Introduction I

- In the models thus far each country is treated as an "island"; its technology is either exogenous or endogenously generated within its boundaries.
- A framework in which *frontier* technologies are produced in advanced economies and then copied or adopted by "follower" countries provides a better approximation.
- Thus, should not only focus on differential rates of endogenous technology generation but on *technology adoption* and *efficient technology use*.
- Exogenous growth models have this feature, but technology is exogenous. Decisions in these models only concern investment in physical capital. In reality, technological advances at the world level are not "manna from heaven".

Introduction II

- Technology adoption involves many challenging features:
  1. Even within a single country, we observe considerable differences in the technologies used by different firms.
  2. It is difficult to explain how in the globalized world some countries may fail to import and use technologies.

Review: Productivity and Technology Differences within Narrow Sectors I

- Longitudinal micro-data studies (often for manufacturing): even within a narrow sector there are significant and persistent productivity differences across plants.
- Little consensus on the causes.
  - Correlation between plant productivity and plant or firm size, various measures of technology (in particular IT technology), capital intensity, the skill level of the workforce.
  - But these correlations cannot be taken to be causal.
- But technology differences appear to be an important factor.
- A key determinant seems to be the skill level of the workforce, though adoption of new technology does not typically lead to a significant change in employment structure.

Review: Productivity and Technology Differences within Narrow Sectors II

- Productivity differences appear to be related to the entry of new and more productive plants and the exit of less productive plants (recall Schumpeterian models).
- But entry and exit account for only about 25% of average TFP growth, with the remaining accounted for by continuing plants.
- Thus models in which firms continually invest in technology and productivity are important for understanding differences across firms and plants and also across countries.

Technology Diffusion I

- Despite technology and productivity differences among firms in similar circumstances, cross-sectional distributions of productivity and technology are not stationary.
- New and more productive technologies diffuse over time.
- Griliches's (1957) study of the adoption of hybrid corn in the US (findings confirmed by others):
  - Slow diffusion affected by local economic conditions.
  - Likelihood of adoption related to the contribution of the hybrid corn in a particular area, the market size and the skill level.
  - S-shape of diffusion.

Technology Diffusion II

- Important lessons:
  - Differences are not only present across countries, but also within countries.
  - Even within countries better technologies do not immediately get adopted by all firms.
- But note causes of within-country and cross-country productivity and technology differences might be different:
  - e.g., within-countries might be due to differences in managerial ability or to the success of the match between the manager and the technology.

Technology Diffusion: Exogenous World Growth Rate I

- Endogenous technological change model with expanding machine variety and lab equipment specification.
- Aggregate production function of economy $j = 1, ..., J$ at time t:

$$Y_j(t) = \frac{1}{1-\beta}\left[\int_0^{N_j(t)} x_j(v,t)^{1-\beta} dv\right] L_j{}^{\beta}, \tag{1}$$

- L_j is constant over time, x's depreciate fully after use.
- Each variety in economy j is owned by a technology monopolist; sells machines embodying this technology at the profit maximizing (rental) price $\chi_j(v,t)$.
- Monopolist can produce each unit of the machine at a cost of $\psi \equiv 1-\beta$ units on the final good.

Technology Diffusion: Exogenous World Growth Rate II

- No international trade, so firms in country j can only use technologies supplied by technology monopolists in their country.
- Each country admits a representative household with the same preferences as before except $n_j = 0$ for all j.
- Resource constraint for each country:

$$C_j(t) + X_j(t) + \zeta_j Z_j(t) \leq Y_j(t), \tag{2}$$

- ζ_j: potential source of differences in the cost of technology adoption across countries (institutional barriers as in Parente and Prescott, subsidies to R&D and to technology, or other tax policies).

Technology Diffusion: Exogenous World Growth Rate III

- *Innovation possibilities frontier*:

$$\dot{N}_j(t) = \eta_j \left(\frac{N(t)}{N_j(t)} \right)^{\phi} Z_j(t), \tag{3}$$

  where $\eta_j > 0$ for all j, and $\phi > 0$ and is common to all economies.

- World technology frontier of varieties expands at an exogenous rate $g > 0$, i.e.,

$$\dot{N}(t) = gN(t). \tag{4}$$

- Flow profits of a technology monopolist at time t in economy j:

$$\pi_j(t) = \beta L_j.$$

Steady State Equilibrium I

- Suppose a steady-state (balanced growth path) equilibrium exists in which $r_j(t)$ is constant at $r_j^* > 0$. Then the net present discounted value of a new machine is:

$$V_j^* = \frac{\beta L_j}{r_j^*}.$$

- If the steady state involves the same rate of growth in each country, then $N_j(t)$ will also grow at the rate g, so that $N_j(t)/N(t)$ will remain constant, say at ν_j^*.