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CHAPTER 1: The Decline of Fertility in Europe since the Eighteenth Century As a Chapter in Demographic History

Ansley J. Coale

From the appearance of Homo sapiens until the present, the average rate of increase of the human population must have been very close to zero, simply because man's origin was so many years ago. If the present total is accepted as four and a half billion persons, and if the origin is taken as 100,000 years in the past, the average rate of increase has been an addition each year of a mere two persons per 100,000 population. Within each extended interval until quite recently in this long span, the average annual rate of increase was also very low. In the 90,000 years before the development of settled agriculture, the average annual rate was only about 1.6 per 100,000; from that point until some 200 years ago, the average rate was still only about 4.6 per 10,000. Since 1750, average annual increase has been much greater—about 7.4 per thousand per year. The world's population has been multiplied by about 5.5 in only 230 years. In these 230 years, growth accelerated remarkably, from an annual rate of increase of about 4 per thousand at the beginning of the nineteenth century to 7 per thousand early in the twentieth, to nearly 20 per thousand in the 1960s. In the last 15 years, the rate of increase has turned down, as it must sooner or later. Sustained growth at the rate of increase reached a few years ago is a physical impossibility, because the total population would in a surprisingly short time completely cover the surface of the earth, or even fill its volume. At the peak of two percent a year, the population would be multiplied by a thousand in 350 years, by a million in 700 years, and by a billion in 1,050 years. Since such multiplication is simply not feasible, we may conclude that from a very long perspective—looking back from a thousand or more years in the future—the rapid growth that began in the eighteenth century will be seen as a brief episode in human history, during which a much enlarged population was generated. This explosion in numbers, to a total that will reach 7 to 15 billion even if growth ceases within another 50 to 150 years, is surely a momentous as well as a unique episode in the history of our population.

This outburst of rapid increase in the world's population started at the time that the industrial revolution was beginning, as newly developed modern science and more rapid advances in technology contributed to a continuous expansion of transportation and trade, and to increased agricultural productivity, as well as to the development of mechanized manufacturing. The peoples of Europe (and of European descent in America and Oceania) grew more rapidly in number than the rest of the world's population during the early phases of accelerated growth; more recently European populations were the first to return to moderate rates of increase. The decline in fertility in Europe, which accounted for the slowdown in the rate of increase of the European population, was the subject of the conference of which this book is the *Proceedings.*

Fertility and Mortality in Pre-industrial Populations

The very low rate of increase of world population over each long interval of time before the eighteenth century implies an almost perfect balance between the birth rate and the death rate. For example, the average rate of increase of 0.46 per thousand from about 10,000 years ago until the eighteenth century implies an average death rate of 39.54 per thousand, on the hypothetical assumption that the average birth rate was 40.00 per thousand. Within each continuously occupied territory, if it did not gain or lose consequentially from migration, there must also have been near equality of average birth and death rates.[1] A difference of only five per thousand between the two rates would lead to multiplication (or division) by a factor of ten in five centuries, and there are few documented instances of such large increases in the absence of immigration before the 18th century.

Figure 1.1 shows combinations of fertility and mortality that would lead in the long run to rates of increase of minus one percent, zero, one percent, two percent, three percent, and three and a half percent.[2] Fertility is expressed as the total fertility rate (TFR), the average number of children

[1] "Average" birth and death rates, because the actual course of growth did not ordinarily approximate the same rate year after year. Irregular changes, including periods of substantial growth interrupted by setbacks, must have been the usual rule. In other words, the fertility and mortality that prevailed much of the time may have produced positive growth, which was offset by intermittent periods of loss.

[2] The equilibrium rate of increase implied by given rates of mortality and fertility is $r = \log_e(\text{NRR})/T$, where NRR is the net reproduction rate, and T is the mean length of generation. NRR, in turn, is approximately equal to $(\text{TFR}/2.05) \cdot p(\bar{m})$, where $p(\bar{m})$ is the proportion of women surviving to the mean age of childbearing. In Figure 1.1, e_0^0 is taken from a "West" female life table (Coale and Demeny, 1968) with an appropriate $p(\bar{m})$; $\bar{m} = 29$.

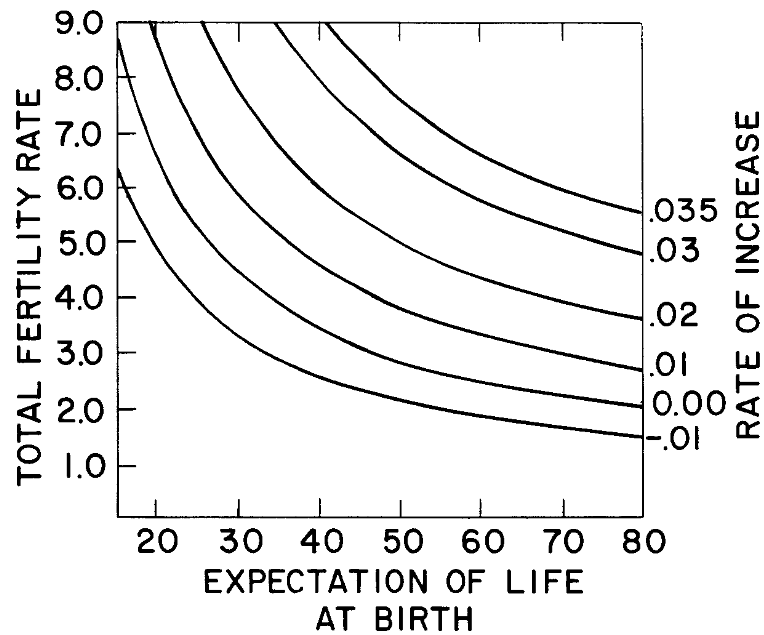

Figure 1.1. Combinations of total fertility rate and expectation of life at birth that produce long-run growth from minus one percent to three and a half percent.

born per woman reaching age 50 subject to given rates of childbearing at each age. Mortality is expressed by the average duration of life, or the expectation of life at birth e_0^0 (the length of life implied by the death rates at each age). During most of history, the world's population must have had average values of TFR and e_0^0 that in combination lay within a narrow band around the line representing combinations that lead to a growth rate of zero.

How did pre-industrial populations achieve a near-balance in birth and death rates? Logically, it seems that some form of homeostatic mechanism must be postulated to cause death rates to rise or birth rates to fall when there was an extended period of growth leading to a greatly enlarged population in a given area, and that caused death rates to fall or birth rates to rise after an extensive depletion of numbers.

It is easy to picture how death rates might increase as a result of a large increase in population. If technology is unchanging—if there is a fixed inventory of known methods of acquiring or producing useful goods, especially food and other essentials—and if the land that is accessible is limited by a combination of geography, culture, and feasible mobility, overcrowding would lower the average duration of life. After a point, a larger population means more contagion, more contamination, and less adequate nutrition.[3] Increases in mortality of this sort were what Malthus called "positive checks" to population growth. The operation of these sorts of positive checks (homeostasis through mortality that is in some degree dependent on population size within a given area) brings death rates in line with birth rates, whatever the level of fertility, provided fertility is sufficient to offset at least the minimum death rate achievable in the given cultural and technological environment. In terms of the total fertility rate and expectation of life at birth shown in Figure 1.1, if it is assumed that an average e_0^0 of 35 years is achievable, maintenance of a TFR of 4.0 would in the long run bring the average duration of life a little below 35 years, a TFR of 5.0 would lower e_0^0 to 26, and a TFR of 6.5 would in the long run drive e_0^0 down to 20 years.

Of course fertility must be high enough so that the population does not shrink even when mortality is at the lowest average level attainable. If the greatest average duration of life consistent with the achievable regularity of food supply, the unavoidable incidence of endemic disease, and the frequency and severity of epidemics is 25 years, any total fertility rate less than about 5.25 would lead to a decline in numbers and ultimate extinction.

Recognition of the necessity to maintain fertility at a level sufficient to offset mortality prompted Notestein to write:

> We may take it for granted that all populations surviving to the modern period in the face of inevitably high mortality had both the physiological capacity and the social organization necessary to produce high birth rates.

[3] Deliberately induced mortality, usually although not always infant mortality and most frequently mortality of female infants, is described by anthropologists as occurring in many populations—in Asia, among American Indians, and in the Pacific Islands, for example. The extraordinarily high mortality rates among infants in foundling homes in Europe in the eighteenth and early nineteenth centuries could also be classified, not unfairly, as a form of infanticide. Deliberate mortality can presumably have a homeostatic effect on the increase in population.

> Peasant societies in Europe, and almost universally throughout the world, are organized in ways that bring strong pressures on their members to reproduce . . . .
>
> These arrangements, which stood the test of experience throughout centuries of high mortality, are strongly supported by popular beliefs, formalized in religious doctrine, and enforced by community sanctions. (Notestein, 1953)

An unspecified component of Notestein's argument is this: How high must fertility be to offset inevitably high mortality? The general determination of how high fertility has to be is illustrated in Figure 1.1. The required total fertility rate can be found on the curve showing combinations of TFR and e_0^0 that lead to a long-run growth rate of zero, if the highest average e_0^0 achievable for a given entire population is known. In fact, the expectation of life at birth is known for few pre-industrial populations.

Lacking anything like full information, we shall consider a few examples of pre-industrial fertility and mortality in long-established societies. Figure 1.2 shows combinations of e_0^0 and TFR calculated or estimated for several European populations in the eighteenth century, for rural China about 1930, and for India in 1901 to 1911. Note that the long-run rates of increase implied for the European populations and for India are moderate positive values, and for China close to zero.

The most surprising feature of Figure 1.2 is the moderate level of fertility—TFR from about 4.1 to 6.2—in these pre-industrial populations.

The high birth rates that, according to Notestein, were an inevitable feature of pre-industrial societies were not nearly as high as can be imagined by picturing a situation in which separate high fertility characteristics reliably recorded in different populations are combined in one population. The highest reliably recorded rates of childbearing by married women are found among twentieth-century Hutterites (an Anabaptist sect settled in the north-central part of the United States, adhering to a religious prohibition of contraception or abortion), and the French Canadian population of the seventeenth century. Age of marriage was not very early in these two populations. Early marriage, and high proportions of people currently married at potentially fertile ages, *are* found, on the other hand, in many Asian and African populations. If the high marital fertility of the Hutterites were combined with the high proportions married of rural China, the total fertility rate would be over 10. No population has ever

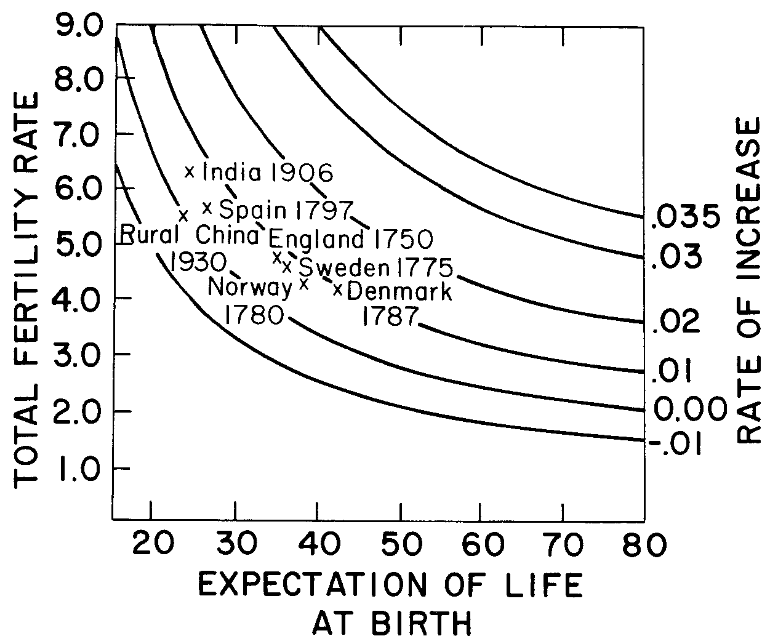

Figure 1.2. Combinations of total fertility rate and expectation of life at birth in selected pre-industrial populations—European populations in the eighteenth century, India in 1906, and rural China in 1930.

been observed to have a total fertility rate close to 10. The level of fertility actually achieved by the pre-industrial populations in Figure 1.2 is only 40 to 60 percent of what might be possible.

Although very high fertility can be imagined and could in principle be achieved, it would not be advantageous to the welfare or even to the survival of pre-industrial populations. Facing the constraints of limited technology and territory, a population with a total fertility rate of 8 to 10 would increase at annual rates of more than one percent, if its e_0^0 were over 20 years; in no more than a few centuries, overcrowding would drive its growth rate back to zero as e_0^0 fell to 13–17 years, at which point only 20 to 25 percent of women would survive to the mean age of childbearing. The long-run combination of very high fertility and very high mortality is not a combination that best enables a society to cope with adversity or rival groups. A population would have more resilience and vitality if its fertility and mortality were only moderately high. Optimal fertility in pre-industrial populations would be no higher than is consistent with zero growth at the greatest average duration of life that can be achieved in the given culture and environment. Maintenance of the lowest achievable mortality is easier if fertility responds in a homeostatic fashion to increases or decreases in the population—that is, if fertility falls when the population overfills its habitat, and rises when the population is decimated, but maintains a modest average level.

The statement that traditional societies developed customs that promoted high fertility, or faced extinction, should therefore be amended to say that traditional societies developed customs that kept fertility at *moderate* levels, avoiding both fertility so low that negative growth would make the population shrink to zero, or so high that positive growth would lead to an overcrowded habitat, and hence to higher mortality, and greater vulnerability to catastrophe or rival groups (Wrigley, 1978a).

The advantages of moderate fertility in a different context with some analogous features are known to biologists. The reproductive strategy that confers genetic advantages on animal species sometimes requires moderate rather than very high fertility. Evolutionary theorists postulate two polar strategies that are optimal for contrasting categories of animal life. Species of small body size, short life span, and short intergenerational intervals who have a limited area of foraging and a highly variable habitat survive successfully through a capacity for very rapid multiplication when their habitat is sparsely populated; species of large body size, long life span, and long intergenerational intervals who have an extensive area of foraging and a stable habitat persist successfully with limited reproduction that maintains a population of stable size, permits adequate care for a modest number of young during their long period of maturation, and avoids surpassing the capacity of the niche. The two strategies are known as *r selection* (bacteria, insects, some fish) and *K selection* (large mammals and some birds, of which the most notable is the wandering albatross, which matures only after 9 to 11 years, and lays a single egg every other year) (May and Rubenstein, forthcoming). The genetically governed reproductive strategy that is advantageous for large, slowly maturing organisms in a stable habitat has as its analog nongenetically governed reproductive strategies of human societies. In both instances, a moderate rate of reproduction rather than a very rapid rate is advantageous. Moderate reproduction is attained among larger mammals and birds by various genetically programmed restrictions on fertility, and in human populations by various social customs or practices (Dupâquier, 1972).

How Moderate Fertility Was Achieved in Pre-industrial Populations

There are two categories of constraint that kept pre-industrial fertility at moderate rather than at very high levels. One strategy consists of customs of entry into and exit from marriage that shield a large fraction of potentially fertile women from exposure to the risk of bearing children. In most pre-industrial populations, women were married within a short interval after menarche, having a mean age at first marriage of 16 to 18 years. Almost all who survived to age 25 or 30 had experienced marriage. In such populations, men may marry rather early (as in rural China in 1930, where the average age at first marriage for males was 21.3 years, compared to 17.5 for females), or rather late (as in the Uzbek Republic in the Soviet Union in 1926, where the average age at first marriage for males was 26.4, compared to 17.8 for females). Pre-industrial Europe, especially Western Europe, was exceptional in that not only males but also females married late, with a mean age of entry into first marriage of 23 to 28 years for females. The difference in age at marriage of men and women was not large; under adverse conditions marriage for both might be postponed. Moreover, again in contrast to Asian or African populations, a large fraction (10 percent or more) of women in Western Europe were still unmarried at age 50. The effect of this unusual pattern of nuptiality was to reduce fertility to less than 50 percent of its potential level if all women from 15 to 50 were currently married.[4] In contrast, the loss of potential fertility when some women between 15 and 50 years of age are not currently married is only 10 to 15 percent in many Asian and African pre-industrial populations.

Other forms of constraint that kept pre-industrial fertility moderate were various modes of behavior that limited the fertility of married couples. In almost all instances where relevant evidence exists, including (in particular) European populations, the limitation of marital fertility in pre-industrial populations is found to be nonparity-specific.

[4] Extensive marital dissolution and limitations on remarriage can also restrict exposure to childbearing. In many Western populations, divorce is quite frequent, but so is remarriage, particularly of younger women. In India early in this century, child marriage (mean age at first marriage was about 11 years), high mortality, and a tabu on remarriage of widows led to high proportions of women widowed, even at early ages. In 1901, the proportion widowed was 4.3 percent at ages 15–19, rising to 46.3 percent at 45–49. The overall reduction in fertility (compared to immediate and universal remarriage) was about 12 percent.

In this discussion, cohabitation outside marriage has been omitted for most pre-industrial populations. The argument could be readily modified to include other forms of unions.

Parity-specific and Nonparity-specific Limitation of Marital Fertility

At this point a digression is needed to describe the difference between parity-specific and nonparity-specific limitation of marital fertility, a distinction introduced by Louis Henry. Parity-specific limitation means that couples modify their behavior to avoid having more children after a certain number—the maximum desired—has been born (Henry, 1961). Parity-specific limitation typically involves contraception (folk methods, such as withdrawal, or more modern techniques, such as condoms, diaphragms, IUDs, or pills), or induced abortion. Nonparity-specific limitation includes any circumstances or forms of behavior that reduce the chance of conception or increase the interval between births—circumstances or behavior that are not modified according to the number of births that has already been experienced, but occur after the first birth as well as after the fifth or sixth. Henry proposed that parity-specific limitation be called *controlled fertility*, and that fertility affected only by behavior that is not parity-specific be called *natural fertility*. To avoid the disputes that occasionally center on the terms "natural" and "controlled," Henry's distinction will here be expressed in terms of parity-specific and nonparity-specific limitation of childbearing by married couples.

Fertility not affected by parity-related limitation varies a great deal in level because of health-related factors, such as reduced sexual activity in populations subject to chronic fevers, high rates of miscarriage for anemic women, and sterility caused by venereal disease or tuberculosis. It is also reduced by periodic separation of spouses associated with seasonal migration, or by periods spent away from home by fishermen, herdsmen, or hunters (F. van de Walle, 1975; Menken, 1979).

The most important source of differences in fertility that is not limited by parity-related measures is variation in breast-feeding. When a mother nurses an infant, postpartum resumption of menstruation and ovulation is delayed, and so is the next conception. The duration of amenorrhea varies from three or four months when the baby is not breast-fed to eighteen months in Bangladesh and Indonesia, where breast-feeding is prolonged. Very long interbirth intervals (almost four years on the average) are recorded for the !Kung tribe in Southwest Africa. A recent study provides an explanation in terms of the nursing practices in this population. Intensive observation of a number of !Kung mothers shows that nursing bouts occur all day at intervals separated by an average of only about fifteen minutes, and that the children sleep next to the mother, and have access to the breast at night. Nursing continues until the child is more than three years old. Blood samples of women with these breastfeeding routines show reduced levels of serum estriol and progesterone, hormonal changes that inhibit the return of ovulation (Konner and Worthman, 1980).

Another source of variation is tabus on sexual intercourse. A tabu found in many societies rules out sexual relations for a nursing mother. The prohibition is often reinforced by the belief that sperm poison the mother's milk—a belief reported in Africa, Asia, and Europe. The period of prescribed postpartum abstinence sometimes extends beyond the period of nursing, particularly in West Africa. It may seem odd that deliberate abstinence from intercourse is not parity-related, particularly since the couples resorting to abstinence in West Africa testify that their purpose is to postpone the next birth to protect the health of the child recently born, and of the mother. However, abstinence is practiced after the first birth as well as after the sixth—it is not in fact a parity-related measure. John Caldwell reported at a conference on natural fertility the results of a West African survey showing that couples of high parity with more of their children still living actually abstain for a somewhat *shorter* interval than those at the same parity with fewer living children (Caldwell, 1979). In contrast to parity-related control measures, West African abstinence is apparently intended to *increase* the number of surviving children. It is very different from parity-related limitation among couples who manage to avoid further childbearing after a certain number have been born.

Indications That Marital Fertility Is or Is Not Subject to Parity-specific Limitation

I will argue in the course of this essay that the decline in fertility that has been almost universal in Europe was a change from (a) moderate fertility, kept from a very high level by late marriage and permanent celibacy, and by nonparity-specific limitation of marital ferility, to (b) low fertility brought about primarily by the parity-specific practice of contraception or abortion. (Newly instituted parity-specific limitation of marital fertility is also a frequent, although in the early stages not a universal, feature of fertility reduction in those less developed countries in which a fall in fertility has occurred. In some of these countries, a rise in age at marriage for women from a mean age of 18 or less to a mean age in the twenties has also been very important in contributing to the decline and frequently precedes the widespread initiation of parity-related control.)

An essential part of the evidence sustaining the argument that there was a transition from nonparity-related to parity-related limitation of marital fertility consists of empirical indications that pre-industrial marital fertility was not limited by parity-specific behavior. This section—a further digression on parity-specific limitation—is a description of such indicators.

Direct indication of parity-specific limitation of marital fertility is obtained today in sample surveys in which women are asked to provide detailed histories of their own fertility, and to supply information about the practice of contraception or abortion following each of the births they have had. Further, they are asked questions about the number of children they want and whether births that had already occurred were wanted at the time. Direct testimony of this sort cannot be obtained about populations in the past. The presence or absence of parity-related limitation must be inferred from what has been recorded about these populations.

A very useful indirect indication of parity-related limitation of marital fertility can be derived from records of the age of women at the birth of their last child. Statistics from many populations show that in the absence of parity-related limitation, the mean value of this age is within about one year of 40. It may be slightly less because of health-related factors or nonparity-specific practices such as terminal abstinence from sexual intercourse after a married son or daughter takes up life in the household. But very low age at last birth (an average below 36, say), or large reductions in the mean age, or a lower mean age at the last birth for women married young than for those first married at a later age are good indicators of the prevalence of parity-related limitation. However, data on the age of women when they gave their last birth can be found only in detailed individual records such as have been constructed from genealogies, or from the reconstruction of life histories from the data on births, deaths, and marriages in parish registers.

A more accessible form of evidence of the existence of parity-related limitation is the age pattern of the fertility of currently married women. The age pattern of marital fertility is similar in different populations not subject to parity-related limitation. Such fertility is at its highest, almost on a plateau, from age 20 to 30, after which it declines with increasing rapidity until zero fertility is reached before age 50. With fertility at ages 20–24 set at 100, the typical sequence of rates in the successive five-year intervals is 94, 86, 70, 36, and 5. On the other hand, the presence of the widespread practice of parity-related limitation causes a different age pattern of marital fertility, a pattern of much steeper decline as age increases. This increased steepness of decline means that as age advances, marital fertility rates with parity-related control form an ever smaller ratio to the marital fertility rates of a population *not* affected by parity-related limitation.

In his original article on parity-related and nonparity-related limitation of marital fertility, Henry presented a number of schedules of marital fertility not affected by parity-related limitation (which he called natural fertility). These schedules were later the basis of model schedules of marital fertility in which the effect of parity-related limitation ranged from no effect to a very great steepening of the decline of marital fertility with age (Coale, 1971; Coale and Trussell, 1974, 1978). The model schedules of marital fertility had the following mathematical expression:

$$r(a) = Mn(a)\exp(m \cdot v(a)),$$

where $r(a)$ is marital fertility at age a, $n(a)$ is a typical schedule of marital fertility in the absence of parity-related limitation, M is ratio $r(a)/n(a)$ at ages 20–24, and $v(a)$ is a steadily decreasing function from ages 20–24 and 45–49. The value of m is a measure of the extent to which parity-related limitation affects the sequence of age-specific marital fertility rates.[5] The values of m differ by less than 0.2 from zero in the marital fertility schedules assembled by Henry in his article on natural fertility. In Norway, Sweden, and Taiwan, the value of m before marital fertility began its modern decline (in the 1880s or 1890s in Sweden and Norway; in the 1950s in Taiwan) was close to zero, and then rose monotonically to over 1.0 as marital fertility fell (Knodel, 1977b; and Knodel, 1982). If the fitted value of m is close to zero, indicating that the decline of marital fertility with age is no steeper than in a typical schedule not affected by parity-related limitation, the presumption that such limitation is virtually absent is a strong one, even though the level of marital fertility may be low because of nonparity-related limitation.

[5] For computation of m, the schedule $n(a)$ is taken as the average of the ten schedules least affected by poor-quality data in Henry's original article, and $v(a)$ is taken as an average of values calculated for forty-eight schedules of parity-related control, with m in each set as 1.0 for the purpose of calculation. If m is 1.00, the ratio of limited marital fertility to fertility not affected by parity-related limitation at 20–24 to 45–49 is 1.0, 0.757, 0.513, 0.353, 0.243, 0.188. The value of m is estimated by noting that $\log(r(a)/n(a)) = \log M + mv(a)$, and fitting a straight line to $\log(r(a)/n(a))$; its slope is m. The values of $n(a)$ and $v(a)$ for five-year age intervals beginning at age 20 are as indicated in the accompanying table.

	20–24	25–29	30–34	35–39	40–44	45–49
$n(a)$	0.460	0.431	0.396	0.321	0.167	0.024
$v(a)$	0.000	−0.279	−0.667	−1.042	−1.414	−1.670

Evidence of the Absence of Parity-Related Limitation of Fertility in Pre-Industrial Europe

There are not many national data on age-specific marital fertility rates in Europe before the sustained modern reduction in fertility began. In Norway, data on the number of legitimate births by age of mother and on the number of women classified by age and marital status are available for the years since the late 1870s, and in Sweden since 1870. The value of m in Norway was −0.01 in 1878 to 1880; rose to 0.18 in 1910, 0.30 in 1920, 0.56 in 1930, 0.61 in 1946, 0.79 in 1950, 0.92 in 1955, and 1.08 in 1960. Similarly, in Sweden there was a monotonic increase from an m of 0.078 in 1871–1880 to an m of 1.22 in 1951–1960 (Knodel, 1982). In both instances the rise in m begins at the end of a plateau of essentially constant overall marital fertility, and increasing m correlates closely with decreases in overall marital fertility. These two Scandinavian populations conform well to a general picture of fertility moderated by nonparity-related limitation—primarily late marriage and frequent avoidance of marriage even at the age of menopause—until a certain moment when parity-related limitation, almost certainly some form of contraception, began to have effect, and then had increasing effect until marital fertility was reduced by at least 50 percent.

At a level lower than national coverage, a number of age-specific marital fertility schedules have been calculated by reconstitution of parish registers, or by analyzing genealogies. Knodel has assembled marital fertility schedules for fourteen German villages beginning in 1750 (Knodel, 1982). For the three 25-year periods from 1750 to 1825, the age structure of marital fertility shows no evidence of a consequential degree of parity-related limitation, since the value of m differs from zero by less than 0.1. In his doctoral dissertation at Cambridge University, Chris Wilson (1982) has analyzed marital fertility rates of sixteen English parishes, using reconstitution of demographic data covering fifty years at a time, from 1550 to 1850. In each half century, the value of m differs from zero by less than 0.1. The slight positive values of m for these parishes are the result of high levels of marital fertility at ages 20–24 and 25–29; above age 30 the decline has a steepness virtually identical with the model schedule of nonparitylimited fertility rates. In these parishes, many of the women (in aggregate 25 percent) were pregnant at the time of marriage. Since women pregnant at marriage necessarily have a marital fertility rate of 1.0 during the first year of marriage, premarital pregnancy increases marital fertility rates in those age intervals containing a large fraction of newlyweds. The slight positive values of m for the English parishes are reduced even closer to zero when adjustment is made for this effect.[6]

The greatest degree of conformity to a model schedule of marital fertility not affected by parity-related limitation is found in a set of marital fertility schedules presented at an IUSSP seminar by Jacques Dupâquier (1979). These schedules were calculated by various authors who reconstituted the registers of twenty-two French parishes in the seventeenth and eighteenth centuries: when the data from these parishes are combined, the age-specific marital fertility rates are virtually the same as in the model schedule with no parity-related limitation; the ratio of one set of rates to the other from ages 20–24 to ages 40–44 falls in the very narrow range of 0.96 to 1.00, and the calculated value of m is less than 0.01.

Exceptional Instances of Pre-Industrial Parity-Related Limitation of Fertility

Parity-related limitation of marital fertility in Europe, while rare, was not completely absent before the sustained modern reduction in fertility began. A survey of early instances of parity-related limitation is found in Massimo Livi-Bacci's contribution to this volume (Chapter 3). His examples occur in special segments of the population in a number of European countries—the nobility in France, England, and Italy, the bourgeoisie of Geneva, and the Jewish population in some Italian cities. These groups were not of sufficient numerical importance to affect the national age-specific fertility rates, although they may be important in understanding factors that later led to the adoption of contraception or abortion in the national populations.

[6] Wilson also shows that among women in these sixteen parishes who bore a child after age 30 (a stipulation that minimizes the effect of secondary sterility), differences in age at birth of last child for women married at different ages were trivial. He applies other tests that show conclusively that parity-related control of fertility was not consequential. By estimating the duration of nursing-induced postpartum infertility (from the difference in inter-birth intervals following infant deaths at various ages), he accounts for the modest level (about two-thirds of the Hutterites) of marital fertility in these parishes.

Two additional instances of early parity-related restriction of fertility occurred in populations that were not elite (like the nobility and the Geneva bourgeoisie) nor urbanized and restricted to special occupations (like the Jewish population in Italian cities). The most conspicuous example of the early adoption of parity-related control is in the rural population of much of France in the late eighteenth and early nineteenth centuries. Evidence for such control takes the form of very low and steadily declining marital fertility, as measured by the index I_g (see Chapter 2 by Coale and Treadway for definition of I_g). By 1830 marital fertility in many *départements* was as little as 35 to 50 percent of the Hutterite level, and steadily falling (E. van de Walle, 1974).

The second instance of precocious parity-related control of fertility, not confined to privileged classes nor to special urban populations, occurred in subgroups of the rural population in a region in southern Hungary stretching from Somogy, south of Lake Balaton, to Krassó-Szorény, bordering on Rumania (Demeny, 1968). The fraction of the population with low fertility was not large enough in all of the counties to lower the fertility of the county as a whole, but in some villages the birth rate was below 20 or even below 15 per thousand early in this century, and consistently lower than the death rate. Hungarian demographers, drawing on the parish registers in some of the villages with very early low fertility, have calculated age-specific marital fertility schedules. In Table 1.1 values of m are shown, which are based on reconstituted fertility data for five villages in southern Transdanubia in the eighteenth and nineteenth centuries. In all

Table 1.1. Index of fertility control (m) in selected Hungarian villages.

Village	Period	m	Village	Period	m
Besence and Vajszlo	1747–1790	.05	Sarpilis	1760–1790	-.17
	1791–1820	.30		1791–1820	.26
	1821–1850	.70		1805–1830	.82
	1851–1893	1.49			
Alsonyek	1760–1790	.33	Bakonya	1759–1779	.50
	1791–1820	.55		1780–1804	.74
	1821–1850	.75		1805–1831	1.03

Sources: Andorka, 1978; Table 3.1.

five, rising m clearly indicates an increasing degree of parity-related control, culminating in a marital fertility schedule little different from European populations in the middle of the twentieth century. In Besence and Vajszlo, the median size of a completed family declined from 6.0 children ever born to older women in 1747–1790 to only 2.0 in 1851–1893 (Andorka, 1978, Table 3.5).

The low fertility of certain sectors of the Hungarian population was noticed (generally with disfavor) by contemporary Hungarian observers. The chief medical officer of Baranya, the county wherein three of the villages in Table 1.1 are located, wrote in 1845: "... in most Hungarian villages of the county the young wives consider it a shame to bear in the first four or even ten years of their marriage, and even the healthiest and strongest women bear not more than two children.... Many young wives hinder birth clandestinely and sinfully in order to maintain their beauty, while many others are induced by poverty to do this, because often three or four families have to live on half a plot of land.... They are taught methods of birth control by older people ... abortions are performed, ... as is well known" (Holbing, 1845, in Andorka, 1978). According to Andorka, low marital fertility was not only well known, but was popularly called the "one child system"; in Baranya in the late nineteenth century a "one child system committee" was formed to investigate the custom.

A puzzling additional possible exception to the general absence of parity-related control before the modern decline began is Denmark. From 1787 until the 1880s, the index of marital fertility for Denmark (I_g) remained in the narrow range of 64.5 to 68.5 percent of Hutterite marital fertility. Such constancy is typical of the absence of parity-related limitation; once contraception and abortion are widely used, marital fertility usually falls steadily, as it did in Denmark beginning in the 1880s. It is only after 1868 that the availability of age-specific marital fertility rates makes possible the calculation of m for the rural areas and provincial towns of Denmark. The average value of m from 1868 to 1880 is 0.24 for the provincial towns, and 0.20 for the rural areas—values a little too high to be accepted as indications of the absence of parity-related limitation. The earliest calculated value of m for the capital (1875–1879) is 0.62. Thus there may have been some parity-related restriction of fertility in Denmark prior to 1880; there almost certainly was in Copenhagen. Since the positive values of m in the rural areas and the provincial towns are found just before the index of marital fertility began to fall, it is possible that the initiation of some kind of contraceptive practice by some older women may have occurred

shortly before 1880. The slight decline in marital fertility of older married women may not have resulted, as might be expected, in a decline in I_g, because it may have been offset by small increases among younger married women—from slightly curtailed breast-feeding, for example. In the later years of the century, a sustained decline in I_g began, and it was accompanied, as expected, by a steady rise in m from about 0.3 in the 1880s to nearly 1.0 in the 1930s and 2.0 in the 1960s.

Further Observations on Moderate Fertility in Pre-industrial Populations

In the West European populations in which marriage was late and exposure to the risk of childbearing was less than 50 percent of the potential maximum (because of the large fraction of women not currently married), the level of marital fertility was moderately high—from 65 to 80 percent of the exceptionally high marital fertility of the Hutterites. In a number of non-European populations in which marriage is early and universal, 85 to 90 percent of potentially fertile women are exposed to the risk of childbearing by being married. In such populations the level of marital fertility is substantially lower than in Western Europe—only 50 to 60 percent of Hutterite marital fertility. Very high proportions married are rarely combined with moderately high marital fertility, even in pre-industrial populations. If Asian proportions married were combined with West European pre-industrial marital fertility, the total fertility rate would be at least 7 to 8, compatible in the long run with an average duration of life of less than 20 years. For reasons stated earlier, such combinations of high fertility and high mortality would be disadvantageous for the long-run welfare, and possibly the viability, of a pre-industrial population.

What, then, accounts for the different levels of pre-industrial fertility already noted—from a TFR of 4.1 in Denmark to 6.2 in India? And what explains the still higher fertility levels (over 7 in the United States in 1800, nearly 7 in Russia in the late nineteenth century, over 7 in Bangladesh, Pakistan, and some Latin American populations a decade ago, and about 8 in Kenya) in other pre-industrial populations? The low pre-industrial fertility in Scandinavia would be consistent with an e_0^0 of about 33 years, that of rural China with an e_0^0 of about 24 years, and the fertility in India with an e_0^0 of about 20 years. If it is assumed that an e_0^0 of 30 years or more could have been attained in India and China, as in Scandinavia, the higher fertility of these populations might simply be a less effective moderation of fertility than in Scandinavia, no matter what nonparity-related limitation was practiced, with consequent long-run higher mortality. Marital fertility was lower in the Asian populations than in pre-industrial Western Europe, but not low enough to offset the higher nuptiality in Asia than in Europe. More effective moderation of fertility in Europe thus may have permitted a more favorable equilibrium point of birth and death rates, a possibility supported to some extent by the potentially homeostatic character of limitation of fertility by late marriage.

The reconstruction of the population of England from the mid-sixteenth to the mid-nineteenth century by the Cambridge Group for the History of Population and Social Structure shows how important variation in nuptiality was in moderating the rate of increase of the English population (Wrigley and Schofield, 1981). Their estimates of total fertility rates (smoothed by a 25-year moving average) show a variation from a low of 3.9 to a high of 5.7 between 1550 and 1800; the surprisingly small variation in e_0^0 (also smoothed by a 25-year moving average) is from about 32.5 to 39 years. The annual rate of increase implied by the combinations of average TFR and e_0^0 over 25-year intervals varied from below zero in the 25-year period centered on 1670 to nearly 1.3 percent at the end of the eighteenth century. This variation was caused much more by changes in fertility than by changes in mortality; yet evidence from reconstituted parish registers shows that marital fertility was virtually constant. The dominant source of the variation in fertility, and thus in the rate of natural increase, was variation in age at marriage and variation in the proportion remaining permanently single. In terms of the fertility indexes used in the Princeton study of the modern decline of fertility in Europe, the extensive variation in English fertility from 1550 to 1870 was almost wholly a variation in I_m (the index of proportion married), with I_g (the index of marital fertility) virtually unchanging.

Wrigley and Schofield note that large-amplitude variation in fertility (caused by variation in nuptiality) provided an accommodation to the slow and varying growth in resources, not by intense spasms of elevated mortality, but by wide fluctuations in fertility. One can imagine nuptiality as an efficient homeostatic mechanism, if prospective brides and grooms felt compelled to marry later when times were bad. But Wrigley and Schofield conclude:

> It was a system capable of achieving a balance between population and resources, but it is perhaps misleading to describe it as an equilibrium system, since one of its striking features was the remarkable slowness of response between economic (real-wage) and demographic (fertility) changes . . . . England displayed what might be termed dilatory homeostatis, winning the war of adjustment, but doing so by employing a strategy appropriate to yesterday's circumstances. (Wrigley and Schofield, 1981, p. 451)

When marriage is early and universal, as in Asia, it is more difficult to see how restraints on marital fertility (by nonparity-related means such as prolonged breast-feeding or postpartum abstinence) would operate in a homeostatic manner—reducing fertility when population increase puts pressure on resources. It is possible, however, that the higher fertility in India and China may not have been the result of the lesser effectiveness of these practices (as compared to Western European nuptiality) in restraining fertility, but may have been the consequence of unavoidably higher mortality, resulting, for example, from a climate and a technology that made catastrophic food shortages more difficult to avoid. Under this hypothesis, the higher total fertility in India than in China would have been necessary because over the past several centuries, with possibly more contagion in a tropical climate and a less dependable food supply, an average e_0^0 of 20 years was the best that could be maintained, whereas in China the attainable average duration of life was a little greater.

When there is a large change in the availability of resources, traditional restraints on fertility are generally modified. An example is the settlement of North America by West Europeans. The settlers brought with them the technology of Europe, which was applied, with adaptation to new conditions, to extensive and very fertile land, until then sparsely settled by a population still dependent at least partly on hunting and fishing. The native population was progressively displaced; the supply of agricultural land the colonists could occupy was, by European standards, enormous. In Europe, the colonists had been accustomed to marrying late because only at an age in the late twenties or higher had men come into possession of land or qualified for the steady positions that custom dictated marriage required; custom also sanctioned only a slight difference in age between bride and groom, so that women as well as men married late. In America, the young European immigrant or his descendants could always settle at the frontier; also the plentiful supply of land meant a relatively high demand for labor, if individuals chose to work for wages. Indeed, the high fertility in the United States (TFR over 7 in 1800) was highest near the frontier, and much lower in the long-settled seaboard areas (Easterlin, 1976). Similarly, newly available land in the south of Russia and in the Asiatic part of the Russian Empire may be part of the explanation of the high total fertility rate (6.8) in European Russia in the late nineteenth century.

Another instance in which a change in environment led to partial abandonment of fertility-limiting behavior is the rise in fertility among the !Kung, whose four-year interbirth intervals, caused by nursing at fifteen-minute intervals, was described earlier. The !Kung are a people who have continued a traditional life based on hunting and gathering until today, although an increasing fraction has recently adopted a sedentary life. The birth intervals among the !Kung are, according to Richard Lee, associated with the form of child care provided, which in turn is associated with the prevalent food gathering customs.

> Women's work—gathering wild vegetable food—provides well over half of all the food consumed by a !Kung camp. . . . Subsistence work occupies two or three days of work each week for each adult woman. On each work day a woman walks from 3 to 20 kilimeters (2 to 12 miles) round trip, and on the return leg she carries loads of 7 to 15 kilograms. . . . Of course, the major burden carried by women has yet to be mentioned. On most gathering trips and on every visit and group move, a woman has to carry with her each of her children under the age of four years. Infants and young children have an extremely close relationship with their mothers. . . . For the first few years of an infant's life, mother and child are rarely separated by more than a few paces. . . . Since every child has to be carried, it is fortunate that generally the birth interval among the !Kung is as long as it is. The advantage of long birth spacing to hunter-gatherers is obvious. A mother can devote her full attention to caring for an offspring for a longer period, and the older the offspring is when the mother turns to the care of the subsequent young, the better are his chances for survival. (Lee, 1980)

Thus, the nursing of the children at intervals of fifteen minutes is not an unnatural feature of the continued close contact of mother and child. The effect of producing very long interbirth intervals is clearly functional, permitting the woman to have only one child to carry until the child is able to walk on his own.

When the !Kung adopt a sedentary life, the birth intervals are shortened. According to well-founded estimates, large increases (30 to 50 percent) in

marital fertility occurred in Soviet Central Asia from 1926 to 1970, in rural Korea from 1930 to 1960, and in Taiwan from 1930 to 1956. Presumably these increases were the result of the attenuation of nonparity-related fertility-limiting factors such as prolonged nursing (Coale, Anderson, and Härm, 1979).

Why Parity-related Limitation of Fertility Is Rare in Pre-industrial Populations

The absence of a consequential extent of parity-related limitation of marital fertility in pre-industrial European populations (with a few exceptions) was described earlier. Similar evidence of age-specific marital fertility rates in a pattern by age that conforms to the absence of parity-related control exists for rural China around 1930, for Korea in 1960 (before the decline began), for Taiwan before 1956, and for Soviet Central Asia in 1959. In a number of less developed countries in which marital fertility has not yet begun to decline, women have directly reported nonuse of contraception. There seems no basis for believing that in less developed countries in the twentieth century couples stop childbearing when they have a certain number of births before an irreversible decline has begun. A corollary implication is that in these populations contraception was little practiced.

The apparent general absence of contraception and of parity-related limitation in pre-industrial populations is puzzling. Norman Himes (1963) has documented knowledge of contraception in many societies back to classical times. Surveys of modern populations have shown that often very low marital fertility was achieved when the dominant method of contraception was withdrawal, which is mentioned (and condemned) in the Old Testament. Since moderate fertility is beneficial to society as a whole, why did parity-related contraceptive practice not become a general custom in pre-industrial societies? A somewhat fanciful reason is this: parity-related fertility control is too effective and too appealing to individual self-interest. One of the empirical findings of our study of the decline of fertility in Europe is that once the reduction in marital fertility is well started—once marital fertility has fallen by at least 10 percent—the decline is not reversed until marital fertility has fallen very far, by 50 percent or more. Conventional opinion has generally condemned contraception, and beliefs about the bad physical and psychological effects of withdrawal are ubiquitous. Suppose that a segment of a pre-industrial population learns that this form of contraception is in fact harmless and finds that the burdens of childbirth and childcare can be avoided after one or two children have been born. Suppose this group also comes to feel that there is no value in the perpetuation of the family name, and no dishonor in living more confortably with a small number of children. The rate of reproduction of such a group may almost always have fallen to a point below that consistent with replacement, even given the lowest mortality achievable in a pre-industrial population. In other words, parity-related limitation may have been rediscovered and readopted repeatedly, only to die out with its practitioners. It may have been the social equivalent of a lethal mutation that appears recurrently but never persists.

The instances of pre-industrial parity-related limitation of marital fertility cited earlier are examples of how such limitation can reduce fertility below the level consistent with survival. In the villages of Baranya, known by their nineteenth-century contemporaries as addicted to the one-child family, in which marital fertility was very low and strongly restrained by parity-related measures, mortality was still high. In Besence and Vajszlo more than 20 percent of the newborns died before reaching age one until late in the nineteenth century (Andorka, 1978); many of the villages of southern Transdanubia had a negative rate of natural increase as a result of such low fertility while mortality remained high. In the French *départements* where fertility was already low in the early nineteenth century, the rate of childbearing was not adequate to replace the population. In both Lot-et-Garonne (southwest France) and Calvados (in Normandy), the population declined steadily after 1836, by a total of 20 percent in one instance, and 25 percent in the other, with no substantial out-migration (E. van de Walle, 1974).

The Transition in Europe from Moderately High Fertility and Mortality to Very Low Fertility and Mortality

If there were valid data on fertility and mortality for the countries of Europe in the seventeenth or early eighteenth century, it is a good guess that most of the points showing the total fertility rate and life expectancy for each country would have fallen in or around the region in the (TFR, e_0^0) plane delineated as pre-transitional in Figure 1.3. The points for the countries of Europe around 1980 fall in or around the region labeled

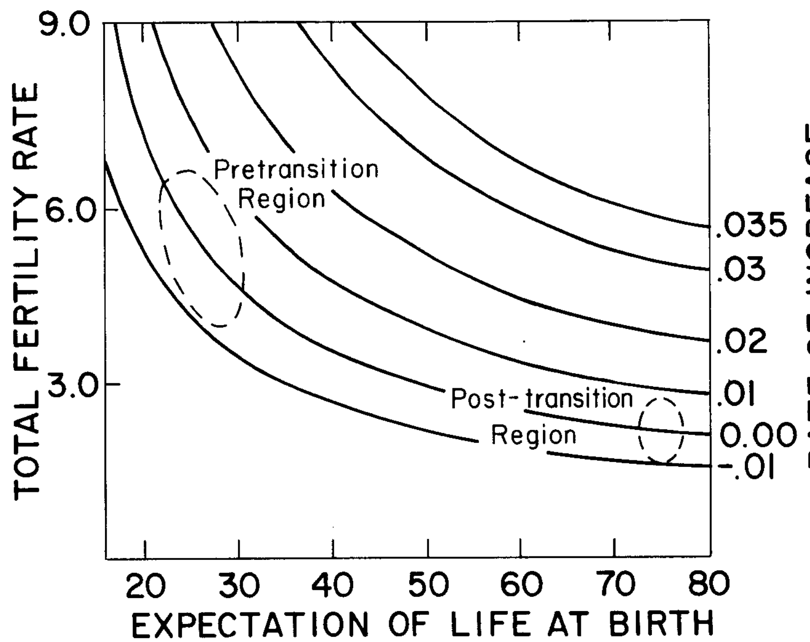

Figure 1.3. The typical locus of total fertility rate and expectation of life at birth in pre-transitional (estimated) and post-transitional (typical of contemporary Europe) populations.

post-transitional. The pre-transitional region is, obviously enough, a set of moderately high fertility and mortality combinations—e_0^0 from about 20 to 30 or 35 years, TFR from about 4 to over 6.5—that would yield near-zero growth; the post-transitional region is a set of very low fertility and mortality combinations—e_0^0 from 72 to 78, TFR from about 1.5 to 2.5—that would also yield near-zero growth.

The pre-industrial region of combinations of TFR and e_0^0 in Figure 1.3 is a region of average values consistent with moderate growth over a long time span. But the average may not have been usual, since the typical time pattern of growth was probably one of positive increase interrupted by catastrophic reductions. The prevalent values of TFR and e_0^0 may have oscillated between combinations to the right or above the delimited pre-industrial region and lower, or more leftward, combinations that led to rapid decrease in numbers.

The first combinations of TFR and e_0^0 derived from valid data are a few in the eighteenth century; all lie to the right of the pre-industrial region because e_0^0 had already begun to increase along its long climb to values above 70 years. The decline in mortality had many antecedents, beginning with the rise of modern science, the development of oceanic navigation, and the growth of world trade. The opening of the Western hemisphere to European settlement, with the consequent increase of food supplies for Europe, the interchange of plant varieties among formerly isolated civilizations, including the introduction of the potato and other nutritious crops into Europe, the construction of roads, canals, and railroads that facilitated internal transportation and the growth of national markets, improved agricultural technology, and the growth of nonagricultural output with the continuous extension of the division of labor and the introduction of mechanized mining and manufacture provided the material basis for a more certain supply of food and other components of a rise in real income, despite a steady increase in population. The development of the first effective forms of preventive medicine, especially vaccination against smallpox; improved habits of personal hygiene such as washing with soap; and the provision of purer water to some cities made possible a gradual rise in e_0^0 in the first half of the nineteenth century. Further economic progress, the discovery of the germ theory of disease and of anesthesia, and more extensive supplies of clean water to urban populations contributed to a more rapid increase in e_0^0 in the later years of the nineteenth century. A rapid increase in e_0^0 had spread to Southern and Eastern Europe by the early twentieth century. A further spurt of rising e_0^0 in the middle of the twentieth century was quite general in Europe. It accompanied unprecedented advances in scientific medicine, including the invention of effective chemotherapy and antibiotics, whcih virtually eliminated what mortality from infectious diseases still remained. By 1980 female e_0^0 was over 72 years in every European population except that of Albania; the median national figure was above 75.

Had pre-industrial fertility remained unchanged during this revolutionary reduction in mortality, the multiplication of the European population would have been prodigious. The intrinsic rate of increase would have risen to more than 2.5 percent in Western Europe and to more than 3.5 percent in most of Eastern Europe. Instead, the universal increase in life expectancy has been matched by a decrease in fertility almost as universal, a decrease in the total fertility rate so great that the intrinsic rate of increase in every European nation except Albania, the Soviet Union, Portugal, Ireland, and Northern Ireland is negative. Were it not for the momentum embodied in the age distribution, the legacy of the past trends, the population of Europe would now be diminishing.

The change from the pre-transitional region to the post-transitional region has not been along a path in which TFR and e_0^0 stayed close to the locus of combinations yielding an intrinsic rate of increase of zero, except in France. In Figure 1.4, the sequence of e_0^0 and TFR values from early data until a recent point is shown for Sweden, France, and Hungary. Points for 1800, 1830, 1850, 1870, 1890, 1910, 1930, 1960, and 1980 are shown for Sweden and France, and for all but 1800 in Hungary. (The earliest points for Hungary are estimated from birth rates and death rates provided by Andras Klinger at the 1979 conference.) In all three countries, the earliest point is on the right (higher e_0^0) of the pre-transitional region, because mortality had probably decreased from a still earlier date. In France alone, TFR fell before 1870, as France from 1800 traced a transitional path with simultaneous declines of fertility and mortality such that the intrinsic rate of increase was never far from zero. The experience of Sweden and Hungary was more typical of the European transition; mortality declined earlier than fertility, and during much of the transition the intrinsic rate of increase was above one percent. (A subtle feature of the shift from one region of zero intrinsic rate of increase to another is that the shift produces a considerable increase in population, even if the intrinsic rate of increase remains at zero, or the net reproduction rate at 1.0. To appreciate the reason for this growth, imagine that the initial population is stationary, and that each cohort exactly replaces itself—cohort net reproduction rates are all 1.0—as e_0^0 rises from 25 to 75. Under these assumptions, the annual number of births would be constant, since annual births were constant in the original stable population, and each cohort replaces itself. The initial population, with an e_0^0 of 25, is twenty-five times the annual number of births; the ultimate population is seventy-five times the annual number of births, or three times as large. If *period* intrinsic growth rates are zero as fertility and mortality decline, fertility is a little lower during the transition, so that the increase is less than the ratio of the final e_0^0 to the initial e_0^0.)

Estimates of TFR and e_0^0 can be obtained for the following countries beginning in about 1870: Austria, Belgium, Denmark, England and Wales, Finland, France, Germany, Hungary, Italy, Netherlands, Norway, Poland,

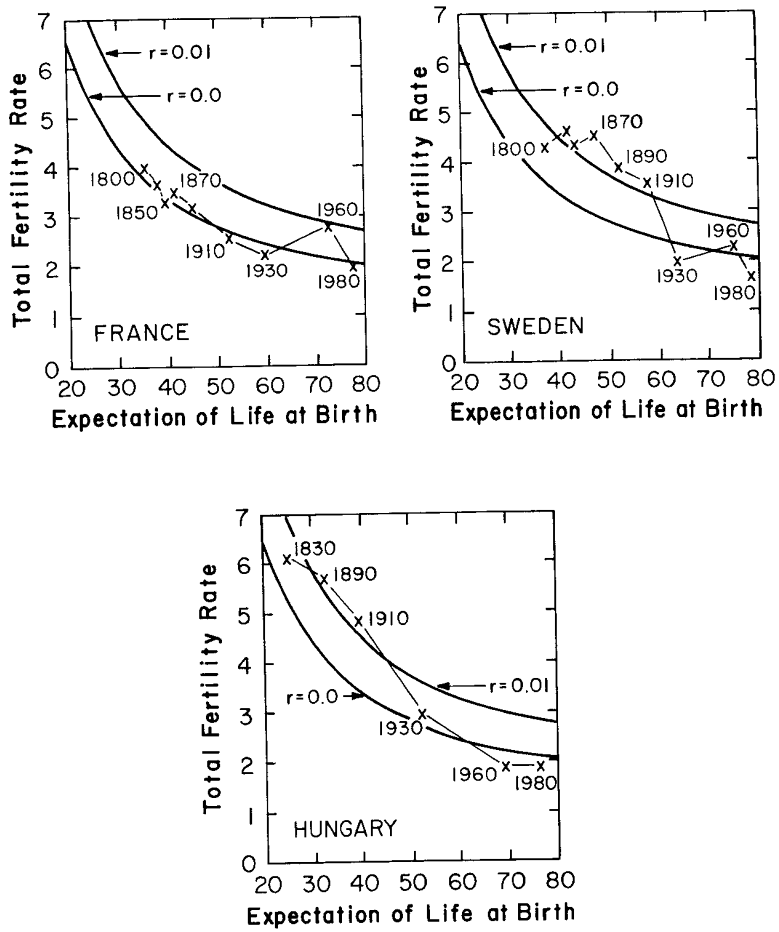

Figure 1.4. The evolution of total fertility rate and expectation of life at birth in France, Hungary, and Sweden from early in the nineteenth century to 1980.

Russia, Scotland, Spain, Sweden, and Switzerland. (For some of the countries, estimates for 1870 were made from the crude birth rate and crude death rate by the use of model stable populations.)

In Figure 1.5, the combinations of TFR and e_0^0 for these countries are shown for selected years from 1870 to 1980. In 1870 all but France and Switzerland had TFRs little if at all reduced from the average over

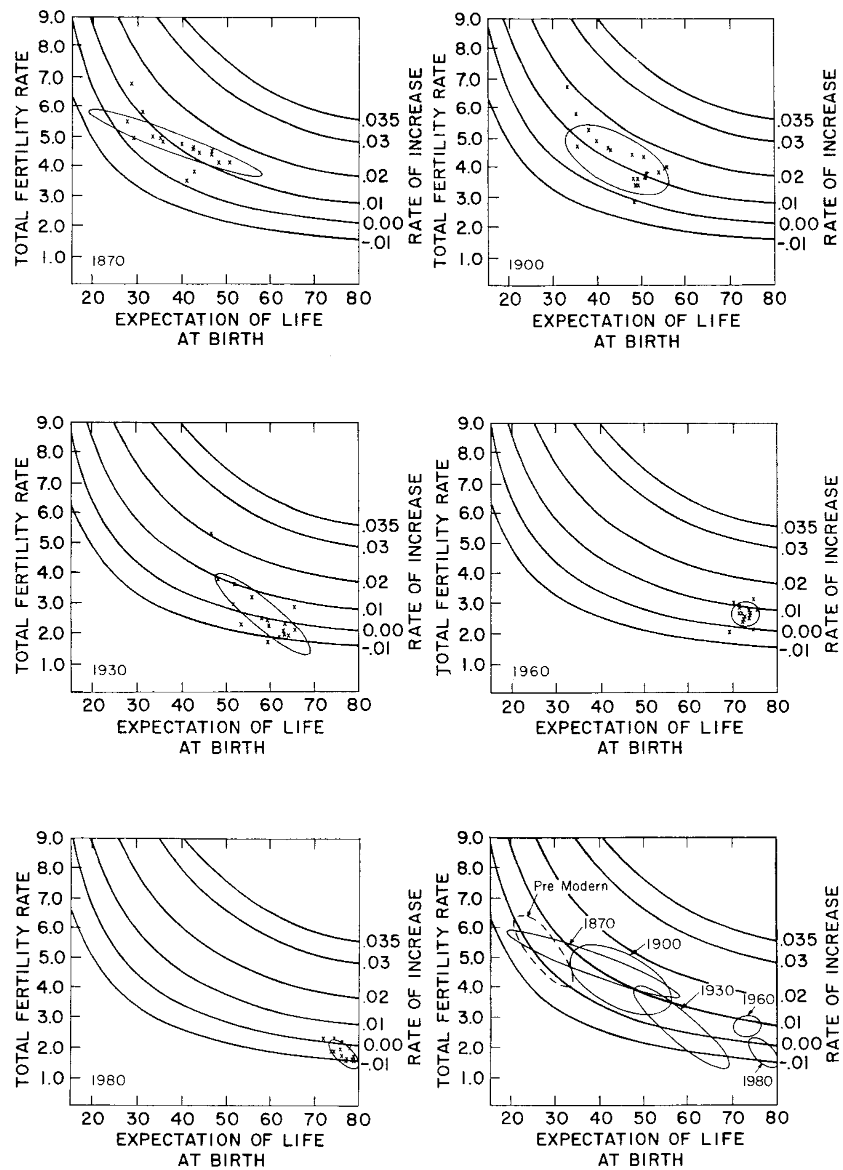

Figure 1.5 The evolution of total fertility rate and expectation of life at birth in 17 European countries, from 1870 to 1980.

an interval extending far into the past, but e_0^0's that had risen since the eighteenth century to establish intrinsic rates of increase above one percent in most countries. By 1900, further increases in e_0^0 had occurred in every country, and in most there had been at least a slight decline in TFR. The decline in TFR from 1900 to 1930 was at least 30 percent in every country except France, which had progressed so far in its transition by 1900. (Russia is also an exception, only because its estimate of TFR and e_0^0 is for 1926, as published data on births were suspended before 1930). From 1930 to 1960, TFR rose in the countries that had negative intrinsic rates of increase in 1930, indeed in all of Northwestern Europe. The principal basis of this increase was a large reduction in age at marriage—a partial abandonment of the long-established West European pattern of late marriage and avoidance of marriage. In Southern and Eastern Europe the decline in TFR continued from 1930 to 1960, creating a much more compact cluster of points at the later date. From 1960 to 1980 every country had a decline in TFR as marital fertility fell, many couples lived together without marrying (but usually with lower fertility than those at the same age who were married), and divorce rates rose sharply.

In each of the first five panels of Figure 1.5, 75 percent of points in each set (combinations of TFR and e_0^0) are encompassed by an ellipse. The ellipses are designed to summarize, graphically, the position of a collection of points in two dimensions. (The technical details of the calculation of the ellipses are given in Chapter 2 by Coale and Treadway). The reader can get his own visual impression of the relation of each ellipse to the points for which it is intended to give a sort of geometric summary. In the last panel of Figure 1.5, the five ellipses are shown in the same diagram, together with a hypothetical ellipse representing the estimated location of the seventeen countries in the mortality and fertility plane, as of the seventeenth century. This last panel provides a succinct summary of the demographic transition in Europe—a movement from fairly diverse combinations yielding low rates of intrinsic increase, with moderate fertility and mortality, through intermediate combinations with higher growth potential because of longer life and only slightly lower fertility, to rather uniform combinations, with low to negative growth potential, of very low fertility and mortality.

The demographic transition in Europe, then, was a transition from approximate balance of birth and death rates at moderately high levels to approximate balance at very low levels. Pre-industrial populations had moderately high mortality because uncertain food supplies and unavoidable disease made low mortality unachievable; fertility was only moderately high because of low proportions married and birth intervals that are extended by various nonparity-related factors. Couples married late, or postponed the next pregnancy for self-interested reasons, such as waiting until attaining the economic position to form a viable household or extending the interbirth interval until the survival of the most recently born would not be jeopardized. These actions were probably not closely linked to reaching a desired specific total number of children, since pursuit of such a goal would naturally lead to parity-related limitation—and there is good evidence that parity-related limitation occurred only in small special subpopulations in pre-industrial Europe, with the exceptions in France and Hungary discussed above. Mortality fell as agricultural and industrial productivity increased, and improved environmental conditions and better medical knowledge and facilities drastically reduced the incidence of fatal infectious disease. The fall in mortality was gradual at first, then more rapid, and cumulated to a quite uniform long average duration of life, not far from 75 years in every European population in 1980.

Except among special subpopulations, such as the nobility, fertility in most of Europe did not fall until about 1870, despite the gradual decline in mortality. The sole national exception was France, where TFR by 1870 was 20 percent lower than in 1800. After 1870, fertility fell in every country; in 1980 there was a notable concentration of TFRs, mostly at levels too low to maintain the population despite the very high e_0^0's. Nuptiality had been far from constant; but the dominant reason for the attainment of low fertility was the universal adoption of parity-related limitation of births—the effective employment of contraception and abortion in order to have no more than the small number of births each couple wishes.

One of the features of this transition is the increased uniformity of fertility and mortality among the European populations. The pre-transitional "region" of TFRs and e_0^0's consistent with near zero growth was a large region—the highest e_0^0 probably exceeded the lowest by 50 percent, and the spread of TFRs was a difference of more than two children per woman. The post-transitional region was much more compact—there is little variation in the aggregate fertility and mortality of these highly modernized populations.

The mathematics of geometric increase insures that no average rate of increase very different from zero can persist for many centuries because the cumulative effect is such a large multiplier or divisor. With fairly static technology, variation in mortality would provide much of the homestatic action required to keep growth within bounds. The revolutionary technical changes of the past two centuries have insulated modern populations from any inevitable increase in mortality as populations grow. If Europe's population had increased in the past century to half again or twice its actual size, individual real incomes might have been lower, but e_0^0 could certainly have reached 65 to 70 years (as in Sri Lanka or Hong Kong), and quite possibly the actual 75. Is the arrival at TFRs that recently have oscillated near the level required for an intrinsic rate of increase of zero an instance of homeostatic forces at work, or is it an accident? Presumably the level of fertility in recent years reflects fairly closely the aggregate outcome of the actions of individual couples, each trying, with general success, to have the fertility each couple prefers. In fact, some of the decline from 1960 to 1980 is the result of more successful avoidance of unwanted births. It would be merely a matter of luck that the population should want, as a matter of individual choice, a number of offspring that would in aggregate keep the populations at a zero rate of increase. It is more likely, in my opinion, that if marriage remains a much less than universally chosen institution, and if women continue to gain their rightful equal opportunities for rewarding lives outside of the home, the TFR will continue well below two. Whether such continuation will generate counterbalancing changes in fertility preferences, or effective pronatalist state intervention, time will tell.

Such, then, is the background of the research that underlay the Conference on European Fertility in Princeton. The research, undertaken by many of the conference participants, and some who were unable to attend, was a study of the decline of fertility by province in individual European countries. At the conference, papers were invited that summarized the data on fertility change since 1870 in the provinces of all of Europe, and that dealt with special subjects such as precursors of the modern decline; the relation of fertility to infant mortality; rural-urban differences during the transition; the relation of fertility decline to secularization and to factors particular to regional cultures. This essay has been an attempt to sketch in the broader demographic setting in which the decline occurred.

CHAPTER 2: A Summary of the Changing Distribution of Overall Fertility, Marital Fertility, and the Proportion Married in the Provinces of Europe

Ansley J. Coale and Roy Treadway

INTRODUCTION

The European Fertility Project was undertaken in 1963 because of the clear importance, not only for Europe, but for the world, of a basic change that had occurred in the preceding fifty to two hundred years in virtually every European province—a decline of some 50 percent in the average number of children born per woman.

The fact that a decline in human fertility had occurred in Europe was widely known; indeed, a general proposition had been formulated that fertility can be expected to fall as a result of a set of social and economic changes characterized as "modernization"; this proposition was often accepted, it seemed, on the basis of a superficial appreciation of European experience.

In particular, both sides in a continuing debate on desirable policies on population in less developed countries have based their positions in large part on impressionistic interpretations of the history of European fertility. According to one position, a reduction in fertility is the inevitable result of urbanization, lower mortality, the spread of education, and the occupational changes that accompany industrialization, so that government support of birth control is unnecessary. Others infer from their impression of European experience that reduction in mortality occurs more readily under the influence of modernization than reduction in fertility, that the consequent rapid transitional growth in population can be an impediment to progress, and that deliberate programs to speed the decline in fertility are useful or even essential.

A deeper and more detailed knowledge of the reduction of fertility in Europe thus seemed desirable. Such deeper and more detailed knowledge appeared attainable. Demographic data for Europe are unusually rich and accurate. Censuses that list the population classified by age and marital status were begun in Europe in the eighteenth century, were common by the mid-nineteenth, and were almost universal by the beginning of the