S. Kuznets, Modern Economic Growth

2 GROWTH OF POPULATION AND PRODUCT

We begin with growth of population, for it is people who produce economic growth and consume its yield; and the increase in population is a distinctive characteristic and condition of modern economic growth. The subject is vast, and our aim is to note only the main features of modern demographic processes most relevant to our central topic.

HIGH RATE OF POPULATION GROWTH

The first finding to be emphasized is the high rate of increase in population since 1750, the period within which modern economic growth is observed. Table 2.1 suggests the orders of magnitude. Although the data on population prior to 1750 are rough estimates, they are sufficiently acceptable to confirm the finding of marked acceleration in the rate of growth in recent centuries.

Several observations, extending and specifying the findings suggested in Table 2.1, can be made. First, given the age of mankind, estimated to range well over 500,000 years, and a world population in the year zero of 210 million, the rate of population growth over the millennia before the Christian era must have been much lower even than that for the first millennium A.D., 0.3 per cent per decade.[1] If we

1. The world population estimate about years 0 to 30 is put between 210 and 250 million in W. S. and E. S. Woytinsky, *World Population and Production* (New York, 1953), pp. 33–34. We use the lower figure here to maximize the rate of growth from 0 to 1000.

TABLE 2.1

World Population, 1000 to 1960

	About 1000 (1)	1750 (2)	1750 (3)	1960 (4)
Total (millions)				
1. World	275	749	728	3,010
2. Europe (including Asiatic Russia)	47	156	144	640
3. Asia (excluding Asiatic Russia)	165*	492*	475	1,684
4. Other	63	101	109	686
a. Africa	50	90	95	257
b. Americas and Oceania	13*	11*	14	429
5. Area of European settlement (2 + 4b)	60*	167*	158	1,069
Percentage distribution				
6. Europe	17	21	20	21
7. Asia	60*	66*	65	56
8. Other	23	13	15	23
a. Africa	18	12	13	9
b. Americas and Oceania	5*	1*	2	14
9. Area of European settlement	22*	22*	22	35
Rate of growth per decade, periods marked by successive dates (%)				
10. World		1.3		7.0
11. Area of European settlement		1.4		9.5
12. All other		1.3		6.0

* Oceania included with Asia.

Sources: Cols. 1 and 2: From M. K. Bennett, *The World's Food* (New York, 1954), p. 9.

Col. 3: The Carr-Saunders estimates in United Nations, *The Determinants and Consequences of Population Trends* (New York, 1963), Table 2, p. 11.

Col. 4: From U.N., *Demographic Yearbook, 1963* (New York, 1963), Table 2, p. 142.

start with an Adam and Eve as late as 500,000 B.C., the implicit rate of growth is about 0.004 per cent per decade. This does not preclude a rate of population growth in some earlier periods comparable with those since 1750, but it is highly unlikely except for large percentage changes from a tiny absolute base. By means of the estimates of world population since 1000 (given in the source cited for columns 1 and 2 of Table 2.1), we can compare the growth from 1750 to 1950—well over 200 per cent—with that for spans of two centuries going back to the year 1000. From 1000 to 1650 the average rise over a two-century period was slightly

over 20 per cent, or less than a tenth of that for 1750–1950; and even in the last span before 1750 (i.e. from 1550 to 1750) the total rise was only about 60 per cent. In short, it is only relatively recently that mankind attained both the large numbers *and* the high rates of growth that are characteristic of the modern era. In this respect, as in many others, the modern era is unique; and much of what we learn from the premodern past must be qualified because of the smaller magnitudes involved.

Second, the acceleration in the rate of population growth appears to have been almost universal, characterizing the underdeveloped countries of Asia as well as Europe and the area of European settlement, where most developed countries are found. But the rate of population growth in recent centuries has been higher in the area of European settlement than in the rest of the world (see Table 2.1, lines 11 and 12, column 4), indicating that, subject to qualifications to be noted below, population has grown more rapidly in the countries that evinced modern economic growth. Other comparisons support this finding: people of European stock increased from about 150 million in 1750 to about 800 million in 1950, a rise of 433 per cent; whereas the rest of the world's population grew from about 580 to about 1,600 million, or less than 200 per cent.[2] An alternative calculation shows that the population of the European countries that are now fully developed (Germany, France, the United Kingdom excluding Ireland, the Scandinavian countries, Belgium, and the Netherlands), combined with North America and Oceania, rose from 59 million in 1750 to 372 million in 1950, or over 500 per cent; whereas population in the rest of the world rose from 669 to 2,137 million, respectively, or slightly over 200 per cent.[3]

2. See ibid., p. 36.

3. The figures for the European countries in 1750 are from B. Ts. Urlanis, *Growth of Population in Europe* (in Russian, Moscow, 1941), pp. 414–15; for world population in 1750, from U.N., *Population Trends*, Table 2, p. 11; all others are from U.N., *Demographic Yearbook, 1963*, Tables 2 and 4.

Third, modern economic growth originated in the smaller European countries and spread largely in Europe and to the overseas descendants of Europe, whereas the large populous countries of Asia and Africa are still underdeveloped. Consequently, even though the spread of the modern industrial system has meant successive additions of new units to the group of developed countries, and even though population growth in the countries that did develop was much higher than in others, successful development of the potentials of modern economic growth is limited, even today, to a minority of the world's population. If, by a most generous interpretation, we classify all areas of European settlement as developed, and add Japan, the total in 1950 would be about 1 billion, or four-tenths of the world population of 2.5 billion. But if we omit from the developed countries much of Eastern Europe, some of Southern Europe, and most of Latin America, the fraction drops appreciably. Application of the per capita income criterion only strengthens the impression. If lack of development is taken to mean a per capita income in 1958 of less than $200, over 60 per cent of the world population were in undeveloped countries. And if $575 per capita is viewed as an acceptable minimum level of economic development, only slightly over a fifth of the 1958 world population was at or above that level.[4] We shall return to this finding, and some of its implications, in Chapter 7.

While world population grew about 7 per cent per decade from 1750 to 1960 (Table 2.1, line 10, column 4), there was a marked acceleration *within* that period (Table 2.2). The rate of increase in world population was less than 5 per cent per decade between 1750 and 1800, and then rose to over 14 per cent in the last long period, from 1930 to 1960. But since this acceleration in the rate of population growth is a reflection of the spread of new demographic patterns to rising proportions of the world population, it is the levels and patterns of movement by continents that are of main interest here.

4. See Table 7.2, p. 368.

TABLE 2.2

World Population, by Continents, 1750–1960

	Europe and Asiatic Russia (1)	North America[a] (2)	Latin America (3)	Oceania (4)	Area of European settlement[b] (5)	Asia (6)	Africa (7)	World (8)
Totals (millions)								
1. 1750	144	1	11	2	158	475	95	728
2. 1800	192	6	19	2	219	597	90	906
3. 1850	274	26	33	2	335	741	95	1,171
4. 1900	423	81	63	6	573	915	120	1,608
5. 1930	532	135	109	10.4	786	1,072	157	2,015
6. 1950	576	167	162	13.0	918	1,384	207	2,509
7. 1960	640	200	212	16.5	1,069	1,684	257	3,010
Rate of growth per decade (%)								
8. 1750–1800	5.9	43.1	11.6	0	6.7	4.7	−1.1	4.5
9. 1800–1850	7.4	34.1	11.7	0	8.9	4.4	1.1	5.3
10. 1850–1900	9.1	25.5	13.8	24.6	11.3	4.3	4.8	6.5
11. 1900–1930	7.9	18.6	20.0	20.1	11.1	5.4	9.4	7.8
12. 1930–1960	6.4	14.0	24.8	16.6	10.8	16.2	17.9	14.3
13. 1950–1960	11.1	19.8	30.9	26.9	16.4	21.7	24.2	20.0

a. Includes the United States, Canada, Alaska, St. Pierre, and Miquelon.
b. Includes North America, Latin America, Europe (including Asiatic U.S.S.R.), and Oceania.
Sources: Lines 1–4: Carr-Saunders' estimates for 1750–1900 in U.N., *Population Trends*, Table 2, p. 11.
Lines 5–7: From U.N., *Demographic Yearbook, 1963*, Table 2.

Growth of Population and Product

The acceleration of the rate of population growth appeared earliest in Europe, where the influence of modern economic growth was first felt; reinforced by the much higher rates of increase on the continents to which European population spread (particularly North America), the rate of growth of total population in the area of European settlement accelerated even more (see columns 1, 2, and 5, lines 8–10). But this process came to an end in the twentieth century; in Europe, in particular, the rates of population growth in the twentieth century (with the exception of the recent decade) are significantly below the peak in the second half of the nineteenth century.

The patterns of growth in Latin America, Asia, and Africa are distinctly different. The marked acceleration in population growth begins much later than in Europe—largely in the twentieth century, and there is no sign of decline from peak levels. The variety of growth patterns would naturally be multiplied if we were to distinguish countries rather than continents. But the important findings here are that the modern type of population growth, with its high rates, is initiated at different dates in the old parts of the world (i.e. excluding the relatively empty areas in North America and Oceania); that the identity of the areas in the acceleration phase of population growth is shifting; and that the acceleration in the rate of growth of world population, *within* the modern period, will have run its course once the modern patterns have spread to all parts of the world. The shifts in relative rates of growth between Europe and Asia, between North and Latin America, stand out quite clearly.

One consequence of the shift in locus, revealed in Table 2.2, should be noted. In the earlier phases of the modern period, until the twentieth century, the high rates of population growth characterized the area of European settlement—older areas within which modern economic growth was taking place, or relatively "empty" areas to which Europeans were migrating and in which European descendants could adopt high birth rate patterns without encounter-

ing major economic obstacles. Thus from 1750 to 1900 the rate of population growth in the area of European settlement was appreciably higher than in Asia and Africa (see columns 5–7, lines 8–10). This was still true from 1900 to 1930 (line 11). But from 1930 to 1960, population growth in the area of European settlement, while not much lower than in 1900–30, was distinctly below the greatly augmented rates for Asia and Africa (line 12); and if we characterize Latin America as an area of European settlement in which economic growth has been most halting, the recent inverse association between the rates of population growth and degree of success in attaining modern economic levels becomes more striking. Thus, at least judging by the large area units distinguished in Table 2.2, one may conclude that while in the earlier periods population grew most rapidly in those countries and areas in which economic performance, on a per capita basis, was high and rising, in the recent decades population growth was most rapid in the countries and areas in which economic performance was relatively low.

BIRTHS, DEATHS, AND MIGRATION

On a world scale, population increase is the excess of births over deaths. Until men learn how to travel and migrate to other planets, withdrawal from world population can only be by death. And until other practices of reproduction are devised and adopted (e.g., artificial incubation), addition to world population can only be by birth. An accelerating high rate of world population growth can therefore be attained only by an increase in the birth rate, reduction in the death rate, or both. The contribution of these trends in births and deaths to the high rate of population increase in modern times is important to economic growth.

Data on births and deaths are far scantier than those on population. They are summarized in Table 2.3, the selection of countries emphasizing those with the longest records. The rates are all crude, i.e. ratios of total annual births and

deaths to total population, regardless of age and sex structure. But they are the immediate determinants of rates of population growth on a world scale, where the rates of natural and total increase are identical. For any smaller area the net balance of immigration over emigration must also be taken into account.

Records for only a few countries reach back to the first half of the eighteenth century, but it is clear even from this small sample that the decline in the death rates has been the more conspicuous trend and the major cause of the acceleration and high level of population increase in modern times. In the early eighteenth century, death rates, even in the European countries, were 30 per thousand or more; and scattered evidence for these countries suggests that in the earlier centuries the rates were significantly higher, perhaps 40 per thousand or over. By the 1950s, crude death rates were in the neighborhood of 10 per thousand in the developed countries. Undoubtedly, over the period from the first half of the eighteenth century to the 1950s, the death rates in almost all parts of the world dropped 20 points per thousand, or more; and even in the presently underdeveloped areas these rates, which are still over 20 per thousand, must have been above 40 per thousand in earlier times.

This reduction in death rates alone could account for the acceleration and high rates of population growth in modern times. If we assume that in the premodern centuries the rate of natural increase was, at most, 1 per thousand (i.e. 0.1 per cent per year, which agrees with the rate of 1.3 or 1.4 per cent per decade in Table 2.1, column 2, lines 10–12, for 1000–1750), a decline in the death rate of 20 points would, provided the birth rate remains unchanged, raise the rate of natural increase from 1 to 21 per thousand. Or if we assume, to simplify the argument, that the death rates declined along a straight line from 1750 to 1950, the decline in the average for the two centuries would be 10 points; and the rise in the rate of natural increase would be from 1 per thousand before 1750 to 11 per thousand on the average for the two recent centuries. This

TABLE 2.3

Birth Rates, Death Rates, and Rates of Natural Increase, Selected Countries, Long Periods (crude rates per 1,000)

	Mid-1700s (1)	End of 1700s (2)	Mid-1800s (3)	1891–1900 (4)	1920–29 (5)	1950–59 (6)
England and Wales	(1731–70)	(1781–1820)	(1841–60)			
1. B.R.	37	37	33	30	19	16
2. D.R.	32	25	22	18	12	12
3. R.N.I.	5	12	11	12	7	4
Denmark	(1736–70)	(1771–1830)	(1841–60)			
4. B.R.	31	31	31	30	21	17
5. D.R.	29	25	20	18	11	9
6. R.N.I.	2	6	11	12	10	8
Finland	(1731–70)	(1771–1830)	(1841–60)			
7. B.R.	42	38	36	32	24	21
8. D.R.	29	27	26	20	15	9
9. R.N.I.	13	11	10	12	9	12
Norway	(1736–70)	(1771–1830)	(1841–60)			
10. B.R.	34	31	32	30	21	18
11. D.R.	28	23	18	16	11	9
12. R.N.I.	6	8	14	14	10	9
Sweden	(1736–70)	(1771–1830)	(1841–60)			
13. B.R.	34	33	32	27	18	17
14. D.R.	29	26	21	16	12	10
15. R.N.I.	5	7	11	11	6	7
Belgium			(1841–60)			
16. B.R.			30	29	20	17
17. D.R.			23	19	14	12
18. R.N.I.			7	10	6	5
France	(1771–75)	(1801–05)	(1841–60)			
19. B.R.	40	33	27	22	19	19
20. D.R.			24	21	17	12
21. R.N.I.			3	1	2	7
Germany			(1841–60)			
22. B.R.			36	36	21	17
23. D.R.			27	22	13	11
24. R.N.I.			9	14	8	6
Netherlands		(1813–24)	(1841–60)			
25. B.R.		38	33	33	25	22
26. D.R.			26	18	11	8
27. R.N.I.			7	15	14	14
Switzerland			(1828)			
28. B.R.			37	28	19	17
29. D.R.				19	13	10
30. R.N.I.				9	6	7
Italy			(1862–70)			
31. B.R.			38	35	29	18
32. D.R.			30	24	17	10
33. R.N.I.			8	11	12	8
United States		(1790–1800)	(1870–80)			
34. B.R.		55	40	33	21	25
35. D.R.		25	23	19	12	9
36. R.N.I.		30	17	14	9	16
Canada			(1867–75)			
37. B.R.			34	28	26	28
38. D.R.			18	16	12	8
39. R.N.I.			16	12	14	20

TABLE 2.3—*Continued*

	Mid-1700s (1)	End of 1700s (2)	Mid-1800s (3)	1891–1900 (4)	1920–29 (5)	1950–59 (6)
Australia			(1871–75)			
40. B.R.			37	42	23	23
41. D.R.			16	13	10	9
42. R.N.I.			21	29	13	14
New Zealand			(1871–75)			
43. B.R.			40	27		26
44. D.R.			13	10		9
45. R.N.I.			27	17		17

Sources: Cols. 1 and 2: England and Wales from John Brownlee, "The History of the Birth and Death Rates in England and Wales Taken as a Whole, From 1570 to the Present Time," *Public Health, 29* (July 1916), 232; Denmark, Finland, Norway, and Sweden through 1800 from H. Gille, "The Demographic History of the Northern European Countries in the Eighteenth Century," *Population Studies, 3* (June 1949), 63–65, 1801–30 from Corrado Gini and Stefano Somagyi, *Proceedings of the International Congress for the Study of Population, 7* (Rome, 1934), Tables XXII and XXIX; France and the Netherlands from ibid.; the United States based on W. H. Grabill, C. V. Kiser, and P. K. Whelpton, *The Fertility of American Women* (New York, 1958), pp. 5–8.

Cols. 3 and 4: England and Wales from B. R. Mitchell and Phyllis Deane, *Abstract of British Historical Statistics* (Cambridge, 1962), Table 10, pp. 29–30 and Table 12, pp. 36–37; Finland (col. 3) and Switzerland (col. 3) from Gini and Somagyi, *Proceedings, 7*, Tables XXII and XXIX; Italy from Istituto Centrale di Statistica, *Sommario di Statistiche Storiche Italiane, 1861–1955* (Rome, 1958), Table 6, p. 44; the United States based on Simon Kuznets, "Long Swings in the Growth of Population and in Related Economic Variables," *Proceedings of the American Philosophical Society, 102* (February 1958), Table 1, p. 37, Table 3, p. 39, and Table 5, p. 41; Canada from O. J. Firestone, *Canada's Economic Development, 1867–1953* (London, 1958), Table 84, pp. 242–43; all other countries from Robert R. Kuczynski, *The Measurement of Population Growth* (London, 1935), Table 29, pp. 104–05 and Table 47, pp. 162–63.

Col. 5: from U.N., *Demographic Yearbook, 1959*, Table 9 and *Demographic Yearbook, 1955*, Table 25.

Col. 6: from U.N., *Demographic Yearbook, 1963*, Tables 19 and 23.

is more than sufficient to account for the acceleration in the rate of growth of population shown in Table 2.1, in comparisons of 1750–1960 with the preceding seven and a half centuries; or for the acceleration in the rate of population growth shown for the world and for settled continents in Table 2.2. Although for shorter periods within the last two centuries, and for some areas, higher birth rates and the rates of migration were also important factors contributing to the rate of population growth—a point to which we shall return below—for the whole modern period and the world, for most of the subperiods and areas within it, the decline in the death rates was the major and perhaps the only source of the acceleration and high rates of growth of population.

Several aspects of this decline are relevant to economic growth. First, the curve of death rates by age, in earlier times and even today, is U-shaped: the rates are high in infancy (0 to 1 year of age)—from 200 to over 300 per thousand in the earlier days, drop sharply to a trough in the late teens, and remain low until the second rise which begins at about age 50. The modern decline in death rates, which has benefited all groups, has been most conspicuous in the younger groups and least in the advanced age groups.[5] Since in earlier times the young groups were large proportions of the population and their death rates were high, most of the lives saved were in these younger groups. This much greater reduction in mortality of the young groups was associated with the greater relative advance in the prevention and control of infectious, respiratory, and digestive diseases, which are most prevalent among the young, than in the prevention and control of circulatory diseases and cancer, which are most prevalent among the older groups.[6]

5. See U.N., *Population Trends*, p. 55. Chapter 4 summarizes a wide literature dealing with factors affecting mortality trends.

6. See for example the data in W. P. D. Logan, "Mortality in England and Wales from 1848 to 1947," *Population Studies, 4* (September 1950), 132–78.

Second, in premodern and even during early modern times death rates were much higher in the cities than in the rural areas. Two examples will indicate the orders of magnitude. In the London area, the crude death rate during the period 1701–50 was 49 per thousand, compared with a rate of 33 per thousand for England and Wales.[7] In the United States, as late as 1830, death rates by age groups, from 5 to 15 and 19 to 79, were over twice as high in Boston, New York, and Philadelphia as in 44 rural townships of New England.[8] Indeed the death rates in premodern cities were so high that despite high birth rates, the cities constituted deficit areas: in 1701–50, London, with a birth rate of 38 per thousand (compared with 34 for England and Wales) suffered a rate of natural *decrease* of 11 per thousand. In more recent times no developed country has experienced a differential unfavorable to urban population. Obviously, the reduction in mortality of the urban population has been far greater than that of the rural population.

Third, even the scanty evidence in Table 2.3 indicates that the decline in the death rate, like the acceleration in the rate of population growth, began at different dates in different parts of the world. Until the last two to three decades, the decline in the death rate was associated with economic conditions; and low death rates were attained only when economic performance was adequate enough to assure not only the satisfaction of needs for living but also the resources for public health and other services relevant to saving and prolonging life. Even in 1958–62 death rates for Latin America, Asia, and Africa were estimated to be 14, 20, and 23 per thousand, respectively, compared with 10, 9, or 8 per thousand for Europe, North America, and Oceania.[9] By and large, the differences in timing of the decline in the death rates accounted for the differences

7. See Phyllis Deane and W. A. Cole, *British Economic Growth, 1688–1959* (Cambridge, 1962), Table 28, p. 127.

8. See Yasukichi Yasuba, *Birth Rates of the White Population in the United States, 1800–1860* (Baltimore, 1961), Table III-1, p. 75.

9. U.N., *Demographic Yearbook, 1963*, Table 2.

in timing of the acceleration of rates of population growth.

Fourth, until quite recently, the decline in the death rate, impressive and rapid as it is compared with the long premodern past, has been a slow process. In England, Denmark, and Sweden, a decline of 10 points, from about 30 in the mid-eighteenth century, took roughly a century; and it was almost as long a period again before the rates dropped to the recent levels of about 10 per thousand. A major factor may have been the rapid growth in the proportion of the urban population and the slower buildup of the medical and public health resources needed to cope with the augmented morbidity problems of mushrooming cities. Whatever the reason, in the countries in which the death rates began to decline long before the recent decades, the rates of decline, while far greater than they must have been in the pre-eighteenth century past, were fairly moderate. But in recent decades, in countries with relatively high death rates, the decline, once begun, has proceeded at impressively rapid rates. Clearly the striking advances in public health and medicine during the last two to three decades have permitted far more rapid reductions in death rates, unrelated to the much slower process of economic growth, than ever before possible.[10]

Turning now to the birth rates, we observe from Table 2.3 that even in the eighteenth and early nineteenth centuries, in the early phases of the modern period, there was a wide spread among countries—even those populated by European stock. Comparison of the rate for the United States in the early nineteenth century, 55 per thousand (and probably no lower in the eighteenth century), with the rate of about 30 per thousand for Denmark and Sweden, and almost 40 for Finland (see lines 34, 4, 7, and 13) indicates that some older countries in Europe made significant adjustments to reduce the birth rate, when the supply of land

10. For a discussion of this recent trend and of other aspects of death rates over the last century see George J. Stolnitz, "A Century of International Mortality Trends," *Population Studies, 9* (July 1955) and *10* (July 1956).

and other resources was not as favorable as in the United States or Finland. Delays in marriage caused by restrictions imposed by institutional arrangements in agriculture and in the town guilds may have been effective; and even voluntary controls after marriage are not out of the question. The point is relevant for it suggests that changes in premodern institutional practices, many of which accompany the beginning of modern economic growth, may have eased the restrictions on the birth rates, permitting them to rise for a while above the previous levels, and may have contributed to the acceleration in the rate of population growth. There may therefore be much validity in recent writings that stress the role of rising birth rates in the early acceleration of population growth in some older European countries.[11] This finding bears upon underdeveloped countries today, for they also may have retained a number of institutional practices (e.g. prohibition of remarriage of widows) that keep the birth rates below their high potential level. Abandonment of such practices under the pressure of modernization, as well as the possible reduction of diseases that cause involuntary sterility, may produce a significant rise in the birth rate that could continue for a

11. See H. J. Habbakuk, "English Population in the Eighteenth Century," *Economic History Review, 6* (December 1953); John T. Krause, "Changes in English Fertility and Mortality, 1781–1850," *Economic History Review, 11* (August 1958); and P. G. Ohlin, "The Positive and Preventive Check: A Study of the Rate of Growth of Pre-industrial Population," (Ph.D. dissertation, Harvard University, 1956).

Furthermore, the aggregate birth rate for large population complexes, e.g. total population of European stock, may rise because of a shift of population toward areas with generally higher birth rates. Unquestionably, the migration of Europeans to North America and Oceania in and of itself raised the birth rate for the aggregate; and continued to do so as long as the birth rate overseas was higher than in Europe. This is another form of easing the restrictions on birth rates imposed by the premodern institutions in the older countries of Europe. Of course, the migrants might have been among the most prolific in Europe, and might have shown the same high birth rates if they had remained at home; but this conjecture is unlikely.

long period before other effects of modernization and economic growth combine to bring it down.

While it is tempting to pursue this topic further, evidence on rises in birth rates during the early phases of modern economic growth is not easily available; and in the broad picture to be painted here it must be regarded as but a detail, albeit an important one. Over the long sweep of modern times our concern is not so much with the effects of a *rise* as with the effects of a *decline* in birth rates. For whatever happened in the eighteenth and early nineteenth centuries in the European countries in which quickening economic growth might have raised the birth rates, from the second half of the nineteenth century for the older European countries and even earlier for their offshoots overseas, the dominant trend was a long-term decline.

This decline was evident in three countries of overseas European settlement early in the nineteenth century. In the United States, by the mid-nineteenth century the crude birth rate was already a quarter below the high levels of the late eighteenth century; and the decline proceeded apace (Table 2.3, line 34). In New Zealand the rate declined a third from the 1870s to the 1890s (line 43). In Canada the rate dropped from 34 per thousand in 1867–75 to 28 per thousand in 1891–1900 (line 37). In Australia, however, the rate rose from the 1870s to the end of the nineteenth century, but by the 1920s it had dropped to less than two-thirds of the level in the 1870s (line 40). In Western European countries the decline began in the last quarter of the nineteenth century; and by the 1950s the rates were about half of those of the mid-nineteenth century. Thus beginning with the mid-nineteenth century for the older developed countries of Europe and early in the nineteenth century for the European offshoots overseas, high rates of population growth were attained *despite* declining birth rates and were due either to a decline in death rates or to immigration.

In the less developed European countries the declines

in the birth rates began much later; and in many of the less developed areas of the world, particularly Latin America, Asia, and Africa, the downward trend is still to come. Yet in almost all these countries the decline in the death rates has already begun and, as noted above, is proceeding rapidly. The rise in the rate of natural increase, produced by the widening gap between the declining death rate and the stationary birth rate, has thus been striking; and it reproduces, in an exaggerated fashion, the gap observed in the earlier decades of the nineteenth century in the older countries of Western Europe.

Of the many aspects of the modern decline in birth rates, only two can be noted here.[12] First, the decline was due to decisions by the people concerned, not to a rise in involuntary sterility; and the decisions were within the framework of marriage, i.e. the decline was in marital fertility, owing to the spread of family planning, rather than to delay in age of marriage or decline in the marriage rate. Second, fertility and birth rates are much affected by economic and related factors: cross-section data for several developed countries until the very recent periods reveal a negative association between level of income and economic status and the birth or fertility rate (evident also in the lower birth rates for urban groups compared with the rural, and for well educated groups compared with the poorly educated). These differences shown in cross-section analysis may reflect the gradual spread of birth control and family limitation practices from the upper income and social groups downward. Whatever the case, the negative association between birth rates, and possibly rates of natural increase, and income position is an important factor in recent economic growth.

12. For a discussion summarizing a vast literature see U.N., *Population Trends*, Chap. 5; and for an interesting analysis of the relation between fertility and social structure see Kingsley Davis and Judith Blake, "Social Structure and Fertility: An Analytic Framework," *Economic Development and Cultural Change*, 4 (April 1956).

One result of the combination of long-term trends in birth and death rates should be noted. In the earlier phases of the modern period, and even more so in premodern times, both birth and death rates were high—running from 30 to over 50 per thousand—and the rate of natural increase was small. Death rates declined before birth rates and, as a result, the rate of natural increase rose appreciably. In developed countries and in many underdeveloped, death rates are down to 10 per thousand, and there is an obvious limit to further reduction. Barring catastrophes, the future course of death rates will be either stationary or slightly downward, and the effects of such trends on future rates of population growth are bound to be minor—certainly compared with the declines of 20 or more points witnessed since the mid-eighteenth century. Hence, except in the rapidly diminishing number of countries with death rates still well above 10 per thousand, the future course of population growth is primarily a matter of birth rates.

For individual countries, the units with which we shall deal in most of the discussion of economic growth, population change is a combination of natural increase with the balance of international migration. The migration of interest here is the movement across the country's boundaries of people intending a change in long-term residence, and excludes tourism, commuting, and other movements involving temporary stays. Ideally, the data would be based on this distinction of intentions and would cover a long period and the full flow across all national boundaries, but long-term series with complete coverage of international migration are not available. We do have fairly comprehensive long-term estimates of *intercontinental* emigration and immigration and long-term records of emigration and immigration for selected individual countries. Fortunately, data are available for Europe, the continent with the largest intercontinental emigration in the modern period; and since such emigration far outran the intra-European, inter-

TABLE 2.4

Intercontinental Migration, 1801 to 1946–55
(absolute figures in millions)

	1801–20 (1)	1821–50 (2)	1851–80 (3)	1881–1910 (4)	1911–40 (5)	1946–55 (6)
Emigration from Europe						
1. *Total flow, per decade*						
a. Gross	0.12	0.98	2.89	8.49	5.39	na
b. Net	0.12	0.90	2.37	5.89	3.32	4.36
2. *As % of average population*						
a. Gross	0.1	0.4	1.0	2.2	1.1	na
b. Net	0.1	0.4	0.8	1.5	0.7	0.8
3. *Share in net decennial change in population plus emigration (%)*						
a. Gross	0.9	5.2	11.7	19.5	14.4	na
b. Net	0.9	4.8	9.8	14.4	9.4	6.8
Immigration into the United States						
4. *Total flow, per decade*						
a. Gross	0.12	0.82	2.57	5.91	3.46	1.95
b. Net	0.12	0.75	2.11	4.10	2.13	1.70
5. *As % of average population*						
a. Gross	1.7	5.5	7.2	8.5	3.0	1.3
b. Net	1.7	5.0	5.9	5.9	1.9	1.1
6. *Share in net decennial change in population (%)*						
a. Gross	5.6	18.0	28.7	42.4	26.2	7.7
b. Net	5.6	16.5	23.5	29.4	16.1	6.7

Sources: Lines 1a and 1b: Gross emigration from Europe beginning in 1846 is from Kirk, *Europe's Population in the Interwar Years*, Table 1, p. 279. Extrapolation to the beginning of the nineteenth century was by data in Gustav Sundbärg, *Aperçus Statistiques Internationaux, 11* (Stockholm, 1908), Table 57, p. 107. We shifted from gross to net in cols. 1–5 by the ratios of gross to net immigration into the United States, lines 4a and 4b below. Line 1b, col. 6 is from Dudley Kirk, "Major Migrations since World War II," in Milbank Memorial Fund, *Selected Studies of Migration since World War II* (New York, 1958), Table 1, pp. 18–19.

Lines 2a and 2b: Decadal flow expressed as percentages of population at midperiod (1810 for col. 1; average of 1830 and 1840 for col. 2; average of 1860 and 1870 for col. 3; average of 1890 and 1900 for col. 4; average of 1920 and 1930 for col. 5; 1950 for col. 6). Underlying population estimates for cols. 1–4 are from Sundbärg, *Aperçus Statistiques, 11*, Table 11, pp. 34–35; for cols. 5 and 6 from U.N., *Demographic Yearbook, 1963*, Table 2, the average for 1920 and 1930 reduced 35 million to exclude Asiatic Russia.

Lines 3a and 3b: Percentage shares of lines 1a and 1b in the sum of net change in total population and either gross or net emigration. The underlying population figures are from the sources cited for lines 2a and 2b, except that for col. 5 the 1910 figure was extrapolated from the 1900 estimate by European population, given in W. S. Woytinsky, *Die Welt in Zahlen, 1* (Berlin, 1925), 24; the U.N. population figure for 1940 was reduced 40 million to exclude Asiatic Russia; and the change in col. 6 was roughly estimated to be 60 million, the difference between the 1945 and the 1955 estimates.

Lines 4a and 4b: The gross immigration data beginning with 1820 are from United States, Bureau of the Census, *Historical Statistics of the United States; Colonial Times to 1957* (Washington, 1961), Series C 88, pp. 56–57. Col. 1 is based on the figure of 250,000 for the period between the close of the Revolutionary War and 1819, cited in ibid., p. 48. Net immigration for 1821–1940 is from Simon Kuznets and Ernest Rubin, "Immigration and the Foreign Born," National Bureau of Economic Research, *Occasional Paper 46* (New York, 1954), table on p. 94, using the Willcox estimates for 1820–70; for col. 1 we assumed that gross and net were identical; for col. 6 to derive net we used departures of immigrants given in *Historical Statistics*, Series C 156, p. 64.

Lines 5a–6b: The underlying population figures (for continental U.S.) are from ibid., Series A 20, p. 8 and A 1, p. 7 for cols. 1–5; from U.N., *Demographic Yearbook, 1960*, Table 4 for col 6. For procedure and selection of years see source notes for lines 2 and 3.

national migration,[13] we can gain some notion of the most important flows in international migration from the intercontinental movements (Table 2.4).

The bulk of total intercontinental emigration, for which we have estimates since the 1800s, was from Europe—over 95 per cent of the total for 1846–1932; and the bulk of intercontinental immigration was to the United States until the very recent years—almost 58 per cent of the total for 1821–1932.[14] It is highly significant that the populations of Asia and Africa barely participated in this flow during the nineteenth and twentieth centuries and that the preponderant bulk of emigrants, almost all from Europe, went to North America (67 per cent for 1821–1932), Australia and New Zealand (6 per cent), and two countries in Latin America (Argentina and Brazil, with 11 and 7 per cent, respectively). The movement was thus largely limited to Europe and the

13. Dudley Kirk, *Europe's Population in the Interwar Years* (Princeton, 1946), pp. 97–104.

14. For these and other data in this paragraph see W. S. and E. S. Woytinsky, *World Population and Production*, Table 83, p. 72.

few European offshoots overseas, in North America and Oceania.

With this introductory observation, we may comment on the major findings suggested by Table 2.4, keeping in mind that the difference between gross and net migration is the movement in the opposite direction.

Even if we allow for understatement, the ratios of emigration to average population and even to population change seem small, but two aspects must be emphasized for proper interpretation. First, through most of the nineteenth and in the early twentieth century emigration from Europe was essentially voluntary, unrestricted, and in response to greater economic opportunities in the country of destination. Emigration was thus dominated by persons in prime working ages; comparisons with labor force and changes in it would be more significant. If we assume realistically that the labor force was between 35 and 45 per cent of total population and assume somewhat unrealistically that *all* migrants were members of the labor force, the relevant percentages would be more than twice as large as in Table 2.4. The second consideration bearing on European emigration (see lines 1–3) is that the base is too wide and the time periods may be too long. During the nineteenth and early twentieth centuries, when intercontinental emigration was high and unimpeded by legal restrictions either at origin or at destination, the identity of the countries in Europe with high emigration proportions changed continuously—moving from the northwestern to northern to central to southern and eastern areas, as different countries entered the phase of transition to modern economic growth that displaced people in agriculture and in some urban occupations (with the conspicuous exception of Ireland where the emigration peak was due to an early breakdown of the rural economy rather than to the beginning of its technological and organizational transformation). Data for these crucial periods for individual countries would yield emigration proportions much larger than those in Table 2.4. To illustrate, the data on immigrants to the United States by country of origin for the single decade of largest immigration,

show (to use just two cases) that Scandinavian immigrants in 1880–89, 672 thousand, constituted over 7 per cent of the total population of the countries of origin; Italian immigrants in 1905–14, 2.2 million, amounted to over 6 per cent of Italy's population.[15]

With such rates of inflow into the United States alone, and the corresponding proportions to the labor force over twice as high, the quantitative importance of the outflow, which siphoned off during a decade perhaps more than the decade's total increase in the labor force, becomes apparent. Undoubtedly, intercontinental (and presumably other international) emigration served as a safety valve for successive European countries as they entered the initial phases of modern economic growth with their dislocating effects on population and an accelerated natural increase. Likewise, the importance of this immigration for the major countries of destination, exemplified by the United States, is obvious. With the share of net immigration in additions to total population ranging from 16 to 29 per cent (line 6b) and thus perhaps from a quarter to a half of the total increase in the labor force, the quantitative contribution of immigration to the growth of population and labor force in the United States is impressive.[16]

15. The immigration data are from *Historical Statistics of the United States*, Series C 92 and C 99, p. 56. Population for Sweden is from Erik Lindahl, Einar Dahlgren, and Karin Kock, *National Income of Sweden, 1861–1930* (London, 1937), Part Two, Table 64, pp. 4–5; for Norway from Juul Bjerke, "Some Aspects of Long-Term Economic Growth of Norway," a paper presented at the 1959 Conference of the International Association for Research in Income and Wealth held at Portoroz (mimeo.), Table II.3; for Denmark from Kjeld Bjerke and Niels Ussing, *Danmarks Nationalprodukt, 1870–1950* (Copenhagen, 1958), Table 1, p. 142; and for Italy from Istituto Centrale di Statistica, *Indagine Statistica sullo Sviluppo del Reddito Nazionale dell' Italia dal 1861 al 1956* (Rome, 1957), Table 37, pp. 251–52.

16. The comparison of net immigration with net changes in population should properly allow for deaths of the former within the average decade. But the resulting downward adjustment of the ratios would be minor. Decadal deaths of immigrants in 1870–1900 in the United States were not much more than 5 per cent (see Kuznets and Rubin, "Immigration and the Foreign Born," Table B-4, p. 100).

The significance of intercontinental, and presumably international, migration in the growth of countries of origin and of destination in the nineteenth and early twentieth centuries lends importance to the failure of Asia, Africa, and much of Latin America to participate—even before World War I—and to the sharp decline in these flows after World War I. Not only did migration decline because of wars and legal restrictions, but its character changed—particularly between the late 1920s and early 1930s and until the very recent decade—away from economically oriented movement of people largely in the prime working ages toward refugee-type movement of people with a much wider spread by age and sex (and in some years with emphasis on the dependent young and old). Perhaps it merits specific notice that Japan, which entered the phase of modern economic growth well before the twentieth century, could not fully participate in the emigration toward the more developed areas. Nor were those European and other countries that began industrializing in the 1920s in a position to participate in the free and large flow that prevailed before World War I—and not only because of restriction in countries of destination. In some of the latecomers to industrialization, e.g. the U.S.S.R. and other Communist countries, exit was barred by the authoritarian structure of society, which served to isolate the population and prevent exposure to the temptations of the demonstration effect of the more developed countries. Thus restrictions at points of origin and destination both tended to reduce the migration adjustments to economic growth to levels far below those prevailing in the nineteenth and early twentieth centuries.

SOME ECONOMIC IMPLICATIONS OF POPULATION GROWTH

The modern population trends sketched briefly in the preceding two sections—the acceleration and high rates of increase in numbers, the decline in death rates, the trends in birth rates, and the great volume (for most of the period) of international economically oriented migration—have

been, in good part, a result of economic growth, if we regard such growth as the capacity to sustain increasing numbers at the same or higher material levels of living. Underlying both processes was an increase in the stock of useful knowledge, relating to the problems not only of health and prolongation of life but also of economic production. In turn, the modern demographic patterns, once established, also set conditions for modern economic growth and may have contributed significantly to the rise in economic performance per capita. It is with these consequences of the population trends for modern economic growth that we are concerned here. In the present state of our knowledge, these specific effects of population growth are not easy to discern, let alone to measure; and the discussion must perforce be speculative and illustrative rather than complete and definitive.

Let us assume that those countries that did develop during the last two centuries could, given the same accumulation of reproducible capital, increase their population without reducing per capita product—either because of access to an increasing stock of natural resources due to migration overseas and to revolutionary changes in the transportation and trade network, or because technological progress allowed substitution for and economy in the use of available natural resources. Given this crucial assumption, it can be argued that the modern increase in population has contributed to a rise in product per capita in several direct ways. First, the composition of population by age has shifted in favor of the most productive years. This point can be illustrated by comparing the age structures of population today, for countries grouped by per capita income and hence economic performance. If we consider ages 15–59 as the most productive, we find that the average ratio of that group to total population is about 58 per cent for the 19 countries with per capita income of $575 or more and only about 51.3 per cent for the 34 countries with per capita income of less than $200.[17] Second, the decline in birth

17. See Table 8.2, p. 438.

rates, offset fully or partly by the decline in mortality, has eliminated the enormous waste involved in rearing a large number of infants only to have them die before they could contribute to society's product and welfare; and it also released a large proportion of the potential female labor force to gainful occupations.[18] Third, the decline in the death rates has meant a decline in the rates of morbidity, i.e. of the incidence of disease with its temporarily or permanently disabling effects on the productivity of the population. Fourth, increasing population with undiminished per capita product has meant an increasing total product and greater opportunities for economies of scale—either for individual countries or, through international trade, for large population complexes and markets. Fifth, a high rate of expansion of production and markets—and a steadier rate resulting from control over epidemics and other disasters that make for violent changes in death rates and in population growth—has provided more favorable conditions for venturesome entrepreneurial undertakings; for under such conditions the penalties of errors of overexpansion are far milder than under conditions of slow and fluctuating growth. Insofar as entrepreneurial proclivity to expand and take risks is an important factor in economic growth, it contributes to a higher rate of growth per capita. Finally, given sustained levels of living and hence of training and skill per capita, a larger population means more potential contributors to the stock of useful knowledge; and there may well be advantages of scale in the production of useful knowledge equally as important as in the production of simpler economic goods.[19]

The above list—far from complete—of the possible direct contributions of population growth to rise in product per

18. For an interesting discussion see W. Lee Hansen, "A Note on the Cost of Children's Mortality," *Journal of Political Economy, 65* (June 1957).

19. For a discussion of this point and some related ones see Simon Kuznets, "Population Change and Aggregate Output," in Universities-National Bureau of Economic Research Committee, *Demographic and Economic Change in Developed Countries* (Princeton, 1960).

capita, under conditions of effective supply of natural resources, is not presented as a claim that all the effects are favorable. Adverse effects include: the reduction of savings and capital accumulation rates resulting from too high a population growth; the limit on economies of scale beyond which expansion of population and markets would have no positive effects on productivity. There is the possibility that in some countries and periods a lower rate of population growth might have resulted in a higher rate of growth of product per capita (e.g. in the early transition phases in many older European countries). The purpose of the remarks above is merely to stress the often overlooked expansive effects of population growth and the role that they may play in explaining the high rate of growth in per capita product.

But some specific aspects of the modern population trends set conditions within which economic growth takes place and so constitute constraints to which the economic growth processes must adjust. While there may be some ultimate effects on growth in per capita product, our interest lies in the chain of consequences by which these are brought about.

Consider, for example, the greater decline in the death rates of younger groups and of urban populations and the possible effects of an alternative set of differentials in the reduction of mortality. If we were to assume that the death rates for infants and the young groups had declined slightly, but that there had been a much larger decline in the death rates of adult and more advanced age groups, accompanied, as would be natural, by the preservation of vigor and health many years longer, a number of important consequences would follow. To begin with, the higher rate of natural increase could not be attained unless the fertility rate *rose*, since the increased proportion of females beyond the childbearing ages would have to be offset by increased fertility within the childbearing ages. The continuation of high death rates at infant and young ages would mean at least continuation of, or more likely a rise in, already high fertility rates, with all the effects on family size, continued

heavy domestic engagement of women until they have passed the childbearing ages, and everything else that follows. Then, the survival of people to more advanced ages, combined with retention of productive power, would necessitate considerable adjustment—extension of working life, room for a more prolonged accumulation of skill and experience, shifting proportions between working life and retirement, and changes in the structure of family units, consumers' demand, and general patterns of life which we may have difficulty in visualizing. Given the dependence of the life cycle of generations, the structure of the family, and the proportions of various age groups in the population on the differential impact of declining death rates, and given the variety of ways in which these characteristics of the population shape the structure and pace of economic life, obviously the latter would have been quite different if the reduction in the age-specific mortality rates had been different.

The differential impact of reduction of mortality on urban and rural populations has been equally important. If, to emphasize the argument, we were to assume that the death rates declined only in rural areas and remained as high in the cities as they were in premodern times—i.e. higher than the high birth rates—the drains on the population of the cities would have limited urbanization, since it would have threatened an absolute population decline (and would in any case have been a major obstacle to cityward migration). Since urbanization is a necessary condition for industrialization and modern economic growth and essential to the economies of scale of modern industry, the obstacles to modern economic growth would have been formidable indeed. Obviously the ability to reduce the mortality of dense population aggregates has been an indispensable requirement of the modern economic process.

Similarly far-reaching social and economic consequences may be ascribed to the decline in the birth rate and the more extensive international migration toward the areas of greater economic opportunity. The combination of low

birth and death rates that permitted the transition from the large, extended, multiple-generation family to the smaller, nuclear two- or one-generation family, and the differential spread of lower birth rates, reflected in the inverse association in cross-section data between birth and natural increase rates and income per capita, have both been of major importance in shaping economic growth. They have influenced the adjustment of human beings to economic opportunities, the structure of ultimate demand, and the allocation of resources to rearing and training of the young—to name a few effects. In particular, the continuous disparity within countries between differential rates of natural increase of several groups in the population, on the one hand, and the locus of differential economic opportunities, on the other, have necessitated vast internal migration—to be discussed in a later chapter in connection with changes in industrial structure accompanying modern economic growth. This internal migration has meant a removal of the younger generations from the family origins to the locus of their active participation in the economic system. It has meant a detachment of the individual from his place of origin, a break between blood and economic ties, and has facilitated the adjustment to and selection of economic opportunities by means of objective tests of performance rather than on the basis of family and status. The possible impact on the efficiency of the modern economy as a productive system is profound; and the possible contribution to the rise in product per capita is of major dimensions. In this respect the effects of international migration have been even more marked. The uprooting of the migrant—his separation not only from his family but also from the institutions and surroundings of his native country—has meant not only an orientation toward economic opportunities and a drive to exploit them that were far less restrained by traditions and ties than they would have been at home, but also a far greater concentration on economic success. These shifts in orientation may well have been more important than the mere transfer of human resources to areas of greater eco-

nomic opportunity; and they continued beyond the first generation immigrant to at least the second, if not further.[20]

Modern demographic patterns have affected the structure of the family, the relations of successive generations and the mechanisms by which people adjusted to changing and differing economic opportunities; and have thus shaped much of the structure of modern economic growth, while indirectly contributing to the high rate of increase in product per capita. Finally, population trends have affected the general views and attitudes of people; and these views and attitudes, though elusive and difficult to formulate unequivocally, are important in shaping behavior in the creation of and response to economic opportunities. The growing control over death, particularly over its catastrophic and less predictable aspects represented by epidemics and infectious diseases, and the increasing use of deliberate human decisions in birth control and family planning must both have reflected and strengthened a belief in man's power to command his destiny, or at least to be relatively free from unknown and uncontrollable terrors. Just as increasing knowledge and power over the rest of nature—the growth in basic science and applied technology—must have contributed to the beliefs and views of modern man on natural order and on the possibility of employing it for useful ends, so must the increasing control over death and disposition over birth have contributed greatly to modern attitudes, which in turn must have played a large role in facilitating modern economic growth, through their emphasis on progress, the value of systematic knowledge and plan, and receptivity to new ideas with respect to nature and society. Despite the continuing existence of attitudes unfavorable to many problems of social adjustment, modern man's general outlook is surely far more favorable to economic growth than that of his forebears in premodern times or, for that matter, than that of his contemporaries in the less developed, more tradition-bound countries. And to this change in views the greater control over deaths and births, reflected in modern population trends, must have contributed. While modern man, like his ancestors, still is born in travail and dies in pain, there is more power of human decision and far less unpredictable terror over both birth and death; and insofar as this power strengthens the belief that man's fate is in man's hands, it contributes to material advancement in this world.

20. For a more detailed discussion of effects of migration, particularly internal migration, on economic growth, see Simon Kuznets, "Introduction," in Hope T. Eldridge and Dorothy Swaine Thomas, *Demographic Analyses and Interrelations*, vol. III of *Population Redistribution and Economic Growth, United States, 1870–1950*, American Philosophical Society Memoirs, 61 (Philadelphia, 1964).

GROWTH OF PRODUCT, TOTAL AND PER CAPITA

Provided that per capita product remained the same or declined only slightly, the much higher rates of population growth in modern times necessarily meant higher rates of growth in total product. The capacity to sustain rapidly increasing numbers at the same or only slightly lower levels of living, in and of itself, can be viewed as economic growth. But the distinctive characteristic of modern economic growth is the combination of high rates of increase in population with high rates of increase in per capita product—with the obvious implication of enormous increases in total product. It is to the growth in per capita and total product that we now turn.

A selective view is provided in Table 2.5. The choice of countries is necessarily limited by the availability of long-term estimates with fairly continuous coverage. But we limited the selection further to countries for which the records revealed a sufficiently long period—no shorter than five decades—of the high rates of increase of population and per capita product that are characteristic of modern economic growth. For all fourteen countries in Table 2.5 the record covers at least half a century, and for over half of them the coverage is close to a century. Most of the developed countries are included; and the choice is wide enough to convey an adequate notion of the overall rates of

TABLE 2.5

Growth of National Product, Population, and per Capita Product, Selected Countries, Long Periods (product in constant prices)

	Duration of period (years) (1)	Rate of growth per decade (%)			Coefficient of multiplication in a century		
		Total product (2)	Population (3)	Product per capita (4)	Total product (5)	Population (6)	Product per capita (7)
England and Wales–United Kingdom							
1. 1700 to 1780	80	5.3	3.2	2.0	1.7	1.4	1.2
2. 1780 to 1881	101	28.2	13.1	13.4	12.0	3.4	3.5
3. 1855–59 to 1957–59	101	21.1	6.1	14.1	6.8	1.8	3.7
France							
4. 1841–50 to 1960–62	105.5	20.8	2.5	17.9	6.6	1.3	5.2
Germany–West Germany							
5. 1851–55 to 1871–75	20	17.6	7.7	9.2			
6. 1871–75 to 1960–62	88	31.1	11.2	17.9	15.0	2.9	5.2
Netherlands							
7. 1900–04 to 1960–62	59	29.7	14.3	13.5	13.5	3.8	3.5
Switzerland							
8. 1890–99 to 1957–59	63.5	25.7	8.3	16.1	9.8	2.2	4.4
Denmark							
9. 1870–74 to 1960–62	89	31.8	10.4	19.4	15.8	2.7	5.9
Norway							
10. 1865–74 to 1960–62	91.5	29.0	8.4	19.0	12.7	2.2	5.7
Sweden							
11. 1861–65 to 1960–62	98	36.9	6.7	28.3	23.2	1.9	12.1
Italy							
12. 1861–65 to 1898–1902	37	9.7	6.8	2.7			
13. 1898–1902 to 1960–62	61	26.8	6.8	18.7	10.7	1.9	5.6
United States							
14. 1839 to 1960–62	122	42.5	21.6	17.2	34.5	7.1	4.9
Canada							
15. 1870–74 to 1960–62	89	40.7	19.1	18.1	30.3	5.7	5.3
Australia							
16. 1861–65 to 1959/60–1961/62	97.5	34.1	24.2	8.0	18.6	8.7	2.2
Japan							
17. 1879–81 to 1959–61	80	42.0	12.3	26.4	33.4	3.2	10.4
European Russia–U.S.S.R.							
18. 1860 to 1913	53	30.2	13.8	14.4	14.0	3.6	3.8
19. 1913 to 1958	45	35.7	6.4	27.4			
20. 1928 to 1958	30	53.8	6.9	43.9	74.1	1.9	38.0

Sources: For all countries except Australia, data are from Simon Kuznets, *Postwar Economic Growth: Four Lectures* (Cambridge, Mass., 1964), Table 4, pp. 63–66. For Australia, total product is from N. G. Butlin, *Australian Domestic Product, Investment and Foreign Borrowing, 1861–1938/39* (Cambridge, 1962), Table 269, pp. 460–61, carried forward to 1948/49 by real product in Colin Clark, *Conditions of Economic Progress* (3d ed., London, 1957), Table IX, pp. 90 ff.; to 1953/54 by gross national product in constant prices, obtained by correspondence from B. D. Haig, Australia National University; to 1961/62 by data supplied by the U.N. Statistical Office. Population in 1863 is based on the 1860 figure in Australia, Bureau of Census and Statistics' *Year Book of the Commonwealth of Australia, 1951* (Canberra, 1951), p. 521 carried forward by the annual series on population increase in N. G. Butlin, "Colonial Socialism in Australia, 1860–1900," in Hugh G. J. Aitken, ed., *The State and Economic Growth* (New York, 1959), Table 2, p. 33. Population in 1960 is from the U.N., *Demographic Yearbook, 1963*, Table 4.

modern growth of total and per capita product as well as of the range of differences in the latter.[21]

For some countries in Table 2.5, e.g. England, Germany, Italy, and Russia, the records cover a period (of at least twenty years) before the acceleration of the rate of product associated with the initial phases of modern economic growth; and the rates for these early years are shown but are excluded from the averages for the long spans. The latter cover the period since modern economic growth began and are adjusted for changes in territory (when these involve significant breaks in the population totals) but include periods of war and similar disturbances. To exclude such periods would require the resolution of the difficult question whether only the years of actual conflict or the immediate prewar and postwar years should also be omitted. The exclusion would imply a debatable assumption that proneness to war is not a characteristic of modern economic growth, and that such growth should therefore be limited to conditions of peace. Hence, these averages record the performance of the economies in the process of modern economic growth, including whatever expansive or depressive effects wars and their aftermaths have had.

Naturally, the underlying measures of total product are synthetic and, while generally conforming to accepted national accounting definitions, are subject to a variety of errors. No firm magnitudes can be attached to these errors; yet it is fair to say that those arising out of difficulties of estimation (as distinct from the biases inherent in the definitions and choices of price weights) are not large enough to

21. Data for other countries can be found in Clark, *Conditions of Economic Progress* (3d ed.) and Simon Kuznets, "Quantitative Aspects of the Economic Growth of Nations: I. Levels and Variability of Rates of Growth," *Economic Development and Cultural Change, 5* (October 1956). The Kuznets paper is one of a series, of which nine have been published and the tenth is in press, with the general title, "Quantitative Aspects of the Economic Growth of Nations," which will be referred to hereafter by the short title, "Quantitative Aspects," followed by the Roman numeral indicating the specific paper in the series; details appear in the List of References.

invalidate the major conclusions that follow. The conceptually imposed biases discussed in Chapter 1 may be more serious, particularly if one rejects the underlying definitions of economic product or is concerned with the effects of inadequate price bases. But if the definitions are considered workable, and an allowance is made for any distortion introduced by inadequate price weights, the rough magnitudes may serve to reveal at least the major aggregative features of modern economic growth; and we turn now to a listing of those suggested by Table 2.5.

1. While for all countries the rates of population growth are high compared with those that must have prevailed in premodern times, they differ considerably over the long periods covered. Even if we omit France with a population increase of only 2.5 per cent per decade, the range from 6 or 7 per cent for the United Kingdom, Italy, Sweden, and the U.S.S.R. (1928–58) to 20 per cent or more for the United States, Canada, and Australia is wide indeed. The difference is between some of the older countries of Europe and the younger countries overseas.

2. Except for Australia,[22] the decade rates of growth in per capita product are well above 10 per cent. For some countries, e.g. Sweden, Japan, and the U.S.S.R. (1928–58), they are more than 20 per cent per decade, implying enormous multiplication of per capita product if the rates are maintained for a century (as they were in fact in Sweden, and for 80 years in Japan). In general, in subsequent discussion we assume a rate of growth in per capita product of 15 per cent per decade as a typically low limit.

3. No clear association appears to exist in the present sample of countries, or is likely in the other developed coun-

22. The series up to the late 1930s was most elaborately and thoroughly prepared. Division into subperiods indicates that while the rates of growth of per capita product have declined, they were not high even in the early periods. The rate for 1861–1910/11 was 10.1 per cent per decade, compared with 5.0 per cent for 1910/11 to 1959/60–1961/62. Australia may genuinely be at the low range of increase in per capita product; it would require special analysis to ascertain the reasons. A supposition is offered in note 30 below.

tries, between rates of growth of population and of product per capita. Among countries with low rates of population increase—the United Kingdom (for 1855–1959), France, Italy (1898–1962), Sweden, and the U.S.S.R. (1928–58)—the rates of increase in per capita income for the last two are among the highest and those for the first three are rather moderate, if not among the lowest. Among countries with high rates of population increase, the rate of growth in per capita income for Australia is the lowest but those for the United States and Canada are quite high. Apparently other factors—relative availability of natural resources, timing of the inception of the modern growth process, or institutional conditions—complicate the effects of population growth and prevent a simple association between it and growth in per capita product: and population growth itself may have both expansive and depressive effects on the increase in per capita product that differ in their weight in conjunction with other factors.

4. Fairly high rates of growth in per capita product and in population mean, of course, high rates of increase in total product. For periods associated with modern economic growth, these range from a minimum of about 21 per cent per decade for France and the United Kingdom to over 40 per cent for the United States, Canada, and Japan, to over 50 per cent for the U.S.S.R. (1928–58). Continued over periods as long as most in Table 2.5, these rates result in enormous multiplication of the total magnitude of performance: a decadal rate of growth of 20 per cent means a multiplication in a century to over 6 times the initial level; a rate of 50 per cent means a rise to about 58 times the initial level.

Three aspects of the growth rates in product summarized in Table 2.5 deserve emphasis. First, the rates are substantially higher than they must have been in premodern times. This is patently clear for the rates of growth of *total* product since, as already indicated, rates of population increase have been much higher and since, certainly for the countries in Table 2.5 and all now developed countries, per

capita product did not decline. But most significant are the high rates of increase in *per capita* product. That they are much higher than those prevailing over similarly long periods before the inception of modern growth can be inferred from a variety of evidence. The most direct are measures of growth in per capita product in immediately preceding periods; and those shown in Table 2.5 (for England and Wales, Germany, Italy, and Russia) are much lower than for the later, modern growth periods. Furthermore, these periods are themselves probably characterized by higher rates of increase in per capita product than the longer stretches of still earlier experience. Data on per capita product over long periods in premodern times are lacking, but we can support the preceding statement by projecting the modern rates of growth backward. A rate of 15 per cent per decade—a moderately low rate for most countries in Table 2.5—means that in a century per capita product rises to over 4 times its initial level; in two centuries the rise is to 16.4 times the early level; in three centuries to 66.2 times. For a decadal rate of growth of 20 per cent, the coefficients of multiplication are 6.2 in a century; 38.3 in two centuries; 237.4 in three centuries. Thus if per capita product had grown 15 per cent per decade for three centuries before the 1960s, per capita product in the 1660s would have been 1/66th of the present level. But a per capita income at even a twentieth of the present levels could not have sustained the population of even the most developed countries; and the assumed rates of growth in per capita product could not have been maintained, in most countries, for over two centuries.[28] It follows that the rates of increase in per capita product in the premodern past could have been as high as the modern rates only if we assumed that per capita product in some more distant past was as high as in the 1960s and had then declined to the

23. For some discussion of the implications of backward projection of modern growth rates for a number of countries see Simon Kuznets, *Six Lectures on Economic Growth* (Glencoe, 1959), Table 3, p. 27 and discussion on pp. 25–26.

low levels immediately preceding modern times—an assumption denied by a variety of historical evidence.[24]

The second feature of modern aggregative growth, not presented in Table 2.5 since it would require a great amount of detail, is the relative steadiness of its rate over time—compared with the variability of such rates in premodern times. This conclusion is highly probable, particularly for rates of growth of total product: viewed in, say, decadal units, the very steadiness of modern population growth, freed from the catastrophic impacts of epidemics and the fluctuations in birth rates associated with them, would make for a greater stability in the rates of growth of total product. Other contributing factors are: technological progress in agriculture, which reduces the chance of crop failures; improvements in transportation, which permit the widening of sources of supply; the decline in the share in total product of agriculture, and the increase in the shares of other industries, technologically more controllable—all basic features of modern growth. Apparently, short of breakdowns of the social system, modern conditions permit a steady growth, even in per capita product, that was not possible in premodern times. And except during periods of violent revolutionary change in institutions and of major wars—both necessarily limited—modern growth rates are steady; successive subperiods (say of one or two decades)

24. It is tempting to offer as support for our suggestion that the rates of growth in per capita income in premodern times were low, the general views of contemporary writers on economic and social progress. The arguments of writers in the seventeenth and eighteenth centuries that population tends to grow faster than resources and that a rise in per capita income is only a matter of a temporary lag of population growth, and the retention even by John Stuart Mill in the middle of the nineteenth century of the prevalent conviction of the imminence of the stationary state because of the pressure of limited natural resources seem to indicate that the growth of per capita product in the past was too low and its cumulative impact too slight to modify such views. But argument from writings of theorists whose conclusions have not been established by testable empirical evidence is treacherous; and its pursuit, to be effective, would take us far afield.

rarely show a drop in the rate of growth below a fairly high positive minimum.[25]

The third aspect that merits stressing is the differences among countries in rates of growth, and particularly the effects of such differences on rapid shifts in economic magnitude. Even if we exclude the countries not fully developed and the most recent entrants into the process of modern economic growth, and confine our attention to the European countries other than Italy, we find wide differences in rates of growth—with implied effects on shifts of weight among countries. Consider as an illustration France and Germany: if, using the entries in Table 2.5, we assumed for these two countries rates of growth in total product from the mid-nineteenth century of about 2.1 and 3.1 per cent per decade, respectively, and assumed that both countries start with the same total product, within half a century that of Germany would be 1.4 times that of France; within less than a century it would be double.

The three aspects of growth of product just noted are interrelated. The capacity for *steady* growth makes *high* average rates of growth possible and likely; for if too many calamitous breaks should occur, obvious difficulties would arise in fully compensating for the catastrophes and achieving a high average level. The high average rates of growth make relatively moderate *proportional* differences in rates productive of large contrasts in coefficients of multiplication over longer periods: over a century the difference between the coefficients would be between 13.8 and 6.2 or over 2 to 1, when the decadal rates are 3.0 and 2.0, respectively (as they are in modern times, judging by Table 2.5); and between 2.4 and 1.8, or only 1.3 to 1, when the decadal rates are 0.9 and 0.6 per cent, respectively.[26] Such interrelations,

25. For a discussion of this aspect of growth of annual gross national product in the United States since the 1870s see Kuznets, *Capital in the American Economy*, Table 1, p. 43, and the text on pp. 40–45 on continuity of trend.

26. For a brief discussion of this point see Kuznets, "Quantitative Aspects: I," pp. 25–27.

and others to be noted, mean that the high rates of modern economic growth carry a variety of implications with them —important both in explaining how such growth comes about and in evaluating its consequences.

GROWTH OF EFFICIENCY

The growth of national product in modern times may have been due either to an increase in input of resources, i.e. labor and capital, or to an increase in efficiency, i.e. greater output per unit of input, or to both. That a substantial proportion is attributable to a rise in inputs seems obvious: the enormous addition to population must have meant a large increase in the labor force, and the rise in total product must have led to an appreciable rise in the volume of capital accumulation and hence at least of reproducible capital. A significant share of the rise in total product must therefore be statistically allocable to an increase in inputs of labor and capital. The interesting question relates to the growth of product *per capita*. Has there been an increase in resource input per capita to which a substantial proportion of the rise in per capita product should be allocated? It is to this question that the discussion is directed.

Table 2.6 deals with the input of labor, in the simple form of man-hours per head of population derived from shares of labor force in total population and the number of hours per man-year. The table is based largely on Colin Clark's estimates of the labor force, excluding women in agriculture,[27] and of hours of work per man-year. The labor force is the total engaged, regardless of actual employment, and the hours are assumed to be those prevailing under full employment. Labor force and hours should be

27. The exclusion of women in agriculture means a higher measured rate of growth of the labor force—labor input—and therefore a correspondingly lower rate of growth of the residual reflecting efficiency. Since we conclude that the rise in per capita product in modern economic growth has been due largely to the rise in efficiency, the use of labor force including women in agriculture would have only reinforced this conclusion.

TABLE 2.6

Man-hours of Labor per Capita, Selected Countries, Long Periods

	Years in period	Rise in % share of labor force in population		% Decline in length of work-year	% Decline in man-hours per capita	
		Absolute	As % of share in initial year		Full period	Per decade
	(1)	(2)	(3)	(4)	(5)	(6)
1. Great Britain, 1870–1952	82	5.5	13.1	19.9	9.4	1.1
2. France, 1840–1952	112	2.1	5.4	38.8	35.5	3.2
3. Belgium, 1846–1951	105	5.5	15.8	30.4	19.5	1.9
4. Germany, 1877-1950	73	6.3	15.8	24.4	12.5	1.7
5. Netherlands, 1900–52	52	1.3	3.6	26.1	23.4	4.5
6. Switzerland, 1890–1951	61	−0.3	−0.7	24.4	24.9	4.1
7. Denmark, 1870–1951	81	10.2	29.4	35.5	16.5	2.0
8. Norway, 1865–1955	90	2.8	7.2	25.7	20.3	2.3
9. Sweden, 1861–1952	91	5.3	14.6	28.5	18.1	2.0
10. Italy, 1901–53	52	−1.4	−3.6	36.5	38.8	7.5
11. United States, 1850–1952	102	8.1	25.2	39.5	24.2	2.4
12. Canada, 1870–1952	82	5.8	18.3	35.0	23.1	2.8
13. Australia, 1861–03 to 1952/53	50.5	−0.1	−0.2	17.6	17.8	3.5

Sources: Except for Germany and Norway, based on Clark, *Conditions of Economic Progress*, 3d ed., Tables IX ff., pp. 90 ff. For each country population was derived by dividing total real income by real income per head; labor force and hours per year were given. For Germany, hours and labor force are from Paul Jostock, "The Long-Term Growth of National Income in Germany," in Simon Kuznets, ed., *Income and Wealth, Series V* (London, 1955), Table V, p. 99 and Table VI, p. 102. For Norway, population and labor force are from Juul Bjerke, "Some Aspects of Long-Term Economic Growth of Norway," Table II.6; and we assumed that the hours per year given in Clark, *Conditions*, Table XXXI, pp. 174–75 for 1891 and 1950 could be used for 1865 and 1955, respectively (the data for Sweden in ibid., Table XXXVII, pp. 181–86 show only a slight change in hours between 1865 and 1891).

measured in this fashion, since underutilization (unemployment and partial employment) reflects inefficiency of the system, and any reduction in the rate of growth of available man-hours due to this factor should not reduce the denominator of the efficiency ratio (ratio of output to resources available for input) since it should not raise the efficiency ratio.

Granted the difficulties of reliable measurement of labor force and hours, the consistency of the finding for the sample of countries and the long periods in Table 2.6 is impressive. For all the countries, except Switzerland, Italy, and Australia, the proportions of labor force to total population show an upward trend. The proportions, 30 per cent or higher in the early years, rise to 40 per cent or more. This rise may have been due to a shift in the age structure of the population in favor of working ages, associated with declines in the birth rates and in the proportions of population *below* working age; or to increasing participation of women in gainful occupations, particularly when women in agriculture are excluded; or to both trends—offsetting the effects of a rise in the age of entry into the labor force and of a lowering of the age of retirement. Whatever the reason, the proportions of gainfully occupied to total population increased; and if customary hours per man-year had remained the same, man-hours per capita would have risen in most countries.

But modern economic growth has been accompanied by a long-term decline in customary working hours per year—by fractions ranging, for the period since the mid-nineteenth century, from less than a fifth to almost two-fifths. By combining the decline in hours per year with the rise in the proportion of the labor force to total population, we can derive the net percentage change in man-hours *per capita* for the full period, i.e. on the basis of Table 2.6: 100 − [(100 − col. 4) × (100 + col. 3) ÷ 100]. For all countries in Table 2.6, without exception, the long-term decline in number of man-hours per capita is significant—ranging

from about 10 to about 40 per cent for the full period and from over 1 to 7.5 per cent per decade.

If we disregard the rather exceptional results for Italy, the general conclusion is that man-hours per capita declined in most countries between 1.1 and 4.5 per cent per decade. Two inferences immediately follow. First, the increase in national product per capita, observed in Table 2.5, could not have been due to greater input of man-hours per capita, at least as a direct cause—whatever the effects of reduction in hours on the efficiency per man-hour. Second, the rate of rise in product per man-hour was distinctly higher than in product per capita. (The former can be approximated by reference to column 6 of Table 2.6 and column 4 of Table 2.5.) If, in general, the decadal rates of growth in per capita product range from 15 to 30 per cent, those in product per man-hour would range from about 18 to almost 35 per cent.

The measurement of capital input is beset with much greater difficulties than that of input of man-hours. The underlying estimate of capital should include natural resources since their relative supply presumably affects product per capita and per man-hour; and even if we had continuous and comprehensive measures of aggregate capital for the long periods, we would need some basis for deriving *annual input*. Unlike labor, most capital is not perceptibly consumed in the process of production; and we need a riskless return rate that, when applied to capital stock, would yield the current contribution of capital in the process of production.

There are few continuous and comprehensive capital stock series in current prices and even fewer in constant prices. We assembled those available in the attempt to derive some notion of the trends in the ratio of capital to product. Having these trends, we can infer the general order of magnitude of the contribution of capital input to rise in product per capita.

Table 2.7 summarizes the data on trends in capital-

TABLE 2.7

Ratio of Capital to Product, Selected Countries, Long Periods

	Period (1)	Capital–product ratio: Initial date (2)	Terminal date (3)	% Change (4)
Great Britain, current prices, national income				
1. Total capital	1885–1927	8.2	4.8	−41
2. Reproducible	1865–1933	4.6	5.0	9
Belgium, current prices, national income				
3. Total capital	1846–1950	9.3	5.4	−42
Norway, 1938 prices, ndp				
4. Net fixed assets	1865–74 to 1947–56	4.0	3.2	−20
West Germany, 1950 prices, gnp				
5. Gross fixed assets	1913 to 1950–55	5.4	4.0	−26
United States, 1929 prices, gnp				
6. Total capital	1850–1950	3.5	2.7	−23
7. Reproducible	1850–1950	1.9	2.1	11
Australia, current prices, gnp				
8. Total capital	1903–1956	6.4	4.0	−37
Japan, 1928–32 prices, national income				
9. Total capital	1905–1935	7.2	5.3	−26
10. Reproducible	1905–1935	2.8	3.0	7

Sources: Lines 1 and 2: From Deane and Cole, *British Economic Growth*, Table 70, p. 271 and Table 71, p. 275.

Lines 3, 5, and 8: From Goldsmith and Saunders, eds., *Income and Wealth, Series VIII*, Table VI, pp. 30–31.

Line 4: From Bjerke, "Economic Growth of Norway," Table IV.3.

Lines 6 and 7: Capital is from Raymond W. Goldsmith, "The Growth of Reproducible Wealth of the United States of America from 1805 to 1950," in Simon Kuznets, ed., *Income and Wealth, Series II* (Cambridge, 1952), Table II, p. 310, and excludes consumers' durables and military. Product is from unpublished annual series for 1948–52 and 1877–81 underlying estimates in Kuznets, *Capital in the American Economy*, extrapolated back to 1850 by estimates of commodity product in Robert E. Gallman, "Commodity Output, 1839–1899," in William N. Parker, ed., *Trends in the American Economy in the Nineteenth Century*, Studies in Income and Wealth, *24* (National Bureau of Economic Research, 1960), Table 1 p. 16.

Lines 9 and 10: From Kazushi Ohkawa and others, *The Growth Rate of the Japanese Economy since 1878* (Tokyo, 1957), Table 5, p. 166, for the ratios of reproducible capital to national income in constant prices (series K_1/Y)—those for 1905–24 being extended by the change from 1924 to 1935 in the new estimates. The ratios in line 9 were derived by multiplying those in line 10 by the ratios of total wealth, including land and mines (from ibid., Table 1, p. 160) to reproducible wealth (from ibid., Table 2, p. 164), both in current prices.

product ratios. Total capital refers largely to material stocks, and it includes land and subsoil resources, construction, and equipment (with allowance for depreciation to avoid duplication), inventories, and net foreign assets. The table is limited to seven countries: for some the periods are much shorter than those for product in Table 2.5, and for some, capital is short of the total required. But, by combining these estimates with relevant long-term data on incremental capital–output ratios and on the post-World War II ratios of capital to product for the same countries, we can reach several plausible conclusions concerning trends in the capital–product ratios.[28]

Table 2.7 suggests that the ratio of *reproducible* capital to national product has risen in Great Britain, the United States, and Japan; and the inference for the last is strengthened by the rise in the incremental capital–product ratio (NDCF/NDP) from 1.6 in the late nineteenth and early twentieth centuries to 3.1 in the twentieth century. There was also a rise between periods covering roughly the second half of the nineteenth century and the first half of the twentieth century in the net domestic incremental capital–output ratios for Sweden (from 2.6 to 3.6), for Norway (from 4.0 to 5.1, the decline shown in Table 2.7 being limited to the twentieth century), for Denmark (from 2.4 to 2.8), and for Australia (from 2.9 to 5.0). While for many countries such comparisons conceal a rise in the incremental capital–product ratio in the early phases of the long periods and a decline in the later phases, and while incremental ratios are not a safe guide to the average ratios, the evidence does suggest that, by and large, the trends in the ratios of reproducible capital to product have been upward, though tempered by recent declines, often to particularly low levels in the post-World War II years.[29]

28. For the long-term ratios, see Kuznets, "Quantitative Aspects: VI"; for the post-World War II ratios, see Raymond W. Goldsmith and Christopher Saunders, eds., *Income and Wealth, Series VIII* (London, 1959).

29. The incremental capital–output ratios are from Kuznets, "Quantitative Aspects: VI," Table 5, pp. 17–18.

But the picture changes when we deal with *total* capital, including land and subsoil resources. In five countries for which we have data (Great Britain, Belgium, the United States, Australia, and Japan), the ratio of total capital to product declines—despite the rise in the ratio of reproducible capital to product (available for Great Britain, the United States, and Japan) and in the incremental capital–product ratio for Australia. Obviously, with the marked decline in the proportion of land and other natural resources in total material capital which accompanies modern economic growth and industrialization, such total capital–product ratios should decline over the long period for all developed countries. At any rate, for purposes of further discussion, we can assume, most conservatively, that the total capital–product ratios remained constant in the long run and, more realistically, that they declined, from a fifth to as much as four tenths.

Constancy of the total capital–product ratios implies that total capital per head increased at the same rate as per capita product. A decline in the total capital–product ratio of, say, a quarter, means that total capital per head changed by a percentage rate equal to $\{[(100 + 0.75\ R_1) : (100 + R_2)] - 1\} \times 100$—where R_1 is the percentage rate of growth for product and R_2 the percentage rate of growth for population. This can be compared with $\{[(100 + R_1) : (100 + R_2)] - 1\} \times 100$, the percentage rate of growth of per capita product. If we divide the first expression by the second, to derive the ratio of the rate of growth of capital per head to the rate of growth of product per head, we get $(0.75\ R_1 - R_2)/(R_1 - R_2)$. This ratio is the smaller, and hence the reduction in shifting from the rate of increase in per capita product to the rate of increase in capital per head is the greater, the greater the ratio of R_2 to R_1. If the rate of population growth is about a third of the rate of growth of product, as it is for the United Kingdom (1855–59 to 1957–59), Germany, Switzerland, Denmark, and Norway in Table 2.5, the ratio in question becomes $(0.75 - 0.33)/(0.67)$, or 0.63, indicating that the rate

of growth in capital per head is over a third lower than the rate of growth in product per capita. If the rate of population growth is about half the rate of growth of product, as it is for the United States and Canada, the ratio becomes $(0.75 - 0.50)/0.50$, or 0.5, and the rate of growth in capital per head is only half the rate of growth of product per capita. If the rate of population growth is as high as seven tenths of the rate of growth of product, as it is for Australia, the ratio becomes $(0.75 - 0.70)/0.30$, or 0.17, and the rate of growth in capital per head is less than a fifth of the rate of growth of product per head.[30] The important point to observe is that if population is constant, a decline in the total capital–product ratio means as great a proportional reduction in the rate of increase of capital per head, and an appreciably greater reduction in the rate of growth of capital per head even if the rate of growth of population is as low as one tenth of the rate of growth of total product.

Let us return now to the assumption of a constant total capital–product ratio and a rate of growth of capital per head as high as that of product per capita. What was the input represented by the former in the process that produced the latter? By relating property income or income from assets to the total capital that yields it, we can ascertain the relevant rate of input. Income from assets, excluding the part implicitly contained in the incomes of individual entrepreneurs (i.e. return on capital excluding entrepreneurial equity) averages about 20 per cent of total income in developed countries and only slightly less in the underdeveloped countries.[31] Returns on entrepreneurial

30. Incidentally, this may provide a clue for the low rate of growth in the per capita product of Australia. If the total capital–product ratio did decline significantly, the implication is a rather low rate of growth of material capital per head. Table 2.7 does show a decline in the total capital–product ratio for Australia from 6.4 in 1903 to 4.0 in 1956.

31. This and other estimates in the paragraph are from Kuznets, "Quantitative Aspects: IV," Table 1, pp. 10–11 and discussion on pp. 15–28. For further discussion see Chap. 4 below.

equity differ widely depending upon the assumptions made in the allocation of entrepreneurial income between labor and capital, but it is realistic to assume that in the developed countries the rate is somewhat lower than for non-entrepreneurial capital (it would be very much lower relatively in the underdeveloped countries). Since entrepreneurial equity capital is at most 25 per cent of total capital in developed countries, a fair estimate of total income from assets—the contribution of capital input to total product—is about a quarter of the latter.

If we apply this ratio and assume a constant total capital–product ratio, the implied increase in total capital per head directly accounts for no more than a quarter of the total rise in product per head—and this is probably an overestimate. If we assume a decline in the total capital–product ratio of a quarter, the implied contribution of the growth in capital per head to the growth in product per head, would vary from as low as a twentieth (when the rate of population growth is 0.7 of the rate of growth of total product) to as high as a seventh (when the rate of population growth is one third of the rate of growth of total product).

The combined inputs of man-hours and capital would account for an even smaller fraction of the growth in product per capita. Since man-hours per capita are found to decline 2 to 3 per cent per decade and their weight in total product is 0.75 (since income from assets is assumed to account for 0.25), the direct contribution would be a *reduction* in the rate of growth of per capita product of 1.5 to 2.25 percentage points. If the rate of growth of per capita product is, say, 15 per cent per decade, the reduction amounts to a tenth of the rate or more. Since the increase in capital per head contributes from a twentieth to a seventh, the combined contributions of man-hours and capital must be proportionately small indeed. While various modifications can be introduced into this statistical allocation, and while the results would clearly vary among individual countries, the inescapable conclu-

sion is that the direct contribution of man-hours and capital accumulation would hardly account for more than a tenth of the rate of growth in per capita product—and probably less. The large remainder must be assigned to an increase in efficiency in the productive resources—a rise in output per unit of input, due either to the improved quality of the resources, or to the effects of changing arrangements, or to the impact of technological change, or to all three.

This conclusion agrees with the findings of studies for the United States and Norway which attempt to allocate growth of total product between inputs of labor and capital, on the one hand, and a residual ascribable to technical change and rise in efficiency on the other;[82] for the limited share attributed to the former would be appreciably lower when resource inputs are reduced to a per capita basis. In this connection a brief reference to the analysis for the United States by Denison is in order. Setting aside the depressing effects of reduction in hours almost completely offset in Denison's analysis by resulting improvement in productivity per hour, we find that of the total growth in real national income per person employed, 1.44 per cent per year for 1909–57 (or 15.4 per cent per decade), capital and land contributed only 0.18, or about 12 per cent; while the increased education of the labor force and the increased output per unit of input, due largely to economies of scale and spread of technical knowledge, contributed together

82. For the United States see Moses Abramovitz, "Resource and Output Trends in the United States since 1870," National Bureau of Economic Research, *Occasional Paper 52* (New York, 1956); Robert M. Solow, "Technical Change and the Aggregate Production Function," *Review of Economics and Statistics, 39* (August 1957); and particularly John W. Kendrick, *Productivity Trends in the United States* (Princeton, 1961) and Edward F. Denison, "The Sources of Economic Growth in the United States and the Alternatives Before Us," Committee for Economic Development, *Supplementary Paper No. 13* (New York, 1962). For Norway see Odd Aukrust and Juul Bjerke, "Real Capital and Economic Growth in Norway, 1900–56," in Goldsmith and Saunders, eds., *Income and Wealth, Series VIII.*

1.25 (0.58 and 0.67, respectively), or over 85 per cent.[33] Since education and economies of scale are results of additions to and spread of the stock of useful knowledge, the dominant role of the latter—compared with the increase in input of resources—in the rise in product per capita is apparent.

The conclusion that increased input of man-hours and capital, as such, plays a minor role in the rise in product per capita reflects some key features of modern economic growth. Such growth clearly was not attained by greater exertion, in the way of more working hours per capita, let alone per worker. It was associated with capital accumulation, but the ratio of capital to output was kept down by capital-saving innovations, investment in human training, and other arrangements that permitted greater output with a diminished relative supply of natural resources and even of reproducible capital; and these enormous economies in the use of capital also limited the return that had to be paid for it and hence the rate of its direct contribution to current production.[34]

Indeed, it is unlikely that much of the high rate of rise in per capita product associated with modern economic growth could have been secured by an increase in quantity of inputs per capita—if only because of the constraints on supplies of labor and material capital. If the rate of growth in per capita product was 15 per cent per decade, which meant quadrupling in a century (see Table 2.5), neither

33. The figures are from Denison, "Sources of Economic Growth," Table 20, p. 149 and Table 32, p. 266. Since population growth from 1909 to 1957 was 1.33 per cent per year compared with 1.43 per cent for growth in persons employed, the increase per person employed would not be much different from the increase per capita.

34. In reaching this conclusion we disregarded quality changes in labor and capital as well as possible indirect effects of increase in size (briefly noted below). Quantity of resource inputs must not be confused with quality, since quality is largely a reflection of the additional knowledge. We wanted to stress the point that one distinctive feature of modern economic growth is the association of rise of per capita product with changes in the *quality* of resource inputs and of the arrangements for their use.

the share of labor force in total population—limited by age and sex constraints—nor hours per worker—limited by considerations of efficiency and preference for increased leisure as per capita real income rises—could have risen enough to contribute much in the *long run*, disregarding short periods of extra effort in emergency or revolutionary situations. With the ratio of labor force to population rising in the long run less than 2 per cent per decade (see Table 2.6), the maximum contribution of increased man-hours per capita could be reasonably set at about 2 per cent per decade (implying a rise in labor supply per capita of close to 3 per cent, weighted by 0.75, the share of labor's contribution in total product). The growth of reproducible capital could have been more rapid than that suggested in Table 2.7, but this would have required a much greater rise in the national capital formation or savings proportion and a corresponding decline in the proportion of product left for consumption; and such a decline is not compatible with increased efficiency of labor and the higher consumption requirements of modern life. But even if the proportional contribution of material capital noted in the illustrations above (between a twentieth and a seventh) were doubled (which would mean more than doubling the rate of growth of capital stock per head) and added to the maximum contribution of labor supply suggested above, labor and capital input would still account for less than half of the growth rate of 15 per cent per decade in per capita product, leaving more than half to be accounted for by rise in efficiency—improvements of quality of labor and capital associated with increased knowledge and better utilization. The main point here is that increasing inputs of labor and material capital per head of total population are subject to constraints arising from other aspects of life (e.g. family, in the case of labor supply) and from considerations of incentives and efficiency of the human factor; that increases in inputs per head at all approximating the high rates of growth of per capita product are extremely unlikely; and that, consequently, a major share of the growth rate *must* be due to

increases in output per unit of input—at least when inputs are measured as simple man-hours and material capital.[35]

Yet a major qualification of the conclusion must be noted, and some unguarded inferences warned against. Although the absolute growth of the labor force, man-hours, and capital did not make a large *direct* contribution to the growth of product per capita, the changes in the volume of resource input may well have had indirect effects on efficiency and hence on the growth in per capita product. The earlier discussion of the economic implications of modern patterns of population growth clearly suggested that in the process of accelerated increase of population, the changes in the factors determining demographic trends and the structural changes in population may have had marked effects on the adjustment of human resources to economic opportunities and hence on per capita product. The absolute expansion of the labor force and of the capital stock could have had similar effects. Economies of scale, requiring as they do additions to technical knowledge, were also contingent upon increases in the absolute volumes of the resource inputs—and this effect is not measured in the statistical allocation presented above. Reduction in hours, which tended to keep

35. Under some conditions, particularly a forced draft of resources, the contribution of inputs to rise in per capita product can be substantial; and the residual fraction ascribable to efficiency correspondingly lower. Thus, for the U.S.S.R. for 1928–58, of the total rise in net national product per capita (in 1937 factor prices), the rise in *inputs* per capita contributed as much as 55 per cent; the residual share of the rise in efficiency is thus 45 per cent. But even here, the result is greatly affected by the unusual initial period 1928–37; and the share of the rise in efficiency was much greater for 1950–58. For the United States, by a similar computation, for 1869/78 to 1899/1908 the share of the higher inputs per capita in the rise in product per capita is only 29 per cent, leaving 71 per cent ascribable to the rise in efficiency; and for 1929–57, inputs per capita in fact declined (over 9 per cent), so that all of the rise in product per capita can be attributed to the rise in efficiency. The income and input data are from Abram Bergson, "National Income," in Abram Bergson and Simon Kuznets, eds., *Economic Trends in The Soviet Union* (Cambridge, Mass., 1963), Table I-1, pp. 4–5; population data are from the standard sources.

down the number of man-hours per capita, most likely affected the efficiency of labor per hour for the shorter working day and year. In general, the direct statistical allocation above measures only the first stage of obvious effects and disregards what may be more important secondary effects and others further removed. We therefore emphasize that the low proportions of the growth in per capita product allocated to increased input of man-hours and capital *do not* mean that the absence of such an increase in input would have resulted in only a small proportionate loss in the secular rise in per capita product. The lines of relationship between the absolute increases in population, labor force, and capital, on the one hand, and growth in per capita product, on the other, are numerous and far-reaching; and they are interwoven with the secular trends in other necessary conditions of economic growth—technological changes, changes in institutional arrangements, changes in the patterns of human responses to economic incentives and difficulties—in ways that make it difficult, if not impossible, to establish the correct partial effects of increases in inputs of man-hours and capital on growth of per capita product.

The aim of the discussion in this last section is not to show the relative unimportance of greater input of resources, but rather to emphasize that the effects of such inputs may have been more of quality than of quantity, indirect rather than direct. Analysis must therefore concentrate on the sources of the rise in efficiency—of the rise in the ratio of output to input of man-hours and capital.

One way to observe the mechanism by which such a rise in efficiency in modern economic growth was effected is to study the structural changes. While economic analysis may never reach down to the basic levels of production and spread of new knowledge and innovations, we may be able, through examining structural changes, to infer some of the ways by which efficiency was improved; and it is to the changes that occurred in industrial structure that we turn in the next chapter.