9

Growth Policies

The "Great Recession" generated by the 2007–2008 economic and financial crisis and the subsequent long period of mediocre growth in the developed world have again put long-term growth at the forefront of economic policy debates. While demand policies may be effective in the short term to dampen cyclical fluctuations and even though they may have a longer term impact through hysteresis effects, they cannot be relied on to trigger lasting growth. Long-term production of goods and services is essentially determined by potential supply, whose rate of growth conditions the increase in wealth and welfare.

Economic growth is by no means a given. In 1913, Argentina's gross domestic product (GDP) per person was 70% higher than Spain's.[1] In the aftermath of World War II, that of Ghana exceeded that of South Korea by almost 50%. In 1970, Italy's GDP per person was more than 60% higher than

Ireland's. Yet, in 2016, Spain's GDP per person was almost 80% higher than Argentina's, Korea's was close to nine times higher than Ghana's, and Ireland's was almost twice Italy's.[2] Prosperity and underdevelopment result from persistent growth divergences over decades. For example, a growth differential of a single percentage point per year (as compared to a 2% trend) cumulated over 50 years results in a 63% income gap; for a differential of two percentage points, the gap after 50 years reaches 164%; and for three percentage points, it is 326%.[3]

People benefit from long-term growth directly through higher incomes or indirectly through wider access to public goods such as health, education, safety, and infrastructures. Their capacity to reap these benefits depends on income distribution: rising concerns about inequalities have made *inclusive growth* a priority objective. People also suffer from some of the consequences of growth, such as damage to the environment, which may in turn make growth unsustainable. It is thus important to address measurement issues through defining and adopting indicators that provide better estimates of living standards than GDP, considering not only material, but also ethical, social, environmental, and even philosophical dimensions.

Yet, growth is the only mechanism that makes it possible to increase the living standards of some individuals without decreasing those of others, and this is why this chapter focuses on growth and growth policies. We recognize the importance of the issues raised by proponents of no-growth and "*degrowth.*"[4] The interest of the discussion they have initiated is to propel noneconomic and nonmonetary concerns to the fore. They also have a point in arguing that sensible environmental goals are not compatible with the current growth models or in challenging the idea that "more is better." However, the assumed contradiction between economic growth and other objectives is misleading. Concerns about sustainability and equity call for better economics of growth and better growth policies, not for disregarding them altogether.

The quest for the determinants of growth is similar to opening successively, and with increasing difficulty, a set of Russian dolls. A first step consists in documenting the trajectories of various countries' economies over long periods of time. A number of stylized facts emerge from this exercise. A second step consists in uncovering the determinants of economic growth by introducing *production factors*; namely, labor and capital, and by calling on what is known as *growth accounting*, which identifies their contribution to economic growth.

To proceed beyond this descriptive approach, however, it is necessary to turn to growth models. So-called *neo-classical growth models* explain human and physical capital accumulation and its impact on income per person. They relate growth to the behavior of savings or to investment in education. These models are useful representations of reality—they help explain, for instance, why growth rates in Europe and Japan slowed down at the end of the twentieth century when income per person in those economies got closer to the

US level—and help address economic policy choices. However, they remain frustrating in that a significant part of the determinants of long-term growth comes out as an unexplained residual. To unearth what is behind that residual, later models, based on explicit microeconomic underpinnings, focus on *endogenous growth* mechanisms that explain how growth can persist over time, and how and why some countries use their production factors more effectively than others and achieve better growth performances. In turn, these models point to deeper determinants such as economic institutions and their adequacy for a given level of development. The last stage of the analysis therefore consists in determining in what context (in terms of education and research systems, of intellectual property protection, of competition, of corporate finance, of taxation, etc.) innovation and endogenous growth are most likely to flourish,[5] with the remaining caveat that growth itself is likely to influence the context.

Moving to a deeper level of analysis does not deprive the previous one of relevance, and the various approaches we have outlined are to a large extent complementary. Basic models go a long way toward explaining growth differences: for example, the largest part of the stellar East Asian growth performance in the last quarter of the twentieth century is accounted for by high saving and investment rates, which, given decreasing returns to capital, cannot produce sustainable growth. As economists move away from the well-charted approaches based on measuring growth and its components toward understanding its deeper determinants, their knowledge and recommendations become less assertive. Informed by past errors, they realize the limits of their science.[6] However, the challenges of economic policymaking underline how essential such investigations are. To find out how to jump-start European growth, for example, it is not enough to observe that it has been diverging from that of the United States or even that investment has slowed down or that innovation has lagged: what matters is to determine whether European countries should, as a priority, devote additional resources to education and research, whether they should enforce tighter competition in product markets, or whether they should embark on tax reforms, among other possible policy measures.

Growth economics therefore relies on a combination of mechanics and alchemy. The former is necessary to isolate and quantify the proximate determinants of output development along a growth trajectory. The latter is called for to understand what makes countries take off and move from one growth trajectory to a higher one. Beyond the obvious laundry list—the recommendation to fix all the major deficiencies that hinder labor market participation, the acquisition of knowledge, capital accumulation, innovation, and productivity improvements—there is therefore no such thing as a growth recipe. This makes the search for successful growth strategies especially arduous. To borrow from the title of a book by a famous development scholar (Easterly, 2001), the quest for growth is likely to remain somewhat elusive.

9.1 Concepts and Issues

9.1.1 Measuring growth and development

"A rising tide lifts all boats," John F. Kennedy once famously said.[7] But all boats are not lifted equally. Aggregate measures of the level of development require aggregating the standards of living of many individuals, and such aggregation involves ethical choices: the utilitarian, or "Benthamian" (cf. Chapter 1) observer will assess development using the well-being of the community as a whole as a criterion and therefore focus on the evolution of average income, while the "Rawlsian" observer will focus on the poorest individual and will therefore be concerned with absolute poverty reduction.[8]

Macroeconomists typically adopt a utilitarian approach, as they have been chiefly concerned with the progression of average income per person and have only come recently to focusing on inequality in income distributions and on absolute poverty reduction. Development economists often blend the two approaches by looking both at average income and at some measure of absolute poverty, such as the proportion of the population living on less than a given daily threshold.[9]

GDP per person, or *per capita GDP*, corresponds to the average value added per person created within a given constituency and is therefore relevant to measuring the average standard of living, however inequitable its distribution may be.[10] Of course, the "average person" is fictitious, so that GDP per person is not a satisfactory representation of any individual's income, not to even mention standard of living.

Comparing countries' incomes at various points in time requires several technical and complex corrections. Across time, GDP needs to be measured *in constant prices*, that is, to be adjusted for the evolution of prices. Across countries, adjustments are also needed to account for variations in exchange rates. The common practice is to use exchange rates adjusted for price differences: *purchasing power parity exchange rates* or *PPP exchange rates* are the nominal exchange rates that would equalize prices across countries (see Chapter 7).[11] These can be computed, but they are fraught with uncertainty and this uncertainty significantly affects comparisons. A major difficulty is the choice of a basket of goods and services that can be similar enough across countries (from a welfare perspective) to compare real incomes and stable enough over time to assess the evolution of real GDP for each country.

It is increasingly recognized that GDP is beset by several shortcomings.[12]

First, it does not include nonmarket and nonmonetary activities that impact on well-being and is therefore a poor measure of the latter (see also Chapter 1). Individual welfare also depends on life expectancy, access to public services, the length and quality of leisure, and more. It is misleading and misguided (Sen, 2000) to reduce the various dimensions of human development

to a single measure. Such considerations and Sen's contributions led to the introduction by the United Nations Development Program (UNDP) in the 1970s of a multidimensional human development indicator to provide a more comprehensive measure of well-being (the Human Development Index [HDI], described in Chapter 1).

More generally, improvements in livelihoods brought by technical progress and economic growth play a decisive role in the long-term evolution of income and living standards. Angus Deaton, who received the Nobel Prize in economics in 2015, has shown how the Scientific Revolution and Enlightenment generated improvements in health and well-being that had been largely underestimated by analyses based on income figures (Deaton, 2013) and how this progress also generated inequalities because not everyone benefitted from it.

Second, GDP sums up individual expenditures and does not consider positive or negative externalities. For example, the value-added generated by polluting industries adds to GDP, but the damage these industries cause to the environment is ignored—on the contrary, expenditures incurred to correct this damage contribute to GDP. Conventional GDP does not consider the depletion of natural resources. The concept of *sustainable development* aims at correcting this shortcoming through the introduction of intertemporal concerns and the consideration of how current patterns of production and consumption will affect those of tomorrow. However, while various efforts have been made to develop integrated so-called environmental-economic or "green" national accounts,[13] no single headline indicator is yet available that adequately captures this intertemporal dimension within national accounts. Instead, the General Assembly of the United Nations unanimously adopted in September 2015 a set of 14 *Sustainable Development Goals*, monitored through a framework of 169 targets and a list of 244 indicators, which partially address the two shortcomings just highlighted—if not by a single indicator, then by mainstreaming objectives other than the growth in monetary income.

Third, per capita GDP is not relevant for studying the efficiency of production because a large part of the national residents do not work. Productive efficiency is better captured by *labor productivity* (see box 9.1). This difference is particularly relevant when comparing economic performance between Europe and the United States. Table B9.1.1 indicates that, in 2013, while the population of the euro area (data available for 11 countries) was 2% lower than the US population, the total number of hours worked in the euro area was 14% lower. This 12% gap chiefly came from the number of hours worked by employees and from the lower proportion of persons in the labor force. Consequently, the comparative judgment differs depending on whether GDP per person or labor productivity is considered. The euro area's GDP per person is 26% lower than that of the United States (see also figure 9.5a), but labor productivity is only 4% lower. Olivier Blanchard (2004) has argued that the gap in GDP per person should therefore not be ascribed to uneven economic performance, but rather to a European "preference for leisure." The accuracy of this

diagnosis has, however, been questioned. Productivity in the euro area may be overestimated because a large proportion of low-skill workers whose potential productivity is below average are excluded from the labor force.[14]

Box 9.1 From Per Capita GDP to Labor Productivity

Per capita GDP is the ratio of the value-added Y created during a given year in a country (the gross domestic product) to the country's total population Pop. It depends on labor productivity but also on participation, employment and hours worked:

- A fraction $(1 - w)$ of the population does not participate in the labor market because it is too young or too old: w is the proportion of the working-age population (often defined as 15–64 years old) to the total population.
- A faction $(1 - x)$ of the working age population $wPop$ (early retirees, but also adults excluded from the labor market such as invalids, housewives, etc.) does not participate in the labor market. x is called the *participation rate*.
- The *labor force* is therefore $L = xwPop$. Within it, however, a fraction u is unemployed (where u is the *unemployment rate*) and e*mployment* is $N = (1 - u)xwPop$.
- Last, each employee works on average d hours per year. The total number of hours worked is therefore $H = d(1 - u)xwPop$.

Finally, hourly labor productivity can be written as:

$$\frac{Y}{H} = \frac{1}{1-u}\frac{1}{d}\frac{1}{x}\frac{1}{w}\left(\frac{Y}{Pop}\right) \qquad \text{(B9.1.1)}$$

This is sometimes adjusted for labor quality to account for divergences in skills.

Table B9.1.1 decomposes the gap between the number of hours worked in 11 countries of the euro area (for which data are readily available) and in the United States in 2013. While the euro-area population (thus defined) was 2% smaller, the quantity of labor supplied was 13% lower—and this gap was even larger in previous years. This divergence stemmed from differences in the average number of hours worked d (1,788 hours a year in the United States, 1,540 in the euro area), in the participation rates x, and in the unemployment rates u. Consequently, in the comparison between the euro area and the United States, there is a factor of $(1788/1540) \times (0.94/0.89) \times (0.74/0.73) \times (0.67/0.65) = 1.26$ between the gap in per capita GDP and the gap in GDP per hour worked.

Table B9.1.1
Comparison of working hours between the United States and the euro area

2013	Variable	US	Euro area (11)	Euro area vs. US
Total population in millions	*Pop*	316.50	308.69	−2%
Proportion of the working age population	*w*	0.67	0.65	−2 pp
Participation rate of those 15–64 years old	*x*	0.74	0.73	−1 pp
Employment rate	$1-u$	0.94	0.89	−5 pp
Average number of hours worked per worker	*d*	1788	1540	−14%
Total number of hours worked (billion)	*H*	260.34	226.70	−13%

Difference in relative terms (%) or in absolute terms (percentage points).
Source: Authors calculations with OECD. Stat data

9.1.2 Growth accounting

The renowned scholar of the quantitative history of growth, Angus Maddison (1997) distinguishes four major determinants of long-term per capita GDP growth: (a) technical progress; (b) the accumulation of productive capital (i.e., of infrastructures and machines that are used for producing goods and services), which in various respects incorporates technical progress; (c) the improvement of know-how, of the level of education, and of the general organization of labor; and (d) the increasing integration of nations through trade, investment, and economic and intellectual exchange.[15] *Growth theory* aims to understand the role, interactions, and characteristics of these determinants based on rational welfare-maximizing individual behaviors (see Section 9.2). *Growth accounting* aims at providing a quantitative account of the role of the various determinants of growth.

The starting point of growth accounting is the *production function*, which connects real GDP Y_t in period t (a *flow variable* over a quarter or a year) to factors of production, typically the *capital stock K* (equipment and buildings available for production), *labor N* (hours worked), and *technology A*:

$$Y_t = f\left(K_t, N_t, A_t\right) \tag{9.1}$$

Capital K_t is a *stock variable* because it is transmitted from one period to another: at time *t,* the economy inherits machines bought and buildings built during previous periods, and its production capacity is primarily determined by them. Each generation thus stands on the shoulders of the previous ones; this goes a long way toward explaining differences in income between countries at any point in time: except for natural resources producers, rich countries are primarily those with a large capital stock. The evolution of the capital stock is generally described by an equation such as $\dot{K}_t = -\delta K_t + I_t$ where δ is the rate of capital depreciation and *I* stands for capital expenditures (a.k.a. gross fixed capital formation). Part of the capital stock thus disappears at each period (through discard or obsolescence), and part is renewed or augmented by the acquisition of new capital. Empirically, *K* is generally computed through the so-called permanent inventory method; that is, by cumulating past investment flows deflated by the replacement cost of capital and by discarding obsolete equipment and buildings after a given lifetime. This may be misleading when a large fraction of the capital stock is being discarded (for example, because of overcapacities) or when obsolescence accelerates (because of technical progress). But most countries do not have better ways to measure the capital stock.

N, the labor input, is generally best measured by the number of hours worked, which is the product of the working-age population, the activity rate, the employment rate, and the working time (see box 9.1).

A, the stock of technologies, depends on past inventions that serve in the production process before they become obsolete. Technology may affect production in various ways. *Solow neutrality*, assumes that technical progress is equivalent to an augmentation of the quantity of labor used in production (and therefore increases the marginal productivity of capital). Alternatively, *Harrod neutrality* is based on the opposite assumption that technical progress is equivalent to an augmentation of the quantity of capital used in production. With Solow-neutral technical progress the production function can be written as $Y_t = F(K_t, A_t N_t)$, while with Harrod-neutral technical progress the production function will be written as $Y_t = F(A_t K_t, N_t)$. Finally, under *Hicks neutrality*—the standard assumption—, technical progress affects the productivity of capital and labor symmetrically. The production function can then be written as $Y_t = A_t F(K_t, N_t)$.

The contribution of technology is more difficult to measure than that of other inputs. It depends not only on technology but also on the functioning of the markets and on the organization of production. It is typically measured as the part of growth that cannot be explained by capital accumulation or by the growth of worked hours (box 9.2). It is therefore a residual, named the *Solow residual* after Robert Solow (1987 Nobel Prize in economics), who introduced this decomposition (Solow, 1956). It represents the increase in the effectiveness of the combination of the two production factors—labor and capital, and it is also called *total factor productivity* (*TFP*).

Box 9.2 Growth Accounting

With constant returns to scale, and under Hicks neutrality of technical progress, the production function can then be written as:

$$Y_t = A_t F\left(K_t, N_t\right) \tag{B9.2.1}$$

where A_t represents total factor productivity (TFP); that is, the effect of technical progress (in the broad sense, encompassing institutional factors) on the productivity of capital and labor.

The growth rate of income can be decomposed into the growth rates of each factor:

$$\frac{\dot{Y}}{Y} = \frac{\dot{A}}{A} + \frac{AK}{Y}\frac{\partial F}{\partial K}\frac{\dot{K}}{K} + \frac{AL}{Y}\frac{\partial F}{\partial L}\frac{\dot{N}}{N} \tag{B9.2.2}$$

where $\dot{X}$ represents the variation of the X variable, measured either as $(X_t - X_{t-1})$ under discrete time between two consecutive periods, or as a time-derivative dX/dt under continuous time.

Defining

$$\omega_k = \frac{AK}{Y}\frac{\partial F}{\partial K}, \omega_N = \frac{AN}{Y}\frac{\partial F}{\partial N} \text{ and } g = \frac{\dot{A}}{A}$$

the decomposition becomes:

$$\frac{\dot{Y}}{Y} = \omega_K \frac{\dot{K}}{K} + \omega_N \frac{\dot{N}}{N} + g \tag{B9.2.3}$$

The growth rate of TFP is not directly observable, but it is deduced from the preceding equation once the growth rates of *Y, K,* and *N* are known. It is the so-called Solow residual. Several methods can be used to calculate the Solow residual.

Method 1. Let us denote by c^K the *user cost of capital*, which represents the real cost of using of a unit of capital during the period of production (equal to the real interest rate plus the rate of capital depreciation); and *w* the real wage (i.e., the nominal wage divided by the price level). In a competitive economy, the factors' costs are equal to their *marginal product* (equal to the additional output that an additional unit of this factor produces) so that $c^K = A\partial F/\partial K$ and $w = A\partial F/\partial N$. ω_K and ω_N are, therefore, the respective shares of capital and labor earnings, $c^K K$ and wN respectively, in the firms' income. They can be observed from national accounts (roughly, at a country level, $\omega_N \sim 0.6$ and $\omega_K \sim 0{,}4$). In a competitive economy and under constant returns to scale,

$$c^K K + wN = Y \tag{B9.2.4}$$

$$\text{and } \omega_K + \omega_N = 1 \tag{B9.2.5}$$

The "Solow residual" g is then deduced from Equation (B9.2.3).

Method 2. An econometric rather than accounting method consists in regressing $\frac{\dot{Y}}{Y}$ on $\frac{\dot{K}}{K}$ and $\frac{\dot{N}}{N}$ and in extracting the residual g. Coefficients ω_N and ω_K are thus estimated, rather than calibrated. This method is delicate to implement because K and N are measured with an error and because they are correlated in the short run with the dependent variable Y, which requires the use of instrumental variables.

Method 3. From the preceding equations, and under the hypothesis that factor incomes are equal to their marginal product, it can be shown (by differentiating Equation B9.2.4) that:

$$g = \omega_K \frac{\dot{c}^K}{c^K} + \omega_N \frac{\dot{w}}{w} \qquad \text{(B9.2.6)}$$

The marginal increase of TFP is therefore given back to workers and capital owners.

These methods can be generalized when more than two factors are used in production; for example, when energy consumption is taken into account or when capital and labor are broken down into several categories. Such a breakdown is useful to limit biases in the calculation of g. Indeed, the categories of capital and of labor that develop fastest are also those whose return increases fastest, as illustrated by high stock market yields of new technologies or by the fast wage increases enjoyed by skilled professionals. If the corresponding rise of the volume of K or of N were weighted by the average return or the average wage in the economy, their contribution to g would be underestimated.

The first and the third approaches are valid only if the factor returns are equal to their marginal products. This is the case neither in the presence of distortions nor in the presence of externalities because the private marginal product then differs from the social marginal product.

TFP should not be confused with labor productivity Y/N: TPF measures the combined effectiveness of labor and capital, while labor productivity measures the sole effectiveness of labor. Capital accumulation mechanically raises labor productivity (each worker is better equipped and therefore more productive). Noting per capita capital $k = K/N$, and under constant returns to scale (box 9.2), the growth rate of labor productivity over time can be decomposed into two components simply derived from Equation B9.2.3:

$$\frac{\dot{Y}}{Y} - \frac{\dot{N}}{N} = g + \omega_K \dot{k} \qquad (9.2)$$

The first term of the right-hand side, *g*, represents TFP growth. The second term relates to the growth rate of the capital stock per person (i.e., the growth rate of the *capital intensity* of the production process). This decomposition helps explain that labor productivity growth can come either from an acceleration of TFP or from an increase in capital intensity (also called *capital deepening)*.

Let us, for example, look at the origin of the growth gap between the euro area and the United States (table 9.1). They somehow traded places between the 1990s and the 2000s. In the early 1990s (as in the previous decade), the United States was a slow-labor productivity, high-employment growth economy while the growth pattern in the euro area was the opposite. By 2000, the United States had become a high-productivity growth, slow-employment growth economy while the euro area had adopted a growth pattern resembling that of the United States in the 1980s. The 2007–09 economic crisis had a big and lasting impact on growth and productivity in both regions. Labor productivity growth was almost halved in the United States, while in the euro area, TFP declined at a rate of 0.5% per year. TFP also slowed down in the United States (to a rate of growth of 0.6% per year on average), but in a much more limited way. This drop in TFP since the 2000s is one of the stylized facts discussed in the next section. Beyond TFP, the negative impact of the crisis has been stronger in Europe and been mainly borne by labor.

Measures of labor productivity components are of course statistical constructs, and it remains difficult to quantify the respective roles of technical

Table 9.1
Growth accounting in the United States and in the euro area (average annual growth rates, in percent per year)

	United States				Euro area			
	1990–1995	1995–2000	2000–2008	2008–2014	1990–1995	1995–2000	2000–2008	2008–2014
GDP (1)	2.6	4.3	2.1	1.2	1.5	2.9	1.9	–0.2
Total hours worked: (2) = (3) + (4)	1.1	2.0	0.1	0.1	–1.0	1.1	0.8	–1.1
Employment (3)	0.7	1.7	0.7	0.1	–0.6	1.5	1.1	–0.5
Working time (4)	0.3	0.3	–0.6	0.0	–0.5	–0.4	–0.2	–0.6
Labor productivity (5) = (1) – (2)	1.6	2.3	2.0	1.1	2.5	1.8	1.0	0.9
Contrib. of capital/labor ratio (6)	0.8	0.7	1.2	0.5	1.8	1.0	1.0	1.4
TFP: (7) = (5) – (6)	0.8	1.6	0.8	0.6	0.7	0.8	0.0	–0.5

Source: Authors calculations from *Penn World Tables* 9.0 (Feenstra, Inklaar, and Timmer, 2015), available for download at www.ggdc.net/pwt

progress and of capital intensity. A telling debate took place in the 1990s on the sources of the Asian "miracle"—the growth, at that time, of small East Asian economies. According to Alwyn Young (1992), their astonishingly strong growth since the 1960s involved nothing miraculous, but was due to massive capital accumulation encouraged by "Colbertist" policies[16] (very low rates of interest, proactive industrial policy, etc.) rather than total factor productivity (see box 9.3). In short, as Paul Krugman later wrote (1994*b*), the Asian miracle was "the fruit of perspiration, not of inspiration." Given decreasing returns to capital and labor, growth ineluctably had to slow down. The 1997–98 financial crises partially validated if not the diagnosis, at least the concerns of Young and Krugman since they were *inter alia* a consequence of overinvestment. Similar debates have developed about the sources of China's growth in the 2000s.

Box 9.3 A Tale of Two Cities: Asian Growth According to Alwyn Young

In 1992, MIT economist Alwyn Young compared the economic models of Hong Kong and Singapore. Both cities had similar histories as UK enclaves in the Chinese world with large commercial ports, having developed their manufacturing industry after World War II and then financial services. The levels of their per capita GDP were identical in the 1960s, and their rates of growth were comparable between 1960 and 1990. But the resemblance stopped there. After a careful growth-accounting study, Young concluded that the growth in Singapore came primarily from the accumulation of productive capital, while total factor productivity slowed down. Singapore was a "victim of its own targeting policies, which are increasingly driving the economy ahead of its learning maturity into the production of goods in which it has lower and lower productivity" (Young, 1992, p. 16). In 1994, Paul Krugman (1994*b*) insisted that: "There is no sign at all of increased efficiency. In this sense, the growth of Lee Kuan Yew's Singapore is an economic twin of Stalin's Soviet Union growth achieved purely through mobilization of resources." In contrast, Hong Kong could maintain a rapid progression of total factor productivity. Young explained this contrast by very different growth models: free market in Hong Kong, central planning in Singapore. In another article, Young (1995) extended his conclusions to other Asian "dragons": growth there was due to capital accumulation, the labor force, and education, but not to technical progress.

Both the figures and the diagnosis were sharply criticized by other economists who, building on different measures of the share of factors in value added, constructed a rate of TFP growth in Singapore higher than Young's (see notably Iwata, Khan, and Murao, 2003, for a synthesis of this debate).

9.1.3 Stylized facts

Four stylized facts emerge from the observation of historical and recent trends:

- By secular standards, fast growth in income per person is a recent phenomenon
- Since the turn of the 21st century, productivity has been on a declining trend
- The "Great Divergence" across nations has given way to (partial and incomplete) convergence
- While remaining high (mainly due to country divergences), global income inequality has somewhat subsided while inequality within nations has deepened.

a) Growth: A recent phenomenon

Figure 9.1 shows the average world GDP per person (in 1990 PPP dollars) since the start of the first millennium and projected to 2030, as estimated by Angus Maddison (Maddison, 2007). Four major periods can be distinguished.

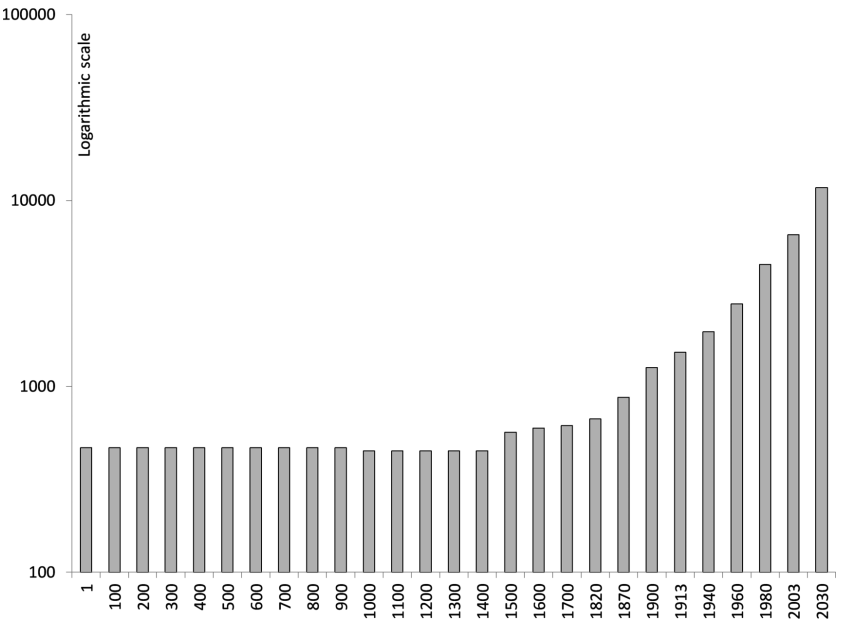

Figure 9.1 Long-term evolution of world gross domestic product (GDP) per person, in 1990 International Geary-Khamis dollars.
The Geary-Khamis dollar (or international dollar) is a current purchasing parity dollar equivalent.
Data from Maddison (2007) and http://www.ggdc.net/maddison/.

From prehistory through the Middle Ages, yearly income remains at around $450 per person (in fact, it declines throughout the first millennium). It then increases to about $600 between 1400 and 1800. The true "take-off" comes with the Industrial Revolution in the nineteenth century, and GDP per person exceeds $1500 on the eve of World War I. By 2003 it reaches $6,500, having multiplied by more than five over the course of the century. Maddison expected it to reach $11,700 by 2030. While there were innovations before the Industrial Revolution, they produced one-off effects and did not lead to the kind of sustained dynamics of accumulation of knowledge and innovation that emerged since that time. Sustained growth of income per person in the world is thus a recent phenomenon. The historically exceptional performance of growth over the past century (in the United States, within the "special century" from 1870 to 1970, as studied by Gordon, 2016) casts a shadow on future growth prospects: Is this exceptional performance to be considered as the new normal, or should we expect a return to the relative stability of the past? How can policies support the first scenario (and should they)?

The historical emergence of the growth phenomenon[17] can be related to changes in the world economic system and especially to breakthroughs that have been conducive to productivity and international trade: improvements in agricultural productivity; the "discovery" of America in the fifteenth and sixteenth centuries; the emergence and expansion of the so-called European world-economy;[18] major technological innovations, such as the steam engine and the railways in the nineteenth century; electricity in the twentieth century; and urbanization on a large scale. However, technology and trade alone hardly account for the recent dramatic increase in world GDP. They cannot explain why the standard of living did not increase until the Middle Ages despite a string of technological innovations (fire, the wheel, metals, and later navigation). Understanding these turning points involves the study of history as much as economics.[19] Mokyr (2017) explores cultural explanations that relate the growth explosion to the European Enlightenment and its twofold foundation: understanding that nature (which is what technological change is about) should be used to advance the well-being of humanity and that power and government should serve society at large. He concludes that the powerful synergy between these two ideas unleashed and sustained the growth explosion.

b) A decline in productivity

Since the 2008 financial crisis at least, TFP growth has significantly slowed (figure 9.2) in most developed and developing countries (see, e.g., Adler et al., 2017), compounding fears of "secular stagnation" (see box 9.4). While the slowdown has been prolonged for the countries of the Organization for Economic Cooperation and Development (OECD) as a group, with negative productivity growth since 2009, TFP growth seems to have started declining in emerging countries (as a group and with the notable exception of India) right after the financial crisis. This is questioning the long-term

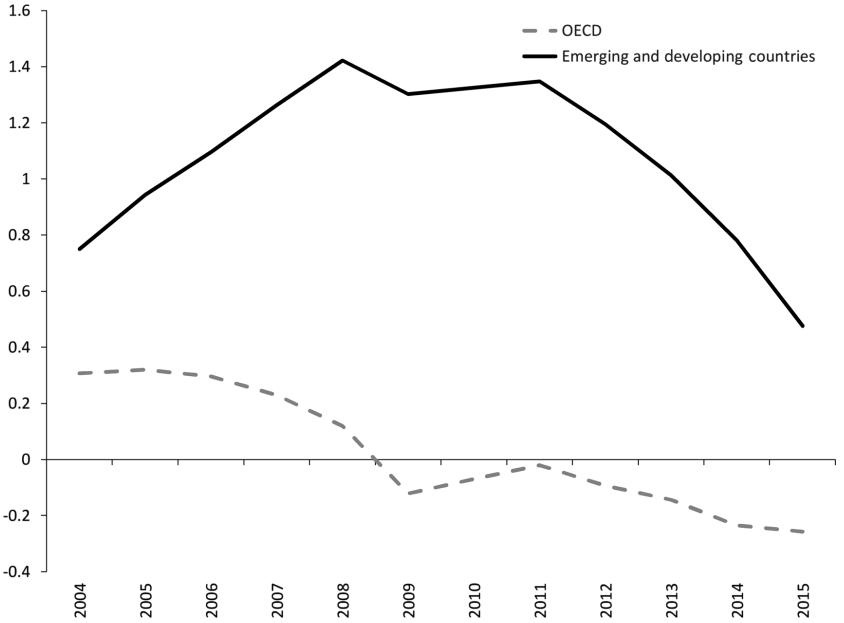

Figure 9.2 Total factor productivity growth in % per year (ten-year moving average, in percent per year).
TFP figures are adjusted by the Conference Board for the rapid price declines in the IT sector.
The Conference Board, 2016. The Conference Board Total Economy Database, Regional Aggregates, adjusted version, November 2016, http://www.conference-board.org/data.economydatabase/.

Box 9.4 Secular Stagnation and Solow's Paradox

The concept of *secular stagnation*, introduced by Alvin Hansen in 1939, was revived by Larry Summers (2014) in the aftermath of the 2008 crisis. According to Summers, it stems chiefly from a supply/demand imbalance: In normal situations, an excess supply of goods and services over aggregate demand can be addressed by a decline in real interest rates which raises aggregate demand to the full employment level. The fallout from the 2008–2009 crisis resulted in aggregate demand remaining lastingly depressed and the zero lower bound (see Chapter 5) prevented a decline of the real interest rate to the level necessary to restore full employment.[a] Output was therefore constrained by insufficient aggregate demand.

The supply-side version of the secular stagnation hypothesis starts from the same observation but puts the blame on a slowdown of technical progress. This may seem paradoxical in view of the spreading of digital technologies.

Indeed, the rebound of TFP in the 1990s owed much to ICTs: through substituting capital for labor, managing inventories, and making better use of inputs, ICT contributed to accelarating the growth of TFP. Yet its contribution to long-term TFP growth is difficult to measure for two main reasons.

First, the ICT volume is poorly apprehended by national accounts because equipment and software prices have been decreasing rapidly. Economists and national accountants have developed *hedonic price indices* that take account of the quality improvements brought by the new generations of products. Instead of focusing on the price of the product itself, hedonic prices are based on the services delivered through the product (for example, in the case of computers, the hedonic price would account for the memory capacity, processing speed, screen resolution, etc.).

Second, TFP is more about the diffusion of innovation than on technical progress per se. Yet, the diffusion of technologies is difficult to track. Robert Gordon (2000), a renowned specialist in productivity and growth, first claimed that the acceleration of TFP in the United States was circumscribed in the computer sector and, apart from that sector, was primarily cyclical (because it corresponded to a period of expanding demand), before revising his assessment.[b] Jorgenson, Ho, and Stiroh (2008) find that between 1995 and 2000, investments in ICT contributed to 37% of labor productivity growth in the United States, and ICT industries contributed to 58% of TFP's. However, the impact of new technologies can be delayed, particularly because the full effect on productivity requires complementary investments in other forms of capital (for example, firms need to reorganize to use the new ICT equipment as much and as efficiently as possible). Such effects have been notably documented Yang and Brynjolfsson (2001), or, in France, by Askenazy (2001).

This result echoes the so-called *Solow paradox*: for a long time, computers were seen everywhere—except in the productivity figures (to paraphrase Robert Solow's famous 1987 statement).[c] In his work on the diffusion of innovation, the economic historian Paul David (1990) notably highlighted that it had taken a long time for the invention of electricity to affect productivity and questioned the very existence of a modern paradox of productivity from a historical perspective.

Productivity pessimists, however, question the analogy between ICT and past generic innovations such as electricity and argue that ICT benefits have now been reaped. Gordon (2016), for example, argues that the kind of innovation that ICT unleashed is unlikely to make contributions to productivity and standards of living that match those that earlier waves of innovation (such as electricity) brought. Others disagree, referring to the capacity of successive waves of innovation to overcome pessimistic expectations in the past and pointing to the promises of new innovations in the areas of artificial intelligence, biotechnologies, and nanotechnologies. Gordon has a point, however, when he emphasizes the exceptional

character of the period between 1870 and 1970 and the dangers of deriving historical lessons from just that period.

TFP, an accounting residual, is clearly not independent from capital and human investments (that are needed to benefit from innovations) and a more granular approach is needed to analyze and understand processes. Jorgenson and Vu (2016) further challenge the priority given to innovation. They argue that it played in fact a relatively modest role that does not justify the weight it has in modern growth theory. Nonetheless, the recent weakness of TFP raises crucial questions about growth patterns.

[a]The corresponding "savings glut" echoes the global savings glut hypothesis formulated by Ben Bernanke (2005). See notably Teulings and Baldwin (2014). A review of the debate is provided by Jaubertie and Shimi (2016).

[b]See Gordon (2000, 2003), Oliner and Sichel (2002), and, in the French case, Cette, Mairesse, and Kocoglu (2004).

[c]"You can see the computer age everywhere but in the productivity statistics," *New York Review of Books*, 12 July 1987.

growth prospects of a group of countries that had been driving global growth.

Figure 9.3 illustrates the different dynamics for the United States and the euro area, already suggested by table 9.1. While TFP growth has been

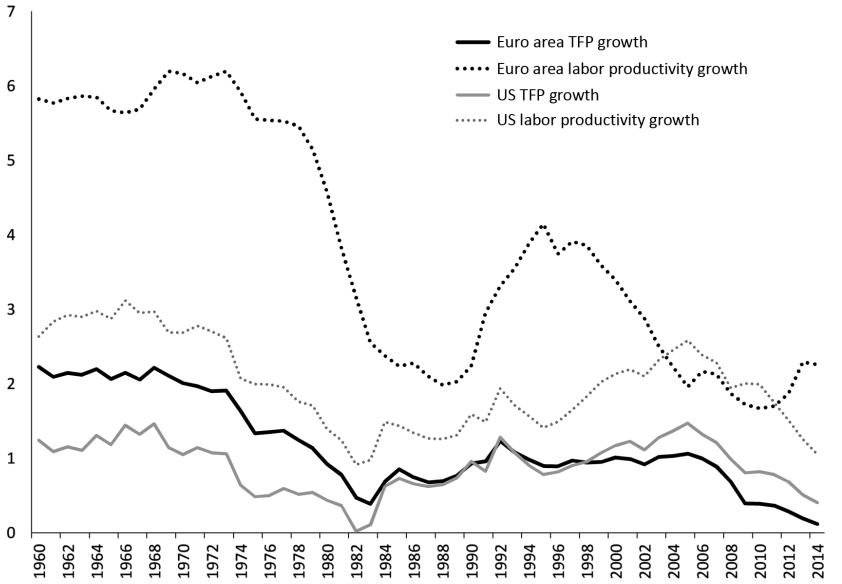

Figure 9.3 Total factor and labor productivity growth 1960–2014, in percent per year. United States and euro area.
PWT 9.0 (Feenstra et al., 2015).

fluctuating in the United States since the 1960s, it did so within a narrow range of between 0% and 1.5% a year. Europe's experience was that of a nearly consistent decline, from more than 2% in 1960 to close to zero in 2014. Its higher productivity growth in the 1960s and 1970s was linked to the catching-up dynamics discussed earlier. In turn, the US total factor (and labor) productivity acceleration in the 1980s and 1990s, which lasted until the mid-2000s, echoed the liberalization of factor markets in the 1980s and the emergence of the "new economy" in the 2000s. Figure 9.3 also suggests that the recent turning point toward renewed deceleration happened in 2005, well before the emergence of the global financial crisis.

c) The end of the "Great Divergence"

In a globalized world where the same technology is accessible everywhere, income levels might be expected to converge across countries. Overall, a positive correlation can be observed between initial and final GDP per person (figure 9.4), with a positive Y-axis intercept indicating that poorer countries have, on average, grown faster over the 1870–2010 period. The dispersion of GDP per person expressed in current PPP dollars, however, was still as high in 2010 as in 1870, with a coefficient of variation of about 65% for both dates.[20]

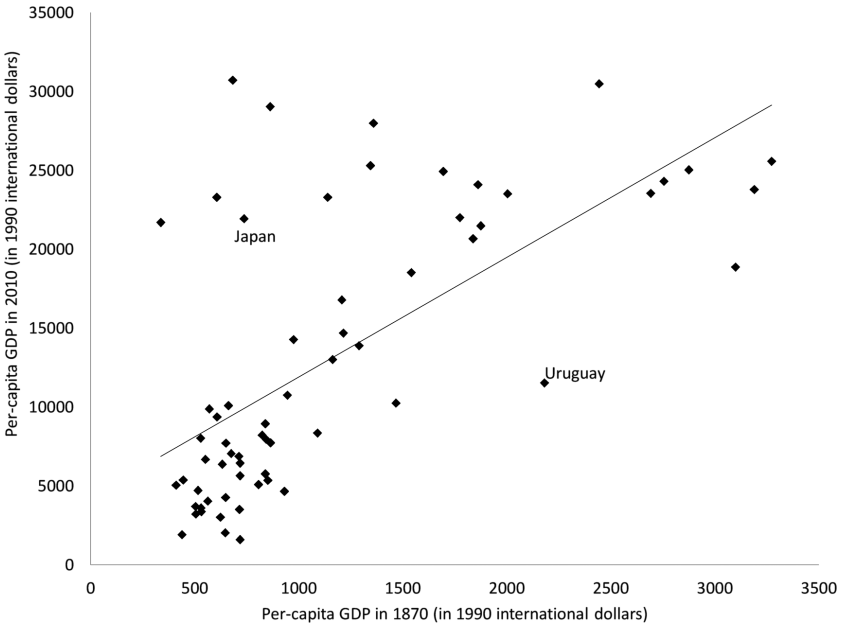

Figure 9.4 Gross domestic product (GDP) per person in 1870 and 2010 (in 1990 International Geary-Khamis Dollars).
Data from Maddison, http://www.ggdc.net/maddison.

These two observations are not incompatible: some countries were poor in 1870 but rich in 2010, and vice versa. For example, Uruguay was three times richer than Japan in 1870 but almost three times poorer in 2010.

These evolutions result from the end of the *Great Divergence,* brought on by the emergence of the Western World by the nineteenth century and by the domination of the US economy in the twentieth century. Growth and income divergence between the West and the rest of the world had characterized the growth explosion from the Industrial Revolution until World War II. Since the second half of the twentieth century, however, the movement of divergence has stopped and given rise to reversal.

In the 1950s and 1960s, Europe and Japan rapidly caught up with the US economy (figure 9.5a). In the 1970s and 1980s, the three major economies slowed down in the aftermath of the oil shocks, but the US economy accelerated again in the 1990s, with the result that catch-up by Europe and Japan came to an end and even started to reverse. Convergence stopped below 80% of US income per person. In the last quarter of the twentieth century, the newly industrialized countries of Asia (Hong Kong, Singapore, South Korea, and Taiwan) also caught up at an impressive pace (figure 9.5b). In turn, China and, to a lesser extent, India experienced stellar growth from the end of the twentieth century. In Europe, Central and Eastern Europe have been converging toward Western Europe.

The picture has remained different in Africa. Many African countries have progressed in absolute terms but little if at all in relative terms (figure 9.5c). The promising resumption of economic growth in Sub-Saharan Africa from 1995 on may signal the start of a slow catching-up process for Sub-Saharan Africa as well.

Economists have approached convergence in two main, complementary ways. The first one is the reduction in the dispersion in income levels across countries. This is called *σ-convergence* because it involves a change in the standard deviation (σ) of cross-country incomes over time. The second one investigates whether poorer countries grow faster than richer ones. This is called *β-convergence* because it can be measured through a positive β coefficient in the following estimation:

$$\frac{1}{T-1}\ln\frac{Y_{iT}}{Y_{i1}} = \alpha - \beta \ln Y_{i1} + \varepsilon_{iT} \tag{9.3}$$

where Y_{i1} is the initial level of per capita GDP of country i and Y_{iT} the final level at date T, α and β are the coefficients to be estimated, and ε_{iT} is an error term. A positive β means that the lower the initial GDP per capita, the higher the growth rate. β-convergence is a necessary condition for σ-convergence. However, the reverse does not apply[21]. β-convergence does not imply that all countries will end up with the same GDP per capita.

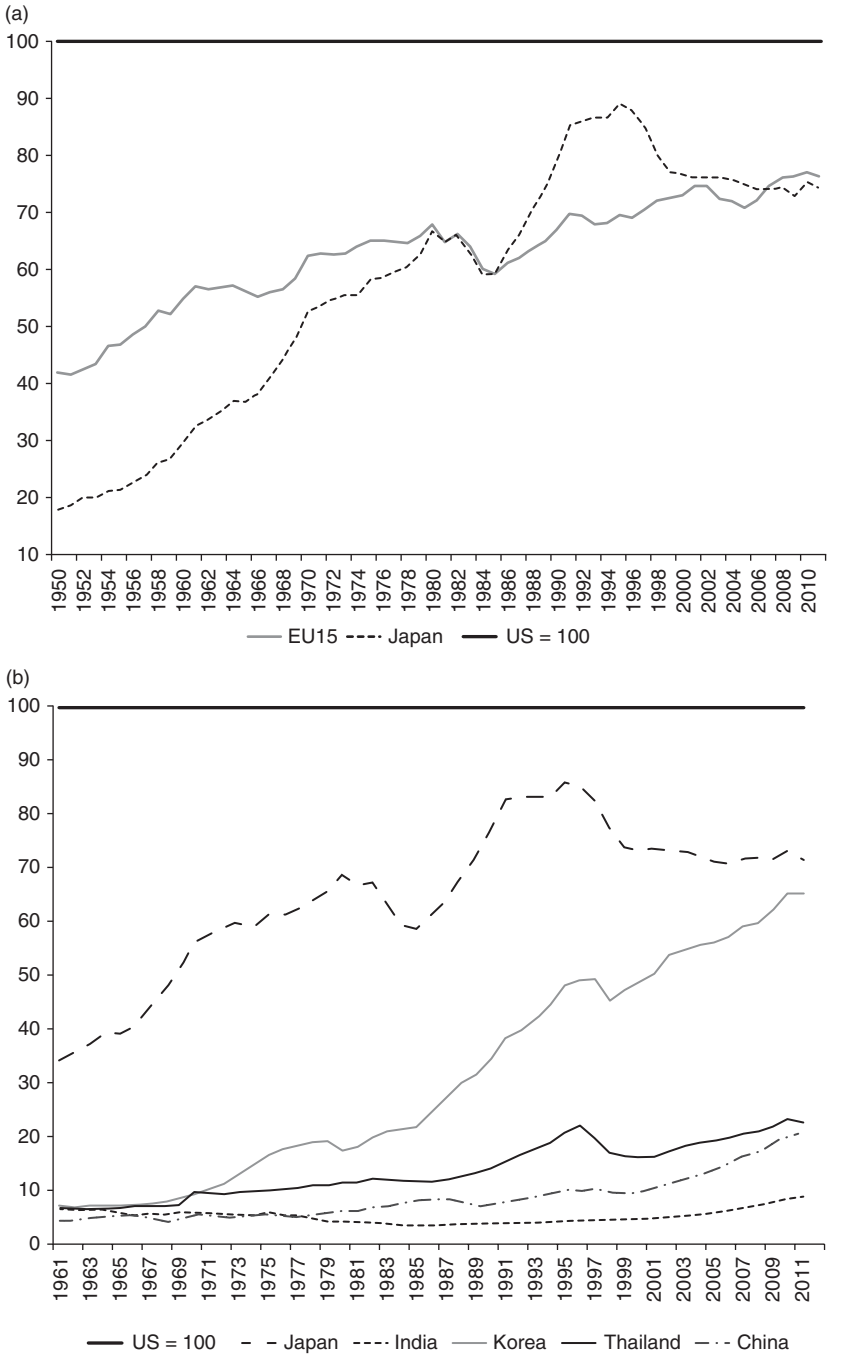

Figure 9.5 (9.5a, 9.5b and 9.5c) Per capita gross domestic product (GDP) in percent of the US level.
GDP is measured in purchasing power parity 2005 dollars.
Penn World Tables PWT 8.1 (Feenstra et al., 2015), available for download at www.ggdc.net/pwt.

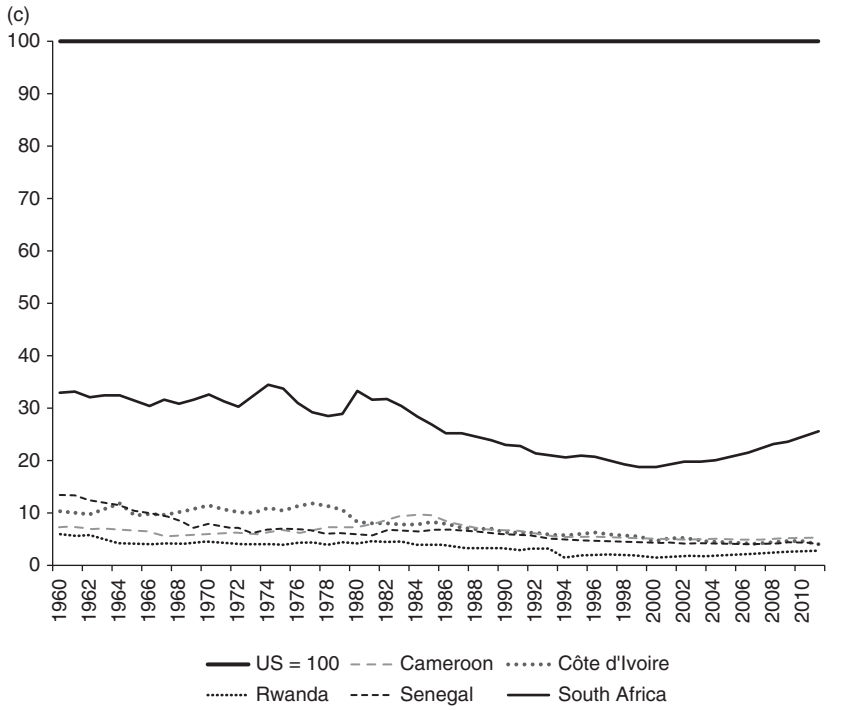

Figure 9.5 (9.5a, 9.5b and 9.5c) Continued

Figure 9.6 shows the link between the average growth rate of countries' per capita GDP between 1950 and 2014 and its 1950 level. There is no worldwide β-convergence (in plain English, poorer countries do not grow faster over that period), but there is clearly convergence within the OECD.

The failure of poor countries convergence may be due to structural factors independent from the initial income level. If this holds *conditional convergence* (as opposed to *absolute convergence*, or *unconditional convergence*) can be uncovered by conditioning Equation (9.1) on structural variables Z_{i1}:

$$\frac{1}{T-1}\ln\frac{Y_{iT}}{Y_{i1}} = \alpha - \beta \ln Y_{i1} + \gamma Z_{i1} + \varepsilon_{iT} \tag{9.4}$$

Conditioning factors may be of various nature: geographic, institutional, legal, political or cultural. Conditional convergence means that two countries sharing the same conditioning factors converge in the long run. It suggests, for example, that Serbia's GDP per person may not be able to converge toward that of Germany or France, but that of Slovenia is more likely to reach that goal because Slovenia benefits from the EU legal and institutional framework while Serbia currently does not.

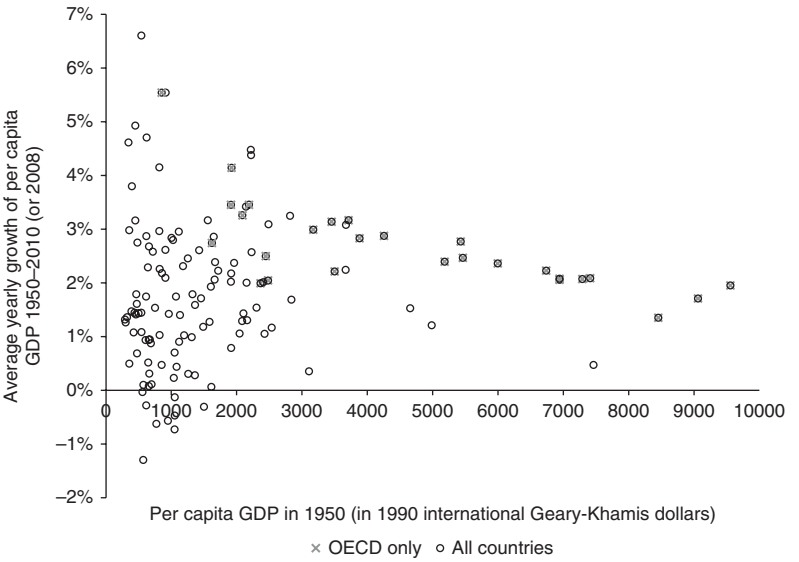

Figure 9.6 Convergence in the world and within the Organization for Economic Cooperation and Development (OECD) (β-convergence).
Penn World Tables PWT 9.0 (Feenstra et al., 2015), available for download at www.ggdc.net/pwt.

Groups of comparable countries within which β-convergence is at play (here, the group of OECD countries) are called *convergence clubs*. A crucial issue for development-aid policies consists in understanding how any country can "join the club." Conditioning variables that are usually found to have a significant long-term impact on per capita GDP are (see Barro and Sala-ì-Martin, 1995, chapt. 12, for a survey):

- The quality of human capital (level of education, life expectancy);
- The functioning of markets (degree of competition, distortions introduced by state interventions, corruption);
- Macroeconomic stability (and, in particular, price stability);
- Political stability (absence of wars, coups, or frequent power shifts between opposite camps).

One problem with this approach, however, is that it implicitly assumes that the capacity to reform institutions is independent of the level of wealth. Recent research on growth has carefully tackled the reverse-causality problem (i.e., fact that better institutions may be an outcome of growth).

Empirical studies show that convergence is often *unconditional* between regions of the same country—be they US states (Barro and Sala-ì-Martin, 1991), Canadian provinces (Coulombe 2007; Coulombe and Lee, 1995), or Japanese prefectures. In such a case, convergence tends to be unconditional because many "Z" factors are identical, and convergence is, moreover, encouraged by cultural

homogeneity, factor mobility, and fiscal redistribution mechanisms specific to each country. However, persistent gaps in income per head can be found within countries. Underdevelopment in southern Italy is a case in point, as is the very slow pace of convergence of the East German regions. Those can be, in part, attributed to outward migration of skilled labor. *A fortiori*, convergence between different countries is generally conditional. However, the catching-up of Asia suggests that globalization may lead to the alignment of conditioning factors (access to technology, strengthening of institutions, etc.) that favor convergence across countries.

d) Less inequality across nations, more within nations

How are growth and globalization benefits distributed across individuals? There are many ways to define and measure *inequality*. One may want to study the income distribution that results from the play of market forces and thus focus on incomes before taxes and transfers. An alternative approach will consist of documenting incomes after taxes and transfers. Instead of incomes, one may observe consumption expenditures, more closely related to living standards. At world level, redistribution through taxes and transfers has a limited impact on income inequalities, which are essentially driven by the returns to capital and labor and by the cumulative political and economic impact of income concentration and of wealth inequalities, notably studied by Piketty's (2014) seminal work. Milanovic (2016), in particular, argues that "deconcentration" of capital and interventions before taxes and transfers is a more promising way to reduce inequalities than is redistribution, especially given the difficulty of increasing taxes on capital income in a globalized world.

Up until the end of the twentieth century, most of the attention was about inequality within the borders of countries, and differences between countries were approached from the perspective of convergence (or the lack of it). In order to assess the distributional consequences of globalization, recent studies have started to focus on global inequalities.[22] After the pioneering work of Bourguignon and Morrisson (2002), the generalization of household surveys has allowed researchers to build richer and more accurate datasets (see notably the work conducted by Branko Milanovic at the World Bank). The calculation of global inequalities requires that similar methodologies govern the household surveys that are used and that incomes can be compared between different currencies, which points to the use of PPP exchange rates.[23]

Global inequality (i.e., inequality among world households irrespective of their country of location) increased considerably during the nineteenth and twentieth centuries, due to the unequal participation in the Industrial Revolution. As figure 9.7 indicates, the Lorenz curve describing the global distribution of income (cf. Chapter 1) departed more and more from the 45-degree line, which indicates a larger concentration of income among the richest individuals.

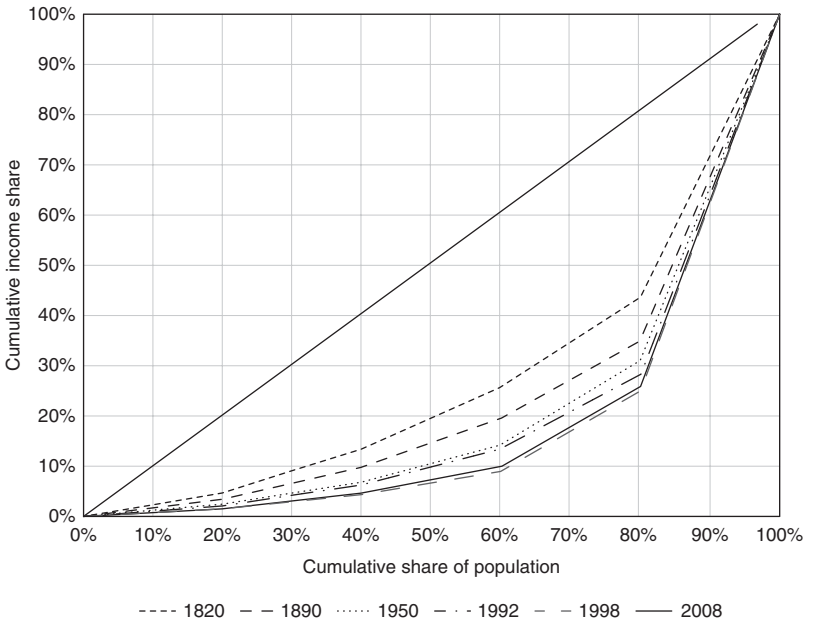

Figure 9.7 Lorenz curve of global income distribution.
Bourguignon and Morrison (2002), Lakner and Milanovic (2015).

Bourguignon and Morrisson (2002) document that the Gini index of world income distribution[24] increased from 0.5 in 1820 to 0.64 in 1950 and 0.66 in 1992. Further work by Bourguignon (2015) and Milanovic (2005, 2012, 2016) suggests that it finally stabilized in the 2000s and afterward started to decline.[25] A major reason is the increase in the standard of living of hundreds of millions of individuals living in fast-growing countries in Southeast Asia and China.

The picture suggested by the Lorenz curve and the evolution of the Gini, however, tells us that growth benefits have been distributed unequally, but it does not tell much about who reaped these benefits. Figure 9.8 introduces a simplified version of the so-called elephant curve (or "growth incidence curve," Lakner and Milanovic, 2015). It shows how the average income of various percentiles (from the 10% poorest to the 1% richest) of the global income distribution grew between 1988 and 2008.[26] The curve confirms the emergence of a global middle class, which typically corresponds to the well-off households in emerging countries. A substantial fraction of the Chinese and Indian populations has attained middle-class status. The upper middle-class in developed countries did relatively poorly, possibly feeding into the growing discontent that surfaced in the elections in these countries in the second-half of the 2010s.

While the lowest decile did not do as well as the global middle class, it still experienced on average a 25% growth over the 20-year period: these latter

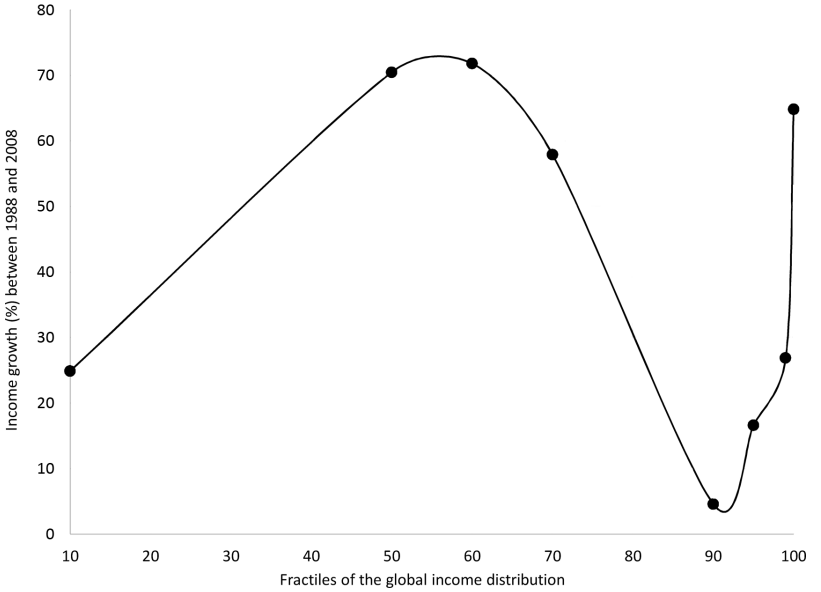

Figure 9.8 The elephant curve: growth incidence on world income distribution (1988–2008). This curve shows the average income growth between 1998 and 2008 for eight percentile points (artificially connected): below 10%, 40–50%, 50–60%, 60–70%, 80–90%, 90–95%, 95–99%, and top 1%
Data from Lakner and Milanovic (2016), table 3, p. 10.

results attest to some success of the global fight against extreme poverty. The global poverty headcount ratio (individuals leaving with less than US$1.90 [2011 PPP] as a percentage of the world population) has declined from 41% in 1981 to 11% in 2013.[27]

Global income inequality combines inequality within countries and inequality across countries (i.e., between average incomes per capita). It is consequently significantly higher than any of its two components. The main force behind global income inequality since the early twentieth century has been inequality between countries (figure 9.9), leading Milanovic (2016) to claim the existence of a rent attached to the country of birth, which he calls the "citizenship premium." That premium seems to have been ebbing toward the end of the 2000s (a movement strengthened by the impact of the financial crisis).

Our earlier discussion of convergence suggests that inequality between countries has been on a declining trend, even though it has still deepened for some countries. However, such convergence amounted to comparing average incomes per head between countries without accounting for the size of their populations and corresponds to what François Bourguignon (2015) labels the "international income scale." A different measure consists in

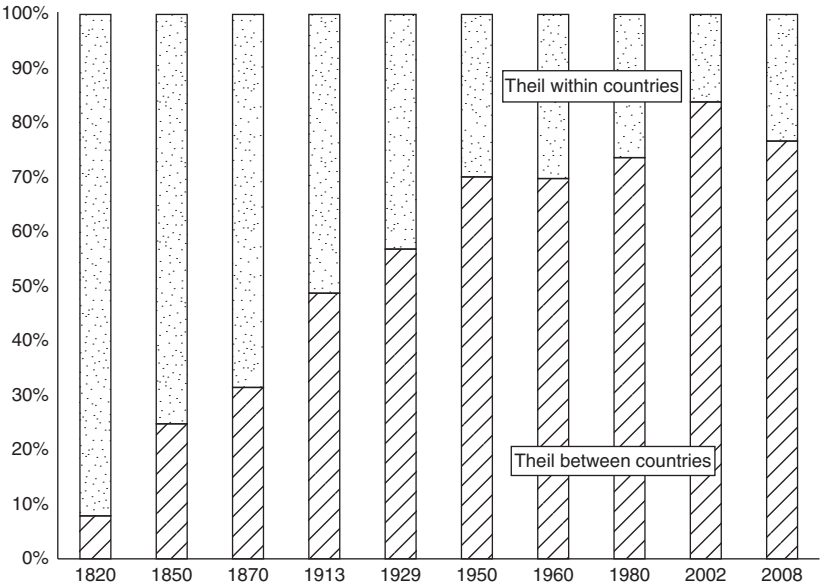

Figure 9.9 Decomposition of global inequality between and within countries, shares of the total Theil (L) index, 1820–2008, in percent.
The Theil index is a measure of generalized entropy that is decomposable (here between inequality within countries and inequality between countries). The inequality indicator used here is the Theil index, a measure of generalized entropy. The indicator used here is Theil (L), the mean log deviation of the sample. For more details, see for example http://siteresources.worldbank.org/PGLP/Resources/PMch6.pdf
Milanovic (2012) and Lakner and Milanovic (2016).

weighing countries according to their populations. The population-weighted intercountry Gini has been declining constantly since 1950, slowly until the early 1990s and much faster since (Milanovic, 2012, figure 2), notably due to the acceleration of economic growth in China and other populous countries such as Brazil, India, Indonesia, Vietnam, and South Africa (Milanovic, 2016, chapt. 4).

Against this change in international inequality patterns, the major recent evolution has been the increase of within-country inequality in a very large number of countries and in a majority of OECD countries. A notable exception is Latin America, where social policies (notably conditional cash transfer programs) and investments in education leading to a narrowing of wage gaps played a major role (Lopez Calva and Lustig, 2010). The two-way relationship between economic growth and inequalities will be further discussed in Section 9.2.3.

9.2 Theories

"Growth accounting" is a description, not an explanation of economic growth. In order to understand the mechanisms of the latter and assess the role of economic policy in fostering it, we need to turn to theory and investigate the determinants of labor force growth, capital accumulation, and technological innovation.

In preindustrial theories like those of Thomas Malthus (1798), fertility was regarded as the fundamental determinant of growth. According to Malthus, fertility adjusted to technological shocks so that the standard of living remained constant. Subsequent theories generally included demography as an important, but exogenous phenomenon, except sometimes for migrations (cf. Barro and Sala-ì-Martin, 1995, chapt. 9). They focused mainly on capital accumulation. In the 1980s, they had reached, however, a somewhat frustrating conclusion: under decreasing marginal returns to capital, incentives to accumulate capital fade over time so that the capital/labor ratio reaches a steady state. Growth in GDP per person can only stem from a constant flow of technological innovation. In the 1960s and 1970s, very few economists remained interested in growth theory, and, in their review of the literature, Hahn and Matthews (1964, p. 890) concluded that it might have reached the point of diminishing returns.

A renewal started in the late 1980s with the advent of the so-called endogenous growth theory, which focuses on the determinants of total factor productivity. In this context, economists revisited Joseph Schumpeter's seminal ideas on what drives innovation and ventured into new areas such as the interaction between growth and geography or between growth and the quality of institutions. Standard models were also revisited to shed light on economic development. This renewal turned growth theory into one of the most active branches of economic analysis.

In what follows, we first present the standard models of growth through capital accumulation with exogenous technical progress; we then turn to models with endogenous technical progress; finally, we discuss the role of deep growth determinants such as geography, income distribution, and institutions.

9.2.1 Growth through capital accumulation

The basic tool for the analysis of growth is the production function already introduced in Section 9.1, which we assume can be written:

$$Y_t = A_t F\left(K_t, N_t\right) \tag{9.5}$$

where Y denotes output, A technical progress (total factor productivity), K the capital stock, and N the employed labor force (or the total number of hours worked), all dated at time t. As growth analysis deals with medium to

long-term horizons, it is generally assumed that the economy is at full employment. Therefore, employment N is equal to the labor force L, so that:

$$Y_t = A_t F\left(K_t, L_t\right) \tag{9.6}$$

The assumption of full employment may seem to run counter to experience. However, it also accounts for situations of persistent unemployment. Let us suppose that there is a rate of structural unemployment u that cannot be permanently reduced whatever the level of aggregate demand. The preceding formulation can be adapted by replacing L by $L(1 - u)$.[28]

a) First steps: Growth and disequilibrium

Theories of the accumulation of productive capital in a closed economy take as a starting point the equilibrium between the supply of capital (i.e., the flow of savings) and the demand for capital (i.e., the flow of investment desired by profit-maximizing companies).

A first intuition was developed independently by economists Roy Harrod in 1939 and Evsey Domar in 1946, who highlighted the risk of economic instability in the growth process. They pointed out that the growth rate of the capital stock determined by investment (and therefore by the savings rate) does not spontaneously correspond to the growth rate that is necessary to maintain full employment. They therefore saw a risk either of a shortage of labor (leading to inflation) or of a shortage of capital (leading to unemployment): balanced growth was possible only if, by sheer coincidence, the economy remained on the "razor's edge" in which the savings–investment balance corresponds to the full employment equilibrium (box 9.5).

Box 9.5 The Harrod-Domar Model

The model developed by Harrod (1939) and Domar (1946) assumes that technology is given and that efficient production requires capital and labor inputs to be in a constant proportion. It is thus based on a production function with *complementary inputs*:

$$Y_t = min(AK_t, BL_t) \tag{B9.5.1}$$

where Y_t is output, K_t is the stock of capital, A and B are constant parameters, and the labor force L_t grows at a constant rate n.

As inputs are complementary, full employment requires a sufficient capital stock to employ all the labor force. Conversely, if the capital stock is higher than this level, production capacity will not be fully employed due to a shortage of labor. Labor growth and the growth of the capital stock are determined independently. Full employment equilibrium therefore hinges on a stroke of luck.

The evolution of the capital stock over time is:

$$\dot{K}_t = -\delta K_t + I_t \qquad \text{(B9.5.2)}$$

where δ is the rate of capital depreciation and I_t is gross fixed capital formation (investment). Investment is financed by available savings: $I_t = \sigma Y_t$ where σ is the constant savings rate. As long as the capital stock remains the binding constraint on production, $Y = AK$ and the evolution of K is given by:

$$\dot{K}_t = \left(\sigma A - \delta\right) K_t \qquad \text{(B9.5.3)}$$

The trajectory of the economy depends on the level of the savings rate: If $\sigma > \delta / A$, then the capital stock and output grow at the constant rate $\sigma A - \delta$, until $AK_t = BL_t$, after which output growth is limited by the availability of labor. Below a certain threshold for the capital–labor ratio, a policy favorable to saving increases the growth rate.

The *Harrod-Domar model* does not provide a realistic description of long-term growth. Domar himself considered it instead as a study of the interaction between temporary shortages of demand and investment in the context of the consequences of the 1929 crisis and then of the war economy characterized by a shortage of capital. A model which predicts that growth is constrained by a shortage of capital also provided an accurate description of Europe in the immediate post–World War II period and a theoretical justification for the reconstruction aid policies meant to compensate for the European countries' insufficient savings and fill their "financing gap." This approach was explicit in the June 1947 *Marshall plan*,[29] and even more so in the "national assessment" simultaneously prepared in France by Planning Commissioner Jean Monnet.

b) Saving, investment, and balanced growth

Firms do not invest to make use of available savings but to make profits: the return to capital is the main engine of investment. In the mid-1950s, recognition of this microeconomic incentive led Robert Solow (1956) and Trevor Swan (1956) to separately develop a model that has carried considerable intellectual influence and still provides a reference framework for the analysis of economic growth.

Unlike Harrod and Domar, Solow and Swan describe a growth path where markets are in balance. Production factors are *substitutable* —therefore, there are no more "razor's edge" equilibriums—and the marginal return to capital is decreasing: The more capital is accumulated, the less profitable it is at the margin. As a consequence, the incentive to invest vanishes when the marginal return on capital is equal to the user cost of capital (i.e., when adding to the capital stock costs exactly the value of the additional production it brings). At

this stage, the per capita level of the capital stock, and therefore also (under constant returns to scale) per capita GDP, are stable over time (see the detailed model in box 9.6). The corresponding growth path is called the *steady state*.

In the basic *Solow-Swan model* the savings rate is exogenous, production exhibits constant returns to scale, labor and capital are substitutes, population and technology are constant, and each exhibits decreasing marginal returns. There is an equilibrium value of the per capita level of the capital stock k that only depends on the savings rate and on the rate of capital depreciation. In a more complete version where population and TFP grow over time at respective exogenous and constant rates n and g, it is the TFP-adjusted level of per capita GDP that is stable in the long run, and its value also depends on g. The capital stock and GDP both grow at a constant rate $n + g$, and, under this specification, the model is fully consistent with growth accounting as introduced earlier.

In this category of models, when the capital stock reaches its equilibrium value, the *growth rate* of GDP only depends on demography and on exogenous technical progress (but *not* on the savings rate, which determines the

Box 9.6 The Solow-Swan Model

The production function is of the Cobb-Douglas type: $Y_t = AK_t^{\alpha}L_t^{1-\alpha}$ with $0 < \alpha < 1$, which implies both decreasing returns to each production factor taken separately and constant returns to scale (output is multiplied by two if capital and labor are multiplied by two). Labor and capital are substitutes.

Assume first that total factor productivity A is constant. Labor supply grows at a constant rate n. The capital stock is augmented every year by the volume of investment I, but each year a fraction δ of it is discarded. In a closed economy, output Y is equal to the income distributed to economic agents. A fraction σ of this income is saved and invested domestically every year. Thus:

$$\dot{L}_t = nL_t \qquad \dot{K}_t = -\delta K_t + I_t \qquad I_t = S_t = \sigma Y_t \qquad \text{(B9.6.1)}$$

Let lower case letters represent variables per person:

$$k_t = K_t / L_t \qquad y_t = Y_t / L_t \qquad s_t = \sigma Y_t / L_t$$

The dynamics of k_t are given by:

$$\frac{\dot{k}_t}{k_t} = \frac{\dot{K}_t}{K_t} - \frac{\dot{L}_t}{L_t} = -\delta + \sigma\frac{y_t}{k_t} - n \qquad \text{(B9.6.2)}$$

On the steady-state trajectory where variables per person y, k, and s are constant, capital accumulation is determined by the following equation:

$$\sigma y^* = (n+\delta)k^* \quad \text{with} \quad y^* = k^{*\alpha} \qquad \text{(B9.6.3)}$$

This means that, in the steady state, the savings of each period exactly finance the capital expenditure necessary to replace the depreciated capital and to equip the new workers with additional capital. The capital stock per person thus remains constant. The steady state levels of per person output, capital, and savings are:

$$y^* = \sigma^{\frac{\alpha}{1-\alpha}}\left(n+\delta\right)^{-\frac{\alpha}{1-\alpha}};\ k^* = \sigma^{\frac{1}{1-\alpha}}\left(n+\delta\right)^{-\frac{1}{1-\alpha}};\ s^* = \sigma^{\frac{\alpha}{1-\alpha}}\left(n+\delta\right)^{-\frac{\alpha}{1-\alpha}} \quad \text{(B9.6.4)}$$

In figure B9.6.1, where the *X*-axis represents the level of the capital stock per person and the *Y*-axis represents savings and investments per person, the steady-state equilibrium corresponds to the intersection of the curve $s_t = \sigma k_t^{\alpha}$ (representing savings) and of the straight line $(n + \delta)k_t$, which represents the investment per person necessary to keep k_t constant.

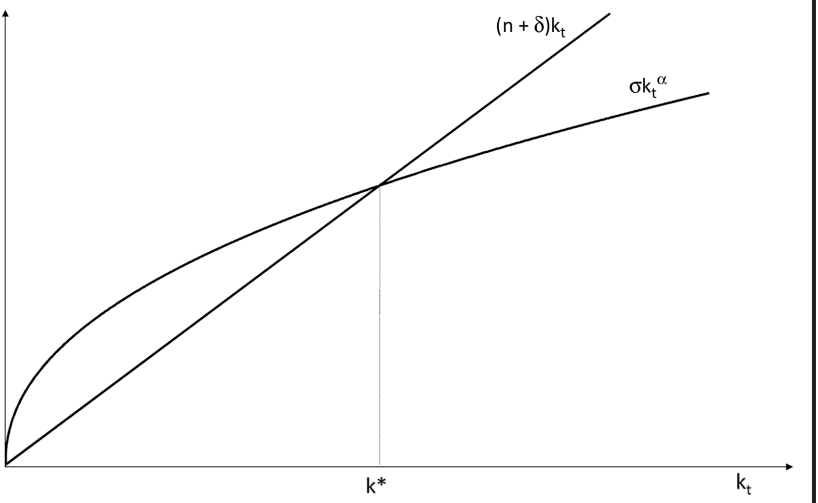

Figure B9.6.1 The Solow-Swan steady-state equilibrium.

The steady-state equilibrium is stable: whatever the initial value k_0, the capital stock per person tends toward k^* when t tends to infinity. The model therefore leads to the following two conclusions:

- In the long run, the levels of the capital stock per person and of income per person are constant. Income grows at a constant rate that depends only on demography.
- In the long run, income per person depends positively on the savings rate, all the more that capital plays an important role in the production function (in a competitive economy, α represents the share of capital income and $(1 - \alpha)$ the share of labor income in output).

The first conclusion is disappointing: the model does not account for the fact that income per person grows over time. The only possible explanation for growth in this model is that total factor productivity increases exogenously. Let us indeed suppose that total factor productivity A grows at rate g:

$$\dot{A}_t = gA_t \tag{B9.6.5}$$

and let us again solve the model for the steady state. Results obtained are similar, but for the inclusion of trend growth rate. We find:

$$y^* = \sigma^{\frac{\alpha}{1-\alpha}}\left(n+g+\delta\right)^{-\frac{\alpha}{1-\alpha}};\ k^* = \sigma^{\frac{1}{1-\alpha}}\left(n+g+\delta\right)^{-\frac{1}{1-\alpha}};\ s^* = \sigma^{\frac{\alpha}{1-\alpha}}\left(n+g+\delta\right)^{-\frac{\alpha}{1-\alpha}} \tag{B9.6.6}$$

where lowercase letters now represent variables per "effective labor unit": $y = Y / AL$, $k = K / AL$, and $s = S/AL$.

The model predicts that, all other things being equal, a 1% increase of the savings rate leads to an $\alpha/(1 - \alpha)$% increase of steady-state per capita GDP. Per capita income y and the per capita capital k grow at rate g, and income grows at rate $(n + g)$ over time. The parameter g can be interpreted as the pace of technical progress. But it is assumed to be exogenous: The model is silent about its origin.

level of GDP per person but not its rate of growth along the stationary path). Growth is temporarily faster when the economy starts from an initial situation of capital shortage (which explains accelerated catching up by developing economies), but it sooner or later adjusts to the (lower) steady state. Hence a first, disappointing, conclusion for economic policy: under decreasing marginal returns to capital, policies aimed at encouraging saving or investment are not able to influence the long-term *growth rate*, but only the long-run *GDP-per capita level*.

Up to now, we have not introduced any normative assumption, but simply drawn logical consequences from the assumption of a decreasing marginal return to capital. We can now use the model for a normative purpose. The social objective cannot be to reach the highest possible level of per capita GDP. Indeed, as box 9.6 explains, this requires maintaining a high per capita capital stock, which necessitates allocating to capital accumulation a large fraction of income that is, therefore, not available for consumption and does not contribute to the individuals' immediate well-being. From a normative standpoint, GDP per person should therefore be high enough to make resources available, but not too high, otherwise replacement investment would absorb too large a share of GDP.[30]

This suggests that there might be an "optimum" level of the per capita capital stock and therefore of per capita GDP, a question addressed as early as in

1928 by Frank Ramsey. He assumed that the social objective was to maximize *per capita consumption* on a sustainable basis. Let us suppose that a benevolent planner (cf. Chapter 1) can choose the households' savings rate. The *Ramsey model* shows (box 9.7) that there is a savings rate that maximizes per capita consumption at the steady state. With a Cobb-Douglas production function, this optimal savings rate is exactly equal to the weight of capital in the production function. It is as if capital income (i.e., dividends paid by firms) were entirely reinvested in the economy, while labor income was consumed. At the optimum, the model shows that the marginal return to capital (i.e., the real interest rate) is exactly equal to the GDP growth rate, $n + g$: this relation is called the *golden rule* of capital accumulation. When it is verified, a marginal increase of the capital stock generates an additional income that exactly covers the additional expenditure needed to maintain that additional unit of capital so that per capita consumption remains unchanged.

Box 9.7 The Ramsey Model and the Golden Rule

Let us start with the model of box 9.6 without technical progress ($g = 0$). The government is assumed to choose the savings rate (for example, by means of tax measures) so as to maximize long-term per capita consumption $c^* = (1 - \sigma)k^\alpha$. The optimal savings rate comes out as:

$$\hat{\sigma} = Arg\max c^*(\sigma) = Arg\max\left[(1-\sigma)\sigma^{\frac{\alpha}{1-\alpha}}(n+\delta)^{-\frac{\alpha}{1-\alpha}}\right] \quad \text{(B9.7.1)}$$

Caps on per capita variables designate variables along the optimal growth trajectory. Simple calculations show that $\hat{\sigma} = \alpha$ (beware that this simple result holds only when the production function is a Cobb-Douglas). The optimal growth trajectory has an interesting property. From the results of box 9.6, the marginal productivity of capital on this trajectory is:

$$\frac{\partial y}{\partial k} = \alpha\hat{k}^{\alpha-1} = \frac{\alpha\hat{y}}{\hat{k}} = n + \delta \quad \text{(B9.7.2)}$$

However, profit maximization in a competitive environment implies that this marginal productivity is exactly equal to the user cost capital K so that:

$$\frac{\partial y}{\partial k} = c^K = r + \delta \quad \text{(B9.7.3)}$$

where r is the real interest rate. These two relations imply that on the steady-state path that maximizes per capita consumption, the real interest r rate is equal to the growth rate of the economy n. This is the so-called *golden rule*. This result also applies when $g \neq 0$, $r = n + g$.

The result can be also represented in figure B9.7.1, which, as in box 9.6, represents per capita income and per capita savings (equal to per capita investment) as functions of the stock of capital per person. At the steady state, and whatever the value of σ, investment σk^{α} is exactly equal to the increase in the capital stock needed to maintain the stock of capital constant, namely $(n + \delta)k$, which leads to the value of the steady-state per capita capital stock k^*. Per capita consumption is represented in the figure by the distance between the two curves k^{α} and σk^{α}. The figure shows that this distance is maximum for $k = \hat{k}$ where the tangent to the production function $y = k^{\alpha}$ is parallel to the line $(n + \delta)k$. This leads to the golden rule $r = n$, since the marginal productivity of capital $\frac{\partial y}{\partial k}$ is equal to the user cost of capital $r + \delta$. In figure B9.7.1, $\sigma > \alpha$ and therefore $k^* > \hat{k}$: there is "too much" savings, "too much" capital, and the real interest rate (measured by the tangent in k to the curve $y = k^{\alpha}$) is lower than the growth rate (measured by the tangent in $\hat{k}$, $n + \delta$).

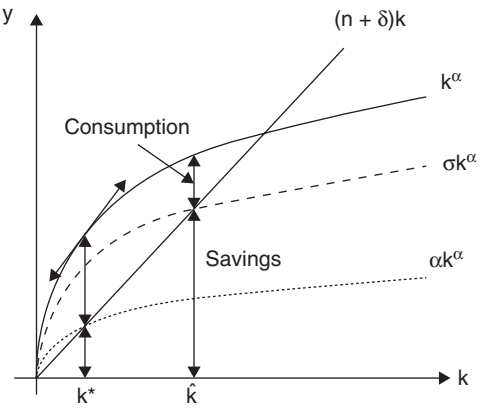

Figure B9.7.1 The Ramsey optimum.

The golden rule provides a simple means for identifying optimal growth trajectories: if the interest rate is durably higher than the growth rate, there is "not enough" capital, and a higher savings rate would allow raising consumption (consumption would have first to decrease to give way to an increase in savings, but it would eventually benefit from the consecutive rise in per capita GDP); if the rate of interest is durably lower than the growth rate, there is "too much" capital and citizens would be better off using the income from it for consumption rather than investment. The former situation can be found in developing economies where too much of the income is consumed, while the latter is called *dynamic inefficiency* and is found in economies where incentives are distorted in favor of investment, such as present-day China or the East

Asian "Tigers" in the late 20th century (box 9.3). Such considerations play an important role in deciding whether pension schemes should be funded and invested in the economy, as explained in Section 9.3.

c) Growth and catching-up

The Solow-Swan model provides a theoretical framework for growth accounting whose empirical importance was emphasized in a previous section. But are its assumptions realistic? With a Cobb-Douglas production function, the model predicts that a one percentage point increase of the savings rate, other things being equal, leads to a $\alpha/(1-\alpha)$% increase in per capita GDP, where α is the weight of capital in the production function (box 9.6). In 1992, N. G. Mankiw, D. Romer, and D. N. Weil tested this relation on a panel of countries and found an elasticity of per capita GDP to the savings rate of approximately 1.5, consistent with a value α of 0.6: in a closed economy under constant returns to scale, capital income would thus absorb 60% of the value added! In reality, α is known to be close to 30–40%.

Mankiw et al. propose an explanation: TFP is not exogenous and rather depends on the accumulation of a second type of capital, namely *human capital*. Indeed, part of national savings is invested in education and training and used to finance the accumulation of human capital. Education expenditures have to be treated as investment and not as consumption; they durably improve the individuals' productive capacities. In this "augmented Solow model," the elasticity of per capita GDP to the savings rate is no longer $\alpha/(1-\alpha)$ but $\alpha/(1-\alpha-\gamma)$ where γ is the share of human capital in the production function. For a value of γ close to 0.5, the model becomes realistic.[31] The model therefore predicts that convergence of per capita GDP is conditional on the proportions of income invested in physical and human capital. Countries that do not invest in education cannot converge toward developed countries whatever their physical investment. Moreover, Mankiw et al. find that the predictions of the standard Solow model without human capital are plausible (they lead to $\alpha = 0.36$) when the sample is limited to the (then) OECD member countries. This suggests that there is unconditional convergence among industrialised economies but not globally. The three authors explain this by the fact that the levels of accumulated human capital are comparable among industrialised countries.

Yet the Mankiw et al. model shows that a simple extension of the standard Solow-Swan model makes it capable of accounting for the complexity of the catching-up process and of explaining an important part of growth divergences between countries. It suggests that the absence of unconditional convergence among all countries in the world illustrated by figure 9.6 might be mainly explained by differences in the rate of accumulation of human capital. But it does not provide a fully satisfactory explanation of growth. Like in the Solow-Swan model, of which it is only an extension, growth in the steady state depends on exogenous factors (demography and technical progress) only.

9.2.2 External effects, innovation, and growth

The Mankiw et al. approach suggests that to better understand the origins of growth, the TFP "black box" must be opened. The corresponding theories were born in the 1980s and 1990s and are known as *endogenous growth theories*.

There are at least two good reasons to suppose that TFP is not an exogenous phenomenon:

1. Productive efficiency does not rely on the sole efforts of each firm but also on the interaction between them: the accumulation of "know-how" and the benefits from agglomeration, such as the attraction of skills, the development of specialized suppliers, and the like. These external effects explain why geographical clusters such as Silicon Valley or (thanks to governement intervention) the Pearl River delta emerge and grow. They need to be incorporated into the theory in order to understand how the organization of markets affects growth and when public intervention is necessary.
2. Technical progress results from major inventions and from innovations that naturally depend on the overall scientific context[32]—and perhaps also on luck—but inventions and their application in industry also respond to economic constraints and incentives: Firms invest in Research and Development (R&D) to create new products that will give them a competitive edge; consequently, the pace of innovation cannot be regarded as given, and it should be incorporated into utility-maximizing economic models.

The common feature of endogenous growth models is to relax the hypothesis of a decreasing return to capital at the aggregate level. Growth can, therefore, be self-sustained even in the absence of exogenous technical progress.

a) Externalities

External effects are at the root of the first type of endogenous growth models, pioneered by Paul Romer (1986). Romer's initial model is presented in a simplified version in box 9.8. The key idea is that in the presence of external effects, the *social* return to capital is higher than the *private* return because investment has positive effects beyond those the investing company can appropriate. Hence, the return to capital may be decreasing at the firm level but be constant economy-wide.

Telecommunication networks provide a good example of such mechanisms. To each user, connection to a network (either for voice communication or, for example, for exchanging music) gives access to transactions with all other connected users. Such access represents for each individual the *private* profit of being connected. However, the connection of an additional user increases the usefulness of the network for each already connected user.[33] Every additional

Box 9.8 Learning-by-Doing and Growth in the Romer Model

In Paul Romer's (1986) "learning-by-doing" model, the economy is made of N identical firms under perfect competition. Each individual firm operates with a Cobb-Douglas production function so that the production of firm i at time t is:

$$Y_{it} = A_t K_{it}^{\alpha} L_{it}^{1-\alpha} \quad \text{(B9.8.1)}$$

Total factor productivity A_t is not exogenous but depends on the economy's total capital stock: Romer considers that the size of the productive sector creates a positive externality through the exchange of know-how, which he designates under the generic term of *learning-by-doing* and which improves productivity. Accordingly, he uses the following specification for TFP:

$$A_t = AK_t^{\beta} \quad \text{(B9.8.2)}$$

where $A > 0$, $K_t = \sum_{i=1}^{N} K_{it}$ and, since firms are identical, $K_{it} = K_t / N$ for all i.

In the specific case of $\alpha + \beta = 1$ and if all firms are identical, we have $Y_{it} = AN^{\beta} K_{it} L_{it}^{1-\alpha}$. The production function is of the generic form known as AK, with constant returns to capital. Unlike in the Solow–Swan model, growth is self-sustained, even in the absence of exogenous technical progress.

connection therefore produces a positive externality, which means that the *social return* it generates is higher than the private return to the new user. This is known as a *network externality*.

More generally, investment carried out by a specific firm often generates positive spillovers onto other firms. For instance, the investing firm needs to train its employees in the new technologies embodied in the new generation of capital. This "know-how" will later be available to other firms through labor mobility and contacts along the supply chain. This *learning-by-doing* process, already formalized by Kenneth Arrow in 1962, forms the basis for Paul Romer's model. Romer's "know-how" resembles the "human capital" of Mankiw et al. A crucial difference, however, is the presence of externalities that allow the economy to escape the curse of a decreasing return to capital.[34] As a result, GDP growth can be sustained even in the absence of exogenous TFP growth.

In Romer's model, since each firm remunerates capital at its marginal productivity, the share of capital income in total income is α, as in the Solow model. Network externalities and know-how are not remunerated: these are public goods freely accessible to all. As a consequence, there are no private incentives to develop them, and public policies play an important role in allowing them to fully come into play. This will be discussed in Section 9.3.

The difference of treatment of human capital in the augmented Solow-Swan model à la Mankiw et al. and in endogenous growth models lends itself to empirical investigations. Does it contribute to growth only transitorily (as the former model would suggest) or permanently (as the latter models would imply)? According to Arnold et al. (2007), growth in OECD countries seems to support the latter rather than the former. This has significant implications for policy as it suggests that spending on research and education can have a lasting impact on economic growth (rather than on the sole level of per capita income).

A variant of endogenous growth models, illustrated in box 9.9, considers public infrastructures (or, more generally, public expenditures on education and public services) as a source of *production externalities* able to prevent marginal returns to private capital from falling. Public infrastructure plays the role of "know-how" described in box 9.8. It is a factor in long-term growth, but through its impact on supply rather than on demand—unlike in the Keynesian models studied in Chapter 4. As we shall see in Section 9.3, such models provide a rationale for infrastructure policies, public investment in research, and official development assistance to poor countries.

There is a limit, however, to the ability of public investment to support long-term growth. Any public expenditure is financed by a tax on (present or future) privately created wealth; this tax reduces the net return on investment and slows down private capital accumulation. Hence, there is a trade-off between, on the one hand, the provision of productivity-enhancing public infrastructures and, on the other hand, the introduction of a distortion likely to lower production. Box 9.9 illustrates this trade-off. At the optimum, a rise in public expenditure increases output by a quantity that is exactly sufficient to finance this additional expenditure.

Box 9.9 Public Intervention and Long-Term Growth

The model, based on Barro and Sala-ì-Martin (1995, chapt. 4), highlights the trade-off between positive externalities generated by public expenditures and taxation-induced distortions. It features an economy where public R&D and education expenditures G financed by a value-added tax τ raise total factor productivity:

$$G = \tau Y \tag{B9.9.1}$$

$$Y = \left(AG^{1-\alpha}\right)K^{\alpha} \tag{B9.9.2}$$

where K is the physical capital stock, and A is exogenous. To simplify, the labor force is supposed constant and equal to unity. From these two equations, the aggregate relationship between K and Y can be written as:

$$Y = \tau^{\frac{1-\alpha}{\alpha}} A^{1/\alpha} K \tag{B9.9.3}$$

Production exhibits constant returns to the physical capital stock: as in box 9.8, it is an AK-type model in which long-term growth is possible even without technical progress.

Equation (B9.9.3) says that, for a given level of private capital K, an increase in the tax rate τ raises output Y. However, K cannot be assumed constant when τ increases, because a rise in τ reduces the marginal return on capital. Indeed, under profit maximization, K is set at a level that allows the after-tax marginal return on capital to be equal to the cost of capital (i.e., to the sum of the interest rate r and of the depreciation rate δ):

$$r + \delta = (1 - \tau)\frac{\partial Y}{\partial K} = (1 - \tau)\tau^{\frac{1-\alpha}{\alpha}} A^{\frac{1}{\alpha}} \qquad \text{(B9.9.4)}$$

In a closed economy, the interest rate is given by Equation (B9.9.4). It is a hump-shaped function of the tax rate τ: For $\tau > 1 - \alpha$, the interest rate increases with τ; beyond $1 - \alpha$, r decreases when τ rises further. Assuming the savings rate σ to be a monotonic, increasing function of r, capital accumulation is given by:

$$\dot{K} = \sigma(\tau)Y - \delta K \qquad \text{(B9.9.5)}$$

where $\sigma(\tau)$ follows the same hump shape as $r(\tau)$. Assuming a constant value for both A and τ, the growth rate of K and of Y is the same (see Equation (B9.9.3)), equal to:

$$g = \frac{\dot{K}}{K} = \sigma(\tau)\tau^{\frac{1-\alpha}{\alpha}} A^{\frac{1}{\alpha}} - \delta \qquad \text{(B9.9.6)}$$

Even without any exogenous technological trend, growth can still be positive in the long run in the presence of public intervention. The relation between the tax rate, τ, and the growth rate, g, is, however, nonlinear. Growth is maximum when $\tau = 1 - \alpha$ because, in this case, the savings rate is maximum.

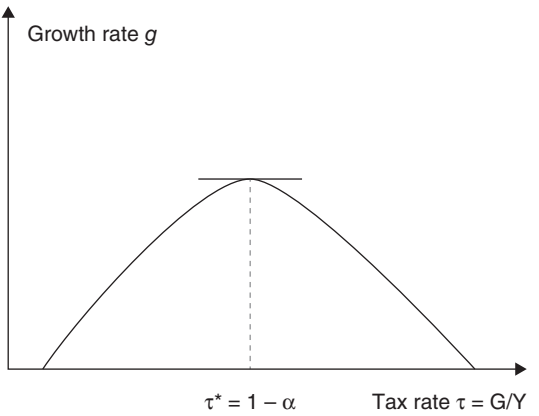

Figure B9.9.1 Growth rate as a function of taxation.

A number of empirical studies have estimated the impact of the accumulation of public capital on GDP per person and found it to be significant. In the US case, a 10% rise in the stock of public capital was found to translate over the long run into a 4% increase of per capita GDP (Munnell, 1992). This elasticity, however, is lower—around 0.2—for regions or municipalities.

Overall, this first type of endogenous growth models justifies public intervention on two conceptually different grounds: on the one hand, to coordinate private decisions and exploit externalities among economic agents and, on the other hand, to produce public goods—infrastructures, education, public research—which enhance private productivity. A model like the one presented in box 9.9, however, suggests that state intervention can either be favorable or detrimental to growth depending on the level of taxation.

b) Creative destruction

The Austrian-born economist Joseph Schumpeter—who had a huge influence on the economics of innovation—identified five types of innovation: (i) on products, (ii) on methods, (iii) on demand, (iv) on raw materials, and, finally (v) on firms' organization. In his 1942 book *Capitalism, Socialism and Democracy*, Schumpeter analyzed the process of *creative destruction* through which a major innovation leads to the disappearance of a previous generation of products. Entrepreneurs engage pecuniary and human resources to find and develop new technologies that will give them an edge over competitors – an innovation rent, as economists call it. But they themselves are constantly challenged by other innovators who aim at destroying their rents and appropriating new ones. The expectation of profit creates an incentive to innovate. Since profit is built on the elimination of the previous generation of innovations, Schumpeter called this process "creative destruction."[35]

> These revolutions periodically reshape the existing structure of industry by introducing new methods of production—the mechanized factory, the electrified factory, chemical synthesis and the like; new commodities, such as railroad service, motorcars, electrical appliances; new forms of organization—the merger movement; new sources of supply—La Plata wool, American cotton, Katanga copper; new trade routes and markets to sell in and so on. . . . Thus, there are prolonged periods of rising and of falling prices, interest rates, employment and so on, which phenomena constitute parts of the mechanism of this process of recurrent rejuvenation of the productive apparatus.
>
> Now these results each time consist in an avalanche of consumers' goods that permanently deepens and widens the stream of real income although in the first instance they spell disturbance, losses and unemployment. [T]he capitalist process, not by coincidence but by virtue of its mechanism, progressively raises the standard of life of the masses. It does

> so through a sequence of vicissitudes, the severity of which is proportional to the speed of the advance. But it does so effectively. (Schumpeter, 1942/1976, p. 68)

Creative destruction has major policy consequences. It implies that declining industries should not be protected. On the contrary, the displacement of existing firms and industries by newcomers should be encouraged as an engine of innovation and economic growth. Implementing such a philosophy has proved difficult, however, since it relies on the adjustment mechanism by which redundant employees in declining industries will find jobs in the new industries. In continental Europe, labor mobility (both geographically and between sectors) is limited, and labor force reallocations are generally accompanied by substantial wage losses. Moreover, job destruction is immediate while "job creation" is slow to materialize. This makes such adjustment socially painful and politically controversial.

The recognition of the creative destruction process at the microeconomic level also sheds light on the sources of productivity divergences between countries. For example, research conducted at the OECD (Bartelsman, Scarpetta, and Schivardi, 2003) has highlighted three salient facts:

- In the developed economies, about one-third of labor productivity gains come from *churning* (i.e., from the creative destruction of firms); the remaining two-thirds being achieved within existing firms. Firms' demography therefore appears as an important determinant of economic growth. With several co-authors, Philippe Aghion provides a theoretical background for such results and notably emphasizes the innovation-promoting role of free entry and product market competition (e.g., Aghion, 2011): increased competition and the threat of entry compel firms to invest more to address the competitive threat.
- New and old firms do not equally contribute to productivity gains. Old firms increase labor productivity through investing and substituting capital for labor. New firms typically raise TFP. The renewal of firms therefore in itself contributes to TFP gains.
- There is a major difference between Europe and the United States. The firms' birth and mortality rates are broadly similar, but surviving firms grow much faster in the United States: they are born small but those that survive have more than doubled their labor force over their first two years. In Europe, they grow by 10–20% only. In other words, the US economy "tests" new firms and enables them to grow very fast when they introduce innovative products or efficient technologies.

In the mechanism of innovation, competition on the goods market and the protection of intellectual property play a decisive role. Innovation can be seen first as widening the range of products available through so-called *horizontal*

differentiation. This mechanism is related to trade liberalization and is further described in the next section. According to a second approach, very close to the original Schumpeterian vision, innovation consists in improving product quality through what is known as *vertical differentiation*. Every new product moves the technological frontier and eventually completely displaces the previous one while squeezing the rents accruing to their producers and opening new profit prospects to innovators. An example is the development of digital photography and the resulting displacement of film photography. In this spirit, a model by Aghion and Howitt (1992) shows how the R&D effort—and therefore eventually the growth rate of the economy—depends on the expected gains from innovation (box 9.10). The *Aghion-Howitt model* predicts that the innovation effort is less when innovation is more easily replicated or when competition on the goods market is fierce (because the innovation rent decreases). Section 9.3 further elaborates on these two conclusions and discusses their consequences for public policy.

Box 9.10 The Economics of Innovation in the Aghion-Howitt Model of 1992

The model focuses on the determinants of the research and development effort and on its effects on growth. This box provides a simplified version (kindly shared by Philippe Aghion).

Labor is the only factor of production and it can be used either in the production of consumer goods or in research, the latter producing innovations that increase productivity.

The total supply of working hours L is therefore allocated either to production, for a quantity X, or to research, for a quantity N. Hence:

$$X + N = L \qquad \text{(B9.10.1)}$$

Consumer goods are produced by firms under perfect competition according to the following technology:

$$Y = AX^{\alpha} \quad \text{with } A > 0,\ 0 < \alpha < 1 \qquad \text{(B9.10.2)}$$

where Y is output.

Productivity is represented by the variable A and is endogenous: it can be raised by innovations, which stem from research. However, research results are random: a unit of labor employed in research produces, with probability $\lambda < 1$, an innovation that improves productivity by a factor $\gamma > 1$. The parameter γ therefore measures the size of innovations and λ their frequency.

Labor–market equilibrium requires that the expected return to research equals the hourly real wage w. If $\pi(\gamma)$ represents the expected profit from innovation (λ being the probability to achieve it) we thus have:

$$w = \lambda\pi(\gamma) \tag{B9.10.3}$$

If the research effort is successful in producing an innovation, the innovator is then the sole person to command a superior technology. He or she benefits from it by eliminating existing firms and immediately deriving a profit π:

$$\pi(\gamma) = \gamma A X^{\alpha} - wX \tag{B9.10.4}$$

However, this gain is temporary. At the next period, innovation is fully disseminated, and the rent from innovation disappears.

If the research effort was unsuccessful in the first place, the quantity of labor devoted to it brings no return.

Profit maximization leads to:

$$\frac{d\pi}{dX} = \alpha\gamma A X^{\alpha-1} - w = 0 \tag{B9.10.5}$$

If each firm considers w as given, Equation (B9.10.5) provides the optimum level of A. Profit then is written as:

$$\pi = \frac{1-\alpha}{\alpha} wX \tag{B9.10.6}$$

Combined with Equation (B9.10.3), this equation leads to the optimum allocation of labor:

$$X = \frac{1}{\lambda}\frac{\alpha}{1-\alpha} \quad \text{and} \quad N = L - \frac{1}{\lambda}\frac{\alpha}{1-\alpha} \tag{B9.10.7}$$

The amount of labor allocated to research logically depends positively on the probability of success λ (it does not depend, however, on the size of innovations γ since, in equilibrium, productivity earnings are passed to employees; the innovator's profit only comes from displacing the existing producers and appropriating their profits).

In this simple economy without demography or capital, the rate of growth of output is simply the growth rate of productivity resulting from the innovation process. Since N units of labor employed in research will produce a productivity gain of Nlambda(gamma-1) on average, we have:

$$g = \lambda(\gamma - 1) = \left(\lambda L - \frac{\alpha}{1-\alpha}\right)(\gamma - 1) \tag{B9.10.8}$$

The growth rate eventually depends on the probability and on the size of innovations, as well as on the size of the economy (the larger the economy, the higher the return to innovation) and on the share of profits in value added (a higher share encourages innovation because the corresponding rent is larger). The model can easily be extended to a situation where the innovator captures the rent only partially, instead of totally displacing existing producers.

There is an important theoretical literature on intellectual property which underlines the difficult trade-off between patent protection (to encourage innovation) and the dissemination of innovation (to promote its adoption throughout the economy). *Ex ante*, policymakers are tempted to promise rents to innovators; *ex post* they are tempted to expropriate them. This problem illustrates the time inconsistency dilemma analyzed in Chapter 2.[36]

Finally, innovation and growth models describe the incentives to innovate, but they ignore the way in which innovations are received and disseminated. However, the dissemination of an innovation requires a "critical mass" of users. Paul David, the historian of innovation, explains how the QWERTY keyboard became a standard on American typewriters (David, 1985). When adopted in the 1870s by one of the first typewriter manufacturers, Remington, this keyboard minimized the risk of keys overlapping each other when the user had to type fast. All competitors eventually adopted it. Yet studies showed that the Dvorak Simplified Keyboard (DSK), a system patented in 1932, allowed much faster typing. Despite its superiority, however, DSK was not able to prevail. The QWERTY system was extended to computer keyboards even though the initial reason (the overlapping of keys) had since long become irrelevant. Paul David uses this example to stress the importance of history in economic choices and the fact that the actual destination often depends on the trajectory (this is called *path dependency*), while economists too often describe equilibrium situations without taking either the initial situation or the trajectory into account. Path dependency generally characterizes any innovation that involves network externalities.

9.2.3 Beyond the production function

a) International trade

For a long time, growth theory and trade theory developed as two separate branches of economic analysis. Growth models were initially developed in a closed-economy framework and trade models hardly addressed growth beyond Bhagwati's (1958) insights on *immiserizing growth*.[37] It is only recently that models have been developed that explore the relationship between growth and trade.

Beyond the traditional efficiency gains from trade due to specialization captured in the classical trade models, the relationship between trade and economic growth can be analyzed along four main dimensions. First, there are productivity gains to be expected from heightened competition through trade liberalization. Not only does competition increase the pressure for firms to innovate in order to stay ahead of new foreign competitors, but it also sustains a Darwinian process through which only the fittest (i.e., the most productive) firms survive and expand. Second, international trade fosters knowledge spillovers that enhance productivity in the less-advanced countries and sectors. Third, international trade increases the size of markets, which both

allows domestic firms to exploit economies of scale (notably through learning by doing) and increases the potential rent accruing to successful innovators (see the model in box 9.10). Finally, trade (boosted by the collapse of costs of communication) allows participants to unbundle or reorganize the production process into subcomponents that can be globally and geographically scattered, thus globalizing competition (as opposed to seeing competition as taking place among nations) and boosting the sharing of know-how (Baldwin, 2016).

The influence of international trade on product innovation is readily understood within the framework of models of trade in varieties of similar products. In those models (introduced by Paul Krugman and others in the 1980s), consumers choose between products (say, cars or restaurant meals) according to their preferences and relative prices, but they also choose between varieties of the same products (say, Toyotas or Volkswagens and sushis or sashimis). The larger the range of varieties available, the greater the consumers' utility: consumers are said to have *taste for variety*.

Taste for variety can result from an exogenous preference of the consumer for a diversified consumption basket (for example, as regards food or cultural products) or from a trial-and-error research into the ideal variety (for example, for the purchase of a car).

Formally, the consumers' utility is often assumed to be represented by a *Dixit-Stiglitz*[38] function which makes utility dependent on both the overall quantity consumed and the number of products available to consumers. Assuming there is a continuum of goods indexed on [0, 1], and calling C_i the consumption of good i, consumer utility $U(C)$ is written as:

$$U(C)=\left[\int_{i=0}^{1}\alpha_i C_i^{(\sigma-1)/\sigma}di\right]^{\sigma/(\sigma-1)} \quad \text{where} \quad \int_{i=0}^{1}\alpha_i\,di=1 \tag{9.7}$$

$\sigma > 1$ represents the elasticity of substitution between products and α_i the weight of good i in the consumer's utility.

Innovation can be regarded as consisting in widening the range of varieties available to consumers. A good example is the food industry where a large part of innovation consists in extending the variety of goods available to consumers (e.g. new yoghurt flavors).

In a closed economy, the expansion of varieties is bound by a trade-off between efficiency in production and the number of varieties produced. A simple way to represent this is to assume that the production of each variety involves a fixed as well as a variable cost. Producing more varieties is then detrimental to productivity.

Under free trade, however, each country produces fewer varieties, while consumers have access to more of them. International trade allows reaping of the benefits from economies of scale in the production process without restraining consumer choice.

Now, let us assume that the producer of each variety enjoys some monopoly power because his or her output is not perfectly substitutable for other products. This provides both an incentive for product innovation, which is then guided by the quest for the rents generated from such monopoly power. Combined with fixed costs, the model delivers an endogenous mechanism for growth, since the return to capital is now increasing. The model thus describes a self-sustained growth process driven by the specialization of the labor force in a constantly increasing range of goods exhibiting increasing returns. The intuition for the mechanism goes back to a 1928 article by Alwyn Young; Romer (1990) and Grossman and Helpman (1989) provide examples of such models.[39]

This approach highlights the importance of *demand externalities* (as opposed to the previously described production externalities): a wider market generates a larger solvent demand for each product variety, which stimulates output and distributed income. The existence of this "virtuous circle" also sheds some light on the reasons why some countries may remain trapped in underdevelopment: their domestic market is simply too small to generate the necessary investments.

b) Geography and history

Growth theory studies the evolution of wealth over time. Its distribution across space was long ignored by classical economists but, following Hotelling's (1929) seminal work on spatial competition, it has elicited a growing interest since the 1950s. Starting in the 1990s, research has explored the interactions between growth and geography.[40]

The supply and demand externalities highlighted by endogenous growth models explain why growth rates differ across countries and regions: firms choose their location according to geographical (access to transportation infrastructures, to natural resources, to drinking water, etc.), cultural (language, political system), and industrial (proximity to suppliers, access to final consumers, know-how externalities) criteria. Understanding such mechanisms has been the focus of the *new economic geography* after Paul Krugman (1991*a*, 1991*c*) outlined this research program in the early 1990s.

The toolkit of the new economic geography resembles that of endogenous growth theory: the assumptions of monopolistic competition, fixed costs, and/or externalities open the way to increasing returns and to the notion that a "critical mass" of activities and product differentiation gives an important role to the size of markets. The specific feature of economic geography is the introduction of transport and congestion costs that may offset the incentives for concentration. Firms face a trade-off between concentrating their activities in a single location to take advantage of economies of scale and disseminating them to reduce transport costs and get closer to end-consumers. Overall, the spatial location of economic activities results from a balance between forces of agglomeration and forces of dispersion.[41]

As a consequence, there is no single growth trajectory, unlike in the Solow-Swan model, but growth paths exhibit multiple equilibriums and path dependency: *history matters*. The *core/periphery model*, revisited by Krugman (1991*b*), provides an example of such thinking. The model formalizes the tension between *dispersion forces* resulting from transport costs and possibly congestion costs (such as traffic jams or water pollution in big cities) and *agglomeration forces* (also known as *polarization forces*) resulting from positive spatial spillovers between economic activities (such as access to suppliers, a pool of skilled workers and research laboratories). When transport costs are high, the former dominate and production remains scattered. When transport costs are small the latter prevail and production concentrates in one place. The equilibrium is discontinuous, even *catastrophic* in mathematical terms:[42] a small change in transport costs can lead to a brutal relocation of firms. Although highly stylized, the core–periphery model captures one of the deep insights of the new economic geography: location is determined by both deterministic and random factors. The reason why the US movie industry is based in Hollywood is that it migrated there from New York in the 1910s after Thomas Edison and a few other companies had liaised to exploit their technological monopoly and had established a centralized patenting system. Independent companies unwilling to abide by the rules set by what had become known as *The Trust* migrated west and soon settled in Hollywood, where D. W. Griffith had shot a movie in 1910. Los Angeles's climate was certainly a factor in the choice of this location, but many other places could have been chosen. However, after the agglomeration effects had been set in motion, the industry quickly concentrated there and the dissolution of the patent oligopoly in 1918 did not reverse the trend. Likewise, cities were initially founded on the basis of geographical criteria such as access to rivers or elevated watch points, which have become less relevant over time.

These mechanisms shed light on past economic history. Why are Hong Kong and Singapore major financial centers? Because both cities developed around their harbors and warehouses and had both a "critical mass" of capital and skilled labor accumulated throughout the twentieth century that they could shift toward new activities in the 1970s and 1980s. Why could peripheral countries like Finland and New Zealand develop in the late twentieth century? The answer is that transport and communication costs decreased dramatically. Why is Sub-Saharan Africa so poor? In large part because of the legacy of colonialism, but also because many African countries are landlocked and too far from dominant markets to be competitive in spite of abundant natural resources and low labor costs. Looking forward, if commodity prices become higher as resources are depleted, the associated rise of transport costs may weaken agglomeration forces in the world economy.

Economic geography also has prescriptive implications. The public sector can influence firms' location decisions; this is why European governments compete to attract company headquarters and regularly quarrel over the

location of regulatory authorities: every country hopes that by so doing it will increase its attractiveness.

c) Income distribution

The two-way relationship between income distribution and development has been the subject of intense debate.[43] In 1955, Simon Kuznets suggested that there was an inverted U-shaped relationship between the level of development and within-country income inequality: inequality would be low in poor countries (like African countries) and in rich countries (like Europe) but high in those in between (like Latin American countries). As a consequence, development came together with a temporary rise in inequality. The *Kuznets curve* was influential in shaping views on the trade-offs implied by development, but it has been empirically disputed (Deininger and Squire, 1996) and rests on unclear theoretical foundations. It provides at best a weak empirical regularity (Barro, 2000). Kuznets explained it by the reallocations of labor during the industrial transition phase. In an agrarian economy, income inequalities are weak; in the first phase of the transition, polarization between the agricultural sector and the manufacturing/urban sector increases inequalities; after manufacturing and urban workers have started to adapt, organize and fight for their share of income, however, inequalities decrease. The very sharp increase in inequality experienced by China in the first phases of its capitalist development and the gradual pick-up in wages that has followed after a significant lag seem to validate this explanation.

Modern thinking emphasizes the income effects of within-sector technological innovation, rather than intersectoral dimensions, as innovation creates temporary but unequally distributed rents (Galor and Tsiddon, 1997). The initial rise in inequality comes as a corollary to the creative destruction process explained earlier. OECD work (Causa, de Serres, and Ruiz, 2014; OECD 2015) finds that technological change that encourages the hiring of skilled labor and forces job cuts in the declining sectors played a significant role in the increase in income disparities in advanced economies. Milanovic (2016) sees such skill-biased technological change as a determinant of a new, possibly lasting, cycle of rising domestic inequalities. Biased technological change is not universal: for example, the strong growth and high productivity gains of the post-World War II period benefited unskilled labor. However, it is not without precedent: the technological innovations brought by the Industrial Revolution provoked desperate reactions, such as the revolt of the Luddites against the new wool and cotton mills in 1811–12 in England, or the uprising of the Lyons *canuts* (silk workers) in 1831 in France. Early 21st century's technological progress, notably information and communication technologies and the advent of artificial intelligence, does put a high premium on skilled labor.

The impact of inequality on growth is also complex and ambiguous. The classic argument is that inequality may result from the normal play of a market economy, in which the returns to individual efforts, innovation, and

risk-taking act as incentives to invest. Moreover, inequality leads to an increase in the savings rate because the rich save more than the poor. In the absence of redistributive taxation, an increase in inequality can then be favorable to growth if wealth accumulated by the richest fraction of the population is invested in the industries that generate productivity gains (Kuznets, 1955; Kaldor, 1957). In turn, those gains may "trickle down" to the less wealthy. This story is consistent with the Kuznets curve, but there is little empirical support for any automatic trickle-down mechanism. Deaton (2013) also argues that wage inequality, stemming from inequalities in returns to education, promotes the supply of skills and, although not desirable per se, can raise living standards for all.

However, inequalities may also negatively affect growth through several channels that economic theory has attempted to clarify:

- Income inequality often translates into an inequality of opportunities. In particular, less-developed countries have underdeveloped financial markets. Exclusion from credit markets prevents the poorest individuals from investing, whether in physical or in human capital (education), which in turns locks them in *poverty traps*—hence the interest in micro-credit pioneered by Muhammad Yunus as a way to relax the credit constraint on the poor.[44]
- There may be a temptation for government policy to react to increased inequality by easing credit conditions for poorer households (see Rajan, 2010). Cynamon and Fazzari (2016) show how the slow income growth for the bottom 95% of the US income distribution since the 1980s could not be compatible with both a stable debt-to-income ratio and a stable consumption ratio. The debt ratio increased dramatically and fed into unsustainable growth dynamics. Moreover, the need for households to deleverage then acted as a powerful drag on domestic demand, affecting the capacity of the economy to bounce back after the crisis.
- Income inequalities may lead to political instability or political deadlock. The risk of misery-based riots or revolutions creates a climate of uncertainty that discourages investment.
- In a democracy, inequality may tilt the political balance toward redistribution rather than toward incentives to wealth creation. For example, Benabou (1996) presents a theoretical model in which income dispersion increases the risk of conflict between social groups over the distribution of profits and creates a "prisoner's dilemma" in which none of these groups wishes to contribute to wealth creation. Alesina and Rodrik (1994) emphasize another mechanism based on tax incentives: the more uneven the primary distribution of income, the more the median voter will vote for a redistributive taxation. However, an excessively high marginal tax rate on high incomes is a barrier to capital accumulation and therefore to growth.

- Inequality may also weaken support for growth-enhancing institutions and systems such as economic openness, open international trade, or even the foundations of the market economy. This interaction, in the context of the rise of populist debates in the 2010s in developed countries, is notably further explored by Rodrik (2017).

In many countries, those issues are a matter for fierce policy debates without conclusive theoretical guidance. Early empirical work suggested that that inequalities may have a negative influence on growth in underdeveloped economies but a positive one in developed countries: having built a very rich dataset, Deininger and Squire (1996) conclude that the relation between inequality (measured by the Gini index of income distribution) and the growth rate depends on the development level; in accordance with the Kuznets model, they find a negative influence of inequalities on growth for either low or high GDP per capita and a positive influence in between.[45] However, they find that the inequalities that hamper growth are not income inequalities but rather factor endowment inequality, especially as regards land distribution. Recent work at the International Monetary Fund (IMF), however, has led to the more general conclusion that inequalities are detrimental to the long-term level and duration of growth. Ostry et al. (2014) find that a 5-point pre-tax and transfers Gini increase (i.e., the difference in the 2010s between Sweden and France, or China and Chile) reduces average annual growth by half a percentage point (holding redistribution and initial income constant). They also empirically document that, for a given redistribution, a 1-point Gini increase in inequality reduces the average expected duration of growth spells by 7%. Moreover, their study does not find any evidence of any adverse direct effect on growth from nonextreme fiscal redistribution, so that the total effects of redistribution, including the growth-enhancing effects of reduced inequality, are on average favorable to growth.

A new frontier for research may be to better relate inequality to the determinants of economic growth, such as innovation. Aghion et al. (2016) for example shows that innovation is positively associated with both top income inequality and upward social mobility, but not with Gini inequality. Innovation may thus spur mobility (because it opens opportunities to innovators) and increase top income inequality (because the innovators get rich) without affecting the broader distribution of income in a major way.

The relationship between growth and inequality thus ultimately depends on both the sources and the nature of growth, as well as on the kind of inequality that is considered.

d) Institutions

So far, we have primarily associated TFP growth with technical progress. However, TFP depends, in a much more general way, on all factors that contribute to raising the effectiveness of labor, capital, and their combination. Important dimensions here are the legal and regulatory environment of

production, the nature of the relationship between employers and employees, and the enforceability of laws and contracts, all factors that can be summarized under the generic term of *institutions*. Douglass North, who was awarded the Nobel Prize in 1993 with Robert Fogel, has defined institutions as "the humanly devised constraints that structure human interaction. They are made up of formal constraints (rules, laws, constitutions), informal constraints (norms of behavior, conventions, and self-imposed codes of conduct), and their enforcement characteristics" (North, 1990). Following Ronald Coase, the emphasis here is on the transaction costs implied by a low-quality institutional environment and on the importance of the security of contracts.[46] Thus, the more uncertain the legal, tax, and social environments are, the larger the precautions that any given investment requires.

In an influential contribution, La Porta et al. (1999) have stressed the importance of *legal origins*. In their view, countries such as France and the former French colonies with a civil law tradition suffer from an overextended government and regulations hampering private initiative, while the UK and its colonies operating under common law benefit from more flexible institutions and a better protection of property rights. According to the authors, such difference can be traced back to the different contexts of France and England in the twelfth and thirteenth centuries, the former being prone to rebellion while the latter was calmer and more industrious. La Porta et al. (1998) have also suggested that civil law is more likely to be associated with intermediated finance, while common law better underpins market finance since it better protects minority shareholders

One can object that countries like China and India have developed original models which cannot be reduced to civil law or common law and that there is always a gap between formal legal principles and on-the-ground experience, as confirmed by Dani Rodrik (2004) in the comparison between China and Russia: investors felt better protected in China even though the country provided no legal protection while they had the full formal protection of a private property rights regime in Russia.

Daran Acemoglu, Philippe Aghion, and Fabrizio Zilibotti (2002) have proposed an interesting framework of analysis by introducing the concept of *distance to the frontier*: for countries farthest away from the technological frontier, technical progress mainly takes place through the adoption of existing technologies, and the institutions favorable to growth are those that encourage this imitation process. But the closer one gets to the frontier, the more important it is to encourage innovation and to develop specific institutions capable of protecting intellectual property, fostering project finance, or giving incentive to risk-taking.

This analytical framework can easily be transposed to other fields. The 1997–98 financial crises in emerging market economies provided a reminder that the opening of the financial account should not be recommended to all countries, as the OECD and the IMF tended to believe before the crises, but only to countries equipped with robust financial institutions (Kose et al.,

2006). The main contribution of Acemoglu et al. (2002) is finally to show the importance of flexible institutions. Institutions matter at all stages of development, but they must adapt to each stage. This is an invitation for international institutions to refine their recommendations to developing countries.[47] Together with J. Wallis and B. Weingast, D. North has developed a theory of development as a transition process between institutions (North, Wallis, and Weingast, 2009; see box 9.11).

Box 9.11 Douglas North's Approach to the Social Development Process

North et al. (2009) emphasize the necessary connection between economics and politics within a "social order." The authors consider that only three generic social orders have existed in history:

- The *primitive social order* that dominated prerecorded human history
- The *limited access social order,* in which violence is contained and order and stability maintained through political manipulation based on rent generation through limited entry and rent distribution. This order rests on the logic of the "natural State." In response to endemic violence, warlords agree on controlling and sharing property rights and rents, which creates a common interest in pacifying relations. Access to all functions is limited and constitutes privileges for those who receive them and share an interest in stability. The limited access order is based on cronyism, personalization, and corruption, but the "natural State" is neither fragile nor failing. It simply corresponds to the first stages of social development of societies prone to natural violence. As such, the limited access social order is stable.
- The *open access social order* emerged over the past 300 years and was adopted by the few countries that successfully developed. It rests on political and economic competition and on the contestability of rents. Rents do exist, but they result from dynamism and innovation, are fundamentally impersonal (rather than attached to a person), and can be contested. They cannot be appropriated forever, and their contestability (through elections or competition) makes their distribution at any point in time acceptable for all, including those who do not benefit from them. Organizations rest on membership and contract. The open access social order is also stable.

For North et al., development really means the transition from a limited access to an open access social order. Preconditions for this transition are the emergence of a legal framework that protects the elites' property rights (and that can, over time, expand beyond the elites), the emergence of impersonal organizations able to survive individuals, and the political control of the military. In order for the transition to take place successfully, changes must be small, mutually reinforcing, and cumulative. They must also be supported by the ruling elites, so they need to be compatible with the elites' perceived interests, even though the final outcome might not be supported by them.

This taxonomy may be oversimplifying (developed countries retain many features of limited access social orders, such as the reproduction of social elites and resistance to the elimination of rents), but it has important implications for policy reform in developing countries. For example, attempts to introduce elements of an open access social order into limited access order societies are bound to fail if the necessary coherence between economics and politics is ignored. Also, a limited access political system is incompatible with economic deregulation and liberalization, and it makes no sense to try to reform it using economic means only. This analysis reinforces North's earlier claim (1994, pp. 4–5) that "it is adaptive rather than allocative efficiency which should be the guide to policy. Allocative efficiency is a static concept with a given set of institutions; the key to continuing good economic performance is a flexible institutional matrix that will adjust in the context of evolving technological and demographic changes as well as shocks to the system. . . . It is doubtful if the policies that will produce allocative efficiency are always the proper medicine for ailing economies."

Empirical studies have endeavored to build indicators of the quality of institutions and to relate them to GDP per person. The World Bank publishes a *Worldwide Governance Indicators* database with five variables: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law and control of corruption (Kaufman, Kray, and Mastruzzi, 2008). Such variables are based on an array of rankings and surveys, and their reliability is therefore debated.

Building on these indicators, the IMF (2003) has uncovered a strong positive correlation between the quality of the institutions and GDP per person—which in turn suggests that institutional improvements can foster growth. Coeuré (2017, slide 6) also finds a very strong correlation within the euro area between 2015 GDP per capita and 2008 world governance indicator ranks. Figure 9.10 illustrates the correlation across countries between the level of GDP per capita, the respect for the rule of law (panel a), and the quality of regulation (panel b).

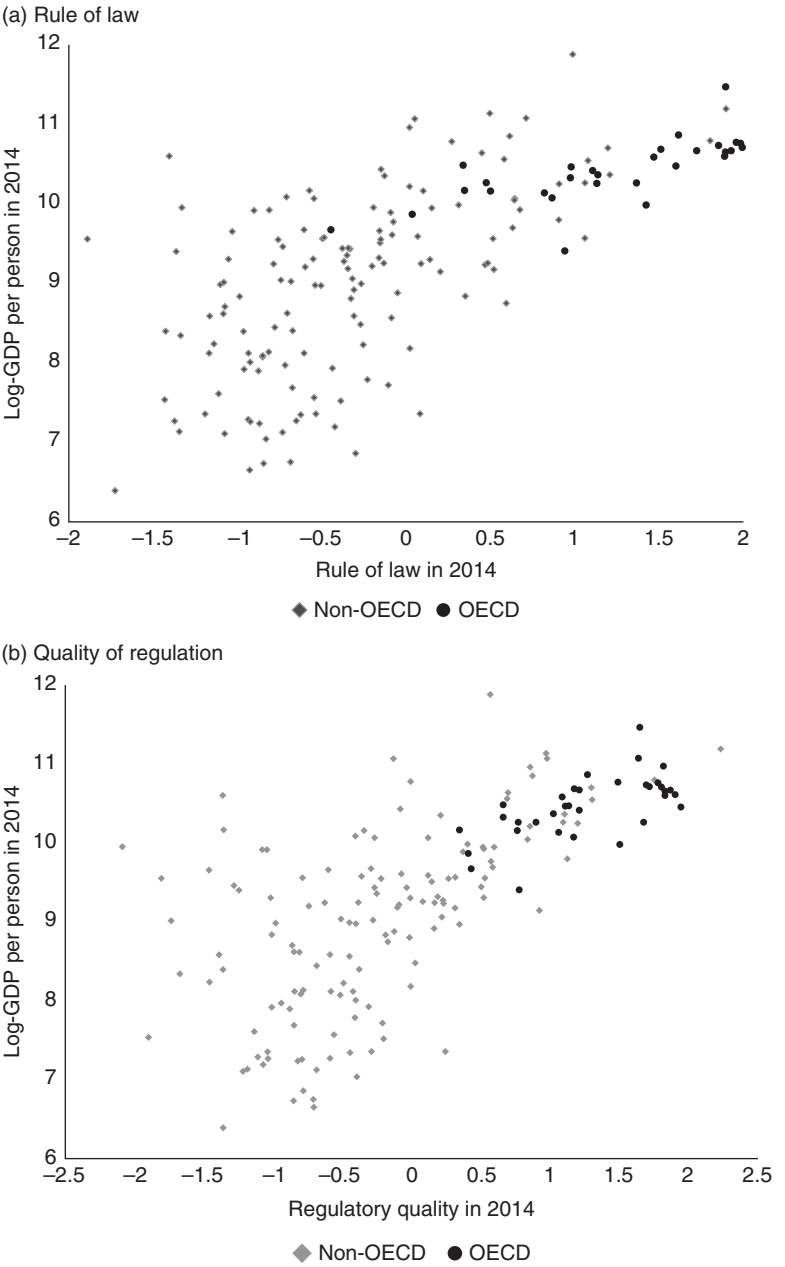

Figure 9.10 (9.10a and 9.10b) Institutions and gross domestic product (GDP) per capita in 2014.
World Bank Worldwide Governance Indicators, and Penn World Table 9.0 (per capita GDP in constant PPP 1991 dollars).

Correlation does not imply causality. Are institutions causing development or vice-versa? It is admittedly easier to convince people to shed their informal protections and networks and trust the rule of law when they can rely on a tax-financed social safety net. This suggests that it may be difficult to find out whether good institutions are conducive to growth or the other way around. Econometric techniques can be used to sort this out with the use of well-chosen instrumental variables, but only up to a point.

The Pandora's box of the origins of institutions will not be closed anytime soon. There is also another dimension to the debate; namely, the nature of the dependent variable: Is institutional quality correlated with the level of income or with the process of economic growth? Meisel and Ould Aoudia (2008) claim that the quality of institutions as measured through the World Bank Worldwide Governance Indicators is strongly correlated with the level of income but not with the speed of development over a medium to long-term horizon. They discuss the specific institutional variables that facilitate economic take-off and those that help sustain economic growth over the long term and make economic catch-up possible.

The emphasis on the role of institutions is both an opportunity and a danger for growth theory. The opportunity is to reach a deeper understanding of the determinants of economic performance and to recognize that there cannot be a single institutional template for all countries and at all times. This makes room for much richer policy conclusions. However, if mechanisms are excessively context-dependent, there is a risk of ending up with "soft" theories which produce neither general testable propositions nor clear policy recommendations. Minimal structure must therefore be imposed on the theoretical description of the links among institutions, organizations, and growth. North's research suggests that these links are complex and nonlinear. This message is increasingly being heard by policymakers (Commission on Growth and Development, 2008). Section 9.3 explores the resulting policy recommendations.

9.3 Policies

Unlike, say, price stability, for which most countries rely on a single instrument (monetary policy), the quest for growth requires playing on several keyboards at the same time, with the risk that any policy recommendation ends up reading like a laundry list of a wide number of measures that should be implemented but among which policy priority is hard to determine. Even when this is avoided, any growth policy package will have to draw on several domains and target several objectives and may end up as a wishful list of objectives that sound like potentially empty promises. As a technocratic rather than political institution, the OECD may be immune from grand promises. However, in recent years, its annual *Going for Growth* report has

altogether addressed education, labor markets, pensions, product market regulation, competition policy, and international trade. This is, in fact, hardly surprising in view of the determinants of growth identified in the previous section. The 10-year growth strategy formulated in March 2010 by the European Union, called the Europe 2020 Strategy (box 9.12), furthermore illustrates the multipronged nature of the notion of economic performance well beyond the growth of GDP.

Box 9.12 Europe 2020

In March 2010, the European heads of state and government agreed on the Europe 2020 strategy, designed to help Europe emerge stronger from the economic and financial crisis and turn it into a "smart, sustainable and inclusive delivering high levels of employment, productivity and social cohesion." Europe 2020 is a common reference framework that serves as a soft coordination device: Member States have set national targets accordingly and report on them in their annual reform programs. The strategy pursues five interrelated goals and their corresponding measurable targets:

- Employment: 75% of the population aged 20–64 should be employed;
- Research and innovation: 3% of GDP should be invested in R&D;
- Climate change and energy: Meeting the so-called 20/20/20 climate/energy targets (specifying that the emissions of greenhouse gases should be reduced by 20% from their 1990 levels, that renewables should represent 20% of energy use, and that energy efficiency should increase by 20%);
- Education: The share of early school leavers should be under 10%, and at least 40% of the younger generation should have a tertiary degree;
- Combating poverty: Reduction by 20 million of the number of people at risk of poverty;

The progress report published in 2016 shows that targets are likely to be reached or exceeded by 2020 for climate change, energy, and education, but that difficulties remain in the areas of employment, R&D, and poverty reduction.

The overriding problem for any government that wishes to promote growth is not to find out what needs to be fixed. It is to select priorities. The economist's role is to make the best use of theory to help it.

9.3.1 A roadmap

To put some order in the discussion, we can start from the theories introduced in Section 9.2 and sort out policies accordingly (figure 9.11):

- The time horizon for effectiveness ranges from a few quarters to a few years. In the short term, governments can stimulate labor supply through policies that favor participation in the labor force. Corresponding measures can be regulations (e.g., on the retirement age) and changes to tax and benefits rules (as, e.g., with the introduction of in-work benefits).
- In the medium run, governments can stimulate capital accumulation through tax incentives (such as accelerated depreciation or cuts to the corporate income tax), competition, and reforms of financial markets. They can also invest in public capital. The time horizon here is a few years.
- In the long run (up to a few decades), the capital stock is endogenous and only total factor productivity and labor supply matter. Public policies affect the quality of the labor force through education and training; they also have a bearing on total factor productivity through the funding of research, investments in infrastructure and improvements to institutions.

The public discussion is less clear-cut as it often confuses long-term and short-term determinants of growth. For example, politicians and voters frequently attribute long-term economic performance to monetary and fiscal policies. Technocrats tend to hold the opposite view and maintain that macroeconomic policies have no bearing on long-term growth. Both views are equally untrue. Before addressing the levers of a growth program one by one, we first discuss the link between short-run and long-run policies.

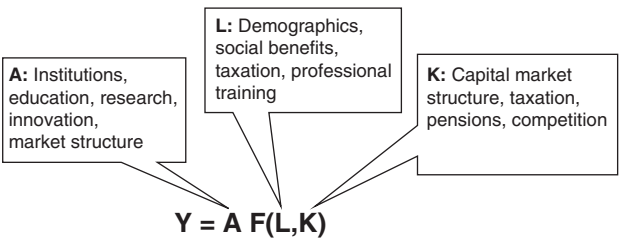

Figure 9.11 Using theory to design growth policies.

Economists usually assume a clear separation between stabilization and allocation policies. The former policies focus on short-term fluctuations and are tasked with maintaining production close to its potential level, while the latter focus on long-term trends and aim at raising this potential level. This is, among others, the underpinning of Europe's economic policy framework described in Chapter 2. Such a sharp distinction may not be entirely correct, and several arguments point to the existence of an interrelation between long-term trends and short-term fluctuations. These are:

- *Precautionary behavior*. Macroeconomic instability leads companies and households to engage in *precautionary behavior*.[48] We saw in Chapter 2 that uncertainty about the return on investment projects raises their break-even return and delays their implementation. Similarly, increased uncertainty over household income makes individuals consume less and invest more in risk-free (hence unproductive) securities such as Treasury bonds. However, negative-growth consequences of macroeconomic instability may only materialize at high levels of uncertainty—say, two-digit inflation.
- *Unemployment hysteresis*.[49] When employees having lost their jobs in an economic downturn remain lastingly unemployed, their skills deteriorate, and they become (and are perceived) as less employable (Blanchard and Summers, 1986). As time goes by, finding a job becomes increasingly difficult and sometimes even impossible. At the macroeconomic level, persistent unemployment, even of a cyclical nature, is not easily reverted (Ball, 1999). Negative demand shocks raise the nonaccelerating inflation rate of unemployment (NAIRU), and the employment rate does not revert to a long-term level. Although empirical evidence on unemployment hysteresis remains weak, the extent of the 2007-09 crisis has raised concern that part of the unemployed would de facto be excluded from the labor market, which would permanently reduce the level of potential output (OECD, 2010).
- *Creative destruction*. The impact of recessions on the demographics of firms and their innovation behavior is disputed. The Schumpeterian tradition sees recessions as productive because they hasten the attrition of the least efficient firms and contribute to creative destruction. Labor and capital freed up by bankruptcies are directed to more productive firms, which raises overall productivity. Governments should therefore not oppose the "cleansing" effect of recessions (Caballero and Hammour, 1994) by attempting to stabilize the economy. In contrast, another line of thinking stresses irreversible losses caused by recessions: companies that go bust are not necessarily the least effective ones and can simply be the most fragile or those which took more risks (Aghion et al., 2008*b*). Furthermore, their disappearance induces a social loss because of

the depreciation of capital goods and of firm-specific skills and knowledge. Far from being stimulated, the productive fabric could thus be hampered by recessions.

Each of these arguments is theoretically relevant, and the jury is out on whether output volatility is good or bad for long-term growth. Ramey and Ramey (1995) look at a sample of 92 countries and find a negative effect of GDP volatility on long-term GDP growth. For example, the "stop-and-go" policies carried out in the UK in the 1980s and 1990s are generally thought to have slowed down UK productivity growth (Barrell and Weale, 2003). Beyond this simple evidence there are, however, good reasons to believe that the sign of the relationship depends on the structure of markets. Recessions are costlier in a country where the labor market is rigid and the probability of exiting unemployment is low or where accessing credit is difficult (so that firms cannot borrow to avoid going bust). Aghion and Banerjee (2005) have shown that the impact of GDP volatility on growth is more negative when financial markets are less developed.

Hence, the dichotomy between stabilization and allocation holds only as a first approximation. Macroeconomic policy is likely to have long-term effects when fluctuations are wide and market institutions do not allow economic agents to weather recessions.[50] Symmetrically, it is increasingly recognized that policies favoring long-term growth are likely to increase resilience to cyclical fluctuations.[51]

When designing a growth program, however, the interaction between short- and long-term policies is generally ignored. Here, we follow the production function sketched in figure 9.11. We start from labor supply (L) and capital (K) accumulation, and then focus on the TFP (A), which is at the core of growth policies. We add a discussion on the spatial dimension of policies and conclude with a discussion on the choice of priorities.

9.3.2 Increasing labor supply

The *participation rate* (the ratio between the population in the labor force and the population of active age) varied in 2015 in the OECD from less than 60% in Turkey and South Africa to more than 80% in Sweden, Switzerland, and Iceland. In other words, if participation in the labor force (and employment) were at the Icelandic level, Turkey's and South Africa's incomes per head could be significantly higher. This is quite an extreme example, but the variance of participation rates is nevertheless striking, especially for women, young workers, and older workers.

As for working hours (box 9.1), genuine preferences may account for some part of observed differences. But a large part of them can be ascribed to the involuntary effects of public policies. Women may be discouraged from working full time by taxation or because of the lack of child care infrastructure. Students

may find it difficult to combine study and work because regulations do not favor part-time work. Older workers may give up working part-time because retirement rules make it difficult to combine with a pensioners' status. So, even though some differences may be genuine, in most countries there is room for improving public policies.

Increasing labor-force participation is an important objective in developing and developed countries for different reasons. In the former, the priority is to deal effectively with the informal sector, where jobs are unprotected and have low productivity, and to raise participation in the formal sector of the economy (which calls for institutional reforms as well). In industrial countries, the population of working age is frequently stagnant or declining while the number of pensioners is rising. In the medium term, at least, a higher participation rate can help offset the effect of aging and contribute to growth. Two main instruments have recently been used to this end: in-work benefits and pension reforms.

Policies of this sort can help maintain a positive rate of growth of the labor force for several years. In the short term, and beyond the medium-term horizon, however, they are bound to have limited impact. The only policies that can contribute to sustaining the growth rate of the labor force in the long run are measures aimed at increasing the fertility rate and/or immigration. The fertility rate is often considered an extraeconomic variable, but it can be raised by providing childcare facilities for young working families so that labor-market participation is not an obstacle to raising children. France and Northern European countries provide examples of such policies. As for the importance of immigration, it has been understood by countries like the United States, Ireland, Sweden, and the United Kingdom, where inward migration has contributed to significant increases of the labor force and correspondingly to higher growth. But the political environment in the mid-2010s and the ensuing backlash against migration put such understanding to a test.

9.3.3 Developing and regulating financial systems

Many growth strategies tend to overlook the role of financial markets even though that role is crucial for growth since they transform households' savings into productive capital accumulation. Financial markets thus fulfil a key allocation function in the sense given in Chapter 1.[52] Three channels of influence on long-term growth can be identified (Pagano, 1993):

- *Lower cost of capital*. Collecting household savings entails transaction costs, which reflect the costs of production of financial services, but also the taxes and regulations in force and oligopoly rents. Competition in the financial sector increases the effectiveness of the intermediation process and lowers the cost of capital.

- *Higher savings.* By giving confidence to savers, a robust financial system makes it possible to increase the saving rate, thus GDP per person (this is again the Solow-Swan model of Section 6.2).
- *Better allocation of capital.* The financial system makes it possible to collect and share information on investment projects, to diversify risk, and to finance innovation: in a nutshell, to direct saving toward the most productive projects.

a) Lower the cost of capital

Firms' investment decisions depend on the difference between the marginal productivity of capital and its cost, which is equal to the interest rate plus the rate of capital depreciation. Public policies can theoretically affect the cost of capital through monetary, regulatory, and tax policies. Monetary policy directly affects short-term interest rates and indirectly influences (see Chapter 5) medium and long-term interest rates (which are relevant for business fixed investment). As for regulatory policies, in advanced countries they have lost the impact they had when governments could direct household savings to the financing of priority investment or to specific sectors, but bank and capital market regulation do have an impact on the cost of capital (Chapter 6). Finally, taxation enters into play through the tax on corporate earnings (and various tax rebates) and through taxes on capital assets, notably real estate, generally raised locally. Taxation also changes the relative return to various savings instruments—public or private, risk-free or risky, short-term or long-term.

The situation is different in emerging economies. East Asia's economies maintained until the early 1990s a system of *financial repression* (i.e., interest rates maintained at low levels by governments to encourage investment), and this remains the case in China.[53] Such policies may stimulate growth in the short to medium run, but they involve the risk of triggering a misallocation of capital that is detrimental to longer-term economic performance. And many governments still extend subsidized loans to help some sectors, such as agriculture. The European Union generally views such interventions, deemed *state aids*, as obstacles to free competition which should be prohibited unless for the sake of general interest.

Turning to taxes, temporary tax exemptions have a limited effect on capital expenditures save for their timing, but the permanent features of corporate taxation such as amortization schemes, the definition of the tax base, and headline tax rates do play a role as incentives or disincentives to invest (see Chapter 8).

b) Stimulate savings

In the Solow-Swan model of box 9.6, steady-state GDP per capita depends positively on the savings rate. If capital moves freely across countries, capital

expenditures are not constrained by the availability of domestic savings, and there is no point in inciting households to save more. But, for various reasons discussed in Chapter 7, savings and investment remain correlated and governments continue to have recourse to policies aimed at encouraging savings. An example is pension reform. Funded pensions are a form of forced savings and help increase GDP per person, provided that pension money is invested in corporate bonds or stocks (but they can encourage excessive investment if savings are already high).

Policies aimed at encouraging savings suffer from several drawbacks. An obvious one is the short time horizon of policymakers, who are bound by the political cycle. Impatient policymakers prioritize consumption at the expense of savings. Ignorant ones prioritize both. Another drawback is the difficulty of judging the adequate level of capital: at an aggregate level, this is about dynamic inefficiency (i.e., over- or undercapitalization) in the sense of the Ramsey model, whereas at the industry level, this is about whether companies are constrained by insufficient capital supply or rather by a poor demand outlook or bad functioning of the labor market.

The relation between financial development and the level of savings is more ambiguous than it may seem. In developed countries, households access insurance through financial markets, and portfolio diversification reduces their precautionary saving. It also lifts their financing constraint by giving them access to financing instruments such as residential mortgages. The low level of household savings in the United States and in the United Kingdom is a case in point. It has been argued that the wave of financial innovation of the 2000s, which ended with the global financial crisis, was encouraged by politicians who supported residential investment, in particular by the less wealthy households, absent the corresponding income streams (Rajan, 2010).

Likewise, in low-income and emerging-market economies with limited social safety nets, households need high levels of savings as self-insurance, but this does not necessarily require a developed financial system as savings can be invested in simple ways such as land, cash, or gold. However, a well-functioning financial system provides additional and better diversified stores of value. Public policies primarily aim to promote *financial inclusion* by encouraging or forcing financial firms to expand cheap access to bank accounts and payment and savings instruments.[54] More recently, digital innovations such as payments via mobile phones have supported market-based solutions, with governments only playing a catalytic role (e.g., by distributing special-purpose electronic money, such as prepaid cards to buy first-necessity products, or by making the regulatory environment friendlier to digital payments).[55] One particular area of interest for public policy in emerging market economies, and for support by multilateral institutions, has been the development of local-currency capital markets, for example, by facilitating the issuance of local-currency bonds. This allows savings to match investment locally without being recycled through US dollar–denominated capital markets.

c) Influence savings allocation

Finally, governments can also influence the allocation of savings between various supports—mortgages, public bonds, stocks, and the like—to direct savings to the productive economy. *Credit rationing*, which was in place until the 1980s in many developed economies, amounted to a central planning of capital allocation to individual companies. Fiscal incentives can nowadays still channel savings—for example, to finance innovation through R&D tax credits (see earlier discussion) or to favor small- and medium-size enterprises (SMEs). Tax policy and regulatory policies influence decisions to invest in equity, bonds, or housing.

The role of the financial system in technological innovation has been a constant feature in history and was recognized by Schumpeter (1911). In eighteenth-century Britain, the rise of government debt allowed savers to switch out of low-return sectors and lifted profits in rising industries such as textiles and iron (Ventura and Voth, 2015). The ability of the US financial market to innovate and channel funds to the most productive uses has been regarded as a major competitive advantage of the US economy in comparison to Europe and Japan. The rise of US corporate finance, together with a fluid labor market, has contributed to the emergence of a growth model that relies on the entry and fast rise of new players that, bringing to the market new products and productivity-enhancing technologies, are able to challenge the incumbents (Philippon and Véron, 2008).

In Europe, the introduction of the euro in 1999 accelerated cross-border integration of financial markets. It created a unified monetary market and, until the 2010-2012 crisis at least, better integrated markets for government and corporate bonds and wholesale financial services. Asset management, retail banking, venture capital, and SME financing have however remained fragmented along national lines. This fragmentation precludes competition, prevents economies of scale from materializing in the financial industry, hurts SMEs that do not have access to global capital markets, holds back innovation, and hampers the diversification of risks. In short, it favors rent-seeking by financial institutions at the expense of European households and companies. Integrating financial services ranks high on the EU agenda since the European Commission and EU Member States have drafted a "Financial Service Action Plan" (European Commission, 2005) aimed at harmonizing the regulation on financial products, consumer protection, and the functioning of the markets. The EU regulatory and supervisory framework has been further streamlined after the financial crisis, with unified bank supervision and resolution within the euro area, and the EU has put forward a plan for a "Capital Markets Union" as a complement.

The financial crisis has led to reconsideration of the usefulness and dangers of the financial innovations of the 1990s and 2000s, beginning with securitization and leverage. Former Federal Reserve Chairman Alan Greenspan's diagnosis that: "clearly, our high financial returns on investment are a symptom

that our physical capital is being allocated to produce products and services that consumers particularly value" (Greenspan, 1998) was, clearly, too benign. This makes the case for a strong regulatory framework and stringent supervision of financial activities, as discussed in Chapter 6, but it does not question the importance of a well-functioning financial system for long-term growth.

9.3.4 Encourage TFP growth

In the long term, the growth of per capita GDP depends on TFP growth, which therefore lies at the very heart of growth policies along three complementary dimensions: (i) improve the institutional environment; (ii) invest in education, research, and infrastructures; and (iii) improve the functioning of markets.

a) Improving institutions

Imperfect as it may seem, research on institutions has produced useful policy recommendations: it suggests that governements should, first, ensure that the legal framework in which the economy operates is conducive to private initiative (through creating an independent judiciary to enforce private contracts, fighting corruption, limiting red tape, ensuring transparent information, etc.); second, that they should put in place effective market regulation (through creating an anti-trust authority, developing proper banking regulation, ensuring consumer protection, etc.); and, third, that they should achieve macroeconomic stability (through, e.g., an independent central bank and appropriate fiscal rules and institutions, as described in Chapters 3 and 4).

Such recommendations form the backbone of the agenda set out by international institutions. These institutions, such as the OECD for economic policy, the IMF for international monetary management, the World Bank for development, or the World Trade Organization (WTO) for trade, have therefore become the guardians of a world policy order. For emerging countries, becoming a member of the OECD or the WTO goes well beyond formally adopting sound institutional principles. It is part of a process of domestic reform and results in tying the hand of current and future policymakers. It is also a strong signal sent to foreign investors and contributes to the credibility and reputation of a country. EU membership, or the prospect of it, has played a similar role for economies in transition after the fall of the Berlin Wall. The importance of "good governance" for economic development has also been recognized by the lower income countries, as illustrated for example by the New Partnership for the Development of Africa (NEPAD), set up by the African Union in 2001, which includes national commitments and peer-country reviews. Likewise, when lending to low-income countries, the IMF and the World Bank take their governance into account.

Beyond first principles, however, it is difficult to identify a set of precise recommendations that could be used as roadmaps by governments and international organizations. Different countries rely on different institutional setups—about, for example, the role of the state in the economy—without clear impact on economic performance. In short, no single policy recipe is right for all countries and at all times.

Williamson (1990) had summarized the growth policy priorities recognized at the end of the 1980s under the name of "Washington consensus" as including 10 priorities: (i) fiscal discipline, (ii) reorientation of public expenditures, (iii) tax reform, (iv) financial liberalization, (v) unified and competitive exchange rates, (vi) trade liberalization, (vii) openness to foreign direct investment, (viii) privatization, (ix) deregulation, and (x) secure property rights. Rodrik (2006) has argued that the "augmented Washington consensus" in the early 2000s included 10 additional priorities—and some confusion: (xi) corporate governance, (xii) anti-corruption, (xiii) flexible labor markets, (xiv) WTO agreements, (xv) financial codes and standards, (xvi) "prudent" capital-account opening, (xvii) nonintermediate exchange-rate regimes, (xviii) independent central banks/inflation targeting, (xix) social safety nets, and (xx) targeted poverty reduction. Since then, the financial crisis dramatically illustrated the importance of sound regulation. But while significant efforts have been devoted to better understanding the sequencing of reforms, the syndrome of the laundry list remains inescapable.

b) Investing in education, innovation, and infrastructures

Governments everywhere have an essential role in human capital accumulation, research, and infrastructure building because all three involve significant externalities. The modalities of government intervention differ across countries—some intervene directly in their financing, some indirectly through giving incentives to private agents to make growth-enhancing investments.

Education

The rate of return to education is hard to measure, since education does not play a direct role in production.[56] More precisely, it is difficult to know which part of the supplementary wage income generated by an additional year of higher education measures the marginal yield of study, preexisting talent, or rent accruing to belonging to a given social, ethnic, or gender group. Moreover, returns to education should not be assessed from a solely monetary perspective.

At a macroeconomic level, however, the link between the education level and GDP per person has been well documented since the seminal study of Nelson and Phelps (1966). After controlling for other factors, Barro (2001) finds that an additional year of schooling raises medium-term growth

by 0.44 percentage points. Other studies, in particular those undertaken under the aegis of the World Bank, have confirmed that (i) primary education exhibits the highest social profitability in developing countries, while tertiary education is more relevant in OECD countries; (ii) the private return to education is higher than the social return because of the opportunity cost of public subsidies; and (iii) the return to female education is higher than to male education (see, e.g., Sianesi and Van Reenen, 2002, for a survey).

Education is an ideal playground for the "distance-to-the frontier" approach to economic growth outlined in the previous section. When an economy is far from the technological frontier, investment in primary and secondary education is enough to make the workforce able to imitate innovations found elsewhere. But countries approaching this frontier must invest in tertiary education to develop their own innovation capacity. Aghion et al. (2008*a*) find that tertiary education has a strong effect on growth in countries close to the technological frontier (whereas it does not affect growth in countries that are distant from it): a one percentage point increase in the proportion of university graduates in the labor force increases medium-term TFP growth by about 0.1 percentage points. This suggests that higher education is a very profitable investment in developed countries.[57]

Against this background, countries exhibit surprising disparity in their investment in human capital accumulation. Some developing countries are known for putting considerable effort into primary and secondary education (as reflected in the Human Development Index presented in Chapter 1), others remain characterized by a high incidence of illiteracy. According to World Bank data, the adult literacy rate was 69% in Morocco and 80% in Tunisia in 2012. Disparity can be found also among developed countries, this time in tertiary education attainment and resources invested in higher education. According to 2016 OECD statistics, in 2015 only 18% of the population aged 25–64 had reached tertiary education in Italy—against 35% in Spain, a country of similar development level. In 2013, total expenditure on tertiary education was 1.2% of GDP (of which 0.2% comes from private funds) in Germany—against 2.6% of GDP (of which 1.7% comes from private funds) in the United States; and 1.6% of GDP (of which 1.0% comes from private funds) in Japan. The large discrepancy between Europe and the United States is one of the key factors behind the lower European TFP performance documented in table 9.1.

To improve the performance of European higher education, however, money will not be enough. Research indicates that both the size of the budget and the quality of governance contribute to determining the research output of universities (Aghion et al., 2008). Stronger incentives for quality teaching and research and increased competition between universities are needed in Europe. These incentives, however, do not need

to imply convergence on a single template for the financing or the governance of universities.

Research and innovation

Two groups of indicators are frequently used to measure research and innovation. The first group covers the effort of each country in terms of R&D spending or personnel. It portrays Europe as a laggard behind Japan and the United States (hence the objective of bringing R&D expenditures to 3% of GDP in the Europe 2020 strategy), notwithstanding very large discrepancies among European countries. Specifically, total (public and private) expenditure on R&D amounts to around 3.5% of GDP in Japan in 2014, about 2.75% of GDP in the United States, and slightly above 2% of GDP in the EU, with a large variance within the region (from 0.38% in Romania to 3.17% in Finland and Sweden in 2014; Eurostat, 2016). In spite of the the stated 3% target, however, the ratio of gross domestic expenditure on R&D for the EU has modestly increased from 1.81% of GDP in 2002 to 2.03% in 2014.

A significant difference between Europe on the one hand and the United States and Japan on the other is the contribution of privately funded R&D: it amounts to 1.3% of GDP in the EU against about 2% in both the United States and Japan. The difference between the two sides of the Atlantic, therefore, does not come from government-funded but rather from private-sector research. The reason why European companies invest less than their European counterparts has primarily to do with the industrial structure (the United States is more specialized in research- and technology-intensive sectors), but also with market imperfections such as the relative underdevelopment of risk capital (Philippon and Véron, 2008), or the lack of a unified digital market.

In addition to market imperfections, there is a broader reason for government intervention in the field of research, which is that the social return on research spending generally exceeds its private return. Many countries have introduced tax incentives for spending on R&D by companies or individuals. In the United States, R&D tax credits exist both at the federal and state levels (Wilson, 2005). The same applies in Europe, although some tax schemes have been challenged by the European Commission because they are deemed to distort markets ("State aids" in EU parlance).[58]

The second group of R&D indicators relates to outcomes, namely published articles and registered patents. As shown in figure 9.12, the EU performs relatively well compared to its R&D efforts: its share of world scientific articles is slightly higher than that of the United States, although its share of *triadic patents*[59] is lower. In turn, Japan performs exceptionally well in terms of patents, although not in terms of publications. Finally, China appears as an impressive newcomer making a substantial effort.

Companies invest in research to develop new products that will give them a competitive edge or new processes that will reduce costs and improve product quality. However, every innovation is soon copied by competitors. This highlights the importance of intellectual property protection in the

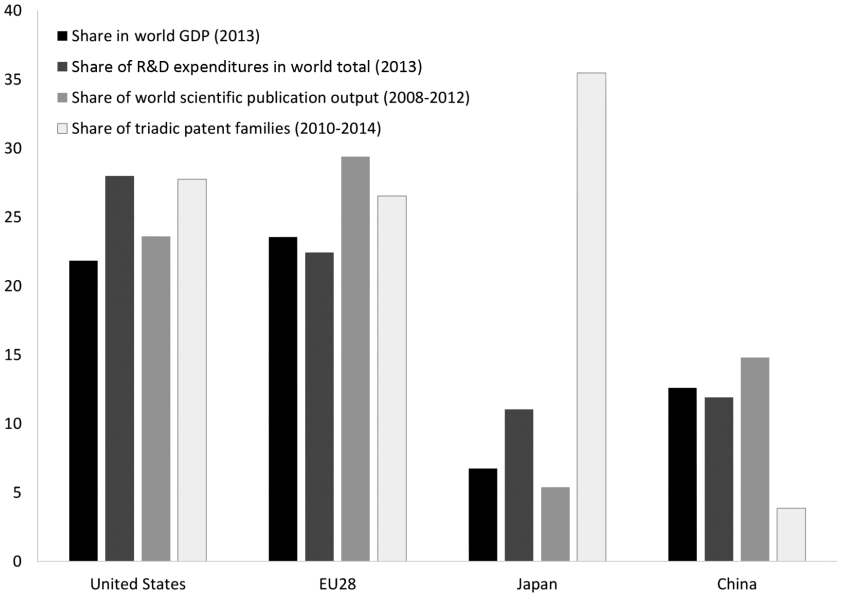

Figure 9.12 Indicators of research achievements (shares of world total), US, EU, Japan and China.
In the share of World Scientific Publication Output, EU data only include Belgium, France, Germany, Italy, the Netherlands, Poland, Spain, Sweden, and the United Kingdom. That indicator is thus underestimating the EU-28 true figure (though it comes out as the highest). Triadic patents are those registred simultaneously in the US, the EU and Japan.
Authors calculations from OECD and Scimago Research Group (CSIS), *Compendium of Bibliometric Science Indicators 2014*; Eurostat; and IMF Economic Outlook.

incentive to innovate. If a new product or a new process remains forever the exclusive property of its inventor, companies have a strong incentive to invest massively in research and development. However, the reward of innovation is appropriated by companies and their shareholders, not by consumers or the society at large. Productivity gains in other companies or sectors may be slowed down by limitations to the dissemination of the invention. Conversely, if companies cannot appropriate the revenue of innovation because it can be accessed freely by competitors, they have little incentive to innovate. Innovation becomes a public good, and it is up to taxpayers to finance it. The case of software patents illustrates this dilemma (box 9.13).

What is the best regime can only be assessed on a domain-by-domain basis. Some inventions are essentially nonrival, such as mathematical formulas and, more generally, ideas.[60] It would be absurd to hinder their dissemination. Others are essentially rival, such as manufacturing processes. Some can be replicated at low cost, such as software (box 9.13), while others cannot, such as

Box 9.13 Software Patents

Without patents, there is little incentive to innovate since any new software can be easily copied. But generalized patenting would also discourage innovation since developers would have to pay fees on every bit and part of their new software and for any algorithm needed to compile the code. Also, it is difficult to prove the "newness" of a software and to distinguish between genuine technical progress and new business methods (such as the "single click" purchase patented by Amazon in the United States). Smaller software producers also fear that large companies would tend to license any line of code as a defense against competition. Substantial litigation costs incurred in disputing software patents should not be ignored. The Economics Nobel Prize winner Gary Becker (2013), writing on the patenting of software, claims that "their exclusion from the patent system would discourage some software innovations, but the saving from litigation costs over disputed patent rights would more than compensate the economy for that cost."

This economic dilemma is reflected by international law. The WTO agreement on *trade-related aspects of intellectual property rights* (TRIPs) states that "patents shall be available for any inventions, whether products or processes, in all fields of technology, provided that they are new, involve an inventive step and are capable of industrial application." Whether software is "technology" and an "invention" is open to discussion.

In 2002–05, a highly contentious discussion developed in the EU along these lines. Software is protected by copyright but not patented as such under European law, contrary to the United States and Japan. The European Patent Office case law nevertheless views as patentable software that solves "technical problems" (as opposed to introducing new business methods). In 2002, the European Commission sought to incorporate this practice into EU law. Unsurprisingly, the proposal was supported by large firms such as Microsoft or IBM and opposed by free software and open source programmers. It was endorsed by the Council of Ministers, but rejected by 648 votes to 14 in the European Parliament in July 2005 and therefore abandoned.

nuclear technologies. The social value of innovation also has to be considered. Drugs are a case in point (box 9.14).

The upshot is that TFP-enhancing innovation depends on a fine balance between (i) government support and private initiative and (ii) patent protection and the dissemination of inventions. Creating a climate that is conducive to innovation and thereby growth is the result of an elaborate chemistry.

Box 9.14 Fighting HIV/AIDS in Poor Countries: Public Health and Intellectual Property

Public health is a major concern in poor countries which suffer from a high prevalence of pandemics such as HIV/AIDS, tuberculosis, and malaria. Medicines to fight these diseases have been developed at a high cost by pharmaceutical companies and are, rightly, protected by patents. Such patents grant the company exclusive rights to produce and sell medicines for a long period of time, generally 20 years. As a result, the cost of therapy makes it inaccessible to many. According to the joint United Nations program on HIV/AIDS, HIV programs in low-and middle-income countries have cost US$13.7 billion in 2008.

Low-income countries have therefore sought to grant so-called *compulsory licenses* so that generic antiretroviral therapy could be produced locally without the consent of the patent holder (which is, nevertheless, entitled to an adequate compensation). The WTO TRIPS agreement (see www.wto.org) originally restricted generic copies to being produced mainly for the domestic market. It was amended in 2003 to allow exportation of a limited list of medicines to countries that cannot produce them themselves. Under this provision, as an example, Indian pharmaceutical firms have exported generic antiretroviral drugs to African countries. In some instances, the mere threat of granting a compulsory license has led pharmaceutical companies to offer significant discounts in the local market.

The new TRIPS agreement strikes a balance between providing incentives for future inventions and disseminating more broadly existing inventions. It has been instrumental in fighting HIV/AIDS in Africa and has thus contributed to lowering mortality rates and supporting long-term GDP growth on the continent. There is, however, wide acknowledgment that intellectual property rights should remain adequately protected to allow private investment in medical research.

Public infrastructures

Why produce goods if there is no way to bring them to the market? Economic development requires proper infrastructures such as schools, hospitals, roads, railways, airports, dams, electricity grids, telecommunication and broadband networks, and water supply and sanitation. Such infrastructures are often financed by governments—or by foreign aid when countries are less developed—and by private money as countries grow richer and develop sophisticated financial markets.

In all cases, however, there is a need for government intervention:

- First, many infrastructures are natural monopolies (see Chapter 1). If in private hands, the government (directly or through a dedicated

agency) has to check that owners do not appropriate an excessive share of the rent they generate and may sometimes decide that the services should be provided for free. Designing appropriate regulatory frameworks that at the same time favor competition and foster investment in infrastructure is a delicate task, especially in network industries such as telecoms, electricity, and railroads.

- Second, infrastructures involve externalities: they are used by the public at large, but they can also damage the environment. There is, therefore, a need for adequate compensation (to subsidize the gap between the private cost and the social benefit) or taxation (to compensate for damages). Dams are often controversial because they offer country-wide social benefits but cause local damage.
- Finally, there are instances in which the market cannot finance infrastructure by itself, in particular because of the lack of financial instruments to manage the risks or time horizon they are associated with. Raising money for long-term investment requires the existence of a market for very-long-term loans and bonds and for the hedging of inflation risk.

Such market imperfections may be a reason for the government to step in, but they should not be an excuse to undertake projects that have political appeal but a negative net social value—so-called white elephants. These remarks underline the crucial role of careful evaluations of public investments, both in making decisions or in assessing their results and impact. Most of the time, evaluations are neglected, and, when they are undertaken, they are often perceived as conditions to be fulfilled rather than a method to guide decision-making, to protect decisions from various interest groups, to manage public debt, to monitor the quality of resource allocation, and to reorient projects. The considerable development during the 2000s and 2010s of impact evaluation techniques has significantly contributed to mainstreaming this necessary interaction between public decisions and the evaluative approach.

From the mid-2000s on, the focus has shifted to a greater attention to *public–private partnerships*[61] to crowd-in significantly higher private investment in infrastructure. Governments have tried to appear as catalysts more than as primary funders of public infrastructure investment. An example of a government-sponsored, PPP-based infrastructure scheme is the Trans-European networks program launched by the European Union in 1994 in the fields of transport, energy, and telecommunications. It is funded by European governments, the EU, and the European Investment Bank (the regional development bank). In the same vein, the Juncker Plan launched in 2015 promised to unlock public and private investments of €315 billion over three years. This plan, however, also came as a response to several years of post-Great Recession mediocre growth. Indeed, infrastructure investments often appear as politically attractive policy measures that can both stabilize the economy (Keynesian motive) and raise long-term potential growth. Increasingly,

priority is given to communication infrastructures such as broadband Internet or satellite networks. These are deemed to generate a higher social return by benefiting sectors with higher productivity gains, but there is a lack of compelling evidence.

c) Making labor and product markets work better

Finally, a proper functioning of markets contributes to TFP growth by improving the quality of resource allocation. The allocation role of markets is by no means a recent discovery, but it is fair to say that the importance of properly functioning markets has gained increasing recognition in the past two or three decades in relation to the growing needs for factor reallocation across sectors and across firms of the same sector (see Comin and Philippon, 2005). We discussed the importance of the market for capital earlier (see also Chapter 6); here, we review labor and product markets.

Labor markets

In an economy where labor is permanently reallocated across firms and sectors, the quality of the match between workers and jobs becomes an important determinant of productivity and growth. First, the shorter the period during which labor remains idle after a lay-off or quitting, the higher the aggregate labor input and production. Second, the better the match between labor supply and labor demand, the higher the productivity level. Conversely, an economy where university graduates end up serving pizzas is unable to attain the productivity level that would be expected from the existing level of human capital.

The two objectives can be contradictory: a quick match is not necessarily a good match. Thus, the performance of labor market institutions matters. In the United States, there is little government involvement in the labor market, and the short duration of unemployment insurance acts as a strong incentive for the unemployed to take up a new job. There is a risk that this could lead to deterioration in the quality of the match. The magnitude of reallocations (as measured by gross flows) ensures that many opportunities exist at each point in time.

In Europe, the traditional pattern is one of job security (for those on regular contracts), but it has been undermined by changes in the structure and dynamics of firms. It is in the Scandinavian countries that labor market institutions have undergone the deepest reforms; this has led to the emergence of a new model generally called *flexsecurity*. Workers are no longer offered job security, but, if unemployed, they benefit from generous unemployment benefits and personalized training and placement services. Benefits are conditional on active search behavior, but they can be extended for a long period if necessary. The model is costly (expenditures on labor market policies amount to more than 4% of GDP in Denmark and 2.5% in Sweden, against 0.5% in the United States) but effective in fostering quality matching. It has been adopted

as a reference by the EU. Yet, in practice, on-the-job protection of employees on regular contracts remains widespread in continental Europe.

Product markets

The functioning of markets for products and services has become increasingly prominent in the evaluation of economic performance, especially by international institutions such as the OECD.[62] Empirical studies have demonstrated the positive impact on productivity growth of suppressing rents created by heavy-handed regulation and/or barriers to entry. Nicoletti and Scarpetta (2005) of the OECD have built synthetic indicators measuring the intensity of regulation. They showed that the variance of these indicators between countries helped explain the different dynamics of labor productivity. However, economic reform in OECD countries led to substantial reduction in regulatory pressure between 1998 and 2013 and to a relative convergence of the aggregate indicator of product market regulation toward low levels (figure 9.13).

Liberalization, however, involves trade-offs. Incentives to invest in research depend on the degree and nature of competition on product markets, and the latter's role as a driver of or an obstacle to innovation is fiercely debated. Economists view competition as the engine of efficient resource allocation, while industrialists often accuse it of weakening industrial champions.

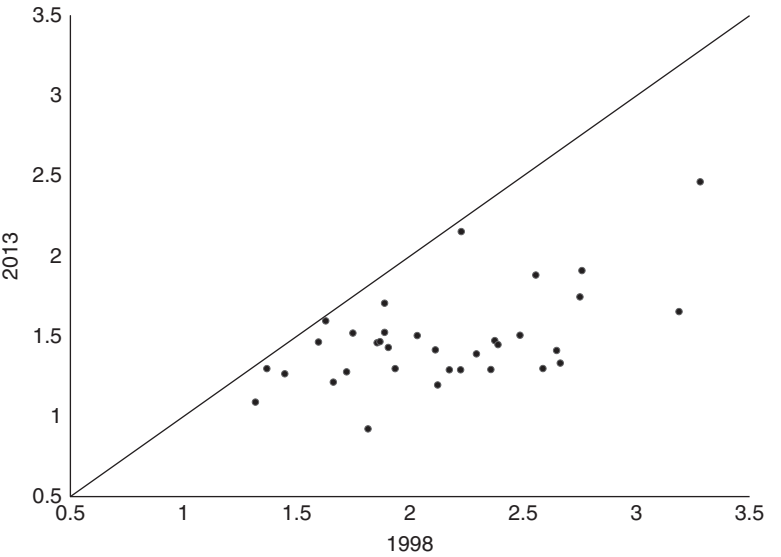

Figure 9.13 Evolution of product market regulation indicator, 1998–2013. Data are for 1998 and 2013 except for Estonia, Israel and Slovenia (2008 and 2013), and for Luxemburg and Slovakia (2003 and 2013).
OECD.

In early models of Schumpeterian innovation, such as the canonic model of Aghion and Howitt (1992, see Section 9.2), too much competition in product markets discourages innovation since it reduces the monopoly rent that rewards it (for the same reasons, in that model, patent protection is unambiguously good for innovation). However, the case can also be made that there should be *enough* competition so that incumbent firms are challenged by new entrants. Put together, this suggests an inverted-U relationship between competition and innovation. Aghion, Bloom et al. (2005) have provided a theoretical underpinning for this trade-off and have uncovered this inverted-U pattern in industry-level data by relating the number of patents submitted by UK companies to a measure of competition based on operational margins.

More generally, Griffith and Harrison (2004) have shown that reforms which have facilitated market entry and reduced administrative costs in Europe have led to lower profit margins and have supported investment and employment. Gutierrez and Philippon (2016) also confirm the role of competition in sustaining investment. Governments have to make sure that markets deliver appropriate price and quality signals and that competition is not stifled by collusion among existing players. This is what market regulation is about. Depending on the legal system, it is enforced by independent anti-trust agencies and/or by courts, and by specialized, technical agencies (such as the Federal Communication Commission and Food and Drug Administration in the United States). The debate is especially acute about network industries. In the telecoms sector, for example, liberalization has led to the entry of new players who have challenged the former monopolies. However, as competition developed, there was a need to ensure that incentives to innovate remained strong enough to invest and innovate, which requires profitability.[63]

Another example is the Microsoft case in the 2000s. Competitors filed cases against Microsoft, complaining that the company was attempting to obstruct them[64] and that this would penalize innovation. Some economists argued that Microsoft stifled its competitors, others countered that the domination of one company did not imply that the market was not contestable and that Microsoft was investing its profits into R&D. The European Commission followed the first and fined Microsoft, which lost its appeal in 2007.

9.3.5 Countering the effects of distance and history

So far, we have envisaged growth policies mostly at the level of a country. However, countries or supranational entities like the EU also implement *regional development policies* with the aim of fostering growth. Those are, in principle, distinct from mere redistribution policies. Regions (and cities) specialize dynamically according to their comparative advantages with capital and, to a lesser extent labor, being permanently relocated across regions. The combination of history, geography, and market forces usually results in a very

uneven distribution of income and wealth.[65] Inequality can to some extent be corrected through tax-based redistribution, but the real issue is whether policy can foster growth in the less-developed regions. This is the aim of regional policies. In Europe, for example, *structural funds* top-up country-level redistribution schemes and focus on growth-enhancing investments, with an aim to equalize GDP per person across European regions. In the EU federal budget for 2017, structural funds (or funds for economic, social and territorial cohesiveness), which are cashed in by regions,[66] amounted to €53.6 billion or 34% of the total.

Are such policies economically efficient? Neo-classical growth theory envisages the convergence of regional income per person conditional to their level of human capital or to the quality of their institutions. European data do not exhibit unconditional convergence: before the financial crisis, convergence was a fact among EU countries but not among EU regions (OECD, 2004, part 2), and fast-converging regions had been rich regions in poorer countries, such as Catalonia.

Economic geography has shed a new light on the discussion of regional policies.[67] As seen in Section 9.2 (and illustrated with the "core/periphery" model), there is a tension between agglomeration and dispersion forces. Agglomeration forces have proved to be powerful. Most of the EU's richest regions lie along a central axis which goes from Northern Italy to Germany, and to the Netherlands. Most of the United States' richest states lie along the nation's coasts and borders. Le Gallo and Dall'erba (2006) have studied the time dynamics of regional wealth in Europe and uncovered a strong dependence of the convergence process of a region's GDP per person on the wealth of its neighbors, leading to the formation of a "nonconvergence club" of peripheral regions.

Agglomeration forces create policy dilemmas. Economic concentration is the outcome of an economically efficient process which leads to a higher GDP growth *at the aggregate level* by exploiting the positive spillovers which arise when activities are clustered, and this higher income can be shared across regions through (preferably lump-sum) tax transfers. In that sense, governments should accept rather than oppose agglomeration, especially in new and R&D-intensive industries where existing capital plays a less important role and network externalities are high. However, the risk is that this will create industrial desertification and feed the resentment of the local populations.

How to promote the development of poor regions without stifling the agglomeration process? A first option might be to lower transport costs (through subsidies or through the improvement of transport infrastructures). However, reduced transportation costs can, at least in a first stage, encourage concentration by easing the relocation of the labor force. In France, high-speed trains have encouraged concentration of economic activity in the Paris region by making it easier to live in remote places and work in the capital. This is economically efficient (because it increases GDP in the aggregate) but it creates geographic inequalities.

Another option is to let agglomeration happen and to increase fiscal transfers to peripheral regions. This is, to a large extent, what has developed within nations, sometimes in an indirect way when laggard regions welcome rich retirees from richer ones. The Sapir report to the president of the EU Commission (Sapir et al., 2004) has advocated in that spirit to distinguish between the allocation and redistribution functions of the EU budget by setting up a "growth fund" at an EU level and a "convergence fund" devoted to less-advanced regions.

A more forward-looking and ambitious way to tackle geographical inequalities and combine economic efficiency with regional equity, however, is to encourage the diffusion of ideas and knowledge so that peripheral regions can "jump" to a more human capital–intensive, less physical capital–intensive development regime (Martin, 1999). This implies, for instance, investing in mobile phone and broadband Internet access. The rise of the Indian information and communication technology (ICT) industry can be understood in that context: fast development of electronic communication infrastructures has supplemented largely defective transport infrastructures. As network coverage expands and the price of Internet access goes down, social and banking services can be provided to poor countries and regions over mobile networks and increase total factor productivity.

As seen in Section 9.2, endogenous growth models also highlight the possibility of multiple equilibriums and the role of history in shaping growth trajectories. As a result, many countries or regions face the challenge of devising policies to escape low-development traps. There are two kinds of complementary remedies:

- Open the domestic economy to international markets to reap the productivity benefits of specialization without constraining the consumers' choice. Such strategies were inaugurated by Britain's repeal of the protectionist Corn Laws and embracing free trade in the 1830s, which proved vastly beneficial to its growth. Yet the empirical literature on trade opening and economic growth does not reach firm conclusions (Rodriguez and Rodrik, 2001). In short, no country has reached a sustainable high-growth path without opening up to trade, yet trade opening does not suffice to generate growth. A reason for this result is that trade opening may also push an economy in the direction of specializing in traditional sectors in which it has comparative advantage, such as agriculture, which may hamper long-term productivity growth. While nineteenth-century Britain was embracing free trade, it was also benefiting from the Industrial Revolution.
- Convince economic agents that future development justifies investing today. Krugman (1991*a*) and Murphy et al. (1989) have modeled situations where industrial development is not deterministic because it depends on demand expectations. Both take-off

and stagnation are possible depending on initial expectations. Underdevelopment as a coordination failure was the dominant model in the postwar years[68] and echoes the "big-push" theory of development that was very popular in the 1950s and 1960s. In this context of multiple equilibriums, the capacity of governments or international institutions to influence expectations and help move the economy from a particular equilibrium to another one becomes crucial. In this coordination role, governments need to be credible (in the same way as they need credibility for the management of short-term demand, as discussed in Chapters 4 and 5). Their credibility can be backed by kick-starting productivity-enhancing investment with public money, by engaging in an overhaul of the regulatory and tax systems, or by seeking public support of international organizations such as the OECD and the IMF for their reform strategy.

- However forceful, "big-push" strategies crucially depend on expectations and are therefore inherently fragile. This was illustrated by the failure of the forced industrialization strategies of many developing countries in the 1960s. Once in place, newly created industries have to generate lasting TFP gains, which brings us back to the preceding set of recommendations. It was not the 1950s "Great Leap Forward" that ensured China's economic take-off, but its transition to a market economy and its opening to international trade in the 1990s.

9.3.6 Choosing priorities

After squeezing theory as hard as we could to extract its policy consequences, we still do not have a recipe for long-term growth. The report produced by the Spence Commission on long-term growth in developing countries (Commission on Growth and Development, 2008) has concluded that growth trajectories are largely idiosyncratic beyond the common features that link recorded experiences of high and sustained growth. The renewal of growth theory in the 1990s has made the latter much richer and has improved its ability to match empirical data. However, the link between policies and outcomes is more tenuous than for the policies outlined in the previous chapters, if only because the timescale is much more extended, objectives are more diverse, and mechanisms are much more complex. Governments should not take these difficulties as an excuse to focus on short-term growth only. They are already all too tempted to do so, given their short political tenures. For developing countries as well as for Europe, investing in growth is crucial.

Successful growth strategies require the identification of priorities. Among the many factors bearing on long-term growth, governments need to choose a

few on which to focus—because political capital is always scarce. Are there robust methods to do so? In its series of "Going for Growth" reports, the OECD intends to help policymakers set their agenda for reform to achieve "strong, sustainable, balanced and inclusive growth." The 2017 report notes that the pace of structural reforms within the OECD has slowed, notably in the areas of education and innovation, and that governments tend to focus on specific policy areas and miss gains from synergies and reform complementarities. The report proposes the following priorities: facilitating entry and growth of innovative firms, promoting equal access to high-quality education and the inclusion of women and migrants in the labor market, boosting investment in infrastructure, and improving the training of workers and labor market activation policies.

Hausmann, Rodrik, and Velasco (2008) propose a country-specific method for deciding on priorities. They analyze obstacles to growth as a series of distortions that introduce wedges between the private and social values of a series of activities (e.g., investment, labor supply, human capital accumulation, etc.). Removing any of those distortions through structural reforms has both direct effects and general equilibrium effects on all activities. They recommend ranking reforms according to their direct effect and start with those having the strongest direct effects. For example, high private returns on education suggest that lack of education is likely to be a severe constraint on growth.

The best strategy would clearly be to remove all distortions at once, but this is neither realistic politically nor practically. In practice, governments also consider political constraints, such as the distribution of winners and losers from the reforms and their prospective voting behavior. In effect, the political economy is key to understanding why growth-enhancing reforms are often not implemented, despite their potential effects on welfare. Policy design and the quality of the policymaking process, therefore, play a crucial role.

Notes

1. The relevance of GDP as a measure of a country's standard of living is discussed in the first section of this chapter.
2. These comparisons are drawn from Angus Maddison's work (2001) on growth in the long term and updated with IMF March 2017 data.
3. The exact figures, of course, depend on the rate of growth used as a benchmark.
4. For a presentation and discussion, see D'Alisa, Demaria, and Kallis (2014). Drews and Antal (2016) question the term "degrowth" (which is coined from the French word "décroissance"), and argue that effective communication instead calls for a more positive word that suggests welfare improvements.
5. Among the explanatory factors of growth, some are beyond the economists' realm because they are truly exogenous. For example, landlocked countries face

significant challenges—which does not mean they cannot develop, depending on the natural resources they have and how well they and their neighbors perform (just compare Switzerland and Rwanda).

6. In the 1950s, there was widespread pessimism with respect to Asian development prospects. In the 1960s, the idea that the Soviet Union was on its way to catching up with the United States was commonly accepted. In the 1970s, European countries seemed to have entered a high growth path. In the 1980s, Japan was regarded as a model, while the US economy was feared to be plagued by deindustrialization and declining productivity. The 2007–2009 financial and economic crisis may lead in retrospect to a more critical diagnosis of economic policies in the 1990s and 2000s and of the underlying health of the US economy in these decades of rapid growth.
7. Remarks in Heber Springs, Arkansas, at the Dedication of Greers Ferry Dam, October 3, 1963.
8. An observer who would be concerned with the distribution of welfare would stand between the two. On these issues, see Amartya Sen's Nobel lecture (Sen, 1999).
9. The World Bank thus uses an international poverty line of PPP US$1.90 (at 2011 prices), updated in October 2015 from the earlier line of PPP US$1.25 in 2005 (at 2005 prices) and PPP US$1 in 1990 (at 1990 prices).
10. We do not discuss here the difference between GDP per person—which measures the average output per person produced by the residents of a given territory within that territory—and gross national product per person (*GNP per person*)—which measures the *residents*' average income. Both measures can differ appreciably when residents own income-producing external assets (or conversely when they are indebted to nonresidents), when they receive private transfers from foreign countries (notably from emigrants working abroad), or when they benefit from international development assistance. Our purpose here is not to analyze these differences, and we shall therefore use income per person and per capita GDP interchangeably.
11. PPP rates are published by the World Bank, which now coordinates an international comparison program (ICP), started in 1968, based on price and expenditure surveys now conducted every six years, as well as estimations for some countries. One of the notable innovations in the 2005 ICP program was the full participation of China, which provided price surveys yielding a more accurate estimate of the country's PPP exchange rate–based GDP. Because of prices being higher than previously thought, China's real GDP was revised downward by about 40%, which in turn affected the measurement of world growth by half a percentage point over the 2005–2008 period. This episode is a strong reminder of the fragility of international comparisons. As of May 2016, the latest available ICP survey had been conducted in 2011 and involved 199 countries.
12. See notably Stiglitz, Sen, and Fitoussi, 2009 (Commission on the Measurement of Economic Performance and Social Progress, chapt. 1). See also Deaton (2013) and Gordon (2016) for discussion and examples and for the argument that the past evolution of per capita GDP underestimated actual gains in welfare.

13. For example, the United Nations Statistical Commission established in 2005 a Committee of Experts on Environmental-Economic Accounting (UNCEEA) to mainstream environmental-economic accounting and establish a system of integrated environmental and economic accounting as an international standard. See also Hamilton (2006) for estimates of produced, natural, and intangible capital as well as "genuine" savings rate that take environmental degradation into account.
14. See Cette (2004, p. 24, table 4).
15. This assumes constant labor market participation and working time.
16. Jean-Baptiste Colbert was in the seventeenth-century a minister under French King Louis XIV and the architect of its economic policy. What became known as "Colbertism" involves systematic state intervention in the development of supply and the promotion of exports.
17. The rise of Europe played a major role. US physiologist Jared Diamond (1997) has proposed a pioneering explanation that opened a lively debate. He has assigned the European successes to the development of agriculture and of livestock farming, themselves due to the local abundance of seeds and the availability of animals which could be domesticated, allowing the growth of productivity and the greater concentration of people. Europe's East–West geography facilitated migration within a constant climatic environment and therefore innovation and technological diffusion. Also, proximity to domesticated animals could have allowed the immunization of local people against microbial germs. When major explorations led to physical contact between the Europeans and indigenous populations in other continents, the latter suffered from imported pandemics while the former were immune from them.
18. On the world economy concept, see Braudel (1981–84, vol. 3, chapt. 1) and Wallerstein (1979).
19. For a synthetic presentation, see Braudel (1985).
20. Levels of per capita GDP ranged in 2015 from 1 to 241 between the Central African Republic (US$597 per person and per year) and Qatar (US$143,788). The five richest countries in the World were four European countries and a country of European immigration: Luxembourg, the United States, Norway, Ireland, and Iceland. The five poorest countries were all African (Malawi, Burundi, Democratic Republic of Congo, Tanzania, and Niger).
21. For a discussion, see Quah (1993) and Sala-i-Martin (1996).
22. For recent work and data, see notably Piketty (2014), Atkinson (2015), Milanovic (2008, 2012, 2016), Deaton (2013), Bourguignon (2015), Alvaredo et al. (2017), and the World Wealth & Income Database (www.wid.world).
23. Even so, the calculation is fraught with problems. Rich individuals, for example, underreport in household surveys, and the poorest countries are unlikely to have developed household surveys. This may lead to underestimating global inequality.
24. The Gini index is equal to twice the area located between the Lorenz curve and the 45-degree line (cf. Chapter 1). It is equal to 0 when income distribution is uniform and to 1 if all income is concentrated on only one individual.
25. Global inequality indicators should of course be interpreted with caution as their calculation is fraught with various types of errors, notably sampling errors.

26. Caution is needed. The chart does not depict how individuals and households within a given percentile fared over time: they may have changed percentiles, these percentiles may include households of different countries for different periods, the country coverage is smaller in 1988, differences in population growth rates shift percentile composition across countries, and the like. Any tempting causality between globalization and the growth incidence curve should accordingly be treated with much caution (for a critique, see, for example, Freund, 2016). But the curve shows how the world income distribution shifted over time, with a top 1% percentile made of comparatively even richer people, for example.
27. Source: World Bank Poverty and Income Database, April 2017. Results for Sub-Saharan Africa have been more sobering, however. The poverty headcount ratio has declined from 54% in 1999 to only 41% in 2013. Moreover, given the fast rate of population growth, the number of extremely poor individuals has in fact increased from 258 million to 378 million over the same period.
28. However, this formulation ignores any interdependence between short-term fluctuations and long-term growth, such as hysteresis in the rate of unemployment. This is a point to which we return at the beginning of the Section 9.3.
29. The European Recovery Program, better known as the "Marshall plan" (after the American Secretary of State George C. Marshall) was a program of financial assistance by the United States for rebuilding the countries of Europe; it cost overall US$13 billion over four years, which represented 5.3% of the 1947 US GDP. The USSR was invited to take part but refused. The institution set up to implement the plan, called the Organization for European Economic Cooperation (OEEC), later became in 1960 the Organization for Economic Cooperation and Development (OECD).
30. Incidentally, this shows why GDP maximization cannot be taken as a criterion for evaluating policies.
31. This is because $0.3/(1 - 0.3 - 0.5) \sim 1.5$.
32. See, for example, Kuhn (1962).
33. Congestion costs are ignored.
34. Mankiw et al.'s model in fact becomes an endogenous growth model when the sum of the shares of both factors—physical capital α and human capital γ in the production function is equal to unity.
35. The central role assigned by Schumpeter to the entrepreneur was criticized by the French historian Fernand Braudel, who advocated a more systemic approach (prefiguring the importance that economists would give to institutions in the 1990s and 2000s; see Braudel, 1985, and the discussion in Section 9.3).
36. See, for example, Guellec (1999) or Tirole (2003).
37. Jagdish Bhagwati, a trade economist, pointed out in 1958 that growth in a country's export supply could result in a deterioration of the relative price of those exports and that this terms-of-trade effect could in turn affect income negatively.
38. Named after the seminal contribution by Avinash Dixit and Joseph Stiglitz (1977), which expands on a monopolistic competition framework initiated in 1933 by Chamberlin. See Krugman (1995) and Combes, Mayer, and Thisse (2006) for a history of these ideas.

39. See Gancia and Zilibotti (2004) for a detailed review.
40. See Combes et al. (2006) for a history of the relations between economics and geography.
41. The handbook by Baldwin et al. (2003) presents these models. Krugman (1995) reviews the history of the theory of development in the light of these mechanisms.
42. A catastrophe, or bifurcation, is a noncontinuous jump from one path to another in a nonlinear dynamic model with several possible paths.
43. See the Kanbur (2000) synthesis.
44. Rajan and Zingales (2003) highlight that the lack of access to finance is a key determinant of the persistence of poverty.
45. Also see Banerjee and Duflo (2003) for a discussion of the methods used.
46. See North (1990) and the literature review in Borner, Bodmer, and Kobler (2003).
47. See Acemoglu, Johnson, and Robinson (2004) for a general synthesis on the role of institutions in growth.
48. Aversion to risk and precautionary behaviors are explained in Chapter 2.
49. The expression was popularized in macroeconomics by Blanchard and Summers (1986). It is borrowed from physics. One speaks of "hysteresis" when the transformation of a material under the effect of temperature and/or pressure is irreversible: The material bears the memory of its last transformations.
50. In this respect, it is ironic that the United States, where the labor market is very fluid and financial markets are deep, has more active stabilization policies than Europe (see Chapters 4 and 5), where labor markets are more rigid and financial markets provide less insurance against macroeconomic risk.
51. The OECD has devoted a lot of attention to this issue. See notably the analysis by Drew et al. (2004) on how labor- and product-market rigidities affect the resilience of countries to temporary economic shocks.
52. See, for example, Greenwood and Jovanovic (1990), Levine (2005), and the pioneering works of Schumpeter (1911) and of Gurley and Shaw (1955).
53. This policy indeed contributed to promoting domestic investment, but may also have led to overinvestment rather than total factor productivity (see Young, 1992). In their seminal works, McKinnon (1973) and Shaw (1973) argue that financial repression is altogether a barrier to successful economic development. Both the theoretical and the empirical literatures, notably in the wake of severe financial crises, have subsequently qualified the McKinnon and Shaw hypothesis.
54. The development of micro-credit also allows households and small enterprises to borrow even in the absence of collateral.
55. On the development of digital retail payments and its consequences for financial inclusion, see Committee on Payments and Market Infrastructures and World Bank Group (2016).
56. We do not intend here to discuss the economics of education as this is beyond the scope of this book. One can refer to the works of Gary Becker, Jacob Mincer, James Heckman, and others. We focus here on the link between education and the level of GDP per person.
57. Aghion, Boustan et al. (2005) find a similar result for US states.

58. To know more about the Commission's attitude to innovation-related tax schemes, see the Frequently Asked Questions section on "Tax incentives to promote R&D" on the EU website.
59. Triadic patents are those filed simultaneously with the US, European, and Japanese patent offices.
60. On the economics of knowledge and the "nonrivalry" of ideas, see Jones (2005).
61. Public–private partnerships are projects that are funded and operated through a partnership between the government and one or several private companies.
62. See, for example, the annual study of the OECD on the euro area. As part of the Lisbon process, European countries also produce "'structural" indicators measuring the degree of integration of markets for goods and services, openness to competition, creation and destruction of companies, and the like. These indicators are available on Eurostat's website.
63. Griffith and Harrison also find that insufficient profits would be unfavorable to R&D, but they take this result with a grain of salt. See Schiantarelli (2005) for a survey.
64. For example, by bundling its Windows operating system and Internet browser with other software such as Windows Media Player and by abusing its dominant position. The complete record is available at www.usdoj.gov.
65. As an example, in 2005, individual income in European regions ranged between €2,519 per year on average in northeastern Romania and €76,053 per year on average in Inner London, a 1:30 ratio.
66. One-tenth of it, known as the "Cohesion Fund," is distributed at a country level.
67. See Martin (1999) and Baldwin et al. (2003, chapt. 17) for a detailed discussion.
68. See, for example, Ray (2001) and Krugman (1994*a*). Initial work on the subject can be traced to Young (1928) and especially to Rosenstein-Rodan (1943).

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