

The Krugman model of international trade with process innovation

Model assumptions

- Countries and goods can be ranked according to their technological level
- An “advanced” country has technological advantages in the production of high-tech goods
- A “TECHNOLOGIC FRONTIER” defines the “state of the art” of technology
- Industries are characterized by different speed of introduction of technological progress
- Industries ranking is stable and is measured on the basis of their time distance from the frontier
- Labour is the only factor of production

Two countries model (1 e 2)

the labour requirement in production of good z
in country paese i is:

$$a_i(z) \quad i = 1, 2$$

$a^*(z)$ is the “best” (lower) labour
requirement in production of good z (it defines
the “best technology”)

labour input (hours) required by the “best technology” continuously decreases through time

$$a^*(z) = \exp[-g_z t] = e^{-g_z t}$$

g_z is the growth rate of technological progress in industry Z

Each country has a time lag with respect to the frontier:

$$a_1(z) = \exp[-g_z (t - \tau_1)]$$

If country 2 has a technological lag with respect to country 1, then: $\tau_2 > \tau_1$

Country 1 is more efficient in every industry

Productivity advantage is equal to:

$$\frac{a_2(z)}{a_1(z)} = \frac{\exp[-g_z(t - \tau_2)]}{\exp[-g_z(t - \tau_1)]} = \exp[-g_z(t - \tau_2) + g_z(t - \tau_1)]$$

$$\frac{a_2(z)}{a_1(z)} = \exp[g_z(\tau_2 - \tau_1)]$$

Productivity advantage is increasing in g_z

Consumers' demand is identical in the two countries
In a continuum of goods ranked in decreasing order of technological efficiency, country 1 productivity advantage is given by

$$A(z) = \frac{a_2(z)}{a_1(z)} \quad A'_z > 0$$

\bar{z} is the good whose production cost is the same in the countries 1 and 2

$$w_1 a_1(\bar{z}) = w_2 a_2(\bar{z})$$

$$\frac{w_1}{w_2} = \frac{a_2(\bar{z})}{a_1(\bar{z})} = A(\bar{z})$$

Goods $z < \bar{z}$ are produced (are cheaper) in 2

Goods $z > \bar{z}$ are produced (are cheaper) in 1

The income share S spent in purchases of goods of country 2 grows with the range of good that are produced in that country:

$$S = S(\bar{z}) \quad S' > 0$$

S is the income share of countries 1 and 2 spent buying goods of country 2 (it is equal)

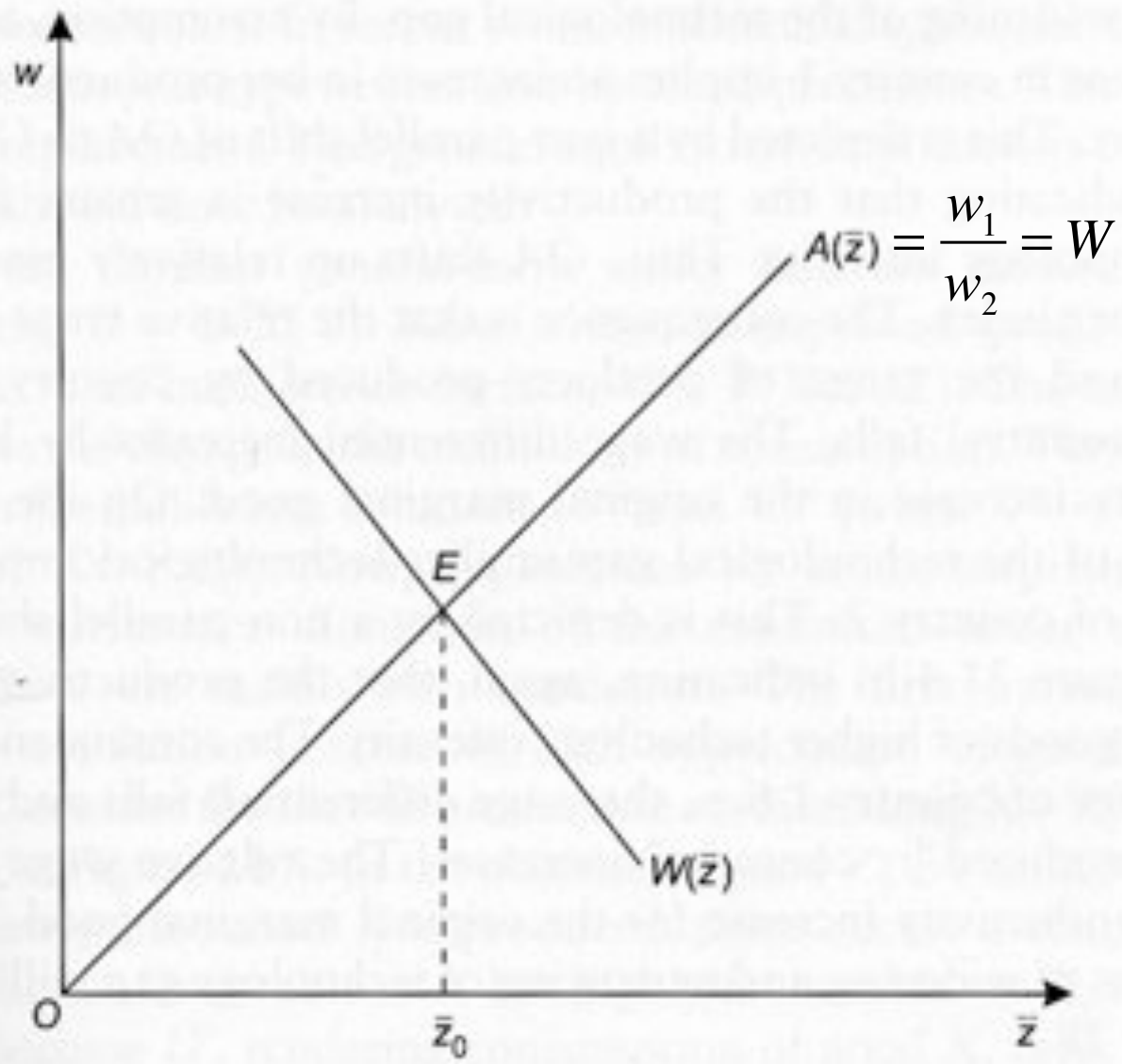
In equilibrium, the output value of country 2 is equal to world demand:

$$w_1 L_1 S(\bar{z}) + w_2 L_2 S(\bar{z}) = w_2 L_2$$

$$w_1 L_1 S(\bar{z}) = w_2 L_2 [1 - S(\bar{z})]$$

If $W = w_1/w_2$ is relative wage, then

$$W = \frac{L_2}{L_1} \frac{1 - S(\bar{z})}{S(\bar{z})} \quad \frac{dW}{d\bar{z}} = \frac{L_2}{L_1} \cdot \frac{-S'(\bar{z})}{[S(\bar{z})]^2} < 0$$

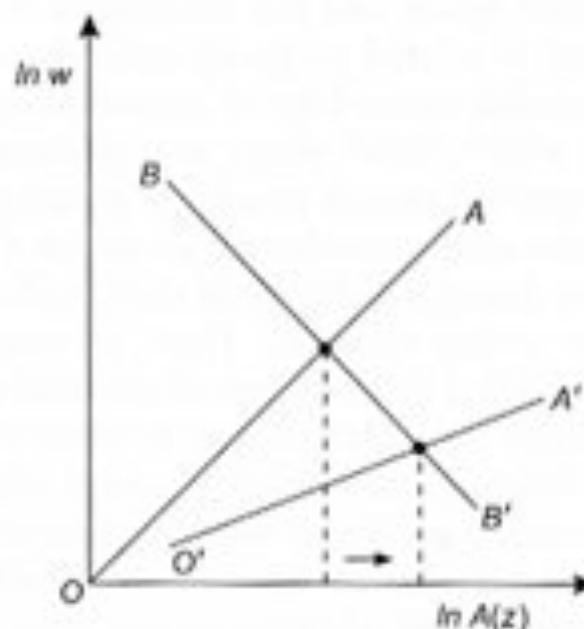
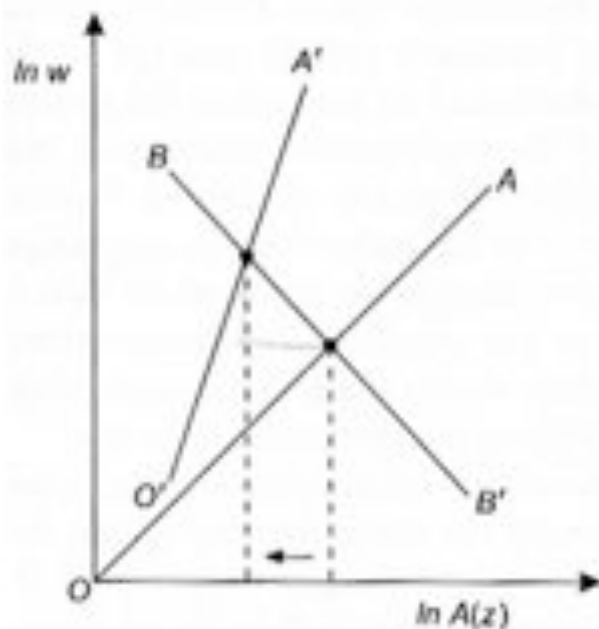


Effects of “technological gap” changes

We use a logarithmic version of the model:

“Gap” increases

“Gap” decreases



- When country I increases its technological advantage, the range of goods produced in country I enlarges
 - Relative wages increases too but *less* than the productivity gap
- If “gap” reduces (catching-up), then we have opposite conclusions.