

Economic Growth: Past, Present and Future

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1. Introduction



1.1 What is Economic Growth?



- *Economics*

- Economists are concerned with the provision of goods and services to which the population has access

- *Economic Growth*

- the total amount and/or the quality of the provided goods and services increases over time
 - either in absolute terms
 - or in per-capita terms



1.2 How is Economic Growth Measured ?



- real gross domestic product (GDP) is the most common measure

Definition The **real GDP** in a given year is the value of all domestically produced goods and services net of all intermediate inputs at market prices of the previous year.

- GDP is closely related to (but not the same as) *national income*, i. e., total income in the form of wages, rents, interest, and profits earned in a country in a given year
- economic growth

Definition There is **economic growth** if real GDP increases in absolute terms and/or in per-capita terms over time.



Remark

- real GDP may be a misleading indicator for the provision of goods and services to which the population has access
 - GDP leaves out non-market activity, e. g., work in the home
 - car accidents and natural disasters like earthquakes or floods increase real GDP
 - measuring the output of services is difficult (“imputations” rather than measurement and productivity growth in services goes largely unmeasured)
 - GDP suffers from an understatement of improvements in quality or of the benefits associated with radically new goods
 - the distinction between GDP and gross national product (GNP) may matter, e. g., for Luxembourg or the State of Kuwait
 - GDP per-capita neglects the distribution of income across the population



- however, per-capita GDP is often correlated with other indicators of the quality of life such as
 - per-capita consumption
 - life expectancy
 - life evaluation
 - literacy rate
 - infant mortality
 - health
 - education
- or even with sophisticated welfare measures (see, e. g., Jones and Klenow (2016), *Beyond GDP? Welfare Across Countries and Time*, American Economic Review, 106, pp. 2426-2457)



1.2 How is Economic Growth Measured ?

The association between income per capita and consumption per capita in 2000

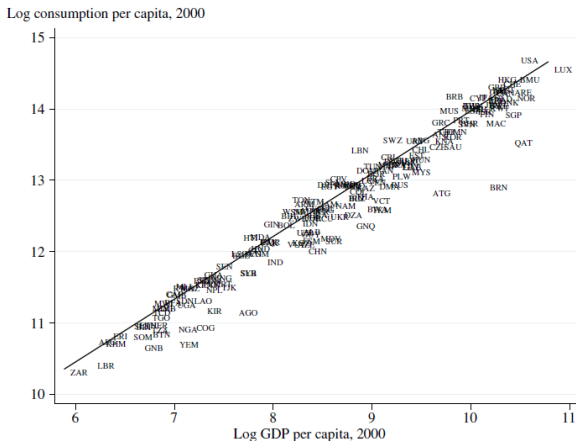


Figure: Daron Acemoglu (2009), *Introduction to Modern Economic Growth*, Princeton University Press, p.7



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2. The World's Economic History in 3 Figures, 1 Photo, and 1 Table



2.1 Per-Capita GDP in the Long-Run



Per-Capita GDP in Western Europe - the Long-Run Perspective 0 - 2000

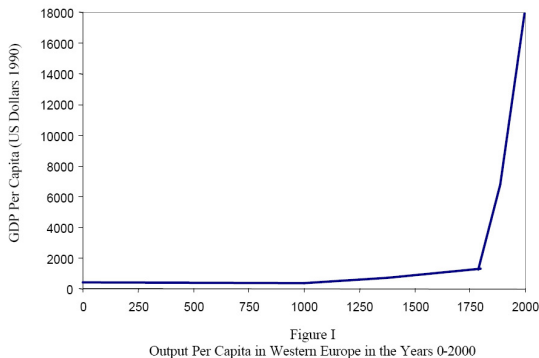


Figure: O. Galor and O. Moav (2002), *Natural Selection and the Origin of Economic Growth*, Quarterly Journal of Economics, vol. 117, 1133-1191



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- since 1870, the average annual growth rate of per-capita GDP in Western Europe has been roughly at 2%
- Is this noticeable? **YES**
 - variable that grows at some constant rate per year, say by g per cent, doubles its value every $70/g$ years
 - between 1870 and 2010 per-capita GDP increased by a factor of 16
- Robert E. Lucas, Jr. (Nobel Prize Winner 1995)

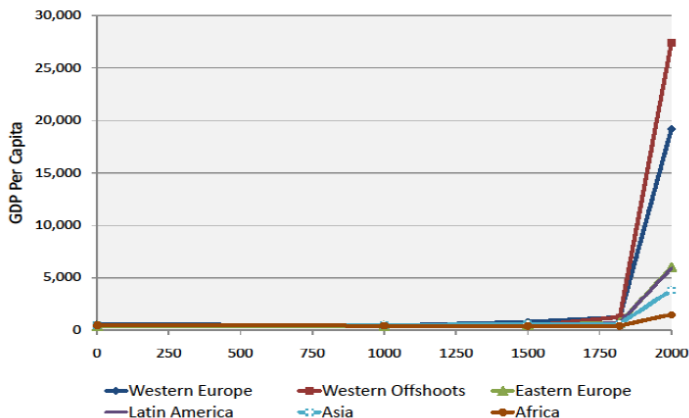
For the first time in history, the living standards of the masses of ordinary people have begun to undergo sustained growth ... Nothing remotely like this economic behavior has happened before.



2.2 The Great Divergence - 1820 to today



Figure: GDP per Capita Across Regions 1-2000 (Data Source: Angus Maddison (2001), *The World Economy: A Millennial Perspective*, OECD, Paris.)



Main Findings on the Great Divergence

- world income distribution in 1820
 - all regions have a low income
 - the richest region is 3 times as rich as the poorest region
 - however, there are big income differences within regions and countries



- world income distribution 2000
 - some regions are very rich, others are still very poor
 - the richest region - Western Offshoots - is 18 times as rich as the poorest - Africa
 - roughly 75% of the world's population lives with less than the world's average income
 - the 20% of world population that lives in the richest countries earns roughly 60% of world income



Today's World Income Distribution From Outer Space

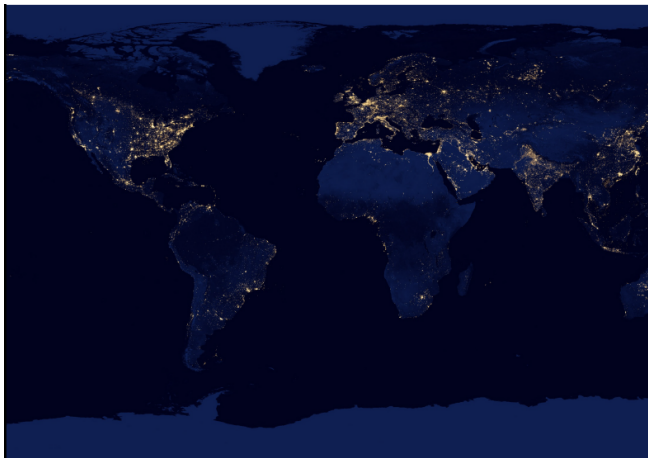


Figure: David N. Weil (2013), *Understanding Economic Growth*, Presentation at Johns Hopkins University, April 18, 2013



2.3 Economic Growth in Recent Decades



2.3.1 Global Growth



Average Yearly Growth Rates of Worldwide GDP Per-Capita 1950 - 2000 (Weighted by Population)

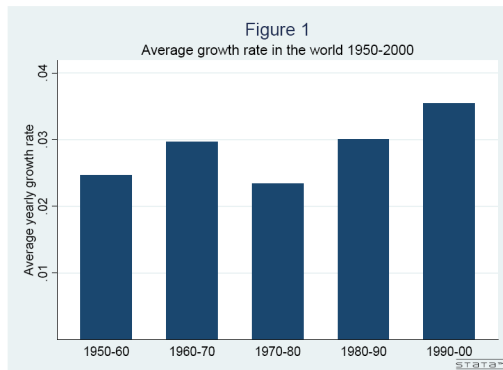


Figure: F. Zilibotti (2008), *Economic Possibilities of Our Grandchildren 75 Years After: a Global Perspective*, in: L. Pecci and G. Piga (eds.), *Revisiting Keynes: Economic Possibilities of Our Grandchildren*, MIT Press, Cambridge



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Main Findings on Recent Global Growth

- average yearly growth rates between 2.4% and 3.5% are substantial
- roughly 72% of the current world population lives in countries where income per capita at least doubled between 1960 and 2000



2.3.2 Declining Growth in the Rich Countries



- there is a slowdown of GDP per capita growth in the world's richest countries over the post-World War II period

Decade	1960-69	1970-79	1980-89	1990-99	2000-09
average growth rate p.a.	4%	2.5%	2.2%	2.2%	0.9%

Table: Average annual growth rates of per-capita GDP over recent decades in 24 rich countries (Angus Deaton (2013), *The Great Escape*, Princeton University Press, p. 231).

3. On the Future of Economic Growth



3.1 Remarks on Economic Forecasting



- a common adage

Never make forecasts, especially not about the future.



- Kaiser Wilhelm II (1859 - 1941 - last German Kaiser and Prussian King)

“Ich glaube an das Pferd. Das Automobil ist eine vorübergehende Erscheinung.”
(*“I believe in the horse. The car is a temporary phenomenon.”*)

- Thomas Watson, chairman of IBM, 1943

“I think there is a world market for maybe five computers.”

- Lewis Strauss, Chairman, US Atomic Energy Commission, 1954

“It is not too much to expect that our children will enjoy in their homes [nuclear generated] electrical energy too cheap to meter.”

Two Difficulties with Forecasts of Economic Growth



1. The object of analysis - the economy - is subject to frequent change

- economic activity hinges on political, institutional, geographic, demographic and technological factors and vice versa
- changes in these dimensions occur often and are difficult to predict
 - Arab Spring starting in December 2010 in Tunisia
 - the fall of the iron curtain in 1991
 - global warming
 - migration of refugees
 - inventions from the steam engine (patented in 1781 by James Watt) to smart phones of today



2. Feedback effects make the prediction of human behavior complicated

- human behavior is forward looking
- today humans do not know what they will know in the future
- expectations about the future matter
- human acting today is based on
 - individual expectations about the future
 - individual expectations about other individuals' expectations about the future



- a forecast of economic growth
 - is essentially a prediction about (aggregate) human behavior
 - affects individual expectations about future economic activity and, hence, their economic behavior today
 - this feedback affects the validity of the initial forecast

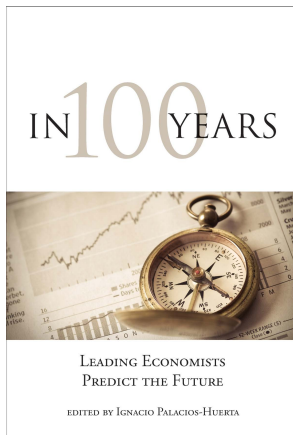


Natural Sciences versus Social Sciences and the two Difficulties

1. Difficulty: in the natural sciences the object of analysis ("nature") is more stable
 - there are various laws of nature that stand the test of time (e. g., the Newtonian gravitation law)
 - laws may be discovered through natural experiments
2. Difficulty: in the social sciences there are no feedback effects of the kind described above
 - Meteorology - the interdisciplinary science of studying the atmosphere - is about a natural phenomenon
 - a weather forecast will not change the course of the weather



- nevertheless, there are interesting attempts to predict the future of economic growth (see, Ignacio Palacios-Huerta (2014), MIT Press)



3.2 Welfare and Growth



3.2.1 The “Stiglitz Report”



- *Report by the Commission on the Measurement of Economic Performance and Social Progress (2009) or “Stiglitz Report”*
 - initiated in 2008 by the then President of the French Republic, Nicholas Sarkozy, to
 - identify the limits of GDP as an indicator of economic performance and social progress
 - consider what additional information might be required for the production of more relevant indicators of social progress
 - assess the feasibility of alternative measurement tools and their presentation
- basic premise

“The welfare of a nation can scarcely be inferred from a measurement of national income.” (Simon Kuznets, 1934)



- two challenging questions

1. What constitutes the “welfare of a nation”?
2. How should welfare or facets thereof be measured?



ad 1. the “Welfare of a Nation” according to the Stiglitz Report

- the welfare of a nation is reflected in the *well-being* of its citizens
- individual well-being is a multi-dimensional concept
- it includes 8 dimensions that should be considered simultaneously
 - 1 material living standards (income, consumption and wealth)
 - 2 health
 - 3 education
 - 4 everyday activities (including the right to a decent job and housing)
 - 5 participation in the political process
 - 6 social connections and relationships
 - 7 natural environment (present and future conditions)
 - 8 personal and economic security



ad 2. recommendations concerning the **measurement** of welfare

- overriding principles
 - shift emphasis from measuring economic production to measuring people’s well-being
 - measures of well-being should be put in a context of sustainability
- there are 12 detailed recommendations; they include
 - use net national income (NNI), real household income and consumption instead of per-capita GDP, and consider wealth
 - emphasize the distribution of income, consumption, and wealth
 - use measures of subjective well-being, e. g., happiness
 - include environmental aspects of sustainability



A Remark on National Income Accounting

GNP (Gross National Product) or GNI (Gross National Income)

- Depreciation of Capital

NNP (Net National Product) or NNI (Net National Income)

- Indirect Taxes on Products
- + Subsidies on Products

National Income or Personal Income

- Personal Taxes
- + Non-Tax Payments

DPI (Disposable Personal Income)



3.2.2 Does Economic Growth Increase Individual Well-being?



- two approaches
 - **1st Approach** measurement of individual dimensions of well-being using individual indicators
 - **2nd Approach** construct a welfare index, i. e., a composite index

Approach 1: Measurement of Individual Dimensions of Well-Being



Example 1: Life Expectancy as an Indicator of a Nation's Health

The Preston Curve: Life Expectancy versus GDP Per Capita

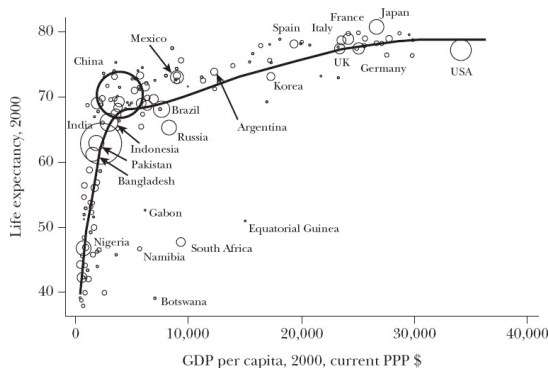


Figure: D. Cutler, A. Deaton, and A. Lleras-Muney (2006), *The Determinants of Mortality*, Journal of Economic Perspectives, vol. 20(3), 97-120

Example 2: Life Evaluation and per-capita GDP in the Gallup World Poll (Linear Scale)

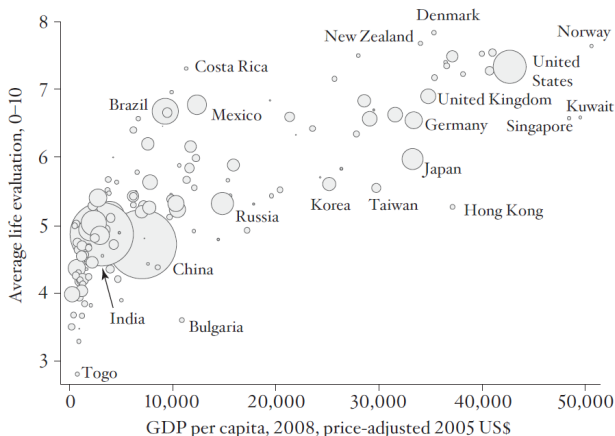


Figure: Angus Deaton (2013), *The Great Escape*, p. 18



3.2.2 Does Economic Growth Increase Individual Well-being ?

Life Evaluation and per-capita GDP in the Gallup World Poll (Logarithmic Scale)

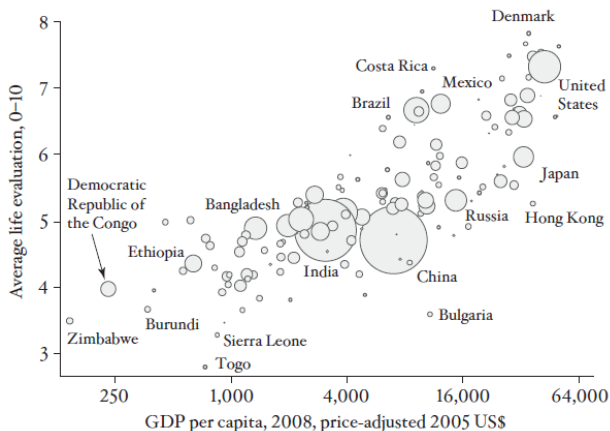


Figure: Angus Deaton (2013), *The Great Escape*, p. 21



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Main Observations

- there is a positive association between life-expectancy and per-capita GDP as well as for life evaluation and per-capita GDP
- life expectancy and per-capita GDP
 - positive association is very strong for poor countries and weaker at high levels of per-capita GDP
 - there seems to be a tendency of satiation
- life evaluation and per-capita GDP
 - Gallup World Poll: the same proportional change in per-capita GDP leads to a constant and positive gain in life evaluation at **all** income levels
 - this contradicts older findings based on the World Value Survey that suggest satiation at high levels of of per-capita GDP



Approach 2: Construct a Welfare Index



Example 3: The welfare index of Jones and Klenow (2016), *American Economic Review*

- **idea:** per capita consumption, leisure, and life expectancy increase welfare, inequality decreases welfare
- **advantage:** there are data on these variables for many countries and time spans
- **findings**
 - per-capita GDP is highly correlated (0.96) with the welfare index across a broad range of countries
 - nevertheless, differences are often important: typical deviation is 27%
 - Western Europe is much closer to the U.S. when Europe's longer life expectancy, additional leisure, and lower inequality is taken into account, e. g., for the year 2000

$$\frac{\text{per-capita GDP U.S.}}{\text{per-capita GDP France}} = 1.43 \quad \frac{\text{welfare U.S.}}{\text{welfare France}} = 1.06$$



3.2.2 Does Economic Growth Increase Individual Well-being ?

Welfare and income are highly correlated at 0.96.

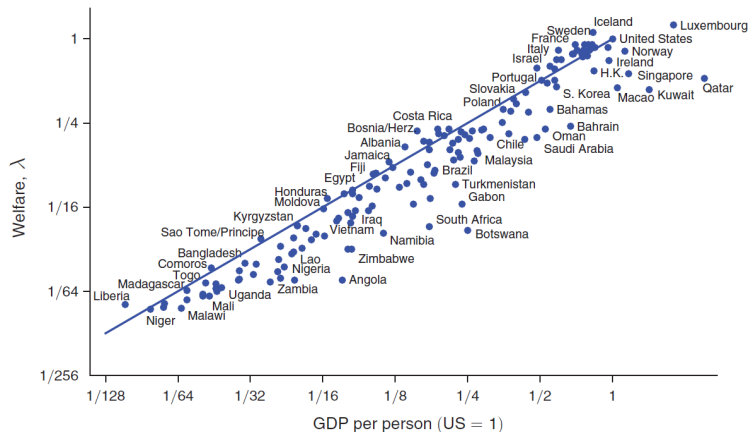


Figure: Jones and Klenow (2016), p. 2451



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Example 4: The Happy Planet Index (HPI) of the New Economics Foundation

- there are 151 countries indexed
- HPI for country i

$$HPI_i = \frac{\text{life expectancy}_i \times \text{average life satisfaction}_i}{\text{ecological footprint}_i}$$

- current ranking of countries (<http://www.happyplanetindex.org/data/>, accessed on April 8, 2016):

1st Costa Rica, 2nd Vietnam, ... , 12th Cuba, ... , 16th Pakistan, ... , 26th Algeria, ... , 36th Iraq, ... , 39th Tunisia, ... , 46th Germany, ... , 105th USA, ... , 138th Luxembourg, ... , 149th Qatar

- what to make out of such a ranking?



Assessment

- what we measure affects what we do; if our measurements are flawed, decisions may be distorted
- a broad set of welfare measures is welcome
- like GDP or per-capita GDP, even allegedly simple indices of welfare must be interpreted with care



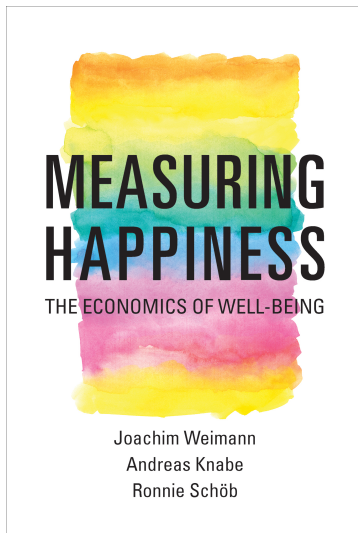
- complex welfare indices aggregate a lot of information into a single number
 - it may be hard to interpret the evolution of such an index in a sensible way
 - conceptually, the question arise about which components to include and how to weight them
 - what is the right welfare index? there are many candidates, e. g., Human Development Index (UN), Happy Planet Index, Sustainable Development Indicator (Eurostat), Gross National Happiness (Buthan), Jones and Klenow (2016) ...



- why not using GDP or GDP per capita as a welfare index ?
 - GDP per capita is highly correlated with per-capita consumption, life expectancy, literacy rates, education and other variables reflecting quality of life
 - GDP or GDP per capita are difficult to manipulate - at least in the industrialized world - since these measures are largely generated by market processes
 - value judgements of elites pretending to know what indicator ought to be used to measure the welfare of a country will have little influence

3.2.2 Does Economic Growth Increase Individual Well-being ?

- for more on this, see Joachim Weimann, Andreas Knabe and Ronnie Schöb (2015), MIT Press



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3.3 Growth and the Two Main Challenges to our Current Standard of Living



3.3.1 International Competitiveness



- real GDP growth is due to
 - an expansion of the variety of goods and services or to improvements in the product quality
 - productivity growth (process innovations, human capital, physical capital)
- inventions, a supply of products with superior quality or cheaper production costs in other parts of the world may reduce real domestic GDP if
 - this leads to domestic unemployment and/or
 - this forces domestic suppliers to reduce their prices in global markets

Implication

- research & development, investments in physical and human capital will be necessary for us to keep real per-capita GDP at its current level



3.3.2 Demographic Challenge: Population Aging



- the old-age dependency ratio, i. e., the ratio of the economically dependent old (population aged 65 and over) to the population of working age (population between 15 and 64), will increase dramatically

Table: Old-Age Dependency Ratios in Selected Countries and Regions stated as the number of dependents per 100 persons of working age (United Nations (2013)).

Year	World	Europe	Poland	Northern America	China	India	Japan
2005	11	23	19	18	11	8	30
2050	25	47	56	36	39	19	72

Implication of Population Aging

- notation
 - GDP = Real Gross Domestic Product
 - N = Population
 - L = Employed Labor Force

$$\frac{GDP}{N} = \left(\frac{GDP}{L} \right) \times \left(\frac{L}{N} \right),$$

per-capita GDP = labor productivity \times participation rate

- since population aging reduces the participation rate, growth of labor productivity will be necessary to maintain the average standard of living in Europe and elsewhere



Some Recent Empirical Findings

- Irmen and Litina (2016), *Population Aging and Inventive Activity*
 - a panel of 33 OECD countries over the period 1960-2012
 - the relationship between innovative activity (patents per 1000 inhabitants) and population aging (old-age dependency ratio) is hump-shaped
 - societies that are not too old are expected to increase their inventive activity as they get older
 - this tendency is an attempt to raise the productivity of the future labor force



- Acemoglu and Restrepo (2017), *Secular Stagnation? The Effect of Aging on Economic Growth in the Age of Automation*
 - key finding: countries that
 - aged faster since the early 1990s
 - adopted new automation technologies, in particular industrial robots, faster
 - grew faster



3.3.2 Demographic Challenge: Population Aging

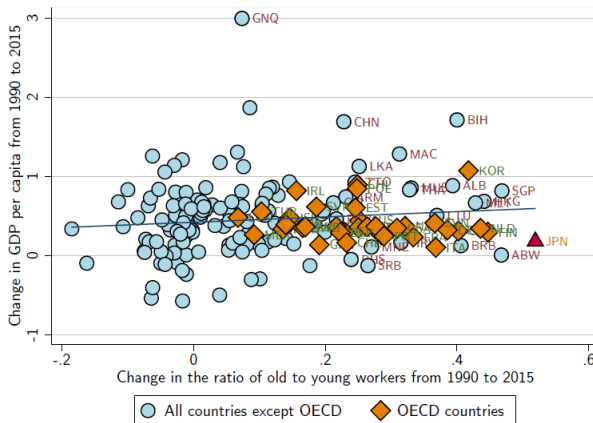


Figure: Correlation between aging and growth in GDP per capita (in constant dollars). Aging is defined as the change in the ratio of the population above 50 years old to the population between 20 and 49. GDP per capita data from the Penn World Tables (Acemoglu and Restrepo (2017), p. 2).

3.3.2 Demographic Challenge: Population Aging



Figure: Correlation between change in the ratio of old to young workers between 1990 and 2015 and change in robots per million hours worked between 1993 and 2014 (from the International Robotics Federation); (Acemoglu and Restrepo (2017), p. 6).

3.4 Remarks on Sustainable Development



3.4.1 The Concept of Sustainable Development



- the Oxford Dictionary defines the adjective “sustainable” in English as

Able to be maintained at a certain rate or level.

(<http://www.oxforddictionaries.com/definition/english/sustainable> - accessed on March 30, 2015)

- Sustainable Development is
 - not necessarily connected to economic growth
 - not a precise concept nor can it be made precise
 - not an exact guide to policy
 - ... but then, what is it?



Which of the following evolutions is sustainable and which is not ?

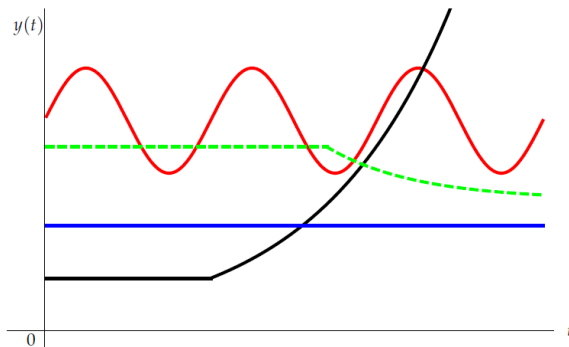


Figure: Let $y(t)$ denote per-capita GDP or any other variable that depends on time t .

“Sustainability” - Etymology

- the term sustainability (“Nachhaltigkeit”) was first used by Hans Carl von Carlowitz (1645 - 1714) who managed mining on behalf of the Saxon court in Freiberg, a city in today’s Free State of Saxony, a German Land
- the term appears in his work “Sylvicultura Oeconomica oder Anweisung zur wilden Baum-Zucht” (Sylvicultura Oeconomica or the Instructions for Wild Tree Cultivation) published in 1713
- historical and economic background
 - despite the forest regulations of the Saxon court, the impact of timber shortages on Saxony’s silver mining and metallurgy industries was devastating
 - the “sustainable use” of the forest: only so much wood should be cut as could be regrown through planned reforestation projects

Sustainable Development - Definitions

- there are several definitions of sustainable development
- all of them
 - share an “intergenerational” perspective
 - are fairly imprecise
- the “classic” definition: United Nations Commission on Environment and Development (Brundtland Commission, 1987, page 41)

***Definition 1** Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*



Problems with Definition 1

- what defines “the needs of the present”? - in the rich countries, the average levels of consumption are a large multiple of human needs
- what defines the needs of future generations? - tastes and preferences of future generations are unknowns today
- what determines the “ability of future generations to meet their own needs”? - available technology in 100 years from now is largely unknown today
- for how many future generations do we care?

Problems with Definition 1 (cont.)

- the definition of the Brundtland commission is much easier to apply in an ex post sense (i. e., looking backward in time) than in an ex ante sense (i. e., looking forward in time)
 - if shortages of natural resources cause declines in the standard of living, then future observers will correctly conclude that economic growth today was unsustainable
 - if world income per capita grows steadily over the next 200 years, then it will be true that today's economic development was sustainable
 - since we cannot see into the future, it is hard to know which of these scenarios will happen

Alternative Definitions

- Robert M. Solow (1991), *Sustainability: An Economist's Perspective*, 18th J. Seward Johnson Lecture, p. 181

Definition 2 Sustainability is an obligation to conduct ourselves so that we leave to the future the option or the capacity to be as well off as we are.

- a more recent definition of sustainable development stems from Jeffrey Sachs (2015), *The Age of Sustainable Development*, Presentation at the International Growth Center of the London School of Economics, February 4, 2015 (<http://docplayer.net/13806321-The-age-of-sustainable-development.html>, accessed on April 20, 2016)

Definition 3 Sustainable Development is the Holistic Integration of Economic, Social, and Environmental Objectives in an Approach to Scientific Analysis, Governance, Problem Solving, and Human Action.



A Broader Notion of Sustainability

- a meaningful definition of sustainable development cannot be confined to the natural environment
- it must include desirable facet of society that are worth being maintained (peace, law and order, states and markets, etc.)
- in the modern discussion the broader notion of sustainability has a social, an economic, and an environmental dimension
- below I discuss
 - Sustainable Development and the Natural Environment
 - Sustainable Fiscal Policy
 - the sustainable distribution of income and wealth



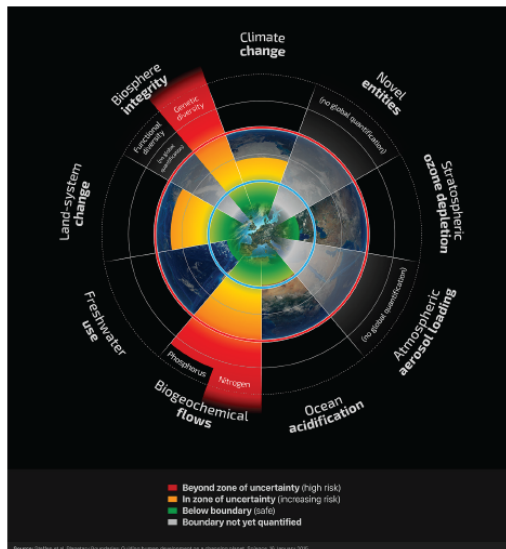
3.4.2 Sustainable Development and the Natural Environment



- continued worldwide economic and population growth has led to unacceptable levels of environmental degradation
 - climate change
 - bio-diversity loss
 - nitrogen loadings
 - change in land use
 - release of novel entities
 - atmospheric aerosol loading
 - global freshwater use
 - ocean acidification
 - stratospheric ozone depletion



Figure: Planetary Boundaries (Will Steffen and Johan Rockström, Science, January 2015)



How can economies develop in a way that respects
the Earth's biophysical boundaries ?



Three Options

1. green growth option

- strive for economic growth and decouple it from material and energy inputs
- problem: rebound effect
 - efficiency improvements often induce changes that reduce, nullify or outweigh environmental and resource benefits
 - example: more fuel-efficient cars reduce the price of transportation by car; hence, people drive more and consume more fuel



Three Options (cont.)

2. encourage growth in sectors that use fewer resources, e. g., the service sector
 - helps temporarily unless it implies the shift of production of resource-intensive products and their environmental burdens abroad
3. limit economic growth (no-growth or 'degrowth' option)
 - in theory, this allows for substantial reductions, e. g., in greenhouse-gas emissions

Assessment

- there is no good solution to the problem of continuing environmental degradation
- international policy coordination on energy and climate issues is weak at best
- technical progress that helps to overcome the scarcity of natural resources is welcome but not sufficient
- if no-growth or 'degrowth' is the solution, how do we need to adapt institutions and regulations in our open societies in the face of tougher distributional conflicts?

3.4 Why Politicians Love Economic Growth



- Chancellor Merkel's government declaration, November 10, 2009

Ohne Wachstum keine Investitionen, ohne Wachstum keine Arbeitsplätze, ohne Wachstum keine Gelder für die Bildung, ohne Wachstum keine Hilfe für die Schwachen. Und umgekehrt: Mit Wachstum Investitionen, Arbeitsplätze, Gelder für die Bildung, Hilfe für die Schwachen und - am wichtigsten - Vertrauen bei den Menschen.

Without growth no investments, without growth no jobs, without growth no money for education, without growth no support for the aged and infirm. And vice versa: growth breeds investments, jobs, money for education, support for the aged and infirm, and - most importantly - trust among the people.

Sans croissance pas d'investissements, sans croissance pas d'emplois, sans croissance pas d'argent pour l'éducation, sans croissance pas de support pour ceux qui sont économiquement faibles. Et inversement, la croissance génère des investissements, des emplois, de l'argent pour l'éducation et pour l'aide de ceux qui sont économiquement faibles, et - ce qui est le plus important - elle crée de la confiance chez les gens.



3.4.1 Okun's "Law"



- Okun's "Law" is about the relationship between economic growth, jobs, and unemployment
- Weiman, Knabe, and Schöb (2015), *Measuring Happiness*, p. 131: **unemployment matters a lot**

Unemployment makes you unhappy! There is probably no other result in happiness research for which there is anywhere nearly as much evidence.... According to the data, unemployed people judge their lives unhappy even if the influences of income and health are removed.

- Okun's "Law"

- is the empirical observation that faster growth of aggregate output (GDP) leads to a decrease in unemployment (it is not (!) a law)
- says for the US that
 - it takes a growth rate of about 3% of GDP to keep the unemployment rate constant
 - on average an increase in the growth rate of GDP of 1% decreases the unemployment rate by roughly -0.4 percentage points



- Okun's "Law" suggests that
 - some GDP growth is necessary to prevent the unemployment rate from rising
 - GDP growth is a countervailing force to
 - population growth and a growing labor force
 - labor productivity growth
 - a policy that accelerates GDP growth reduces the unemployment rate

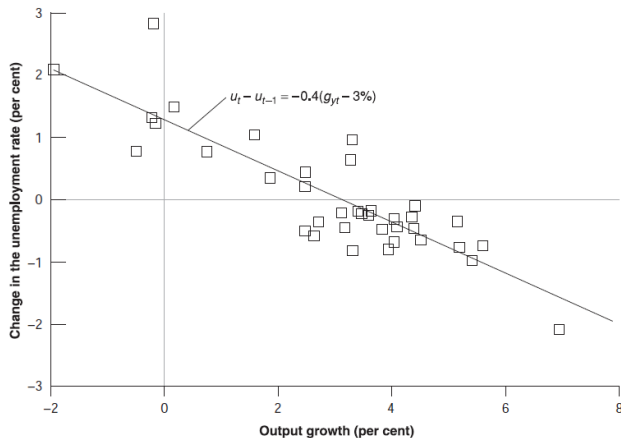


Figure: Okun's Law: Changes in the Unemployment Rate versus Output Growth in the USA, 1960-2010, Blanchard et al. (2013), *Macroeconomics - A European Text*, p. 29

Okun's "Law" and a Linear Aggregate Production Function

- notation
 - GDP = Real Gross Domestic Product
 - N = Labor Supply
 - L = Employed Labor Force
 - A = Labor Productivity
 - g_x = Growth Rate of Variable x
 - Aggregate Production Function

$$GDP = A \times L$$



- u = Unemployment Rate

$$u = \frac{N - L}{N} = 1 - \frac{L}{N} = 1 - \frac{GDP}{A \times N}$$

- \dot{u} = Change in the Unemployment Rate

$$\dot{u} = (-g_{GDP} + g_L + g_A) u$$

- hence, the unemployment rate increases if the growth rate of GDP falls short of the sum of the growth rates of labor productivity and labor supply, i. e.,

$$\dot{u} \geq 0 \quad \Leftrightarrow \quad g_L + g_A \geq g_{GDP}$$

3.4.2 Sustainable Fiscal Policy



Definition A fiscal policy is called **sustainable** if the ratio of the stock of nominal debt to nominal GDP remains constant over time

- this ratio states the number of years an economy would need to redeem its national debt if it paid its entire nominal GDP
- according to the Maastricht Treaty, this ratio must not exceed 60%
- 60% means 0.6 “GDP years” or $0.6 \times 12 = 7.2$ “GDP months”
- however, since 1992 the first twelve states of the Euro area are above this threshold



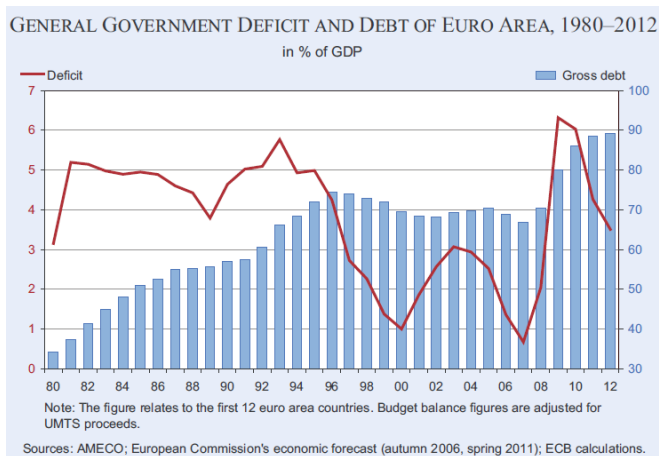


Figure: Ludger Schuknecht et al. (2011), *The Stability and Growth Pact*, DICE Report 3/2011, p. 10

- for a government that runs a balanced budget, a sustainable fiscal policy requires that the growth rate of real GDP is at least equal to the real interest rate to be paid on government bonds
- in case of a budget deficit the required growth rate of real GDP is even higher

Implication

- as long as the real interest rate of government bonds is strictly positive, indebted countries need economic growth
- governments of excessively indebted countries may pick economic growth as a primary policy objective without regard to the environmental consequences



3.5 Remarks on the Role of Economic Theory



3.5.1 Positive Issues



Positive Issues: What does Classical Growth Theory predict ?

1. Thomas Malthus (1766 - 1834): “Essay on the Principle of Population” (1798)

- population growth will outrun growth in food supply, if not kept in balance by ‘positive’ and ‘preventive’ checks
- positive checks: a larger population means a larger labor supply while labor demand is constant due to the limited availability of cultivatable land; real wages fall leading to starvation and famine
- preventive checks: lower wages reduce the birth rate
- as a result, the population size remains constant at subsistence incomes



- history proved Malthus wrong
 - historical and recent evidence shows that income is negatively correlated with the reproduction rate
 - huge efficiency gains in agricultural yields allowed to feed a tremendously growing world population during the 19th and 20th century



2. John Stuart Mill (1806 - 1873): “Principles of Political Economy” (1884)

- the ultimate state towards which the industrial progress converges is a **stationary state**
- unlimited growth has to result in the destruction of the environment and to a reduced quality of life
- instead of accepting population growth and aiming to ever increasing material wealth, a state of constant wealth and population with increasing “happiness” is desirable



- some modern authors come to similar conclusions
 - Club of Rome (1972) “The Limits to Growth” (Meadows, Randers, Meadows and Behrens): growth will reach its limits before 2100



Positive Issues: What does Modern Growth Theory predict?

1. Neoclassical Growth Theory (Ramsey (1928), Solow (1956), Swan (1956), Cass (1965), Koopmans (1965))

- focus on capital accumulation as an engine of growth
- central prediction: economies converge to a stationary state (without growth of per-capita variables)
- reason for long-run growth of GDP is (exogenous) population growth
- neoclassical growth theory can be made consistent with the historical experience of exponential growth of per-capita GDP by adding the assumption of a constantly growing stock of technological knowledge



2. Endogenous Growth Theory (Romer (1990), Grossman and Helpman (1991), Aghion and Howitt (1992))

- focus on technological change as an engine of economic growth
- central results
 - identification of conditions under which sustained economic growth of per-capita variables becomes a possibility
 - explaining why long-run growth rates differ across countries



Example neoclassical growth theory with non-renewable resources

- an economy equipped with a macroeconomic production function $A(t)F(K(t), L(t), R(t))$, where
 - $K(t)$ - capital, $L(t)$ - labor, $R(t)$ - non-renewable resources, $A(t)$ - technological knowledge
- all factors of production
 - are essential for positive output and infinitely substitutable
 - have a positive, yet diminishing, marginal product
- F has constant returns to scale in $K(t)$, $L(t)$, and $R(t)$
- input of the non-renewable resource declines at a constant rate
 $g_R \equiv \dot{R}(t)/R(t) < 0$



- findings

- strictly positive long-run growth of GDP is possible but not guaranteed
- with constant population growth, GDP growth at a strictly positive rate arises only if

$$g_A > c \cdot g_R, \quad c < 0,$$

where c depends on the production function F

- there is growth if technical progress, i. e., the growth in technological knowledge, is sufficiently fast to keep the return to capital constant and to substitute for the input of the non-renewable resource



3.5.2 Normative Issues



Normative Issues: What does Growth Theory recommend?

- neoclassical growth theory
 - What determines the optimal savings/investment rate of an economy?
 - How may policies (e. g., subsidies or taxes) affect the savings rate?
- endogenous growth theory
 - What is the optimal long-run growth rate of an economy?
 - How can it be implemented by economic policy?
 - central results
 - an unregulated economy may provide too much or too little growth
 - a policy that induces maximum growth is never optimal



4. Concluding Remarks - Is the Party Over?



- economic growth is no end in itself
- sustained growth since ca. 1800 became manifest in significant and historically unique improvements in the standard of living and the quality of life
- economic growth brings about leeway and opens opportunities of self-determination and material autonomy



1. The Past of Economic Growth

- sustained economic growth is a recent and unique experience in the economic history of the world
- the world's income distribution today shows huge discrepancies between the rich and the poor nations
- the time span from 1950 to today
 - is likely to be the greatest period of poverty alleviation in the history of our planet (despite all remaining problems!)
 - reveals a petering out of per-capita income growth in the world's richest countries



2. The Future of Economic Growth - Is the Party Over?

- the answer hinges crucially on
 - the evolution of technological knowledge and
 - its usefulness in practice
 - its ability to limit the damages to our natural environment



2. The Future of Economic Growth - Is the Party Over? (cont.)

- opinions diverge ...
 - Tyler Cowen (2011), *The Great Stagnation*, Penguin, US
 - Erik Brynjolfsson and Andrew McAfee (2011), *Race Against The Machine: How the Digital Revolution is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy*, Digital Frontier Press, Lexington, Massachusetts
 - John G. Fernald and Charles Johns (2014), *The Future of U.S. Economic Growth*, American Economic Review, P&P, vol. 104, 44-49
 - Robert J. Gordon (2016), *The Rise and Fall of American Growth: The U.S. Standard of Living since the Civil War*, Princeton University Press, Princeton, New Jersey

3. Growth Policy

- the focus of 'growth policies' in the rich world should be on
 - keeping the current standard of living
 - a sustainable development in a broad sense (environmental, social, fiscal, ...)
- *poor countries* need economic growth to improve their people's standard of living
- they also need our support ...