikr_1}}{\Phi_{ik}(\Omega_{ik})} - f_k$$

  - $\Phi_{ikr} = n_{kr}T_{kr}w_r^{-\theta_k}e^{-\theta_k t_k d_{ir}}$
  - $\theta_k \downarrow t_k \uparrow$ as relationship specificity increases

# Proposition 2

- If $\theta_k t_k$ increases with k, relationship specific inputs tend to be
  - Insourced
  - Outsourced to firms in close regions

# Relationship-specific inputs tend to be sourced from close regions

**Table 5: Distance, Scope of Domestic Outsourcing, and Relationship-Specificity of Inputs**

| | Dependent Variable: ln(# sellers) | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Mesaures of Relationship Specificity (RS) | - | - | BJRS Intermediation Index | Rauch Index |
| $\ln(dist)_{buyer,seller's\ pref}$ | -0.0913*** | -0.153*** | -0.0296*** | -0.0197*** |
| | (0.001) | (0.001) | (0.002) | (0.001) |
| $\ln(dist)_{buyer,seller's\ pref}$ x $RS_{seller's\ ind}$ | | | 0.0441*** | -0.00490*** |
| | | | (0.006) | (0.001) |
| Buyers' Industry FE | yes | | | |
| Buyers' Prefecture FE | yes | | | |
| Sellers' Industry FE | | | yes | yes |
| Sellers' Prefecture FE | yes | yes | yes | yes |
| Buyer's FE | | yes | yes | yes |
| R_sq | .166 | .556 | .271 | .271 |
| Nb of Obs | 124230 | 124230 | 108127 | 108394 |

# Proposition 3

- Buyer's core productivity $\varphi_i$ high → offshore
- If $\theta_k t_k$ goes up with k, generic inputs are more likely to be offshored

# Productive buyers offshore; High RS inputs are offshored

**Table 6: Buyer's Productivity, Relationship Specificty of Inputs, and the Likelihood of Offshoring**

| Dependent Variable: Dummy for Buyer's Starting to Offshore between 2005 and 2010 | | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Measure of Buyer's Productivity | TFP (Olley Pakes) | VA/Emp | | |
| Measure of Relationship Specificity | | | BJRS Intermediation Index | Rauch Index |
| $Productivity_{buyer,2005}$ | 0.00741 | 0.0255*** | | |
| | (0.021) | (0.009) | | |
| $Relationship\ Specificity_{seller's\ ind}$ | | | 0.264*** | -0.0550*** |
| | | | (0.018) | (0.008) |
| Buyer's FE | | | yes | yes |
| Buyer's Ind FE | yes | yes | | |
| Buyer's Prefecture FE | yes | yes | | |
| R_sq | .079 | .0818 | .43 | .441 |
| Nb of Obs | 4530 | 4533 | 75786 | 75786 |

# Propositions 4 and 5

- Consider the case where generic inputs are more likely to be offshored (which is empirically confirmed)

- (same type of inputs that are offshored) Buyers weakly narrow search regions
  - Distant suppliers are dropped
- (Different types of inputs) Buyers weakly expand search regions
  - Distant suppliers are added
  - Less efficient suppliers in all other regions are dropped

# Distant suppliers are added and dropped

**Table 8: Offshoring and Supplier Churning**

| Dep Var: | Drop Dummy | | Add Dummy | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Measure of firm size | Sales | Employment | Sales | Employment |
| $d(\text{Imp Dummy})_{buyer}$ | 0.0160* | 0.0168* | 0.0261** | 0.0204* |
| | (0.008) | (0.009) | (0.013) | (0.012) |
| $\ln(\text{size})_{buyer,t-1}$ | 0.000923 | -0.00000650 | -0.0148*** | -0.0202*** |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| $d\ln(\text{size})_{buyer,t}$ | -0.0250*** | -0.0242** | 0.0821*** | 0.105*** |
| | (0.009) | (0.010) | (0.011) | (0.014) |
| $\ln(\text{size})_{seller,t-1}$ | 0.0124*** | 0.0149*** | 0.00856*** | 0.00930*** |
| | (0.001) | (0.002) | (0.002) | (0.002) |
| $d\ln(\text{size})_{seller,t}$ | -0.0252*** | -0.0266*** | 0.0572*** | 0.0547*** |
| | (0.005) | (0.005) | (0.004) | (0.005) |
| $\ln(\text{distance})_{buyer\text{-}seller}$ | 0.00790*** | 0.00826*** | 0.0182*** | 0.0190*** |
| | (0.001) | (0.001) | (0.002) | (0.002) |
| Buyers' Industry FE | yes | yes | yes | yes |
| Buyers' Prefecture FE | yes | yes | yes | yes |
| Sellers' Industry FE | yes | yes | yes | yes |
| Sellers' Prefecture FE | yes | yes | yes | yes |
| R_sq | 0.0487 | 0.0478 | .0596 | .0588 |
| Nb of Obs | 53096 | 53096 | 61344 | 61344 |

# Conclusion

- Offshoring firms actively change sourcing pattern
- Continue to investigate how the reduction of offshoring costs affect
  - Firms' sourcing pattern
  - Domestic production network
  - Resulting macro impacts such as aggregate productivity