Ch 9: Growth

Where we are going

- Remember that all models are incomplete.
  - They are good at a few things but not everything.
  - Most tend to be good in one area.
- We have models for:
  - Business cycles
  - Growth

The models don't always play well together. This is about Growth

We Tend to focus on Per Capita GDP

We focus on per capita real GDP when talking about growth.

- We are talking about production, not welfare, so GDP is the right measure.
- We don't want to be fooled by price changes so *real* is appropriate.
- We don't want to be fooled by scale.

Lets Look at some

https://www.indexmundi.com/g/r.aspx?v=67

- There are a lot of tax havens/banking hubs in the top
  - And some playgrounds for the rich and famous.
  - And OIL
- European nations are near the top, except Moldova.
- Much of Africa is near the bottom.

The real key is not where you start

The rate that you grow is key.

- ▶ You can make up for starting low by growing fast.
- ▶ Book gives a "Rule of 70".
    - ▶ You may also hear it as "Rule of 72" or "Rule of 69".
    - ▶ Divide 70 or 72 or 69 by the growth rate and it tells you how long to double.

Example

How long to double \$100 when the growth rate, i.e., the interest rate, is 10%?

$$\frac{70}{10} = 7 \ \textit{years}$$

How long to double \$100 when the growth rate, i.e., the interest rate, is 5%?

$$\frac{70}{5} = 14 \ \textit{years}$$

What I mean by Growth Rate Dominates

Caution exact calculations!

Two accounts:

- One with $100 and an interest rate of 10%.
- One with $1,000 and an interest rate of 3%.

Who gets to $10,000 first?

Well

$$F = P(1 + i)^N$$

You can solve for N

$$\frac{ln(F) - ln(P)}{ln(1 + i)} = N$$

In this case

$100 and an interest rate of 10% grows to 10K in:

$$\frac{ln(10000) - ln(100)}{ln(1 + .1)} = 48.32 \text{ years}$$

$1000 and an interest rate of 3% grows to 10K in:

$$\frac{ln(10000) - ln(1000)}{ln(1 + .03)} = 77.9 \text{ years}$$

Crazy things

- In 1900 Argentina had higher per capita real GDP than most European countries.
- Except for the last few centuries, China and India where most of world GDP.

What happened? Different growth rates.

So, How Do you Grow Per Capital Real GDP?

- ▶ Increase per capita physical capital.
- ▶ Increase per capita human capital
- ▶ Technical progress that makes human and/or physical capital more productive.

Physical Capital

Give people more machines to do their job.

- How to get to school?
    - Walk - 3.2hrs (I timed myself but stopped for a cup of coffee).
    - Drive 10K car - 25 min ~ 0.5 hrs

Human Capital

Education and skills of the population. If you don't believe this, why are you here?

The most important: Technological Progress

- This is:
  - New tools and ideas that didn't exist. Like IDEs for programming.
  - Yes, this is massive increase in physical capital, but a technological improvement on people with the finest cross cut saws in the world.
    https://www.youtube.com/watch?v=m0ZELXwFZkc
- It is even:
  - Printed receipts
  - Phones where you don't have to remember the phone number.

We Can Summarize the Effect of All Three

$GDP\ Per\ Capita = T(Per\ Capita\ Physical)^{.4}(Per\ Capita\ Human)^{.6}$

- ▶ The T is technology
- ▶ The .4 and .6 are approximations estimates based on US data.
  - ▶ Don't take the exact numbers seriously
  - ▶ They are the right scale, physical counts for less than human and technology trumps them all.

What Does that Mean

$$GDP\ Per\ Capita = T(Per\ Capita\ Physical)^{.4}(Per\ Capita\ Human)^{.6}$$

- ▶ Technology helps
- ▶ You can add human and physical capital and get more real GDP per capita but you should balance it out and add both – not just one.
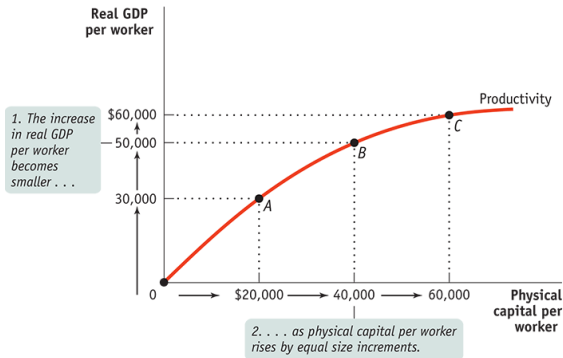
See what I mean

$$\text{GDP Per Capita} = (\text{Per Capita Physical})^{.4}(\text{Per Capita Human})^{.6}$$

- Mostly Physical: $4^{.4} + 1^{.6} = 1.74$
- Mostly Human: $1^{.4} + 4^{.6} = 2.3$
- Balance: $2^{.4} + 3^{.6} = 2.55$

Investments in human and physical capital suffer from declining returns. The more you invest the smaller the benefit of investing more.

Graphical Summary

FIGURE 9-4 Krugman/Wells, *Macroeconomics*, 5e, © 2018 Worth Publishers

Figure 1:

So what does T do?

T is the effect of technology

- The special name is "total factor productivity".
- Cool kids say "TFP"
- We have other kinds of technical change to, e.g.,labor augmenting, but not in this class.
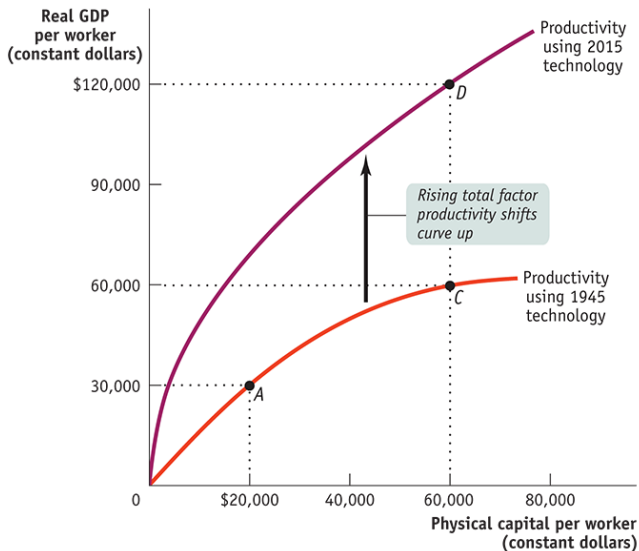- It stretches the curve up.

Graphical Summary

FIGURE 9-5 Krugman/Wells, *Macroeconomics*, 5e, © 2018 Worth Publishers

Figure 2:

What About Natural Resources?

The math says, it is like starting with more.

- ▶ Remember the example of 100 at 10% growth and 1000 at 3%?
- ▶ You need to turn it into growth.
- ▶ Some do and some don't

Natural Resources are often a curse

Often "The Resource Curse" or "Dutch Disease"

- ▶ Because the extraction industry is so big.
- ▶ Most investment is in that industry.
- ▶ The industry pays more and attracts lots of human capital, starving the others.
- ▶ When prices of the resource change, incomes change a lot. The price of any one good as more volatile than many.

Examples:

- ▶ West Virginia and Coal
- ▶ Venezuela and Oil

One of the hazards of over-specialization.

So how do you grow?

Don't spend all your money. Save it and invest:

- Buy lots of physical capital
- Spend lots of education
- Try to increase technological progress.

Who invests in physical capital

We are looking for countries where I, Gross Domestic Private Investment, is a large fraction of GDP.

https://en.wikipedia.org/wiki/List_of_countries_by_gross_fixed_investment_as_percentage_of_GDP

Check the relative rankings of:

- China with 7.13% per capita growth from 2010 - 2016
- World with 1.53%
- EU with 0.71%
- US with 1.33%

BTW, they are in order of percent investment

So What Do Countries Do

The short list:

- ▶ Build infrastructure
- ▶ Subsidize education
- ▶ Subsidize R&D
- ▶ Well functioning financial system
- ▶ Enforce property rights
- ▶ Be good at governing and be stable.

Build infrastructure

What is infrastructure?

- Roads
- Electric and Natural Gas pipeline networks
- Telecommunications
- Water distribution and storage

US Examples

- Federal Aid Highway Act of 1956 – Authorized our interstate highway system
  - Officially completed in 1992.
  - Without this, no long-distance trucking.
- Rural Electrification Act of 1936
  - Zero interest loans for the poles
  - Free install of a few circuits and lights.

Typical Problem with Infrastructure

- Building it is sexy. Maintaining it isn't.
- The US has a $1T backlog

Subsidize Education

- This could be as simple as basic literacy.
- It could also mean more people completing secondary education (HS) or post-secondary education.
- Not all subsidies go where they are intended
  - Some evidence that subsides to you, low interest loans, provides more rewards to others.
  - https://github.com/woodsjam/AAUP-Numbers/blob/master/TuitionSalary.pdf

Subsidize R&D

- This is mostly private not public funded.
- Public funding tends to be towards basic research, not applied.
- There is a problem with the last touch, applied research, getting the financial benefits.
    - Analogous to the goal scorer getting credit winning the game.

Well Functioning Financial System

- This is institutionalizing a trust.
  - Trust that deposits can be withdrawn.
  - Trust that loans are based on merit.
  - Trust that transactions will be completed.

Enforce property rights

- This is a complex topic
- Often this is about intellectual property rights, copyright and patents.
- Could also be about not having your property seized without compensation.
- Not selling off public assets to well placed friends.

Be good at governing and be stable.

- ▶ Often this is about corruption
  - ▶ https://www.transparency.org/news/feature/corruption_perceptions_index_2017#table
  - ▶ Keep in mind that this can be very regional in large countries
- ▶ Or about low bureaucratic overhead
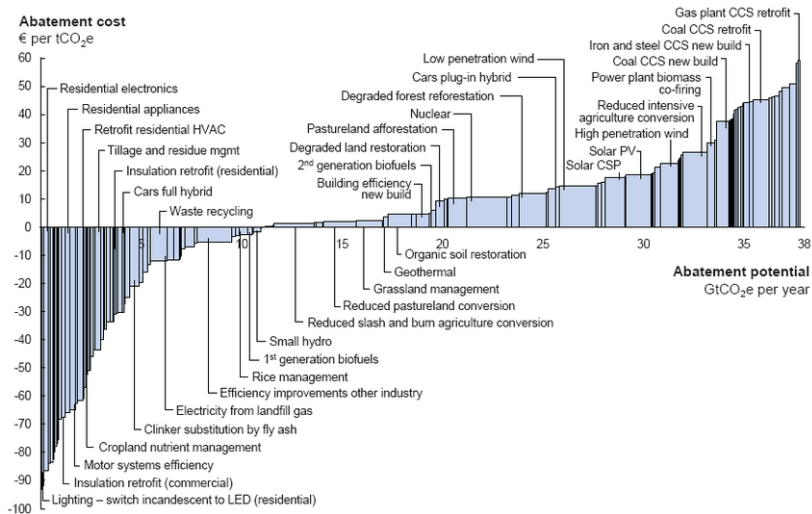
Can We Do This Sustainably (Just Energy)

Figure 3:

Summary

- We do plenty of things now that are cost more than the more sustainable path
    - Other things, perception, perceived risk, get in the way.
    - Cheaper than doing nothing.
- The key is that doing things sustainably produces new winners and losers.