9 . Openness and Growth.

References: Weil: Chapter 11
Krugman, P., 1979, A Model of Innovation, Technology Transfer, and the World Distribution of Income, *Journal of Political Economy* 87, 253-266.

Measuring openness

- (Exports+Imports)/GDP
- Law of one price (very similar countries can be perfectly open without much trade).

Globalization $\rightarrow$ the degree of openness increases over time (world-wide).

- If openness causes growth then globalization should increase growth.
- Pros and cons of globalization $\rightarrow$ course IPE.

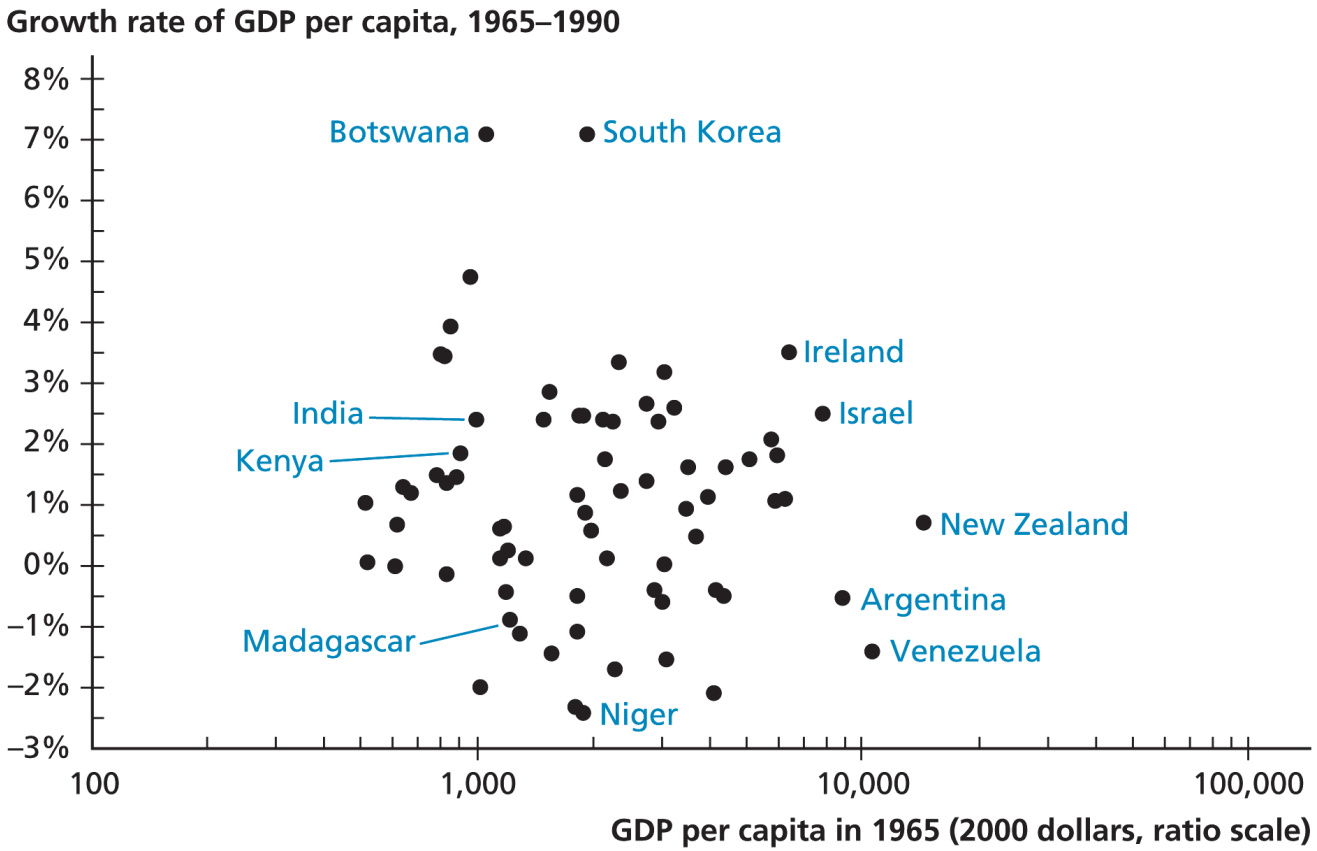
Why globalization?

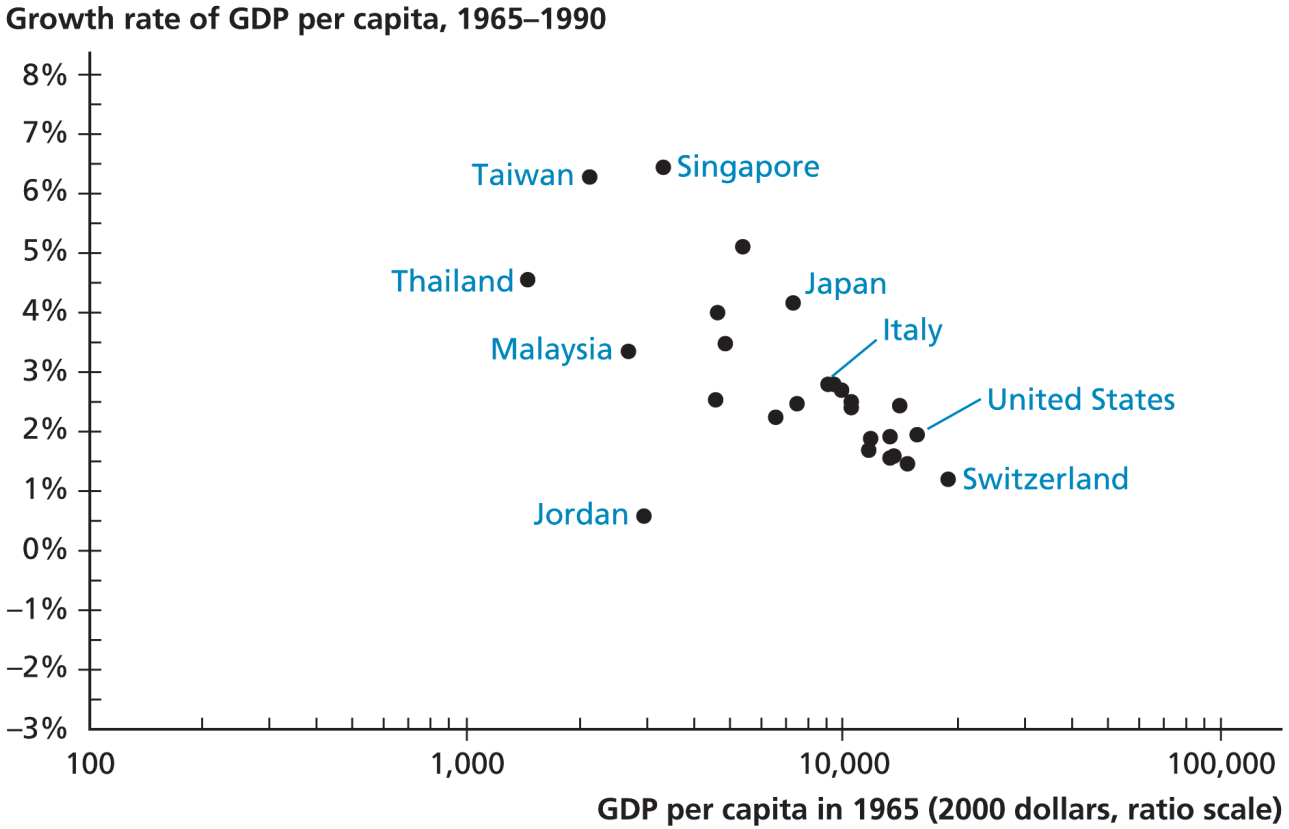
- less transportation costs (tech. progress)
- less information costs (tech. progress)
- less barriers to trade (policy, GATT and WTO)

Note: in one aspect the world was more globalized 150 years ago: labor mobility.

Divide the world's countries in subsets of less and more open countries. Observe:

- more open countries are richer on average
- they have grown faster (on average 3.4 vs. 1.1 % p.a.)
- more open countries converge (vs. no correlation between GDP_0 and growth for less open countries.





Also: opening countries to trade frequently goes hand in hand with growth take offs:

- Japan in 1858
- South Korea and the East Asean Tigers in the 60's
- Recently: China, India

Yet, does openness *cause* growth?...

Econometrically, we can assess causality through IV estimates

- find something (instruments) that cause trade
- but does not correlate with growth directly when trade is accounted for.

For trade we have very natural candidates for instruments: geographic parameters:

- distance between countries (Belgium vs. New Zealand)
- km coastline (or landlockedness)
- size of the country (why that?)

Frankel and Romer (1999) construct and instrument using bilateral trade data for 150 countries.

Their basic results:

- trade causes growth (more openness causes higher income)
- point estimates: raising the trade/GDP ratio by 1% increases income between 0.5 and 2 %.
- The coefficients are only moderately significant.

Why the weak significance of results? One possibility: geography matters through others channels for growth:

- Acemoglu et al. (2000): settler mortality 200 years ago $\rightarrow$ early institution $\rightarrow$ today protection of property rights.
- Strulik (2006): child mortality $\rightarrow$ fertility $\rightarrow$ food demand $\rightarrow$ structural change
- ...?

More on geography in Part III.

3 major channels through which trade may cause growth.

1. Factor mobility.
   - This should lead to convergence across countries in a neoclassical world.
   - Recall the lecture on Lucas (1990) and the Feldstein-Horioka Puzzle.
2. Trade as a form of technology
   - Countries can specialize on products they are good (efficient) at producing.
   - Weil's "Consolidated Alchemy" parable.
   - The gains-from-trade literature
   - Recall: Ricardian trade theory vs. Heckscher-Ohlin trade theory.

We can state the last argument differently:

2.' Barriers to trade as a cause of inefficiency.

- Recall from trade theory: free(-er) trade benefits society as whole in so much as winners could compensate losers.
- There are always losers, e.g. recall the Stolper-Samuelson theorem:

  Trade leads to an increase in the return to a country's abundant factor and a fall in the return to its scarce factor.

- In case of Germany, e.g., relatively abundant are skilled people, relatively scarce are un-skilled people.
- Sectors using only few skilled people (yet producing tradables) like e.g. mining and agriculture suffer from trade and have a *special interest* to block free trade.

Much more on that in the IPE course.

3. Openness and technological progress

- technological progress is capital-embodied.
- FDI
- Adaptation and copying of new technologies. Recall our 2-country toy model on R&D and growth.

From Frankel and Romer's (1999) study: a 1 % increase of the trade ratio leads to

- an 0.5 % increase of capital's...
- an 0.5.% increase of human capital's...
- 2 % increase of productivity's...

contribution to growth.

Finally, let's have a look at Paul Krugman's model.
Side-effect: a 3rd possibility to introduce endogenous technological progress:

- horizontal innovation (Romer's model, variety of intermediate products)
- vertical innovation (Aghion and Howitt's model, quality competition)
- Now: innovation of *consumption goods*.

Basic idea: if income rises and relative prices keep constant, consumers

- don't want to consume more of the same goods (another TV set)
- but strive for new goods (a DVD recorder)

$\rightarrow$ they love variety. Dixit-Stiglitz utility function.

Utility function

$$U = \left(\sum_{i=1}^{n} c_i^{\frac{\epsilon-1}{\epsilon}} \right)^{\frac{\epsilon}{\epsilon-1}} \tag{1}$$

$\epsilon > 1$: elasticity of substitution. At the moment there are n consumables available.

Max. (1) with respect to the budget constraint $Y = \sum_{i=1}^{n} p_i c_i$.

FOC's:

$$\frac{\epsilon}{\epsilon-1} \left(\sum_{i=1}^{n} c_i^{\frac{\epsilon-1}{\epsilon}} \right)^{\frac{\epsilon}{\epsilon-1}-1} \cdot \frac{\epsilon-1}{\epsilon} c_i^{\frac{\epsilon-1}{\epsilon}-1} - \lambda p_i = 0.$$

$$\left(\sum_{i=1}^{n} c_i^{\frac{\epsilon-1}{\epsilon}} \right)^{\frac{\epsilon}{\epsilon-1}-1} \cdot c_i^{-1/\epsilon} = \lambda p_i$$

for all $i = 1, \ldots n$. And thus for any two goods:

$$\left(\frac{c_i}{c_j} \right)^{-1/\epsilon} = \frac{p_i}{p_j} \quad \Rightarrow \quad \frac{c_i}{c_j} = \left(\frac{p_i}{p_j} \right)^{-\epsilon} \tag{2}$$

Verify: ϵ is indeed the elasticity of substitution.

Linear production for each good i:

$$c_i = L_i$$

Conclude from wages w and max of profits, $p_i c_i - wL_i$ that

$$p_i = w \tag{3}$$

for all goods

Given equal prices, households consume equal quantities of each good:

$$c_i = \frac{y}{np}$$

Utility becomes:

$$U = \left[\sum_{i=1}^{n} \left(\frac{y}{np}\right)^{\frac{\epsilon-1}{\epsilon}}\right]^{\frac{\epsilon}{\epsilon-1}} = n^{\frac{\epsilon}{\epsilon-1}} \frac{y}{np} = n^{\frac{1}{\epsilon-1}} \frac{y}{p}$$

Observe: utility is increasing in n.

Suppose there is variety R&D for new consumables. Observe:

- we can have a situation with constant prices and income and n growing.
- i.e. no growth in the conventional sense
- but growth in the sense that utility of people is permanently increasing.

Normally, we would now start to explain endogenous R&D like in Romer (1990). Krugman – who wrote his article in 1979! – takes the above framework to emphasize different things:

- North-South trade
- a continuous global product cycle
- the world income distribution

Learning-by-doing. New products are created through

$$\dot{n} = \iota \cdot n. \tag{4}$$

Central assumption:

- Only leading-edge countries (the North) innovate.
- Why? (They have the skills, the networks, the property rights,...)
- The rest (the South) imitates.

Imitation function:

$$\dot{n}_S = \theta \cdot n_N \tag{5}$$

n_N goods produced exclusively in the North, n_S: goods produced in the South.

Observe:

- exponential decay: without innovation the North would lose exclusive production at a constant rate θ
- This creates a permanent need to innovate.

Actually, we have

$$\dot{n}_N = \iota \cdot n - \theta \cdot n_N$$

Let x denote the share of goods that the North is exclusively producing.

$$x \equiv \frac{n_N}{n} \qquad \Rightarrow \qquad \dot{x} = \frac{\dot{n}_N \cdot n - \dot{n} \cdot n_N}{n^2}.$$

And thus

$$\dot{x} = \frac{\iota \cdot n^2 - \theta \cdot n_N \cdot n}{n^2} - \frac{\dot{n}}{n} \cdot \frac{n_N}{n} = \iota - \theta x - \frac{\dot{n}}{n} \cdot x.$$

Providing

$$\dot{x} = \iota - (\iota + \theta)x$$

Conclude: there exists a stable steady-state at which the North's share is

$$x = \frac{\iota}{\iota + \theta}$$

From

$$x = \frac{\iota}{\iota + \theta}$$

follows for the North-South ratio:

$$\frac{n_N}{n_S} = \frac{n_N/n}{n_S/n} = \frac{x}{1-x} = \frac{\iota}{\iota+\theta} \cdot \frac{\iota+\theta}{\theta} = \frac{\iota}{\theta}.$$

World production and wages:
The South can produce only "old goods". 2 possibilities remain:

1. the North produces new and old goods $\rightarrow$ $w_N = w_S$ (why?)
2. the North specializes on the production of new goods $\rightarrow$ $w_N > w_S$.

From production structure:

- all new goods cost p_N
- all old goods cost p_S.

Thus from (2) and (3):

$$\frac{w_N}{w_S} = \frac{p_N}{p_S} = \left(\frac{c_N}{c_S}\right)^{-1/\epsilon}.$$

Supply: Let L_N denote the North's labor force. From symmetry across sectors:

$$c_N = \frac{L_N}{n_N}$$

And likewise $c_S = L_S/n_S$.

Now, equating supply and demand:

$$\frac{w_N}{w_S} = \left(\frac{L_N}{n_N} \cdot \frac{n_S}{L_S}\right)^{-1/\epsilon} = \left(\frac{L_S}{L_N} \cdot \frac{\iota}{\theta}\right)^{1/\epsilon}.$$

Comparative statics: the income differential between North and South is

- increasing in the South's labor force (why?)
- decreasing in the North's labor force.
- increasing in the rate of innovation ι
- decreasing in the rate of imitation θ

What happens if $\iota \uparrow$ (better R&D in the North)?

1. More varieties available in North and South $\rightarrow$ utility $\uparrow$ for both.
2. The North becomes relatively richer, $w_N/w_S \uparrow$
3. Products of the North become relatively more expensive $p_N/p_S \uparrow$
4. i.e. terms of trade deterioration for the South: a negative effect (of second order).

Now, what happens if $\theta \uparrow$ (better imitation in the South)?

- This doesn't lead to more varieties.
- Effects 2.-4. are just the other way round.

Conclude: the North can actually be worse off $\rightarrow$ international protection of intellectual property rights (TRIPS).

Overall conclusion: another foundation of international trade

- factor endowments (Heckscher-Ohlin)
- specific factors, technology (Ricardo)
- the world product cycle (Krugman).