Australian National University

Macroeconomics 1 (ECON1102)

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Week 4 -- “Economic Growth”

Economic Growth

- Economists are particularly interested in economic growth.
- What does this term mean?
- In a crude sense it means growth in total (national) economic output.
  - GDP is a key measure in this regard.
  - Per capita GDP is a very rough measure of how much of this output there is per person. Though crude, per capita GDP growth at least scales output to population growth.

- **How do we calculate growth?**
- We can use the simple arithmetic of proportionate change, i.e. the change in a value between two periods divided by the value of the variable in the initial period for two periods close together.
- This can be generally expressed as per below, the change in y between period *t* and and *t* + 1:

$$\frac{y_{t+1} - y_t}{y_t}$$

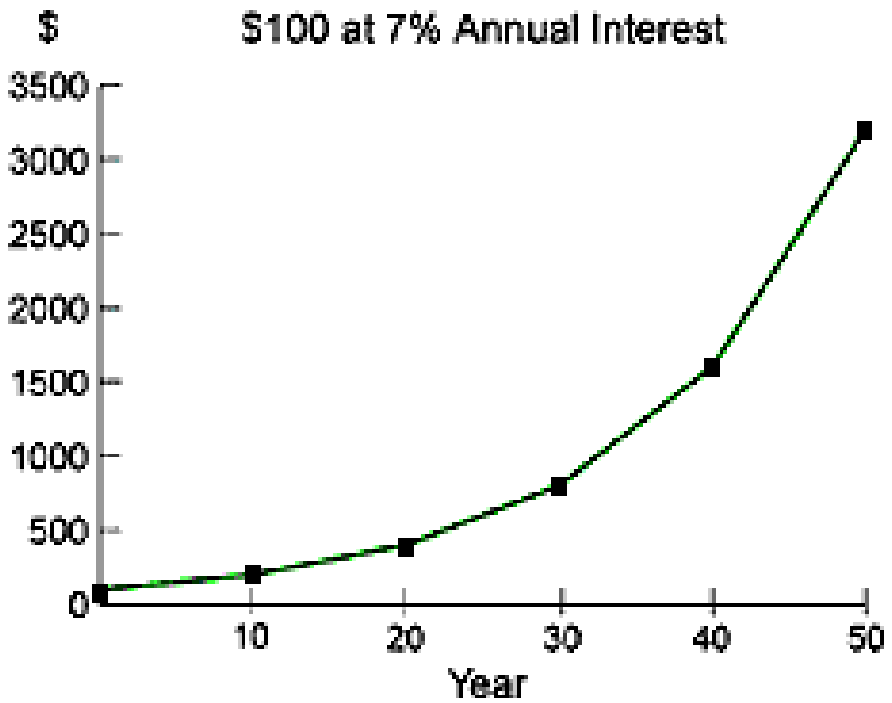
Example of GDP growth calculation

- Let's apply this formula to Australian GDP as an example.
- Given Australian real GDP of $1.452 trillion in 2012 and $1.493 trillion in 2013 (for fiscal years ending in June 30), the growth rate in real GDP between fiscal 2012 and 2013 was:
- ($1.493 trillion - $1.452 trillion)/$1.452 trillion
- = 0.028 x 100 = 2.8%

Financial Compounding

- Financial Compounding refers to “a process whereby the value of an investment increases exponentially over time due to compound interest.”
- Compound interest is “interest which is calculated not only on the initial principal but also the accumulated interest of prior periods.” (source: Investorwords.com)
- In other words, interest is paid on both principal and the interest being earned on that principal as it is accumulating.
- This process means that relatively low annual growth rates (more generally periodic growth rates) can lead to big changes over time.

Compounding in action



One can see that, with compound interest, an amount will grow "exponentially."

Note that one will accumulate significantly less money over 50 years with a 6% growth rate, a 'mere' 1 pp (percentage point) difference.

Time	Interest rate $\bar{r} = 0.01$	Interest rate $\bar{r} = 0.06$
0	100	100
1	101	106
2	102	112
12	113	201
24	127	405
48	161	1,639
60	182	3,299

TABLE 3.2 Bank Balances

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Anything can compound – e.g. population

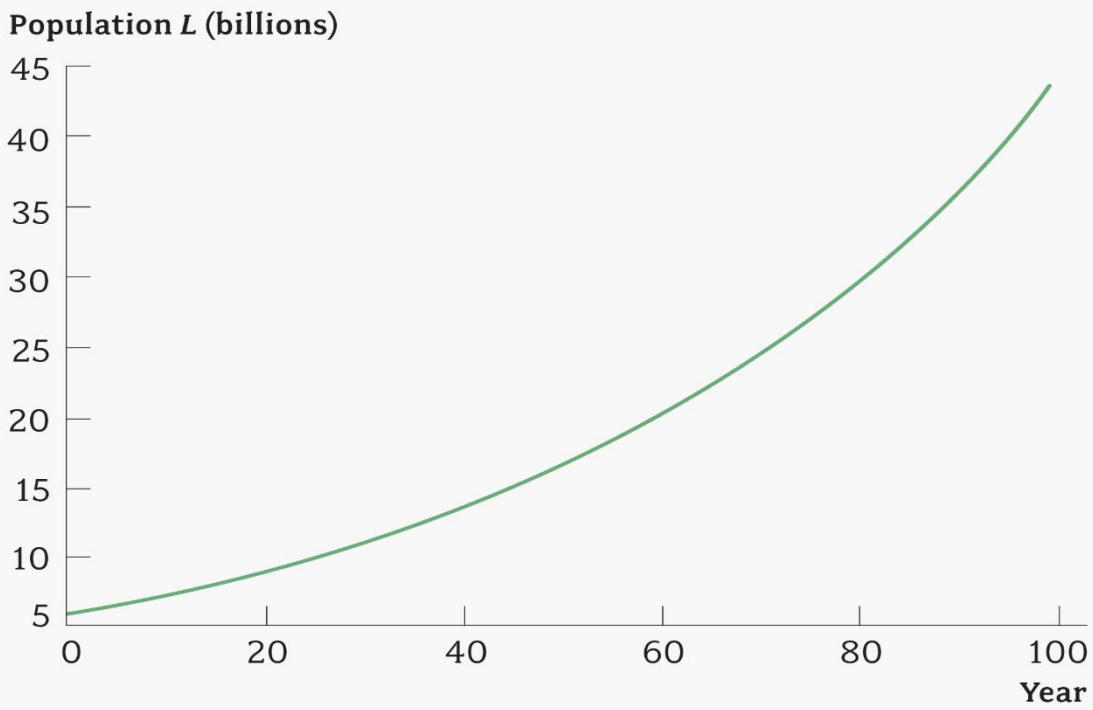

FIGURE 3.3 Population over Time

Macroeconomics, Economic Crisis Update
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Annual compound growth rates

- Because of compounding, one cannot use the simple arithmetic formula we used earlier for one year to calculate annualized growth rates for long periods, such as 10 or more years.
- The reason is because compounding significantly changes the base from which growth is calculated from year to year and a simple average across beginning and ending years does not account for this (though for a few years time period this difference will generally not be that important).
- So we can use the Compound Annual Growth Rate (CAGR) formula to get a better annualized estimate.

CAGR formula

- The formula for CAGR is presented below.
- Of course generally we will not need to be calculating this by hand, using a computer or calculator instead.
- The main point is to recognize that this rate provides a much accurate measure of annualized growth over long periods.

$$\text{CAGR} = \left(\frac{\text{Ending Value}}{\text{Beginning Value}}\right)^{\left(\frac{1}{\#\text{ of years}}\right)} - 1$$

$$\begin{aligned}\text{CAGR} &= \left(\frac{2{,}593{,}743}{1{,}000{,}000}\right)^{\frac{1}{10}} - 1.0 \\ &= (2.593743)^{0.10} - 1.0 \\ &= 1.100000 - 1.0 \\ &= 0.10 = 10.0\%\end{aligned}$$

The economic "problem" of growth

- Modern economies are built on regular and constant economic growth, compounded.
- The modern economic paradigm of the last 300 years or so is built to grow and people have come, overall, to expect regular increases in economic output and income.
- If there is no growth, stagnation occurs and this is leads to what feels like a permanent recession – or worse.

Japan's lost economic decades

"In 1991, [Japan's] real [PPP adjusted] output per capita was 87% of that in America; in 2011 that figure had fallen to 72%. For most of the 1990s, Japan was the second richest large economy in the world—richer than Canada, Britain, Germany, France, and Italy. It is now poorer than all of those economies except for Italy. In 1987, Japan's real output per person reached 98% of Germany's, and from 1988 to 1998 its income was higher than that in Europe's strongest economy. In 2011, its real GDP per capita stood at 92% of that in Germany. Japan has underperformed and fallen behind Western Europe, and it has badly lagged North America. And neither Western Europe or North America had a very good decade in the 2000s!"

(source: http://www.economist.com/blogs/freeexchange/2012/08/lost-decades)

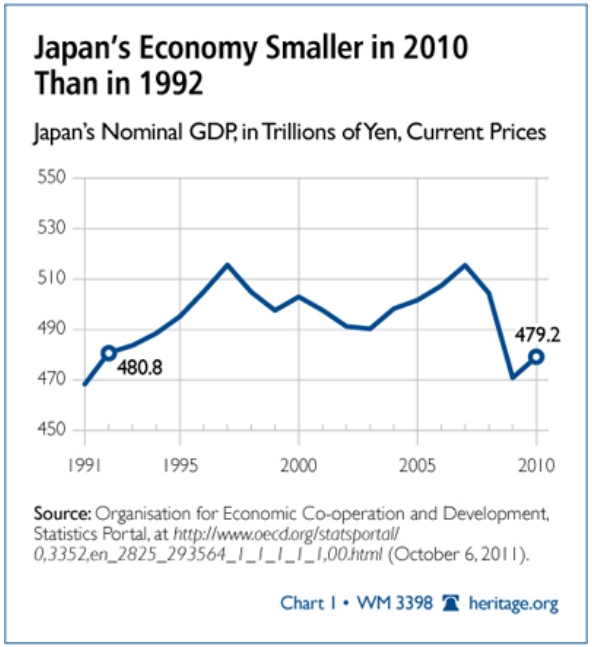


FIGURE 5.1

Real GDP per capita, 1901–2013

Measured in 1966/67 dollars, real GDP per capita in Australia grew from about $1150 in 1901 to about $6222 in 2013. The average Australian in the year 2013 could buy more than five times as many goods and services as the average Australian in the year 1901

Here is the power of economic growth: real GDP per capita (GDP adjusted for inflation) in Australia increased by a factor of 5 over 100 years.

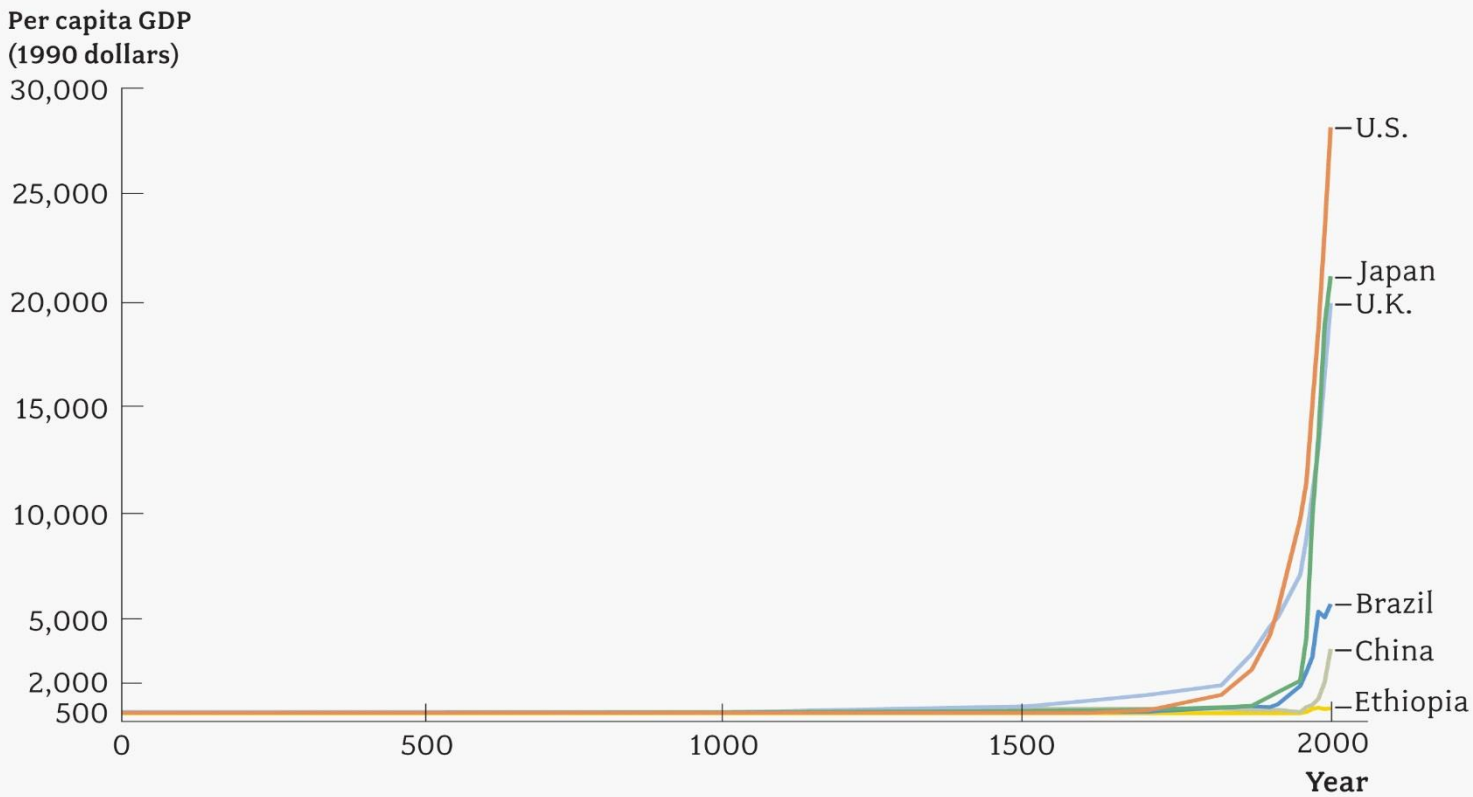
Understanding and explaining growth

- Japanese GDP has basically remained stagnant for 20 years now while other countries have grown.
- Even compared to those countries with tepid growth this means Japan's economy is shrinking relative to the rest of the world.
- It also means that Japanese living standards are stuck in absolute terms and falling in relative terms.
- The economic question is: why?
- And the policy question: what can be done about it?
- We'll consider a model of economic growth and measures of growth that can be used to understand possible causes and potential cures – for Japan and other countries.

Long-run v short-run growth

- We make a distinction between ‘long-run and ‘short-run’ growth.
- Macroeconomics is generally concerned with *short-run* fluctuations in growth. This is not a precise time period, maybe a year or two. Economically it refers to a period where most factors of production, e.g. supply of capital, labour and the state of technology, are ‘fixed.’
- The *long-run* on the other hand can be a generation or thousands of years and anything in between. One economic definition of the long run is a period of time where all factors of production and costs are variable and more generally where social and demographic factors are also variable.

Long-Run Growth....according to Angus Maddison



Source: Angus Maddison, *The World Economy: Historical Statistics* (Paris: OECD Development Center, 2003).

FIGURE 3.1 Economic Growth over the Very Long Run in Six Countries

Macroeconomics, Economic Crisis Update
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Which set of numbers do you find more credible?

- The Maddison time series of 2000 years is a highly respected piece of work and a very respectable effort.
- The Australian time series presented earlier is based largely on government census data collected over the period.
- Which piece of work do you find more believable?
- A proper answer to that question requires a careful look at the actual underlying data, but in general one should approach very long time-series, like Maddison's, with considerable caution. Most of the data, especially pre-1800, has had to be imputed or cobbled together from other sources and very ancient data are often least reliable of all.

“Modern” Growth Rates

Having said that, Maddison's data do point to a true pattern: sustained increases in material output (related to but distinct from standards of living) is a recent phenomenon, i.e. there was a ‘take-off’ in per capita GDP, as far as we can measure it, on a national level starting in the 1700s.

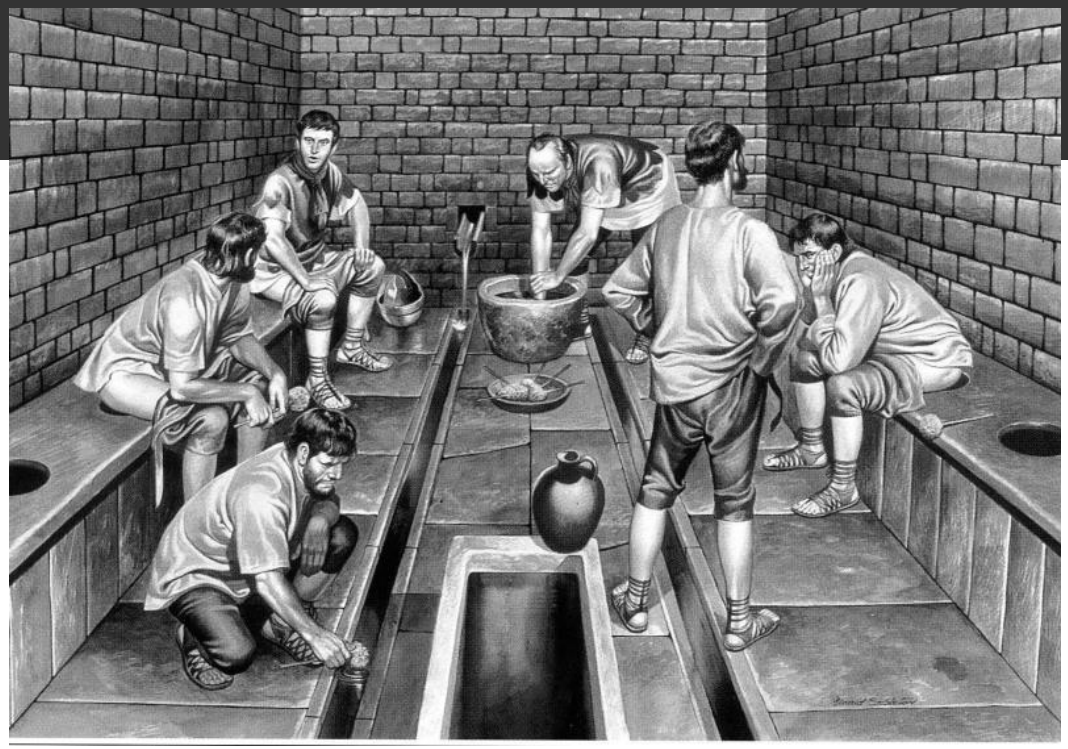
Modern economic growth only emerged in the most recent two or three centuries.

“The Great Divergence” as economists call this trend, refers to the era of increased difference in material output per capita across countries.

Before 1700, nations differed in this regard by only by a factor of two or three, while today it is over a factor of 50 for several countries.

A word about history

- Figures like this suggest – and the textbook asserts – that until the 1700s there were centuries of economic primitivism and mostly stasis.
- This is a misleading and incorrect view.
- It is true that material output and material standards of living have taken a sharp and unprecedented turn upwards in the past few centuries. But even ancient societies at times offered reasonably comfortable circumstances for the well-off at least and in some cases even the broader society.

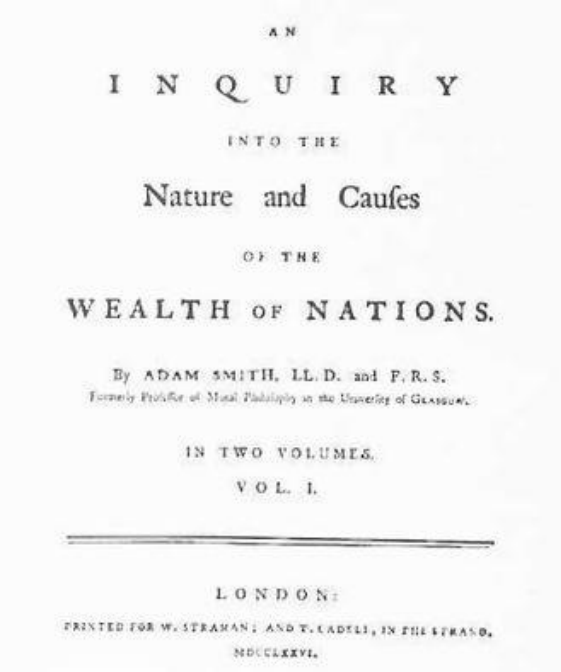


- Roman villas for example had running water and natural air conditioning through ecologically well designed architecture as well as decent food and an array of consumer goods and objects.
- Oversimplification of the sweep of economic history into ‘before’ and ‘after’ has a grain of truth to it – there is a clear ‘break’ economically with the onset of the Industrial Revolution and the Commercial Revolution that preceded it – but not all ‘old’ societies were economically barren or primitive.

http://www.romanaqueducts.info/picturedictionary/pd_onderwerpen/hygieneandhealth.htm

“Progress”

- **Thomas Hobbes**, an influential English philosopher of the 17th century, famously wrote that primitive life was ‘nasty, brutish and short’ and his attitude was embedded in much English thinking.
- **Adam Smith** came out with his ‘Wealth of Nations’ in 1776. Arguing in part on behalf of economic interests that were already upending English society by the 18th century and which he saw as set against reactionary forces keeping England backwards, Smith claimed that these new forces would put an end to the perceived misery of ‘primitive’ times.
- This notion of linear ‘progress’ was well-established throughout Europe, based on Enlightenment era thinking that saw human ‘reason’ as bringing ever more civilized times. Thus there was an explicit bias of seeing all that is new as ‘advanced’ and all that is old as ‘outmoded’ or backwards.
- Any *a priori* bias should be identified and avoided.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INQUIRY

INTO THE

Nature and Caufes

OF THE

WEALTH OF NATIONS.

By ADAM SMITH, LL.D. and F.R.S.

Formerly Profeſſor of Moral Philoſophy in the University of GLASGOW.

IN TWO VOLUMES.

VOL. I.

LONDON:

PRINTED FOR W. STRAHAN; AND T. CADELL, IN THE STRAND.

MDCCLXXVI.

So what drives economic growth?

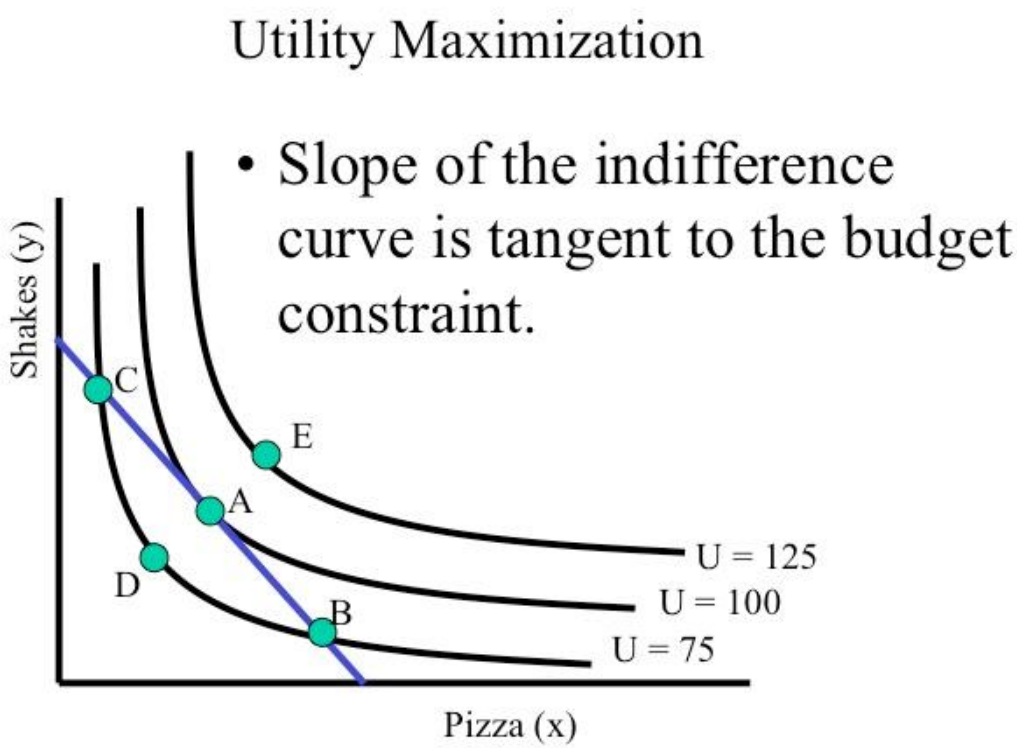
- Back to the present: we've described some basic measures of economic growth but we still have to explain what drives it.
- This is where an economic model would be useful.
- We actually have two: one for long-term growth and one for short-term fluctuations. We'll consider, right now, a long-term model.

- **Robert Solow** won the Nobel Prize in Economics in 1987 for his work in growth theory. He wrote in 2001 an addendum to his Nobel speech in which he said: “growth theory should be an integral part of pragmatic macroeconomics...a way of fitting together short-run macroeconomics, when the main action consists of variations in aggregate demand, with the long run factors...when the main action is on the supply side.”
- We’ll take a quick look at his model now, referred to as the Solow-Swan model, Swan being Trevor Swan of ANU who also developed a similar model – but did not win a Nobel for it!

Constrained optimization

- Solow did not invent growth theory. In fact there were models similar to his, particularly the Harrod-Domar model (named after its two principal authors), which posited economic growth in terms of constrained optimization.
- This is a type of problem whereby an ‘objective function’ (i.e. a functional relationship posited for a particular goal) is maximized subject to posited constraints.

- Here's a classic example from microeconomics: maximizing one's utility (satisfaction) 'U' subject to a budget constraint.
- For this graph the generic problem could be expressed as:
- max U=f(y,x) s.t. PxQx + PyQy



https://courses.byui.edu/econ_150/econ_150_old_site/images/5-2_Indifference_Curves_08.jpg

Maximizing growth

- Similarly, one could posit the problem of **maximizing GDP growth** subject to particular resource constraints.
- So we could say
- max: $Y=f(K,L)$
- Subject to $\bar{K}, \bar{L}$
- Where the 'bars' above the inputs indicate some fixed amount. (This is a very crude problem, crudely stated. We'll see a more subtle way of positing it shortly).

Growth theory pre-Solow-Swan

- This is basically how Harrod and Domar posited the growth problem (generically speaking). Their time-frame was the 'long-run'. That is, they were trying to model an economy's 'growth path', given constraints, over many years. The 'short-run', e.g. what might happen this year, was not part of the formulation.
- The problem with their model and the reason it needed to be superceded was technical – it was extremely sensitive to small changes in variable values and would expand or contract 'explosively'. In other words, the model had difficulty with producing stable growth paths, and the paths it did predict changed radically in response to small changes in economic values – an outcome that was very much at variance with actual experience of growth in economies. We won't concern ourselves here with the technicalities but the Solow-Swan model assumes 'diminishing returns' to inputs and some degree of technological flexibility in an economy (more on all this in a moment).

The Solow-Swan 'Neoclassical' Growth Model

So let's tuck into the constrained optimization growth problem as Solow-Swan posits it (referred to as 'neoclassical').

1. Production:

- The Solow-Swan growth model is pretty simple. It starts with a national production function put into a particular functional form referred to as 'Cobb-Douglas'):

$$Y_t = F(K_t, L_t) = \bar{A} K_t^{1/3} L_t^{2/3}$$

2. Resource Constraint:

- It then adds an explicit constraint in which output can be used for either consumption or investment:

$$C_t + I_t = Y_t$$

3 .Capital Accumulation:

- We also add a description of the evolution of capital stock (and in so doing make it 'endogenous'):

$$K_{t+1} = K_t + I_t - \bar{d}K_t$$

- **Depreciation**, as we mentioned earlier, is the amount of capital worn out each period
  - What the equation above says is that capital accumulation at time t + 1 consists of investment in time t, plus new investment at time t minus the change in existing capital stock due to depreciation. Thus we have net investment which equals (gross) investment less depreciation

4. Labour:

- We assert that the amount of labour in the economy remains (for simplicity, though not out of necessity) exogenous and constant at

$$\bar{L}$$

5. Investment:

- Meanwhile, total investment equals a constant investment rate times total output:

$$I_t = \bar{s} Y_t$$

Saving and Investment

- **Saving** is difference between income and consumption
- Saving equals investment:

$$\underbrace{Y_t - C_t}_{\text{saving}} = \underbrace{I_t}_{\text{investment}}$$

- The return on saving must equal rental price of capital (r) (which is also the return on loanable funds)
- The real interest rate in this economy is equal to the rental price of capital which is equal to the marginal product of capital.
- We'll consider these dynamics more when we discuss financial markets.

The model is summarized below. This simple model can now allow us to focus on the main question of the factors that determine growth.

Unknowns/endogenous variables: Y_t, K_t, L_t, C_t, I_t	
Production function	$Y_t = \bar{A}K_t^{1/3}L_t^{2/3}$
Capital accumulation	$\Delta K_t = I_t - \bar{d}K_t$
Labor force	$L_t = \bar{L}$
Resource constraint	$C_t + I_t = Y_t$
Allocation of resources	$I_t = \bar{s}Y_t$
Parameters: $\bar{A}$, $\bar{s}$, $\bar{d}$, $\bar{L}$, $\bar{K}_0$	

TABLE 5.2 The Solow Model: 5 Equations and 5 Unknowns

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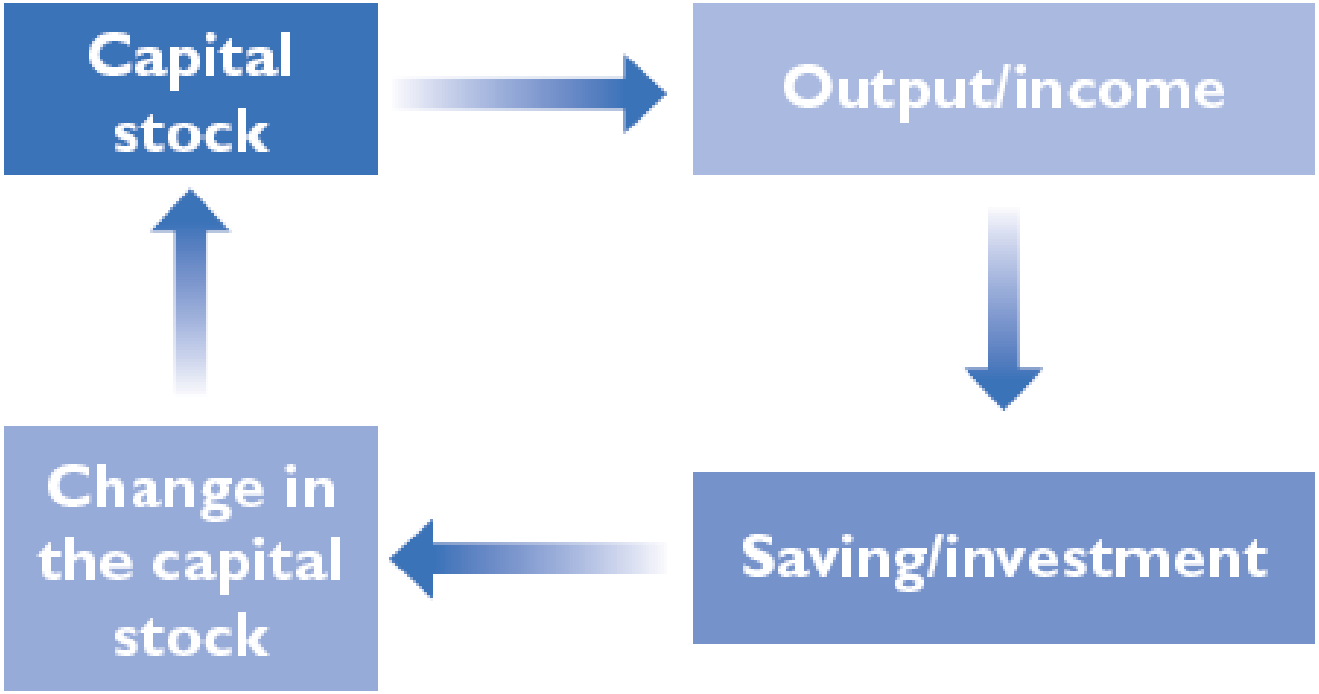
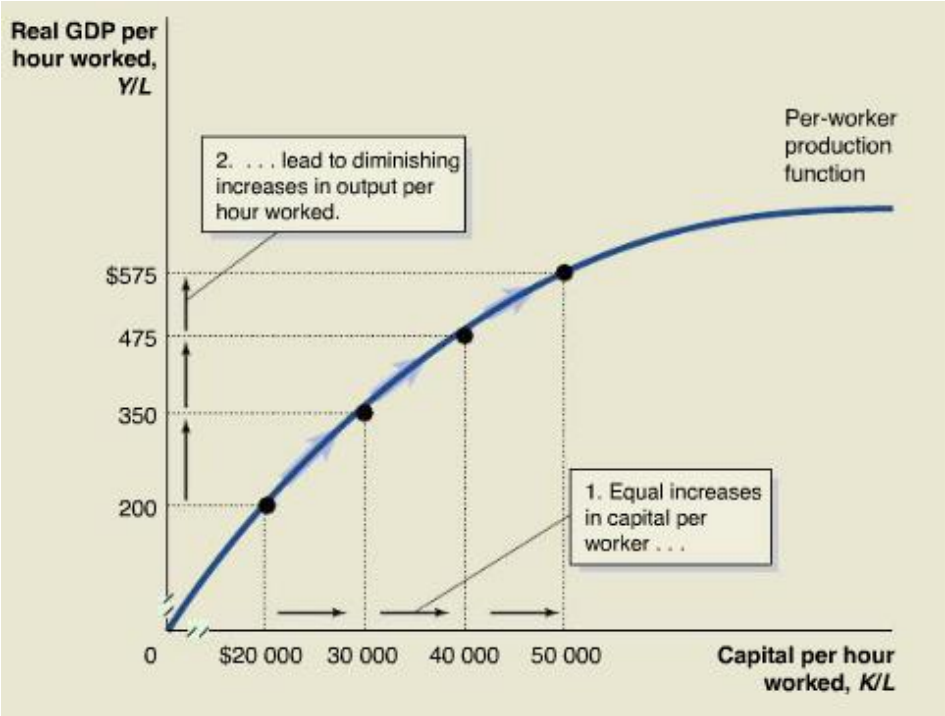
For this introductory class, we will not solve the model or work it out further in detail. The intuition is that this is a 'machine' model of the economy in which capital stock (K) (joined with L and technology) drive output and output per capita with K is driven in part by savings which drives investment (I).

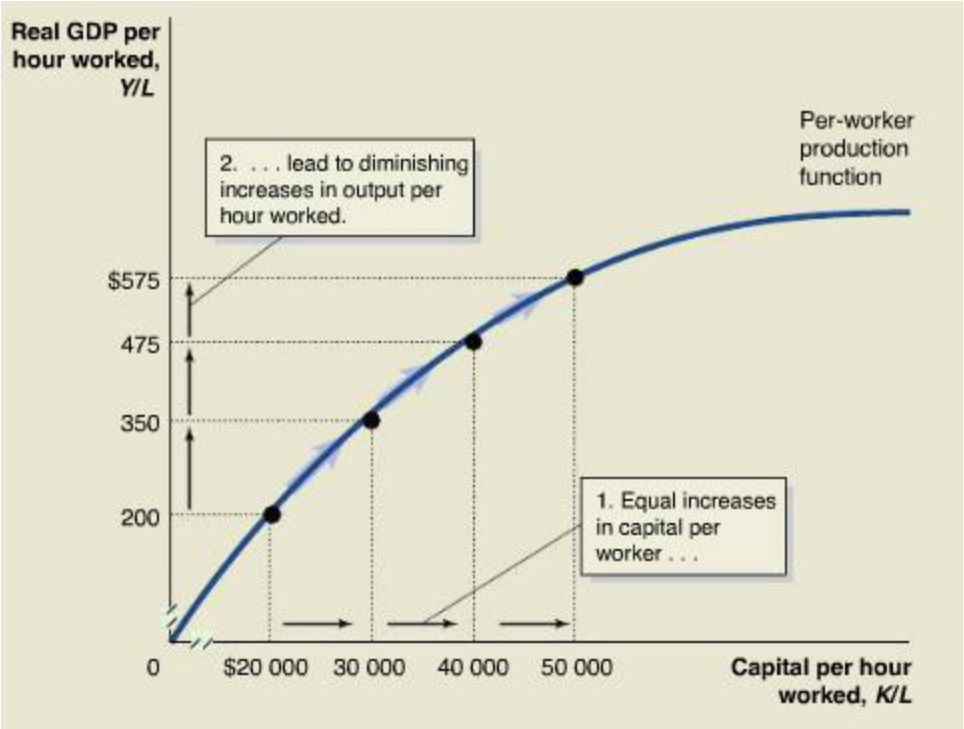


A graphical result



- Here is a way of summarizing the key relationships:
- real output per hour worked (Y/L) and
- capital per hour worked (K/L)
- with a given technology – f()
- determine the shape of the curve (tradeoffs between the two).

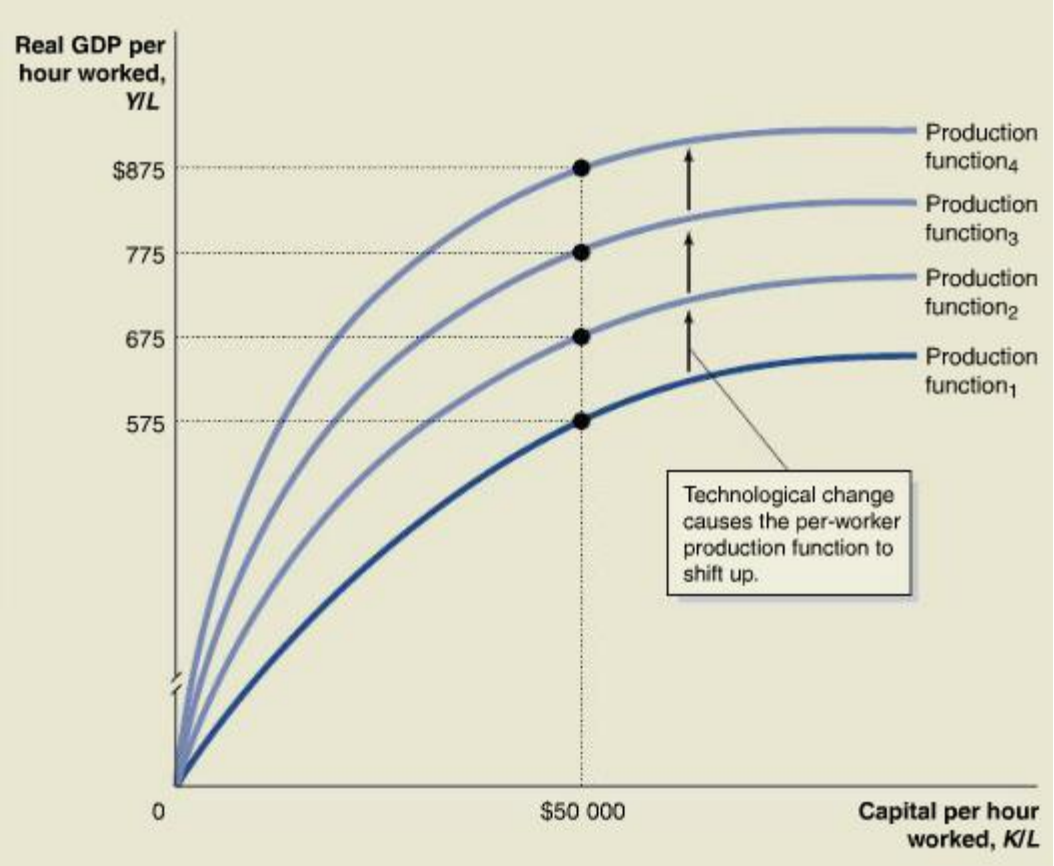
Why diminishing returns?



- Formally speaking diminishing returns occur because of the specification used for the production function in the growth model.
- Intuitively and generally speaking, workers become more productive with more capital only up to a point. So if I get one computer my productivity increases. I get a second one – not so much.

A ‘comparative static’

- And here is a conceptual comparison of what happens when an economy’s technology improves, ceteris parabus (technology here refers to the ‘f’ in Y = f(K,L).
- More real GDP is earned for a given amount of hours worked and capital provided as technology improves.



Why are some countries rich and some poor?

- One big question of growth theory involves the ‘wealth of nations’, to use Adam Smith’s phrase.
- We observe obvious differences in the per capita GDP of various countries and want to know what accounts for those differences.
- Our growth model provides some possible answers.
- K accumulation and depreciation are important (and thus so is I and hence the S (i.e. Y-C) which funds it).
- Technology is even more important.
- So our model predicts.

$$Y_t = \bar{A} K_t^{1/3} \bar{L}^{2/3}$$

- Let's return to the core of that model: the production function.
- Total amounts of K and L are obviously important to a nation's GDP. The more saving there is, the more I and hence K and the higher Y is. Also a larger labour force (L) yields higher Y. But there are diminishing returns to simply accumulating more and more of either.
- When we look at actual GDP and L,K data we see that levels of national K and L do not fully account for differences in GDP. To make the data match the model, we adjust 'A' - the 'productivity' parameter. The higher A is the more GDP per capita produced with given levels of K and L.

Accounting for productivity differences

Now we have another puzzle to explain – what accounts for productivity differences between countries?

Put another way: why are some countries more efficient at using capital and labour?

The model does not explicitly capture productivity dynamics. For this reason it is often referred to as a 'black box' model of productivity. But some possibilities are implied:

- (1) Human capital
- (2) Technology
- (3) Institutions
- (4) Exogenous shocks

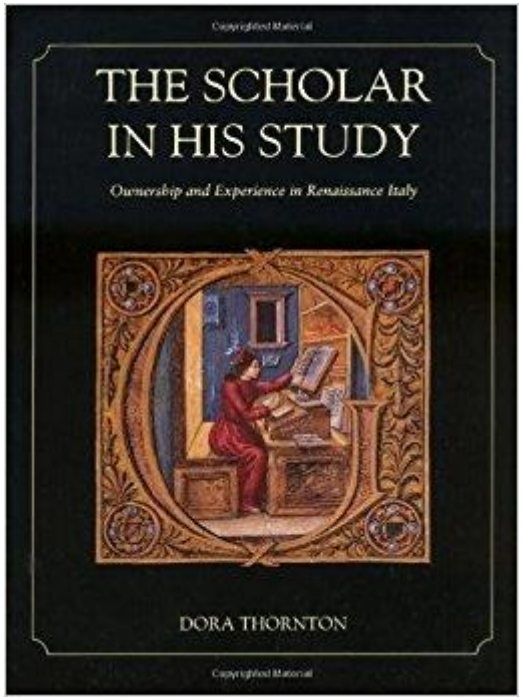
Human Capital

- Human capital refers to the stock of skills that individuals accumulate to make them more productive. It is analogous to K, which is physical capital. It is different from L (hours worked) in that it refers to the actual qualities of the human being doing the work which in turn affects the quality of their L, i.e. the human embodied counterpart to physical capital.
- Gary Becker is the inventor of this widely used idea. He won the Nobel Prize in economics in part for this invention and related economic models of time.

http://www.omservices.org/wp-content/uploads/2015/11/Human-capital-1-300x245.jpg

Improving human capital: education

- Education is, of course, of prime importance – not just the amount but the quality and nature and effectiveness of it.
- This is not necessarily just primary and secondary education but professional training and informal education (e.g. from mentoring).
- Of course if our sole aim is to improve GDP per capita, desirable education improvements may be fairly narrow, i.e. education which increases worker productivity.
- Overall, education should also be about making better human beings and some education may contribute to this but not necessarily to productivity increases.
- However even ‘impractical’ education, such as music and art, can have productivity effects by creating sharper and more creative minds.



Improving human capital: health

- Unhealthy workers are also less productive workers.
- So especially in developed rich countries, increasing levels of physical exercise and lowering fat, salt and sugar intakes in diets are important. In poorer nations, ensuring adequate nutrition and basic care is key.
- Improved health is good for its own sake, of course, but also has definite GDP and productivity enhancing effects.
- Improved health also lowers social and economic costs through lower morbidity and mortality.

http://www.livemint.com/Politics/sW8PPcoPsTyfflEsoBHPEL/Will-the-2017-budget-go-beyond-health-insurance-to-address-I.html

Technology

- Another explanation for GDP per capita differences is that physical capital itself may have qualitative differences between countries.
- One of these differences may be physical technology, such as a particular machine or invention.
- Richer countries generally use more modern and more efficient technologies.
- And technology also encompasses process innovations such as better ways of organizing a factory floor or an office.
- Intellectual property (IP) – creative ideas and concepts – also fall into this category.

http://www.biltstone.com/technology

Institutions

- Another critical issue is the nature of 'institutions'.
- “Institutions” is a broad term in economics, referring to property rights, the rule of law, government systems, organisational form of firms, contract enforcement, among many other items.
- Well-defined institutions and laws create a climate for economic growth that is much better than an environment with corrupt and uncertain institutions.
- Institutional forms themselves may have efficiencies or inefficiencies of design as well.
- These types of differences are critical but are difficult to handle well with typical orthodox economic modeling methods.

Policies as institutions

- Often economists use the word institutions to refer to labour market and capital market policies and regulations by government.
- Clearly the loosening of work rules and trade regimes during the Hawke-Keating period in Australia allowed for more efficient use of K and L and also for better use of the two together through leading to higher productivity.
- However it is important to distinguish between policies that make more intensive use of factors (making workers work harder for example) as opposed to more efficient use of them (making them work ‘smarter’).
- This is always a hot issue for labour markets 'reforms' (note the leading nature of that word) where looser work arrangements could lead to more work hours at lower pay. In that instance GDP will go up, but only because L is increasing and people are working more.
- What is best from a productivity point of view are changes that allow for more efficient use of L and hence more labour productivity.

Exogenous shocks

- Finally, there are exogenous shocks such as war, famine, plague and death (the names of the traditional “four horsemen of the apocalypse”, as this Albrecht Durer print shows) – or more mundane things like oil price shocks.
- Exogenous shocks are by definition temporary but they can have long term consequences, especially if the shocks are long and severe enough in and of themselves. At least for some periods of time countries may lag behind because of being set back by some shock and having to recover. Shocks can be positive too.

http://www.metmuseum.org/toah/works-of-art/19.73.209/

World War 1

Here's an example: the large number of young men lost in Europe during World War 1, men who would otherwise have served as productive labour.

This loss, combined with the vast physical destruction of the War, definitely set European growth back as compared to the United States which suffered relatively few casualties, almost no physical destruction and which also became a world-wide creditor nation for the first time.

http://ww1facts.net/quick-reference/ww1-casualties/

Historical accident

- Many economic historians (and 'New Trade' theorists) who try to explain comparative advantage of nations, focus on the role of historical accident in making a particular country more successful at something than others.
- So, for example, the warm dry weather of Southern California and availability of large swathes of cheap land in the 1920s provided excellent conditions for manufacture of airplanes and World War 2 kicked off a major manufacturing investment boom led by government rearmament. Some argue that this was a key reason why that part of the world became the global centre of commercial passenger aircraft manufacturing (until the rise of Airbus in Europe and, to a lesser extent, Embraer in Brazil).
- The idea in this and other examples, is that a set of circumstances allows a region or country to become the first significant player in a market, get a **'first-mover'** advantage that cements its competitive position and then build up economies-of-scale in production that make the industry largely unassailable. It is hard to prove such things but it is clear that 'dumb luck' does play a role in economic position.

A word on economies-of-scale:

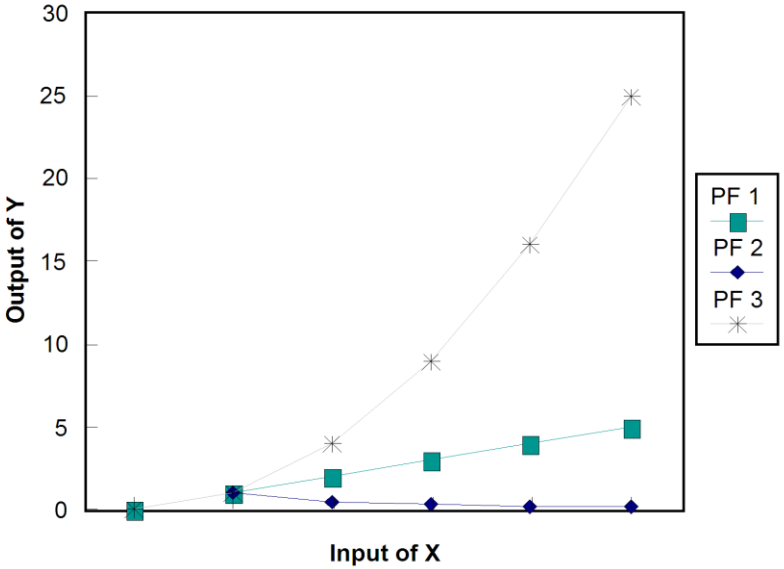
Note that Solow-Swan is a **constant returns to scale (CRS)** model.

Graphed at the right are three different examples of production functions:

(PF1) Y=X

(PF2) Y=1/X

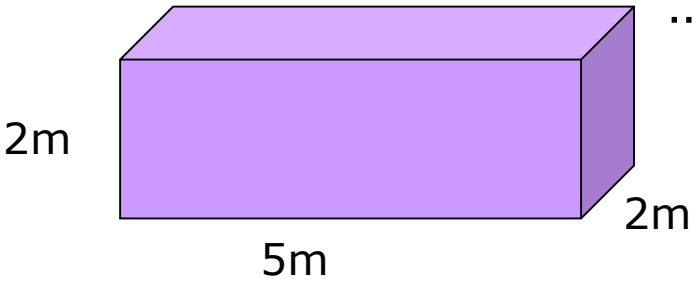
(PF3) $Y=X^2$



With PF1 the input X, which goes into producing the output Y, there is **CRS**. If the input X is doubled, say from 1 to 2, output Y also doubles from 1 to 2. PF2 has **negative returns to scale**, i.e. if X is doubled from 1 to 2, Y actually falls from 1 to 0.5. This is a special case, where returns are negative, of **decreasing returns to scale** in which output increases but proportionately less than input.

Finally, PF3 has **increasing returns to scale**, i.e. if X is raised from 1 to 2, Y increases proportionately more than that, from 1 to 4. Note that technologies may have different returns to scale over different ranges, e.g. have increasing returns at low levels, constant returns at medium levels and decreasing returns at high levels of output.

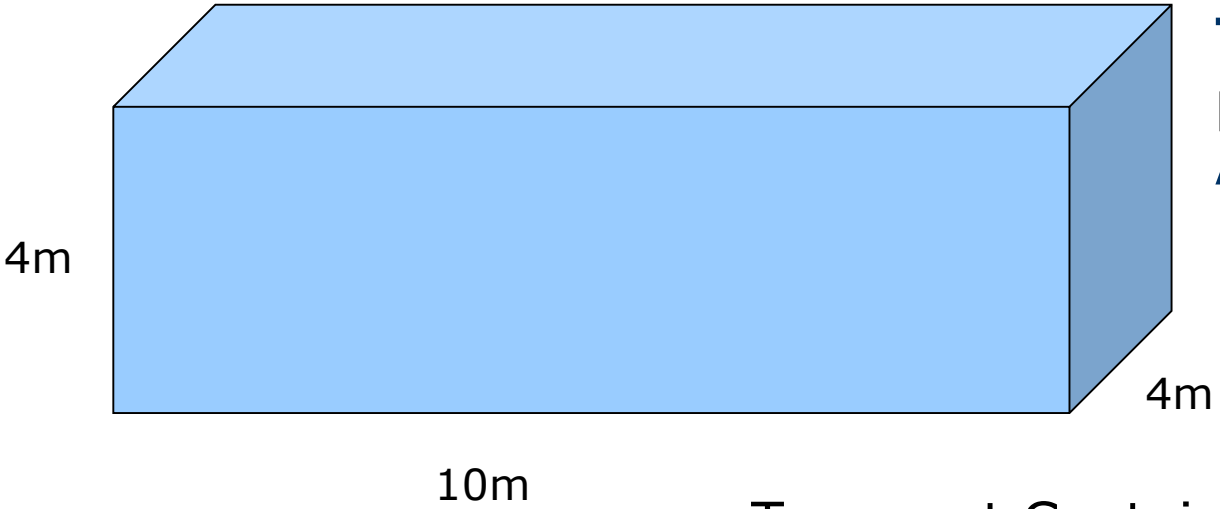
There are many examples of increasing returns to scale, even something simple like a…



…Transport container = Volume of $20m^3$

Total Cost: Construction, driver, fuel, maintenance, insurance, road tax = £600 per journey

AC = £30m³



Total Cost = £1800 per journey

AC = £11.25m³

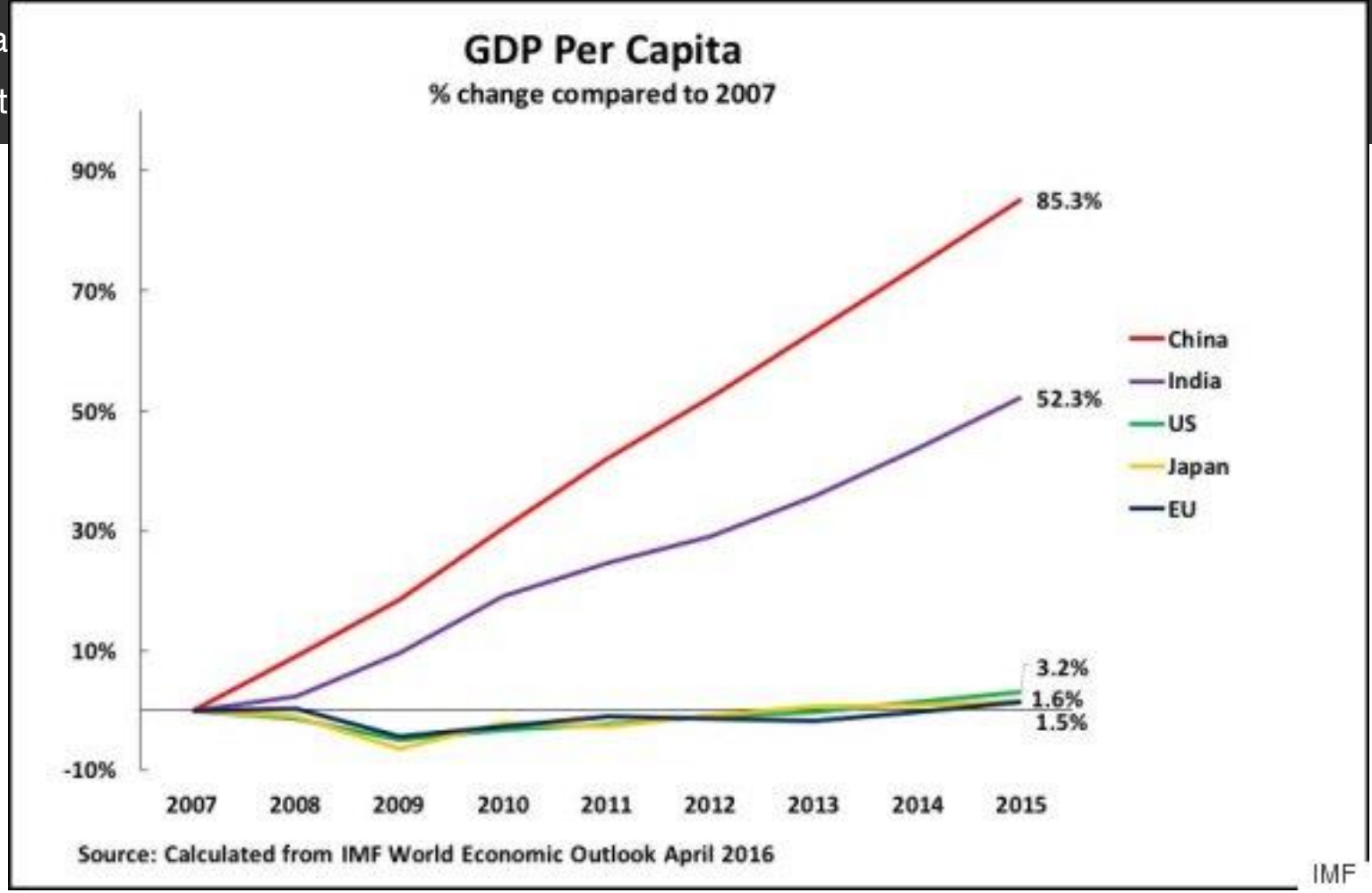
Transport Container 2 = Volume $160m^3$

The importance of economies-of-scale

- CRS is a very easy to model and leads to what mathematicians refer to as ‘tractability’, i.e. a model that is easy to manipulate and which yields pliable, interpretable and predictable results.
- Increasing returns to scale are not so easy to model, leading to more mathematical complexity and less theoretical manageability.
- However, actual economies are full of increasing returns to scale – think Google, Facebook and Amazon to name a few ‘tech’ examples – and these may be just as critical to productivity and economic growth as the other factors we have considered.
- There are also areas where there may be decreasing returns to scale as well, and ‘optimal scales’ of production that economic enterprise may fall short of. There are models that do incorporate this but as of yet we do not have a core growth model that does.

Productivity Growth and GDP per capita growth

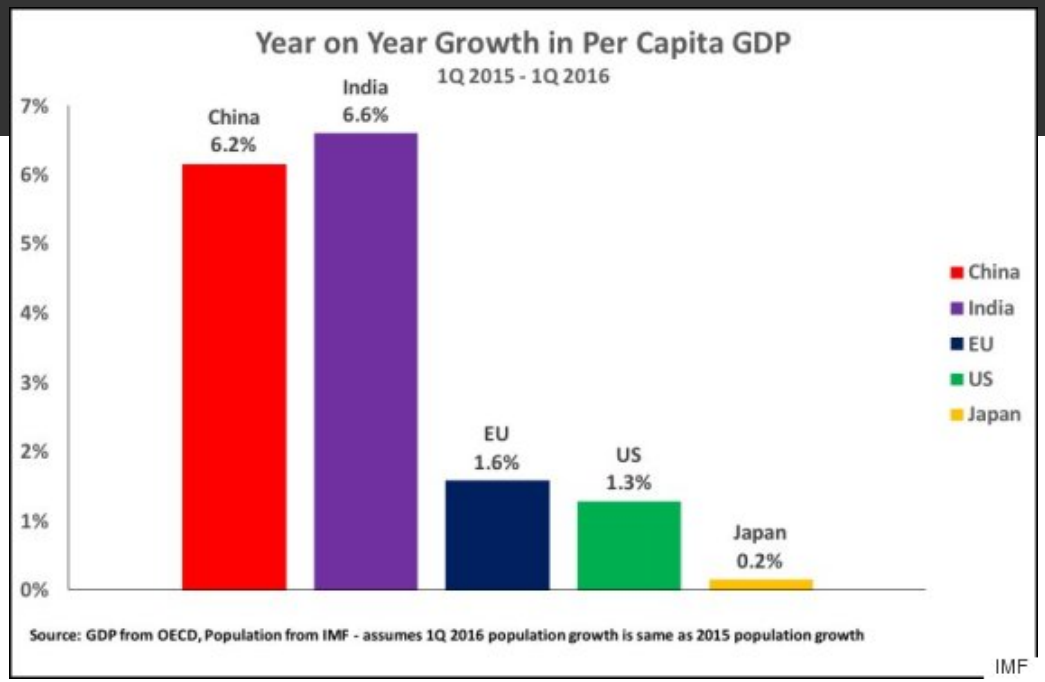
- Whatever its source, productivity growth aids GDP per capita growth and with compounding this can make countries shift their economic positions relative to others, up or down, significantly over time.
- Of course the supply of L and K is a key part of the GDP per capita growth equation but productivity provides a more powerful booster.
- Over the last twenty years, taking the disruption of the GFC out of the data, most developed countries have sustained about 2 percent growth in per capita GDP.



http://www.huffingtonpost.com/john_ross-/china-india-growth_b_11655472.html

- Here is what has been happening for a while – high per capita GDP growth in the developing world (especially China and India as shown here) and relatively tepid growth in the developed world.

http://www.huffingtonpost.com/john_ross-/china-india-growth_b_11655472.html



The Great Convergence

- The developed world still remains wealthier than the developing world, but faster growth rates in the latter have narrowed the gap between the two in terms of GDP per capita – hence the term above.
- This has been a counterpoint to the Great Divergence that occurred after the Industrial Revolution when western countries powered ahead of most eastern ones (Japan being a notable exception).

Growth Accounting

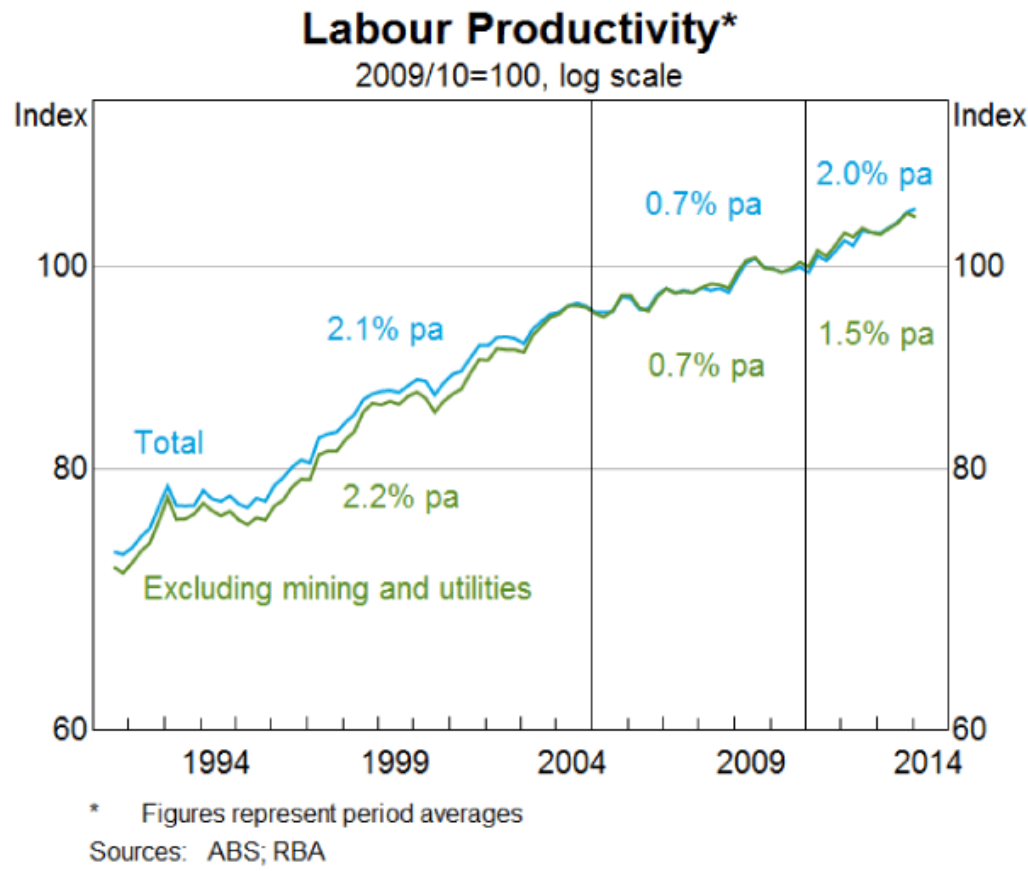
- National income accountants are particularly interested in decomposing overall growth into its component parts.
- What are these components? Our neoclassical model suggests the main ones: inputs (and their quality and usage) and productivity.
- We cannot measure these things directly generally, but growth accounting models can estimate contributions to growth offered by changes in inputs, technology and outputs.

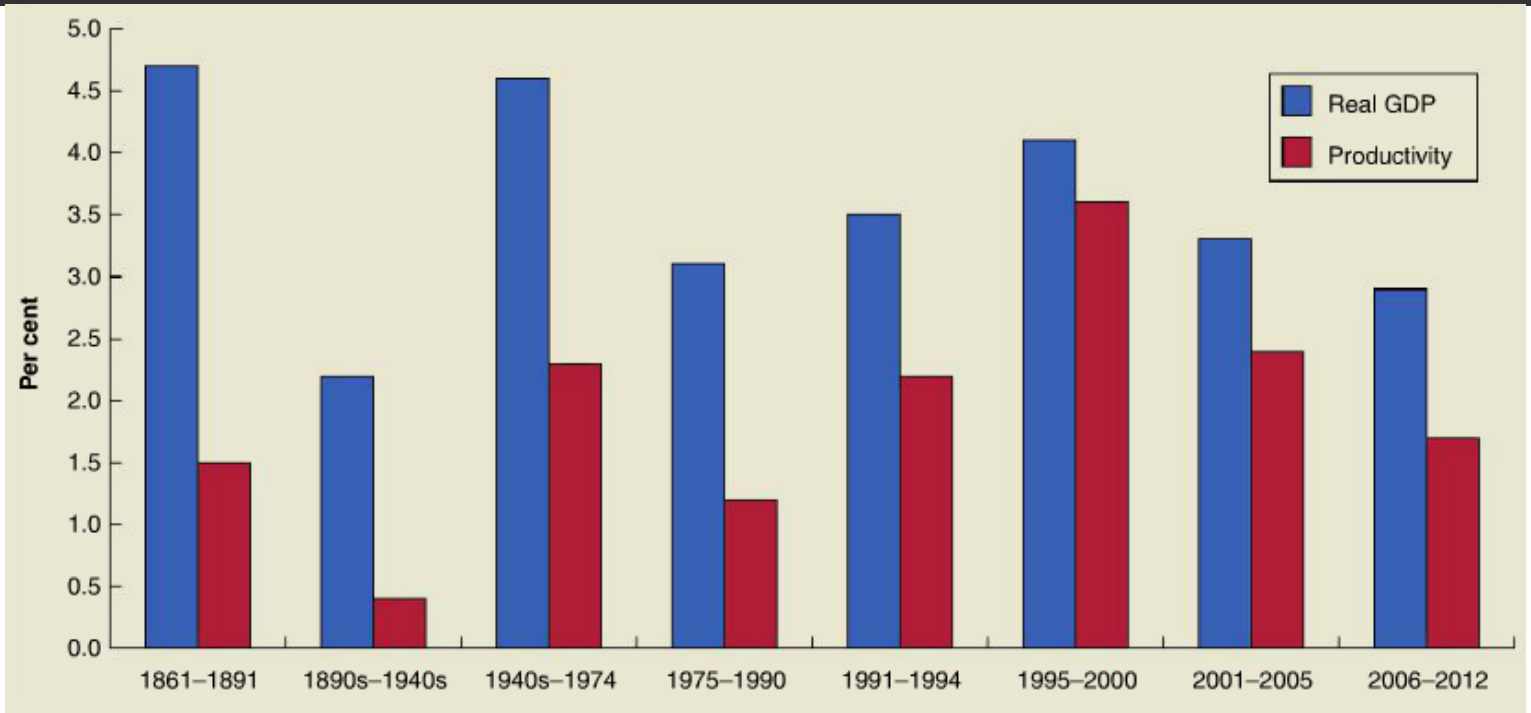
- Recent data from the Productivity Commission decomposes Real GDP growth in Australia into three components over the past four decades or so:
- (1) **Growth in the population**.
- (2) **Labour force participation rates** (i.e. how much of the working age population is actually working – we will delve into this more when looking at unemployment measurement) ("Changes in participation are determined by the share of population of working age, their labour market participation, employment share (share actually working, which is the inverse of the unemployment rate) and the average hours worked per person employed."
- (3) **Labour productivity**.
- More population means more potential workers; more people 'participating' in the labour force means more 'L'; and we know what productivity means. (Labour productivity is a term that refers to a summary measure of the amount of goods and services produced by one hour of labor, i.e. the amount of real gross domestic product (GDP) produced by an hour of labour).

Figure 2.1 Contributions to the growth in aggregate real output, 1979-80 to 2014-15 (Per cent per year)

http://www.pc.gov.au/research/ongoing/productivity-update/pc-productivity-update-2016/contributions-to-output-and-per-capita-income-growth

- Here's some other data that focusing on labour productivity, a bit differently in terms of time periods. This contrasts overall productivity and how much the mining and utility sectors contributed.
- Economic 'structure', i.e. what industries make up a national economy, has an impact on overall national productivity because some industries are more/less productive than others.





- Here's very long-term Australian data that shows a strong link between real GDP growth and productivity.
- Before World War 2 increases in L and K were probably more important to GDP growth than productivity. That changes a lot after the War – until more recently.
- Productivity is important but other things are too.

Innovation

- Of course the current buzzword is ‘innovation.’
- The OECD defines innovation as “the implementation of a new or significantly improved product (good or service) process, new marketing method or a new organisational method in business practices, workplace organisation or external relations.”
- The OECD estimates that as much as 50 percent of economic growth in its member countries can be accounted for by innovation activity.

Innovation and productivity

- It is important to note that innovation by itself does not necessarily lead to new growth and productivity.
- A new product may not meet a clear need or desire in which case it will go nowhere economically and may even represent a waste of economic resources.
- Some innovations may impose significant costs as well as benefits, especially external ones. The splitting of the atom and the creation of nuclear power is an example of this.
- And some innovations may be bad. This is especially the case for some financial product innovations, as the Subprime Crisis shows.
- With these provisos in mind economists and policy-makers know that innovation is key to growth.

Creative destruction and entrepreneurship

- The economist Joseph Schumpeter coined the term 'creative destruction' to describe the process of entrepreneurial innovation and competition.
- Innovation and entrepreneurship is risky because its outcomes are highly uncertain. Such activities may not even result in a tangible outcome, especially the case with much new technology.
- Even if such an outcome is achieved, there is no guarantee that it will make money for those putting capital at risk.
- Therefore failure is much more likely than success. But the potential for return is very high, which is what motivates the entrepreneur.
- This is why Schumpeter called the destruction of most speculative business enterprises “creative” – the few successful ventures are generally transformative and add more value than the value lost in failures.

Example of an entrepreneur

- “Janine Allis, Shark Tank shark and creator of healthy fast-food chain Boost Juice.”
- “She opened her first juice bar in Adelaide in 2000 and her business empire now includes Salsa's Fresh Mex Grill, Cibo Espresso and Hatch as well as Boost Juice, with the BRW rich list putting her personal fortune at $66 million.”
- [Allis]: "Businesses are never something with a start, middle and an end. They are a moving organism that has to change every year. I think there are new problems all the time and that influences me. It's that continual journey of creating."

http://www.smh.com.au/small-business/entrepreneur/australias-most-influential-female-entrepreneurs-20160301-gn7nqt.html

Knowledge, research and development and innovation

- So far this has been innovation in a vacuum.
- How does it actually happen? What are its causal dynamics?
- There is no single or easy answer to this, though there are a number of conceptual models of innovation.
- The basic models focus on how an idea becomes manifest into physical form (especially a technology) and how that form then becomes commercialised so as to have impact on an economy. Our current understanding of this process is still rather diffuse.

Nuance: is per capita GDP equal to a 'standard of living?'

– We often speak of the 'standard of living' and want to see that increase over time. Is this measured by per capita GDP?

– Basically, no.

– There is no standard definition of standard of living (no pun intended) but broadly it is measured by looking at access to material goods and services; health; education; economic mobility; political and economic freedom; and income and wealth inequality, amongst other things.

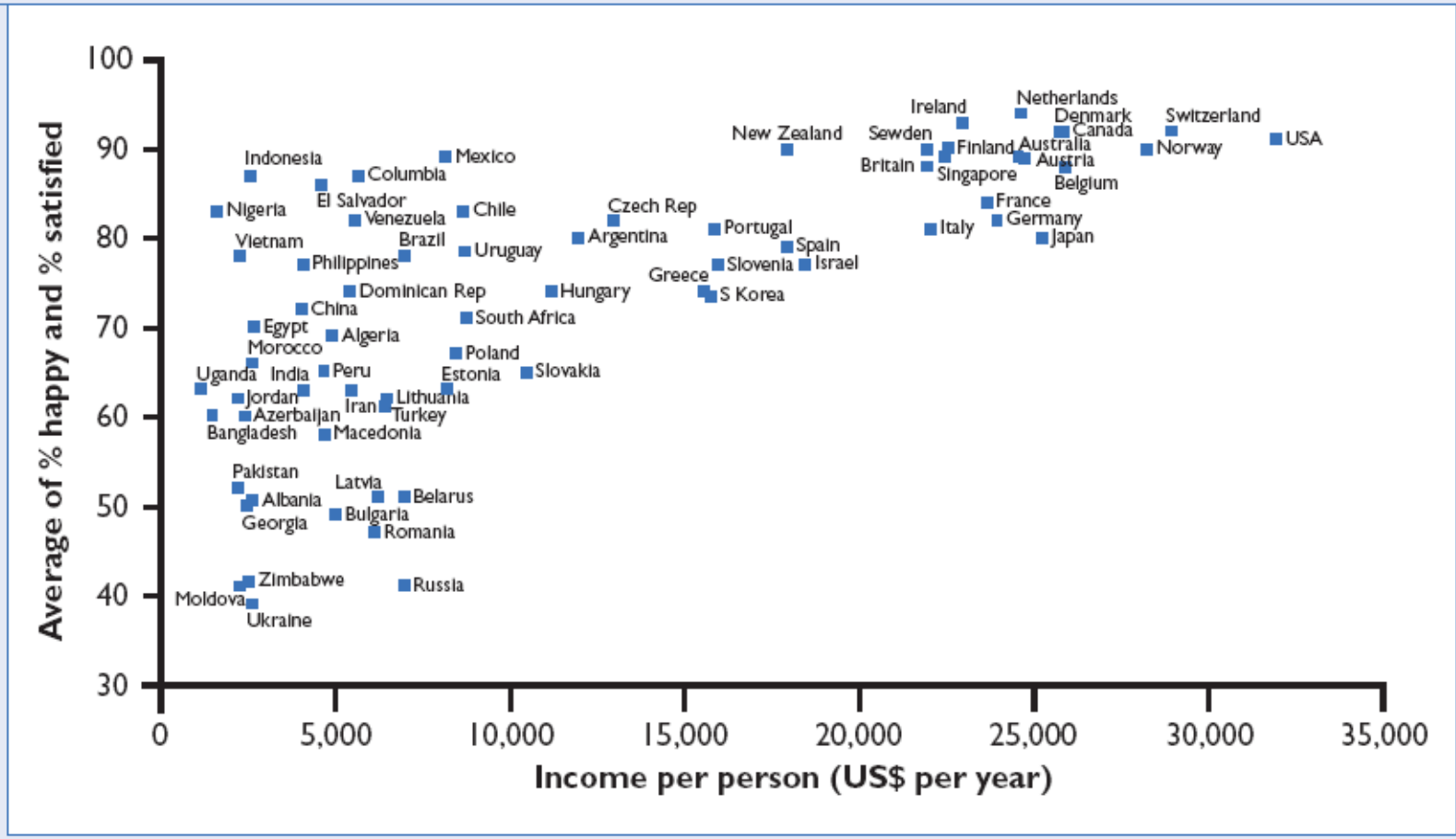
– GDP does capture some of these things, such as overall output levels, and is associated with other things (e.g. higher income people are generally healthier and more educated), but it is not a complete measure of an overall standard of living.

Quality of Life

- A related point is that a standard of living is a material measure, i.e. how well off we are in physical terms.
- Quality of life is a broader term, less well-defined, that refers to how people feel about their life, their enjoyment of it, and if one reaches beyond economics, their spiritual and emotional maturity and depth.
- Thus one might hear someone speak of how the quality of life is better in, say, Portugal than in the UK, because even though the UK is richer than Portugal, the lifestyle in Portugal could be more laid-back, food is better, people are friendlier etc. (and I am just saying this for argument's sake – it is not a 'truth').

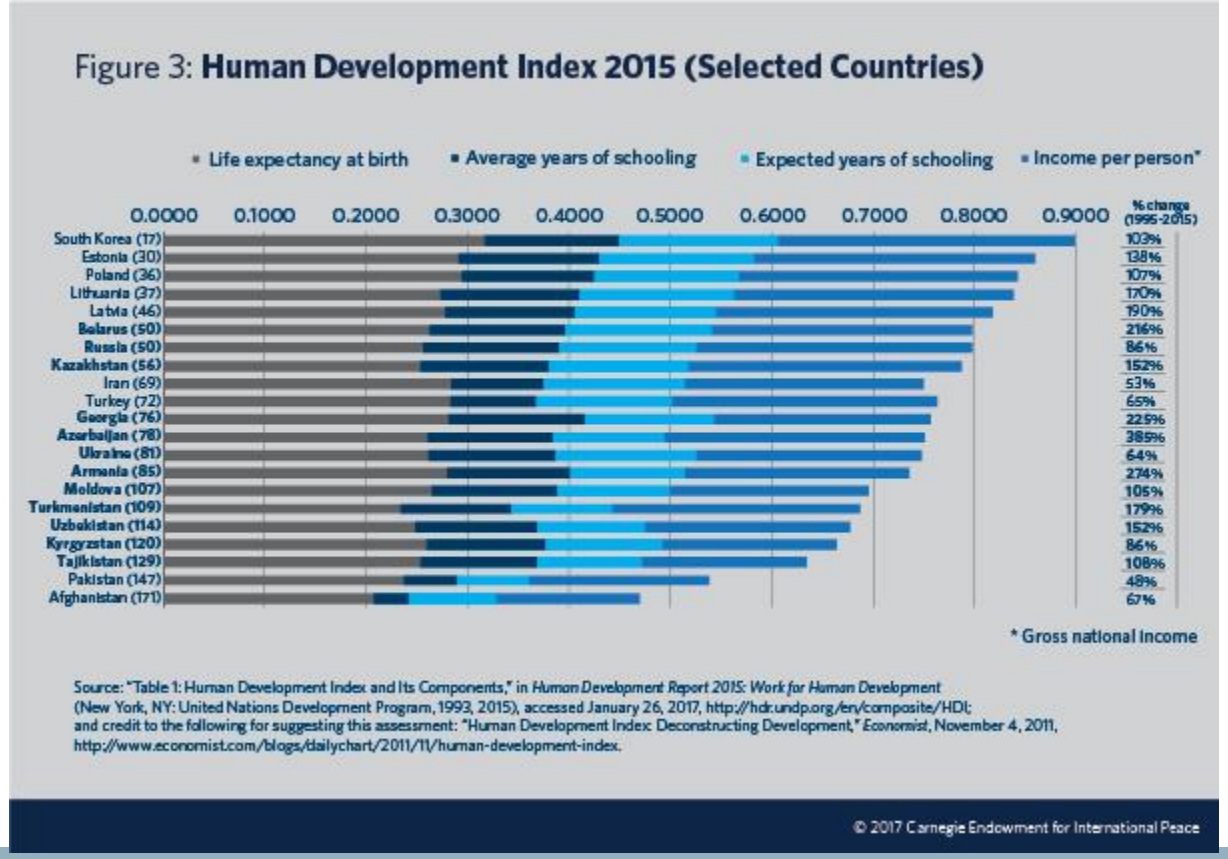
Money doesn't necessarily buy happiness

Figure 1
Happiness and output per capita across countries



SOURCE: World Values Survey, 1999–2000 Wave.

- The divergence between GDP and quality of life has led people to develop alternative measures that attempt to get a broader view of well-being.
- The Human Development Index (HDI) is one example that starts with income per person but adds life expectancy and schooling data.



http://carnegieendowment.org/2017/02/09/illusions-vs-reality-twenty-five-years-of-u.s.-policy-toward-russia-ukraine-and-eurasia-pub-67859

Short-run economic growth

- We've been talking about long-run growth where everything in the economy is variable including technology and capital stock.
- In the short-run this is not the case. For example the total stock and quality of K in an economy generally cannot be changed much within a year.
- Similarly for the labour force. These are effectively fixed for shorter time periods. And of course technology is fixed too.

Capacity and capacity utilization

- In the short-run, productive capacity of the economy is thus effectively fixed.
- For the short-run we therefore focus on capacity utilization: how much of existing productive capacity is being used and how much ‘slack’ there is left over.
- To take an example of a single assembly line making cars: perhaps only 80% of the time is the assembly line in operation. We would say that 80% of its capacity is being utilized.

Potential versus actual output

- Continuing the analogy, if the assembly line were running 100% of the time let's say it could produce 100 cars a day. That would be its full potential output.
- At an 80% capacity utilization rate only 80 cars a day are actually produced. This leaves 20 cars that could be made daily unproduced, an economic loss because that slack car-making capacity is tying up resources that could be put to use elsewhere – an opportunity cost.
- A side-note: usually facilities cannot be actually worked 100% because this would put too much wear and tear on the system. So potential output is properly calculated at whatever utilization rate is maximum but feasible (though there can be short periods of 100% utilization as needed).

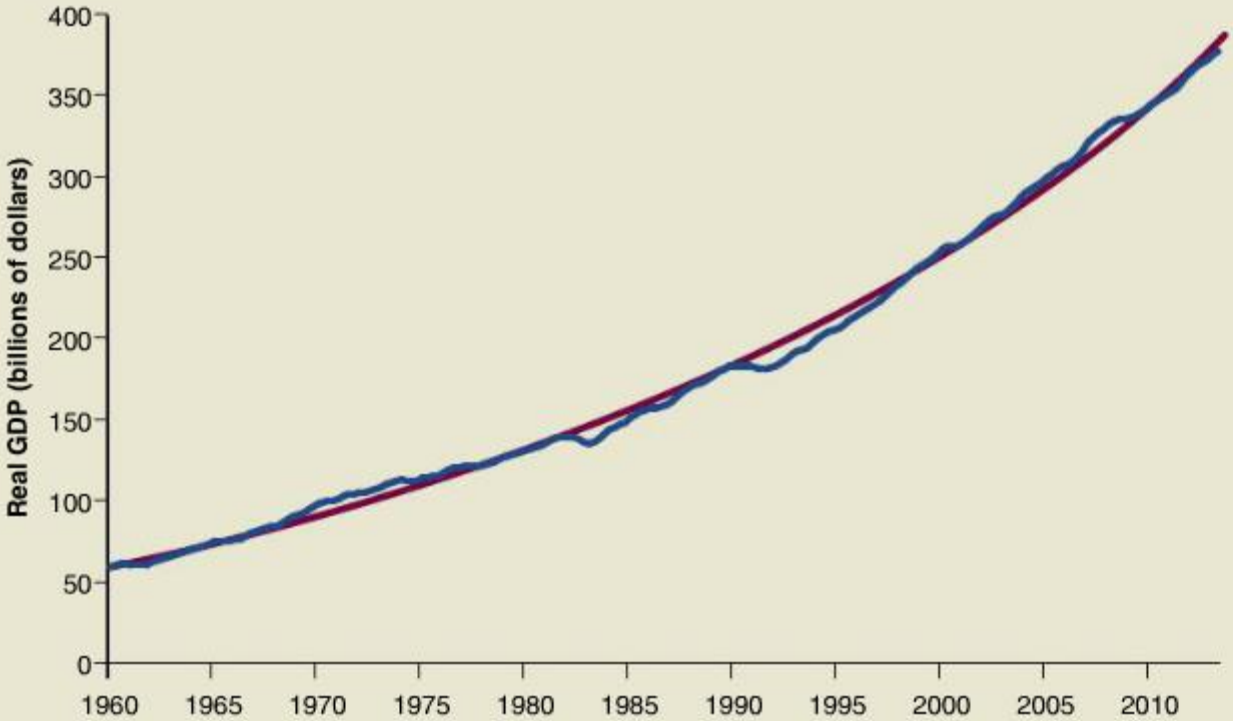


FIGURE 5.2

Actual and potential GDP, Australia, 1960–2013

Potential GDP increases every year as the labour force and the capital stock grow and technological change occurs. The smooth red line represents potential GDP and the blue line represents actual real GDP. Because of the business cycle or economic shocks, actual real GDP has sometimes been greater than potential GDP and sometimes less

We can apply this model to an entire economy. So in the short-run of a year, the Australian economy will have a potential output (GDP) against which actual output (GDP) can be measured to arrive at capacity utilization. As this figure shows sometimes the economy is above capacity, other times below.

Here is an example of changes in the US consumer economy leading up to the Great Depression.

As we can see there was a vast increase in the percentage of Americans owning various consumer good and amenities during the 1920s.

But many of these markets were reaching saturation amongst consumers who could afford to buy such goods and part of the reason for the severity of the downturn was that there was too much productive capacity and not enough demand. The result was significant **capacity underutilization**.

Percentage of Americans Owning Selected Items

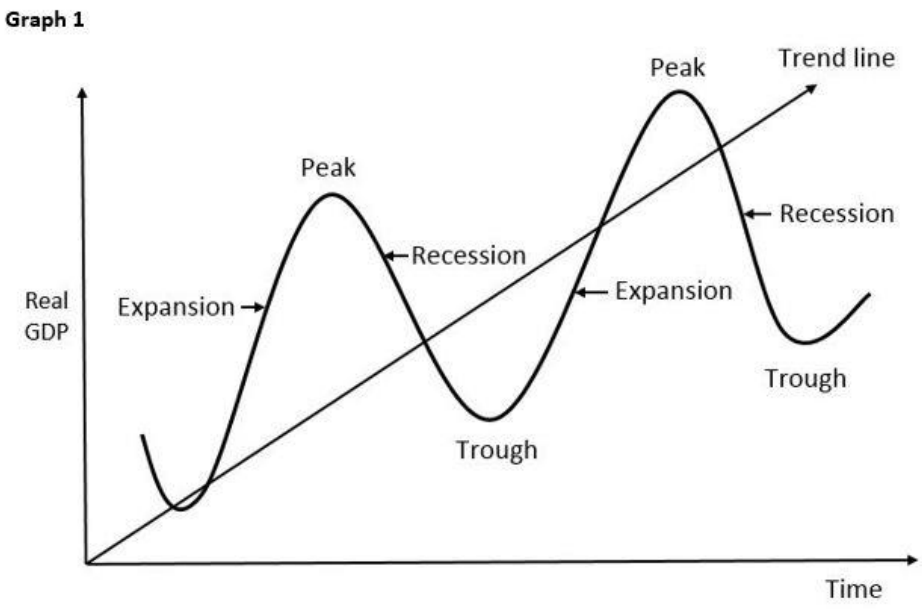
Item	1920	1930
Autos	26%	60%
Radios	0%	46%
Electric lighting	35%	68%
Washing machines	8%	24%
Vacuum cleaners	9%	30%
Flush toilets	20%	51%

Source: Stanley Lebergott, *Pursuing Happiness: American Consumers in the Twentieth Century* (Princeton: Princeton University Press, 1993), pp. 102, 113, 130, and 137.

Business cycles

- Capacity utilization forms one underlying cause of (though not the only one) of business cycles – the alternation between slack periods where actual short-run output is below potential capacity, and ‘overheated’ periods where short-run actual output is above potential.
- A basic conceptual definition of a business cycle is fluctuation of actual output around potential as the prior graph of Australian fluctuations showed.

- Here we see a conceptual map of business cycles. There is the trend across time of potential output. This is our long-run trend.
- But then there are the short-run fluctuations of actual output around the trend which can vary in both length of time (wave or cycle length) and severity (wave amplitude). Trends also peak and trough – i.e. top and bottom out.



http://www.higherrockeducation.org/glossary-of-terms/business-cycle

The technical definition of a recession however is two quarters of negative GDP growth. That is related to but not exactly the same measure as what is presented above.

FIGURE 5.6

Movements in real GDP, Australia, 1980–2013

In 1982–1983 the Australian economy entered a recession, quickly recovered to reach a peak in 1985 only to go into an economic contraction in 1986. The subsequent expansion was short lived with a fall in the rate of economic growth commencing in 1990, with the economy then entering a recession. The expansion that began after 1991 continued throughout the late 1990s until 2008–2009, when a short contraction occurred—the result of the effects of the GFC. Since then, economic growth has occurred, although mostly below trend

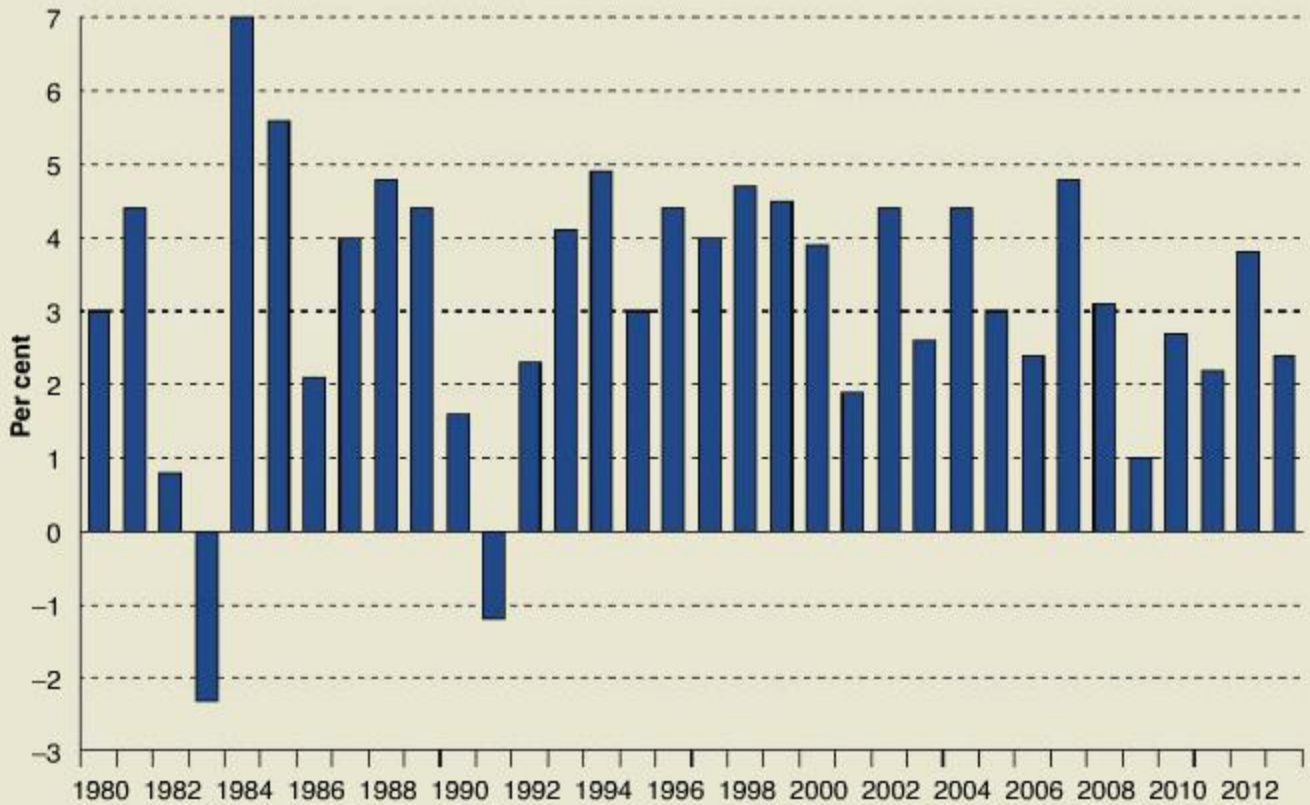
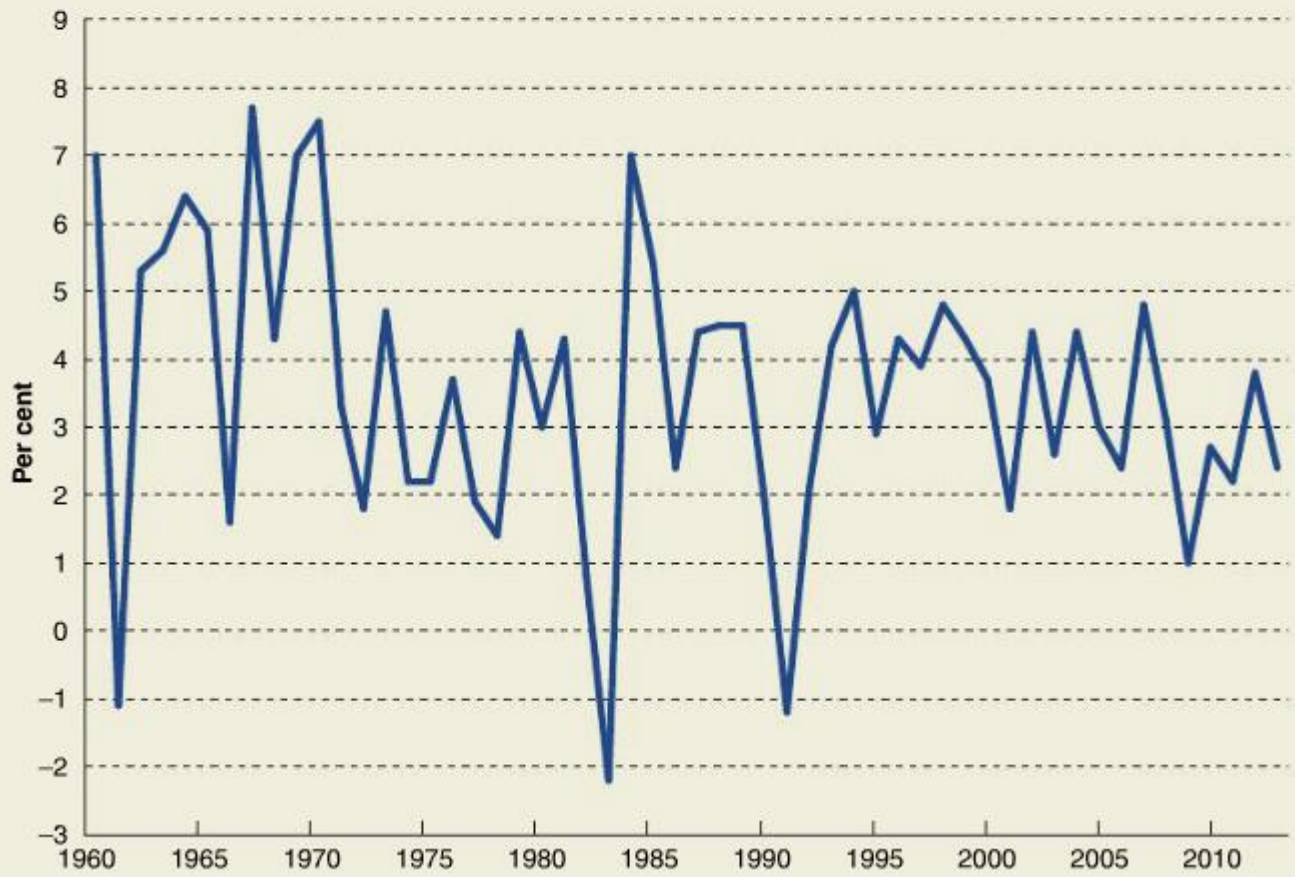


FIGURE 5.10

Fluctuations in economic growth, Australia, 1960–2013

From the 1960s to the early 1990s economic growth had much more severe swings than it has had since the early 1990s



Business cycles have become less extreme (until the GFC)

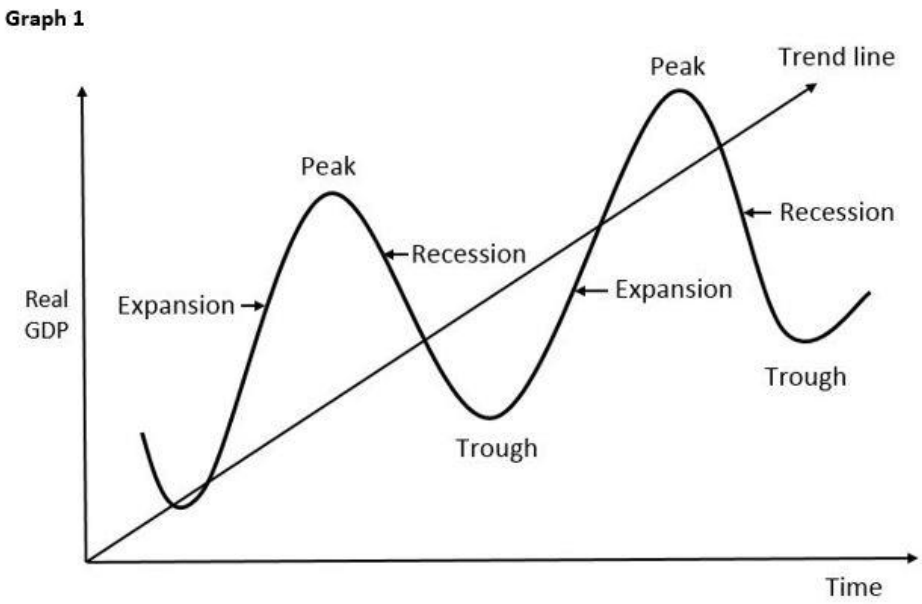
- Why? Three things stand out.
- (1) The shift from manufacturing to services -- Manufacturing and other goods production requires long-term investment in capacity and so it is easier to have mismatch between actual demand and potential in the short-run. Service investments are more flexible.
- (2) Government policies – management of the business cycle by government and the increase in transfer payments has helped cushion the impacts of fluctuations which can feed on each other and increase cycle severity, e.g. unemployed people now have benefits which help them spend more and thus support the economy more.
- (3) Financial sector stability – until the GFC financial sectors around the world have been more stable and more regulated.

A quick word on the GFC

- Similar to the Great Depression (though keeping in mind that history does not repeat itself exactly), the GFC began with a financial crisis which then turned into a real economy crisis.
- Explicit and de facto deregulation of financial institutions in the US was part of the reason for the financial crisis.
- Not all business cycles – most in fact – start with a financial crisis. These are in a class all their own. More on this later.

Long-run v short-run policy

- So, to sum up:
- Macroeconomic management involves managing the cycles around the trend.
- Long-term growth policy involves increasing the slope of the line upward.



AD-AS Model

- We have not yet gotten to this yet but soon we will be working with a macro-model of the short run economy – AD and SRAS (for Short-Run Aggregate Supply) – or AS for short.
- The Growth Model we have been considering today is focus on the LRAS curve – the Long Run Average Supply curve – which refers to the full potential of the economy at any given point of time.
- We want this LRAS to be as high as possible AND we want it to be shifting outward (i.e. growing) over time. These dimensions are what the Solow-Swan model is focused on modeling and explaining and predicting.

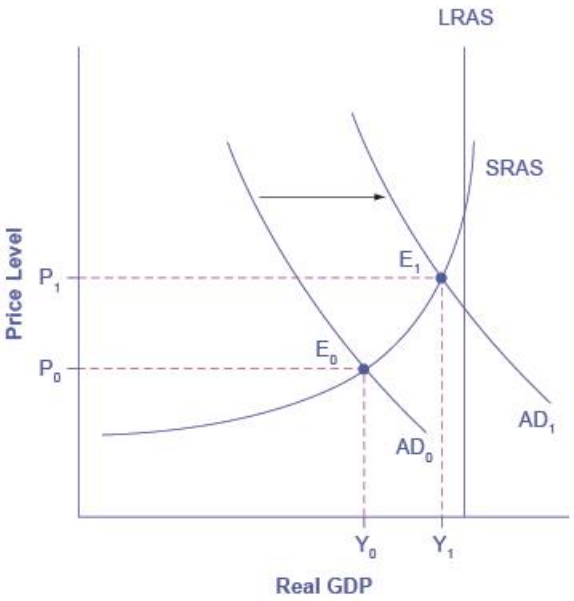


Image credit: *Figure 2* in "Shifts in Aggregate Demand" by OpenStaxCollege, CC BY 4.0