Commentary: Global Demographic Change: Dimensions and Economic Significance

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The connection between demographic and economic change, on which Bloom and Canning have done so much important work, has been at the center of work in economic history for many decades now. Population change used to be at the very center of economic thought: In the first half of the 19th century, Malthus' ideas dominated much of the thought of the macroeconomics of classical political economy, and every professor teaching the Industrial Revolution gloats in recounting how the famous "An Essay on the Principle of Population" was obsolete almost from the day it was published.

Most economic historians still believe that in the historical past prior to 1750 or so, population change has played a central role in determining the fate of the economy and that the Industrial Revolution was the watershed in which this nexus was weakened. Economic and demographic historians have carried out a huge amount of research reconstructing population history, casting new light on dark statistical ages (Wrigley and Schofield 1981, 1997). We know a lot about the demographic past of European populations, though as we go further back in time the dates become steadily more unreliable until they all but vanish altogether and matters become inevitably vague. Let me sum up the points of consensus and then say a few things about what it is we simply do not know yet. I will mostly

confine myself to the history of Europe after 1750. I will first list a few consensus facts, then some remaining puzzles and debates, and finally propose a very brief outline how to think of it.

Facts

1. Before 1750, Europe was, by and large, in a "high-pressure" equilibrium in which both birth and death rates were quite high, but population growth was slow, uneven, and often reversed (Livi Bacci 2000).

2. The only effective measure of population control, prevalent in much of Europe, was delayed marriage [infanticide was not compatible with Judeo-Christian religion, though neglect often approximated it] (Hajnal 1953, 1965). Women in early modern Britain often waited until age 23-24 to get married, lopping off an effective full one-third of their reproductive life span.

3. By 1750, population started to increase all over the European continent, a process that continued until the 20th century, when it grinds to a halt. The rise and subsequent decline of population growth is known as the demographic transition (Chesnais 1992), as illustrated in Figure 1.

4. In the intervening years, Europe's population increased approximately from 140 million to around 800 million, despite the rapid emigration of the period between 1840 and 1910 (McEvedy and Jones 1978).

5. The increase was in part due to falling mortality and in part to increasing fertility, though the relative size of these components differs considerably from country to country, from period to period, and between rural and urban areas (Coale and Watkins, eds., 1986; Chesnais,1992), as demonstrated in Table 1.

Figure 1
The European Fertility Transition

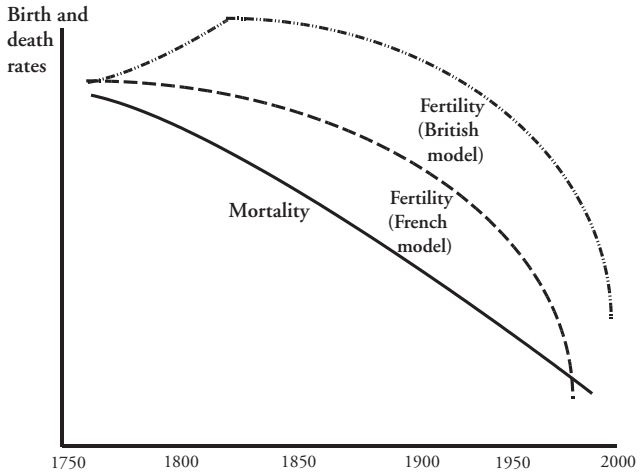


Table 1
Crude Death and Infant Mortality Rates, Selected European Countries, 1881-1913

	England and Wales		Germany		France		Sweden		Netherlands	
	Crude death rate	Infant mortality	Crude death rate	Infant mortality	Crude death rate	Infant mortality	Crude death rate	Infant mortality	Crude death rate	Infant mortality
1881-85	19.40	139	25.76	229	22.20	167	17.5	116	21.4	181
1886-90	18.88	145	24.44	224	21.98	165	16.4	105	20.5	175
1891-95	18.74	151	23.26	224	22.32	170	16.6	103	19.6	165
1896-00	17.68	156	21.26	217	20.64	158	16.1	101	17.2	151
1901-05	16.06	138	19.90	199	19.58	141	15.5	91	16.0	136
1906-10	14.70	117	17.54	174	19.18	128	14.3	78	14.3	114
1911-13	13.90	111	15.97	163	18.27	126	13.9	71	13.0	105

6. Until the mid-20th century, the decline in mortality has been largely due to the decline in infectious diseases, and most of the life expectancy gains were due to a decline in infant and child mortality (McKeown 1976, 1988).

7. Much of the decline in mortality was slowed down by urbanization: Because urban death rates were for many decades much higher than rural ones, mortality rates were stagnant even though both urban and rural rates were falling (Woods and Woodward, eds., 1986).

8. Fertility followed a more complex path, with appreciable increases in the period 1750-1850 in some economies but not everywhere. After 1850, a decline sets in, which *eventually* covers all countries but which happens much earlier in some places than others (Coale and Watkins 1986).

9. The decline in fertility is in part due to better fertility control but mostly due to a decline in desired family size.

Where things are still quite controversial is in understanding *why* all this happened. Here are some of the more poorly understood issues:

Puzzles

1. What, if any, was the connection between the Industrial Revolution and demographic change? Focusing too much on the British case could be misleading here: The rise in fertility, because of increased propensity to marry, observed by Wrigley and Schofield, was attributable to the expansion of employment opportunities in domestic industries and later factories. There is some reason to believe that this phenomenon was specifically British, though fertility may have also increased in Ireland and Germany in the second half of the 18th century.

2. How did demographic change affect economic growth in the early stages of the Industrial Revolution? Between 1760 and 1840, demographic change is likely to have retarded the onset of modern economic growth because of Bloom-Canning type of effects—that is to say, a temporary increase in the proportion of children under age 15 as fertility rates increased and infant mortality rates declined. Wrigley and Schofield (1981) document a rise in dependency ratio until about 1825. This, too, may be specific to Britain.

3. How did changes in mortality and fertility affect growth rates in the long run? This question is hard to answer, since Bloom-Canning effects work in part through labor participation effects. The picture is contaminated by changes in participation rates (decline in child labor and married women participation rates), a decline in frictional and seasonal unemployment rates due to improved transportation and communications technology, and emigration of people in "prime ages."

4. A more obvious connection between demographic change and economic growth, and one not stressed by Bloom and Canning, was through physical health and decline in morbidity. Diseases come in different kinds, and the net economic effect of any decline in morbidity depends both on the age of the patients and on the types of diseases that are being eliminated. In the 19th century, some of the diseases on the retreat were mostly dangerous to babies (smallpox, food poisoning), whereas tuberculosis, for instance, killed young adults. Some diseases had higher measurable social costs if they debilitated but did not kill (such as parasitic disease or polio). Other diseases either killed patients very quickly or they made a full recovery. A third kind of diseases weakened immune systems and thus made people more susceptible to *other* diseases. The social costs of medical progress thus differed a great deal by disease. The net effects of the decline in each disease are still not fully understood. What is therefore needed is a general disease-specific analysis of mortality decline.

What is often argued, however, is that relative to Africa and the warmer parts of East and South Asia, Europe suffered relatively less from parasitic and debilitating diseases, making morbidity less costly. For an interesting example of the impact of hookworm on the U.S. South, see Brinkley (1997).

5. After 1860, there are signs that improved nutrition and housing, as well as breakthroughs in certain kinds of medicine, start to improve immunity and reduce the impact of certain diseases. There are subtle signs that people grow healthier late in the 19th century: Most of them are from estimates of height (Steckel 1995; Floud and Steckel, eds., 1997). Taller people are, in and of themselves, not more productive of course, but height is correlated with health. Healthier and better-fed children grow taller and can absorb human capital more efficiently. Healthier adults are more productive. This kind of change shows up in the "residual" of standard measures of total factor productivity (TFP), and it is precisely the kind of effect that Bloom and Canning have in mind. During the industrialization process, urbanization clearly increased mortality, but this was increasingly attenuated by rising real incomes and improved nutrition after 1850, though not before. Perhaps the sharpest decline in mortality, especially in infant mortality, occurs in the first two decades of the 20th century. This has never been fully explained, but one prime candidate is that urban mortality rates finally came down as a result of urban public health campaigns and the so-called "urban penalty" was eliminated.

6. How do we distinguish between McKeown effects, which attribute the decline in mortality to rising incomes that led to improved nutrition and housing, as opposed to public-health effects that attribute the decline in death rates primarily to public health campaigns? The literature on this issue is complex and cannot be done justice to here. At an early stage, empirical work by Preston (1976) indicated only weak support for the income-

led health hypothesis, and subsequent work by Szreter (1988) has further weakened it, but see Fogel (2004).

7. The decline in 20th century European fertility seems the most puzzling of all demographic phenomena. A naive Darwinian approach would perhaps underline the surprise. After all, in the 19th century, the population of the Western world had become the most successful species in the history of the planet in terms of its ability to control its external environment, command resources, and increase its living standards. Yet, despite the fact that if sociobiology means anything, it must mean that Darwinian selection over thousands of generations presumably should have selected people by their "preference for offspring," meaning that as living standards rose, people should have enjoyed vast families—this is not what happened. Instead, it seems as if the Western world is well on its way to commit demographic suicide. There are, of course, some good explanations for this, but which of the many suggested holds true is still up in the air.

8. What is also poorly understood is the internal variation within Europe. Basically, the stylized facts are these: In terms of economic development and technological leadership, Britain was the undisputed leader. But in terms of demographic change, it was somewhere in the middle. In terms of mortality, as far as we can tell, England and Wales were behind the Scandinavian countries, Germany was behind France, and Belgium was behind the Netherlands. Obviously, industrialization and income were not the only explanation of mortality (Chesnais 1992, pp. 77, 145). The same is true for fertility decline: France, as is well-known, led the world in fertility decline, followed closely by Sweden, Belgium, and Switzerland (Chesnais 1992, pp. 104-105, 146). What we can say, therefore, is that while all European countries made the transition from the high-pressure to the low-pressure regime after 1750, they followed quite different trajectories. Some of them, like Ireland and Russia, were highly unusual for different reasons. Yet, oddly enough, after 1945 we observe a

great demographic convergence, in which the differences between the various European countries slowly evaporated—so that by now most of the variations in crude birth and death rates, as well as infant mortality rates, have become very small (excepting many of the succession states of the former Soviet Union).

Table 2
The Demographic Convergence

	Birth rate, 1900	Birth rate, 2000	Death rate, 1900	Death rate, 2000
Great Britain	28.7	10.6	18.2	10.4
Germany	35.6	8.2	22.1	10.6
France	21.3	12.3	21.9	9.3
Italy	33.0	8.6	23.8	10.9
Ireland	22.7	15.3	19.6	8.3
Netherlands	31.6	10.6	17.9	8.9
Belgium	28.9	9.7	19.3	10.0
Sweden	27.0	8.2	16.8	10.6
Hungary	39.4	8.8	27.0	13.5
Switzerland	28.6	8.6	19.3	9.8
Russia	49.3	8.6	31.1	14.6
Romania	38.8	10.4	24.2	12.5
Coefficient of variation	0.24	0.20	0.18	0.16

Toward an explanation of long-term demographic behavior

How are we to think of this? Demographic behavior is hugely complex—some of it rather simple at the level of incomes and costs, and much of it at levels of analysis that economists rarely deal with. Social historians used to refer to "modernization" before the term became unfashionable. Yet, some aspects of it are clearly central to the story here. I will just mention two: secularization and gender history. The role of religion in daily life in Europe declined sharply after 1800, whether we look at Catholic, Protestant, or Orthodox countries. With secularization came two related phenomena that affected demographic behavior: One was a less fatalistic approach to disease

and death, which prompted people to take a more activist approach toward the prevention and treatment of disease. The other was a greater willingness to control fertility.

Furthermore, modernization, whatever it is, also affected the division of labor between men and women in Western society. As far as gender roles are concerned, the identification problem is simply horrendous: Did women have fewer babies because their economic role in society changed or did their economic function change because of lower desired family size? To confuse things further, the development here was far from linear and monotonic: Between 1800 and maybe 1920 or 1930, women's role in society changed toward greater specialization in home-making; only after 1945 do we see a slow increase in married women in the labor force. The decline in fertility preceded this emancipation.

To propose a theory explaining all of this in a few pages would be pretentious indeed. Yet, let me make an argument taken from my earlier work on the role of knowledge in the economic transformation of society (Mokyr 2002). The argument is microeconomic in nature and thus complements the fundamentally macroeconomic approach of Bloom and Canning. The model is an explanation of the decline of mortality, but it can easily be adapted to matters of fertility control. Look at the standard model of consumer behavior. Each consumer chooses a set of goods he or she buys or obtains at some cost. These goods are chosen because they are in some way pleasure-enhancing, or because the consumer thinks that they are health-enhancing or both. This can be written simply as

$$U = U(X_1, X_2, \ldots X_n, H). \qquad (1)$$

and

$$H = H(X_1, X_2, \ldots X_m), \qquad (2)$$

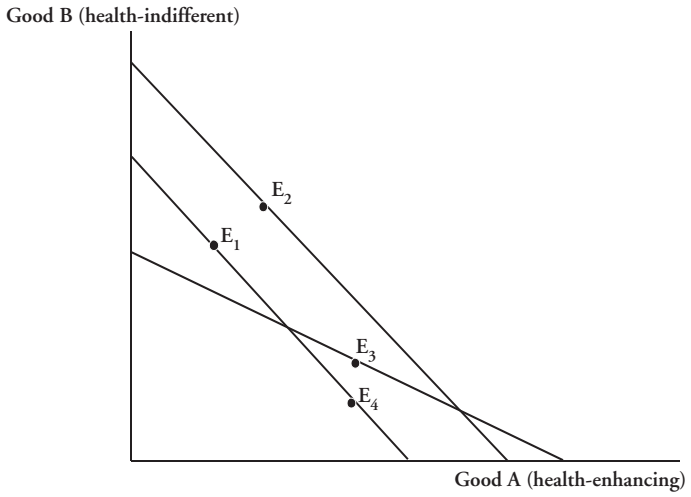
where m < n goods affect Health. Note that the X's stand for both market-purchased and home-produced goods and services.

How does the consumer choose, given some budget constraints? The problem is that equation 2 is never directly observed and hugely complex, containing complex relations between microbes, the immune system, and climate. Two extreme cases: (a) complete information, that is, the consumer behaves as if he or she fully knows equation 2. This implies a bundle of **X**'s that maximize utility including health, say **X***, (b) primitive consumption: The consumer ignores equation 2 altogether. This implies a very different bundle of **X**'s, say **X**'.

Consumers normally find themselves at an allocation somewhere in between the two. But within that continuum there is a great deal of room for improvement, as consumers become better informed and change consumption habits to accommodate the new knowledge. The point I wish to emphasize is that *private* health improvements may have been as important as the much touted "public health" improvements. When the consumer learns more about his or her health being affected by consumption, he or she can often redeploy resources in a fairly minor way and attain considerable improvements in health without major additional expenses. This explains the decline in mortality rates from infectious and deficiency diseases long before cures were available: Prevention was easier than cure. As can readily be seen, a rise in income would have a comparable effect, since at higher income a consumer would consume more goods he and she likes, and hopefully the effect of the increase in the consumption of health-enhancing goods dominates that of health-reducing goods. But an increase in the consumer's knowledge of equation 2 can improve health even when income stays the same. Thus, rising income and improving knowledge reinforced one another. To complete the argument, moreover, we can regard changes in public policy as income-preserving changes in relative prices, in which health-enhancing goods such as clean water or insect control are now supplied at a much lower price due to the government taking a more active role. There are, thus, three effects: a McKeown effect (pure income rise), a public policy effect (relative prices), and a *knowledge* effect (in which health improves even in the absence of the other two simply because equation 2 is now somewhat better understood. These

three effects are illustrated in Figure 2. Good A is assumed to be health-enhancing and health is a rising function of A. We start off from E_1. A pure income effect would take the economy to E_2 whereas a pure relative price (public policy) effect would take us to E_3. A fourth possibility is for the economy to move to E_4 on account of better knowledge of equation 2. In reality, of course, the three effects occurred side by side, but analytically they are quite distinct.

Figure 2
Income, Price, and Knowledge Effects in Mortality Decline



Between 1870 and 1920, the main developments in this field were the discovery of the germ theory of disease, the discovery that consuming trace elements of certain substances could prevent diseases, and the growing use of experimental methods and statistics in medical science to establish patterns and regularities that would help epidemiologists understand modes of infection. This led, for example, to the discovery that insects were vectors of certain diseases but not others, how fresh cow milk could pass on bovine tuberculosis, how and when water that looked clean and tasted fine might still have to be boiled or filtered, and many similar discoveries. At times, of course, the new knowledge turned out to be wrong and needed to be corrected. Some diseases defied medical knowledge, and there was

little consumers could do to help them avoid them (for example, polio before the vaccine).

These advances were constrained in their diffusion to the population at large. First, the knowledge had to be developed and scientists had to persuade one another. Second, the knowledge had to be disseminated to the population at large through education and information channels. Third, once people were aware of the effects, they still had to be persuaded to change their behavior in the face of customs, habits, suspicion of authority, addiction, lack of self-control, and plain conservatism. Fourth, of course, the new allocation toward more health-enhancing consumer goods had to satisfy the budget constraints of the population. It is therefore not surprising that there were substantial lags in this process and that it spread out over the better part of a century, and that it caught on more in some societies and groups than elsewhere. Yet, the fact remains that from 1890 on, many of the main infectious diseases that killed people declined and some disappeared altogether, despite the fact that almost none of those diseases could be cured before the appearance of antibiotics.

Improved knowledge can also be argued to have affected fertility behavior, though the story here is a bit more complicated. Of course, contraception is a technology, and not necessarily a simple one. Women and men had to learn things about their bodies, as well as understand risks and find solutions. Bloom and Canning rightly point to the Irish example as evidence of the point that sheer availability of contraceptive means may make a difference to fertility rates.

But many scholars argue that the main reason for the decline in fertility is a different aspect of increasing knowledge: Modern technology meant a rise in the rate of return to human capital, and that the substitution effect here offset the income effect, so that parents preferred to have smaller families with high-quality, well-educated children. This argument is now almost a canon of the economic growth literature. And yet, in my view, the argument is not very persuasive without a great deal more details and elaboration. For

instance, the budget constraint of time has changed in the past 50 years: Men, at least, have far more leisure than they used to have. Why is it that they spend it watching sports rather than raising children? Moreover, much of the investment in human capital of children that is supposedly so time intensive as to swamp the income effect is outsourced to specialists, from kindergartens to summer camps to universities.

What this simple model is pointing to is something deeper than just another explanation of falling mortality rates. It points to the central factor in economic modernization, which led to the demographic transition. The real question is not so much whether income affected health or health affected income. Instead, I suggest that the main engine of *both* demographic and economic change was neither income nor fertility or mortality but an improved ability and willingness to control the external environment in which we live. This required modern science, but it also requires the mechanisms by which the insights of modern science diffuse to the population at large, requiring not just "education" but a certain status of authority and power of the people who control this knowledge, so that they can do more than just inform and enlighten people, but actually make them change their behavior and consumption patterns. That, as we all know, is a much tougher task.

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