

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%?

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

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

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

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

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

- ▶ 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.

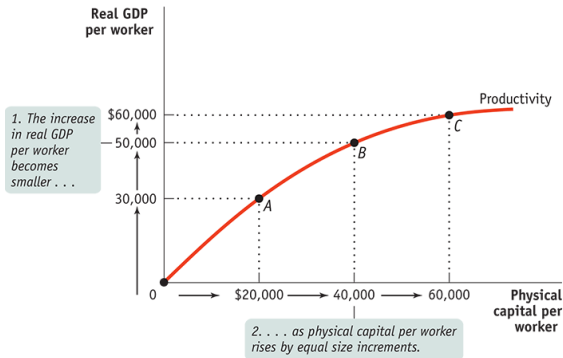
See what I mean

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

- ▶ 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



Physical capital per worker	Real GDP per worker
\$ 0	\$ 0
20,000	30,000
40,000	50,000
60,000	60,000

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

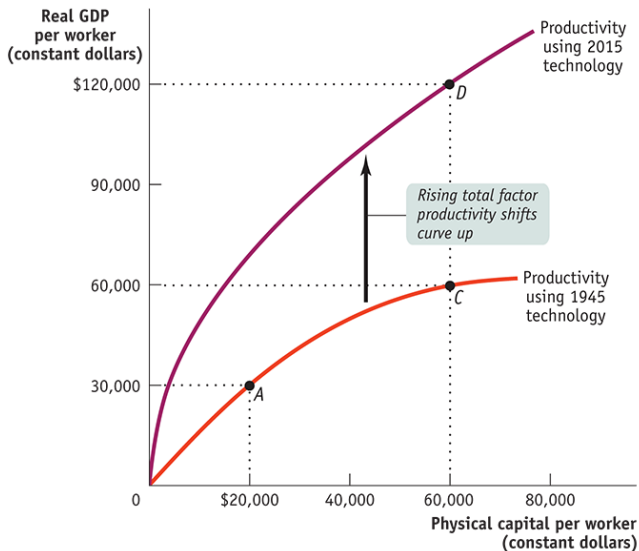


FIGURE 9-5 Krugman/Wells, *Macroeconomics*, 5e, © 2018 Worth Publishers

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

Subsidize education

Subsidize R&D

Well functioning financial system

Enforce property rights

Be good at governing and be stable.

A Few Areas To Check in On

- ▶ East Asia
- ▶ Latin America
- ▶ Africa

East Asia

Latin America

Africa

Productivity in US has gone up but

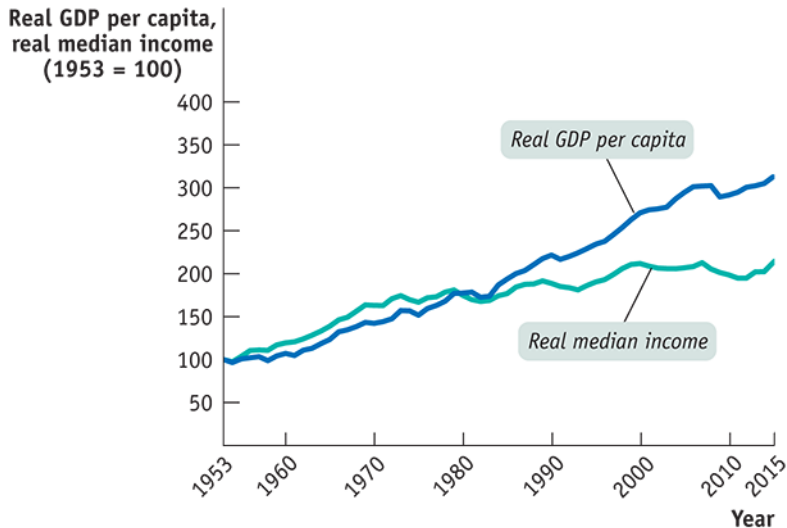


FIGURE 9-10 Krugman/Wells, *Macroeconomics*, 5e, © 2018 Worth Publishers
Data from: U.S. Census; FRED.

Convergence or Conditional Convergence

Can We Do This Sustainably

Yea, its cheaper than the other way, but different groups benefit.