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4 Was Industrialization Hazardous to Your Health? Not in Sweden!

Lars G. Sandberg and Richard H. Steckel

4.1 Introduction

The consequences of industrialization and associated urbanization for the health and well-being of the mass of the population have been a topic of study and intensive debate in Britain at least since the days of Toynbee and Marx. Two sides quickly crystallized: the "optimists," who argued that most British workers experienced some modest increase in their standard of living even before 1840, and the "pessimists," who painted a far grimmer picture of impoverishment and degradation. In terms of traditional measures of the standard of living, the consumption of goods and services, the optimists seem to have largely won, although they admit that the pre-1840 gain to the workers was very modest and involved an increasingly unequal distribution of income (the first leg of the "Kuznets curve"). The attempt by the pessimists to counter, by stressing deteriorating living and working conditions (from "sweet Auburn" to the "satanic mills"), was cleverly repulsed by Williamson, who pointed out that the workers accepted increased squalor and risk of disease in return for modest wage premiums (Williamson 1981, 1982). It might be noted, however, that the most striking consequence of an unhealthy environment—namely, increased infant and child mortality—only affected the wage earner–decision maker indirectly. While parents, and would-be parents, no doubt found the prospect of high child death rates distressing (and indeed the result was somewhat higher wage rates in particularly unhealthy areas), still, the principal losers were the dead children themselves. They, however, had no say in the family's location decision.

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More recent work on the health status of the population, in the United States as well as in Great Britain, indicates a deterioration during periods of rapid industrialization and urbanization around the middle 50 years of the nineteenth century (see, e.g., Komlos 1987). This deplorable development is discernible not just in mortality and morbidity, but also, and perhaps most strikingly, in height and weight measures. Despite some apparent increase in the standard of living as conventionally measured, the population was physically deteriorating. Nutrition, net of the demands of growth, work, and struggle against disease and infection, seems to have been tending downward for a majority of the population.

These results raise a number of interesting historical questions. One rather obvious question is whether the "welfare" of the population was in fact improving, even if per capita real income and consumption (as traditionally measured) were tending upward. Another equally important question is what specific aspects of the British and American experience were responsible for the observed deterioration in health. Was it a more or less inevitable consequence of industrialization or urbanization or was it specific to some particular aspect of these processes in those particular countries? Hopefully, this second question can be answered with the help of studies, interesting in their own right, of the health consequences of industrialization and urbanization in other countries and therefore in other settings and time periods.

One interesting alternative case is Sweden. By Western European standards it experienced a rather late but, by any standard, extremely rapid industrialization. Thus the country was in relatively short order transformed from one of the poorest to one of the richest countries in Europe. Today Sweden also has one of the healthiest and, not coincidentally, one of the tallest populations of any country. The fact that Swedish industrialization had distinct rural, or at least semirural, aspects also makes it an interesting contrast to the United States and, particularly, to Great Britain. Finally, the plenitude of (believable) economic, social, and demographic data makes Sweden a prime candidate for study.

4.2 Economic and Demographic Trends: 1800–1995

4.2.1 1800–1870

The important characteristic required of this initial period is that it predate the onset of rapid industrialization and economic growth. The key problem, therefore, is the choice of end point. Although some economic historians have opted for 1850 or 1860 as the most useful break point between traditional and modernizing Sweden, the consensus clearly leans toward (circa) 1870. The best available national income data indicate that per capita GDP increased by approximately 0.25 percent per annum between 1820 and 1850, approximately 1 percent per annum between 1850 and 1870, and approximately 2 percent per

Table 4.1 Raw Data for the Human Development Indexes

Year	Life Expectancy	Stature	Infant Mortality	Literacy	Index of Per Capita Income	Per Capita Income (1970 U.S. $)
1820	39.16	167.0	17.06	82.50	6.87	294.8
1825	44.18	167.6	15.79	83.75	6.81	292.2
1830	39.02	167.9	18.18	85.00	6.75	289.5
1835	42.46	168.2	16.46	86.25	6.91	296.4
1840	42.09	167.6	16.13	87.50	7.07	303.3
1845	42.99	168.1	15.70	88.75	7.24	310.5
1850	43.91	168.2	14.87	90.00	7.41	317.6
1855	40.67	168.4	14.84	91.25	7.98	342.1
1860	44.81	169.5	13.72	92.50	8.55	366.6
1865	45.26	169.0	13.43	93.75	8.42	361.0
1870	44.99	170.2	13.76	95.00	9.33	399.9
1875	45.43	170.3	13.80	96.25	10.86	465.5
1880	48.05	170.9	12.07	97.50	11.32	485.6
1885	49.61	171.5	11.15	98.75	12.09	518.4
1890	51.11	172.3	10.55	100	12.92	554.0
1895	52.80	172.4	9.97	100	14.65	628.2
1900	52.89	172.5	9.83	100	16.12	691.4
1905	55.52	173.0	8.47	100	18.46	791.8
1910	57.65	172.9	7.51	100	20.91	896.8
1915	58.28	173.4	7.05	100	17.87	766.4
1920	57.33	174.1	6.48	100	22.55	966.9
1925	62.61	174.8	5.76	100	27.77	1,190.9
1930	63.07	175.2	5.59	100	32.47	1,392.4
1935	64.95	175.8	4.62	100	35.58	1,525.5
1940	67.02	176.1	3.75	100	39.38	1,688.7
1945	68.89	177.4	2.84	100	42.85	1,837.3
1950	71.40	177.9	2.18	100	49.64	2,128.5
1955	72.56	178.6	1.80	100	54.97	2,357.2
1960	73.38	179.1	1.61	100	63.59	2,726.7
1965	73.94	179.3	1.37	100	77.23	3,311.7

Sources: Keyfitz and Fleiger (1968), Krantz and Nilsson (1980), Maddison (1991), and Cipolla (1968). See text for discussion of height data. The literacy numbers are based on Cipolla's conclusion that Swedish literacy in 1850 was 90 percent and virtually all youths were literate. We concluded that a reasonable rate of increase of literacy in this period was 0.25 percent per year, which implies that literacy reached 100 percent around 1890. The real per capita GDP figures for the period 1820–60 are taken from Maddison (1991). They are then connected to estimates from Krantz and Nilsson until 1970. This procedure was recommended by Krantz, who is the ultimate source of both series. Swedish kronor were converted into 1970 U.S. dollars assuming an exchange rate of 5.18 Skr per dollar.

annum in the following decades (see table 4.1). While these numbers lend some credibility to using either 1850 or 1870 as the break point, other factors point especially to 1870. For example, the fact that Sweden experienced its last non-war-induced subsistence crisis in the late 1860s, together with the extremely rapid industrialization spurt of the early 1870s, certainly argues for

making 1870 the year of choice. More generally, after 1870, numerous economic and demographic indicators started to rise or, when appropriate, to fall rapidly compared with previous rates. More important, even if they on occasion later slowed down, or even reversed slightly, nothing even close to pre-1870 levels were ever to be seen again (Sandberg 1978).

The choice of starting date for the period is less obvious and less important. Whether it is 1720, 1750, 1800, or even 1820 matters relatively little. Whatever the starting date, the period before 1870 presents a basically agrarian country with periods of relative prosperity interspersed with war- or crop-failure-induced periods of famine and unspeakable suffering. The cycle was not of business but of harvests (Carlsson 1961, 33–49).

This is not to deny that things were changing. A distinct upward trend can be discerned in population, and organizational and technological change was beginning to affect the economy, definitely including agriculture. Still, as one of us once wrote with only slight exaggeration, "About the best thing that can be said for the country's economic performance between 1720 (or 1800) and 1850 (or 1870) is that Sweden proper was supporting more than twice as large a population in 1850 as in 1720" (Sandberg 1978, 651). Between 1800 and 1870, the Swedish population increased from 2.3 to 4.2 million. Since a virtually unchanged 75–80 percent of the population was dependent on agriculture for its living in both years, it is hardly surprising that the share of the population categorized as belonging to the "rural proletariat" was increasing. It had grown from about 25 percent of the agricultural population and 20 percent of the entire population in 1750 to close to 50 percent and 40 percent, respectively, during the period between 1850 and 1870. Despite the fact that substantially more land was being cultivated in 1870 than in 1750 or 1800, it was also the case that the average holding of those fortunate enough to be land-owning peasants had clearly shrunk (Gårdlund 1942, 268; Heckscher 1954, 171–72; Samuelsson 1963, 10–13; Hildebrand 1978, 597).

On a slightly more optimistic note, it does seem likely (as confirmed by the per capita GDP figures mentioned above) that output per worker in Swedish agriculture was starting to increase, albeit slowly, after circa 1830. In view of rapidly rising (real) land prices, however, it seems unlikely that per capita income among the agricultural proletariat was improving, and it certainly was declining during the crisis years of the "hungry forties" and the late 1860s. Data on the real wages of day labor tend to support this conclusion. They shows no discernible trend before circa 1870, and there are distinct downturns in the 1845–54 and 1865–69 periods. In view of the positive relationship between rural wages and work opportunities, the wage rate downturns probably fail fully to reflect the true level of distress (Sandberg and Steckel 1988, 12–14).

With regard to other sectors of the economy, there were stirrings in the pre-1870 period. Ironworking began to make a noticeable comeback around the middle of the nineteenth century, and there was progress in mechanical industry. Even more important, the growing demand for timber products, especially

in Great Britain, led to a major expansion of the timber industry starting around 1850. It was not before 1870, however, that modernization got up a real head of steam. The very modest level of industrialization before 1870, together with the rural, or at most semiurban, nature of that industrialization is reflected in the data on urban population. Even though it must be kept in mind that Swedish cities were defined in legal rather than economic or demographic terms, it is still apparent that at least until 1870 urban Sweden was stagnating. Indeed, a recent demographic and economic history of Stockholm during this period is entitled *A Stagnating Metropolis* (Soderberg, Jonsson, and Persson 1991). The share of the total population classified as urban had increased only from around 10 percent in 1800 to around 13 percent in 1870. Even more striking, Stockholm's share of the entire population declined between 1800 and 1850 and had barely recovered to its 1800 level by 1870 (Montgomery 1939, 108; Statistiska Centralbyrån 1969, table 6).

4.2.2 1870–1914

By any standard, this period witnessed extremely rapid industrialization and economic growth. Scholarly debate deals with questions of how fast it was—for example, did Sweden grow faster than any other country in Europe? About the basic trend, there is no disagreement. The same can be said about the late 1890s, which was the most remarkable subperiod within this longer period (Sandberg 1978). It might also be noted that the reason for ending in 1914 is strictly related to World War I (Sweden was neutral) and has no particular economic significance.

During these decades, Sweden's population increased from approximately 4.2 to approximately 5.7 million inhabitants (Statistiska Centralbyrån 1969, 46–47). This reflects a rate of growth somewhat below that experienced during the previous period. It was the net result of falling birth and death rates combined with a very high rate of emigration, overwhelmingly to the United States (see Hofsten and Lundström 1976). Close to a million Swedes departed their homeland, and since virtually all of them were young adults, the long-term effect on the Swedish population was even greater than that number implies (Carlsson 1961, 454–62; Hildebrand 1978, 599). Absent this emigration, the rate of population growth clearly would have been outpacing that of the previous period. While the great mass of the emigrants no doubt improved their economic condition, whether those staying behind gained or lost is less clear and depends, among other things, on the rate of remittances from the emigrants. As for the age structure of the population, the net effect was a very modest change in the size of the working-age (15–64) population from 60.5 percent in 1870 to 59.9 percent in 1910 (Statistiska Centralbyrån 1969, 68).

Our economic data, which are admittedly imperfect, indicate that Swedish national income grew at an average annual rate of approximately 2.8 percent between 1870 and 1910. In per capita terms, this amounts to an equally impressive rate of 2.0 percent (Krantz and Nilsson 1980, table 3.1; Maddison 1991,

table B1). Not surprisingly, statistical measures of rising living standards show similar growth. Real hourly wages and annual incomes more than doubled (Hildebrand 1978, 609). This growth, of course, was also reflected in a rapid change in the sectoral distribution of the population. The share of the population dependent on agriculture dropped from approximately three-quarters to less than one-half, while the share dependent on manufacturing rose from less than one-sixth to approximately one-third (Cole and Deane 1968, 27; Jörberg 1994, 452–53).

From an international perspective, a striking aspect of Swedish industrialization, especially during this period, was its predominately nonurban location. The percentage of all industrial workers employed in noncity locations reached its peak only around the turn of the century. At that time, something in the vicinity of 65 percent of all industrial workers were employed outside the cities (Gårdlund 1942, 296). While it is true that these distinctions are based on legal rather than strictly economic definitions of cities and that the "rural" industrial "agglomerations" were not salubrious garden spots, still, there is, and especially was, a big difference between them and large industrial cities (Swedish or not). Naturally, this rural-dominated location of industry is also reflected in the general urbanization statistics. Between 1870 and 1913, the percentage of the population living in cities had roughly doubled from 13 to 26 percent (Statistiska Centralbyrån 1969, 46). Of course, the figures, especially the latter, would be somewhat higher if the "rural industrial agglomerations" are included. While this rate of growth was far from trivial, it still does not compare with urbanization in the major industrial countries. Furthermore, Swedish cities were overwhelmingly small. In 1910, the population of Stockholm was still less than 350,000, and of the others, only Gothenburg exceeded 100,000 (Milward and Saul 1973, 497–98; Heckscher 1954, 145). The fact of the matter is that almost all Swedish "cities," in 1914 containing a clear majority of all city dwellers, would by contemporary American or British standards best be described as "towns" or, in some cases, as "small towns."

4.2.3 1914–1950

The road Sweden traveled to get from 1914 to midcentury was, in many respects, a rocky one. At the same, however, it clearly was less painful than that of most, or even all, other industrialized countries. Sweden's big advantage, of course, was the ability to remain neutral in both world wars.

Though war is never a good thing, World War I only became a source of suffering in Sweden with the introduction of unlimited submarine warfare and tight blockades in 1917. The food shortage of the winter of 1917–18 was sufficiently serious, however, to set off food riots and to earn Prime Minister Hammarskjöld the less than complimentary nickname "Hungerskjöld." Thus, although Sweden did not endure anything like the hardships of the combatants, the peace was certainly welcome. Unfortunately, there, as elsewhere, it was accompanied by the arrival of the Spanish flu pandemic.

The interwar period began rather inauspiciously with a deliberately created

deflation crisis. Once the prewar position of the krona had been reestablished in 1922, however, the 1920s evolved into a period of growth and prosperity. As in the rest of the industrial world, the good times ran out with the onset of the Great Depression. Despite the distinctly Swedish nature of the so-called Krueger crash of 1932, Sweden weathered the 1930s a lot better than most other countries. The principal reasons for this relatively favorable experience were (1) a prompt devaluation of the krona, (2) the generally favorable development of Swedish export markets, (3) a more expansionary—or at least less contractionary—economic policy than that pursued in most other industrial countries, and (4) good luck. While international political developments were obviously worrisome, not to say downright scary, Swedes had little reason to complain about economic conditions during the late 1930s.

World War II was certainly unpleasant in Sweden. Fuel in particular was in short supply—lots of shivering, not many baths, and virtually no driving. Food was rationed, but unlike the latter part of World War I, nothing resembling starvation or malnutrition threatened. For most people, the biggest irritation was probably the lack of coffee and tobacco. None of this, of course, even deserves to be mentioned in the same breath as the unspeakable suffering that occurred in many other countries.

At the end of the war, Sweden's Keynesian economic establishment shared the general fear of renewed worldwide depression. In fact, of course, a lack of effective demand was the least of Europe's, or the world's, problems. Physically unscathed by the war, Sweden was in almost as good a position as the United States (although obviously on a much smaller scale) to take advantage of the postwar reconstruction boom. Thus, good, if inflationary, times started almost immediately with the war's end, and they were far from over in 1950. Over the entire period 1914–50 the Swedish population grew, but only modestly. The total population increased from approximately 5.7 million in 1914 to approximately 7.0 million in 1950. This slowing rate of growth was the joint result of rapidly falling birth and death rates (Hofsten and Lundström 1976, 12–17). As for migration, after a modest final burst in the 1920s, Swedish emigration fell to very low levels. Instead, a rising level of immigration, much of it consisting of political refugees, took over. Migration was now a net contributor to population growth. It also had the effect of slowing the percentage shrinkage of the economically active age groups (Statistiska Centralbyrån 1969, 124, 130–31). Despite the fluctuations of the period, the general economic trend was clearly upward. Real per capita domestic product increased by an average of 2.5 percent per year (Krantz and Nilsson 1980, table 3.1; Maddison 1991, table B1). Similar gains were recorded in per capita income and other measures of living standards. Between 1913 and 1939, real hourly wages in industry increased by 88 percent, with annual real earnings increasing by 52 percent. The difference was due to a sharp decrease in the workweek. Between 1939 and 1949, these percentage increases were 25.5 and 27 percent, respectively (Heckscher 1954, 280–81).

The continuing rapid industrialization of Sweden can be seen in the figures

for the sectoral distribution of the labor force. By 1950, the share of the population dependent on agriculture had declined to 25 percent. Meanwhile, the share of manufacturing had increased to 43 percent while that of the service sector had risen to an impressive 22 percent. As for the urban-rural division, the cities maintained a fairly steady rate of relative growth. By 1937, the population of the cities had reached the 36 percent level, and by 1950 their share stood at 48 percent (Statistiska Centralbyrån 1969, 46). Once again, these percentages would have been larger if the "industrial agglomerations" were included. In addition, on a world scale, Stockholm was now beginning to approach the size of at least a midsized metropolitan area. Still, the lack of crowding and the availability of space, both within the cities, and certainly in rural areas, continued to be a principal characteristic of Sweden.

4.2.4 1950–1995

The period since 1950 can best be divided into two periods, the split occurring around 1975. The first half, especially the 1960s, was a period of truly spectacular economic growth and prosperity. During the whole quarter of a century between 1950 and 1975 real per capita GDP increased at an annual rate of approximately 2.5 percent. During the period 1960–75, it did so by over 3 percent per annum. Starting around the middle of the 1970s, however, developments in Sweden, as in most of Western Europe, became much more mixed. Between 1975 and 1989, real GDP per capita increased at an annual rate of approximately 1.5 percent. Since then growth has been even slower and more uncertain.

These years, of course, also witnessed the emergence of a so-called service economy. At least in the Swedish case it was, and continues to be, dominated by government services. The share of government expenditures in GNP, as well as the share of taxes in income, reached levels (well above 50 percent) unprecedented in Sweden or elsewhere. Indeed, although apologists for the exploding public sector like, or at least liked, to blame the "oil shocks" for Sweden's recent economic, and especially its productivity, retardation, most informed observers tend principally to blame the bloated government services sector together with the incentive-destroying features of the income redistribution policies being followed.

Sweden's population continued to grow at a modest rate during this period. Increasingly, however, such growth came to depend on continued large-scale immigration. This dependence is seen to be even greater when it is noticed that the immigrant groups have much higher birthrates than do native-born Swedes.

Sweden's urbanization also has continued apace, despite government policies favoring rural areas and small towns. In particular, there has been a striking concentration of population in the three major urban areas centered around Stockholm, Gothenburg, and Malmo. Even these metropolitan areas, however, are characterized by an availability of space not typical of the European continent. In the rest of the country, the forests and their denizens are making a

spectacular comeback. Wolves and bears are reappearing in areas where they have not been seen since the late eighteenth century. Indeed one of the currently popular political justifications for agricultural subsidies is that they help prevent Sweden from losing its open landscape and becoming a single great big forest.

4.3 Mortality, Health, and Heights

4.3.1 1800–1870

One of the most striking features of this period overall is the clear downward trend in mortality and the associated increase in life expectancy (see table 4.1 and figs. 4.1–4.6). This development is made even more intriguing by the absence of any pronounced trend in per capita incomes at least until 1850. Indeed, even if there was some modest increase in average incomes, that trend, as far as health and mortality is concerned (once again, at the very least until 1850), tended to be offset by the increasingly unequal distribution of income and wealth. It thus seems clear that the improvement in health and life expectancy was not principally, or at all, the result of higher incomes and living standards (as normally defined). It is, of course, possible that the opposite effect, from health to income, was at work. That, however, would imply that without the improvement in health, incomes would have been falling.

It is also interesting to look at the trend in heights. Our principal source of height data for this paper comes from measurements of conscripted militia.[1] These records cover cohorts of virtually the entire male population, but unfortunately they only go back to cohorts born in 1819. For earlier periods we have to rely on measurements of the settled (*indelta*) army. The trend in military heights was clearly upward for cohorts born in the 1790s until the 1840s. After that point, average adult heights declined either a lot (based on the settled army) or a little (based on the militia). Growth then resumed, especially for those young men who reached puberty after the subsistence crisis of the late 1860s (Sandberg and Steckel 1988).

We suppose it is possible to argue that the fact that adult heights for cohorts born around 1840, and reaching maturity in the 1860s, were similar to those born in the 1800–1810 period indicates the absence of any overall trend in heights during the whole 1800–1870 period. From such a conclusion, it would then follow that there was little or no connection between trends in mortality

1. Three qualifications about this data source are fully described in the data appendix. First, the age at measurement, originally 21 years, gradually decreased until it reached 18 years after World War II. Since the age was reduced in line with the decline in age at maturation, however, these changes have very little effect on the trend in final adult heights. Second, data are missing for a few scattered years, which required us to interpolate. Third, the military imposed nontrivial minimum height standards on cohorts born between 1819 and 1839. We adjusted for the resulting shortfall using the Quantile Bend Estimator.

Fig. 4.1 Age-specific mortality rates for men aged 1–14, 1751–1970 (deaths per 1,000)
Source: Hofsten and Lundström (1976).

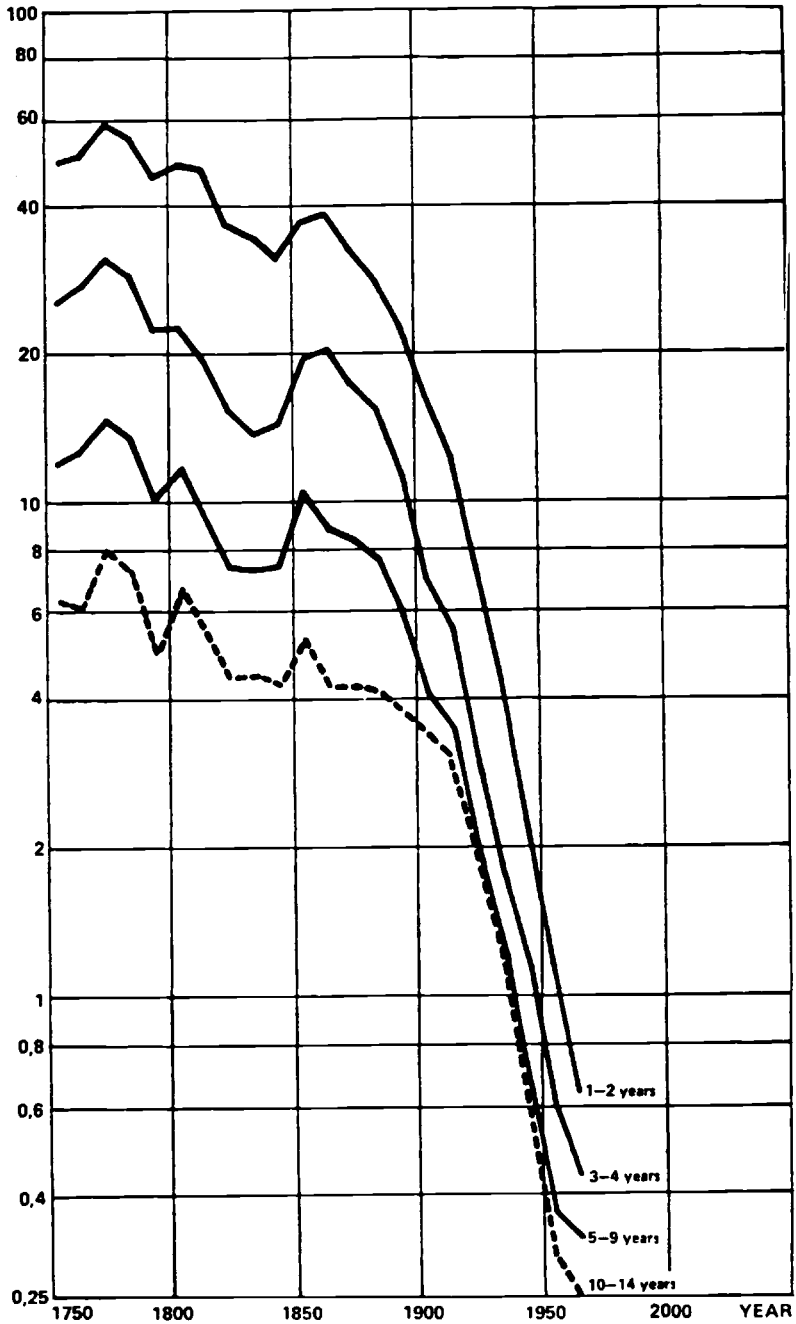

Fig. 4.2 Age-specific mortality rates for women aged 1–14, 1751–1970 (deaths per 1,000)

Source: Hofsten and Lundström (1976).

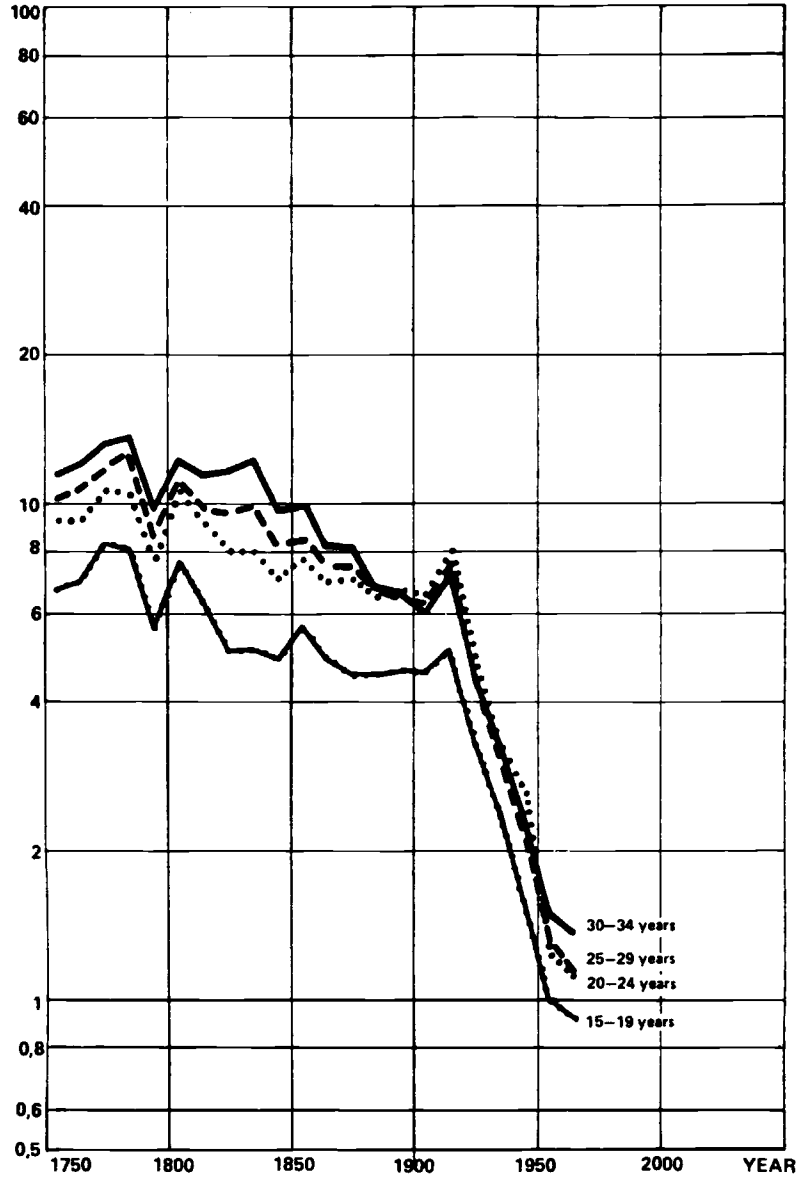

Fig. 4.3 Age-specific mortality rates for men aged 15–34, 1751–1970 (deaths per 1,000)
Source: Hofsten and Lundström (1976).

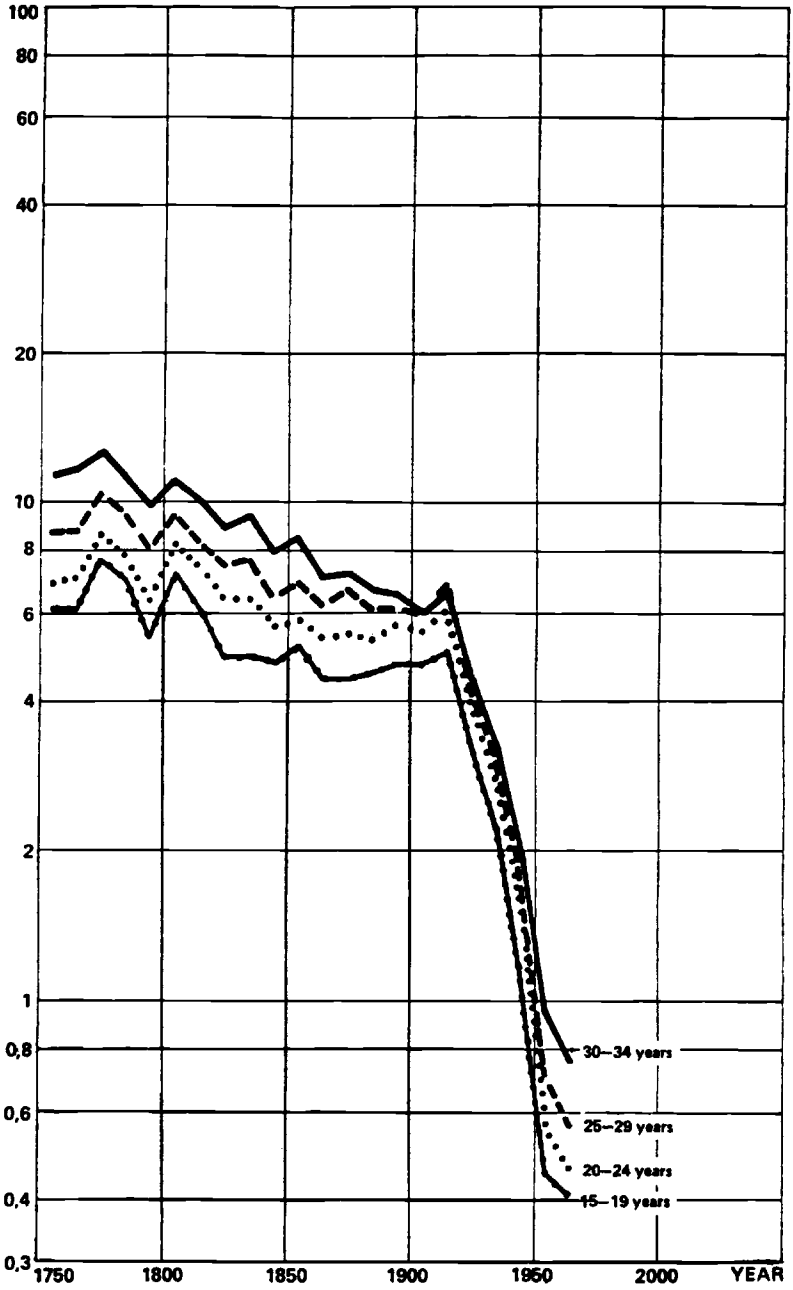

Fig. 4.4 Age-specific mortality rates for women aged 15–34, 1751–1970 (deaths per 1,000)
Source: Hofsten and Lundström (1976).

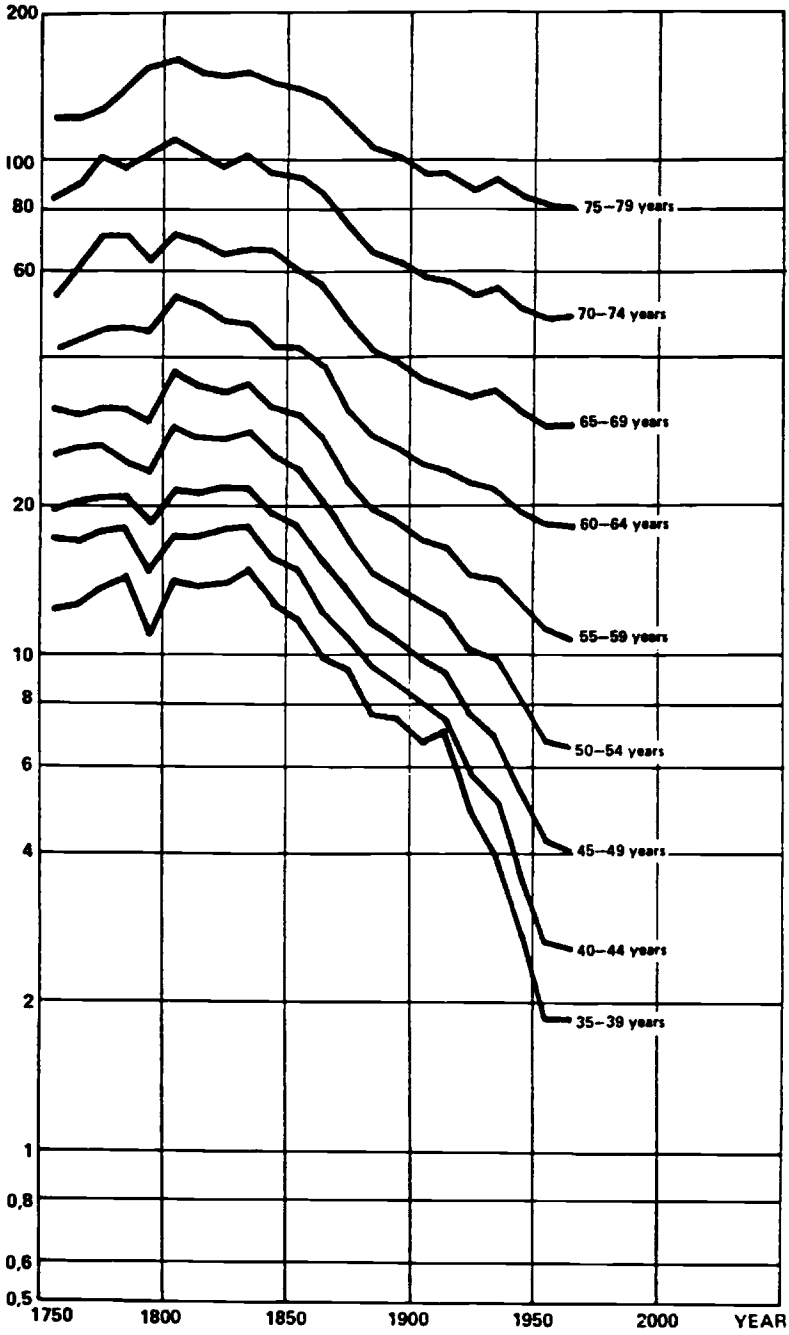

Fig. 4.5 Age-specific mortality rates for men aged 35–79, 1751–1970 (deaths per 1,000)

Source: Hofsten and Lundström (1976).

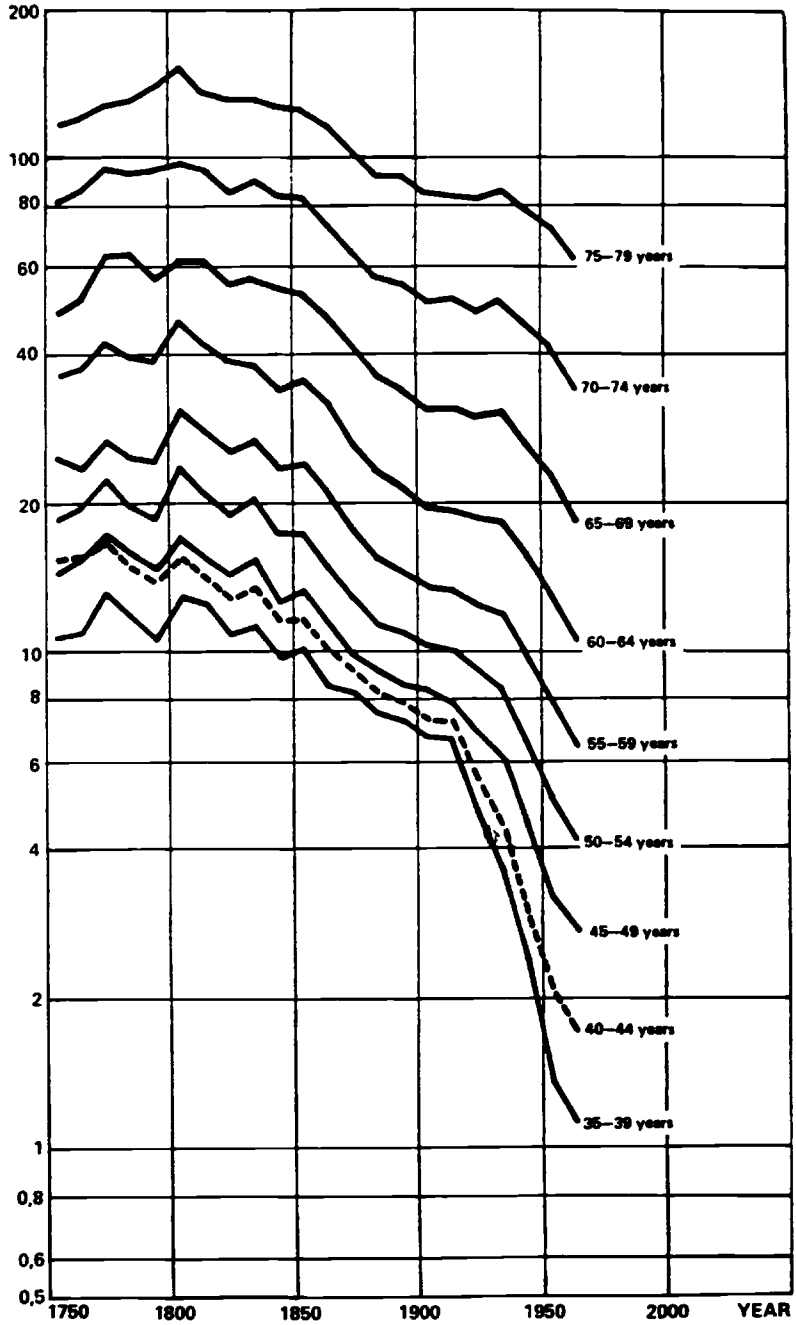

Fig. 4.6 Age-specific mortality rates for women aged 35–79, 1751–1970 (deaths per 1,000)

Source: Hofsten and Lundström (1976).

and trends in average adult heights. That would be a rather startling result. From an even longer perspective, however, it seems clear that the decline in heights for cohorts of the 1840s was quickly reversed and constituted no more than a temporary dip in an upward trend. The levels reached by the cohorts of the 1830s were soon reestablished and surpassed after 1870. Furthermore, while there was no large increase in mortality rates for adults during the late 1840s and early 1850s, there was a sharp increase for children, especially young children. Since average adult heights are not materially affected by the income and nutrition levels of adults, it seems clear that the drop in recorded heights was the result of the particularly, and indeed atypically, harsh conditions endured by young children during those years (Sandberg and Steckel 1988). An additional explanation of this rising child mortality would stress factors that spread disease, such as the substantial increase in internal migration as well as growing school attendance around the middle of the century.[2]

Accepting that argument leads to the conclusion that the trend in heights during the 1800–1870 period was clearly upward. Thus, the larger conclusion is that during those decades life expectancy and average adult heights tended upward, while income or the standard of living fluctuated without trend at least until 1850. After 1850, the increase in per capita GDP may or may not have been offset by an increasingly unequal distribution of income. Obviously then, the apparent trend toward improving health, while perhaps contributing to income growth, cannot have been a product of such growth until, at the very earliest, 1850. One possible boost to improving health probably came from the general lack of urbanization. As noted above, there was very little growth in urbanization during this period, and Stockholm especially stagnated. In view of the unhealthy condition of Swedish cities, and especially of Stockholm, this lack of urbanization certainly must have been beneficial to health.

The absence of both income growth (a supposed plus for health) and urbanization (a supposed minus for health) prior to at least 1850, however, can hardly constitute an explanation for improved health. Clearly, some other forces must have been at work. The standard explanations offered by historians are the potato, peace, and smallpox vaccinations (e.g., Carlsson 1961, 37).

This was the period during which the extremely high yielding potato became a field crop in Sweden. This in turn led to a considerable increase both in direct human consumption and to the replacement of grain in distilling. Since potatoes are more nutritious than bread and bread is more nutritious than alcohol, it is not surprising that this development tended to raise both life expectancy and average heights. The low price of potatoes, however, meant that increases in its consumption had little impact on measured incomes. It seems apparent that the population preferred to eat bread, but low incomes, or the

2. The Elementary Education Act of 1842 promoted schooling of young children, and the Poor Law Act of 1847 eliminated restrictions on personal movement. For a discussion of these points, see Carlsson (1961, 377, 380).

attraction of low potato prices, induced them to eat potatoes instead. The resulting improvement in nutrition, and consequently in health, thus becomes ultimately a matter of serendipity. Consumers simply may not have anticipated the health benefits of the potato. If, on the other hand, those benefits were recognized, thus making potato consumption more attractive, then what we have is a case of massive, unrecognized (and unrecorded) consumer surplus.

Peace, or the absence of war, was certainly a blessing. The disastrous consequences of war on health and mortality in Sweden can easily be seen from data on the eighteenth and very early nineteenth centuries. On the other hand, it is clear that nineteenth-century health was considerably better even than that of the peaceful years of the eighteenth century, once again without there being any great difference in measured incomes.

We are choosing to expand "vaccination" beyond its, certainly very important, literal meaning to include public and, to a lesser extent, private health measures. In addition to vaccinations (especially against smallpox) per se, there were marked improvements in sanitation, hygiene, and child care. Much of this was accomplished through government propaganda in favor of breastfeeding and general improvements in sanitation (Lithell 1981, 183). The church and, even more so, the system of compulsory schools were effectively used to spread official views on these subjects. The fact that Sweden was a highly literate country with a long tradition of bureaucratic and church control over the individual's private life meant that these campaigns were a good deal more successful than would have been the case in countries, such as England or the United States, where much more emphasis was put on individual freedom and autonomy.

More concrete measures were also undertaken. The system of training midwives, first controlled by the government as early as 1711, was improved and expanded following the issuance of new regulations in 1819 and again in 1840 (Lundquist 1963, 645–48). During the same period, the system of state district physicians that dated back to 1773 was similarly expanded and improved markedly (Bergstrand 1963, 127, 156–57). Even more important, the 1857 statute on epidemics, which put great emphasis on improved sanitation, was quickly followed by improvements in water and sewage systems. The major improvements in Stockholm's access to clean water and efficient sewers during the 1860s had immediately observable effects on the city's death rate from typhus (Bergman 1963, 379–80).

Some interesting facts concerning the human capital aspects of low Swedish, and other Scandinavian, infant and child mortality rates can be gleaned from data on various ethnic groups in the United States in 1900. The infant mortality rate for children of Swedish-born women in America was very low, both relative to other groups of immigrants and relative to the children of native-born white American women, but it was somewhat higher than contemporaneous Swedish levels. It is also noteworthy that the superior mortality performance of the Swedes et al. in America, just as in Scandinavia itself, was

greatest for young children (Sandberg 1979, 234). A final alternative, or supplementary, explanation for the improving health trend is an improving epidemiological environment. That is certainly possible, although at least one major new disease, cholera, appeared in Sweden during this period. Once again, however, although it was a terrible killer in the major cities, especially Stockholm, the basically rural nature of the country strictly limited the effect even of this new killer disease.

Although no long-run connection can be established between rising income and improving health during this period, there seems to be a clear connection between downturns in income, almost invariably the result of poor harvests, and downturns, or at least stagnation, in health. This connection can be seen especially in the late 1840s and early 1850s. Similar, although perhaps not so powerful, effects can be seen resulting from income declines in roughly the late 1810s, the early 1830s, and the late 1860s. The apparent connection between income and health during these periods at least raises the possibility that the effects of rising income and nonincome trend effects on improving health can be separated. Such a separation would also be very useful in interpreting the experience of later periods when income and health were trending upward together.

4.3.2 1870–1914

The time after 1870 is in some sense less interesting than the preceding period. This is so because, starting around 1870, all Swedish indicators of health and income have rapidly trended upward together. Nonetheless, there are some differences in rate and composition that throw light on the interrelationship among the variables being studied. If the increase in child mortality that occurred around the middle of the century is impressive, the even greater drop that followed after circa 1870 is truly startling. Ultimately, all that can be said is that child mortality in Sweden nosedived after the onset of rapid industrialization and income growth. Clearly, the conditions, presumably a shortage of food, that had caused the crisis in child health were totally reversed.

Not only was the crop failure of 1868–69 never repeated but increasing domestic production was augmented by a rising flood of basic foodstuffs from America. To the distress of Swedish commercial agriculture, but to the benefit of consumers, the result was a clear fall in the relative price of food (see Carlsson 1961, 558). Thus even the rapid growth of real incomes fails fully to reflect the increased access to food. The commencement of major public health projects, especially the construction of water and sewer facilities, in urban areas also was a major plus for life expectancy.

For other age groups, there were also benefits, but they were less spectacular than those for the children. Interestingly enough, by far the smallest gains were achieved by young adults. Since these groups, generally speaking, were the survivors of the young child cohorts that had experienced such high rates of mortality during the previous decades, there is an implication here that the

hungry forties and fifties were still claiming victims a decade or two later. Put somewhat differently, it implies that any selectivity effect from the earlier high child death rates was more than offset by the damage to the long-run health of the survivors.

Height data are consistent with such an observation. The cohorts that reached maturity before circa 1870 were clearly shorter than those who matured later. It should not be surprising if these height-impaired cohorts showed evidence of poor health and high mortality throughout their lives.

It is also interesting to note that the special position of Stockholm, shorter than the national average, and of the north, taller than the national average, began to erode during this period. The health disadvantage of urban living, especially big city living, was beginning to disappear. By the same token, the advantage of low-density, relatively high protein (mostly from game) living in the north also was coming to an end. Today Stockholm is no different from the rest of the country, and the north, possibly due to ethnic genetic differences, is on the short side.

These trends in health and heights, of course, are perfectly compatible with the rapid growth of income. On the other hand, greater urbanization does not seem to have been a major health problem. As already noted, Swedish urban areas generally had never been as bad as in many other countries. More important, the pre-1870 public health measures described above were accelerating during this period. Stockholm, in particular, was rapidly losing its previously well-deserved reputation as a pesthole.

4.3.3 1914–1950

Rising incomes allowed greater access to food, decent housing, and ever improving medical care. The government helped things along with greater expenditures on water and sanitation facilities, as well as an expansion and improvement of the system of publicly provided district medical facilities and personnel. Once again, during this period health, heights, and incomes steadily advanced together. The only noticeable exception to this experience occurred in the period right around the end of World War I. The food shortage of 1917–18 was closely followed by the Spanish flu pandemic. The net effect was serious enough to lower, albeit very briefly, life expectancies at birth. The reversal in mortality rates, however, was heavily concentrated among young adults. These groups were then the first to benefit spectacularly once the pandemic had passed. In this case, there might have been some selectivity effect—the survivors were on average healthier than the whole cohort, and the Spanish flu had left no serious permanent ill effects on those who recovered from it.

Over the entire period, it is clear that all age groups, with the possible exception of the elderly, benefited from a spectacular decrease in all mortality rates. For the elderly, the improvement was merely impressive. For some older groups, there was also a slight, but certainly perceptible, upturn in mortality during the 1930s.

Throughout the period, average heights continued their upward trend. Simi-

larly, the special position of the large cities, on the short side, and the north, on the tall side, vanished entirely before the period was over. Another interesting development was the shrinkage of the height difference between social classes (by now it has disappeared entirely). This was probably a combined effect of a more equal distribution of income and the sharp general increase in income and, therefore, in nutrition. Virtually all children were at least, and at last, well fed.

4.3.4 1950–1995

This most recent period continues to show improvements in the health of the Swedish population. An ever rising standard of living has included improvements in diet, housing, and medical care. The government has chipped in with increased expenditures on public health measures, while the advance of medical science, especially in the form of new vaccines and antibiotics, has played a major role. Average life expectancy at birth has continued to increase as have average adult heights. It seems clear, however, that, particularly for the most recent decades, the increase in heights has slowed to at most a crawl. Apparently, genetic limits are being approached. The fact that social class differences in heights no longer seem to be detectable tends to confirm the belief that better nutritional status can yield little in the way of greater stature. By the same token, the great reduction in infectious diseases that has already occurred leaves little room for improvement in that regard.

There may be greater room for increases in average life expectancy. Once again, however, better access to food is not likely to be the key. Rather a combination of increasingly sophisticated medical knowledge and procedures together with some helpful "lifestyle" changes are the most likely remaining possible sources of greater life expectancies.

4.4 Trends in Human Welfare

As was noted in the introduction, the interrelationship in various countries among industrialization, urbanization, income growth, and health is a complex and contentious matter. While the Swedish experience might be said to be similar to that of the United States and Great Britain in that signs of declining health, that is, a reduction in heights and an increase in mortality rates, occurred around the middle of the nineteenth century, the comparison is misleading. The Swedish problems were the result of population growth and poor harvests, not of industrialization and urbanization. While it is certainly possible that industrial work and city living per se might have had bad effects on health even in Sweden, rapid industrialization and urbanization were in fact accompanied by clear net improvements in health. Whatever negative effects there may have been were clearly more than offset by favorable developments, no doubt including, but not limited to, income growth.

There is no doubt that the level of health is a major component of human

welfare and, therefore, of any reasonable definition of the standard of living. A serious question thus arises as to whether our standard measures of per capita income, particularly those for earlier periods, take adequate account of the level, and changes in the level, of health. To the extent that part of measured incomes are spent for the express purpose of attaining improved health and increased life expectancy, there is probably no great measurement problem. Thus, the vast amounts currently expended on health care in all industrial countries can be considered purchases of improved health and extended life. To the extent that we eat to live longer, part of the health benefits of a better diet might be said to be reflected in our level of measured income and expenditures. By the same token, expenditures on medical research create improvements in the production of better health and longer life pretty much the same way as other research produces more enjoyable consumer products. All such improvements raise questions of adequate accounting for consumer surplus.

It is difficult to believe, however, that past improvements in health are adequately accounted for in income statistics. Changes in health have often occurred in the form of externalities that have no noticeable effect on income figures. For example, the Swedish experience in 1800–1850 of a noticeable upward trend in health during a period of stagnating incomes can hardly have been included in those income figures. Such an inclusion would imply that the Swedish population was shifting substantial amounts of its income away from other goods and services and toward health-producing goods and services. This simply did not happen. The role of the potato was serendipitous, and the expenditures on public health (e.g., smallpox vaccines and improved sanitation and hygiene) were tiny compared to the resulting health benefits. In short, major improvements in welfare in the form of better health were occurring that were barely, if at all, recorded in the income data.

Even for the later period, it seems clear that health and life expectancy were largely being improved by factors that were not adequately accounted for in income data. Thus, a case can be made for trying explicitly to account for changes in health status when constructing historical income (or welfare) series.

One approach recently developed by the United Nations for dealing with this problem has been to calculate a so-called Human Development Index (HDI; United Nations Development Programme 1990).[3] The HDI is calculated by subtracting the average of three "deprivation" indexes from 1.00. The deprivations used are lack of life expectancy, lack of literacy, and lack of income. These indexes are based on a country's position on a scale between minimum and maximum values for life expectancy, literacy, and income, respectively. In order to incorporate a wide range of historical human experience, we have chosen scales between 30 and 80 years for life expectancy, from zero to 100

3. For a summary of critiques of this approach, see United Nations Development Programme (1993, 104–14).

Table 4.2 Deprivation Indexes

Year	Life Expectancy	Stature	Infant Mortality	Literacy	Per Capita Income
1820	0.817	0.542	0.487	0.175	0.699
1825	0.716	0.517	0.451	0.163	0.702
1830	0.820	0.504	0.519	0.150	0.706
1835	0.751	0.492	0.470	0.138	0.697
1840	0.758	0.517	0.461	0.125	0.687
1845	0.740	0.496	0.449	0.113	0.678
1850	0.722	0.492	0.425	0.100	0.669
1855	0.787	0.483	0.424	0.088	0.639
1860	0.704	0.438	0.392	0.075	0.611
1865	0.695	0.458	0.384	0.063	0.617
1870	0.700	0.408	0.393	0.050	0.575
1875	0.691	0.404	0.394	0.038	0.514
1880	0.639	0.379	0.345	0.025	0.497
1885	0.608	0.354	0.319	0.013	0.471
1890	0.578	0.321	0.301	0.000	0.444
1895	0.544	0.317	0.285	0.000	0.393
1900	0.542	0.313	0.281	0.000	0.354
1905	0.490	0.292	0.242	0.000	0.299
1910	0.447	0.296	0.215	0.000	0.249
1915	0.434	0.275	0.201	0.000	0.312
1920	0.453	0.246	0.185	0.000	0.218
1925	0.348	0.217	0.165	0.000	0.134
1930	0.339	0.200	0.160	0.000	0.071
1935	0.301	0.175	0.132	0.000	0.034
1940	0.260	0.163	0.107	0.000	0.000
1945	0.222	0.108	0.081	0.000	0.000
1950	0.172	0.088	0.062	0.000	0.000
1955	0.149	0.058	0.051	0.000	0.000
1960	0.132	0.038	0.046	0.000	0.000
1965	0.121	0.029	0.039	0.000	0.000

Source: Calculated from table 4.1.

percent for literacy, and from the cost of a subsistence diet ($140 in 1970 U.S. prices) to the upper bound on the per capita income component recommended by the United Nations ($4,861 in 1987 U.S. dollars, or $1,660 in 1970 U.S. dollars; see the discussion of the HDI in the introduction of this volume). The index is linear for life expectancy and for literacy (implying constant marginal utility) and logarithmic for income (implying declining marginal utility of income).

We have calculated this index and its components for Sweden at five-year intervals between 1820 and 1965 (see tables 4.2 and 4.3 and figs. 4.7–4.9). In order to determine the sensitivity of the index to alternative measures of health, we have made the same calculation substituting adult male heights (by birth

Table 4.3 **Human Development Indexes**

Year	Life Expectancy	Stature	Infant Mortality
1820	0.436	0.528	0.546
1825	0.473	0.539	0.561
1830	0.441	0.547	0.542
1835	0.472	0.558	0.565
1840	0.476	0.557	0.576
1845	0.490	0.571	0.587
1850	0.503	0.580	0.602
1855	0.496	0.597	0.617
1860	0.537	0.626	0.641
1865	0.542	0.621	0.646
1870	0.558	0.655	0.660
1875	0.586	0.681	0.685
1880	0.613	0.700	0.711
1885	0.636	0.721	0.733
1890	0.660	0.745	0.752
1895	0.688	0.764	0.774
1900	0.701	0.778	0.788
1905	0.737	0.803	0.820
1910	0.768	0.818	0.846
1915	0.751	0.804	0.829
1920	0.776	0.845	0.865
1925	0.839	0.883	0.900
1930	0.863	0.910	0.923
1935	0.888	0.930	0.945
1940	0.913	0.946	0.964
1945	0.926	0.964	0.973
1950	0.943	0.971	0.979
1955	0.950	0.981	0.983
1960	0.956	0.988	0.985
1965	0.960	0.990	0.987

Source: Calculated from table 4.2.

cohort) and infant mortality respectively for life expectancy.[4] We are also planning to utilize alternative measures of education for literacy. The problem with using literacy in the Swedish case is that it had reached a level around 90 percent by 1850 and was close to 100 percent before the turn of the twentieth century. Thus, despite the clear benefits accruing through increasing levels of schooling, education ends up playing very little role in the growth of the HDI for Sweden. The results of our calculations are presented in table 4.3 and figure

4. Our range for stature was defined at the low end by possibly the smallest population ever measured—the Bundi of New Guinea (156 cm)—and at the upper end by 180 cm, which approximately corresponds to the tallest population today (Eveleth and Tanner 1976, 1990). Our range for infant mortality extends from zero percent to 35 percent, which is approximately the highest found for large historical populations.

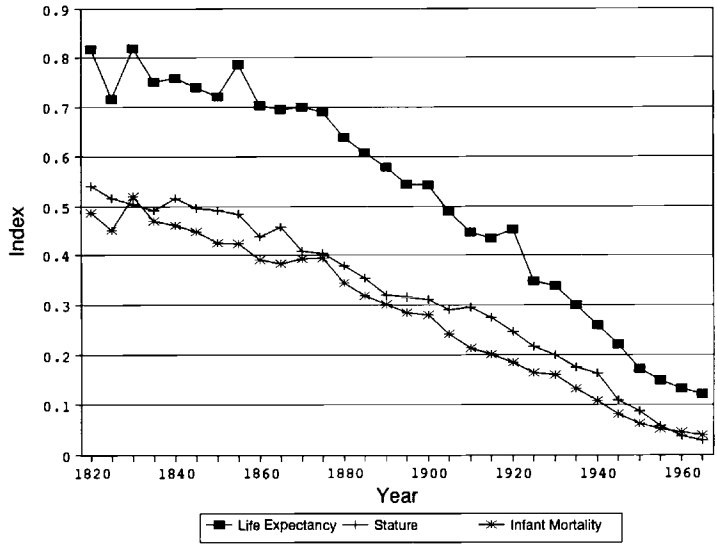

Fig. 4.7 Deprivation indexes of health
Source: Table 4.2.

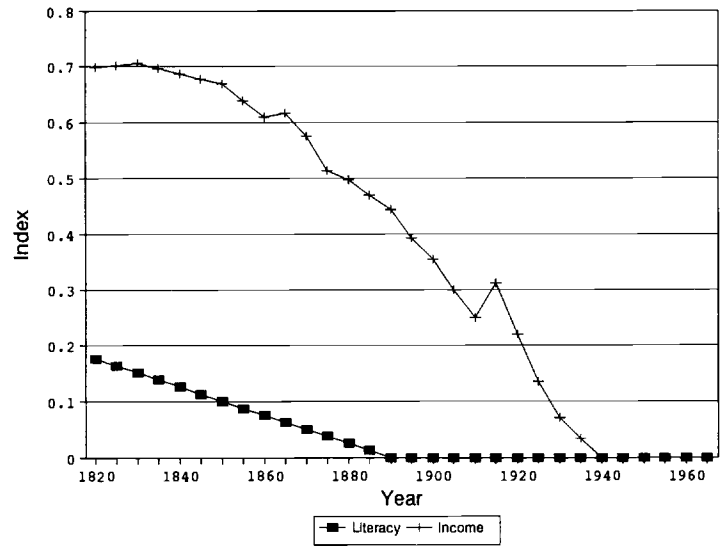

Fig. 4.8 Deprivation indexes of income and literacy
Source: Table 4.2.

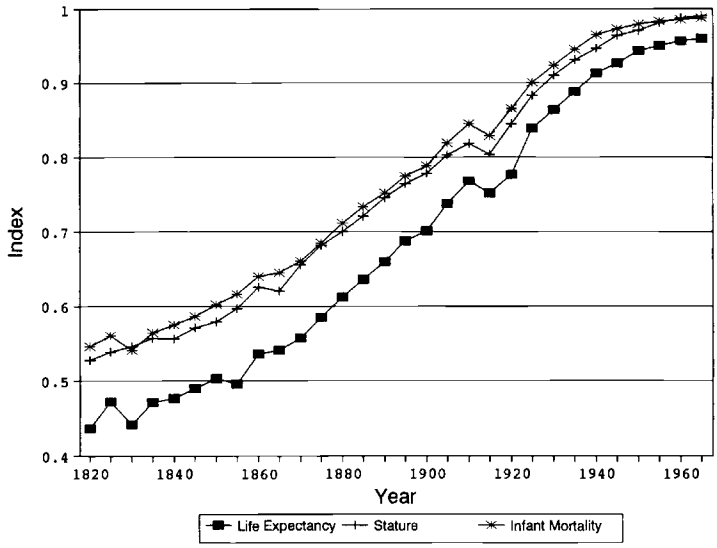

Fig. 4.9 Human development indexes
Source: Table 4.3.

4.9. A number of interesting aspects of these indexes are apparent even from casual observation. First of all, all three alternative HDIs show very similar growth patterns. Indeed, the HDIs based on infant mortality and human stature are virtually identical. This result tends to confirm our view that final adult height in Sweden was very heavily influenced by conditions during the first year of life. Furthermore, while the level, although not the growth pattern, of the life-expectancy-based HDI differs from its siblings, that difference reflects substantially the choice of the life expectancy minimum. If 25 years, rather than 30 years, were used as the minimum, all three series would be nearly identical.

Another striking feature of these HDIs, particularly compared to those for some other industrialized countries, is their persistent upward trend. There are virtually no reversals. Even if annual data had created a few more such instances, at least in the preindustrial period, the result is still remarkable. The only post-1870 reversal is recorded for 1915 (i.e., 1913–17) and, of course, is the result of the serious economic problems caused by World War I. The food supply problems and the Spanish flu epidemic included in the 1920 (1918–22) index numbers are not enough to prevent a modest increase between 1915 and 1920. The fact that the indexes continued to grow during the 1930s (at least on a five-year average basis) confirms the view that the Great Depression was both relatively mild and short lived in Sweden. Yet another interesting aspect of these indexes is their growth rate by periods. Clearly, they all accelerate after

roughly 1870—that is, with the onset of rapid industrialization. While there was improvement before industrialization, it has been much more rapid since. This more rapid growth has occurred despite the fact that literacy, having reached 100 percent by 1890 (at least according to our measure), stopped contributing to the HDIs at that point. As to the relative contributions of income growth and health improvement, it is clear that health improvement was the dominant factor up to circa 1850. Income growth then began to play a greater role, especially after 1870. This situation was then reversed during the twentieth century, largely because of the assumption that the marginal utility of income is declining.

It is also interesting to compare the HDIs we have computed for Sweden with the results reached for other countries. One such comparison can be made with the HDI (stature based) that Costa and Steckel have computed for the United States. In 1820 the American HDI (including slaves) was 0.580 while the comparable result for Sweden was 0.528. Since Swedes then were clearly more literate than Americans, the difference is the result of American advantages in income and especially health (height). By the time of the great Swedish migration to the United States (circa 1870), the indexes stood at 0.702 for America (including African Americans) and 0.655 for Sweden. Since Swedes were still considerably more literate and almost as healthy (tall), the American advantage was unquestionably in income. Thus, emigration, particularly of landless (literate and healthy) Swedish farm youths made good sense. By 1960, however, improvements in Swedish health (height) had reached the point that the Swedish HDI nosed out that for the United States despite higher U.S. incomes.

Finally, a comparison can be made between the Swedish HDI and those of various less developed countries today. Overall, the Swedish HDI (this time based on life expectancy) just before the onset of rapid industrialization around 1870 was at a level similar to that of countries currently classified as being at the lower level of "medium human development" (e.g., Egypt). The components of the index, however, were drastically different. In the case of Egypt in 1987, per capita incomes are roughly similar (Sweden, $1,224; Egypt, $1,357) but life expectancy and literacy differ greatly. In 1870, Swedish life expectancy at birth was 44.99 years, compared to 62 years for Egypt in 1987. Clearly, Egyptian life expectancy has benefited greatly from developments in public health that have occurred during the past 120 years. On the other hand, the Swedish literacy rate in 1870 was in the vicinity of 95 percent compared to 45 percent for Egypt in 1985. For the individual, a long life expectancy may well be more important than being literate, but it seems likely that Sweden's prospects for rapid future economic growth in 1870 were a good deal better than Egypt's prospects today.

As an alternative to the HDI calculations, we have also applied Daniel Usher's well-known work assigning dollar values to increases in survival probabilities (Usher 1973, 1980). Usher's work rests on the following set of, admittedly

rather strong, assumptions: (1) utility (U) is a function of consumption (C) in each time period (t); (2) utility is separable in C_t; (3) all utility functions are of the form $U_t = \sum_{i=0}^{t-1} C_i^{\beta}/(1 + r)^t$, where β is the elasticity of utility with respect to C and r is the individual's subjective rate of discount; and (4) consumption is constant across age groups. On this basis, he is able to calculate the change in consumption that a person would be willing to forgo in return for a given increase in survival rates as a function of C, β, and r. The presence of a discount factor means that the further into the future a person's reduced age-specific mortality decrease lies, the less it will be worth. Thus, reductions in infant and child mortality rates will have an especially great effect on the Usher-adjusted well-being of the population.

Table 4.4 presents actual Swedish five-year interval GDP growth in addition to Usher-adjusted (actual GDP plus or minus the value of changes in survival rates) well-being rates using four different, reasonable, assumptions about β and r for the period 1820–1965. Table 4.5 presents numerical values for per capita Swedish GDP, both Usher adjusted and unadjusted, in terms of 1970 U.S. dollars, with 1820 being the base. In effect, survival rates in 1820 are given zero value while the value of post-1820 changes in those survival rates is added (or subtracted) from actual per capita GDP. The same information for the period 1870–1965 is presented in table 4.6, but this time per capita GDP in 1870 is taken as the base where survival rates have zero value.

All these tables tend to confirm the general pattern of Swedish HDI development, that is, a steady upward trend with setbacks only on a few occasions in the first half of the nineteenth century and once around World War I. The Usher-adjusted numbers, however, fluctuate much more drastically than does the HDI. The reason for this is that survival rates, especially infant and child mortality rates, which weigh very heavily in the Usher-adjusted calculation, fluctuated much more than the other components of the HDI. These results, especially for the pre-1850 period, strongly support the conclusions concerning welfare, especially child welfare, that we presented in an earlier paper (see Sandberg and Steckel 1988).

The overall result for the 1820–50 period is that it was a time of very modest, preindustrial, growth in both per capita GDP and in Usher-adjusted welfare. What is worse, there were extremely wide swings in dollar-evaluated survival rates. Clearly, this represents a preindustrial regime where agricultural growth was low and subject to wide swings in harvest outcomes, which resulted in even wider welfare swings. In addition, the epidemiological environment was highly variable. Improvements in welfare were slow and uncertain.

We do not, however, accept the possible implication of the 1820–50 line in table 4.7, which shows no clear-cut gain in welfare from the Usher adjustment, that there was no improvement in health whatsoever during that period. The apparent lack of health improvement is entirely the result of a temporary upward blip in young child, but not infant, mortality during the period around 1850. In view of the temporary nature of this unfortunate development, as well

Table 4.4 **Measured and Revised Per Capita GDP Five-Year Growth Rates (in percentages)**

		$r = 0.05$		$r = 0.10$	
Years	Measured	$\beta = 0.25$	$\beta = 0.45$	$\beta = 0.25$	$\beta = 0.45$
1820–25	−0.88	44.81	24.50	41.88	22.88
1825–30	−0.92	−41.55	−23.49	−37.70	−21.36
1830–35	2.38	32.52	19.13	29.56	17.48
1835–40	2.33	−0.79	0.60	−0.52	0.75
1840–45	2.34	9.47	6.30	8.39	5.70
1845–50	2.32	−17.44	−8.66	−10.07	−4.57
1850–55	7.71	7.42	7.55	1.43	4.22
1855–60	7.16	41.84	26.43	37.48	24.01
1860–65	−1.53	2.38	0.64	2.07	0.47
1865–70	10.80	9.13	9.87	9.48	10.07
1870–75	16.38	18.45	17.53	17.44	16.97
1875–80	4.32	23.62	15.04	21.44	13.83
1880–85	6.75	18.43	13.24	17.76	12.87
1885–90	6.87	18.27	13.20	17.90	12.99
1890–95	13.39	24.47	19.54	23.31	18.90
1895–1900	10.06	10.98	10.57	11.16	10.67
1900–1905	14.52	32.24	24.36	31.17	23.77
1905–10	13.26	27.33	21.08	26.64	20.70
1910–15	−14.54	−10.13	−12.09	−9.96	−12.00
1915–20	26.16	20.20	22.85	21.32	23.47
1920–25	23.17	55.76	41.27	51.73	39.04
1925–30	16.92	19.88	18.56	19.74	18.49
1930–35	9.56	20.31	15.53	19.28	14.96
1935–40	10.70	22.17	17.07	20.97	16.40
1940–45	8.80	18.33	14.09	17.25	13.49
1945–50	15.85	28.44	22.84	26.89	21.98
1950–55	10.74	16.13	13.73	15.25	13.25
1955–60	15.68	19.10	17.58	18.47	17.23
1960–65	21.45	23.42	22.54	23.18	22.41

Source: See text.

as the fact that heights, infant mortality, and overall life expectancy all improved, we are sticking to our view that there was a modest general trend toward better health during the 1820–50 period.

After 1850, the situation improved markedly. Indeed for the period 1850–70, the rate of growth of per capita GDP was approximately 1.1 percent per annum, with the Usher-adjusted welfare index growing at approximately twice that rate. Thus, increased survival rates added as much to welfare as did the, not inconsiderable, growth of per capita GDP. After 1870, the rate of growth of per capita GDP accelerated while the growth in the value of rising survival rates appears to, at least, have continued at the 1850–70 rate. Over the entire period, 1870–1950 per capita GDP grew at a rate of about 2.1 percent per

Table 4.5 **Measured and Revised Real Per Capita GDP (in 1970 U.S. dollars), 1820–70**

		$r = 0.05$		$r = 0.10$	
Year	Measured	$\beta = 0.25$	$\beta = 0.45$	$\beta = 0.25$	$\beta = 0.45$
1820	295	295	295	295	295
1850	318	297	327	328	335
1870	400	506	491	510	486

Source: See text.

Table 4.6 **Measured and Revised Real Per Capita GDP (in 1970 U.S. dollars), 1870–1965**

		$r = 0.05$		$r = 0.10$	
Year	Measured	$\beta = 0.25$	$\beta = 0.45$	$\beta = 0.25$	$\beta = 0.45$
1870	400	400	400	400	400
1890	554	820	693	792	679
1910	897	1,908	1,380	1,803	1,335
1950	2,128	8,598	4,731	7,684	4,428
1965	3,311	14,677	7,752	12,923	7,196

Source: See text.

Table 4.7 **Measured and Revised Real Per Capita GDP Annual Growth Rates (in percentages), 1820–1965**

		$r = 0.05$		$r = 0.10$	
Year	Measured	$\beta = 0.25$	$\beta = 0.45$	$\beta = 0.25$	$\beta = 0.45$
1820–50	0.3	0.0	0.3	0.4	0.5
1850–70	1.1	2.7	2.1	2.3	1.8
1820–70	0.6	1.1	1.0	1.1	1.0
1870–1950	2.1	3.9	3.1	3.8	3.1
1950–65	3.0	3.6	3.4	3.5	3.3
1870–1965	2.3	3.9	3.2	3.6	3.1

Source: See text.

annum, while increasing survival rates added at the very least another percentage point to the annual growth of Usher-adjusted welfare.

What is perhaps most striking, however, is that after circa 1950 (and up to the end of our data in 1965), increasing survival rates have added very little, perhaps a third of a percentage point, to the annual growth of Usher-adjusted welfare. This is less than for any substantial number of years since approximately 1850. Equally intriguing, a similar result can be observed for the United States.

This clear recent slowdown in the contribution of reduced mortality to increasing well-being is made no less interesting by the fact that, during this same period, expenditures on medical care in Sweden, and the United States and elsewhere, have been increasing at an extraordinary and, indeed, a frightening rate. Today, of course, controlling the "monstrous" level and rate of growth of medical expenditures is a major economic and political problem in all high-income countries. It is no doubt this relatively recent experience with huge and exploding medical costs that has made the criticism of double counting levied, especially by Jeffrey Williamson, at the Usher welfare adjustment seem so compelling. That is, the charge that the decrease in mortality rates has to a very substantial degree been the direct result of the deliberate expenditure of resources already counted in per capita GDP.

Our data, however, seem to indicate that the really impressive contribution of mortality decrease to welfare, at least in Sweden, occurred during a period when the share of national product devoted to public health and medical care was still quite modest. During that period, it seems likely that the very impressive drops in mortality were largely (1) the by-product of income-induced improvements in nutrition and housing, (2) the result of disembodied advances in knowledge concerning sanitation and health, and (3) the result of public health and medical expenditures (e.g., sanitation infrastructure and vaccinations) that yielded huge amounts of consumer surplus in the form of improved health. More recently, these cheap sources of reduced mortality and improved health have been largely exhausted. For the past 40 or 50 years, further improvements have come in return for great expenditures on medical research, equipment, and personnel. Thus, it may well be that in the relatively recent past there should not be any Usher adjustment of welfare growth. The modest increases recorded in the value of survival probably have been fully paid for by expenditures recorded in GDP.

4.5 Conclusions

The principal conclusion of this paper is stated in the title. In Sweden rapid industrialization certainly accompanied, and almost certainly was responsible for, major improvements in health and welfare. The general state of health of the population was improving, albeit at a modest and uncertain rate, even during the pre-1850 period when average incomes were stagnating and the distribution of that income was deteriorating. After 1850, and especially after the onset of rapid industrialization around 1870, the improvement in health accelerated. It took the events of World War I and the Spanish flu to create one (hopefully) final downward blip in Swedish health statistics.

The fact that health conditions, and the level of human welfare, were trending upward even while average incomes were stagnating, income distribution was becoming less equal, and the earnings of the mass of the population was probably declining clearly indicates that other developments (composition of

diet, public health measures, improved child care, and epidemiological conditions) favored improved health. The very rapid, and continuing, improvements in health conditions following 1870 indicate that the income gains that industrialization generated more than offset any deleterious effects of industrialization and, rather limited, urbanization. More and better food, housing, medical care, and (government financed) public health measures carried the day. Compared to most other nationalities, Swedes had, and continue to have, no right to be dour. Skoal!

Data Appendix

In this paper we have relied on four basic types of historical data.

Real Per Capita Income

All of our real per capita income (strictly, per capita GDP) figures for the period 1820–1965 ultimately are based on the work of Olle Krantz and Carl-Axel Nilsson. On the recommendation of Krantz, we used the figures published in Maddison (1991) for the period 1820–60. This series was then connected to the series for the period 1860–1965 contained in Krantz and Nilsson (1980). These original numbers were reported in 1970 Swedish kronor, which we converted to U.S. dollars at the 1970 exchange rate of 5.18 Skr per U.S. dollar.

Life Expectancy at Birth

Our life expectancy at birth figures come from Keyfitz and Fleiger (1968). It is their five-year intervals that dictated our use of the same interval for calculating the HDI.

Literacy Rates of the Adult Population

The literacy numbers are based on the conclusion reported by, although by no means unique to, Cipolla (1969) that Swedish literacy had reached 90 percent by 1850 and that virtually all Swedish youths were then literate. The compulsory education act of 1842 was unquestionably having an effect, although schools were certainly commonplace even before that year. Given a flow of virtually 100 percent literate cohorts reaching adulthood after 1850, a 0.25 annual rate of increase in literacy up to 100 percent in 1890 seems highly reasonable. Similarly, a 0.25 percent rate before 1850 also yields a reasonable result of 82.5 percent in 1820.

Adult Male Heights

Estimates of Swedish heights come from two different military sources. The data for cohorts born starting in 1820, and used in our numerical calculations,

come from the heights of the conscripted militia. These nationwide average data cover the great majority of young men measured in the year they turned age 21 (born 1820–97), age 20 (born 1898–1929), age 19 (born 1930–35), and finally age 18 (born 1936–present). Since these age reductions occurred in line with the decline in the age of maturation, however, these changes have very little effect on the trend in final adult heights. More worrisome was the fact that the military imposed nontrivial height standards on cohorts born between 1819 and 1839. We corrected for the resulting shortfall using the Quantile Bend Estimator (Wachter and Trussell 1982). The fact that data are missing for a few scattered years forced us to interpolate for those years.

Our second source of height data, the trend results of which we discuss for cohorts born before 1820 but which are *not* included in any of our indexes, is based on a sample of approximately 40,000 soldiers of various ages who served in the "settled" (*indelta*) army between roughly 1730 and 1980. In social and economic terms, the soldiers were approximately on a par with crofters. Below them were all the various categories of landless rural residents. We sampled the data by selecting regiments scattered around the country (including the city of Stockholm) and then drew a sample of soldiers from each regiment. In view of the inevitable shortfall in these data, the average heights were then corrected using the Quantile Bend Estimator. See Sandberg and Steckel (1988) for a more extensive discussion of these data.

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