The Demographic Transition

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Demographic transition is a set of changes in reproductive behaviour that are experienced as a society is transformed from a traditional pre-industrial state to a highly developed, modernized structure. The transformation is the substitution of slow growth achieved with low fertility and mortality for slow growth maintained with relatively high fertility and mortality rates. Contrary to early descriptions of the transition, fertility in pre-modern societies was well below the maximum that might be attained. However, it was kept at moderate levels by customs (such as late marriage or prolonged breast-feeding) not related to the number of children already born. Fertility has been reduced during the demographic transition by the adoption of contraception as a deliberate means of avoiding additional births. An extensive study of the transition in Europe shows the absence of a simple link of fertility with education, proportion urban, infant mortality and other aspects of development. It also suggests the importance of such cultural factors as common customs associated with a common language, and the strength of religious traditions. Sufficient modernization nevertheless seems always to bring the transition to low fertility and mortality.

I. MODERATE GROWTH CHARACTERISTICS OF TRADITIONAL SOCIETIES

In a very long perspective, the human population has grown from the hypothetical origin of the species (presumably with two persons) about a hundred thousand years ago to about 4½ billion persons today. The increase from 2 persons to 4½ billion has taken so long that the average rate of growth has been only about two-tenths of a person per thousand population per year. Any population of ten thousand would scarcely notice an increase of 2 per year. In the first 90,000 years the population grew to perhaps ten million. According to an estimate, it was ten thousand years ago that the domestication of animals and the cultivation of land began. The estimate of ten million for the population at that time is based on what historical anthropologists consider to be the likely maximum number that could be supported by hunting and gathering — without domestication of plants and animals. A growth in 90,000 years from a hypothetical 2 persons to about ten million implies

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an average rate of only about 16 per hundred thousand (.16 per thousand). From 10,000 years ago until about 1750 (the beginning of the period we shall be discussing when we speak of the demographic transition), the population grew from about 10 million to about 500 million. Such an increase in a little less than 10,000 years implies an average annual rate of increase that was still very low — only about half of a person per thousand per year. Since 1750, in the period in which the demographic transition took place, the average rate of increase of world population has been much more rapid, an average of about 7.5 per thousand, some 15 times as high as in the previous ten thousand years. In the past two centuries, the growth of world population accelerated, reaching an annual rate of increase in the 1960s of about 2 percent, or 20 per thousand. The peak rate is very much higher than the low average since the origin of the species, or in any extended period before 1750. The average increase of 7.5 per thousand since 1750, though less than the growth rates in the late 20th century, was enough to produce a multiplication of the population of the world by a factor of 8 or 9 in a little over two centuries.

The nearly imperceptible average annual growth of the human population until 1750 is an inevitable long-run feature of the population of any long-enduring pre-modern society. If such a society grew by as little as 5 per thousand per year, a slow rate by contemporary standards, its size would be multiplied by about 12 in only five centuries. In five centuries a population of 10 million would become 120 million; or, if the growth were negative, it would shrink from ten million to less than a million. Increases by a factor of 12 in five centuries rarely occurred. Indeed, a population that employs only slowly changing technology, that depends, for example, on agriculture using traditional techniques, and that has access to limited territory could not support repeated multiplication by a factor of 12 every five centuries. Once the accessible territory is fully settled, further multiplication by such a large factor is not possible with a nearly fixed technology. I think we can take it as approximately correct that in a pre-modern society which has stable traditions and long inhabits a fixed territory, the long-run rate of increase is close to zero, implying a balance in the average birth and death rates.

A very close balance between birth and death rates must have been the average experience of the world population over its long history. For example, from the average rate of increase of about 0.5 per thousand that one can calculate from about ten thousand years ago to about 1750, it follows that if one estimates an average of about 40 births per thousand population per year, the average death rate must have been 39.5 per thousand. The inevitability of slow growth in traditional societies and the implied close balance between birth and death rates leads to this question: How was such a close balance achieved? It seems reasonable to suppose that some kind of homeostatic mechanism was in operation. A homeostatic mechanism is a mechanism that achieves a balance by causing rates to change in a direction to correct any positive or negative deviation from the equilibrium.

In other words, there must have been some kind of homeostatic mechanism that caused death rates to rise or birth rates to fall when an episode of rapid growth produced a greatly enlarged population within a given area, and a mechanism that caused lower death rates or higher birth rates when numbers were depleted. In pre-modern conditions, it is easy to see that mortality can serve as such a balancing force. Overcrowding of a limited territory under pre-modern conditions can lead quite understandably to higher death rates. In a pre-modern context a large population in a limited territory provides a critical mass that can maintain endemic disease and allow the rapid spread of any newly introduced pathological contagious agent. A large pre-modern population is more liable to infestation with intestinal parasites because of contaminated food and water; ultimately, too large a pre-modern population suffers worse nutrition because of low per capita availability of food. Similarly a favourable relation to resources following a large reduction in population allows both better nutrition and less contagion. Thus a homeostatic mechanism that operates through variations in the death rate is readily visualized. When the population becomes too dense, the death rate goes up; and when density is less, mortality rates are lower.

In Figure 1 one axis is a measure of fertility and the other a measure of mortality. There are a series of curves in the figure, each showing the long-run rate of increase that would result from the continued prevalence of a combination of fertility (as shown on the vertical axis) and mortality (as expressed by a measure on the horizontal axis). The measure of fertility is one that has proved most useful to demographers. It is called the total fertility rate, which is simply the average number of children per woman born in a lifetime according to a given regime of childbearing rates by age of mother. In other words, in a population with a total fertility rate of 6, the birth rates experienced by age of woman from age 15 to 50 would produce on the average 6 children in a lifetime. The expectation of life at birth is the average duration of life that would be experienced in a hypothetical collection of persons, who from birth until all are extinct are subject to a specified set of death rates by age. An expectation of life of 20 years means that according to a given mortality regime, the average age at death would be 20 years. At the other extreme (just now being attained by the most advanced populations), an expectation of life of 80 years means that the population would survive to that average age, if subject to a set of very low mortality rates. Figure 1 shows the rate of increase caused by the continued prevalence of a particular combination of total fertility rate and expectation of life at birth. The line labelled zero is the locus of combinations of lifetime births and average durations of life that lead to a population that does not grow. For example, if the total fertility rate were about 8½, an average duration of life of about 15 years would lead to zero growth. If the total fertility rate were about 7 (approximately the rate in Pakistan), an expectation of life of a little less
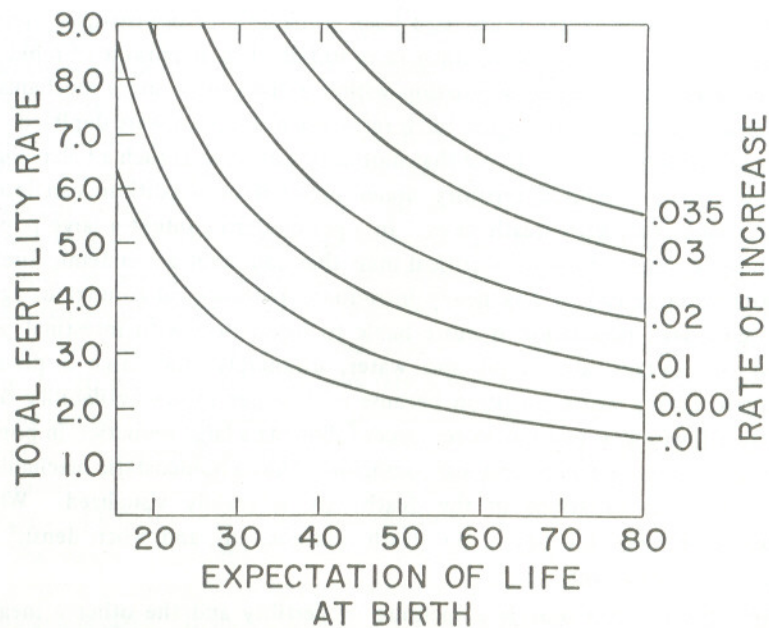
Figure 1. Combinations of Total Fertility Rate and Expectation of Life at Birth that produce various long-run growths from minus one per cent to three and a half per cent

than 20 years would cause the population to remain stationary. At the other extreme, if the expectation of life were as high as has yet been observed, the average number of children born would be a little over 2 to maintain a population that is not growing. Other lines in Figure 1 show combinations of total fertility rate and life expectancy that produce other rates of growth, from minus one percent to 3½ percent per year. The combination in Pakistan today of a total fertility rate close to 7 and a life expectancy around 50 years is consistent in Figure 1 with a growth rate of about 3 percent a year, very close to the actual rate of increase in Pakistan. Because of the numerical implications of long-sustained growth, in pre-modern societies one expects a combination of fertility and mortality consistent with a rate of increase close to zero. Empirical evidence on this point is very sparse because there are few reliable records of fertility and mortality in pre-industrial societies. There are some scattered data permitting calculation of the approximate total fertility rate and life expectancy in a handful of populations that had not yet begun or had just begun the demographic transition. In Figure 2 the x's represent combinations of estimated fertility and mortality in selected populations not yet much affected by modern industrialization and associated social change. Several are European populations in the late 18th century. By the late 18th century, the rate of increase had begun to rise in many European populations; the European growth rates
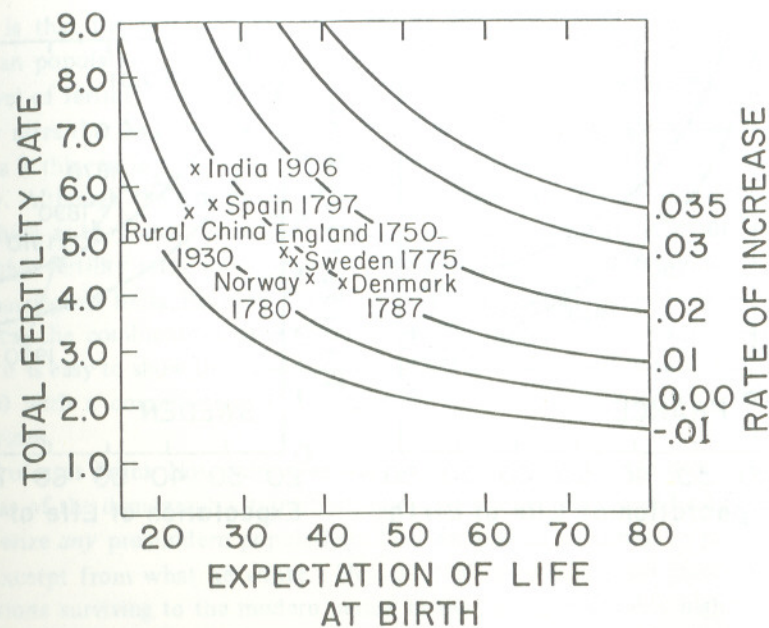
Figure 2. Combinations of TFR and e_o^o in selected pre-industrial populations — European populations in the 18th century, India in 1906, and rural China in 1930

in Figure 2 are thus less than one percent, although above zero. The modern decline in the birth rate had not yet begun in these populations. As far as we can judge, they had a total fertility rate that had prevailed for some time prior to the date shown.

The non-European populations in Figure 2 are the rural population of China about 1930 and the population of India between 1901 and 1911. The total fertility rate in rural China in 1930 was about 5½ children per woman; the expectation of life was about 24 years; the annual rate of increase was close to zero. In India during the decade from 1901 to 1911, the expectation of life was about 26 years and the total fertility rate was about 6.2 children per woman. In Figure 3 the typical combinations of fertility and mortality in pre-modern societies fall in the ellipse labelled "pre-transition region". These are combinations of fertility and mortality that lead to a rate of increase not far from zero. Contemporary European populations that have been through the demographic transition have combinations in the small ellipse labelled "post-transition region". These populations have expectations of life of about 75 years and total fertility rates that are only about 2 children per woman; some are just above but most are below the level that is required for long-run zero growth.

A surprising feature of the pre-industrial combinations of fertility and mortality in Figure 2 (of selected 18th century European populations plus India and
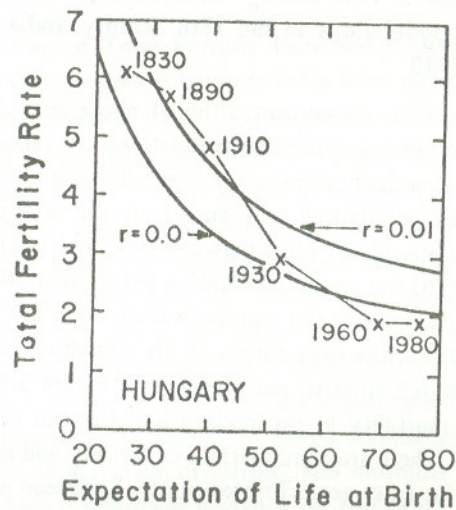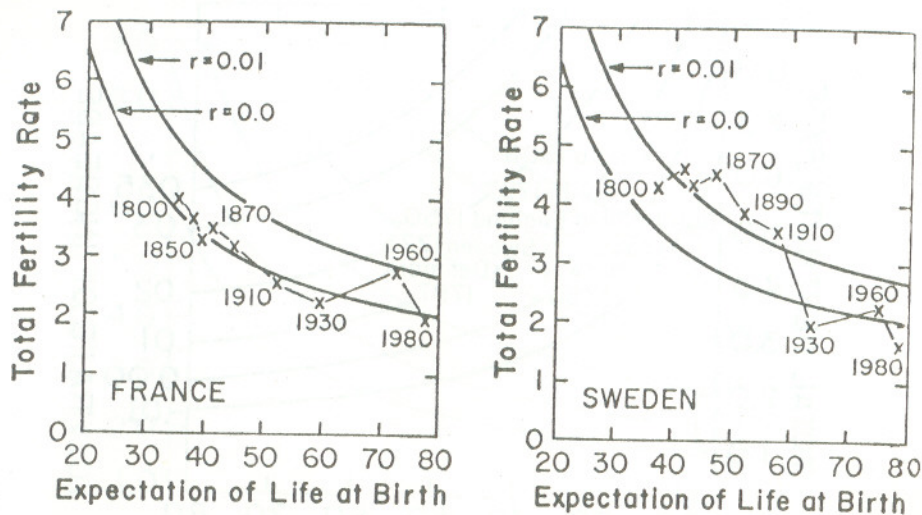
Figure 3.   Combinations of fertility and mortality in pre-modern societies, leading to a rate of increase not far from zero

China) is that the total fertility rates are so low: just above 4 in some of the European populations, only 5½ in rural China, and 6.2 in the Indian subcontinent. This level of fertility is surprising to a demographer because of the very much higher fertility rates that have been reliably recorded among certain religious sects in North America in this century, and the equally high rates among French Canadians in the 17th century. Although these populations had quite high total fertility rates, they were not as high as they might have been, because marriage occurred at relatively late age. If the high fertility rates among married French Canadians were combined with the early marriage in India, Pakistan, China, or Egypt, or in many other countries in Asia or Africa, the combination would lead to a total fertility rate over 10. In other words, it is easy to show that it would be possible to have a total fertility rate greater than 10 with a combination of demographic characteristics observed in different populations.

Professor Frank Notestein, who was one of the pioneers in the development of the ideas of the demographic transition, said that one would expect high fertility to characterize *any* pre-modern population. I can express his ideas best by giving here a short excerpt from what he wrote. He said: "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"[7]. Thus high mortality was inevitable because the means of making it low had not been developed yet; for survival, birth rates also had to be high. He goes on to say: "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".

In other words, Notestein (and other originators of the concepts of the demographic transition) said that pre-transition societies must have had high fertility. Yet in examining empirical data on the fertility in pre-modern societies, we find that it is not nearly as high as it might be. Rather than total fertility rates of 10 or more, the actual range is from 4.1 in Denmark to 6.2 in India. How can these moderate levels of fertility be reconciled with statements about the demographic transition to the effect that high fertility is inevitable if a pre-modern society is to survive to the modern period? In re-examining these issues, I have come to the conclusion that a pre-modern society was most likely to survive to the modern era with *moderately* high rather than *very* high fertility. The rationale making moderately high rather than very high fertility advantageous is the necessary existence of an average rate of increase close to zero over any very long period. Such a rate may be achieved by any one of the combinations shown in Figures 1–3. Thus there is a choice, or at least there are alternatives, of very high mortality and very

high fertility or moderately high fertility and moderately high mortality to achieve a growth rate near zero. *Low* fertility and *low* mortality are not a choice, because, as Notestein noted, low mortality could not be achieved. I have come to realize that a society which developed customs that promoted the highest fertility possible (with a total fertility rate of 10 or higher) would, over a long period, inevitably have an average duration of life of less than 15 years. Only 20—25 percent of the women would survive to the mean age of childbearing. Such a combination of very high fertility and very high mortality would make the population more vulnerable to catastrophe, and would make it poorly competitive with other societies that had a lower mortality and fertility. When this idea first occurred to me, it seemed contrary to the rudimentary ideas I had of evolutionary competition between species. Why would not the population with the highest fertility swamp out its neighbours? Feeling uneasy about the conclusion that moderate fertility was advantageous, I called a colleague in Princeton's Biology Department who is a prominent scholar in mathematical biology and an expert on reproductive strategies and the theory of evolution. I asked him whether it makes sense to say that a society with moderate fertility would have a better survival chance than one with very high fertility. He said, well, if you were talking about large complicated mammals, I would say that you were right. Thus I learned that evolutionary theorists have found two polar strategies for survival in the Darwinian struggle. One is known as "r selection" and the other is known as "k selection". The first strategy — r selection — is what I had visualized as the essence of evolutionary theory from a rather weak grounding in the subject. It is a strategy that entails an inordinately high capacity for reproduction. It is characteristic of species of small body size, short life-span and short intergenerational intervals, with a limited area of foraging and a highly variable habitat. Such species survive successfully through a capacity for very rapid multiplication. They may be depleted when the environment is unfavourable, and spring back to large numbers when the environment permits, and do so before competitors might fill their niche.

The second strategy — k selection — is characteristic of large complicated animals with long life-spans, long intergenerational intervals, a large area of foraging, and a stable habitat. Such species survive more successfully by moderate fertility which is consistent with a long duration of gestation and maturation and which avoids overcrowding the habitat. This reproductive strategy is found among large mammals (like elephants) and large birds, such as the wandering albatross that lays its first egg at an age of 8 or 9 years and lays only one egg every two years.

Pre-modern human societies develop socially transmitted and socially enforced customs that lead to moderate reproduction. Moderate reproduction is conducive to better survival of a society in the same way that genetically determined moderate reproduction is favourable to the survival of large, slowly maturing animal species.

How did pre-modern societies maintain a moderately high rather than a very high level of fertility? Different methods of attaining a moderately high level of fertility have prevailed in different societies. In the 18th century Western Europe, where total fertility rates were from four to five and a half, there was a source of moderate fertility not found in pre-modern times in other societies: late marriage and a surprisingly high proportion of the population that remains unmarried. The mean age at first marriage in Western Europe varied from 23 to 28 years for women. The proportion remaining permanently single was at least 10 percent and sometimes as high as 20 or 30 percent. As a result, only about 50 percent of the women in the childbearing ages from 15 to 50 were married at any given moment, keeping fertility about 50 percent below what it might have been if marriage were universal. Thus postponement of marriage and permanent celibacy were one way of keeping fertility only moderately high. The prohibition of widow remarriage has a similar, though a smaller, effect. Women still in the fertile ages in India are kept from the possibility of childbearing by not being allowed to remarry. The combination of the extremely early marriage that was traditional in India, including infant marriage, with a prohibition of remarriage meant that a substantial percentage (8 to 10 percent) of women in India in 1901 were widowed, even at ages fifteen to twenty. Twelve to fifteen percent of all women of childbearing age were kept from possible reproduction by the prohibition of the remarriage of widows. In Asia and Africa, marriage has traditionally been early and universal: less than one percent of women remain single at age 30 and above, and the mean age at first marriage is less than 20 years, so that restricted participation in marriage has not been an important factor. Nevertheless, the total fertility rate in these populations has not been 10, but only 5½ in China and a little over 6 in India. When most women of childbearing age are married, there are a variety of practices that limit marital fertility well below the high levels recorded among the French Canadians in the 17th century. The most important one is extensive lactation. Breast-feeding prolongs the period of post-partum amenorrhoea, and postpones the resumption of ovulation, thus lengthening the interval between births. In addition, in many societies there is a taboo on intercourse while a child is being nursed. Such a taboo is typically based on a folk belief that sperm poisons the milk or is bad for the child in various other ways. Louis Henry, a French historical demographer, in citing the beliefs that sperm poisons mother's milk, said that such beliefs were common in Asia and Africa but not in Europe. Etienne and Francine van de Walle examined European medical literature from the 17th and 18th centuries and found, to the contrary, that such ideas were common. A particularly amusing example is the advice which they found had been given by a German doctor to his patients. He said that while the woman is nursing there should be no intercourse because the sperm might curdle the milk and give the child a lifelong distaste for cheese.

Another factor that can lower fertility is periodic separation. Agriculturalists who migrate for seasonal work will be separated from their wives for as much as half the year. Shepherds and fishermen are away from home as part of their regular work. Reduction in the probability of conception is approximately proportional to the fraction of the time the couple is separated. Lastly, sterility is caused by venereal disease and certain forms of tuberculosis; other forms of ill-health reduce fecundability and raise the frequency of intra-uterine mortality.

II. THE ABSENCE OF PARITY-RELATED RESTRICTION OF FERTILITY BEFORE THE DEMOGRAPHIC TRANSITION

The important distinction between the moderate fertility that characterized pre-modern populations and the low fertility that was introduced during the demographic transition is this: all of the customs that led to moderate fertility in traditional societies, whether late marriage, prolonged lactation or periodic separation, are not what demographers call parity-specific limitation of fertility. Parity is a term (borrowed from medicine) that means the number of children a woman has borne. A nulliparous woman has had no children; a one-parity woman has had one child; and a five-parity woman has had five. In many pre-modern societies lactation is prolonged; in much of Africa the taboo on resumption of intercourse extends beyond the point of weaning. Yet these customs that reduce the total fertility rate are followed after the first birth just as they are after the sixth. They differ from the restraint on fertility in post-transition populations, where couples change their practices after a certain number of children are born in order not to have any more. That kind of restraint of fertility is parity-specific. Parity-specific limitation is behaviourally different from non-parity-specific limitation although it may have a numerically similar effect. An extreme example of non-parity-specific limitation of fertility has been observed among the !Kung tribesmen in the Kalahari Desert in Southwestern Africa. The !Kung are an anthropologist's delight, since they are still dependent on hunting and gathering, rather than on settled agriculture. They live on vegetables and nuts that are gathered by the women and the irregular supply of meat brought in by the men. The inter-birth intervals among the !Kung have been closely observed by anthropologists who have lived among them for years at a time. The inter-birth interval averages about four years. The total fertility rate of a little over four is about as low as the lowest listed for a West European population in the eighteenth century, restrained by late marriage and permanent celibacy. The !Kung achieve such low fertility by very prolonged and intense breast-feeding. The children are nursed for more than three years. Medical anthropologists have observed that the average interval between nursing bouts is only about 15 minutes, and the children sleep with the woman and have access to the breast at night. These anthropologists have taken daily blood samples to measure variation in the prevalence of hormones that inhibit the resumption of ovulation. There is a positive association between the frequency of breast-feeding and the presence of such inhibiting factors [4]. A social anthropologist who lived among the !Kung reports that the women themselves want many children, and say that God is cruel because He does not give them more children [3]. Note that prolonged breast-feeding was not a conscious effort to have few children, but was a consequence of the way of life. The proportion of the caloric intake of the !Kung the women provide is about 70 percent. The round trip to gather the nuts and fruits is 2–12 miles. The women must carry any infants they have with them. Carrying two children plus the gathered food would be impossible. On these trips there is a very close relation between mother and the child, who is at the mother's heels even when able to walk [6]. The custom of prolonged and intense nursing is very functional in this setting.

Pre-modern societies thus do not achieve biologically maximal fertility, but restrain it by one or another of these sets of measures. How is the absence of parity-specific limitation inferred, since there are few detailed observations of pre-modern fertility? A direct observation of the !Kung is very unusual. In pre-modern European populations, there were no fertility surveys. Women were not asked whether they were practising contraception; its absence must be inferred indirectly. The kind of evidence that shows the absence of parity-related methods is that the mean age of the woman at the birth of the last child does not change, just as we observe in populations today that do not practise contraception. Parish records show that women in the 17th and 18th century European populations bore the last child at a mean age of about 40 years. We know from modern observations that such a mean age at last birth is characteristic of populations that do not practise contraception. Women using parity-related restraint of fertility bear the last child well before age 40. Other indirect evidence (especially the pattern of age-specific marital fertility) shows that parity-related control was not characteristic of pre-modern populations in the aggregate. Small segments of the population may resort to deliberate contraception, but not the majority.

Since moderately high rather than very high fertility is usual in pre-modern societies, and since, moreover, a total fertility rate of only four to six and a half is advantageous in these countries, why was it not achieved by parity-related methods? Effective forms of contraception are known, at least to some, in almost every culture. Withdrawal or coitus interruptus was the predominant method of contraception in Europe in the 19th century and at least until World War II. It is quite effective when practised scrupulously, but is not a modern invention. It is mentioned in the Old Testament and in seven different branches of medieval Islamic Law. If moderate fertility was advantageous and the techniques of parity-related restraint of fertility were known, why were they not widely used? My unscientific

conjecture is that from time to time in pre-modern societies contraception was used by segments of the population, but that they died out. Recall Notestein's statement that high fertility is a must for societies in which mortality is high. I have argued that moderate fertility is advantageous to the traditional society, but if fertility becomes too moderate, or falls below the combination with the lowest attainable mortality that is consistent with replacement, the population does not last. My conjecture is that periodically members of a group within a society will say: Why should I worry about posterity? Why shouldn't we have only one or two children, enjoy our life more, allow the mother in the family to keep her figure, live more comfortably, and eat better? Why worry about the maintenance of the family name? Why don't we stop after we have had a small number of children? But if parity-related restriction diffuses among a group in a pre-modern society, that group disappears. If they produce too few children to be consistent with the lowest mortality level attainable, they gradually vanish. When I outlined this argument to John Hajnal, he said, "It is like a lethal mutation". Prior to the development of the conditions that make low mortality possible, parity-related fertility may be too attractive to its practitioners so that they carry it to a point that is inconsistent with replacement of the parents. This conjecture is reinforced by the results of contraceptive practice in a few pre-modern societies where it has occurred.

Some *departements* in France attained quite low marital fertility beginning in the late 18th century. As early as 1830 the birth rate was only 20 per thousand, a level characteristic of other parts of Europe only in the 20th century. At the time infant mortality was still high, and the expectation of life at birth still low. One such *departement*, Lot-et-Garonne, in Southwestern France, had a persistent negative rate of increase in the 19th century and lost 25 percent of its population from 1830 to 1900, without out-migration. There was a similar pathology in Hungary in the 19th century. Low fertility in some villages was known at the time as the one-child family; it was denounced vigorously in the churches as selfish. Villages where the "one-child family" was common also had a strong negative rate of increase.

III. THE DEMOGRAPHIC TRANSITION IN EUROPE

A full account of the European demographic transition would require a description and explanation of the decline in mortality. I shall say only a few words about the reduction of mortality in Europe since the middle of the 18th century. The technological revolution that is generally considered the basis of the demographic transition, the so-called industrial revolution, produced many changes that made lower death rates possible. It coincided with the opening up of the Western hemisphere, which greatly expanded the food supply. The regularity of the food supply was further insured by increases in agricultural productivity in

Europe and by development of transportation, both trans-oceanic and internal, with canals, improved roads, and later railroads. There was an improvement in personal sanitation; people began to take baths and wash their hands. Later a clean water supply was provided, sewage-disposal plants were built, and urban environmental sanitation generally improved. Thus technological change and increases in food supply made it possible for the death rate to go down; and some specific improvements in medicine helped, such as vaccination against smallpox. A natural implication of the technological changes that characterized the industrial revolution was thus a reduction in mortality. The less obvious part of the transition is the explanation of the universal decline of the birth rate in Europe.

We can characterize the fertility transition in Europe as the replacement of a regime of moderate fertility maintained by late marriage and non-parity-related methods within marriage, by a regime of low fertility within marriage attained by parity-related contraception. Parity-related restriction of fertility was initiated sooner or later in every part of Europe, spread through the population, and produced an extraordinary decline in fertility. We have conducted a twenty-year research project at Princeton, called the European Fertility Project. It was a study consisting of a documentation, and then an analysis, of the decline in fertility in all the 700 provinces of Europe. With almost no exceptions (a few provinces in Ireland and some impoverished areas in the Balkans), there has been at least a 50-percent reduction in marital fertility in all the provinces. The fertility transition has thus been virtually universal. It has clearly been a reduction in marital fertility caused not by more intensive or prolonged breast-feeding or abstinence or other non-parity-related practice, but by contraception. The intellectual challenge of the demographic transition is to explain what caused this universal adoption of voluntary control of fertility among married women. The underlying idea that Notestein and others suggested was that fertility declined because the social and economic changes that are part of modernization make a reduction in fertility inevitable. In a traditional society the locus of production is the family; social standing is determined mostly by family membership. In an agricultural setting, children make a contribution to production while still very young by feeding the chickens or bringing in the sheep or cattle; they also help take care of younger children, and run errands for adults. Families are extended, so that care of the young children can be shared not only among older children but also with other relatives. Education is not an important expense, as few children go to school. Thus children contribute a lot but do not cost much. There are religious and cultural supports for having children. The proper role of women is to have children, and the proper sign of true masculinity is to sire a large number. There are both ideological and practical advantages in large families.

Industrialization changes all of these factors. When people work in factories, their status is determined by what they do rather than by who they are. Children

must be trained and typically do not start working as early as on a farm. Part of modernization is the development of universal education, ultimately compulsory education. Instead of enjoying the economic services of children, parents have to support them for a long time before they become productive. With impersonal employment and urban residence, the influence of others' opinions becomes less. If it is considered improper to practise contraception and admirable to have lots of children, village residents feel the pressure to conform. In the impersonal life of a city, individuals become indifferent about what the neighbours think; and if they find contraception advantageous, they do not hesitate to use it. The changes that are an inevitable part of adapting to large-scale production, moving to a city, and so on, include a reduced motivation for having children. Notestein affirmed that it was a change in motivation, not the development of new techniques, that caused the decline in fertility. One of the lessons of the European fertility study is that both new preferences for smaller numbers of children and improved knowledge of effective techniques are important. For example, although coitus interruptus was known, it was burdened with much false information such as the belief that it caused idiocy. In fact, many individuals did not know about it, or lacked the degree of self-discipline that is required to make it effective. The prevalence of illegitimate births in the 18th and 19th century Western Europe and the parallel reduction of marital and extramarital fertility rates in the late 19th century suggest the diffusion of a new skill through the population. Presumably the desire to avoid illegitimate births did not newly arise. The desire to limit the number of children by married couples doubtless did grow stronger during the transition, but the ability to restrict fertility by contraception was also strengthened.

The European Fertility Project documented the decline in marital fertility in most European provinces from a pre-transition plateau, in which there was little parity-related limitation, through a period of sustained decline (typically at least 50 percent) as contraception was introduced and then more extensively and more effectively used. An almost universal feature of this reduction in marital fertility is that once it started in a province it continued without major reversals to a level no more than half as high as the pre-transition plateau. A major difference among provinces was in the date at which the decline in marital fertility began, and the pace with which it fell. We have estimated a date for each province when marital fertility had fallen by 10 percent from its pre-decline plateau in a sustained reduction.

The earliest date of the initiation of decline was the late 18th century in a few *departements* in France. In much of France the decline began before 1830, but except just across the border from France, as in Geneva, scarcely any other province of Europe experienced this systematic decline in fertility until after 1870. Indeed 50 percent of the European provinces began the decline between 1890 and 1920.

We expected to find that fertility declined first in provinces where mortality had been reduced, in provinces where literacy was highest, in provinces where non-agricultural employment had grown, and in the urban parts of provinces before the rural. In some countries such associations between fertility and socio-economic characteristics did hold, but no fixed list of factors associated with the initiation of a fall in fertility was found.

For example, I mentioned the decline in fertility in Lot-et-Garonne that began before 1800. It was a rural *departement* with a peasant population; its infant mortality rate was high, and the proportion literate not low, yet it was an early pioneer in the reduction of fertility. In England, which *was* the pioneer in the industrial revolution, the decline didn't begin until after 1870. The expected close association of fertility with industrialization and urbanization was not found when we looked at the picture in detail. It is a more complicated picture than that.

It remains true that when a society is fully transformed to a modern way of life, parity-related fertility restriction is always prevalent. Massimo Livi Bacci, who contributed studies of Portugal, Spain, and Italy to the European project, puts it this way: If a population lives in apartment houses and has radios, television sets, telephones, refrigerators, and autmobiles, it never has an average of eight children per couple. While full modernization seems almost always to connote reduced fertility, it has not been possible to make a check list of levels of literacy, mortality, proportion in non-agricultural employment, and the like, that constitute a sure sign that the fertility decline must have started. A complicating factor that emerged in our detailed look at European experience is an apparent cultural element in the decline of fertility, an element that we can observe, although not very satisfactorily explain. One of the first studies of the demographic transition at an intensive geographical level was by a graduate student (William Leasure) writing his doctoral dissertation at Princeton [5]. Leasure decided to analyse the decline of fertility in Spain, since it was somewhat surprising that there had been a major reduction by 1930 in conservative Catholic Spain. He made a colour-coded map of marital fertility in the 49 provinces of Spain in 1911, in the middle of the transition. A striking feature of this map was that the provinces that had the same colour were geographically clustered, although they were not identical in social, economic, or educational characteristics. For example, Catalonia, an area on the Mediterranean near the border with France, which contains Barcelona as one of its provinces, had low fertility earlier than any other region, and the lowest fertility in Spain in 1911. Catalonia as a region includes some rural provinces that had very little industry and also were not very high in literacy. Yet these provinces were low in fertility as well as Barcelona, which *was* industrialized. In contrast, the Basque region, the locus of the steel industry, had high fertility. Not being able to understand this regional clustering, I suggested to Leasure that he take his map to someone in the modern

languages department who specialized in Spanish culture and language. When the professor of Spanish looked at the colour-coded but unlabelled map, he said it was a linguistic map of Spain. Perhaps one of the reasons for regional clusterings that are similar to linguistic regions is that the spread of contraceptive practice and deliberate limitation of family involve both a change in ideas and a mastery of technique. These social changes are probably accomplished by a combination of person-to-person communication and imitation. If the community leaders limit their families, then contraception becomes socially sanctioned. If the next-door neighbour reports that her husband "takes care" (the folk expression for withdrawal) and that he remains mentally stable, a housewife can learn that there is a feasible way of avoiding pregnancy. Both imitation and intimate communication naturally have linguistic boundaries. It is hard to imagine a Frenchman imitating a German, and the transmission of intimate information is difficult for persons speaking different languages. Another possible reason for the regional clustering of fertility patterns is that regions in Spain that have different dialects also have very different histories. Originally they were different kingdoms, with different legal and social traditions.

Livi Bacci, in his study of Italy, examined the relation between marital fertility by province in each census year from 1911 to 1961 and the vote in 1974 in a national referendum on the liberalization of laws governing divorce. There was a significant association – the provinces in which the vote went against the church were those in which at earlier dates (including 1911) marital fertility was low. From 1931 to 1961 the correlation among the Northern provinces between marital fertility and the divorce rate was higher than the multiple correlation with six socio-economic variables. Why was marital fertility in 1931 (or 1911) so closely associated with a vote on divorce legislation in 1974? Doubtless it was conservative adherence to the position of the Catholic Church that led to a vote against the liberalization of divorce laws in 1974; a similar adherence to the precepts of the church in the same provinces several decades earlier impeded adoption of contraception.

Ron Lesthaeghe has found that secularization (as indicated by the proportion of votes cast for socialist or social-democratic parties) is strongly correlated in several European countries with the date of initiation and the pace of fertility decline.

Additional evidence from the European Fertility Project about the importance of cultural factors in the decline of fertility comes from the book on the decline in fertility in Russia, of which I was co-author [2]. (The book on Russia extended beyond Europe, including Asiatic as well as European Russia.) In Russia we found a strong correlation between the nationality composition of the population of each province and the timing of the decline in marital fertility. The Baltic provinces of Russia that are the most Western in culture, strongly influenced by Swedish or German ties, were the first to reduce fertility. Next were provinces in the west of

Russia with non-Great Russian populations (such as Ukrainian, White Russian, Polish, or Rumanian). Next were the provinces with Great Russian populations, although those with a large representation of eastern Finnish, or other non-Slavic groups, generally reduced fertility later. Finally, the Central Asian area had not experienced a decline in marital fertility as late as 1970, despite greatly reduced mortality rates and impressive progress in education (more than 90 percent of women 20–29 had at least primary schooling.) These peoples – the Tadjiks, Kirghiz, Turkmen, and Uzbeks – had very low levels of female literacy and very high mortality rates and predominantly agricultural or pastoral occupations in 1926. They also had a culture in which the position of women was very subordinate, and in which high rates of childbearing, especially of male children, were greatly valued.

The failure of fertility to decline in the Central Asian Republics (in the rural areas, the absence of a reduction in the birth rate as late as 1980 suggests that a decline has not occurred yet) leads me to suspect that the Muslim culture in these republics and elsewhere may be particularly resistant to lower fertility. I am not suggesting that there is an official Islamic religious doctrine, like that of the Roman Catholic Church, stating that artificial contraception is contrary to natural law and sinful behaviour. Rather it is the traditional culture that has developed in Islamic populations that retards the decline in fertility as modernization begins. The culture elements involved include an extremely subordinate position for women, and a belief that their proper role is childbearing and child-rearing.

The European Fertility Project leads me, then, to the following tentative conclusions:

(1) A sufficiently complete degree of modernization (including universal education for both males and females through secondary school, predominantly urban residence, employment in large-scale non-agricultural industries, advanced scientifically based techniques of manufacturing, transport, and communications, and widespread owner-ship of modern amenities) is accompanied by the general use of parity-related methods of controlling fertility and much reduced rates of childbearing by married women.

(2) The initiation of a decline in fertility is often associated with lowered mortality, increased education, and changes in occupation. No check-list of such characteristics can be formed that defines a threshold indicating that fertility reduction will begin.

(3) There are cultural factors that help determine the start and spread of controlled fertility. In European experience, populations with a more secular, less religious orientation seem to have been more prone to begin the deliberate reduction of the rate of childbearing.

In summarizing preliminary findings of the project in 1973, I listed three prerequisites for a sustained reduction in fertility caused by parity-related use of contraception: (i) fertility must be within the calculus of conscious choice — i.e. the deliberate decision to have a certain number of children must be viewed as morally and socially acceptable; (ii) reduced fertility must be viewed as advantageous; and (iii) effective techniques of fertility reduction must be available [1]. When a less developed country becomes fully transformed by modernization, these three preconditions come to prevail. But some cultures and traditions are more resistant than others to the emergence of these prerequisites.

The Demographic Transition in the Less Developed Countries

In Figure 3, the transition in fertility and mortality in two European countries is represented by a series of dated combinations of total fertility rate and expectation of life at birth. The classical pattern of the demographic transition is an increase in expectation of life while fertility remains fixed, followed by a further increase in expectation of life accompanied by a decline in fertility. This pattern is approximated in the experience of Sweden. The rise in expectation of life while fertility remains constant causes a period of accelerated growth in populations; the later stage of declining fertility restores a low rate of population increase. In France the declines in mortality and fertility were nearly synchronous; the combination of total fertility rate and expectation of life was never far from the point of zero growth.

In all less developed countries some part of the rise in average duration of life that characterizes the transition in mortality has occurred. In many instances the decline in mortality is shamefully short of what it might be; nevertheless, even the most isolated countries in Tropical Africa now have a life expectancy substantially higher than 20 years ago. There have been two categories of mortality transition in the LDCs. In one category the possibilities provided by modern medicine and public health have been progressively realized, and major gains in life expectancy have continued. A few areas — for example, Hong Kong, Singapore, and Taiwan — now have mortality rates by age indistinguishable from the rates found in many European countries. In these same areas, however, increases in income and progress in education make the term "less developed" no longer very apt.

The second category of the LDC mortality experience (found, for example, in India, Pakistan, Bangladesh and, approximately, in Egypt) is a large increase in expectation of life from about 30 to 50 years in the middle years of this century. In this second category, the increase in expectation of life has decelerated — mortality may still be falling, but not so rapidly. Mortality has fallen in the LDCs for several reasons. Deaths from famine have been avoided by increased agricultural productivity plus improvements in the internal and international distribution of food, which soften the impact of local crop failures. Most important in attaining an expectation of life around 50 years rather than 30 or 40 has been scientific and technical progress in low-cost prevention and treatment of disease. Smallpox has been eradicated; it was a major cause of death. Vaccines now reduce the incidence of many childhood diseases, and insecticides have drastically lowered mortality due to malaria and other high-mortality ailments transmitted by insects. Antibiotics can cure many formerly fatal illnesses and can be inexpensively distributed.

The increase in expectation of life at birth has slowed because of the absence, in the second category of the LDC mortality experience, of basic changes in the environment and the sanitary habits of the population. Water and food are contaminated with bacteria and intestinal parasites. Children are subject to diarrhoea and enteritis as soon as supplementation of mother's milk begins; mortality rates from age six months to five years are very high as a result. Unsanitary obstetrical practice causes infant mortality from umbilical tetanus. Such sources of high mortality can be changed only by fundamental changes in attitude and day-to-day behaviour and provision of new facilities in the villages.

Some countries in which per capita incomes remain very low have risen above the apparent barrier that seems to retard increases in expectation of life once an average duration of life of about 50 years is reached. Two such countries in Asia are China and Sri Lanka. In both, health programmes have been effective although average income is probably no higher than in Pakistan. Emphasis on health education, on extension of availability of medical services to the rural pupulation, on training in basic medicine of millions of "barefoot doctors", and on the development of thousands of epidemiological centres has increased the expectation of life in China to nearly 68 years.

The expectation of life at birth has increased by a large margin in all LDCs, but there is no similar uniformity in recent fertility trends. In Table 1 there is a list of LDC populations in which there has been a recent major decline in fertility. The countries are ordered from the greatest to the least proportionate reduction in the total fertility rate. The ordering is imprecise because not all the data are highly accurate; moreover, the time interval is different from country to country. The top six countries on the list are all in East Asia, and either have a predominantly Chinese population or a culture (S. Korea) strongly influenced by Chinese traditions. Also Singapore, Taiwan, Cuba, Mauritius, and Puerto Rico are islands; all eight populations with a 50-percent reduction are East Asian, or islands, or both. The large reduction in fertility in the East Asian populations under quite different governmental structures and economic conditions supports the view that culture is important in fertility reduction. Moreover, in all of these populations a combination of a major increase in age at marriage and the wide practice of contraception or abortion accounts for the decline.

Table 1

Recent Reductions in Fertility (Total Fertility Rate) in Selected Less Developed Countries

Country	Earlier TFR		Later TFR		Percent reduction
Singapore	6.3	(1959)	1.9	(1977)	70
Taiwan	6.5	(1956)	2.5	(1980)	61
China	5.9	(1966–70)	2.6	(1977–81)	55
Hong Kong	5.1	(1960)	2.4	(1977)	53
S. Korea	6.0	(1960)	2.9	(1976–80)	52
Cuba	4.7	(1960–64)	2.3	(1977)	52
Mauritius	6.4	(1952)	3.1	(1977)	52
Puerto Rico	5.0	(1950–54)	2.4	(1975–79)	51
Costa Rica	7.4	(1960)	3.8	(1976)	49
Thailand	6.6	(1965)	3.9	(1979)	41
Chile	5.3	(1955–59)	3.1	(1975–79)	41
Colombia	6.8	(1964)	4.2	(1978)	38
Malaysia	6.9	(1957)	4.3	(1976)	38
Sri Lanka	5.9	(1950–54)	3.7	(1970–74)	37
Mexico	7.2	(1965)	4.7	(1979)	35
Brazil	6.2	(1945–49)	4.3	(1975–79)	31
Venezuela	6.8	(1960–64)	4.8	(1975–79)	30
Turkey	6.8	(1945–49)	5.1	(1970–74)	25
Philippines	6.6	(1960)	5.1	(1976)	23
Dominican Republic	6.7	(1960–64)	5.3	(1975–79)	23
India	6.2	(1951–60)	4.9	(1979)	21
Tunisia	7.3	(1965-66)	5.9	(1974+75)	19
Panama	5.9	(1960–64)	4.8	(1975)	19
Egypt	6.7	(1959-60)	5.5	(1975-76)	18
Peru	6.6	(1964)	5.5	(1974)	17
Indonesia	5.5	(1968)	5.0	(1977)	10

There are 9 populations listed in Table 1 with a drop in TFR of 30 – 50 percent and 9 more with a reduction of 10 – 25 percent. The 26 populations listed total 2.4 billion persons; about 900 million live in LDCs with a decrease of less than 10 percent, no decrease at all, or some increase in fertility. The 900 million live in Tropical Africa, and a belt extending from Bangladesh through Nepal, Pakistan, Afghanistan, Iran and most Arab countries to Morocco — with exceptions such as Egypt and Tunisia.

Is the Demographic transition in Europe a key to explaining demographic changes in the LDCs and a guide to estimating future fertility trends? The basis of the decline in mortality in the 19th century Europe and the 20th century Asia, Africa, and Latin America is different, and so is the pace of change. Gradual economic improvement and slow changes in preventive and curative medicine caused a slow rise in expectation of life in Europe; the sharp impact of the transfer of modern technology in medicine, sanitation, agriculture, transport, and communications has brought a much more abrupt recent increase in the average duration of life in the LDCs.

The pace of the mortality component of the transition in the LDCs is thus much more rapid than in any European population.

In those LDCs in which the fertility component of the transition has already occurred, the reduction in fertility has also been at a pace more rapid than that in Europe. There are a number of possible reasons for the unprecedented speed of decline in the eight LDCs in which the TFR has fallen by at least 50 percent (generally in less than 20 or 25 years). In most of these populations there has been a very rapid social and economic transformation, with major declines in mortality, large increases in school enrolment, and impressive gains in per capita income. A novel element absent in the 19th century Europe is family planning programmes, governmental and private, with clinics that offer modern contraceptive techniques more effective and easier to use than any forms of contraception known before World War II and supporting educational and informational activities.

The LDCs that have had a large and steep decline in fertility differ from those that have had only a modest and gradual decline, and from those that have had none at all, in one or more of these characteristics:

(1) the rapidity and pervasiveness of general social and economic progress, especially in reducing mortality and attaining universal education;

(2) the presence or absence of an effective family planning organization (public, private, or both) providing distribution of contraceptives, clinics for various related medical services, information and education;

(3) the existence or non-existence of incentives and penalties that favour couples who restrict their childbearing; and

(4) the compatability of voluntary decisions to limit childbearing, and the choice of small families, with the general culture and strongly held beliefs.

Only the first and fourth factors were operative in the demographic transition in Europe. A thorough look at European experience has revealed that social and economic changes affect fertility differently in different cultural contexts. The

absence of fertility reduction in the Central Asian parts of the Soviet Union suggests that in Pakistan in the next two or three decades attainable progress in health and education might by itself bring little reduction in the rate of childbearing.

In terms of the evolution from a combination of a high TFR and a low expectation of life consistent with near zero growth to a combination of low TFR and a high expectation of life with the same low growth potential, Pakistan has moved far along the path to longer life (from a mean duration of less than 30 years to more than 50 years), but has hardly moved towards lower fertility rates. The Pakistan Fertility Survey revealed very low rates of contraceptive practice (only five percent of married women currently practising). A slight reduction in the total fertility rate has probably resulted from a recent increase in age at marriage, but the rate remains close to 7 children per woman. To interpret the demographic transition as implying that economic development will soon bring a lower birth rate and a rate of increase less than three percent is unwarranted.

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Intersectoral Tax Burdens in Pakistan: A Critical Review of Existing Evidence and Some New Estimates

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The study has two objectives: to evaluate existing empirical work on the subject of sectoral tax burdens, and to present alternative estimates of relative tax capacity and tax burden for the farm and non-farm sectors during the Seventies. The results indicate that whereas the agricultural sector as a whole was overtaxed compared to the non-agriculture sector, the higher income groups in the farm sector were substantially undertaxed as compared to their urban counterparts. This fact reflects the extreme regressiveness of the agrarian tax structure in the absence of an effective direct tax on agricultural income.

Taxation of the agricultural sector is a major instrument for mobilization of the surplus and redistribution of income in the economy, the two most crucial problems facing developing countries today. Agriculture, by virtue of the fact that it is the largest sector in most of the developing countries, is expected to make a significant contribution to the resource mobilization effort in the public sector. The importance of agricultural taxation in the development literature also derives from its role as a major mechanism for transferring resources from agriculture to finance the expansion of industrial investment. Mobilization of agricultural surpluses through tax policy or changes in intersectoral terms of trade has played a vital role in the development policy of several centrally planned economies as well as a number of capitalist countries.

Apart from considerations of economic objectives, a strong case can be made for comparable tax treatment of agriculture on the basis of the traditional fiscal canon of equity which "demands that the burden involved in rapid economic development be distributed equally among the different sections of the population" [4, p. 67]. There are two aspects of equity; tax-paying units in similar economic conditions should be treated equally (horizontal equity), whereas those with greater ability to pay should bear a greater tax burden (vertical equity) whatever the sectoral origins of the income.