Product Cycle Models Lacked FDI

- In standard product cycles models, for production to be shifted to the South, Southern firms must expend effort to imitate production technologies.
- Why don’t Northern firm shift their production to the South instead?
  - Build a plant in the South to reap cost savings.
FDI Important

- Greater and greater shares of world output are being produced and traded by multinational firms.
- Need some product cycle models with foreign direct investment (FDI) to understand the role of multinational in innovation, international technology transfer, and imitation.
- Possible that results found in standard product cycle models might be differ if FDI occurs.

FDI in Product Cycle (Helpman 1993)

- First effort to add FDI to a product cycle model less than satisfying.
- Purpose of model was to examine effects of IPRs on Southern welfare.
  - Stronger Southern IPR protection captured as an exogenous reduction in imitation intensity.
- Two models: one with endogenous innovation but no FDI, and the other with FDI but innovation exogenous.
FDI with Endogenous Innovation

- Lai saw need for a model with FDI and endogenous innovation to properly assess effects of IPRs.
- What Helpman should have done was add FDI keeping innovation endogenous, but likely that welfare analysis (including transitional dynamics) would have been too complex.
- If willing to stick to steady-state analysis, FDI with endogenous innovation can be done, as Lai shows.

IPRs Matter

- Helpman found that reducing the imitation intensity:
  - Reduced rate of innovation in the base case without FDI,
  - Reduced FDI in the version with exogenous FDI.
- Remained unknown what reducing imitation intensity would do to FDI and innovation in a model with FDI and endogenous innovation.
  - Lai finds FDI and innovation both fall.
FDI Matters

- Comparing the case with FDI to that without, having FDI occur leads to a reversal of the effect of reducing the imitation intensity on innovation.
  - Without FDI, less imitation leads to less innovation.
  - With FDI (and no imitation prior to becoming a multinational), less imitation leads to more innovation.
  - When FDI and imitation coexist as channels of international technology transfer, all depends on which channel is predominate.

IPRs Encourage FDI

- That stronger IPR protection in the South encourages FDI seems to make intuitive sense.
  - Less imitation makes profit stream last longer (in expected value), which encourages innovation.
- Less obvious that there is an effect related to labor constraints.
  - Without FDI, more demand for Northern labor due to longer monopolies pushes up the Northern wage and makes innovation more expensive.
  - But with FDI, demand for labor rises in the South rather than the North, so this effect discouraging innovation is avoided.
Modifications Needed to Add FDI

- Helpman’s base model was just Grossman and Helpman’s product cycle model but with exogenous imitation (no imitation valuation condition).
- Helpman’s model with FDI had already tackled how to put FDI into product cycle model.
- Lai’s model is a mixture of Helpman’s two models, which is Grossman and Helpman’s product cycle model plus FDI minus endogenous imitation.

Lai’s Model

- Consumer side is same as GH, as it is in most variety-based product cycle models.
- In terms of market structures, need to add one more: multinational production.
  - Measures of products produced by Southern imitators, Northern firms producing in the North, and multinational firms producing in the South must sum to one.
Profit Maximization by MNCs

- Lai normalizes the unit labor requirement in production to one $a_x = 1$.
- Multinationals, like Northern firms, price at a fixed markup over marginal cost.
- Multinationals enjoy lower costs producing in the South due to lower wage there, so they change lower prices than Northern firms. ($p_F$ is $p_m$ in article).

$$p_F = \frac{w_S}{\alpha} < \frac{w_N}{\alpha} = p_N$$

Exogenous Imitation

- Innovation modeled the same as in GH but imitation is exogenous here.
- $M$ ($i\delta$ in the article) is the exogenous hazard rate, the probability that a multinationalized product will be imitated in the next instant.
- There is no imitation targeting products produced in the North in the base model.
- Imitation is costless.
Profit Maximization by Southern firms

- Once a product has been imitated, the Southern firm prices at marginal cost $p_S = w_S$.
  - Bertrand competition against the multinational producing that variety.
  - MNCs have same cost as Southern firms.
- Adding FDI gets rid of large gap versus small gap.
  - Like always small gap as price at rival’s marginal cost.
  - Here wage gap across countries irrelevant since rival producing in same country.

IPRs and Imitation

- As in Helpman, a strengthening of Southern IPR protection is captured as an exogenous reduction in the imitation hazard rate.
  - Can be thought of as better enforcement of patent laws.
  - If all imitation illegal (patent not expired), better enforcement means more copiers are caught so fewer successfully compete in the marketplace.
MNCs More Profitable

- The pricing expressions for MNCs and Northern producers and the standard demand function lead to:

\[
\frac{\pi_F}{\pi_N} = \left( \frac{W_S}{W_N} \right)^{1-\varepsilon}
\]

- Profits for MNC exceed those for Northern producer due to lower wage in the South.
  - Wage is per efficiency unit of labor since unit labor requirement in production normalized to one.

Profit Streams

- Expected present discounted value (PDV) of profits for a MNC ($\Pi_m$ in article):

\[
V_F = \frac{\pi_F}{r + M}
\]

- Expected PDV of profits for a Northern firm ($\Pi_N$ in article):

\[
V_N = \frac{\pi_N}{r}
\]
Valuation Conditions

- Valuation (free entry) condition for innovation: cost of innovation must equal reward.
  \[ \frac{a_N w_N}{n} = V_N = \frac{\pi_N}{r} \]

- Valuation condition for multinationalization: Northern firms indifferent to becoming MNC.
  \[ V_N = V_F = \frac{\pi_F}{r + M} \]

MNCs and Imitation Risk

- Putting the two conditions together, MNC profits must exceed profits as a Northern firm to offset imitation hazard.
  \[ \frac{\pi_N}{r} = \frac{\pi_F}{r + M} \Rightarrow \frac{\pi_N}{\pi_F} = \frac{r}{r + M} < 1 \]

- Putting together with relative wage version:
  \[ \left( \frac{w_S}{w_N} \right)^{1-\epsilon} = \frac{\pi_N}{\pi_F} = \frac{r}{r + M} \]
Profit Expressions

- Recall
  - Unit labor requirement in production normalized to one.
  - Price is constant markup over marginal cost.

- Profit of Northern firm
  \[ \pi_N = (p_N - w_N)x_N = \left( \frac{1 - \alpha}{\alpha} \right)w_N x_N \]

- Profit of MNC
  \[ \pi_F = (p_F - w_S)x_F = \left( \frac{1 - \alpha}{\alpha} \right)w_S x_F \]

Labor Constraints

- Northern labor constraint: demand for innovation and Northern production cannot exceed Northern labor supply.
  \[ a_N \dot{n} / n + n_N x_N = L_N \]

- Southern labor constraint: demand for production by MNCs and Southern firms cannot exceed Southern labor supply.
  \[ n_F x_F + n_S x_S = L_S \]
System of Equations

- Main equations are valuation conditions for innovation and multinationalization, and Northern and Southern labor constraints.
- Find expressions for market measures based on endogenous arrival rate of innovations \( g \) and hazard rate of multinationalization \( \omega \), and exogenous imitation.
- Boil down to two equations in \( g \) and \( \omega \).

Relative Wages

- Effects on relative wages across countries indicate consequences for income distribution.
- Using \( r = \rho + \phi g \) and the expression for profits of MNC relative to Northern firm gives an expression for the Southern wage relative to the Northern wage:

\[
\frac{w_S}{w_N} = \left( \frac{\pi_N}{\pi_F} \right)^{\frac{1}{\tau-1}} = \left( \frac{\rho + \phi g}{\rho + \phi g + M} \right)^{\frac{1}{\tau-1}}
\]

- Decrease in \( M \) leads to increase in \( g \), which both increase the Southern relative wage.
Main results

- If multinationalization is the channel of international production transfer, stronger IPRs in the South lead to:
  - higher rate of innovation,
  - higher rate of production transfer from the North to the South, and
  - higher wage of South relative to North.

- Opposite happens if imitation is the channel.

Effects of Southern IPR Protection

<table>
<thead>
<tr>
<th></th>
<th>Channel of Production Transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Multinationalization</td>
</tr>
<tr>
<td>Rate of innovation</td>
<td>+</td>
</tr>
<tr>
<td>Rate of production transfer</td>
<td>+</td>
</tr>
<tr>
<td>Relative wage of South</td>
<td>+</td>
</tr>
</tbody>
</table>