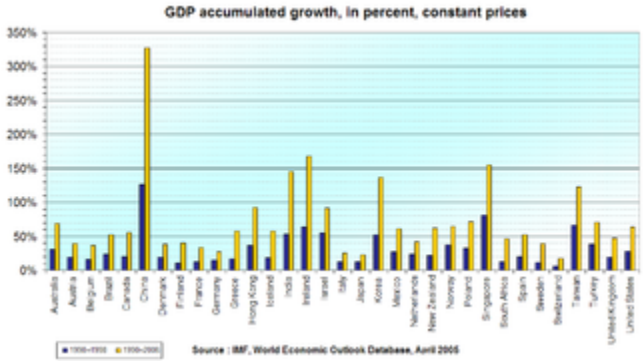
Economic growth



Gross domestic product

real growth rates, 1990–1998 and 1990–2006, in selected countries

Rate of change of gross domestic product, world and Organisation for Economic Co-operation and Development, since 1961

One can define **economic growth** as the increase in the inflation-adjusted market value of the goods and services produced by an economy over time. Statisticians conventionally measure such growth as the percent rate of increase in real gross domestic product, or real GDP.[1]

Growth is usually calculated in *real* terms - i.e., inflation-adjusted terms – to eliminate

the distorting effect of inflation on the prices of goods produced. Measurement of economic growth uses national income accounting.[2] Since economic growth is measured as the annual percent change of gross domestic product (GDP), it has all the advantages and drawbacks of that measure. The economic growth-rates of countries are commonly compared using the ratio of the GDP to population (per-capita income).[3]

The "rate of economic growth" refers to the geometric annual rate of growth in GDP between the first and the last year over a period of time. This growth rate represents

the trend in the average level of GDP over the period, and ignores any fluctuations in the GDP around this trend.

Economists refer to an increase in economic growth caused by more efficient use of inputs (increased productivity of labor, of physical capital, of energy or of materials) as *intensive growth*. In contrast, GDP growth caused only by increases in the amount of inputs available for use (increased population, for example, or new territory) counts as *extensive growth*.[4]

Development of new goods and services also generates economic growth. As it so

happens, in the U.S. about 60% of consumer spending in 2013 went on goods and services that did not exist in 1869.[5]

Measurement

The economic growth rate is calculated from data on GDP estimated by countries' statistical agencies. The rate of growth of GDP per capita is calculated from data on GDP and people for the initial and final periods included in the analysis of the analyst.

Long-term growth

Living standards vary widely from country to country, and furthermore the change in living standards over time varies widely from country to country. Below is a table which shows GDP per person and annualized per person GDP growth for a selection of countries over a period of about 100 years. The GDP per person data are adjusted for inflation, hence they are "real". GDP per person (more commonly called "per capita" GDP) is the GDP of the entire country divided by the number of people in the country; GDP per person is conceptually analogous to "average income".

Economic growth by country[6]

Country	Period	Real GDP per person at beginning of period	Real GDP per person at end of period	Annualized growth rate
Japan	1890-2008	$1,504	$35,220	2.71%
Brazil	1900-2008	$779	$10,070	2.40%
Mexico	1900-2008	$1,159	$14,270	2.35%
Germany	1870-2008	$2,184	$35,940	2.05%
Canada	1870-2008	$2,375	$36,220	1.99%
China	1900-2008	$716	$6,020	1.99%
United States	1870-2008	$4,007	$46,970	1.80%
Argentina	1900-2008	$2,293	$14,020	1.69%
United Kingdom	1870-2008	$4,808	$36,130	1.47%
India	1900-2008	$675	$2,960	1.38%
Indonesia	1900-2008	$891	$3,830	1.36%
Bangladesh	1900-2008	$623	$1,440	0.78%

Seemingly small differences in yearly GDP growth lead to large changes in GDP when

compounded over time. For instance, in the above table, GDP per person in the United Kingdom in the year 1870 was $4,808. At the same time in the United States, GDP per person was $4,007, lower than the UK by about 20%.

However, in 2008 the positions were reversed: GDP per person was $36,130 in the United Kingdom and $46,970 in the United States, i.e. GDP per person in the US was 30% more than it was in the UK. As the above table shows, this means that GDP per person grew, on average, by 1.80% per year in the US and by 1.47% in the UK.

Thus, a difference in GDP growth by only a few tenths of a percent per year results in large differences in outcomes when the growth is persistent over a generation. This and other observations have led some economists to view GDP growth as the most important part of the field of macroeconomics:

> *...if we can learn about government policy options that have even small effects on long-term growth rates, we can contribute much more to improvements in standards of*

> *living than has been provided by the entire history of macroeconomic analysis of countercyclical policy and fine-tuning. Economic growth [is] the part of macroeconomics that really matters.*[7]

Growth and innovation

It has been observed that GDP growth is influenced by the size of the economy. The relation between GDP growth and GDP across the countries at a particular point of time is convex. Growth increases with

GDP reaches its maximum and then begins to decline. There exists some extremum value. This is not exactly middle-income trap. It is observed for both developed and developing economies. Actually, countries having this property belong to *conventional growth domain*. However, the extremum could be extended by technological and policy innovations and some countries move into *innovative growth domain* with higher limiting values.[8]

Determinants of per capita GDP growth

In national income accounting, per capita output can be calculated using the following factors: output per unit of labor input (labor productivity), hours worked (intensity), the percentage of the working-age population actually working (participation rate) and the proportion of the working-age population to the total population (demographics). "The rate of change of GDP/population is the sum of the rates of change of these four variables plus their cross products."[9]

Economists distinguish between short-run economic changes in production and long-run economic growth. Short-run variation

in economic growth is termed the *business cycle*. Generally, economists attribute the ups and downs in the business cycle to fluctuations in aggregate demand. In contrast, economic growth is concerned with the long-run trend in production due to structural causes such as technological growth and factor accumulation.

Productivity

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Increases in labor productivity (the ratio of the value of output to labor input) have historically been the most important source of real per capita economic

growth.[10][11][12][13][14] "In a famous estimate, MIT Professor Robert Solow concluded that technological progress has accounted for 80 percent of the long-term rise in U.S. per capita income, with increased investment in capital explaining only the remaining 20 percent."[15]

Increases in productivity lower the real cost of goods. Over the 20th century the real price of many goods fell by over 90%.[16]

Economic growth has traditionally been attributed to the accumulation of human and physical capital and the increase in

productivity and creation of new goods arising from technological innovation.[17] Further division of labour (specialization) is also fundamental to rising productivity.[18]

Before industrialization technological progress resulted in an increase in the population, which was kept in check by food supply and other resources, which acted to limit per capita income, a condition known as the Malthusian trap.[19][20] The rapid economic growth that occurred during the Industrial Revolution was remarkable because it was in excess of population growth, providing an escape

from the Malthusian trap.[21] Countries that industrialized eventually saw their population growth slow down, a phenomenon known as the demographic transition.

Increases in productivity are the major factor responsible for per capita economic growth – this has been especially evident since the mid-19th century. Most of the economic growth in the 20th century was due to increased output per unit of labor, materials, energy, and land (less input per widget). The balance of the growth in output has come from using more inputs. Both of these changes increase output.

The increased output included more of the same goods produced previously and new goods and services.[22]

During the Industrial Revolution, mechanization began to replace hand methods in manufacturing, and new processes streamlined production of chemicals, iron, steel, and other products.[23] Machine tools made the economical production of metal parts possible, so that parts could be interchangeable.[24] (See: Interchangeable parts.)

During the Second Industrial Revolution, a major factor of productivity growth was the substitution of inanimate power for human and animal labor. Also there was a great increase in power as steam powered electricity generation and internal combustion supplanted limited wind and water power.[23] Since that replacement, the great expansion of total power was driven by continuous improvements in energy conversion efficiency.[25] Other major historical sources of productivity were automation, transportation infrastructures (canals, railroads, and highways),[26][27] new materials (steel) and power, which includes steam and internal

combustion engines and electricity. Other productivity improvements included mechanized agriculture and scientific agriculture including chemical fertilizers and livestock and poultry management, and the Green Revolution. Interchangeable parts made with machine tools powered by electric motors evolved into mass production, which is universally used today.[24]

Productivity lowered the cost of most items in terms of work time required to purchase. Real food prices fell due to improvements in transportation and trade, mechanized agriculture, fertilizers, scientific farming and the Green Revolution.

Great sources of productivity improvement in the late 19th century were railroads, steam ships, horse-pulled reapers and combine harvesters, and steam-powered factories.[28][29] The invention of processes for making cheap steel were important for many forms of mechanization and transportation. By the late 19th century both prices and weekly work hours fell because less labor, materials, and energy were required to produce and transport

goods. However, real wages rose, allowing workers to improve their diet, buy consumer goods and afford better housing.[28]

Mass production of the 1920s created overproduction, which was arguably one of several causes of the Great Depression of the 1930s.[30] Following the Great Depression, economic growth resumed, aided in part by increased demand for existing goods and services, such as automobiles, telephones, radios, electricity and household appliances. New goods and services included television, air conditioning and commercial aviation

(after 1950), creating enough new demand to stabilize the work week.[31] The building of highway infrastructures also contributed to post World War II growth, as did capital investments in manufacturing and chemical industries.[32] The post World War II economy also benefited from the discovery of vast amounts of oil around the world, particularly in the Middle East. By John W. Kendrick's estimate, three-quarters of increase in U.S. per capita GDP from 1889 to 1957 was due to increased productivity.[14]

Economic growth in the United States slowed down after 1973.[33] In contrast

growth in Asia has been strong since then, starting with Japan and spreading to Four Asian Tigers, China, Southeast Asia, the Indian subcontinent and Asia Pacific.[34][35] In 1957 South Korea had a lower per capita GDP than Ghana,[36] and by 2008 it was 17 times as high as Ghana's.[37] The Japanese economic growth has slackened considerably since the late 1980s.

Productivity in the United States grew at an increasing rate throughout the 19th century and was most rapid in the early to middle decades of the 20th century.[38][39][40][41][42] US productivity growth spiked towards the end of the

century in 1996–2004, due to an acceleration in the rate of technological innovation known as Moore's law.[43][44][45][46] After 2004 U.S. productivity growth returned to the low levels of 1972–96.[43]

Factor accumulation

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Capital in economics ordinarily refers to physical capital, which consists of structures (largest component of physical capital) and equipment used in business (machinery, factory equipment, computers and office equipment, construction equipment, business vehicles, medical

equipment, etc.).[2] Up to a point increases in the amount of capital per worker are an important cause of economic output growth. Capital is subject to diminishing returns because of the amount that can be effectively invested and because of the growing burden of depreciation. In the development of economic theory the distribution of income was considered to be between labor and the owners of land and capital.[47] In recent decades there have been several Asian countries with high rates of economic growth driven by capital investment.[48]

The work week declined considerably over the 19th century.[49][50] By the 1920s the average work week in the U.S. was 49 hours, but the work week was reduced to 40 hours (after which overtime premium was applied) as part of the National Industrial Recovery Act of 1933.

Demographic factors may influence growth by changing the employment to population ratio and the labor force participation rate.[10] Industrialization creates a demographic transition in which birth rates decline and the average age of the population increases.

Women with fewer children and better access to market employment tend to join the labor force in higher percentages. There is a reduced demand for child labor and children spend more years in school. The increase in the percentage of women in the labor force in the U.S. contributed to economic growth, as did the entrance of the baby boomers into the workforce.[10]

See: Spending wave

Other factors affecting growth

Human capital

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Many theoretical and empirical analyses of economic growth attribute a major role to a country's level of human capital, defined as the skills of the population or the work force. Human capital has been included in both neoclassical and endogenous growth models.[51][52][53]

A country's level of human capital is difficult to measure since it is created at home, at school, and on the job. Economists have attempted to measure human capital using numerous proxies, including the population's level of literacy, its level of numeracy, its level of book production/capita, its average level of

formal schooling, its average test score on international tests, and its cumulative depreciated investment in formal schooling. The most commonly-used measure of human capital is the level (average years) of school attainment in a country, building upon the data development of Robert Barro and Jong-Wha Lee.[54] This measure is widely used because Barro and Lee provide data for numerous countries in five-year intervals for a long period of time.

One problem with the schooling attainment measure is that the amount of human capital acquired in a year of

schooling is not the same at all levels of schooling and is not the same in all countries. This measure also presumes that human capital is only developed in formal schooling, contrary to the extensive evidence that families, neighborhoods, peers, and health also contribute to the development of human capital. Despite these potential limitations, Theodore Breton has shown that this measure can represent human capital in log-linear growth models because across countries GDP/adult has a log-linear relationship to average years of schooling, which is consistent with the log-linear relationship

between workers' personal incomes and years of schooling in the Mincer model.[55]

Eric Hanushek and Dennis Kimko introduced measures of students' mathematics and science skills from international assessments into growth analysis.[56] They found that this measure of human capital was very significantly related to economic growth. Eric Hanushek and Ludger Wößmann have extended this analysis.[57][58] Theodore Breton shows that the correlation between economic growth and students' average test scores in Hanushek and Wößmann's analyses is actually due to the relationship

in countries with less than eight years of schooling. He shows that economic growth is not correlated with average scores in more educated countries.[55] Hanushek and Wößmann further investigate whether the relationship of knowledge capital to economic growth is causal. They show that the level of students' cognitive skills can explain the slow growth in Latin America and the rapid growth in East Asia.[59]

Joerg Baten and Jan Luiten van Zanden employ book production per capita as a proxy for sophisticated literacy capabilities and find that "Countries with high levels of

human capital formation in the 18th century initiated or participated in the industrialization process of the 19th century, whereas countries with low levels of human capital formation were unable to do so, among them many of today's Less Developed Countries such as India, Indonesia, and China."[60]

Political institutions

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> *"As institutions influence behavior and incentives in real life, they forge the success or failure of nations."*[61]

In economics and economic history, the transition to capitalism from earlier economic systems was enabled by the adoption of government policies that facilitated commerce and gave individuals more personal and economic freedom. These included new laws favorable to the establishment of business, including contract law and laws providing for the protection of private property, and the abolishment of anti-usury laws.[62][63]

Much of this literature was built on the success story of the British state that after the Glorious Revolution of 1688 combined high fiscal capacity with constraints on the

power of the king generating some respect for the rule of law.[64][65][66][61] However, others have questioned that this institutional formula is not so easily replicable elsewhere as a change in the Constitution—and the type of institutions created by that change—does not necessarily create a change in political power if the economic powers of that society are not aligned with the new set of rule of law institutions.[67] In England, a dramatic increase in the state's fiscal capacity followed the creation of constraints on the crown, but elsewhere in Europe, increases in state capacity

happened before major rule of law reforms.[68]

There are many different ways through which states achieved state (fiscal) capacity and this different capacity accelerated or hindered their economic development. Thanks to the underlying homogeneity of its land and people, England was able to achieve a unified legal and fiscal system since the Middle Ages that enabled it to substantially increase the taxes it raised after 1689.[68] On the other hand, the French experience of state building faced much stronger resistance from local feudal powers keeping it legally

and fiscally fragmented until the French Revolution despite significant increases in state capacity during the seventeenth century.[69][70] Furthermore, Prussia and the Habsburg empire—much more heterogeneous states than England—were able to increase state capacity during the eighteenth century without constraining the powers of the executive.[68] Nevertheless, it is unlikely that a country will generate institutions that respect property rights and the rule of law without having had first intermediate fiscal and political institutions that create incentives for elites to support them. Many of these intermediate level institutions relied on

informal private-order arrangements that combined with public-order institutions associated with states, to lay the foundations of modern rule of law states.[68]

In many poor and developing countries much land and housing are held outside the formal or legal property ownership registration system. In many urban areas the poor "invade" private or government land to build their houses, so they do not hold title to these properties. Much unregistered property is held in informal form through various property associations and other arrangements.

Reasons for extra-legal ownership include excessive bureaucratic red tape in buying property and building. In some countries it can take over 200 steps and up to 14 years to build on government land. Other causes of extra-legal property are failures to notarize transaction documents or having documents notarized but failing to have them recorded with the official agency.[71]

Not having clear legal title to property limits its potential to be used as collateral to secure loans, depriving many poor countries one of their most important potential sources of capital. Unregistered businesses and lack of accepted

accounting methods are other factors that limit potential capital.[71]

Businesses and individuals participating in unreported business activity and owners of unregistered property face costs such as bribes and pay-offs that offset much of any taxes avoided.[71]

"Democracy Does Cause Growth", according to Acemoglu et al. Specifically, "democracy increases future GDP by encouraging investment, increasing schooling, inducing economic reforms, improving public goods provision, and reducing social unrest."[72] UNESCO and

the United Nations also consider that cultural property protection, high-quality education, cultural diversity and social cohesion in armed conflicts are particularly necessary for qualitative growth.[73]

According to Daron Acemoglu, Simon Johnson and James Robinson, the positive correlation between high income and cold climate is a by-product of history. Europeans adopted very different colonization policies in different colonies, with different associated institutions. In places where these colonizers faced high mortality rates (e.g., due to the presence

of tropical diseases), they could not settle permanently, and they were thus more likely to establish extractive institutions, which persisted after independence; in places where they could settle permanently (e.g. those with temperate climates), they established institutions with this objective in mind and modeled them after those in their European homelands. In these 'neo-Europes' better institutions in turn produced better development outcomes. Thus, although other economists focus on the identity or type of legal system of the colonizers to explain institutions, these authors look at the environmental conditions in the

colonies to explain institutions. For instance, former colonies have inherited corrupt governments and geopolitical boundaries (set by the colonizers) that are not properly placed regarding the geographical locations of different ethnic groups, creating internal disputes and conflicts that hinder development. In another example, societies that emerged in colonies without solid native populations established better property rights and incentives for long-term investment than those where native populations were large.[74]

Entrepreneurs and new products

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Policymakers and scholars frequently emphasize the importance of entrepreneurship for economic growth. However, surprisingly few research empirically examine and quantify entrepreneurship's impact on growth. This is due to endogeneity - forces that drive economic growth also drive entrepreneurship. In other words, the empirical analysis of the impact of entrepreneurship on growth is difficult because of the joint determination of entrepreneurship and economic growth. A few papers use quasi-experimental

designs, and have found that entrepreneurship and the density of small businesses indeed have a causal impact on regional growth.[75][76]

Another major cause of economic growth is the introduction of new products and services and the improvement of existing products. New products create demand, which is necessary to offset the decline in employment that occurs through labor-saving technology (and to a lesser extent employment declines due to savings in energy and materials).[44][77] In the US by 2013 about 60% of consumer spending was for goods and services that did not

exist in 1869. Also, the creation of new services has been more important than invention of new goods.[78]

Structural change

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Economic growth in the U.S. and other developed countries went through phases that affected growth through changes in the labor force participation rate and the relative sizes of economic sectors. The transition from an agricultural economy to manufacturing increased the size of the sector with high output per hour (the high-productivity manufacturing sector), while reducing the size of the sector with lower

output per hour (the lower productivity agricultural sector). Eventually high productivity growth in manufacturing reduced the sector size, as prices fell and employment shrank relative to other sectors.[79][80] The service and government sectors, where output per hour and productivity growth is low, saw increases in their shares of the economy and employment during the 1990s.[10] The public sector has since contracted, while the service economy expanded in the 2000s.

The structural change could also be viewed from another angle. It is possible

to divide real economic growth into two components: an indicator of extensive economic growth—the 'quantitative' GDP—and an indicator of the improvement of the quality of goods and services—the 'qualitative' GDP.[81]

Growth theories

The Malthusian theory

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The Malthusian theory proposes that over most of human history technological progress caused larger population growth but had no impact on income per capita in the long run. According to the theory, while

technologically advanced economies over this epoch were characterized by higher population density, their level of income per capita was not different than those among technologically regressed society.

The conceptual foundations of the Malthusian theory were formed by Thomas Malthus,[82] and a modern representation of these approach is provided by Ashraf and Galor.[83] In line with the predictions of the Malthusian theory, a cross-country analysis finds a significant positive effects of the technological level on population density

and insignificant effect on income per significantly over the years 1–1500.[83]

Classical growth theory

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In classical (Ricardian) economics, the theory of production and the theory of growth are based on the theory or law of variable proportions, whereby increasing either of the factors of production (labor or capital), while holding the other constant and assuming no technological change, will increase output, but at a diminishing rate that eventually will approach zero. These concepts have their origins in Thomas Malthus's theorizing about

agriculture. Malthus's examples included the number of seeds harvested relative to the number of seeds planted (capital) on a plot of land and the size of the harvest from a plot of land versus the number of workers employed.[84] See also Diminishing returns.

Criticisms of classical growth theory are that technology, an important factor in economic growth, is held constant and that economies of scale are ignored.[85]

One popular theory in the 1940s was the big push model, which suggested that countries needed to jump from one stage

of development to another through a virtuous cycle, in which large investments in infrastructure and education coupled with private investments would move the economy to a more productive stage, breaking free from economic paradigms appropriate to a lower productivity stage.[86] The idea was revived and formulated rigorously, in the late 1980s by Kevin Murphy, Andrei Shleifer and Robert Vishny.[87]

Solow–Swan model

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Robert Solow and Trevor Swan developed what eventually became the main model

used in growth economics in the 1950s.[88][89] This model assumes that there are diminishing returns to capital and labor. Capital accumulates through investment, but its level or stock continually decreases due to depreciation. Due to the diminishing returns to capital, with increases in capital/worker and absent technological progress, economic output/worker eventually reaches a point where capital per worker and economic output/worker remain constant because annual investment in capital equals annual depreciation. This condition is called the 'steady state'.

In the Solow–Swan model if productivity increases through technological progress, then output/worker increases even when the economy is in the steady state. If productivity increases at a constant rate, output/worker also increases at a related steady-state rate. As a consequence, growth in the model can occur either by increasing the share of GDP invested or through technological progress. But at whatever share of GDP invested, capital/worker eventually converges on the steady state, leaving the growth rate of output/worker determined only by the rate of technological progress. As a consequence, with world technology

available to all and progressing at a constant rate, all countries have the same steady state rate of growth. Each country has a different level of GDP/worker determined by the share of GDP it invests, but all countries have the same rate of economic growth. Implicitly in this model rich countries are those that have invested a high share of GDP for a long time. Poor countries can become rich by increasing the share of GDP they invest. One important prediction of the model, mostly borne out by the data, is that of *conditional convergence*; the idea that poor countries will grow faster and catch up with rich countries as long as they have similar

investment (and saving) rates and access to the same technology.

The Solow–Swan model is considered an "exogenous" growth model because it does not explain why countries invest different shares of GDP in capital nor why technology improves over time. Instead the rate of investment and the rate of technological progress are exogenous. The value of the model is that it predicts the pattern of economic growth once these two rates are specified. Its failure to explain the determinants of these rates is one of its limitations.

Although the rate of investment in the model is exogenous, under certain conditions the model implicitly predicts convergence in the rates of investment across countries. In a global economy with a global financial capital market, financial capital flows to the countries with the highest return on investment. In the Solow-Swan model countries with less capital/worker (poor countries) have a higher return on investment due to the diminishing returns to capital. As a consequence, capital/worker and output/worker in a global financial capital market should converge to the same level in all countries.[90] Since historically

financial capital has not flowed to the countries with less capital/worker, the basic Solow–Swan model has a conceptual flaw. Beginning in the 1990s, this flaw has been addressed by adding additional variables to the model that can explain why some countries are less productive than others and, therefore, do not attract flows of global financial capital even though they have less (physical) capital/worker.

In practice, convergence was rarely achieved. In 1957, Solow applied his model to data from the U.S. gross national product to estimate contributions. This

showed that the increase in capital and labor stock only accounted for about half of the output, while the population increase adjustments to capital explained eighth. This remaining unaccounted growth output is known as the Solow Residual. Here the A of (t) "technical progress" was the reason for increased output. Nevertheless, the model still had flaws. It gave no room for policy to influence the growth rate. Few attempts were also made by the RAND Corporation the non-profit think tank and frequently visiting economist Kenneth Arrow to work out the kinks in the model. They suggested that new knowledge was indivisible and

that it is endogenous with a certain fixed cost. Arrow's further explained that new knowledge obtained by firms comes from practice and built a model that "knowledge" accumulated through experience.[91]

According to Harrod, the natural growth rate is the maximum rate of growth allowed by the increase of variables like population growth, technological improvement and growth in natural resources.

In fact, the natural growth rate is the highest attainable growth rate which

would bring about the fullest possible employment of the resources existing in the economy.

Endogenous growth theory

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Unsatisfied with the assumption of exogenous technological progress in the Solow–Swan model, economists worked to "endogenize" (i.e., explain it "from within" the models) productivity growth in the 1980s; the resulting endogenous growth theory, most notably advanced by Robert Lucas, Jr. and his student Paul Romer, includes a mathematical explanation of technological

advancement.[17][92] This model also incorporated a new concept of human capital, the skills and knowledge that make workers productive. Unlike physical capital, human capital has increasing rates of return. Research done in this area has focused on what increases human capital (e.g. education) or technological change (e.g. innovation).[93]

On Memorial Day weekend in 1988, a conference in Buffalo brought together the great minds in economics the idea was to evaluate the conflicting theories of growth. Romer, Krugman, Barro, Becker were in attendance along many other rising star

and high profiled economist of the time. Amongst many papers that day the one that stood out was Romer's “ Micro Foundations for Aggregate Technological Change.” The Micro Foundation claimed that endogenous technological change had the concept of Intellectual Property imbedded and that knowledge is an input and output of production. Romer argued that outcomes to the national growth rates were significantly affected by public policy, trade activity, and intellectual property. He stressed that cumulative capital and specialization were key, and that not only population growth can increase capital of knowledge, it was human capital that is

specifically trained in harvesting new ideas.[94]

One branch of endogenous growth theory was developed on the foundations of the Schumpeterian theory, named after the 20th-century Austrian economist Joseph Schumpeter.[95] The approach explains growth as a consequence of innovation and a process of creative destruction that captures the dual nature of technological progress: in terms of creation, entrepreneurs introduce new products or processes in the hope that they will enjoy temporary monopoly-like profits as they capture markets. In doing so, they make

old technologies or products obsolete. This can be seen as an *annulment* of previous technologies, which makes them obsolete, and "destroys the rents generated by previous innovations".[96]:855[97] A major model that illustrates Schumpeterian growth is the Aghion–Howitt model.[98][96]

Unified growth theory

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Unified growth theory was developed by Oded Galor and his co-authors to address the inability of endogenous growth theory to explain key empirical regularities in the growth processes of individual economies

and the world economy as a whole.[99][100] Unlike endogenous growth theory that focuses entirely on the modern growth regime and is therefore unable to explain the roots of inequality across nations, unified growth theory captures in a single framework the fundamental phases of the process of development in the course of human history: (i) the Malthusian epoch that was prevalent over most of human history, (ii) the escape from the Malthusian trap, (iii) the emergence of human capital as a central element in the growth process, (iv) the onset of the fertility decline, (v) the origins of the modern era of sustained economic growth, and (vi) the

roots of divergence in income per capita across nations in the past two centuries. The theory suggests that during most of human existence, technological progress was offset by population growth, and living standards were near subsistence across time and space. However, the reinforcing interaction between the rate of technological progress and the size and composition of the population has gradually increased the pace of technological progress, enhancing the importance of education in the ability of individuals to adapt to the changing technological environment. The rise in the allocation of resources towards education

triggered a fertility decline enabling economies to allocate a larger share of the fruits of technological progress to a steady increase in income per capita, rather than towards the growth of population, paving the way for the emergence of sustained economic growth. The theory further suggests that variations in biogeographical characteristics, as well as cultural and institutional characteristics, have generated a differential pace of transition from stagnation to growth across countries and consequently divergence in their income per capita over the past two centuries.[99][100]

Inequality and growth

Theories

E...

The prevailing views about the role of inequality in the growth process has radically shifted in the past century.[101]

The classical perspective, as expressed by Adam Smith, and others, suggests that inequality fosters the growth process.[102][103] Specifically, since the aggregate saving increases with inequality due to higher property to save among the wealthy, the classical viewpoint suggests that inequality stimulates capital

accumulation and therefore economic growth.[104]

The Neoclassical perspective that is based on representative agent approach denies the role of inequality in the growth process. It suggests that the while the growth process may affect inequality, income distribution has no impact on the growth process.

The modern perspective which has emerged in the late 1980s suggests, in contrast, that income distribution has a significant impact on the growth process. The modern perspective, originated by

Galor and Zeira,[105][106] highlights the important role of heterogeneity in the determination of aggregate economic activity, and economic growth. In particular, Galor and Zeira argue that since credit markets are imperfect, inequality has an enduring impact on human capital formation, the level of income per capita, and the growth process.[107] In contrast to the classical paradigm, which underlined the positive implications of inequality for capital formation and economic growth, Galor and Zeira argue that inequality has an adverse effect on human capital formation and the development process, in all but the very poor economies.

Later theoretical developments have reinforced the view that inequality has an adverse effect on the growth process. Specifically, Alesina and Rodrik and Persson and Tabellini advance a political economy mechanism and argue that inequality has a negative impact on economic development since it creates a pressure for distortionary redistributive policies that have an adverse effect on investment and economic growth.[108][109]

In accordance with the credit market imperfection approach, a study by Roberto Perotti showed that inequality is associated with lower level of human

capital formation (education, experience, apprenticeship) and higher level of fertility, while lower level of human capital is associated with lower growth and lower levels of economic growth. In contrast, his examination of the political economy channel found no support for the political economy mechanism.[110] Consequently, the political economy perspective on the relationship between inequality and growth have been revised and later studies have established that inequality may provide an incentive for the elite to block redistributive policies and institutional changes. In particular, inequality in the distribution of land ownership provides the

landed elite with an incentive to limit the mobility of rural workers by depriving them from education and by blocking the development of the industrial sector.[111]

A unified theory of inequality and growth that captures that changing role of inequality in the growth process offers a reconciliation between the conflicting predictions of classical viewpoint that maintained that inequality is beneficial for growth and the modern viewpoint that suggests that in the presence of credit market imperfections, inequality predominantly results in under investment in human capital and lower economic

growth. This unified theory of inequality and growth, developed by Oded Galor and Omer Moav,[112] suggests that the effect of inequality on the growth process has been reversed as human capital has replaced physical capital as the main engine of economic growth. In the initial phases of industrialization, when physical capital accumulation was the dominating source of economic growth, inequality boosted the development process by directing resources toward individuals with higher propensity to save. However, in later phases, as human capital become the main engine of economic growth, more equal distribution of income, in the

presence of credit constraints, stimulated investment in human capital and economic growth.

In 2013, French economist Thomas Piketty postulated that in periods when the average annual rate on return on investment in capital (*r*) exceeds the average annual growth in economic output (*g*), the rate of inequality will increase.[113] According to Piketty, this is the case because wealth that is already held or inherited, which is expected to grow at the rate *r*, will grow at a rate faster than wealth accumulated through labor, which is more closely tied to *g*. An advocate of reducing

inequality levels, Piketty suggests levying a global wealth tax in order to reduce the divergence in wealth caused by inequality.

Evidence: reduced form

E...

The reduced form empirical relationship between inequality and growth was studied by Alberto Alesina and Dani Rodrik, and Torsten Persson and Guido Tabellini.[108][109] They find that inequality is negatively associated with economic growth in a cross-country analysis.

Robert Barro reexamined the reduced form relationship between inequality on

economic growth in a panel of countries.[114] He argues that there is "little overall relation between income inequality and rates of growth and investment". However, his empirical strategy limits its applicability to the understanding of the relationship between inequality and growth for several reasons. First, his regression analysis control for education, fertility, investment, and it therefore excludes, by construction, the important effect of inequality on growth via education, fertility, and investment. His findings simply imply that inequality has no direct effect on growth beyond the important indirect effects through the

main channels proposed in the literature. Second his study analyzes the effect of inequality on the average growth rate in the following 10 years. However, existing theories suggest that the effect of inequality will be observed much later, as is the case in human capital formation, for instance. Third, the empirical analysis does not account for biases that are generated by reverse causality and omitted variables.

Recent papers based on superior data, find negative relationship between inequality and growth. Andrew Berg and Jonathan Ostry of the International Monetary Fund,

find that "lower net inequality is robustly correlated with faster and more durable growth, controlling for the level of redistribution".[115] Likewise, Dierk Herzer and Sebastian Vollmer find that increased income inequality reduces economic growth.[116]

Evidence: mechanisms

E...

The Galor and Zeira's model predicts that the effect of rising inequality on GDP per capita is negative in relatively rich countries but positive in poor countries.[105][106] These testable predictions have been examined and

confirmed empirically in recent studies.[117][118] In particular, Brückner and Lederman test the prediction of the model by in the panel of countries during the period 1970–2010, by considering the impact of the interaction between the level of income inequality and the initial level of GDP per capita. In line with the predictions of the model, they find that at the 25th percentile of initial income in the world sample, a 1 percentage point increase in the Gini coefficient increases income per capita by 2.3%, whereas at the 75th percentile of initial income a 1 percentage point increase in the Gini coefficient decreases income per capita by -5.3%.

Moreover, the proposed human capital mechanism that mediate the effect of inequality on growth in the Galor-Zeira model is also confirmed. Increases in income inequality increase human capital in poor countries but reduce it in high and middle-income countries.

This recent support for the predictions of the Galor-Zeira model is in line with earlier findings. Roberto Perotti showed that in accordance with the credit market imperfection approach, developed by Galor and Zeira, inequality is associated with lower level of human capital formation (education, experience, apprenticeship)

and higher level of fertility, while lower level of human capital is associated with lower levels of economic growth.[110] Princeton economist Roland Benabou's finds that the growth process of Korea and the Philippines "are broadly consistent with the credit-constrained human-capital accumulation hypothesis".[119] In addition, Andrew Berg and Jonathan Ostry[115] suggest that inequality seems to affect growth through human capital accumulation and fertility channels.

In contrast, Perotti argues that the political economy mechanism is not supported empirically. Inequality is associated with

lower redistribution, and lower redistribution (under-investment in education and infrastructure) is associated with lower economic growth.[110]

Importance of long-run growth

Over long periods of time, even small rates of growth, such as a 2% annual increase, have large effects. For example, the United Kingdom experienced a 1.97% average annual increase in its inflation-adjusted GDP between 1830 and 2008.[120] In 1830, the GDP was 41,373 million pounds. It

grew to 1,330,088 million pounds by 2008. A growth rate that averaged 1.97% over 178 years resulted in a 32-fold increase in GDP by 2008.

The large impact of a relatively small growth rate over a long period of time is due to the power of exponential growth. The rule of 72, a mathematical result, states that if something grows at the rate of x% per year, then its level will double every 72/x years. For example, a growth rate of 2.5% per annum leads to a doubling of the GDP within 28.8 years, whilst a growth rate of 8% per year leads to a doubling of GDP within nine years. Thus, a

small difference in economic growth rates between countries can result in very different standards of living for their populations if this small difference continues for many years.

Quality of life

E...

One theory that relates economic growth with quality of life is the "Threshold Hypothesis", which states that economic growth up to a point brings with it an increase in quality of life. But at that point – called the threshold point – further economic growth can bring with it a deterioration in quality of life.[121] This

results in an upside-down-U-shaped curve, where the vertex of the curve represents the level of growth that should be targeted. Happiness has been shown to increase with GDP per capita, at least up to a level of $15,000 per person.[122]

Economic growth has the indirect potential to alleviate poverty, as a result of a simultaneous increase in employment opportunities and increased labor productivity.[123] A study by researchers at the Overseas Development Institute (ODI) of 24 countries that experienced growth found that in 18 cases, poverty was alleviated.[123]

In some instances, quality of life factors such as healthcare outcomes and educational attainment, as well as social and political liberties, do not improve as economic growth occurs.[124]

Productivity increases do not always lead to increased wages, as can be seen in the United States, where the gap between productivity and wages has been rising since the 1980s.[123]

Equitable growth

E...

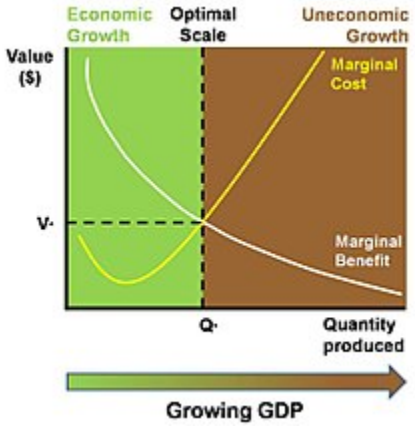
While acknowledging the central role economic growth can potentially play in

human development, poverty reduction and the achievement of the Millennium Development Goals, it is becoming widely understood amongst the development community that special efforts must be made to ensure poorer sections of society are able to participate in economic growth.[125][126][127] The effect of economic growth on poverty reduction – the growth elasticity of poverty – can depend on the existing level of inequality.[128][129] For instance, with low inequality a country with a growth rate of 2% per head and 40% of its population living in poverty, can halve poverty in ten years, but a country with high inequality would take nearly 60 years

to achieve the same reduction.[130][131] In the words of the Secretary General of the United Nations Ban Ki-Moon: "While economic growth is necessary, it is not sufficient for progress on reducing poverty."[125]

Environmental impact

Critics such as the Club of Rome argue that a narrow view of economic growth, combined with globalization, is creating a scenario where we could see a systemic collapse of our planet's natural resources.[132][133]



The marginal costs of a growing economy may gradually exceed the marginal benefits, however measured.

Concerns about negative environmental effects of growth have prompted some people to advocate lower levels of growth, or the abandoning of growth altogether. In academia, concepts like uneconomic growth, steady-state economy and degrowth have been developed in order to achieve this and to overcome possible

growth imperatives. In politics, green parties embrace the Global Greens Charter, recognising that "... the dogma of economic growth at any cost and the excessive and wasteful use of natural resources without considering Earth's carrying capacity, are causing extreme deterioration in the environment and a massive extinction of species."[134]:2

The 2019 *Global Assessment Report on Biodiversity and Ecosystem Services* published by the United Nations' Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services warned that given the substantial loss of

biodiversity, society should not focus solely on economic growth.[135][136] Anthropologist Eduardo S. Brondizio, one of the co-chairs of the report, said "We need to change our narratives. Both our individual narratives that associate wasteful consumption with quality of life and with status, and the narratives of the economic systems that still consider that environmental degradation and social inequality are inevitable outcomes of economic growth. Economic growth is a means and not an end. We need to look for the quality of life of the planet."[137]

Those more optimistic about the environmental impacts of growth believe that, though localized environmental effects may occur, large-scale ecological effects are minor. The argument, as stated by commentator Julian Lincoln Simon, states that if these global-scale ecological effects exist, human ingenuity will find ways to adapt to them.[138]

In 2019, a warning on climate change signed by 11,000 scientists from over 150 nations said economic growth is the driving force behind the "excessive extraction of materials and overexploitation of ecosystems" and that

this "must be quickly curtailed to maintain long-term sustainability of the biosphere." They add that "our goals need to shift from GDP growth and the pursuit of affluence toward sustaining ecosystems and improving human well-being by prioritizing basic needs and reducing inequality."[139][140]

Global warming

E...

Up to the present, there is a close correlation between economic growth and the rate of carbon dioxide emissions across nations, although there is also a considerable divergence in carbon

intensity (carbon emissions per GDP).[141] Up to the present, there is also a direct relation between global economic wealth and the rate of global emissions.[142] The Stern Review notes that the prediction that, "Under business as usual, global emissions will be sufficient to propel greenhouse gas concentrations to over 550 ppm CO_2 by 2050 and over 650–700 ppm by the end of this century is robust to a wide range of changes in model assumptions." The scientific consensus is that planetary ecosystem functioning without incurring dangerous risks requires stabilization at 450–550 ppm.[143]

As a consequence, growth-oriented environmental economists propose government intervention into switching sources of energy production, favouring wind, solar, hydroelectric, and nuclear. This would largely confine use of fossil fuels to either domestic cooking needs (such as for kerosene burners) or where carbon capture and storage technology can be cost-effective and reliable.[144] The Stern Review, published by the United Kingdom Government in 2006, concluded that an investment of 1% of GDP (later changed to 2%) would be sufficient to avoid the worst effects of climate change, and that failure to do so could risk climate-

related costs equal to 20% of GDP. Because carbon capture and storage are as yet widely unproven, and its long term effectiveness (such as in containing carbon dioxide 'leaks') unknown, and because of current costs of alternative fuels, these policy responses largely rest on faith of technological change.

British conservative politician and journalist Nigel Lawson has deemed carbon emission trading an 'inefficient system of rationing'. Instead, he favours carbon taxes to make full use of the efficiency of the market. However, in order to avoid the migration of energy-intensive

industries, the whole world should impose such a tax, not just Britain, Lawson pointed out. There is no point in taking the lead if nobody follows suit.[145]

Resource constraint

E...

Many earlier predictions of resource depletion, such as Thomas Malthus' 1798 predictions about approaching famines in Europe, *The Population Bomb*,[146][147] *and the Simon–Ehrlich wager (1980)*[148] *have not materialized. Diminished production of most resources has not occurred so far, one reason being that advancements in technology and science have allowed*

some previously unavailable resources to be produced.[148] *In some cases, substitution of more abundant materials, such as plastics for cast metals, lowered growth of usage for some metals. In the case of the limited resource of land, famine was relieved firstly by the revolution in transportation caused by railroads and steam ships, and later by the Green Revolution and chemical fertilizers, especially the Haber process for ammonia synthesis.*[149][150]

Resource quality is composed of a variety of factors including ore grades, location, altitude above or below sea level, proximity

to railroads, highways, water supply and climate. These factors affect the capital and operating cost of extracting resources. In the case of minerals, lower grades of mineral resources are being extracted, requiring higher inputs of capital and energy for both extraction and processing. Copper ore grades have declined significantly over the last century.[151][152] Another example is natural gas from shale and other low permeability rock, whose extraction requires much higher inputs of energy, capital, and materials than conventional gas in previous decades. Offshore oil and gas

have exponentially increased cost as water depth increases.

Some physical scientists like Sanyam Mittal regard continuous economic growth as unsustainable.[153][154] Several factors may constrain economic growth – for example: finite, peaked, or depleted resources.

In 1972, *The Limits to Growth* study modeled limitations to infinite growth; originally ridiculed,[146][147][155] some of the predicted trends have materialized, raising concerns of an impending collapse or

decline due to resource constraints.[156][157][158]

Malthusians such as William R. Catton, Jr. are skeptical of technological advances that improve resource availability. Such advances and increases in efficiency, they suggest, merely accelerate the drawing down of finite resources. Catton claims that increasing rates of resource extraction are "...stealing ravenously from the future".[159]

Energy

E...

Energy economic theories hold that rates of energy consumption and energy efficiency are linked causally to economic growth. The Garrett Relation holds that there has been a fixed relationship between current rates of global energy consumption and the historical accumulation of world GDP, independent of the year considered. It follows that economic growth, as represented by GDP growth, requires higher rates of energy consumption growth. Seemingly paradoxically, these are sustained through increases in energy efficiency.[160] Increases in energy efficiency were a portion of the increase in Total factor

productivity.[14] Some of the most technologically important innovations in history involved increases in energy efficiency. These include the great improvements in efficiency of conversion of heat to work, the reuse of heat, the reduction in friction and the transmission of power, especially through electrification.[161][162] There is a strong correlation between per capita electricity consumption and economic development.[163][164]

See also

- Degrowth

- Economic development
- Export-oriented industrialization
- Growth accounting
- *The Limits to Growth*
- List of countries by real GDP growth rate
- Post-growth
- Productivism
- *Prosperity Without Growth*
- Sufficiency economy
- Uneconomic growth
- Unified growth theory

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- CEPR Economics Seminar Series Two seminars on the importance of growth with economists Dean Baker and Mark Weisbrot
- On global economic history by Jan Luiten van Zanden. Explores the idea of the inevitability of the Industrial Revolution.

- The Economist Has No Clothes – essay by Robert Nadeau in Scientific American on the basic assumptions behind current economic theory
- World Growth Institute. An organization dedicated to helping the developing world realize its full potential via economic growth.
- Why Does Growth Keep Slowing Down? St. Louis Federal Reserve Bank

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