

FIGURE 1.1 Estimates of the distribution of countries according to PPP-adjusted GDP per capita in 1960, 1980, and 2000.

income per capita. It is more natural to look at the log of variables, such as income per capita, that grow over time, especially when growth is approximately proportional, as suggested by Figure 1.8 below. This is for the simple reason that when $x(t)$ grows at a proportional rate, $\log x(t)$ grows linearly, and if $x_1(t)$ and $x_2(t)$ both grow by the same proportional amount, $\log x_1(t) - \log x_2(t)$ remains constant, while $x_1(t) - x_2(t)$ increases.

Figure 1.2 shows a similar pattern, but now the spreading is more limited, because the absolute gap between rich and poor countries has increased considerably between 1960 and 2000, while the proportional gap has increased much less. Nevertheless, it can be seen that the 2000 density for log GDP per capita is still more spread out than the 1960 density. In particular, both figures show that there has been a considerable increase in the density of relatively rich countries, while many countries still remain quite poor. This last pattern is sometimes referred to as the “stratification phenomenon,” corresponding to the fact that some of the middle-income countries of the 1960s have joined the ranks of relatively high-income countries, while others have maintained their middle-income status or even experienced relative impoverishment.

Figures 1.1 and 1.2 demonstrate that there is somewhat greater inequality among nations today than in 1960. An equally relevant concept might be inequality among individuals in the world economy. Figures 1.1 and 1.2 are not directly informative on this, since they treat each country identically regardless of the size of its population. An alternative is presented in Figure 1.3, which shows the population-weighted distribution. In this case, countries such as China, India, the United States, and Russia receive greater weight because they have larger populations. The picture that emerges in this case is quite different. In fact, the 2000 distribution looks less spread out, with a thinner left tail than the 1960 distribution. This reflects the fact that

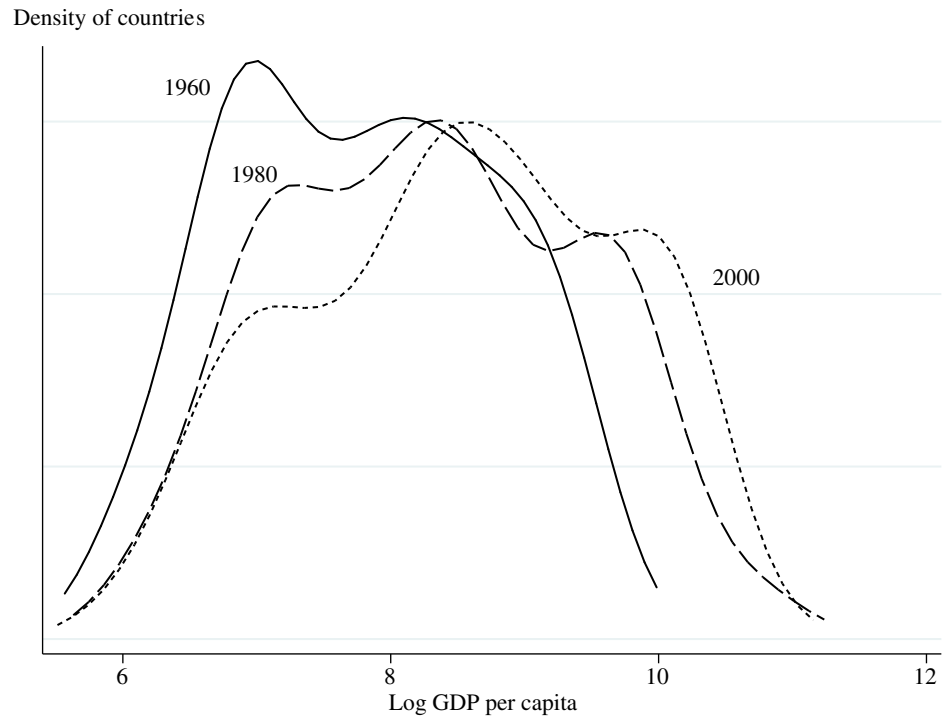


FIGURE 1.2 Estimates of the distribution of countries according to log GDP per capita (PPP adjusted) in 1960, 1980, and 2000.

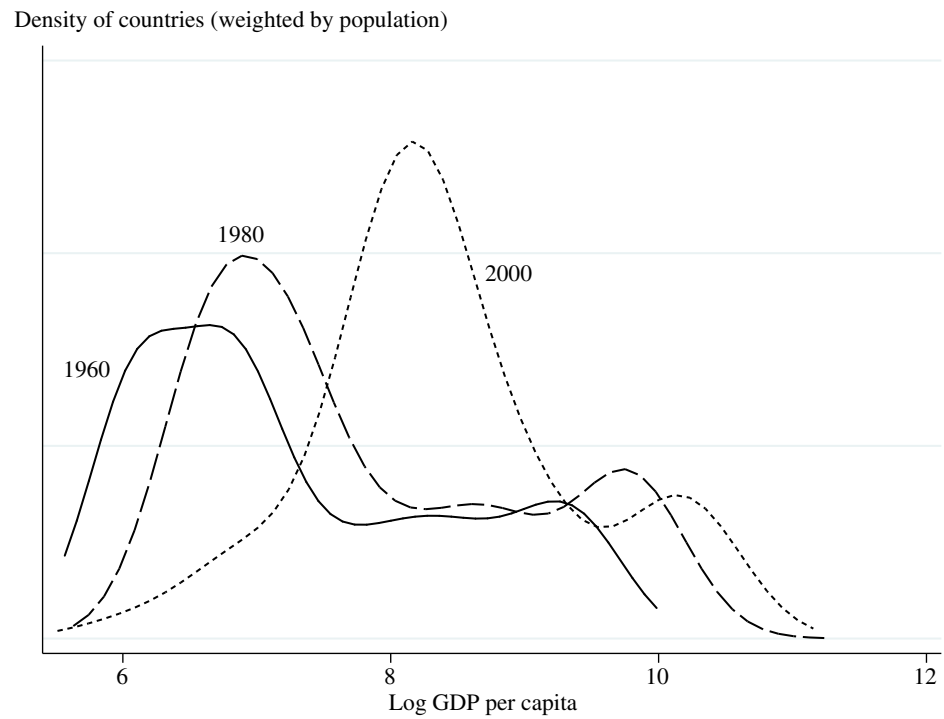


FIGURE 1.3 Estimates of the population-weighted distribution of countries according to log GDP per capita (PPP adjusted) in 1960, 1980, and 2000.

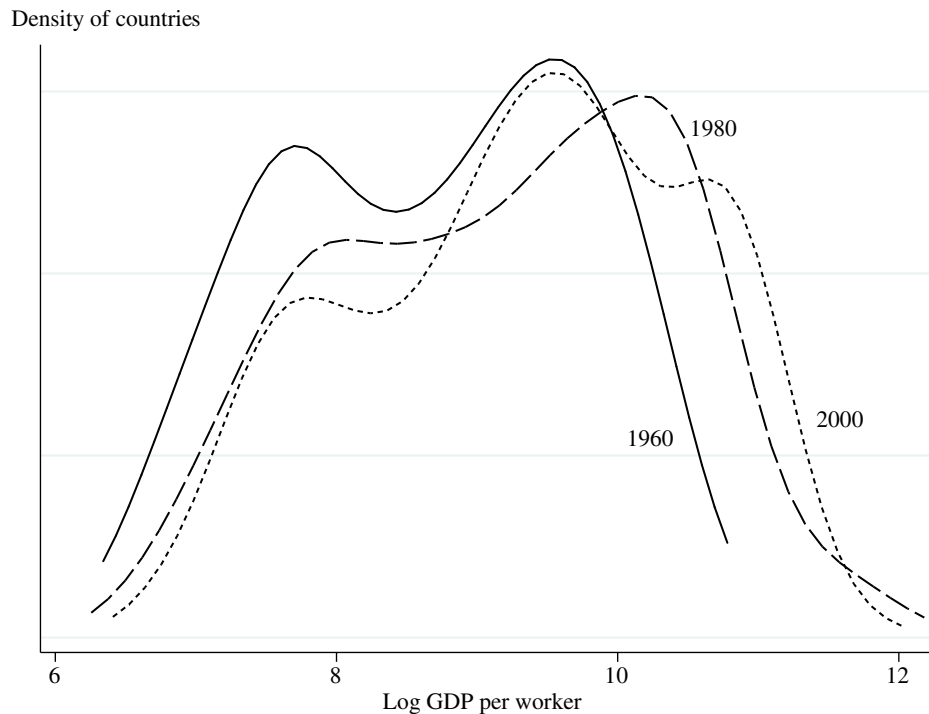


FIGURE 1.4 Estimates of the distribution of countries according to log GDP per worker (PPP adjusted) in 1960, 1980, and 2000.

in 1960 China and India were among the poorest nations in the world, whereas their relatively rapid growth in the 1990s puts them into the middle-poor category by 2000. Chinese and Indian growth has therefore created a powerful force for relative equalization of income per capita among the inhabitants of the globe.

Figures 1.1, 1.2, and 1.3 look at the distribution of GDP per capita. While this measure is relevant for the welfare of the population, much of growth theory focuses on the productive capacity of countries. Theory is therefore easier to map to data when we look at output (GDP) per worker. Moreover, key sources of difference in economic performance across countries are national policies and institutions. So for the purpose of understanding the sources of differences in income and growth across countries (as opposed to assessing welfare questions), the unweighted distribution is more relevant than the population-weighted distribution. Consequently, Figure 1.4 looks at the unweighted distribution of countries according to (PPP-adjusted) GDP per worker. “Workers” here refers to the total economically active population (according to the definition of the International Labour Organization). Figure 1.4 is very similar to Figure 1.2, and if anything, it shows a greater concentration of countries in the relatively rich tail by 2000, with the poor tail remaining more or less the same as in Figure 1.2.

Overall, Figures 1.1–1.4 document two important facts: first, there is great inequality in income per capita and income per worker across countries as shown by the highly dispersed distributions. Second, there is a slight but noticeable increase in inequality across nations (though not necessarily across individuals in the world economy).

1.2 Income and Welfare

Should we care about cross-country income differences? The answer is definitely yes. High income levels reflect high standards of living. Economic growth sometimes increases pollution or may raise individual aspirations, so that the same bundle of consumption may no longer satisfy an individual. But at the end of the day, when one compares an advanced, rich country with a less-developed one, there are striking differences in the quality of life, standards of living, and health.

Figures 1.5 and 1.6 give a glimpse of these differences and depict the relationship between income per capita in 2000 and consumption per capita and life expectancy at birth in the same year. Consumption data also come from the Penn World tables, while data on life expectancy at birth are available from the World Bank Development Indicators.

These figures document that income per capita differences are strongly associated with differences in consumption and in health as measured by life expectancy. Recall also that these numbers refer to PPP-adjusted quantities; thus differences in consumption do not (at least in principle) reflect the differences in costs for the same bundle of consumption goods in different countries. The PPP adjustment corrects for these differences and attempts to measure the variation in real consumption. Thus the richest countries are not only producing more than 30 times as much as the poorest countries, but are also consuming 30 times as much. Similarly, cross-country differences in health are quite remarkable; while life expectancy at birth is as

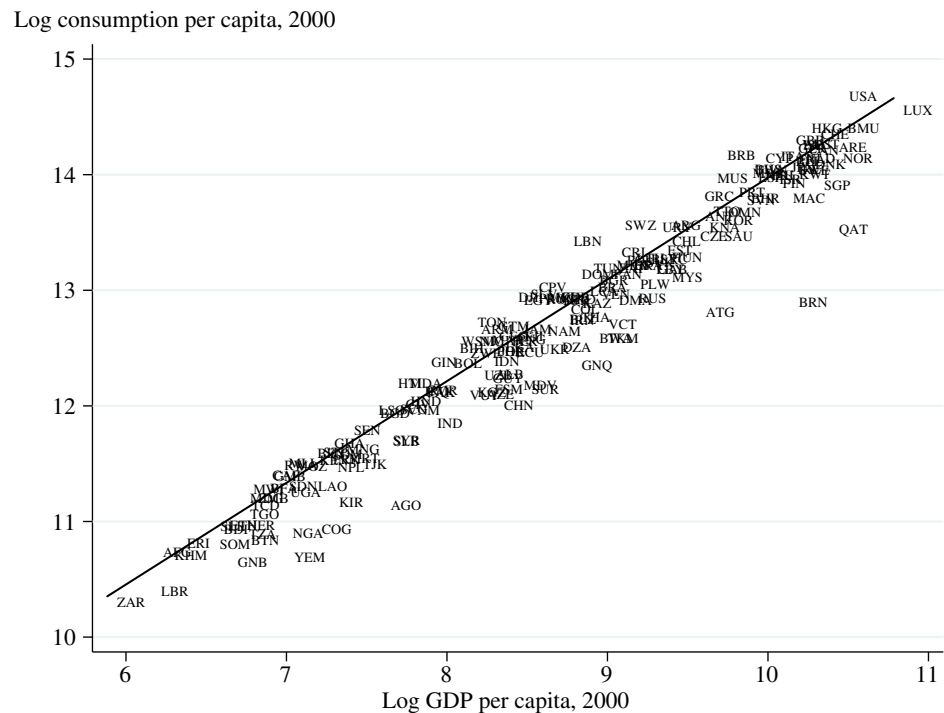


FIGURE 1.5 The association between income per capita and consumption per capita in 2000. For a definition of the abbreviations used in this and similar figures in the book, see <http://unstats.un.org/unsd/methods/m49/m49alpha.htm>.

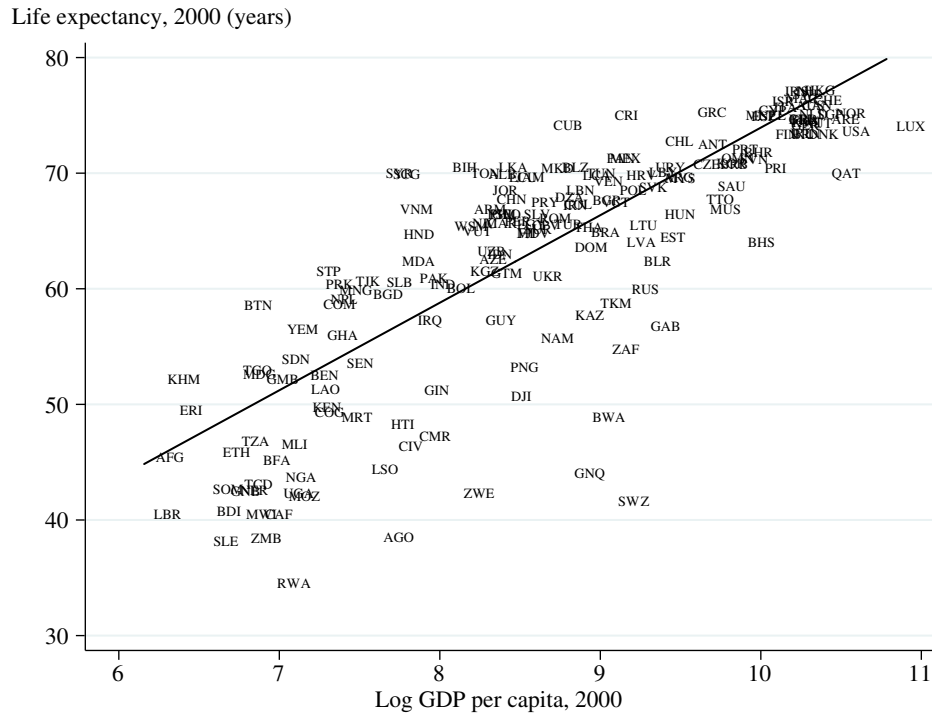


FIGURE 1.6 The association between income per capita and life expectancy at birth in 2000.

high as 80 in the richest countries, it is only between 40 and 50 in many sub-Saharan African nations. These gaps represent huge welfare differences.

Understanding why some countries are so rich while some others are so poor is one of the most important, perhaps *the* most important, challenges facing social science. It is important both because these income differences have major welfare consequences and because a study of these striking differences will shed light on how the economies of different nations function and how they sometimes fail to function.

The emphasis on income differences across countries implies neither that income per capita can be used as a “sufficient statistic” for the welfare of the average citizen nor that it is the only feature that we should care about. As discussed in detail later, the efficiency properties of the market economy (such as the celebrated First Welfare Theorem or Adam Smith’s invisible hand) do not imply that there is no conflict among individuals or groups in society. Economic growth is generally good for welfare but it often creates winners and losers. Joseph Schumpeter’s famous notion of creative destruction emphasizes precisely this aspect of economic growth; productive relationships, firms, and sometimes individual livelihoods will be destroyed by the process of economic growth, because growth is brought about by the introduction of new technologies and creation of new firms, replacing existing firms and technologies. This process creates a natural social tension, even in a growing society. Another source of social tension related to growth (and development) is that, as emphasized by Simon Kuznets and discussed in detail in Part VII, growth and development are often accompanied by sweeping structural transformations, which can also destroy certain established relationships and create yet other winners and losers in the process. One of the important questions of

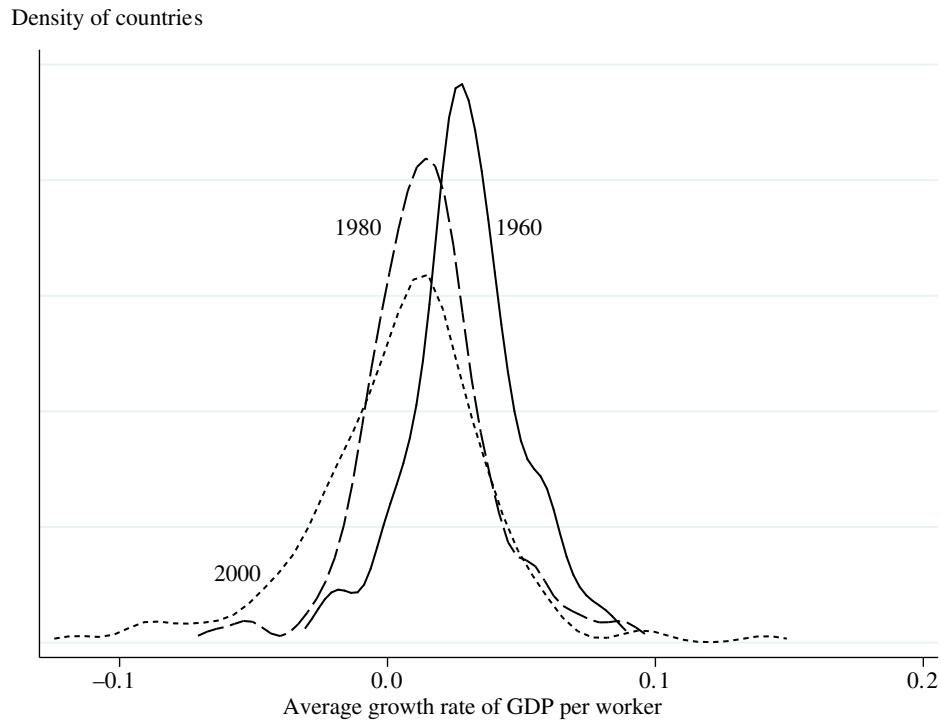


FIGURE 1.7 Estimates of the distribution of countries according to the growth rate of GDP per worker (PPP adjusted) in 1960, 1980, and 2000.

grows rapidly, and by the mid-1990s it has become richer than both. South Korea has a similar trajectory, though it starts out poorer than Singapore and grows slightly less rapidly, so that by the end of the sample it is still a little poorer than Spain. The other country that has grown very rapidly is the “African success story” Botswana, which was extremely poor at the beginning of the sample. Its rapid growth, especially after 1970, has taken Botswana to the ranks of the middle-income countries by 2000.

The two Latin American countries in this picture, Brazil and Guatemala, illustrate the often-discussed Latin American economic malaise of the postwar era. Brazil starts out richer than South Korea and Botswana and has a relatively rapid growth rate between 1960 and 1980. But it experiences stagnation from 1980 on, so that by the end of the sample South Korea and Botswana have become richer than Brazil. Guatemala’s experience is similar but even more bleak. Contrary to Brazil, there is little growth in Guatemala between 1960 and 1980 and no growth between 1980 and 2000.

Finally, Nigeria and India start out at similar levels of income per capita as Botswana but experience little growth until the 1980s. Starting in 1980, the Indian economy experiences relatively rapid growth, though this has not been sufficient for its income per capita to catch up with the other nations in the figure. Finally, Nigeria, in a pattern that is unfortunately all too familiar in sub-Saharan Africa, experiences a contraction of its GDP per capita, so that in 2000 it is in fact poorer than it was in 1960.

The patterns shown in Figure 1.8 are what we would like to understand and explain. Why is the United States richer in 1960 than other nations and able to grow at a steady pace thereafter? How did Singapore, South Korea, and Botswana manage to grow at a relatively rapid pace for

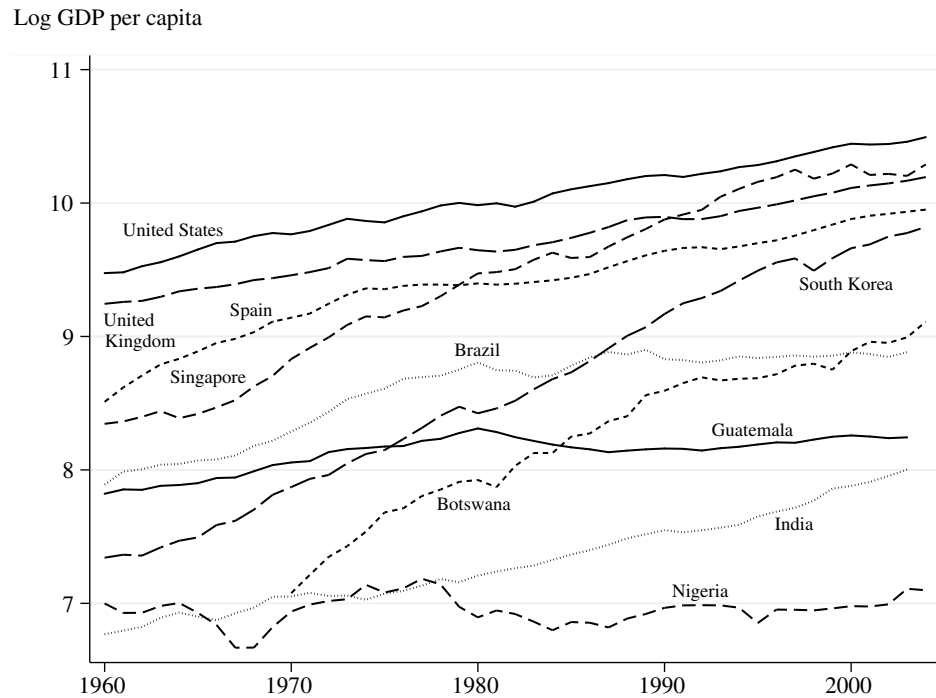


FIGURE 1.8 The evolution of income per capita in the United States, the United Kingdom, Spain, Singapore, Brazil, Guatemala, South Korea, Botswana, Nigeria, and India, 1960–2000.

40 years? Why did Spain grow relatively rapidly for about 20 years but then slow down? Why did Brazil and Guatemala stagnate during the 1980s? What is responsible for the disastrous growth performance of Nigeria?

1.4 Origins of Today's Income Differences and World Economic Growth

The growth rate differences shown in Figures 1.7 and 1.8 are interesting in their own right and could also be, in principle, responsible for the large differences in income per capita we observe today. But are they? The answer is largely no. Figure 1.8 shows that in 1960 there was already a very large gap between the United States on the one hand and India and Nigeria on the other.

This pattern can be seen more easily in Figure 1.9, which plots log GDP per worker in 2000 versus log GDP per capita in 1960 (in both cases relative to the U.S. value) superimposed over the 45° line. Most observations are around the 45° line, indicating that the relative ranking of countries has changed little between 1960 and 2000. Thus the origins of the very large income differences across nations are not to be found in the postwar era. There are striking growth differences during the postwar era, but the evidence presented so far suggests that world income distribution has been more or less stable, with a slight tendency toward becoming more unequal.

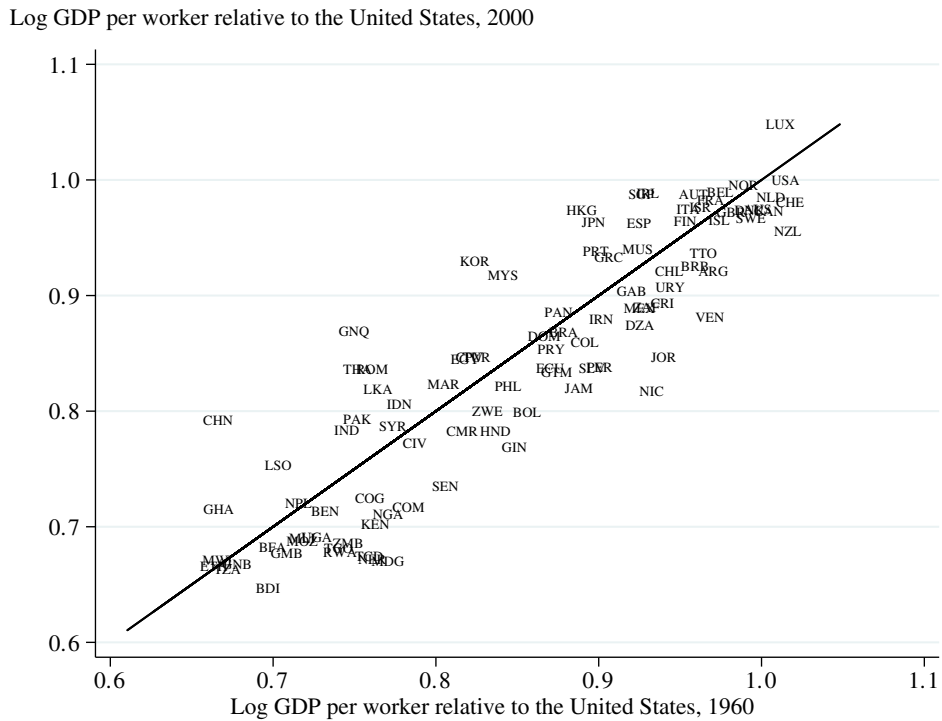


FIGURE 1.9 Log GDP per worker in 2000 versus log GDP per worker in 1960, together with the 45° line.

If not in the postwar era, when did this growth gap emerge? The answer is that much of the divergence took place during the nineteenth and early twentieth centuries. Figures 1.10–1.12 give a glimpse of these developments by using the data compiled by Angus Maddison for GDP per capita differences across nations going back to 1820 (or sometimes earlier). These data are less reliable than Summers-Heston’s Penn World tables, since they do not come from standardized national accounts. Moreover, the sample is more limited and does not include observations for all countries going back to 1820. Finally, while these data include a correction for PPP, this is less complete than the price comparisons used to construct the price indices in the Penn World tables. Nevertheless, these are the best available estimates for differences in prosperity across a large number of nations beginning in the nineteenth century.

Figure 1.10 illustrates the divergence. It depicts the evolution of average income among five groups of countries: Africa, Asia, Latin America, Western Europe, and Western offshoots of Europe (Australia, Canada, New Zealand, the United States). It shows the relatively rapid growth of the Western offshoots and West European countries during the nineteenth century, while Asia and Africa remained stagnant and Latin America showed little growth. The relatively small (proportional) income gap in 1820 had become much larger by 1960.

Another major macroeconomic fact is visible in Figure 1.10: Western offshoots and West European nations experience a noticeable dip in GDP per capita around 1929 because of the famous Great Depression. Western offshoots, in particular the United States, only recovered fully from this large recession in the wake of World War II. How an economy can experience a sharp decline in output and how it recovers from such a shock are among the major questions of macroeconomics.

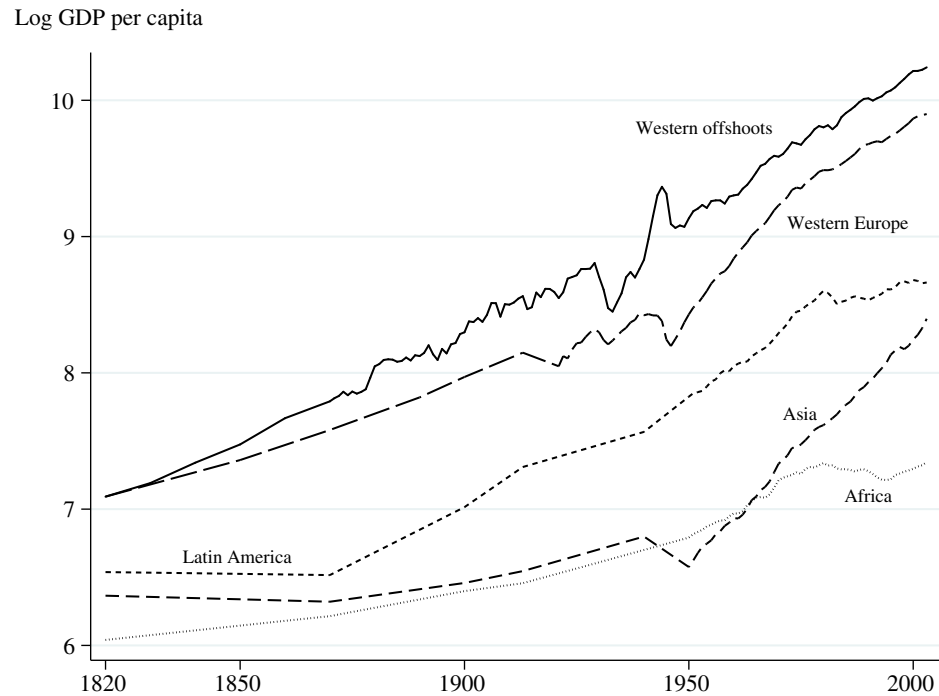


FIGURE 1.10 The evolution of average GDP per capita in Western offshoots, Western Europe, Latin America, Asia, and Africa, 1820–2000.

A variety of evidence suggests that differences in income per capita were even smaller before 1820. Maddison also has estimates for average income for the same groups of countries going back to 1000 A.D. or even earlier. Figure 1.10 can be extended back in time using these data; the results are shown in Figure 1.11. Although these numbers are based on scattered evidence and informed guesses, the general pattern is consistent with qualitative historical evidence and the fact that income per capita in any country cannot have been much less than \$500 in terms of 2000 U.S. dollars, since individuals could not survive with real incomes much less than this level. Figure 1.11 shows that as we go further back in time, the gap among countries becomes much smaller. This further emphasizes that the big divergence among countries has taken place over the past 200 years or so. Another noteworthy feature that becomes apparent from this figure is the remarkable nature of world economic growth. Much evidence suggests that there was only limited economic growth before the eighteenth century and certainly before the fifteenth century. While certain civilizations, including ancient Greece, Rome, China, and Venice, managed to grow, their growth was either not sustained (thus ending with collapses and crises) or progressed only at a slow pace. No society before nineteenth-century Western Europe and the United States achieved steady growth at comparable rates.

Notice also that Maddison's estimates show a slow but steady increase in West European GDP per capita even earlier, starting in 1000. This assessment is not shared by all economic historians, many of whom estimate that there was little increase in income per capita before 1500 or even before 1800. For our purposes this disagreement is not central, however. What is important is that, using Walter Rostow's terminology, Figure 1.11 shows a pattern of *takeoff* into sustained growth; the economic growth experience of Western Europe and Western offshoots appears to have changed dramatically about 200 years or so ago. Economic historians also debate whether there was a discontinuous change in economic activity that deserves the

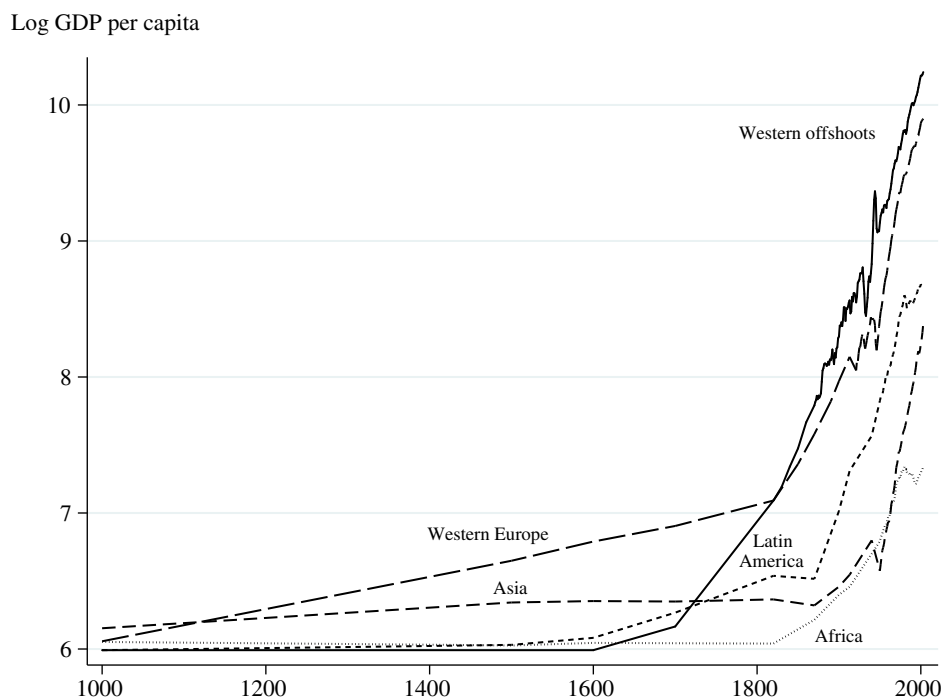


FIGURE 1.11 The evolution of average GDP per capita in Western offshoots, Western Europe, Latin America, Asia, and Africa, 1000–2000.

terms “takeoff” or “industrial revolution.” This debate is again secondary to our purposes. Whether or not the change was discontinuous, it was present and transformed the functioning of many economies. As a result of this transformation, the stagnant or slowly growing economies of Europe embarked upon a path of sustained growth. The origins of today’s riches and also of today’s differences in prosperity are to be found in this pattern of takeoff during the nineteenth century. In the same time that Western Europe and its offshoots grew rapidly, much of the rest of the world did not experience a comparable takeoff (or did so much later). Therefore an understanding of modern economic growth and current cross-country income differences ultimately necessitates an inquiry into the causes of why the takeoff occurred, why it did so about 200 years ago, and why it took place only in some areas and not in others.

Figure 1.12 shows the evolution of income per capita for the United States, the United Kingdom, Spain, Brazil, China, India, and Ghana. This figure confirms the patterns shown in Figure 1.10 for averages, with the United States, the United Kingdom, and Spain growing much faster than India and Ghana throughout, and also much faster than Brazil and China except during the growth spurts experienced by these two countries.

Overall, on the basis of the available information we can conclude that the origins of the current cross-country differences in income per capita are in the nineteenth and early twentieth centuries (or perhaps even during the late eighteenth century). This cross-country divergence took place at the same time as a number of countries in the world “took off” and achieved sustained economic growth. Therefore understanding the origins of modern economic growth are not only interesting and important in their own right, but also holds the key to understanding the causes of cross-country differences in income per capita today.

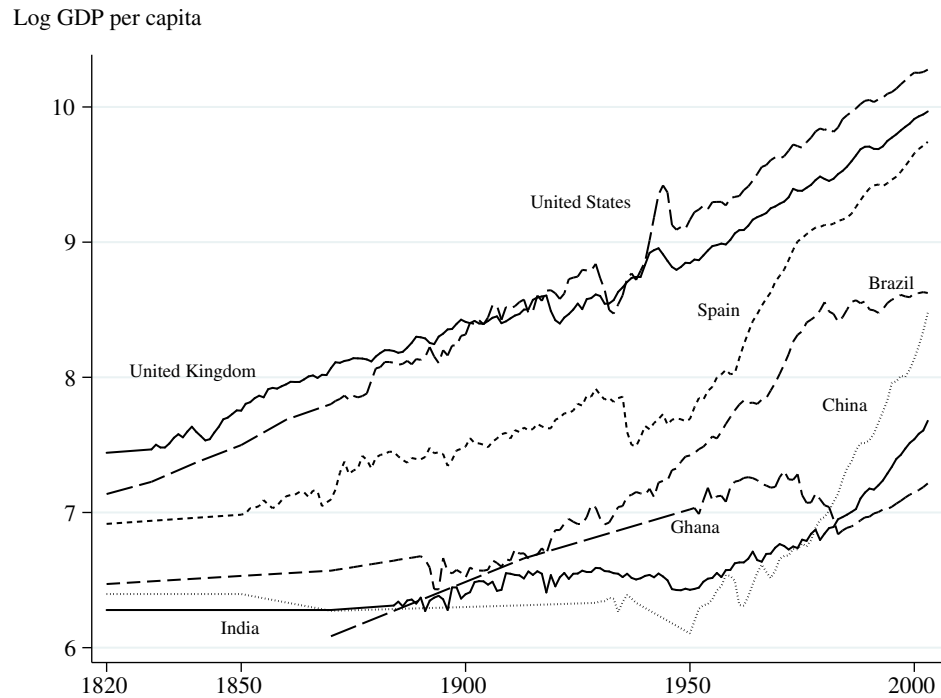


FIGURE 1.12 The evolution of income per capita in the United States, the United Kingdom, Spain, Brazil, China, India, and Ghana, 1820–2000.

1.5 Conditional Convergence

I have so far documented the large differences in income per capita across nations, the slight divergence in economic fortunes over the postwar era, and the much larger divergence since the early 1800s. The analysis focused on the unconditional distribution of income per capita (or per worker). In particular, we looked at whether the income gap between two countries increases or decreases regardless of these countries' characteristics (e.g., institutions, policies, technology, or even investments). Barro and Sala-i-Martin (1991, 1992, 2004) argue that it is instead more informative to look at the conditional distribution. Here the question is whether the income gap between two countries that are similar in observable characteristics is becoming narrower or wider over time. In this case, the picture is one of conditional convergence: in the postwar period, the income gap between countries that share the same characteristics typically closes over time (though it does so quite slowly). This is important both for understanding the statistical properties of the world income distribution and also as an input into the types of theories that we would like to develop.

How do we capture conditional convergence? Consider a typical *Barro growth regression*:

$$g_{i,t,t-1} = \alpha \log y_{i,t-1} + \mathbf{X}_{i,t-1}^T \boldsymbol{\beta} + \varepsilon_{i,t}, \quad (1.1)$$

where $g_{i,t,t-1}$ is the annual growth rate between dates $t - 1$ and t in country i , $y_{i,t-1}$ is output per worker (or income per capita) at date $t - 1$, \mathbf{X} is a vector of other variables included in the regression with coefficient vector $\boldsymbol{\beta}$ (\mathbf{X}^T denotes the transpose of this vector), and $\varepsilon_{i,t}$