Lecture 5

Trade and structural change

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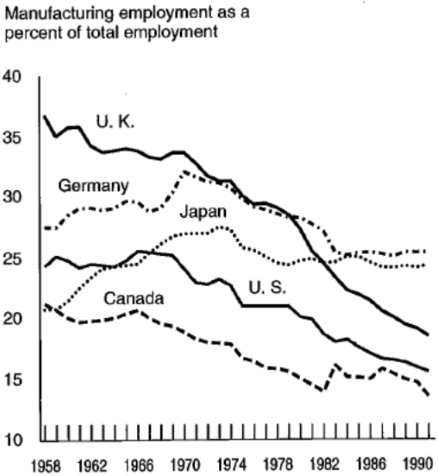
Taking stock so far

- So far focused one country
- Predicts that as A or M sector becomes more productive, labor switches out of that sector
  - demand-driven story: because people like services more as they get richer
  - supply-driven story: because of elasticity effects

Global picture

- Japan 1960-1990
  - rapid growth rate of GDP driven by high productivity in manufacturing
  - share of manufacturing in GDP *increased*
- Obstfeld and Rogoff (1996): "Considering that Japan has had exceptionally high productivity growth in manufacturing relative to services, its experience is especially hard to square with productivity-based theories of manufacturing employment decline."
- Similar stories for South Korea, Hong Kong, Taiwan, Vietnam, and Indonesia

Manufacturing employment, %



Countries with faster TFP growth in manuf did not experience faster decline in manuf labor share

Trade and structural change

- One obviously missing ingredient in earlier model is trade
  - as you become more productive in sector i, your comparative advantage in sector i increases
  - can sell more of i stuff to the rest of the world
  - higher productivity in $i \Longrightarrow$ higher demand from ROW
- Next: a simple model of structural change with trade
  - based on Matsuyama (JEEA, 2009)

Set up

- Two Countries: Home and Foreign (*)
  - Each is endowed with one unit of the nontradeable factor (Labor).
  - They differ only in Labor Productivity.
- Three Goods:
  - Numeraire (A); tradeable at zero cost;
    - No production. Endowment of y units
  - Manufacturing (M); tradeable at zero cost;
    - A unit of Home (Foreign) Labor produces X_M (X_M^*) units of M.
  - Services (S): nontradeable;
    - A unit of Home (Foreign) Labor produces X_S (X_S^*) units of S.

Preferences

- Utility function

$$U = \begin{cases} (C_A - \gamma_A)^\alpha \left[\beta_M (C_M - \gamma)^\theta + \beta_S C_S^\theta\right]^{(1-\alpha)/\theta} & \text{if } \theta \in (0,1) \\ (C_A - \gamma_A)^\alpha (C_M - \gamma)^{\beta_M(1-\alpha)} C_S^{\beta_S(1-\alpha)} & \text{if } \theta = 0 \end{cases}$$

- Elasticity of substitution between M and S is

$$\sigma = 1/(1-\theta)$$

- Budget Constraint:

$$C_A + p_M C_M + p_S C_S \leq y + w$$

Technology

- Agriculture:

$$Y_A = y$$

- Manufacturing:

$$\max_{Y_M, L_M} p_M Y_M - wL_M$$

s.t.

$$Y_M = X_M L_M$$

- Services:

$$\max_{Y_S, L_S} p_S Y_S - wL_S$$

s.t.

$$Y_S = X_S L_S$$

Market clearing

- Global goods feasibility

$$\begin{aligned} C_A + C_A^* &= 2y \\ C_M + C_M^* &= Y_M + Y_M^* \\ C_S &= X_S L_S \\ C_S^* &= X_S^* L_S^* \end{aligned}$$

- Labor feasibility

$$\begin{aligned} L_M + L_S &= 1 \\ L_M^* + L_S^* &= 1 \end{aligned}$$

- Free trade in A and M:

$$p_M = p_M^*$$

Competitive equilibrium

Excercise

Define competitive equilibrium for this economy

Firm optimality

- Optimality in S:

$$p_S = \frac{w}{X_S}, \quad p_S^* = \frac{w^*}{X_S^*}$$

- Optimality in M + free trade condition

$$p_M = \frac{w}{X_M} = \frac{w^*}{X_M^*}$$

Consumer optimality

Excercise

Show that demand for A and S at Home is given by

$$
\begin{aligned}
C_A &= \gamma_A + \alpha \left(y - \gamma_A + w - \gamma p_M \right), \\
C_S &= \frac{\beta_S^{\sigma} p_S^{-\sigma} \left(1 - \alpha\right) \left(y - \gamma_A + w - \gamma p_M \right)}{\beta_M^{\sigma} p_M^{1-\sigma} + \beta_S^{\sigma} p_S^{1-\sigma}}.
\end{aligned}
$$

Derive analogous expression for Foreign demand.

Equilibrium employment shares

Excercise

Show that if equilibrium labor allocation is interior, $L_M \in (0,1)$, $L_M^* \in (0,1)$, *then it is given by*

$$
\begin{aligned}
L_M &= \frac{\frac{\alpha}{2}\left(1-\frac{X_M^*}{X_M}\right)+\frac{\gamma}{X_M}+\left(\frac{\beta_M}{\beta_S}\right)^{\sigma}\left(\frac{X_S}{X_M}\right)^{1-\sigma}}{1+\left(\frac{\beta_M}{\beta_S}\right)^{\sigma}\left(\frac{X_S}{X_M}\right)^{1-\sigma}} \\
L_M^* &= \frac{\frac{\alpha}{2}\left(1-\frac{X_M}{X_M^*}\right)+\frac{\gamma}{X_M^*}+\left(\frac{\beta_M}{\beta_S}\right)^{\sigma}\left(\frac{X_S^*}{X_M^*}\right)^{1-\sigma}}{1+\left(\frac{\beta_M}{\beta_S}\right)^{\sigma}\left(\frac{X_S^*}{X_M^*}\right)^{1-\sigma}}
\end{aligned}
\tag{1}
$$

Demand side effects

- Focus on demand-driven structural change: $\gamma > 0$ and $\sigma = 1$
- Then (*) becomes

$$
\begin{aligned}
L_M &= (1-\beta)\left[\frac{\alpha}{2}\left(1-\frac{X_M^*}{X_M}\right)+\frac{\gamma}{X_M}\right]+\beta \\
L_M^* &= (1-\beta)\left[\frac{\alpha}{2}\left(1-\frac{X_M}{X_M^*}\right)+\frac{\gamma}{X_M^*}\right]+\beta
\end{aligned}
$$

where

$$
\beta = \frac{\beta_M}{\beta_M+\beta_S}
$$

Demand side effects

- *Global* productivity growth in manufacturing

$$\frac{\Delta X_M}{X_M} = \frac{\Delta X_M^*}{X_M^*} > 0$$

- Effect for labor is

$$\Delta L_M < 0 \text{ and } \Delta L_M^* < 0$$

- *National* productivity growth in manufacturing

$$\frac{\Delta X_M}{X_M} > 0 = \frac{\Delta X_M^*}{X_M^*}$$

- Effect of labor is

$$sign\left[\Delta L_M\right] = sign\left[\frac{\alpha}{2} - \frac{\gamma}{X_M^*}\right] \text{ and } \Delta L_M^* < 0$$

Trade effect

- Ambiguity due to an additional force: trade effect
  - comparative advantage dictates that production of manufacturing goods is shifted to the country that is more efficient at producing that good.
  - whether home country experiences decline in manufacturing, depends on the relative strengths of non-homotheticity vs trade effects.
- Trade Effect can cause, in cross-section, a positive correlation between productivity gains and the employment share in M.

Supply side effects

- Focus on supply-driven structural change: $\gamma = 0$ and $\sigma < 1$
- Then (*) becomes

$$
\begin{aligned}
L_M &= \frac{\frac{\alpha}{2}\left(1 - \frac{X_M^*}{X_M}\right) + \left(\frac{\beta_M}{\beta_S}\right)^{\sigma}\left(\frac{X_S}{X_M}\right)^{1-\sigma}}{1 + \left(\frac{\beta_M}{\beta_S}\right)^{\sigma}\left(\frac{X_S}{X_M}\right)^{1-\sigma}} \\
L_M^* &= \frac{\frac{\alpha}{2}\left(1 - \frac{X_M}{X_M^*}\right) + \left(\frac{\beta_M}{\beta_S}\right)^{\sigma}\left(\frac{X_S^*}{X_M^*}\right)^{1-\sigma}}{1 + \left(\frac{\beta_M}{\beta_S}\right)^{\sigma}\left(\frac{X_S^*}{X_M^*}\right)^{1-\sigma}}
\end{aligned}
$$

Supply side effects

- *Global* productivity growth in manufacturing

$$\frac{\Delta X_M}{X_M} = \frac{\Delta X_M^*}{X_M^*} > \frac{\Delta X_S}{X_S} = \frac{\Delta X_S^*}{X_S^*} = 0$$

... implies

$$\Delta L_M < 0 \text{ and } \Delta L_M^* < 0$$

- *National* productivity growth in manufacturing

$$\frac{\Delta X_M}{X_M} > \frac{\Delta X_M^*}{X_M^*} = \frac{\Delta X_S}{X_S} = \frac{\Delta X_S^*}{X_S^*} = 0$$

... implies

$$sign\left[\Delta L_M\right] \text{ ambiguous and } \Delta L_M^* < 0$$

- Ambiguity due to the two forces: Relative Supply & Trade Effects

Take aways

- Higher productivity gains in Japanese M means that M must decline somewhere in the world, but not necessarily in Japan
- In cross-section of countries, M productivity can be positively correlated with M employment share, due to comparative advantage
- Global trend of M decline occurs due to productivity gains in M