INTRODUCTION

I.1 THE IMPORTANCE OF GROWTH

The real per capita gross domestic product (GDP) in the United States grew by a factor of 8.1 from $2244 in 1870 to $18,258 in 1990, all measured in 1985 dollars. The increase in real per capita GDP corresponds to a growth rate of 1.75 percent per year. This performance gave the United States the highest level of real per capita GDP in the world in 1990 (with the possible exception of the United Arab Emirates, an oil producer with a small population).[1]

To appreciate the consequences of apparently small differentials in growth rates when compounded over long periods of time, we can calculate where the United States would have been in 1990 if it had grown since 1870 at 0.75 percent per year, one percentage point per year below its actual rate. A growth rate of 0.75 percent per year is close to the rate experienced in the long run—from 1900 to 1987—by India (0.64 percent per year), Pakistan (0.88 percent per year), and the Philippines (0.86 percent per year). If the United States had begun in 1870 at a real per capita GDP of $2244 and had then grown at a rate of 0.75 percent per year over the next 120 years, then its real per capita GDP in 1990 would have been $5519, only 2.5 times the value in 1870 and 30 percent of the actual value in 1990 of $18,258. Then, instead of ranking first in the world in 1990, the United States would have ranked 37th out of 127 countries with data. To put it another way, if the growth rate had been lower by just 1 percentage point per year, then the U.S. real per capita GDP in 1990 would have been close to that in Mexico and Hungary and would have been about $1000 less than that in Portugal and Greece.

[1]The long-term data on GDP are in Tables 10.2 and 10.3 of Chapter 10. The cross-country information for recent years is in Table 10.1. See Chapter 10 for sources and definitions.

Suppose, alternatively, that the U.S. real per capita GDP had grown since 1870 at 2.75 percent per year, 1 percentage point per year greater than the actual value. This higher growth rate is close to those experienced in the long run by Japan (2.95 percent per year from 1890 to 1990) and Taiwan (2.75 percent per year from 1900 to 1987). If the United States had still begun in 1870 at a real per capita GDP of $2244 and had then grown at a rate of 2.75 percent per year over the next 120 years, then its real per capita GDP in 1990 would have been $60,841—27 times the value in 1870 and 3.3 times the actual value in 1990 of $18,258. A real per capita GDP of $60,841 is well outside the historical experience of any country and may, in fact, be infeasible. We can say, however, that a continuation of the long-term U.S. growth rate of 1.75 percent per year implies that the United States will not attain a real per capita GDP of $60,841 until the year 2059.

The comparison of levels of real per capita GDP over a century involves multiples of as high as 20; for example, Japan's real per capita GDP in 1990 was about 20 times that in 1890. Comparisons of levels of real per capita GDP across countries at a point in time exhibit even greater multiples. Figure I.1 is a histogram for the log of real per capita GDP for 118 countries in 1960. The mean value corresponds to a real per capita GDP of $1470 (1985 U.S. dollars). The standard deviation of the log of real per capita GDP—a measure of the proportionate dispersion of real per capita GDP—is 0.90. This number means that a 1-standard-deviation band around the mean encompasses a range from 0.41 of the mean to 2.5 times the mean. The

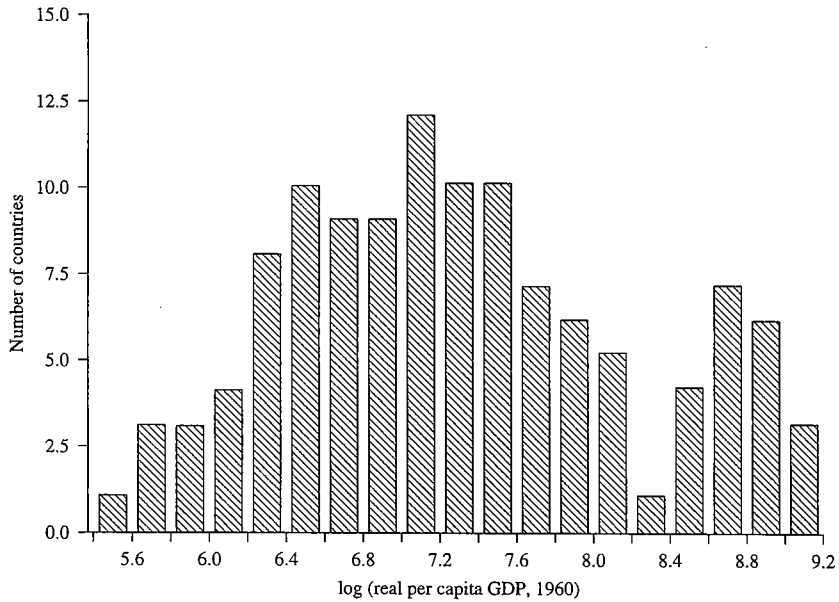

FIGURE I.1
Histogram for the log of real per capita GDP in 1960.

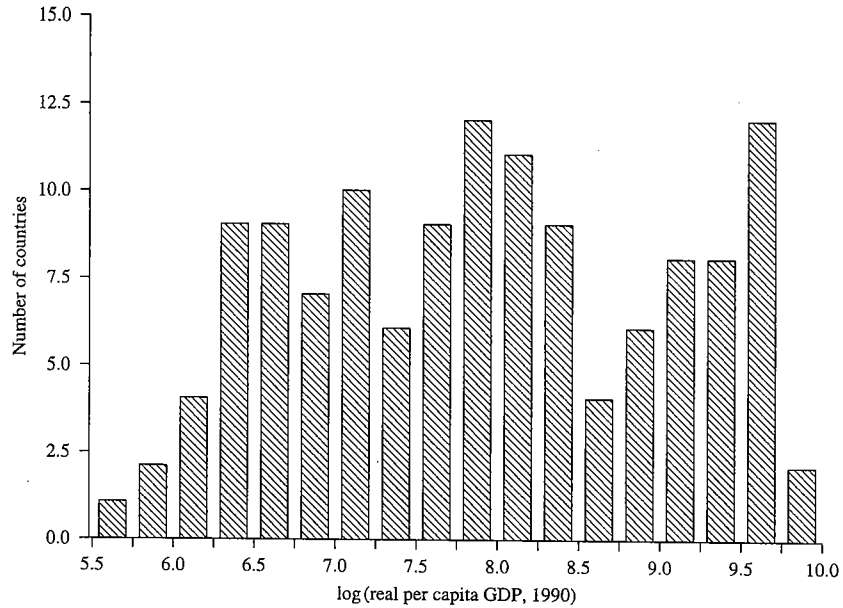

FIGURE I.2
Histogram for the log of real per capita GDP in 1990.

highest real per capita GDP of $9774 for the United States is 39 times the value of $249 for Ethiopia.

Figure I.2 shows a comparable histogram for 1990 for 129 countries. The mean here corresponds to a real per capita GDP of $2737, 1.9 times the value in 1960. The standard deviation of the log of real per capita GDP in 1990 is 1.11, implying a 1-standard-deviation band from 0.33 of the mean to 3.0 times the mean. Hence, the proportionate dispersion of real per capita GDP increased from 1960 to 1990. The highest value, $18,399 for the United States, is now 65 times the lowest value—$285 for Ethiopia.

If Ethiopia were to grow at the long-term U.S. rate of 1.75 percent per year, then it would take 239 years to reach the 1990 level of U.S. real per capita GDP. The required interval would still be 152 years if Ethiopia were to grow at the long-term Japanese rate of 2.75 percent per year.

For 114 countries, the average growth rate of real per capita GDP between 1960 and 1990 was 1.8 percent per year—nearly the same as the long-term U.S. rate—with a standard deviation of 1.8. Figure I.3 is a histogram of these growth rates; the range is from −2.1 percent per year for Iraq to 6.7 percent per year for South Korea. Thirty-year differences in growth rates of this magnitude have enormous consequences for standards of living. South Korea raised its real per capita GDP by a factor of 7.4 from $883 in 1960 (rank 83 out of 118 countries) to $6578 in 1990 (rank 35 of 129), while Iraq lowered its real per capita GDP by a factor of 0.5 from $3320 in 1960 (rank 23 of 118) to $1783 in 1990 (rank 82 of 129).

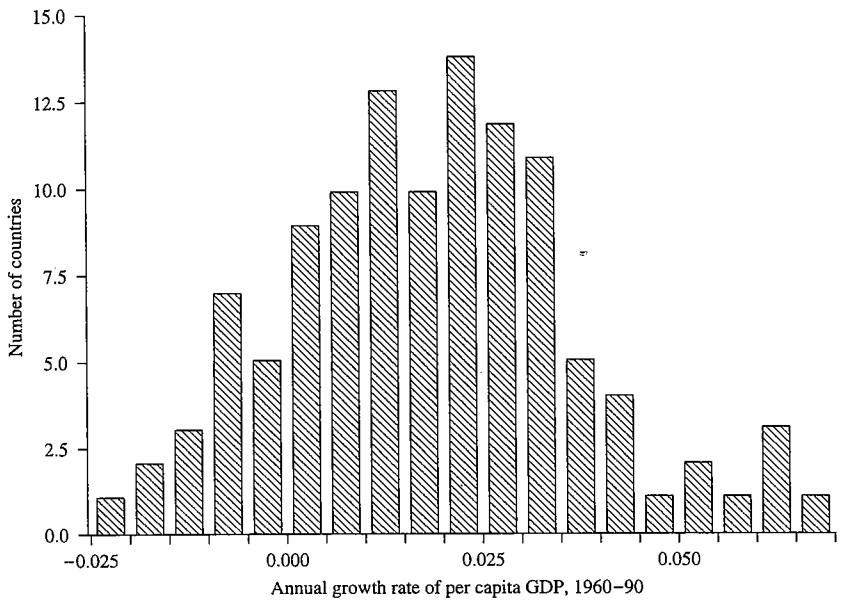

FIGURE I.3
Histogram for growth rates from 1960 to 1990.

A few other countries had growth rates from 1960 to 1990 that were nearly as high as South Korea's; those with rates above 5 percent per year were Singapore with 6.3 percent, Hong Kong with 6.2 percent, Taiwan with 6.1 percent, Botswana with 5.7 percent, Malta with 5.4 percent, and Japan with 5.4 percent. These countries increased their levels of real per capita GDP by a multiple of at least 5 over a single generation, that is, 30 years.

At the other end, 17 countries in addition to Iraq had negative growth rates of real per capita GDP from 1960 to 1990. The list, starting with the lowest rate, is Chad, Madagascar, Mozambique, Somalia, Zambia, Uganda, Guyana, Zaire, Nicaragua, Benin, Central African Republic, Haiti, Burundi, Ghana, Venezuela, Mauritania, and Niger. Thus, sub-Saharan African countries dominate the low-growth group; for the 39 sub-Saharan African countries with data, the mean growth rate from 1960 to 1990 was only 0.8 percent per year. That is, the typical country in sub-Saharan Africa increased its real per capita GDP by a factor of only 1.3 over 30 years.

If we want to understand why countries differ dramatically in standards of living (Figures I.1 and I.2), then we have to understand why countries experience such sharp divergences in long-term growth rates (Figure I.3). Even small differences in these growth rates, when cumulated over a generation or more, have much greater consequences for standards of living than the kinds of short-term business fluctuations that have typically occupied most of the attention of macroeconomists. To put it another way, if we can learn about government policy options

that have even small effects on the long-term growth rate, then 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—the subject matter of this book—is the part of macroeconomics that really matters.

I.2 EMPIRICAL REGULARITIES ABOUT ECONOMIC GROWTH

Kaldor (1963) listed a number of stylized facts that he thought typified the process of economic growth:

1. Per capita output grows over time, and its growth rate does not tend to diminish.
2. Physical capital per worker grows over time.
3. The rate of return to capital is nearly constant.
4. The ratio of physical capital to output is nearly constant.
5. The shares of labor and physical capital in national income are nearly constant.
6. The growth rate of output per worker differs substantially across countries.[2]

Fact 6 accords with the cross-country data that we have already discussed. Facts 1, 2, 4, and 5 seem to fit reasonably well with the long-term data for currently developed countries. For discussions of the stability of the long-run ratio of physical capital to GDP in Japan, Germany, Italy, the United Kingdom, and the United States, see Maddison (1982, Chapter 3). For indications of the long-term stability of factor shares in the United States, see Denison (1974, Appendix J) and Jorgenson, Gollop, and Fraumeni (1987, Table 9.3). Young (1994) reports that factor shares were reasonably stable in four East-Asian countries—Hong Kong, Singapore, South Korea, and Taiwan—from the early or middle 1960s through 1990. Studies of seven developed countries—Canada, France, Germany, Italy, Japan, the Netherlands, and the United Kingdom—indicate that factor shares are similar to those in the United States (Christensen, Cummings, and Jorgenson [1980] and Dougherty [1991]). In some Latin-American countries considered by Elias (1990), the capital shares tend, however, to be higher than those in the United States.

[2]Kuznets (1973, 1981) brings out other characteristics of modern economic growth. He notes the rapid rate of structural transformation, which includes shifts from agriculture to industry to services. This process involves urbanization, shifts from home work to employee status, and an increasing role for formal education. He also argues that modern growth involves an increased role for foreign commerce and that technological progress implies reduced reliance on natural resources. Finally, he discusses the growing importance of government: "... the spread of modern economic growth placed greater emphasis on the importance and need for organization in national sovereign units ... The sovereign state unit was of critical importance as the formulator of the rules under which economic activity was to be carried on; as a referee ...; and as provider of infrastructure ..." (1981, p. 59).

Kaldor's claimed fact 3 on the stability of real rates of return appears to be heavily influenced by the experience of the United Kingdom; in this case, the real interest rate seems to have no long-run trend (see Barro [1987, Figures 4 and 7]). For the United States, however, the long-term data suggest a moderate decline of real interest rates (Barro [1993, Table 11.1]). Real rates of return in some fast-growing countries, such as South Korea and Singapore, are much higher than those in the United States but have declined over time (Young [1994]). Thus, it seems likely that Kaldor's hypothesis of a roughly stable real rate of return should be replaced by a tendency for returns to fall over some range as an economy develops.

We can use the data in Chapter 10 to assess the long-run tendencies of the growth rate of real per capita GDP. Tables 10.2 and 10.3 contain figures from Angus Maddison for 31 countries over periods of roughly a century. These numbers basically exhaust the available information about growth over very long time intervals.

Table 10.2 applies to 16 currently developed countries, the major countries in Europe plus the United States, Canada, and Australia. These data show an average per capita growth rate of 1.9 percent per year over roughly a century, with a breakdown by 20-year periods as follows:

Period	Growth rate (percent per year)	Number of countries
1870–1890	1.2	13
1890–1910	1.5	14
1910–1930	1.3	16
1930–1950	1.4	16
1950–1970	3.7	16
1970–1990	2.2	16

These numbers are consistent with Kaldor's proposition that the growth rate of real per capita GDP has no secular tendency to decline; in fact, the periods following World War II show growth rates well above the long-run average. The reduction in the growth rate from 3.7 percent per year in 1950–70 to 2.2 percent per year in 1970–90 corresponds to the often discussed *productivity slowdown*. It is apparent from the table, however, that the growth rate for 1970–90 is high in relation to the long-term history.

Table 10.3 contains figures for 15 currently less-developed countries in Asia and Latin America. In this case, the average long-run growth rate from 1900 to 1987 is 1.4 percent per year, and the breakdown into four subperiods is as follows:

Period	Growth rate (percent per year)	Number of countries
1900–1913	1.2	15
1913–1950	0.4	15
1950–1973	2.6	15
1973–1987	2.4	15

Again, the post–World War II period (here, 1950–87) shows growth rates well above the long-term average.

Table 10.1 contains information on real per capita GDP for over 100 countries from 1960 to 1990. We can use these data to extend the set of stylized facts that was provided by Kaldor. One pattern in the cross-country data is that the growth rate of real per capita GDP from 1960 to 1990 is essentially uncorrelated with the level of real per capita GDP in 1960 (see Chapter 12). In the terminology developed in Chapter 1, we refer to a tendency for the poor to grow faster than the rich as β convergence. Thus, the simple relationship between growth and the starting position for a broad cross section of countries does not reveal β convergence. This kind of convergence does appear if we limit attention to more homogeneous groups of economies, such as the U.S. states, regions of several European countries, and prefectures of Japan (see Barro and Sala-i-Martin [1991, 1992a, and 1992b] and Chapter 11). In these cases, the poorer places tend to grow faster than the richer ones. This behavior also appears in the cross-country data if we limit the sample to a relatively homogeneous collection of currently prosperous places, such as the OECD countries (see Baumol [1986] and DeLong [1988]).

We say in Chapter 1 that *conditional* β convergence applies if the growth rate of real per capita GDP is negatively related to the starting level of real per capita GDP after holding fixed some other variables, such as initial levels of human capital, measures of government policies, the propensities to save and have children, and so on. The broad cross-country sample—that is, the data set that does not show β convergence in an absolute sense—clearly reveals β convergence in this conditional context (see Barro [1991a]; Barro and Sala-i-Martin [1992a]; and Mankiw, Romer, and Weil [1992]). The rate of convergence is, however, only about 2 percent per year. Thus, it takes about 35 years for an economy to eliminate one-half of the gap between its initial real per capita GDP and its long-run or target level of real per capita GDP. (This target tends to grow over time.)

The results in Chapter 12 show that a number of variables are significantly related to the growth rate of real per capita GDP, once the starting level of real per capita GDP is held constant. For example, growth depends positively on the initial quantity of human capital in the form of educational attainment and health, negatively on the ratio of government consumption spending to GDP, and negatively on measures of distortions of markets and political instability. The ratio of gross investment to GDP is strongly positively correlated with the growth rate, but the timing evidence suggests that much of this association may reflect the reverse impact of growth prospects on the attractiveness of investment, rather than the favorable effect on growth from exogenous variations in the willingness to save. Similarly, Coe and Helpman (1993) demonstrate that investment in research and development (R&D) is highly correlated with productivity growth in a sample of 22 OECD countries (a group that has relatively satisfactory data on R&D expenditures). The direction of causation between R&D spending and growth has, however, not yet been established.

The cross-country evidence brings out a number of ways in which the government affects an economy's growth rate. Negative influences include the volume of consumption spending (and the associated level of taxation), distortions of

international trade, and political instability. Positive influences involve the maintenance of institutions that sustain the rule of law, possibly policies that promote the development of financial institutions, and perhaps spending on some forms of public infrastructure. In most cases, the empirical work does not provide robust estimates for the effects of a specific governmental policy on growth, but it does show that the overall package of policies matters a lot. Thus, by affecting long-run growth rates, the government's actions can have major consequences for standards of living that we highlighted earlier. As a corollary, the relation between government policies and growth is a priority area for economic research.

The cross-sectional data also reveal regularities in the behavior of the ratio of gross investment to GDP. This ratio is positively related to initial human capital in the forms of educational attainment and health and is also positively correlated with the level of real per capita GDP. However, the correlation with real per capita GDP becomes virtually nil once the quantity of human capital is held constant. These observations suggest that the investment/GDP ratio would tend to rise over some range as a country develops and increases its human capital per person.

We can learn more about the patterns in the investment ratio from the long-run time-series data. Maddison (1992) provides long-term information for a few countries on the ratios of gross domestic investment to GDP and of gross national saving (the sum of domestic and net foreign investment) to GDP. (See Figures 10.5–10.15 and the sources discussed in Chapter 10.) Averages of the investment and saving ratios over 20-year intervals for the eight countries that have enough data for a long-period analysis are as follows:

Ratios to GDP of Gross Domestic Investment and Gross National Saving (%)

Period	Austrl.	Canada	France	India	Japan	Korea	U.K.	U.S.
1. Gross Domestic Investment								
1870–1889	16.5	16.0	12.8	—	—	—	9.3	19.8
1890–1909	13.7	17.2	14.0	—	14.0	—	9.4	17.9
1910–1929	17.4	19.8	—	6.4	16.6	5.1*	6.7	17.2
1930–1949	13.3	13.1	—	8.4	20.5	—	8.1	12.7
1950–1969	26.3	23.8	22.6	14.0	31.8	16.3†	17.2	18.9
1970–1989	24.9	22.8	23.2	20.2	31.9	29.1	18.2	18.7
2. Gross National Saving								
1870–1889	11.2	9.1	12.8	—	—	—	13.9	19.1
1890–1909	12.2	11.5	14.9	—	12.0	—	13.1	18.4
1910–1929	13.6	16.0	—	6.4	17.1	2.3*	9.6	18.9
1930–1949	13.0	15.6	—	7.7	19.8	—	4.8	14.1
1950–1969	24.0	22.3	22.8	12.2	32.1	5.9†	17.7	19.6
1970–1989	22.9	22.1	23.4	19.4	33.7	26.2	19.4	18.5

*1911–1929

†1951–1969

Note: See Chapter 10 for further discussion.

For an individual country, the table indicates that the time paths of domestic investment and national saving are usually similar. Domestic investment was, however, substantially higher than national saving (that is, borrowing from abroad was large) for Australia and Canada from 1870 to 1929, for Japan from 1890 to 1909, for the United Kingdom from 1930 to 1949, and for Korea from 1950 to 1969 (in fact, through the early 1980s). National saving was much higher than domestic investment (lending abroad was substantial) for the United Kingdom from 1870 to 1929 and for the United States from 1930 to 1949.

For the United States, the striking observation from the table is the stability over time of the ratios for domestic investment and national saving. The only exception is the relatively low values from 1930 to 1949, the period of the Great Depression and World War II. The United States is, however, an outlier with respect to the stability of its investment and saving ratios; the data for the other seven countries show a clear increase in these ratios over time. In particular, the ratios for 1950–1989 are, in all cases, substantially greater than those from before World War II.

The long-term data therefore indicate that the ratios to GDP of gross domestic investment and gross national saving tend to rise as an economy develops, at least over some range. This pattern in the long-run time series accords with the information that we have already discussed for the broad cross section of countries from 1960 to 1990. The assumption of a constant gross saving ratio, which appears in Chapter 1 in the Solow–Swan model, therefore misses this regularity in the data.

The cross-country data also reveal some regularities with respect to fertility rates and, hence, rates of population growth. For most countries, the fertility rate tends to decline with increases in real per capita GDP. For the poorest countries, however, the fertility rate may rise with real per capita GDP, as Malthus (1798) predicted. Even stronger relations exist between educational attainment and fertility. Except for the most advanced countries, female schooling is negatively related with the fertility rate, whereas male schooling is positively related with the fertility rate. The net effect of these forces is that the fertility rate—and the rate of population growth—tend to fall over some range as an economy develops. The assumption of an exogenous, constant rate of population growth—another key element of the Solow–Swan model—conflicts with this empirical pattern.

I.3 A BRIEF HISTORY OF MODERN GROWTH THEORY

Classical economists, such as Adam Smith (1776), David Ricardo (1817), and Thomas Malthus (1798), and, much later, Frank Ramsey (1928), Allyn Young (1928), Frank Knight (1944), and Joseph Schumpeter (1934), provided many of the basic ingredients that appear in modern theories of economic growth. These ideas include the basic approaches of competitive behavior and equilibrium dynamics, the role of diminishing returns and its relation to the accumulation of physical and human capital, the interplay between per capita income and the growth rate of population, the effects of technological progress in the forms of increased specialization of labor and discoveries of new goods and methods of production, and the role of monopoly power as an incentive for technological advance.