

Lecture Notes: Chapter 5: The Reality of Economic Growth: History and Prospect

J. Bradford DeLong
<http://econ161.berkeley.edu/>
delong@econ.berkeley.edu

Before the Industrial Revolution

Economic Growth Through Deep Time

Longest-Run Economic Growth		
Year	Population*	GDP per Capita**
-5000	5	\$130
-1000	50	\$160
1	170	\$135
1000	265	\$165
1500	425	\$175
1800	900	\$250
1900	1625	\$850
1950	2515	\$2030
1975	4080	\$4640
2000	6120	\$8175

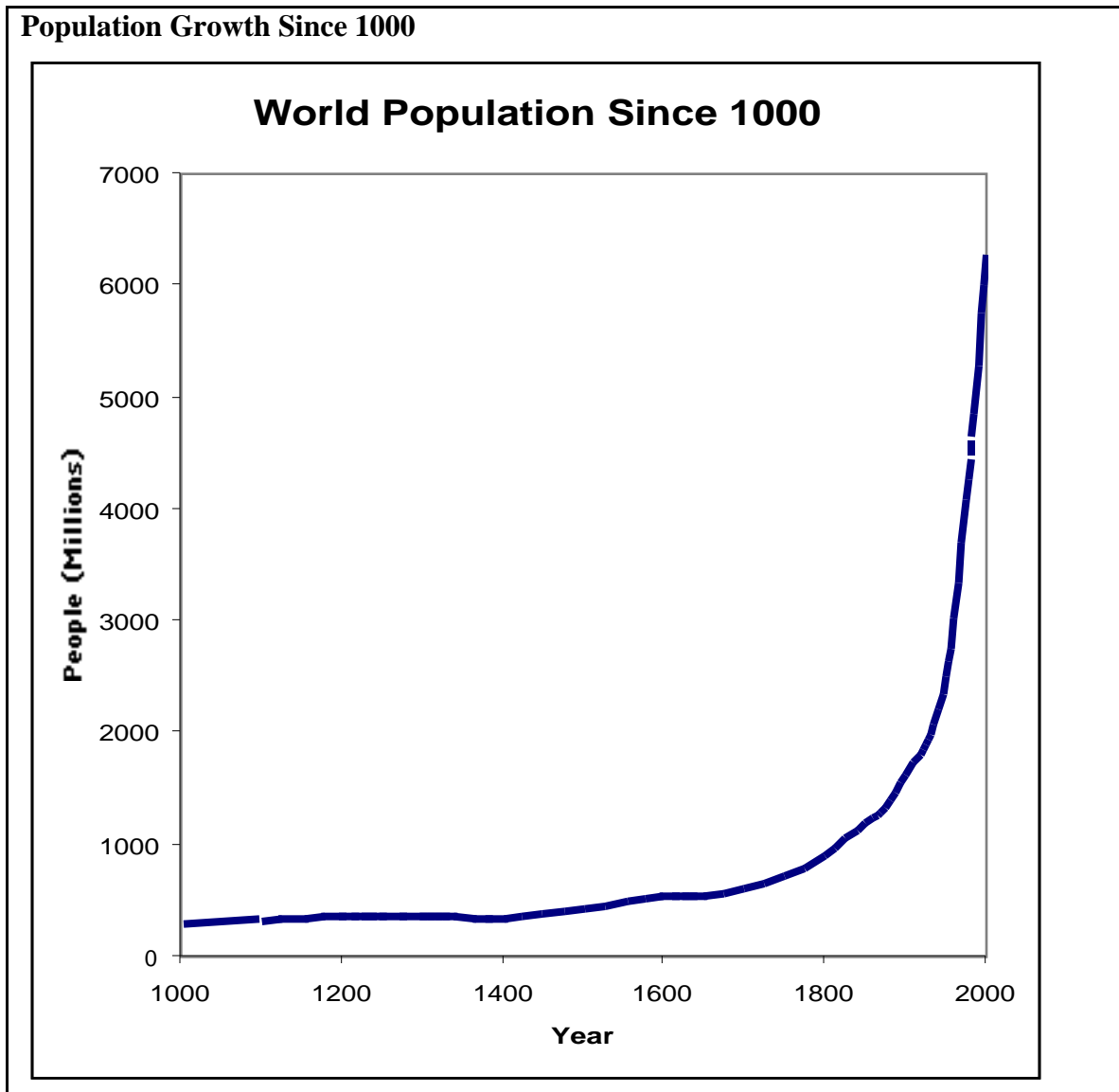
*Millions
 **In year-2000 international dollars.

Up until 1800 the growth rates of human populations were glacial. Population growth between 5000 B.C. and 1800 averaged less than one-tenth of a percent per year. (Nevertheless, the cumulative magnitude of population growth was impressive, carrying the number of human beings alive on the planet from perhaps 5 million in 5000 B.C. to 900 million in 1800; 7,000 years is a long time.)

Up until 1500, as best we can tell, there had been next to *no* growth in output per worker for the average human for millennia. Even in 1800 the average human alive had a material standard of living (and an economic productivity level) at best twice that of the average human alive in the year 1. The problem was not that there was no technological progress. There was. Humans have long been ingenious. Warrior, priestly, and bureaucratic elites in 1800 lived much better than their predecessors in previous millennia had lived. But just because the elite that ruled you lived better does not mean that you--if you were average--lived any better.

Only after 1800 do we see large sustained increases in worldwide standards of living. After 1800 human numbers grew as the population explosion took hold. It carried our total population to 6 billion in October 1999. Population growth on a world scale accelerated from a rate of 0.2% per year between 1500 and 1800 to 0.6% per year between 1800 and 1900, 0.9% per year between 1900 and 1950, 1.9% per year between 1950 and 1975, and—in the first slowing of the global rate of population growth--1.6% per year from 1975 to 2000.

Average rates of material output per capita, which grew at perhaps 0.15% per year between 1500 and 1800, grew at perhaps 1.0% per year worldwide between 1800 and 1900, and have grown at an average pace of perhaps 2.0% per year worldwide between 1900 and 2000.



Why were there no sustained increases in the material productivity of human labor back before 1500? Because improved technology quickly ran aground on resource scarcity. As human populations grew the stocks of natural resources known had to be divided up among more and more people: miners had to exploit lower-quality metal ores, farmers had to farm lesser-quality agricultural land, and forests vanished. Who alive today has ever seen one of the cedars of Lebanon? In spite of technological progress resource scarcity meant that the efficiency of labor was little if any greater in 1500 A.D. than in 1500 B.C.

One of the oldest ideas in economics is that increases in technology inevitably run into natural resource scarcity, and so lead to increases in the numbers of people but not in their standard of living or productivity. This idea was introduced into economics late by Thomas R. Malthus, who was to become the first academic professor of economics (Adam Smith had been a professor of moral philosophy) at the East India Company's Haileybury College.

Malthus saw a world in which inventions and higher living standards led to increases in the rate of population growth. With higher living standards women ovulated more frequently. More pregnancies were successfully carried to term. Better-nourished children (and adults) had a better chance of resisting diseases. Moreover, when incomes were high new farmsteads are relatively plentiful, and getting the permission of one's father or elder brother to marry was easier. For these reasons both social and biological, a higher standard of living back before 1800 led to a faster rate of population increase. And faster rates of population growth increased natural resource scarcity and lowered productivity until once again people were so poor and malnourished that population growth was roughly zero.

The End of the Malthusian Age

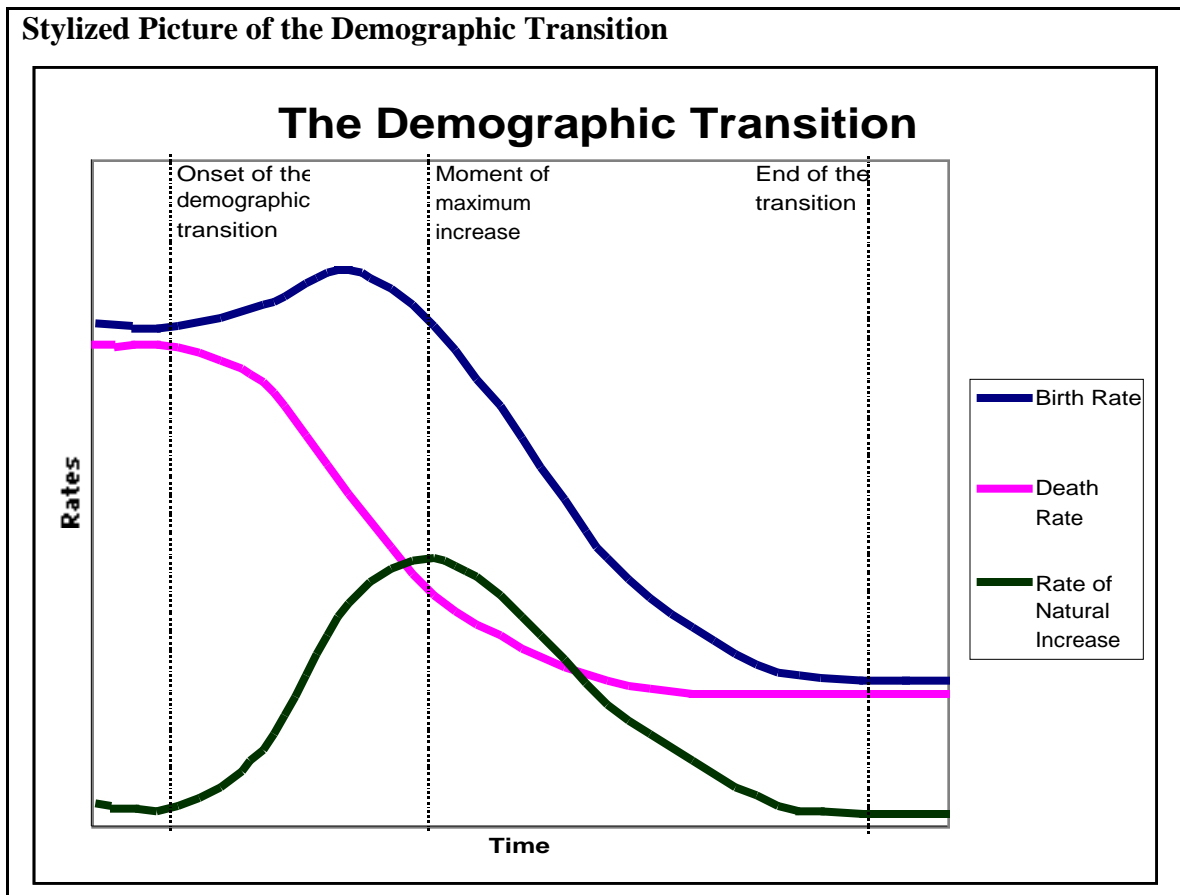
We clearly no longer live in a Malthusian age. For at least two hundred years improvements in the efficiency of labor made possible by new technologies and better organizations have *not* been neutralized by natural resource scarcity. (But a Malthusian age may return: project twentieth century population growth rates forward and calculate that the year-2200 population of the earth would be 93 billion; it requires skill and ingenuity to argue today that resource scarcity would not be a dominant feature of such a world).

So what caused the end of the Malthusian age? How did humanity escape from the trap in which invention and ingenuity increased the numbers but not the material well-being of humanity?

The key is that even in the Malthusian age the pace at which inventions were made increased steadily. First of all, the population grew. Inventions made communication easier: especially after the invention of printing knowledge could diffuse widely and quickly. More people meant more inventions: two heads are greater than one. The rate of

technological progress slowly rose over millennia. And about 1500 it passed the point at which natural resource scarcity could not fully offset it. Sustained increases not just in population but in the productivity of labor followed.

At first the rise in material standards of living brought sharp increases in the rate of population growth: the population explosion. But as material standards of living rose far above subsistence, countries began to undergo the *demographic transition*.



Birth control meant that those who did not wish to have more children could exercise their choice. Parents began to find more satisfaction out of having a few children and paying a great deal of attention to each. The resources of the average household continued to increase, but the number of children born fell. The long-run relationship between levels of productivity and population growth rates was not--as Malthus thought--a spiral of ever-faster population growth rates as material standards of living increased. Instead population growth rates peaked and began to decline.

In the world today not all countries have gone through their demographic transitions. Many countries today are not rich enough to have begun the population growth declines seen in the second half of the demographic transition. Countries like Nigeria, Iraq, Pakistan, and the Congo are currently projected to have population growth rates in excess of two percent per year over the next generation, as Figure 5.3 shows. But there is also a large group of developing countries like Thailand, China, Korea, and South Africa in which population growth over the next generation is projected to be less than one percent per year. And in the industrialized countries—like Japan, Italy, and Germany—populations are projected to stay nearly the same over the next generation.

The Industrial Revolution

The century after 1750 saw the industrial revolution proper: the invention of the steam engine, the spinning jenny, the power loom, the hydraulic press, the railroad locomotive, the water turbine, and the electric motor--as well as the hot-air balloon, gas lighting, photography, and the sewing machine.

But the industrial revolution was not just a burst of inventions. It was an economic transformation that revolutionized the process of invention as well. Since 1850 the pace of invention and innovation has further accelerated: steelmaking, the internal combustion engine, pasteurization, the typewriter, the cash register, the telephone, the automobile, the radio, the airplane, the tank, the limited-access highway, the photocopier, the computer, the pacemaker, nuclear weapons, superconductivity, genetic fingerprinting, and the human genome map. The coming of the industrial revolution marks the beginning of the era of modern economic growth: the era in which it is expected that new technological leaps will routinely revolutionize industries and generate major improvements in living standards.

The fact that Britain was the center of the industrial revolution meant that for a century--from 1800 to 1900--British levels of industrial productivity were the highest in the world, and British standards of living were the highest in the world as well. It also meant that English (rather than Hindi, Mandarin, French, or Spanish) became the world's de facto second language. But the technologies of the industrial revolution did not remain narrowly-confined to Britain. Their spread was rapid to western Europe and the United States. Their spread was less rapid--but still relatively thorough and complete--to southern and eastern Europe and--most interesting perhaps--Japan.

Perhaps the most important lesson to draw from this short look back at economic history is that the standard growth models of economists apply to a relatively narrow slice of time. Back before 1800 the growth model set out in chapter 4 does not illuminate very much. Yet the model of chapter 4 is very useful in analyzing what is going on today with respect to the growth of different national economies, and very useful in analyzing what has happened over the past two centuries.

American Long Run Growth, 1800-1973

U.S. Measured Economic Growth



Throughout the nineteenth and the first three quarters of the twentieth century the *measured* pace of economic growth continued to accelerate. The measured growth rate of

output per worker rose from perhaps 0.5 percent per year from 1800 to 1870 to perhaps 1.6 percent per year from 1870 to 1929, on the eve of the Great Depression, as is shown in Figure 5.5. Growth slowed slightly over the Great Depression and World War II decades--a measured growth rate of 1.4 percent per year from 1929 to 1950. But then it accelerated: the growth rate of output per worker between 1950 and 1973 in the United States was 2.1 percent per year.

Moreover, it is likely that *true* output per worker growth since 1890 has been even faster. Many economists believe that official estimates overstate inflation and understate real economic growth by 1.0 percent per year, in large part because national income accountants have a very hard time valuing the boost to productivity and standards of living generated by the invention of new goods and services, and new types of goods and services. So instead of 1.5 percent per year, perhaps we should be thinking of 2.0 to 2.5 percent per year for the rate of output per worker growth since 1870.

If so, then those of us living in the United States today have a level of productivity--a material standard of living-- somewhere between 14 and 25 times that of our counterparts back in the late nineteenth century. For middle-class and richer consumers today such an estimate does not seem at all unreasonable. It takes only 1/8 as much time to earn the money to buy a hairbrush, 1/12 as much time to earn the money to buy a chair, 1/35 as much time to earn the money to buy a book today as in 1895. And in 1895, no matter how long you worked, you couldn't earn enough money to buy a plane ticket, or a TV, or a portable CD player, or a laptop computer, or an automatic washing machine, or an electric blender, or a microwave oven.

For the relatively poor of the world, or even of the United States, it is not reasonable to say that their incomes and material standards of living have multiplied to so great an extent. The fact of an invention or innovation has no effect on your material standard of living if you cannot afford it.

Modern economic growth is also a shift in the kinds of things we do at work and play and in the way we live. Back in the immediate aftermath of the Civil War perhaps half of all Americans were farmers. Today less than two percent of American workers are farmers and farm laborers: there are more gardeners, groundskeepers, and growers and maintainers of ornamental plants in America today than there are food-growing farmers and farm laborers. Americans in the second half of the nineteenth century traveled by foot, by horse, by wagon, by train, and by riverboat. American at the end of the twentieth

century traveled by foot (rarely), bicycle (rarely), automobile, bus, train, boat, and plane. Most Americans in the second half of the nineteenth century were literate. But very few had finished anything like what we would call high school. Modern economic growth is the large-scale shift of employment from agriculture to manufacturing and now to services. And modern economic growth is the creation of large business organizations. Back at the start of the nineteenth century, a business with one hundred people was a very large business organization for its time indeed.

Between approximately 1890 and 1930—or perhaps 1890 and 1950—a host of innovative technologies and business practices were adopted in the United States. Europeans speak of “Fordism”: taking the part--Henry Ford’s assembly lines in Detroit, and his mass production of the Model-T Ford--for the whole. The fact that other industrial economies were unable to fully adopt American technologies of mass production and mass distribution in the first half of the twentieth century gave the United States a unique level of industrial dominance and technological leadership in the years after 1950.

Three factors have taken pride of place in explanations of America's place at the world economy's leading edge in its level of technology throughout the twentieth century:

- First, the U.S. had an exceptional commitment to education: to schooling everyone (everyone who was white, that is; and boys more than girls) even in the largely-rural economy of the nineteenth century, and to making the achievement of a high-school diploma the rule rather than the exception in the cities of early twentieth.
- Second, the U.S. was of extraordinarily large size--the largest market in the world. Thus the U.S. could take advantage of potential economies of scale in ways that other, smaller economies could not match.
- Third, the U.S. was extraordinarily rich in natural resources, particularly energy. To the extent that energy and natural-resource intensive industries were at the heart of early twentieth century industrial growth, the U.S. was again well-positioned.

The Productivity Growth Slowdown

But in 1973 the steady trend of climbing rates of productivity growth stopped cold. Between 1973 and 1995 *measured* growth in output per worker in the U.S. economy grew at only 0.6 percent per year. The slowdown did not affect the U.S. economy alone: the slowdown hit--to different degrees and with different effects--the other major economies of the world's industrial core in western Europe, Japan, and Canada as well.

The Productivity Slowdown in the G-7 Economies

Country	1950-1973 Output per Worker Annual Growth	1973-1995 Output per Worker Annual Growth
United States	2.1%	0.6%
Canada	2.7%	1.6%
Japan	7.4%	2.6%
Britain	2.4%	1.8%
Germany (West)	5.7%	2.0%
France	4.4%	1.5%
Italy	4.9%	2.3%

What caused the productivity slowdown? Observers have pointed to four factors--oil prices, the baby boom, increased problems of economic measurement, and environmental protection expenditures--and there are no doubt others.

But the causes of the productivity slowdown remain uncertain. The productivity slowdown remains a mystery.

The End of the Productivity Slowdown

As computers improved and spread throughout the U.S. economy in the 1970s and 1980s, economists kept waiting to see the wonders of computing show through in national productivity. But it didn't happen. The productivity growth slowdown continued throughout the 1970s and 1980s. This surprising phenomenon came to be called "the computer paradox" after Robert Solow's famous 1987 observation that: "We see the computer age everywhere except in the productivity statistics."

Since 1995, however, productivity growth in the American economy has accelerated once again to a pace of 2.1 percent per year. Half a decade is a very short time on which to pin

any long-run trend, but there is certainly reason to hope that the productivity slowdown has come to an end.

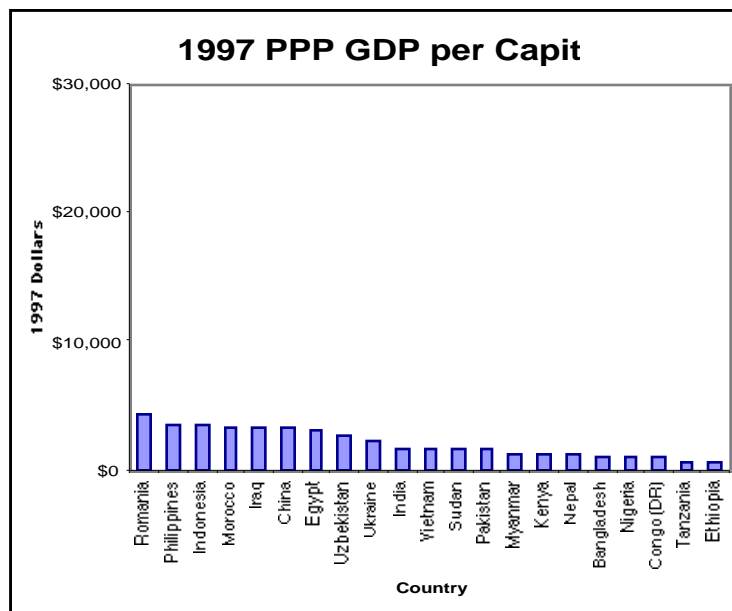
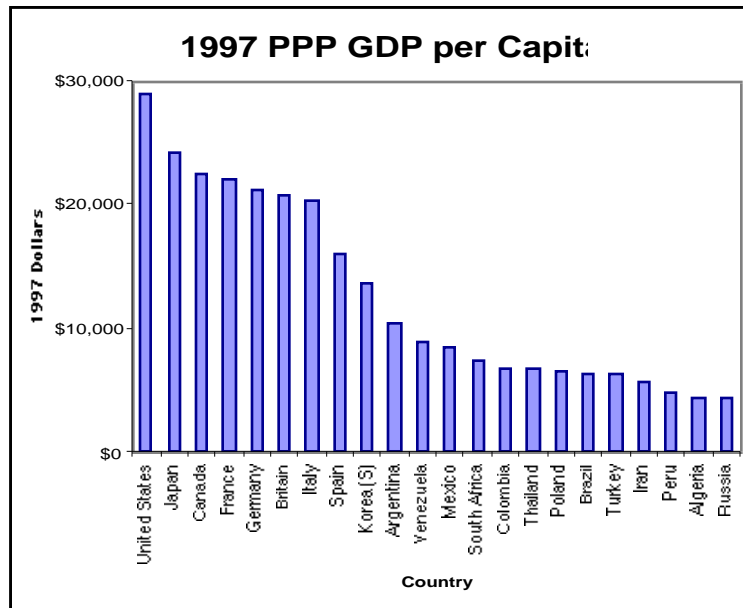
The U.S. economy has benefited from a stunning investment boom since 1992. Between 1992 and 1998 real GDP rose by an average of 3.6% per year, and business fixed investment soared at a 10.1% average rate--almost three times as fast. As a consequence, the share of business fixed investment in GDP jumped from 9.2% to 13.2%, with much of the additional investment going into computers and related equipment. At least one major economic forecasting business attributes the recent acceleration in productivity growth to this investment boom, a huge share of which is driven by the rapidly-falling price of computers.

There is every reason to expect technological progress in the computer and communications sectors to continue. And there is every reason to expect these useful technologies to continue to diffuse throughout the economy. Thus the best bet in forecasting future productivity growth is to project what has happened in the past half-decade forward. If these projections are accurate, then the productivity slowdown has been brought to an end, and it is the technological revolution in computers and communications that has done it. But that is a subject for the end of this book.

Divergence, Bigtime

The industrial core of the world economy saw its level of material productivity and standards of living explode in the nineteenth and twentieth centuries. Elsewhere the growth of productivity levels and standards of living and the spread of industrial technologies was slower. As the industrialized economies grew while industrial technologies spread slowly elsewhere, the world became a more and more unequal place. As development economist Lant Pritchett puts it, the dominant feature of world economic history is "divergence, bigtime." In terms of relative incomes and productivity levels, the world today is more unequal and more *divergent* than ever before.

World Distribution of Income Today: Selected Countries



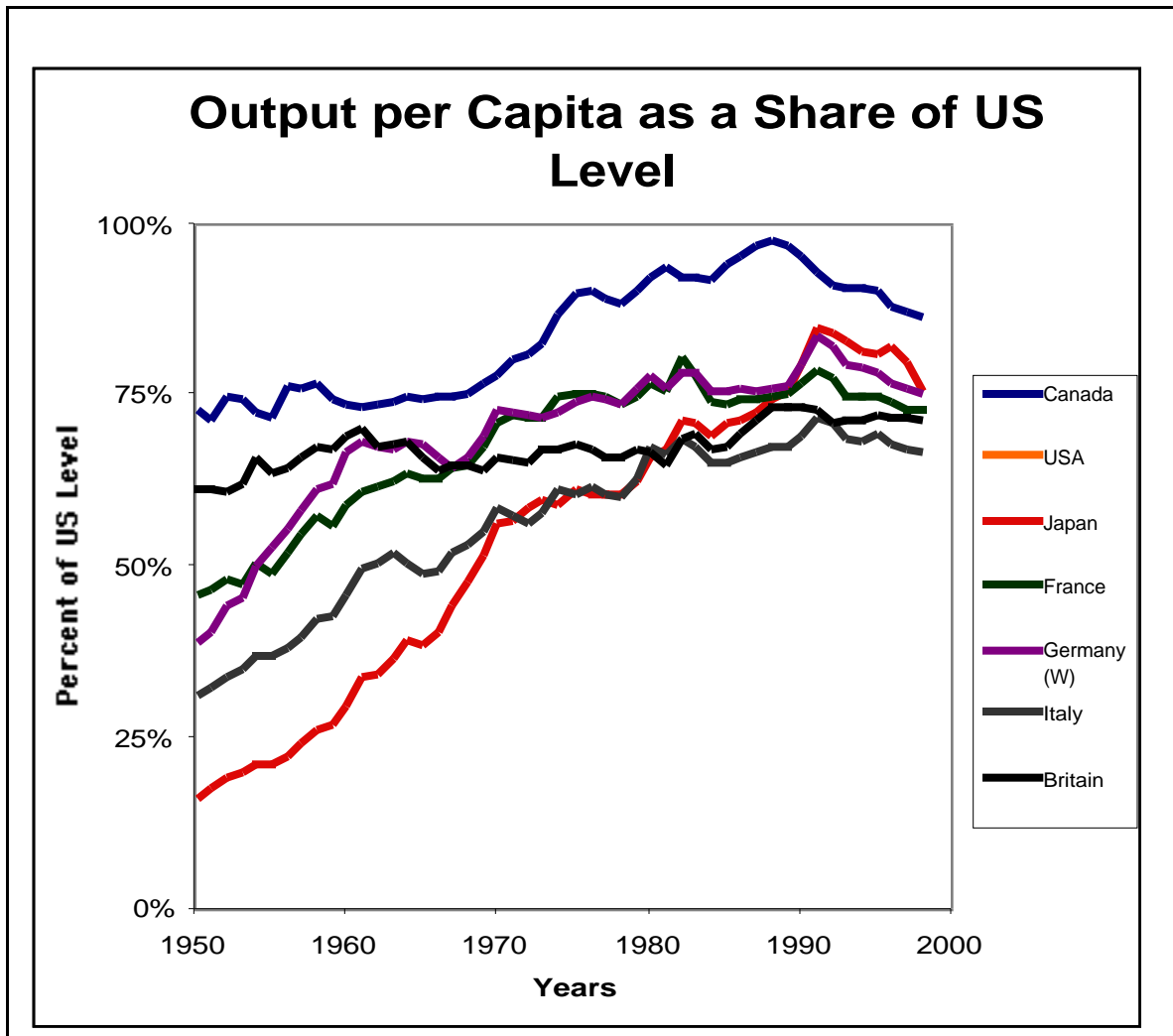
Legend: In some places modern economic growth has taken hold and propelled levels of productivity and living standards upward. In other places people on average live little if any better than their ancestors did. The world is a more unequal place, in relative income terms, than it has been since there were some human tribes that had fire and others that did not.

Source: Author's calculations.

Those who live in relatively poor regions of the world today have higher material living standards than their predecessors who lived in those regions a century ago. But the relative gap vis-à-vis the industrial core has grown extraordinarily and extravagantly. In the first half of the nineteenth century the average inhabitant of an average country had perhaps one-half the material standard of living of a citizen of the world's leading industrial edge economy. Today the average inhabitant of an average country has only one-sixth the material standard of living and productivity level of the leading edge.

An Exception: OECD Economies

It is not inevitable that there be such divergence. The United States--with its 14 to 25-fold increase in output per worker over the years since 1870--has not been the fastest-growing economy in the world. A number of other economies at different levels of industrialization, development, and material productivity a century ago have now *converged*, and their levels of productivity, economic structures, and standards of living are now very close to those of the United States. The six largest of these converging economies are today, with the United States, the so called Group-of-Seven, the G-7 economies whose leaders gather for annual summit meetings. Their steady process of convergence to the U.S. level from 1950 until 1990 is shown in Figure 5.7.



Most of these economies were significantly poorer than the U.S. back in 1870 and even in 1950. The Japanese economy, for example, went from a level of output per capita equal to sixteen percent of the U.S. level in 1950 to 84 percent of the U.S. level in 1992-- before falling steeply backwards during Japan's recent recession. Italian levels of GDP per capita have gone from 30 percent of the U.S. to 65 percent of the U.S. level; German levels have gone from 40 percent to 75 percent; Canadian levels have gone from 70 percent to 85 percent; and British levels of GDP per capita have gone from 60 to 70 percent of U.S. levels in the past half century.

Policy: Why Have These Economies Converged?

By and large the economies that have converged are those that belong to the OECD: the Organization for Economic Cooperation and Development, which was started back in the first post-WWII years in the days of the Marshall Plan as a club of countries that received (or gave) Marshall Plan aid to help rebuild and reconstruct after World War II. Countries that received Marshall Plan aid adopted a common set of economic policies: large private sectors freed of government regulation of prices, investment with its direction determined by profit-seeking businesses, large social insurance systems to redistribute income, and governments committed to avoiding mass unemployment.

The original OECD members all wound up with mixed economies. In these, markets direct the flow of resources, while governments stabilize the economy, provide social-insurance safety nets, and encourage entrepreneurship and enterprise. They arrived at this institutional setup largely due to good luck, partly due to the Cold War, and partly as a result of post-World War II institutional reforms.

This post-World War II institutional configuration was essentially the price countries had to pay for receiving Marshall Plan aid. The U.S. executive was unwilling to send much aid to countries which it thought were likely to engage in destructive economic policies, largely because it did not believe that it could win funding from the Republican-dominated congress for a Marshall Plan that did not impose such strict *conditionality* upon recipients. By contrast, countries that were relatively rich after World War II but that did not adopt OECD-style institutional arrangements--like Argentina and Venezuela--have lost relative ground.

As the OECD economies became richer, they completed their demographic transitions: population growth rates fell. The policy emphasis on entrepreneurship and enterprise boosted national investment rates, so the OECD economies all had healthy investment rates as well. These factors boosted their steady-state capital-output ratios. And the diffusion of technology from the U.S. did the rest of the job in bringing OECD standards of economic productivity close to the U.S. level.

Policy: The East Asian Miracle

But the set of extraordinarily successful economies is not limited to the set of original OECD economies. The economies of the East Asian miracle have over the past two generations exhibited stronger growth than has ever before been seen anywhere in world

history. They have not yet converged to the standards of living and levels of economic productivity found in the world economy's industrial core. But they are converging.

Immediately before World War II the regions that are now South Korea, Hong Kong and Singapore, and Taiwan had output per worker levels less than one-tenth of the United States. Today Singapore's GDP per capita is 90%, Hong Kong's is 70%, Taiwan's is 50%, and South Korea's is 45% of the U.S. level. A second wave of East Asian economies--Malaysia, Thailand--now average more than one quarter of the United States's level of GDP per capita.

The successful East Asian economies have a number of similarities in economic policy and structure to the OECD economies. Resource allocation decisions are by and large left to the market. Governments regard the encouragement of entrepreneurship and enterprise as a major goal. And high savings and investment rates are encouraged by a number of different government policies.

Yet there are also a number of differences vis-à-vis the OECD as well.

Governments in East Asia have been more aggressive in pursuing *industrial policy*, and somewhat less aggressive in establishing social insurance systems than the OECD economies. However, they have also had more egalitarian income distributions, hence less need for redistribution and social insurance. They have subsidized corporations that they believe are strategic for economic development, thus thinking that their bureaucrats know better than the market--heresy to economists. (However, it is worth noting that they have focused subsidies on those companies that have proved successful at exporting goods to other countries--so their bureaucrats have in a sense been rewarding the judgment of *foreign* markets.) The examples of successful catching-up suggest that things could have been otherwise for the world economy. Economies--even very poor economies--*can* rapidly adopt modern machine technologies and move their productivity levels close to first-world leading-edge standards.

The Rule: Divergence Behind the Iron Curtain

But "convergence" is the exception. "Divergence" is the rule. And perhaps the most important driving force behind divergence is Communism: being unlucky enough to have

been ruled by communists in the twentieth century is a virtual guarantee of relative poverty.

There used to be a snaky geographic line across Eurasia that Winston Churchill had once called the “Iron Curtain.” On one side were regimes that owed their allegiance to Karl Marx and to Marx’s viceroys on earth. On the other side were regimes claiming in the 1946-1989 Cold War to be of the “free world”--that were, if not good, at least less-worse guys.

The Iron Curtain: GDP per Capita Levels of Matched Pairs of Countries

East-Block Country	GDP per Capita	Matched West-Block Country	GDP per Capita	Relative Gap
North Korea	\$700	South Korea	\$13,590	94%
China	\$3,130	Taiwan	\$14,170	78%
Vietnam	\$1,630	Philippines	\$3,520	54%
Cambodia	\$1,290	Thailand	\$6,690	81%
FSR Georgia	\$1,960	Turkey	\$6,350	69%
Russia	\$4,370	Finland	\$20,150	78%
Bulgaria	\$4,010	Greece	\$12,769	69%
Slovenia	\$11,800	Italy	\$20,290	42%
Hungary	\$7,200	Austria	\$22,070	67%
Czech R.	\$10,510	Germany	\$21,260	51%
Poland	\$6,520	Sweden	\$19,790	67%
Cuba	\$3,100	Mexico	\$8,370	63%

Notice as you walk that to your right, outside the Iron Curtain, the countries are far better off in terms of GDP per capita. They are not necessarily better off in education, or health care, or in the degree of income inequality. If you were in the poorer half of the population, you probably received a better education and had access to better medical care in Cuba than in Mexico. But the countries fortunate enough to lie outside what was the Iron Curtain were and are vastly more prosperous. Depending on how you count and how unlucky you are, forty and ninety-four percent of the potential material prosperity of a country was annihilated if it happened to fall under Communist rule in the twentieth century. The fact that a large part of the globe fell under Communist rule in the twentieth century is one major factor responsible for the world's *divergence*.

Policy: Post-Communism

The demolition of the Berlin Wall and the take-down of the Iron Curtain has not significantly improved the situation in what are euphemistically and optimistically called "economies in transition" [from socialism to capitalism, that is]. Figuring out how to move from a stagnant, ex-Communist economy to a dynamic, growing one is very difficult, and no one has ever done it before.

A few of the "economies in transition" appear on the path to rapid convergence to western Europe: Slovenia, Hungary, the Czech Republic, and Poland have already clearly and successfully maneuvered through enough of "transition" to have advanced their economies beyond the point reached before 1989. It seems clear that their economic destiny is likely to become effectively part of western Europe. Slovakia, Lithuania, Latvia, and Estonia appear to have good prospects of following their example.

Elsewhere, however, the news is bad. Whether reforms have been step-by-step or all-at-once, whether ex-communists have been excluded from or have dominated the government, whether governments have been nationalist or internationalist, the results have been similar. Output has fallen, corruption has been rife, and growth has not resumed. Material standards of living in the Ukraine today are less than half of what they were when General Secretary Gorbachev ruled from Moscow.

Economists debate ferociously the appropriate economic strategy for unwinding the inefficient centrally-planned Soviet-style economy. The fact that such "transition" has never been undertaken before should make advice-givers cautious. And there is one other observation that should make advice-givers depressed: the best predictor of whether an eastern European country's transition will be rapid and successful or not appears to be its distance from western European political and financial capitals like Vienna, Frankfurt, and Stockholm.

The Rule: Divergence in General

But even if attention is confined to non-communist-ruled economies, there still has been enormous divergence in relative output per worker levels over the past hundred years. Since 1870, the ratio of richest to poorest economies has increased sixfold. Back in 1870 two-thirds of all countries had GDP per capita levels between 60 and 160 percent of the average. Today the range that holds two-thirds of all countries extends from 35 to 280 percent of the average.

Sources of Divergence

The principal cause of the extraordinary variation in output per worker between countries today are differences in their respective steady-state capital-output ratios. Two secondary causes are, first, openness to creating and adapting the technologies that enhance the efficiency of labor as measured by levels of development two generations ago, and, second, the level of education today.

Productivity two generations ago is a good indicator the level of technological knowledge that had been acquired as of half a century ago. The level of education today captures the country's ability to invent and acquire further technological expertise today. Without education, inventing new and adopting foreign-born technological knowledge is simply not possible.

Together these factors--the determinants of capital-output ratios, and the two determinants of access to technology--together account for the bulk of the differences between countries in their relative productivity levels.

The determinants of the steady-state balanced-growth capital-output ratio play a very powerful role. A higher share of investment in national product is powerfully correlated with relative levels of output per worker. No country with an investment rate of less than ten percent has an output per worker level even twenty percent of the United States. No country with an investment share of less than twenty percent has an output per worker level greater than seventy-five percent of the United States level.

A high level of labor force growth is correlated--albeit less powerfully--with a low level of output per worker. The average country with a labor force growth rate of more than 3 percent per year has an output per worker level less than 20 percent of the U.S. The average variable with a labor force growth rate of less than one percent has an output per worker level greater than 60 percent of the U.S. level.

Together these determinants of the steady-state capital-output ratio can, statistically, account for up to half of the variation in national economies' levels of productivity per worker in the world today. The power of these factors central to the theoretical model of economic growth presented in chapter 4 should not be underestimated. Indeed, their

power is the reason that we spent so much space on the standard growth model in chapter 4.

But the factors stressed in chapter 4 are not the only major determinants of relative wealth and poverty in the world today. Differences in the efficiency of labor are as important as differences in steady-state capital-output ratios. Differences in the efficiency of labor arise from the differential ability of workers to handle and utilize modern technologies.

The efficiency of labor is high where educational levels are high—so that workers can use the modern technologies they are exposed to—and where economic contact with the industrial core is high—so that workers and managers are exposed to the modern technologies invented in the world's R&D laboratories.

Schooling is the variable that has the strongest correlation with output per worker. Countries that have an average of 4-6 years of schooling have output per worker levels that average 20 percent of the U.S. Countries with an average level of schooling of greater than 10 years have output per worker levels of 65 percent of the U.S. level, as Figure 5.9 shows.

Policies and Long-Run Growth

In many respects, it is decidedly odd that the world distribution of output per worker is as unequal as it is. World trade, migration, and flows of capital should all work to take resources and consumption goods from where they are cheap to where they are dear. As they travel with increasing speed and increasing volume as transportation and communication costs fall, these commodity and factor-of-production flows should erode differences in productivity and living standards between national economies. Moreover, most of the edge in standards of living and productivity levels held by the industrial core is no one's private property, but instead the common intellectual and scientific heritage of humankind. Hence every poor economy has an excellent opportunity to catch up with the rich by adopting and adapting from this open storehouse of modern machine technology.

We can view this particular glass either as half empty or as half full. Half full is that much of the world has already made the transition to sustained economic growth. Most people today live in economies that, while far poorer than the leading-edge post-industrial nations of the world's economic core, have successfully climbed onto the

escalator of economic growth and thus the escalator to modernity. The economic transformation of most of the world is less than a century behind the economic transformation of the leading-edge economies--only an eyeblink behind from the perspective of the six millennia since the spread of agriculture out of the Middle East's Fertile Crescent.

Moreover, perhaps we can look forward to a future in which convergence of relative income levels will finally begin to take place. The bulk of humanity is now achieving material standards of living at which the demographic transition takes hold. As population growth rates in developing countries fall, their capital-output ratios will begin to rise quickly. And--with tolerable government, reasonable security of property, and better ways of achieving an education--their output per worker levels and material standards of living will converge to the world's leading edge.

Half empty is that we live today in the most unequal--in terms of the divergence in the life prospects of children born into different economies--age that the world has ever seen. One and a half billion people today live in economies that have *not* made the transition to intensive economic growth, and have *not* climbed onto the escalator to modernity. It is very hard to argue that the median inhabitant of Africa is *any* better off in material terms than his or her counterpart of a generation ago.

Savings and Investment

Policies to ensure that savers get reasonable rates of return on their savings have the potential to boost the savings rate. By contrast, systems of economic governance in which profits are diverted into the hands of the political powerful through restrictions on entrepreneurship will tend over time to diminish savings, as will economic policies that divert the real returns to savings into the hands of financiers or the government through inflation. Government deficits also have the potential to reduce the savings rate: unless consumers and investors are far-sighted enough to recognize that a government deficit now means a tax increase later, a government that spends more than it raises in revenue must borrow--and this amount borrowed is not a contribution to total national savings because it is not available to fund investment.

A number of potential policies work to boost investment for a given amount of savings. Policies that welcome foreign investors' money have the potential to cut a decade or a generation off of the time to industrialize--if the foreign funded capital is used wisely. Free-trade policies that allow businesses to freely earn and spend the foreign exchange

they need to purchase new generations of machinery and equipment are an effective way of boosting investment. Policies that impose heavy tariffs or require scarce import licenses in order to purchase foreign-made capital equipment are a sure sign that a country will not get its money's worth out of a given nominal savings share, but will instead find that real investment remains low. Indeed, many of the most successful *developmental states* have done the opposite. They have provided large subsidies to fund investment and expansion by businesses that have demonstrated their competence and productivity by successfully exporting and thus competing on the world market.

Education

Universal education--especially universal education of girls--pays a two-fold benefit. Investments are more likely to be productive with a better-educated workforce to draw on; hence investments are more likely to be made. Educated women are likely to want at least as much education for their children, and to have relatively attractive opportunities outside the home--and so the birthrate is likely to fall.

It is certainly the case that the developing countries of the world appear, for the most part, to be going through the demographic transition faster than the economies of today's industrial core did in the past three centuries. Thus current estimates of the world's population in 2050 are markedly lower than the estimates of a decade ago. A decade ago the projected global population in 2050 was sixteen billion or more; today it is twelve billion or less. This is in part at least due to rapid expansions in educational attainment in today's developing economies.

A high level of educational attainment also raises the efficiency of labor both by teaching skills directly and by making it easier to advance the general level of technological expertise. A leading-edge economy with a higher level of educational attainment is likely to make more inventions. A follower economy with a higher level of educational attainment is likely to have a more successful time at adapting to local conditions inventions and innovations from the industrial core of the world economy. How large these effects are at the macroeconomic level is uncertain. That they are there nobody doubts.

The East Asian economies, especially, provide examples of how uncorrupt and well-managed developmental states can follow macroeconomic policies that accelerate economic growth and convergence. These economies that have provided incentives to

accelerate the demographic transition and boost savings and investment have managed to close the gap vis-à-vis the world economy's industrial core faster than anyone would *ex ante* have believed possible.

Policies for Technological Advance

Without better technology, increases in capital stock produced by investment rapidly run into diminishing returns. And without improvements in the "technologies" of organization, government, and education, productivity stagnates.

Somewhat surprisingly, economists have relatively little to say about what governs technological progress. Why did better technology raise living standards by 2% annually a generation ago, but by less than 1% today? Why did technology progress by only 0.25% per year in the early 1800s? Improving literacy, communications, and research and development may help explain faster progress since than before the industrial revolution, and faster progress in the twentieth than in the nineteenth century. Yet, as noted above, as important a feature of recent economic history as the post-1973 productivity slowdown remains largely a mystery.

Will Governments Follow Good Policies?

That governments *can* assist in growth and development does not mean that governments *will*. The broad experience of growth in developing economies--outside of the East Asian Pacific rim, outside of the OECD--has been that governments often *won't*. Over the past two decades many have argued that typical systems of regulation in developing countries have retarded development by:

- Embarking on "prestige" industrialization programs that keep resources from shifting to activities in which the country had a long-run comparative advantage.
- Inducing firms and entrepreneurs to devote their energies to seeking rents by lobbying governments, instead of seeking profits by lowering costs.
- Creating systems of regulation and project approval that have degenerated into extortion machines for manufacturing bribes for the bureaucrats.

Many governments--particularly unelected governments--are not *that* interested in economic development. Giving valuable industrial franchises to the nephews of the

dictator; making sure that members of your ethnic group are in key places to extort bribes; or taking the foreign exchange that would have been spent importing productive machinery and equipment and using it instead to buy more modern weapons for the army--these can seem more attractive options. In the absence of political democracy, the checks on a government that does not seek economic development are few.

Moreover, checks on government that do exist may not be helpful. In a non-democracy-- or a shaky semi-democracy--there are two possible sources of pressure on the government: riots in the capital, and coups by the soldiers. Even a government that seeks only the best for its people in terms of economic growth will have to deal with these sources of pressure, and will have to avoid riots in the capital, and avoid coups by the soldiers.

Coups by the soldiers are best avoided by spending money on the military. Riots in the capital are best avoided by making sure that the price of food is low, and that influential opinion leaders in the capital are relatively happy with their material standards of living. Thus governments find themselves driven to policies that redistribute income from the farms to the cities, from exporting businesses to urban consumers of imported goods, from those who have the power to invest and make the economy grow to those who have the power to overthrow the government.

If the rulers have the worst of motives, government degenerates into *kleptocracy*: rule by the thieves. If government has the best of motives, it is still hard to avoid policies that diminish saving and retard the ability to translate saving into productive investment. W.W. Rostow recounts a visit by President Kennedy to Indonesia in the early 1960s; Kennedy talked about economic development, and a South Asian Development Bank to provide capital for Indonesia's economic growth. Indonesia's then-dictator Sukarno's response? "Mr. President, development takes too long. Give me West Irian [province, the western half of the island of New Guinea, to annex] instead."

Taken as a group, the poor countries of the world have *not* closed any of the gap relative to the world's industrial leaders since World War II.

Neoliberalism

Thus much thinking about the proper role of government in economic growth over the past two decades has led to conclusions that are today called *neo-liberal*. The government

has a sphere of core competencies--administration of justice, maintenance of macroeconomic stability, avoidance of deep recessions, some infrastructure development, provision of social insurance--at which it is effective. But there is a large area of potential activities in which governments--or, at least, governments that do not have the bureaucratic honesty and efficiency needed for a successful *developmental state*--are more likely to be destructive than constructive. Hence the neo-liberal recommendation that governments attempt to shrink their role back to their core competencies, and thus to deregulate industries and privatize public enterprises. Whether such policies will in fact lead to convergence rather than continued divergence is still an open question.