Relocating the value chain: offshoring & agglomeration in the global economy

Richard Baldwin
Tony Venables

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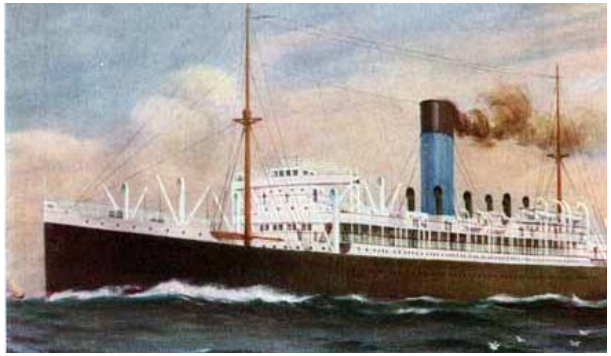
RIETI, Tokyo

The 1st & 2nd unbundlings

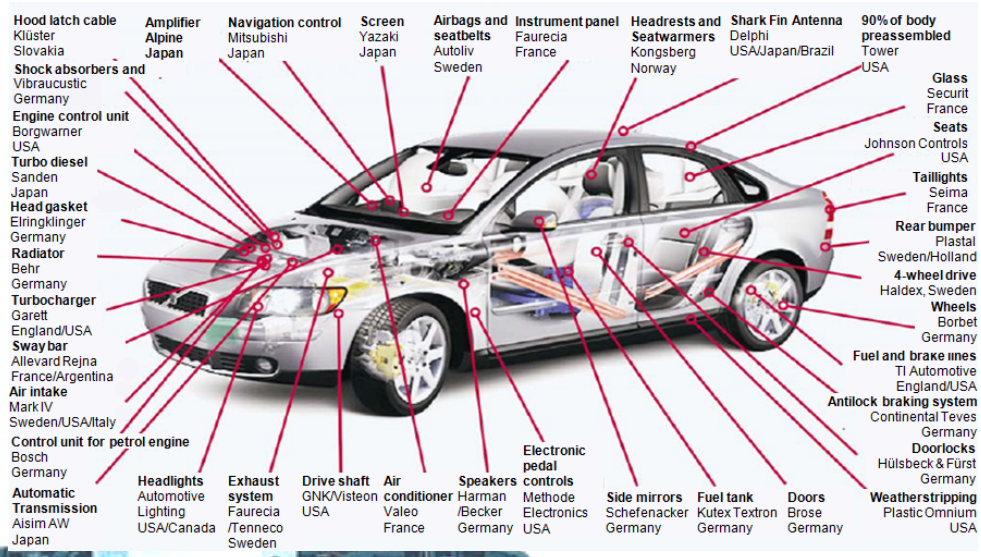
1st unbundling:

Spatial separation of production & consumption.



2nd unbundling:

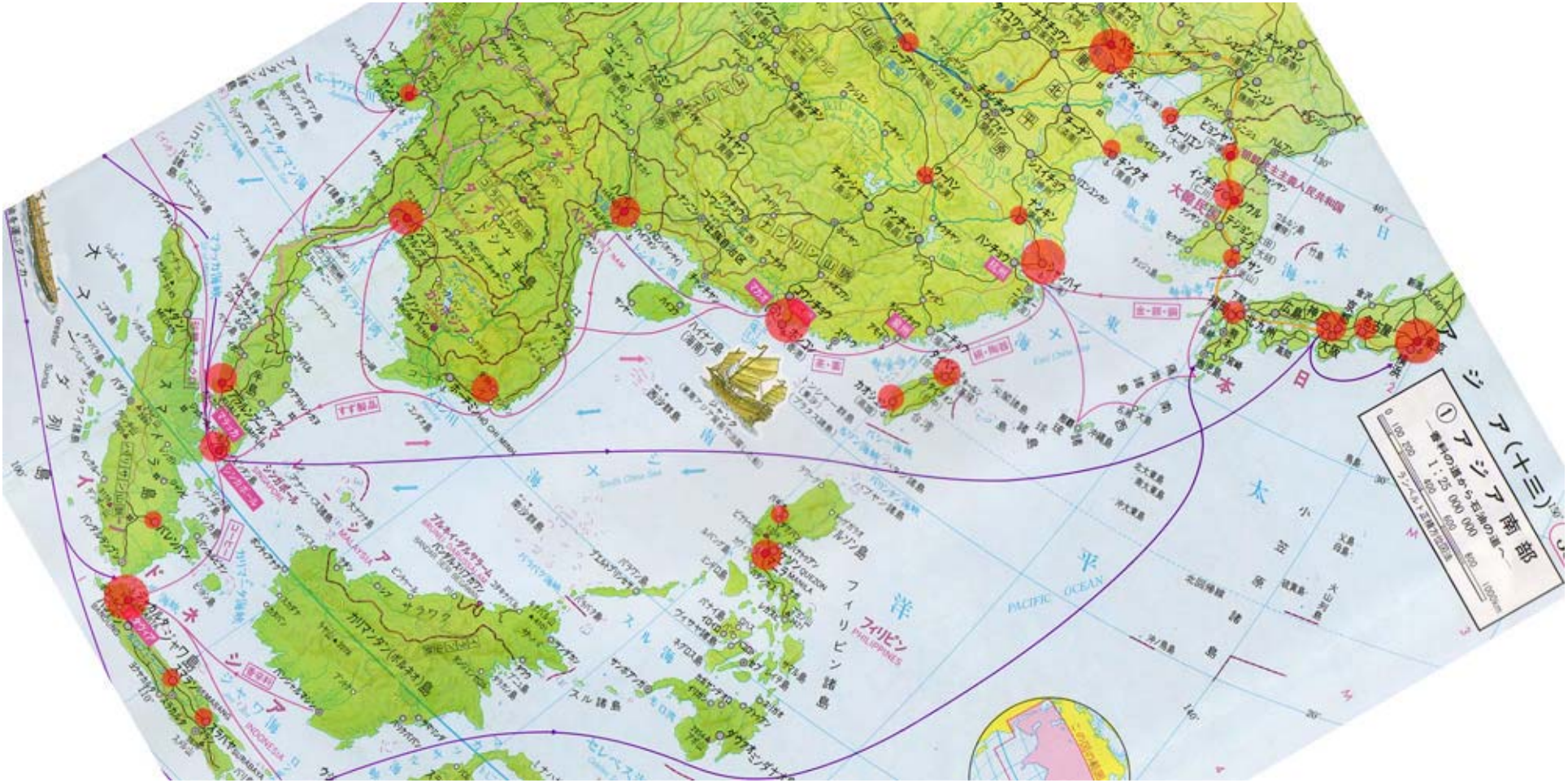
2.1 Factories.



2.2 Offices.

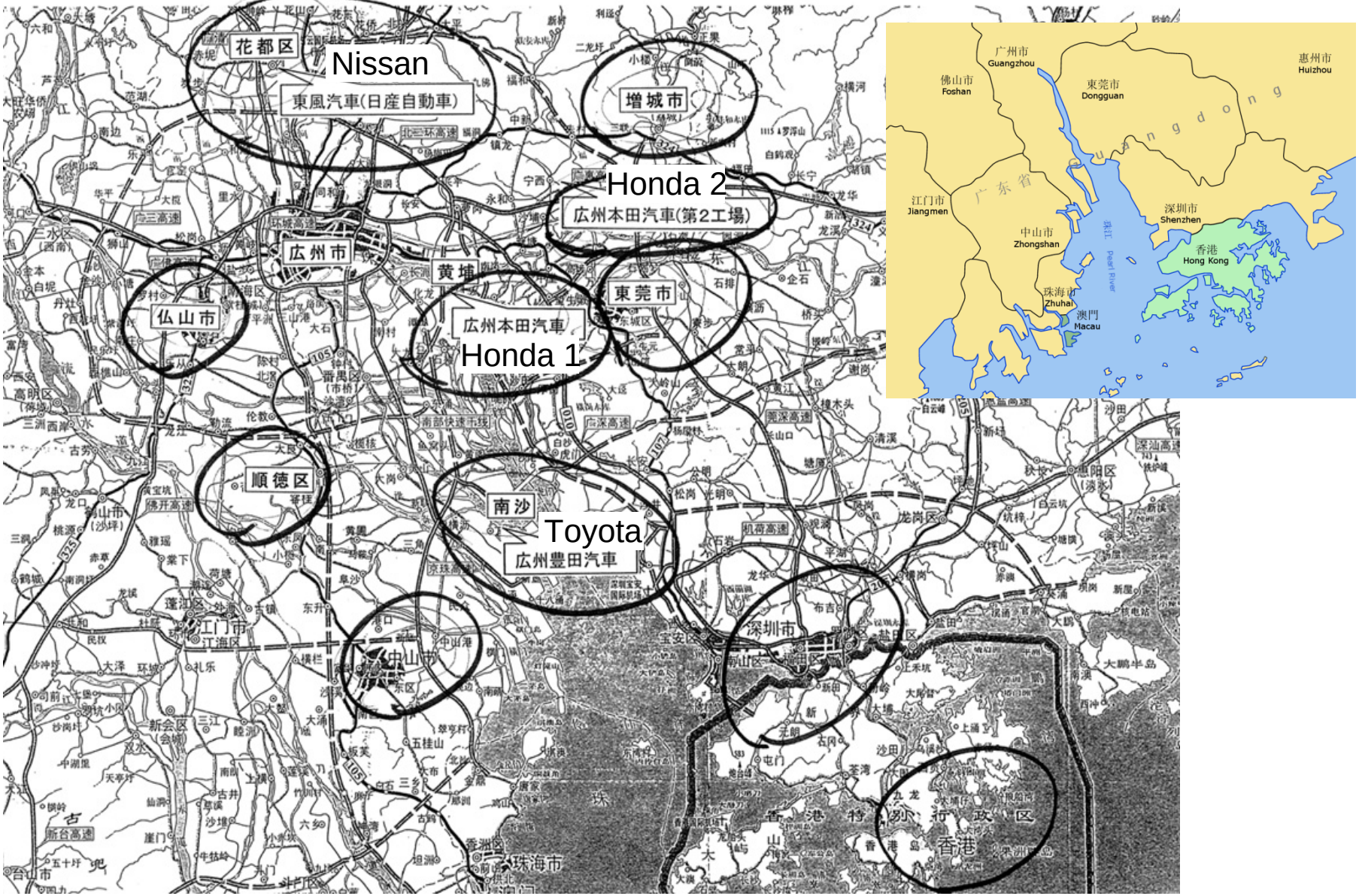
Unbundling 2.1: Factory Asia

Clusters&uneven unbundling (death of distance mistake)



Unbundling 2.1: Factory Asia

Growing Automobile Agglomeration in Pearl River Delta

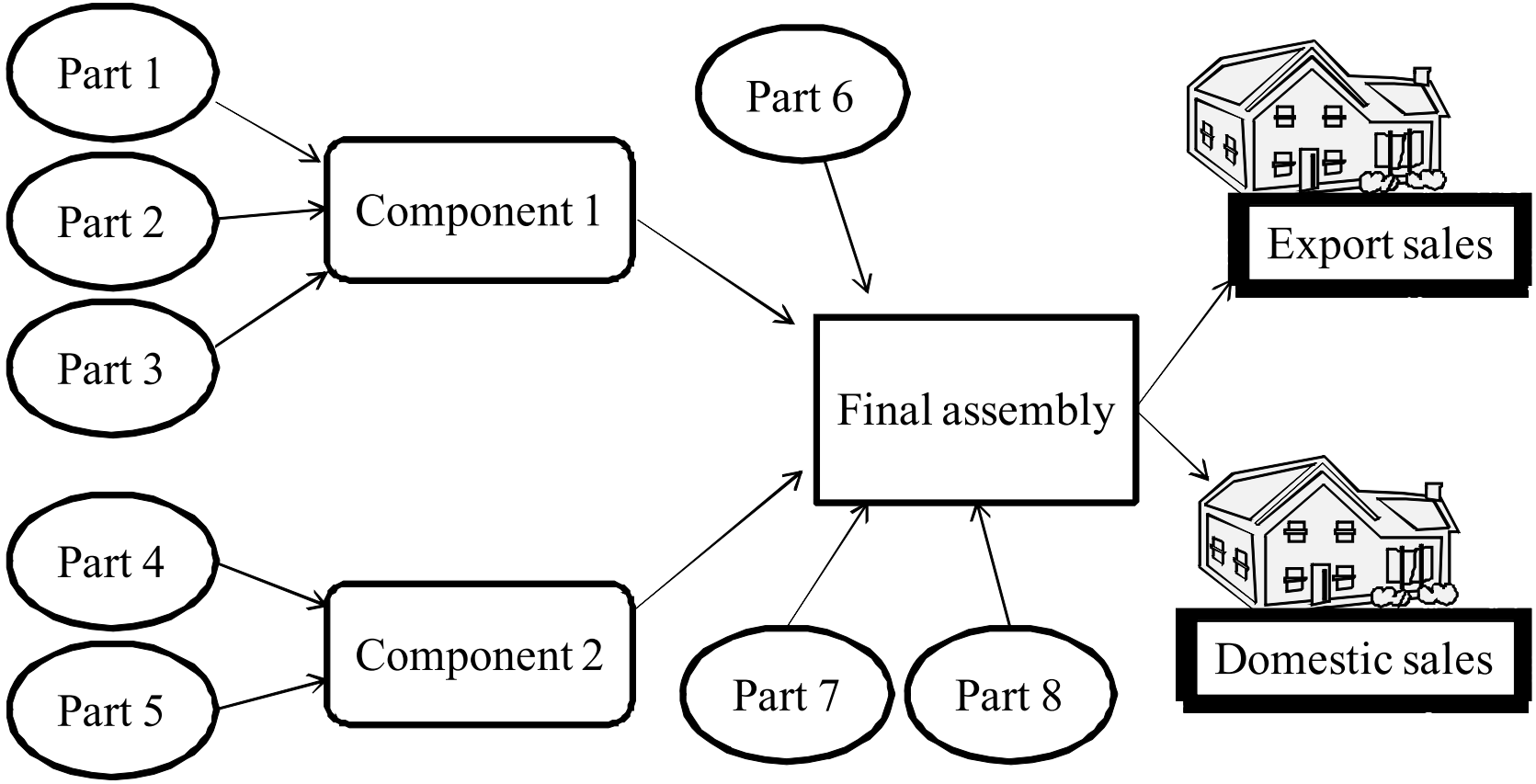


2nd Unbundling : “New paradigm”

- Conceptual framework
- Grossman & Rossi-Hansberg
  - Simple model of ‘tasks trade’.
- Baldwin & Robert-Nicoud
  - Integrates tasks trade into Hecksher-Ohlin & monopolistic competition trade theory.
  - Offshoring as ‘shadow migration’ on quantity side and technological change on price side.

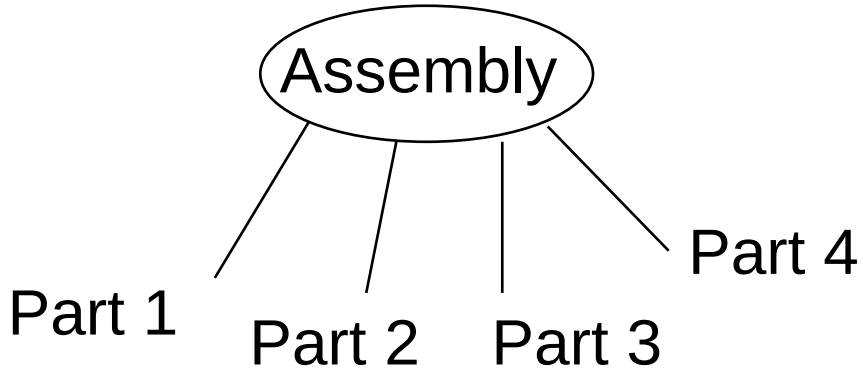
This paper

- Study the process of 2nd unbundling taking seriously engineering details of supply chain.

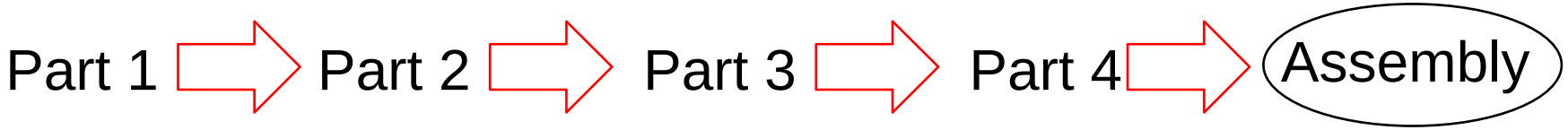


Spider & Snake

“spider”



“snake”



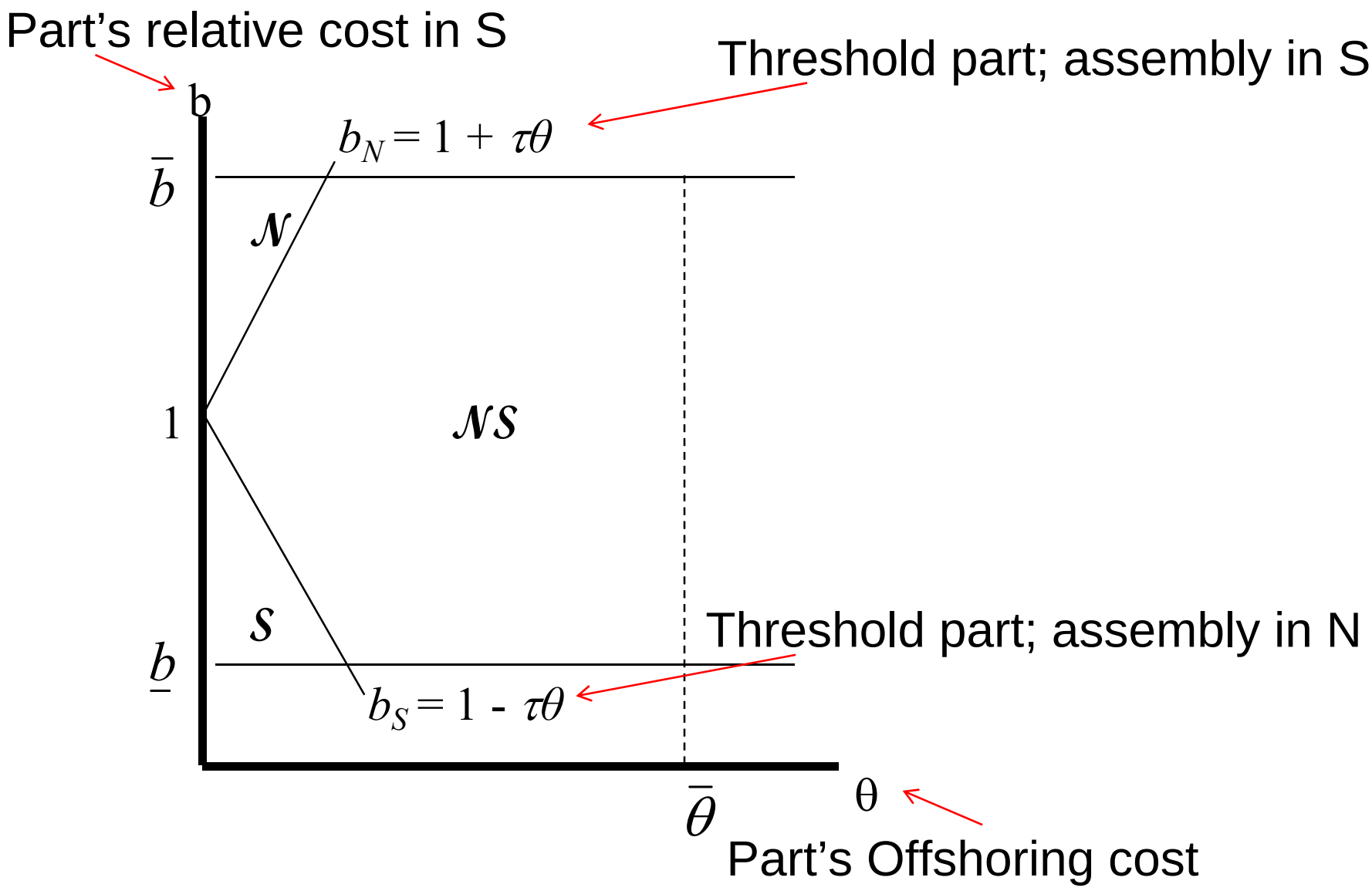
Basic assumptions

- Perfect competition, constant returns.
- All final consumption in North
- Shipping costs of final good αt.
  - *Traditional trade costs*
- Offshoring cost of a part, $\theta(i)\tau$
  - Costs that explain why factories bundled spatially even within nations.

Specifically

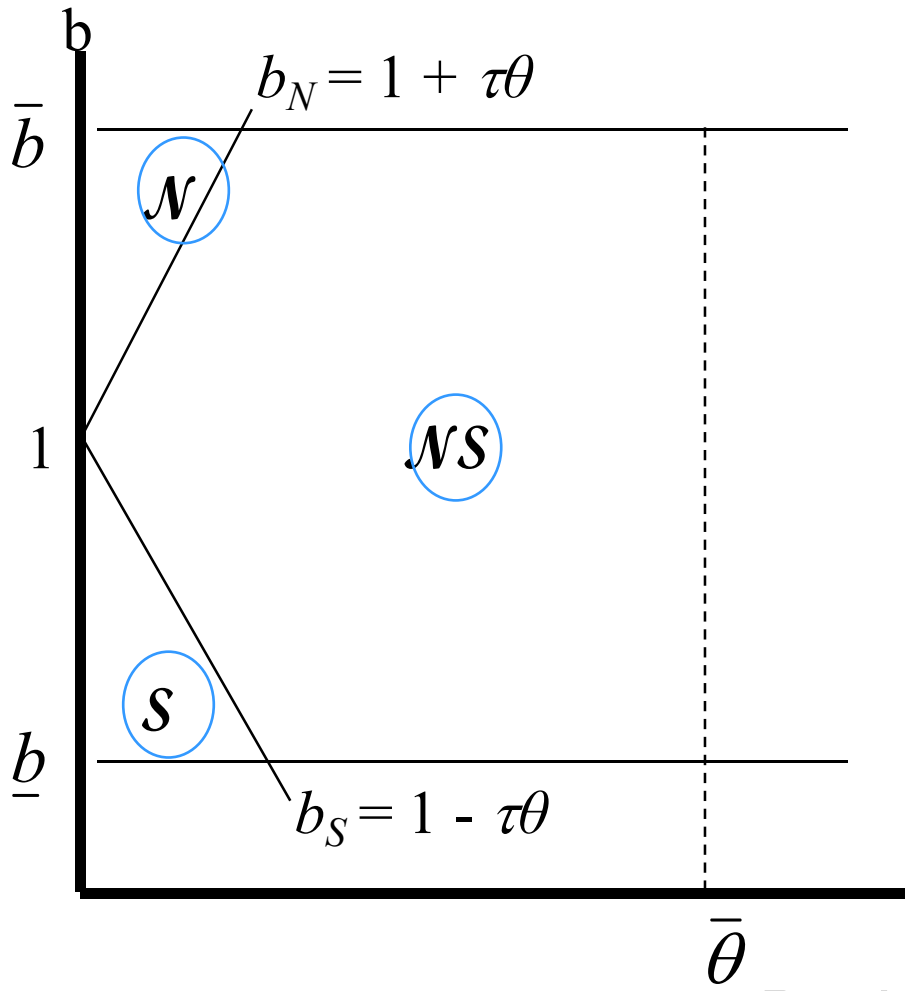
- Parts are indexed by type $y \in Y$
- Unit production cost in S is $b(y)$; unit costs of all parts normalised to 1 in N.
- Low b parts can be produced more cheaply in S
  - refer to low b parts as 'labour-intensive'
- Assembly of parts: a_N, a_S in N & S.
- Per-unit off-shoring costs is $t\theta(y)$ if not produced in region of assembly (shipping & coordination costs).
- If assembly in S then $t\alpha$ is paid to ship to N consumers.

Spider


Part's relative cost in S
Threshold part; assembly in S
b
$b_N = 1 + \tau\theta$
$\bar{b}$
$\mathcal{N}$
1
$\mathcal{NS}$
$\mathcal{S}$
Threshold part; assembly in N
$\underline{b}$
$b_S = 1 - \tau\theta$
$\bar{\theta}$
θ
Part's Offshoring cost

Spider

Part's relative cost in S



Part's Offshoring cost

Each part is a point in b,θ space.
-3 sets of parts, N, NS, S
-N is set always cheapest in N & S in S.
-NS, cheapest location of part depends upon location of assembly.

Single agent cost minimisation

- Assembly in S iff

$$a_N + \int_{y \in \mathcal{N} \cup \mathcal{N}s} \psi(y)dy + \int_{y \in s} [b(y) + t\theta(y)]\psi(y)dy$$

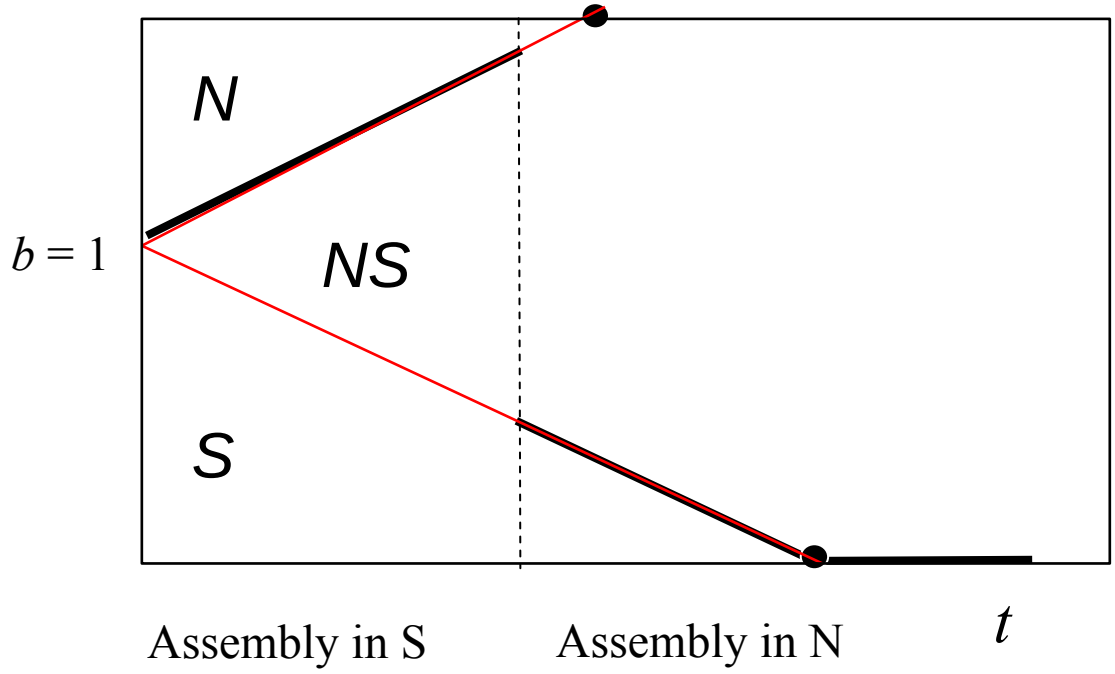
- is greater than

$$a_S + \alpha t + \int_{y \in \mathcal{N}} [1 + t\theta(y)]\psi(y)dy + \int_{y \in s \cup \mathcal{N}s} b(y)\psi(y)dy$$

- NB:
  - if t=0, then NS disappears => pure comparative advantage for parts & assembly.
  - If t=∞, trade costs dominate; all parts made in N & assemble in North.
  - For intermediate, get tension trade costs vs comparative advantage.

Cost minimising location

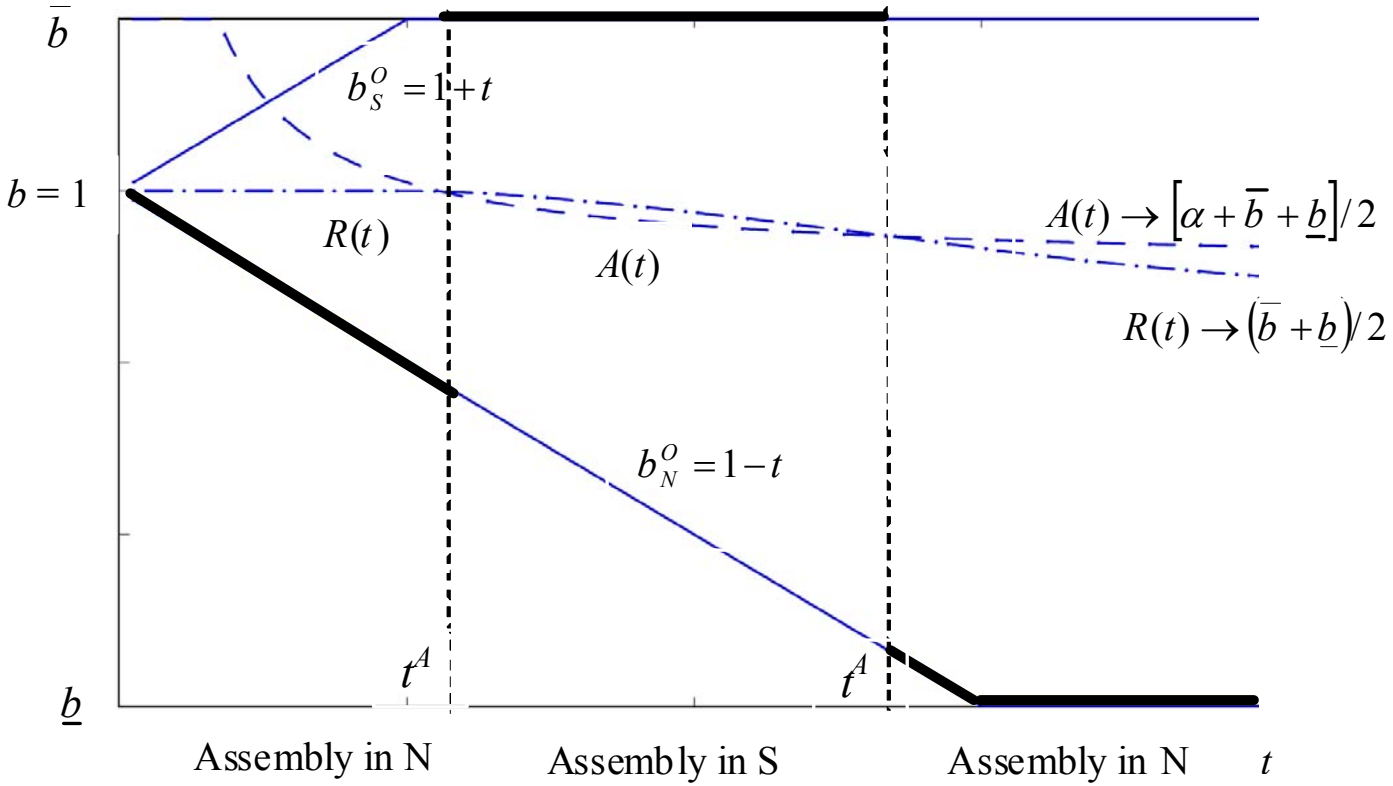
- Focus on comparative advantage;
  - Assume all offshoring costs equal for all parts, soo horizontal axis now “t” , not theta
- Start with assembly in North; assume $a_S < a_N$.



Result: Offshoring “overshooting” of parts

Another example

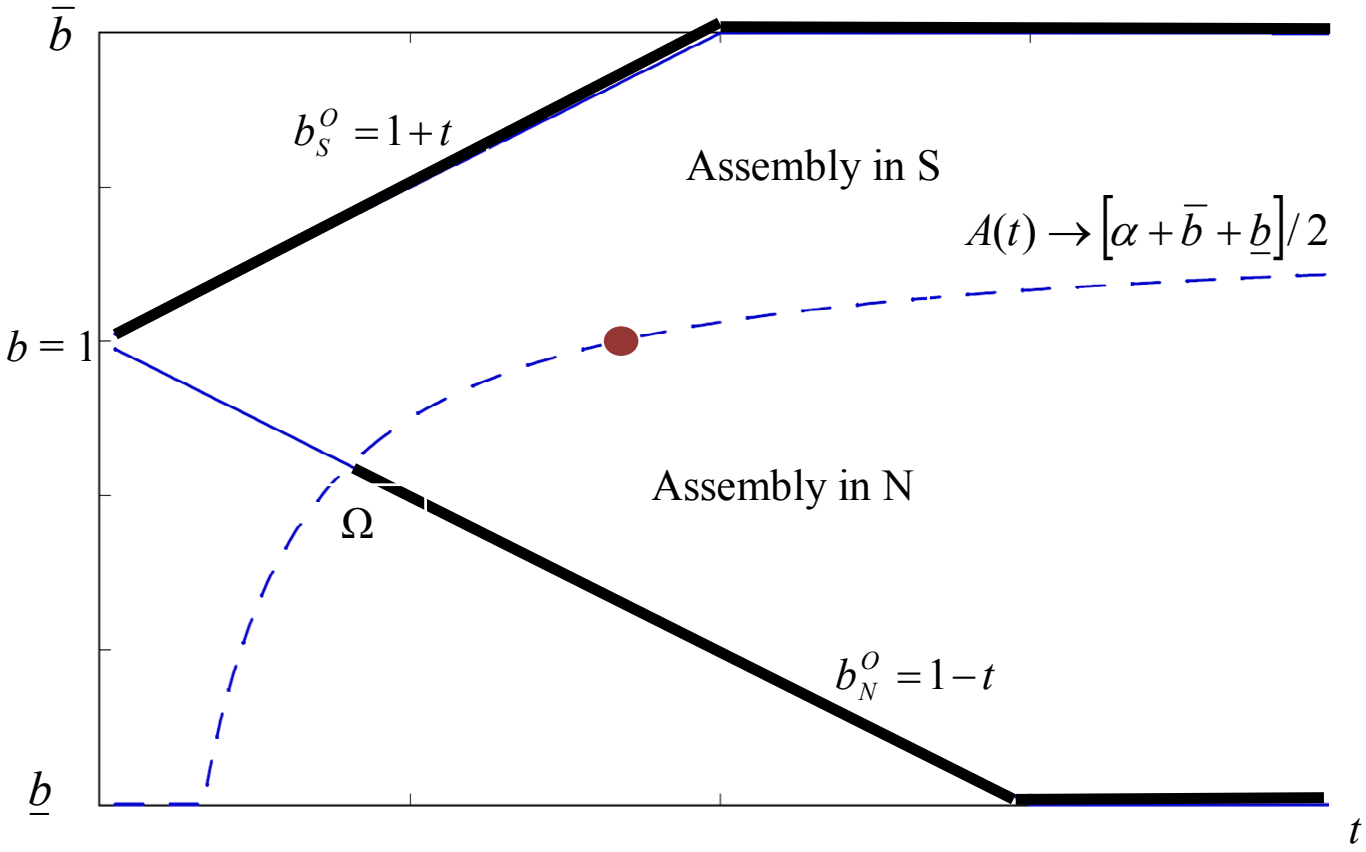
- S'pose S has strong c.a. in parts, but N has c.a. in assembly $a_S > a_N$.



Nash in parts location

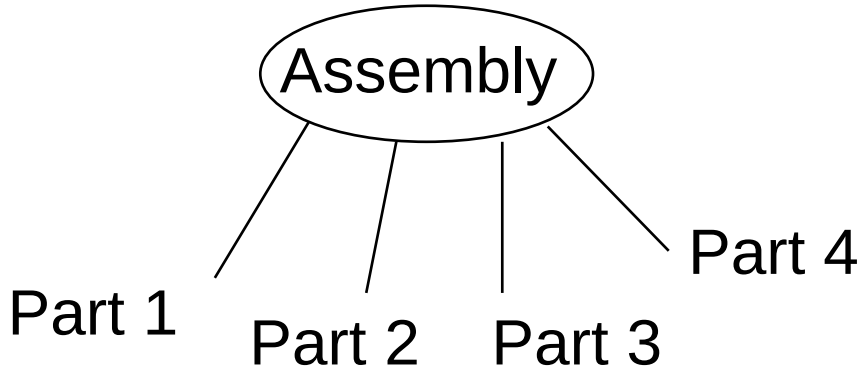
- Multiple eq'm arise:

Figure 5: Equilibrium locations, low cost assembly in S ($a_S < a_N$)

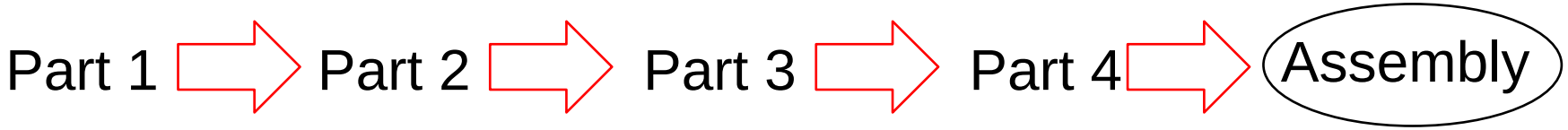


Snake

“spider”



“snake”

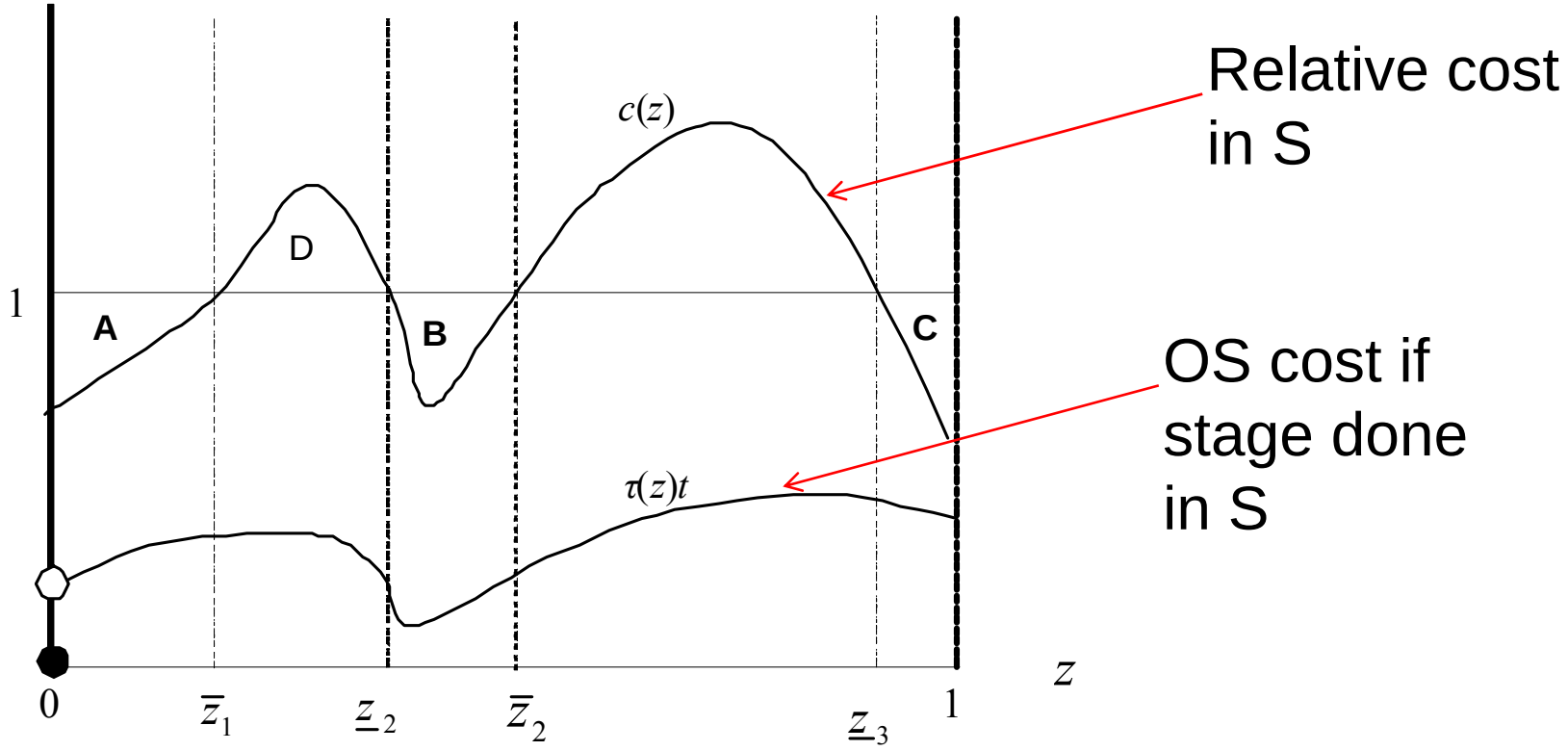


Basic assumptions

- Stages of produciton continuum; $z \in (0,1)$
  - $z = 0$ the most upstream
- Each stage combines primary factors with the output of the previous stage.
- In general factor intensity need not vary continuously with z, but we assume this.
- Factor cost in S is c[z]; normalised to 1 in N.
  - Low c[z] = “very L-intensive”
- Off-shoring costs $\tau[z]t$;

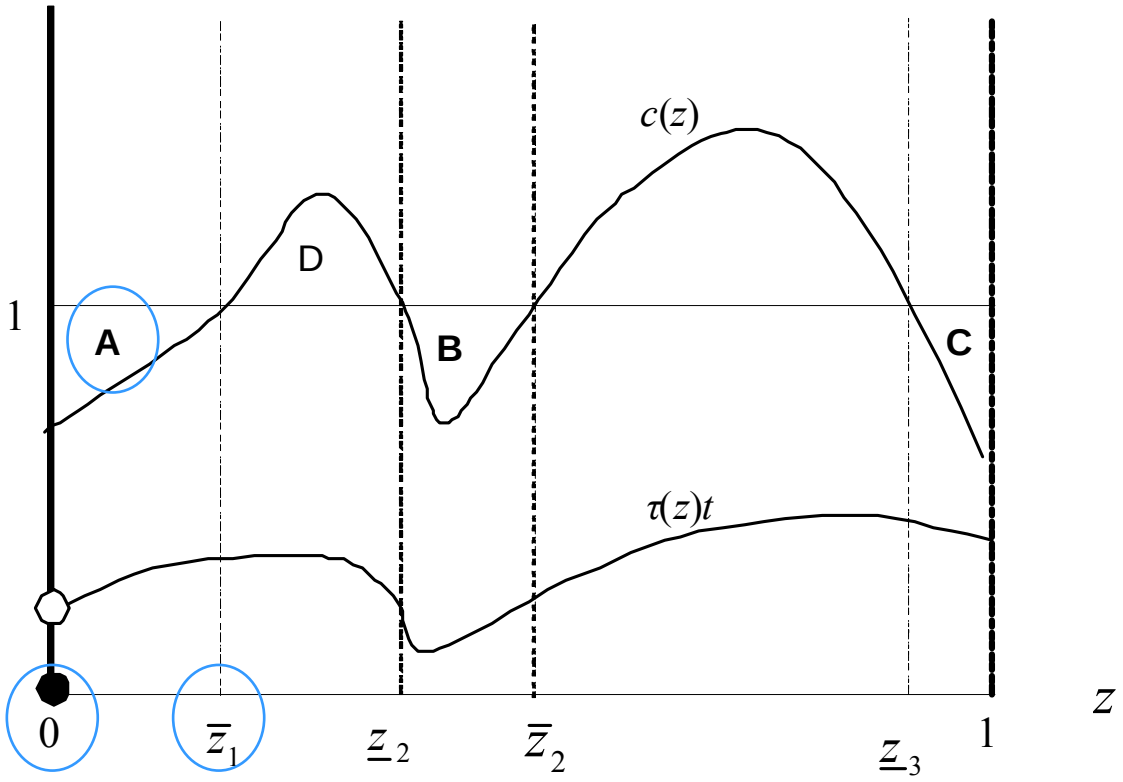
Snake: General issues

- More difficult as cannot freely re-order the parts by comparative advantage.
- Parts vary by c.a. and by offshoring costs



Snake: General issues

- If stages 0 to z_1 in S
  - Save area A on factor cost, but pay $(\tau[0]+\tau[z_1])t$ in offshoring costs.



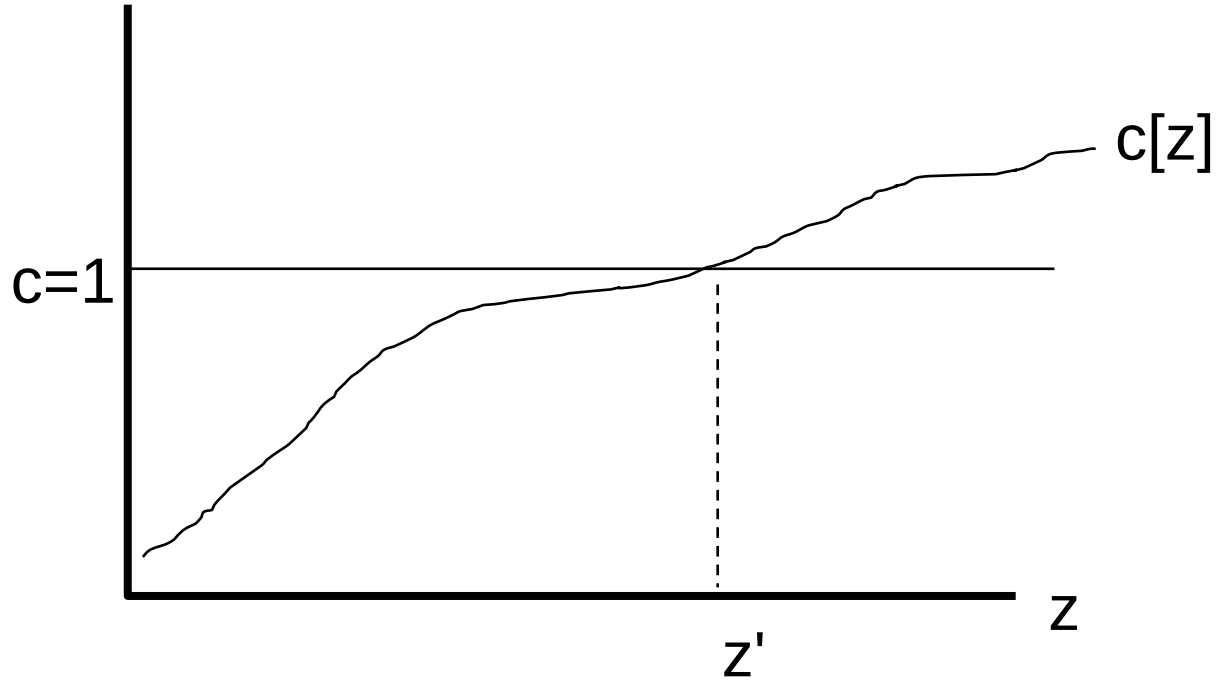
General results

- Won’t get infinitely small segments of supply chain offshored; cluster tendency
- Offshore overshooting again; if one stage is offshored already, trade costs favours production of immediate up and down stream stage in S.
  - In multiple S world, suggests agglomeration.

Example 1: Upstream offshoring

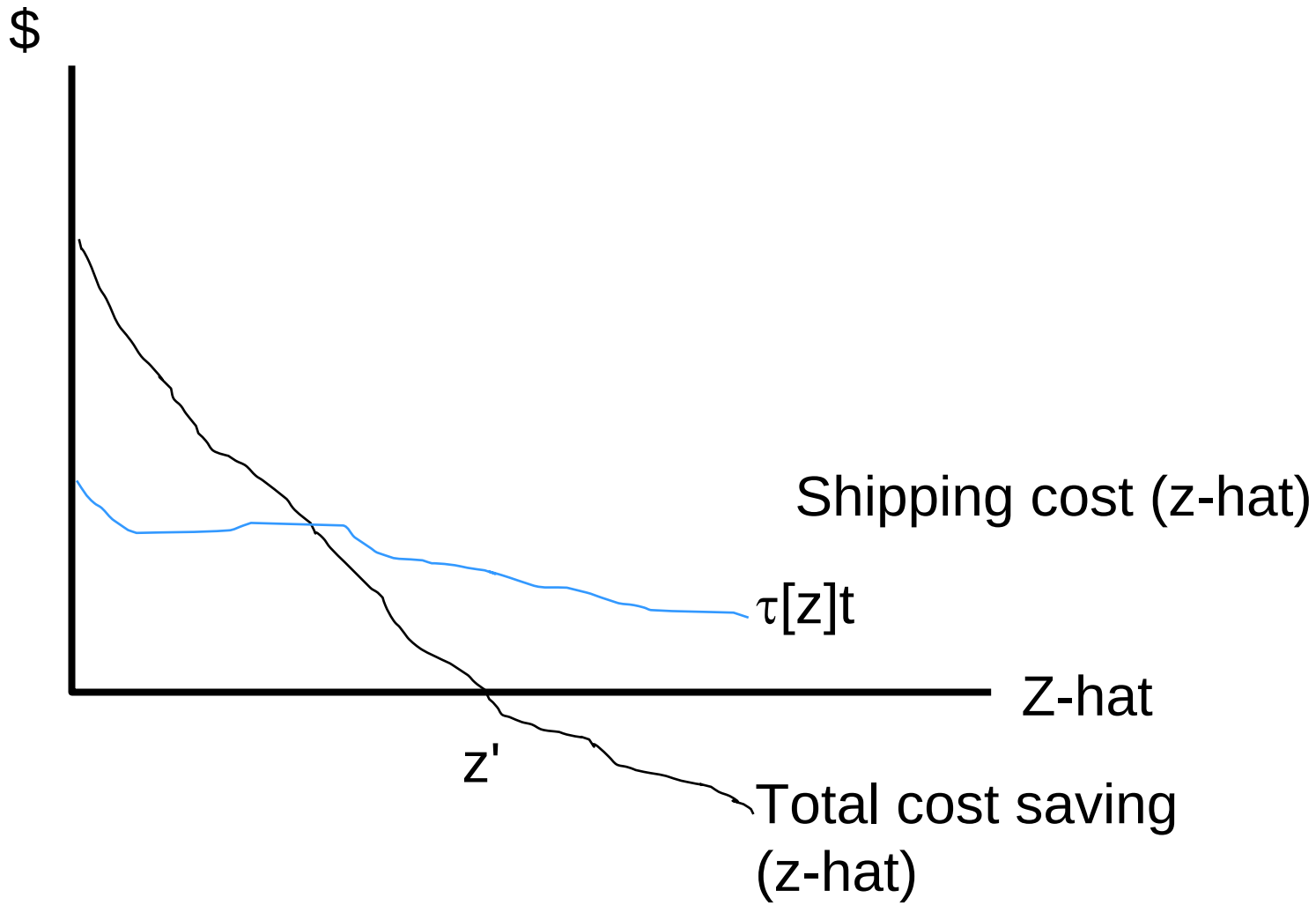
- S'pose c[z] increase (i.e. upstream parts are most L-intense and so c.a. in S).
  - Single break in supply chain, z-hat.

$$\hat{z} \in (0,1]: \quad U(\hat{z}) = \int_0^{\hat{z}} c(z)dz + \tau(\hat{z})t + \int_{\hat{z}}^1 dz$$



Upstream offshoring

- Factor cost savings vs OS'ing costs



Labour mkt implications

- Baldwin & Robert-Nicoud insight
- Start with standard HO 2x2x2 model with free trade in goods but no offshoring.
- Assume N has Hicks neutral tech advantage.

$$\begin{bmatrix} X \\ Y \end{bmatrix} = \mathbf{A}^{-1} \begin{bmatrix} L \\ K \end{bmatrix} \qquad \begin{bmatrix} X^* \\ Y^* \end{bmatrix} = \frac{1}{\gamma} \mathbf{A}^{-1} \begin{bmatrix} L^* \\ K^* \end{bmatrix}$$

$$\begin{bmatrix} w \\ r \end{bmatrix} = \left(\mathbf{A}^{\mathbf{T}}\right)^{-1} \begin{bmatrix} 1 \\ p \end{bmatrix} \qquad \begin{bmatrix} w^* \\ r^* \end{bmatrix} = \frac{1}{\gamma} \left(\mathbf{A}^{\mathbf{T}}\right)^{-1} \begin{bmatrix} 1 \\ p \end{bmatrix}$$

Allow offshoring

- N can combine its superior tech with lower prices S labour and re-import that stage.
- Means N can produce same output with fewer resources, i.e. shadow migration.

Offshoring : Equilibrium

- Full-employment conditions ('o' ≡ offshoring)

$$\underbrace{\begin{bmatrix} L \\ K \end{bmatrix} = (\mathbf{A} - \mathbf{A}_1)\begin{bmatrix} X_O \\ Y_O \end{bmatrix}}_{\text{Home}}, \qquad \underbrace{\begin{bmatrix} L^* \\ K^* \end{bmatrix} = \gamma \mathbf{A}\begin{bmatrix} X_O^* \\ Y_O^* \end{bmatrix} + \mathbf{A}_1\begin{bmatrix} X_O \\ Y_O \end{bmatrix}}_{\text{Foreign}}$$

$$\mathbf{A}_1 \equiv \begin{bmatrix} a_{LXI} & a_{LYI} \\ a_{KX1} & a_{KY1} \end{bmatrix}$$

→ "Shadow migration"

$$\begin{bmatrix} L + \Delta L \\ K + \Delta K \end{bmatrix} \equiv \begin{bmatrix} L_O \\ K_O \end{bmatrix} = \mathbf{A}\begin{bmatrix} X_O \\ Y_O \end{bmatrix} \qquad \begin{bmatrix} \Delta L \\ \Delta K \end{bmatrix} \equiv \mathbf{A}_1\begin{bmatrix} X_O \\ Y_O \end{bmatrix} > \mathbf{0}; \qquad \tilde{L}_O^w \equiv L + \frac{L^*}{\gamma} + (1 - \frac{1}{\gamma})\Delta L$$

→Offshoring in L-intensive sector tends to shift N towards L-int production

Offshoring : Equilibrium (ctd.)

- Pricing conditions

$$\underbrace{\begin{bmatrix} 1 \\ p_O \end{bmatrix} = (\mathbf{A}^{\mathbf{T}} - \mathbf{A}_1^{\mathbf{T}}) \begin{bmatrix} w_O \\ r_O \end{bmatrix} + \mathbf{A}_1^{\mathbf{T}} \begin{bmatrix} w_O^* \\ r_O^* \end{bmatrix}}_{\text{Home}} \qquad \underbrace{\begin{bmatrix} 1 \\ p_O \end{bmatrix} = \gamma \mathbf{A}^{\mathbf{T}} \begin{bmatrix} w_O^* \\ r_O^* \end{bmatrix}}_{\text{Foreign (no change)}}$$

→ Cost saving ⇔ technical progress (Stolper-Samuelson)

$$\begin{bmatrix} S_X + 1 \\ S_Y + p_O \end{bmatrix} = \mathbf{A}^{\mathbf{T}} \begin{bmatrix} w_O \\ r_O \end{bmatrix} \qquad \begin{bmatrix} 1 \\ p_O \end{bmatrix} = \gamma \mathbf{A}^{\mathbf{T}} \begin{bmatrix} w_O^* \\ r_O^* \end{bmatrix} \qquad \begin{bmatrix} S_X \\ S_Y \end{bmatrix} \equiv \mathbf{A}_1^{\mathbf{T}} \begin{bmatrix} w_O - w_O^* \\ r_O - r_O^* \end{bmatrix}$$

→ Wage effects depends upon cost savings by sector, not nature of cost-savings per se.

Conclusion

- Early stage in theory development.
- Theory needs guidance from facts on unbundling in specific industries.
- Please see:

  www.VoxEU.org