Macroeconomics

Creative Destruction and Growth Policies

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The opening up of new markets, foreign or domestic, and the organizational development from the craft shop to such concerns as U.S. Steel illustrate the same process of industrial mutation — if I may use that biological term — that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one. This process of **Creative Destruction** *is the essential fact about capitalism. (Joseph Schumpeter Capitalism, Socialism, and Democracy, 1942, pp 82)*


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Schumpeterian Growth Model - Aghion and Howitt 1992

Technical Change and Creative Destruction

- Technological Innovation increases the quality of intermediate products used in consumption good production.
- It increases overall productivity but at the same time makes old intermediate products obsolete.
  - creative destruction (Schumpeter): Technical progress creates loss (destruction of rents) as well as gain;
  - critical role of forward looking expectations. The amount of research carried out today depends on the expected stream of future rents generated by the innovation. More new products are expected tomorrow, less research will be conducted today

$$\begin{aligned} (R\&D)_t &= F\,(R\&D)_{t+1} \\ F' &< 0 \end{aligned}$$

The Model

Inputs

1. unskilled labour (L)
2. Skilled Labour (H)
3. Knowledge (A)
4. Intermediate input of different quality, where $x(i+1) > x(i)$, i.e. the last intermediate good is better that the previous one (and the previous one goes out of the market)

The Model

Three sectors

1. Research sector - Uses H to produce design for better intermediate goods. Design patented and sold to firm in the intermediate good sector.
2. Intermediate Good Sector. A Firm buys design (i) to produce the corresponding input $x(i)$ using linear technology and H. Once a new firm introduce a new technology $x(i+1)$, the old firm goes out of business (Drastic Innovation.Assumption).
3. The Final Good Sector used unskilled labour and the most productive input $x(i)$ to produce the unique consumption good.

The model

Technology

- Final Good Sector $(L = 1)$

$$Y(i)_t = A(i)\, x(i)_t^{\alpha} L^{\beta} = A(i)\, x(i)_t^{\alpha} \tag{1}$$

where the index (i) indexes inventions by their order of introduction

- Intermediate Good Sector

$$x(i)_t = H_{1t} \tag{2}$$

and the additional requirement that the firm producing $x(i)$ must have bought the design (i) before starting manufacturing the product

The Model

Research Sector

- Innovation arrives randomly - i.e. when resources are invested into R&D there will be a positive probability of success and a positive probability of failure.

$$A_t = \begin{cases} \gamma A_t & \text{with probability } z \\ A_{t-1} & \text{with probability } (1-z) \end{cases}$$

- The probability of success increases with the number of skilled workers involved in research.
- A firm employing H_2 workers in R&D at time t will discover a new design with probability $z = \lambda H_2 dt$ and will discover nothing with probability $(1-z) = (1-\lambda H_2)\, dt$. New discoveries randomly occur with a Poisson arrival rate λH_2

The Model

Research Sector

The implication of this assumption is that the length of the interval between successive innovations is a function of the amount of skilled workers employed in research and development.
All innovations have a constant size, and the law of motion of productivity is

$$A(i) = \gamma A(i-1)$$

or, equivalently

$$A(i) = \gamma^i A(0)$$

where $\gamma > 0$

Solution of the model

Final Good Sector

FGS competitive. firms maximise profits

$$\pi_F(i) = A(i)\, x(i)_t^{\alpha} - p(i)\, x(i) - w_L(i) \tag{3}$$

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$$p(i) = \alpha A(i)\, x(i)_t^{\alpha-1} \tag{4}$$

Solution of the model

Intermediate Good Sector

- The IGS is a monopoly.
- Given the demand constraint above (and the production function $x(i)_t = H_{1t}$), the monopolist chooses production as to maximise:

$$\pi_I(i) = p(i)\,x(i) - w_H(i)\,H_1(i) = \alpha A(i)\,x(i)_t^{\alpha} - w_H(i)\,x(i) \tag{5}$$

First order conditions

$$x(i) = \left(\frac{w_H(i)}{\alpha^2 A(i)}\right)^{\frac{1}{\alpha-1}} \tag{6}$$

Solution of the model

Intermediate Good Sector

Which in turn by substituting (4) in (6) gives the monopoly price solution

$$p(i) = \frac{w_H(i)}{\alpha} \tag{7}$$

and the monopoly profits

$$\pi_I(i) = \left(\frac{1-\alpha}{\alpha}\right) w_H(i)\, x(i) \tag{8}$$

Solution of the model

Research Sector

Firm to choose H_2 to max "expected profits"

$$\pi_I^e = \lambda H_2 V(i+1) - w_H(i) H_2(i)$$

where

- $V(i+1)$ is the value of the $i+1$ innovation, which is the present discounted value of the flow of monopoly profit.
- λH_2 is the probability of discovering a new design employing H_2 researchers.
- Value of the innovation $V(i+1)$

$$V(i+1) = \frac{\pi(i+1)_I}{r + \lambda H_2(i+1)} \tag{9}$$

Growth

- The rate of economic growth is the proportional growth rate of the final good which is also the proportional growth rate of the productivity parameter A_t:

$$g = \frac{A_t - A_{t-1}}{A_{t-1}}$$

- Growth is Random

$$g = \begin{cases} \frac{\gamma A_{t-1} - A_{t-1}}{A_{t-1}} = (\gamma - 1) .. \text{with probability } z \\ g = \frac{A_{t-1} - A_{t-1}}{A_{t-1}} = 0 ... \text{with probability } (1 - z) \end{cases} = z \cdot (\gamma - 1)$$

In the long run, the economy growth rate equals the frequency of innovations times the size of innovations.

Comparative Static

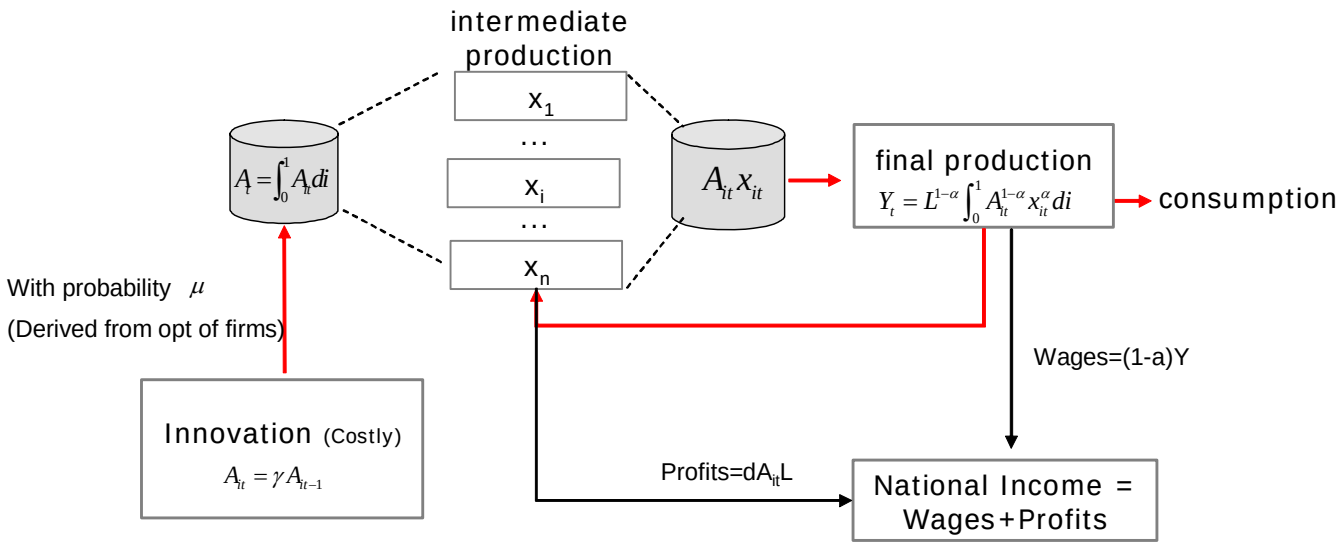
- Growth increases with the productivity of innovations. This result points to the importance of education, and particularly higher education, as a growth- enhancing device.
- Growth increases with the size of innovations,γ. Advantage of Backwardness Gerschenkron (1962): the further it lags behind the frontier, the bigger the productivity improvement it will get if it can implement the frontier technology when it innovates, and hence the faster it can grow.
- An increase in the size of population should also bring about an increase in growth by raising the supply of labour. This effect disappear with small modification of the model (result is not robust)

Growth Policies in Schumpeterian Growth Model

1. Competition Policies
2. Education Policies
3. Trade Policies
4. Finance Development

Trade Policies

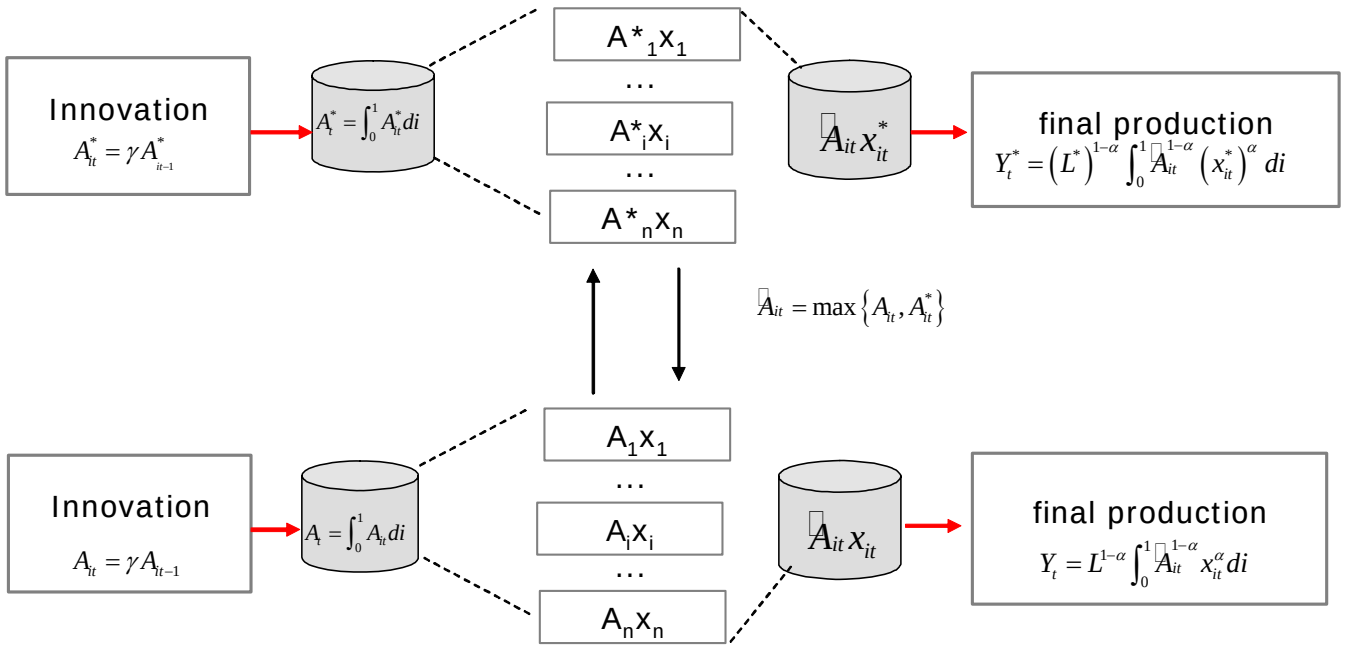
Close Economy



Growth rate = $g = \mu(\gamma - 1)$

Trade Policies

Open Economy



Implications

- Trade liberalization "always" increases aggregate productivity (and wages)
- Innovation in sectors in which firms are closer to the technological frontier react positively to an increase in product market competition due to trade liberalization
- Innovation will react less positively, or negatively, to trade liberalization in sectors in which firms are further away from the technological frontier.
- Only sectors closer to the technological frontier will benefit from the scale effect of a trade liberalization
- Overall growth will converge towards world growth, with significant distributional shifts

General Principles

Spence Report

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