Agglomeration, routin-biased technological change and offshoring

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Introduction

- The story begins with the Adam Smith's pin factory...
- Since transportation and communication were slow and costly in the 18th century, specialization required spatial proximity, to coordinate activities.
- Advances in transportation and ICT have weakened the link between specialization and geographic concentration, making it viable to separate tasks in space.
- The result has been a boom in "offshoring" of particular tasks, changing the spatial division of labor.
- Offshoring, however implies transaction costs including information frictions and trade costs.

Related literature

- So far, of course, much has been written about offshoring...
- Choice of organizational form *(e.g. Grossman and Helpman 2004, 2005; Antràs 2003; Antràs, Garicano and Rossi-Hansberg 2006)*
- Fragmentation *(e.g. Jones and Kierzkowski 1990, 2001, Kohler 2004)*
- Task trade *(Grossman and Rossi-Hansberg 2006)*

The concept of offshorability

- Not every task is offshorable...
- Autor, Levy and Murnane (2002 distinguish between “routine” and “non-routine” tasks. Levy and Murnane (2004) argue that the routine tasks are easier to move offshore because the instructions can be described by deductive rules.
- Leamer and Storper (2001) draw a distinction between tasks that require codifiable information and those that require tacit knowledge. The former, are more suitable to perform at a distance.
- Blinder (2006) and Blinder and Krueger (2013) argue that those tasks requiring geographical proximity can not be moved offsore.

Routin biased technological change

- Recent technological change (new machines, computer aided manufacturing) makes routine tasks more productive and easier to perform. Therefore the demand for these tasks gets lower.

Preferences

Preferences

$$U_s = \zeta \left(\int_{s \in n_s} q_s(j)^{\frac{\epsilon - 1}{\epsilon}} dj \right)^{\frac{\alpha\epsilon}{\epsilon - 1}} h_s^{1-\alpha}, \quad P_s = \left(\int_{s \in n_s} p_s(j)^{1-\epsilon} dj \right)^{\frac{1}{1-\epsilon}}$$

Demand

$$q_s(j) = \alpha \upsilon_s p_s(j)^{-\epsilon} P_s^{\epsilon - 1}, \quad h_s = \frac{1-\alpha}{\alpha} \frac{\upsilon_s}{Q_s}$$

Production

Final goods

$$q_s(j) = \left(l_s^a(j)^{\frac{\beta-1}{\beta}} + A_s^{\frac{\beta-1}{\beta}} \left(\int_{\omega\in\Omega} q_s^r(j,\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma(\beta-1)}{\beta(\sigma-1)}} \right)^{\frac{\beta}{\beta-1}}$$

Price index of intermediates

$$P_s^r = \left(\int_0^1 p_s^r(\omega)^{1-\sigma} d\omega \right)^{\frac{1}{1-\sigma}}$$

Production

Prices of intermediate goods

$$p_{is}^{r}(\omega) = \frac{w_i}{z_i(\omega)} d_{is}, \quad p_{s}^{r}(\omega) = \min_{i \in S} \{p_{is}^{r}(\omega); i \in S\}$$

Production technology - Eaton and Kortum (2002)

$$F_i(z) = e^{-T_i z^{-\theta}}$$

- The productivity term z is iid and drawn from Fréchet-distribution, where T_i and θ are parameters. The latter governs the diversity of productivity levels within regions.

Expenditure shares and prices

Expenditure shares

$$\lambda_{is} = \frac{T_i (w_i d_{is})^{-\theta}}{\Phi_s}$$

Price index of intermediates in s

$$P_s^r = \gamma \Phi_s^{-\frac{1}{\theta}}, \quad \Phi_s = \sum_{i \in S} T_i (w_i d_{is})^{-\theta}$$

Location choice

Location choice and income

$$U_s = \frac{\upsilon_s}{P_s^{\alpha} Q_s^{1-\alpha}} \equiv \bar{u}$$

Total income (wage and an equal share of total housing income

$$\upsilon_s L_s = w_s L_s + (1-\alpha)\upsilon_s L_s = \frac{w_s L_s}{\alpha}$$

Total income (wage and an equal share of total housing income

$$Q_s = \frac{1-\alpha}{\alpha}\frac{w_s L_s}{H_s}$$

General equilibrium

- **Definition** (General equilibrium) *Given labor and land endowments* (H_s, L)*, a competitive equilibrium for this economy is a utility level* U*; a set of factor prices* (w_s, P_s^r) *in each region, a set of labor allocations, intermediate good expenditures, and prices* $(L_s^r, L_s^a, P_s, X_s^r)$ *and pairwise regional intermediate expenditure shares* (λ_{is})*, such that the optimization conditions for consumers and intermediate and final goods producers hold, all markets clear, aggregate trade is balanced and utility is equalized across regions.*
- The existence and uniqueness of equilibrium cannot be proven analitically... or maybe (e.g. Allen, Arkolakis and Li, 2014) ???
- It is capable to perform counterfactual exercises based on real-world data.

Theoretical predictions

- **Proposition 1** *As transaction costs between i and s* (d_{is}) *become suffciently high, the share of non-routine workers* L_s^a/L_s *increases in* A_s *if* $\beta < 1$.
- According to Proposition 1 the effects of q^r-augmenting technology (A_s) depend on the elasticity of substitution between non-routine labor and the intermediate goods. If $\beta < 1$, the increasing efficiency of intermediate good use causes excess demand for non-routine labor. However Proposition 1 is shown under the condition that transaction costs are high.
- But what happens when transaction costs decrease? Previous literature argues that, in this case non-routine tasks are moved offshore. Well, not necessarily... when $d_{is} \longrightarrow 1$, the price of intermediates are equalized, regions specialize according to T_s and w_s (i.e. comparative advantages and agglomeration).

What to do next...

- Putting theory into practice
- Perform counterfactual exercises (i.e. what happens when exogenous factors (A_s, d_{is}, T_s change?
- Problem: measuring offshorability, assigning offshorable (or tradable) tasks

Thank you for your attention!

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