Structural Change in an Interdependent World: A Global View of Manufacturing Decline

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1. Introduction

- We live in the global economy, where countries are interdependent with one another.
- The only closed economy we know of is our planet, the world economy.

Yet,

- Most studies on structural change develop a closed economy model, apply it to each country, and use the cross-country data to test it,
- as if countries were still independent fiefdoms in the Middle Ages or were located on different planets.

- We show how misleading this common practice can be in the context of productivity-based theory of manufacturing employment decline.

What is "Productivity-Based Theory of Manufacturing Decline"?

Productivity growth in *M* causes the broad trend of its employment decline observed in many countries.

Logic: High productivity growth in *M* sectors
→ Less workers are needed to produce the same amount of *M* goods
→ Unless demand for *M* goods keeps up with productivity growth, some *M* workers has to move to other sectors, such as Services.

Cross-country evidence: higher productivity growth in *M* is *not* associated with a faster decline in *M*. Some (very good) economists have interpreted this as a *rejection* of the theory.

The following example shows that this interpretation is *false*.

2. A Ricardian Model of the World Economy

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 *(O)*; tradeable at zero cost;
  No production. Endowment of y units
- Manufacturing *(M)*; tradeable at zero cost;
  A unit of Home (Foreign) Labor produces A_M (A_M*) units of M.
- Services (S): nontradeable;
  A unit of Home (Foreign) Labor produces A_S (A_S*) units of S.

Prices and Wages:

P_M: World Price of M,
W (W^*): Home (Foreign) Wage Rate
P_S (P_S^*) Home (Foreign) Price of S.

Perfect Competition implies that, when both economies produce M and S,

$$P_M = \frac{W}{A_M} = \frac{W^*}{A_M^*},$$

$$P_S = \frac{W}{A_S} \quad \& \quad P_S^* = \frac{W^*}{A_S^*}.$$

Home Preferences:

$$U = \begin{cases} (C_O)^{\alpha}\left[\beta_M (C_M - \gamma)^{\theta} + \beta_S (C_S)^{\theta}\right]^{\frac{1-\alpha}{\theta}} & \text{for } \theta < 1,\ \theta \neq 0, \\ (C_O)^{\alpha}(C_M - \gamma)^{\beta_M (1-\alpha)}(C_S)^{\beta_S (1-\alpha)} & \text{for } \theta = 0. \end{cases}$$

If $\gamma > 0$, the income elasticity of demand for M is less than one.
If $\theta < 0$, the price elasticity of relative demand of M & S is less than one.

Home Budget Constraint:

$$C_O + P_M C_M + P_S C_S \leq y + W$$

Home Demand Schedules for *O* and *S*:

$$C_O = \alpha(y + W - \gamma P_M), \qquad C_S = \frac{(\beta_S)^{\sigma}(P_S)^{-\sigma}(1-\alpha)(y + W - \gamma P_M)}{(\beta_M)^{\sigma}(P_M)^{1-\sigma} + (\beta_S)^{\sigma}(P_S)^{1-\sigma}}$$

$\sigma = 1/(1-\theta)$: the price elasticity of relative demand of M & S.

Likewise,

Foreign Demand Schedules for *O* and *S*:

$$C_O^* = \alpha(y + W^* - \gamma P_M), \qquad C_S^* = \frac{(\beta_S)^{\sigma}(P_S^*)^{-\sigma}(1-\alpha)(y + W^* - \gamma P_M)}{(\beta_M)^{\sigma}(P_M)^{1-\sigma} + (\beta_S)^{\sigma}(P_S^*)^{1-\sigma}}$$

Market Clearing Conditions:

$$C_O + C_O^* = 2y,$$

$$C_S = A_S(1 - L_M),$$

$$C_S^* = A_S^*(1 - L_M^*)$$

where

L_M (L_M^*): Home (Foreign) Manufacturing Employment Share.

Equilibrium Employment Shares:

$$L_M = \frac{\frac{\alpha}{2}\left(1 - \frac{A_M^*}{A_M}\right) + \frac{\gamma}{A_M} + \left(\frac{\beta_M}{\beta_S}\right)^{\sigma}\left(\frac{A_S}{A_M}\right)^{1-\sigma}}{1 + \left(\frac{\beta_M}{\beta_S}\right)^{\sigma}\left(\frac{A_S}{A_M}\right)^{1-\sigma}},$$

$$L_M^* = \frac{\frac{\alpha}{2}\left(1 - \frac{A_M}{A_M^*}\right) + \frac{\gamma}{A_M^*} + \left(\frac{\beta_M}{\beta_S}\right)^{\sigma}\left(\frac{A_S^*}{A_M^*}\right)^{1-\sigma}}{1 + \left(\frac{\beta_M}{\beta_S}\right)^{\sigma}\left(\frac{A_S^*}{A_M^*}\right)^{1-\sigma}},$$

3. Comparative Statics: Structural Change in an Interdependent World

3.1. Income-elasticity Differentials across sectors: $\gamma > 0$ & $\sigma = 1$ ($\theta = 0$).

(Non-homothetic preferences)

$$L_M = (1-\beta)\left[\frac{\alpha}{2}\left(1-\frac{A_M^*}{A_M}\right)+\frac{\gamma}{A_M}\right]+\beta,$$

$$L_M^* = (1-\beta)\left[\frac{\alpha}{2}\left(1-\frac{A_M}{A_M^*}\right)+\frac{\gamma}{A_M^*}\right]+\beta$$

where $\beta \equiv \dfrac{\beta_M}{\beta_S+\beta_M}$,

- *Global Productivity Gains in Manufacturing:* ***Income Effect***

$$\frac{\Delta A_M}{A_M} = \frac{\Delta A_M^*}{A_M^*} > 0 \quad \Rightarrow \qquad \Delta L_M < 0 \quad \& \quad \Delta L_M^* < 0.$$

- *National Productivity Gains in Manufacturing:*

$$\frac{\Delta A_M}{A_M} > 0 = \frac{\Delta A_M^*}{A_M^*} \quad \Rightarrow \; \mathrm{sgn}[\Delta L_M] = \mathrm{sgn}\left[\frac{\alpha}{2} - \frac{\gamma}{A_M^*}\right] \; \& \quad \Delta L_M^* < 0.$$

- Ambiguity due to the two forces: ***Income & Trade Effects***
- ***Trade Effect*** can cause, in cross-section, a *positive* correlation between productivity gains and the employment share in *M*.

3.2. Productivity growth differentials across sectors: $\gamma = 0$ & $\sigma < 1(\theta < 0)$. (M and S are not very substitutable)

- *Global Productivity Gains in Manufacturing:* ***Relative Supply Effect***

$$\frac{\Delta A_M}{A_M} = \frac{\Delta A_M^*}{A_M^*} > \frac{\Delta A_S}{A_S} = \frac{\Delta A_S^*}{A_S^*} = 0 \quad \Rightarrow \ \Delta L_M < 0 \quad \& \quad \Delta L_M^* < 0.$$

- *National Productivity Gains in Manufacturing:*

$$\frac{\Delta A_M}{A_M} > \frac{\Delta A_M^*}{A_M^*} = \frac{\Delta A_S}{A_S} = \frac{\Delta A_S^*}{A_S^*} = 0 \quad \Rightarrow \ \Delta L_M \, ??0 \quad \& \quad \Delta L_M^* < 0.$$

- Ambiguity due to the two forces: ***Relative Supply & Trade Effects***
- ***Trade Effect*** can cause, in cross-sections, a *positive* correlation between productivity gains and the employment share in *M*.

The model suggests both:

- A *broad, global* trend of manufacturing decline occurs due to productivity gains in manufacturing.
- In *cross-section of countries*, manufacturing productivity can be *positively* correlated with the manufacturing employment share, due to *comparative advantage.*

Hence, **you *cannot* use cross-country evidence to reject the first implication.**

e.g. Higher productivity gains in the South Korean manufacturing sector means that the manufacturing sectors must decline *somewhere* in the world, but not necessarily in South Korea.

Messages:

- **A Caution when using the Cross-Country Data to test a Closed Economy Model**

- **Need for A Global Perspective on Structural Change**

Some earlier related work:

Role of Agriculture in Industrialization: As many historians believe,

- Agricultural Revolution was a necessary precondition for Industrial Revolution.
- Countries and regions with less productive agricultural sectors (Britain, Belgium, Switzerland, New England) were the first to industrialize.

Matsuyama (1992) showed that these two observations are not contradictory.

Growth Convergence in an Endogenous Growth Model:
Many (very good) economists interpreted that growth convergence in cross-section of countries as the evidence against endogenous growth.

See Acemoglu and Ventura (2002) for a counter-example.