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Your money or your life?
Inequality of lifetimes and welfare: 20,000 BC to 2,000 AD

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Abstract

I develop the first set of long-term, consistent estimates of inequality by using length of life as a measure of welfare. Although *income* inequality has recently increased, lifetime *welfare* is probably more equally distributed now than in the past. I measure the inequality of lifetimes in the United States and Europe over the past century and a half, and present similar measurements for several populations back to 20,000 BC.

Lifetimes have become substantially more equally distributed. The Gini coefficient of lifetimes declined from 0.355 for the 1900 U.S. birth cohort to 0.113 for the 2000 cohort; similar improvements are observed in other developed countries. Inequality levels for preindustrial populations were much higher; for a Maghreb population of roughly 20,000 BC, the lifetime Gini coefficient was 0.593.

Unlike income data, lifetimes data suggest that men are disadvantaged relative to women. Men face, and have faced, greater lifetime inequality than women, while having shorter expected lifetimes.

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I Introduction

Julia Lehan was born in Boston in 1898, the fifth of six children of Irish immigrants. She, like most Americans of her day, was acquainted with death in ways that many today can only imagine. She lived to age 75, but her eldest brother died at four months of age. Her father, a laborer for the Boston and Maine Railroad, died when she was five. When she married in her early thirties, her new husband, although not much older than she, was a widower. Her younger sister died at the age of 42. Friends and neighbors were also candidates for mortality well before "old age". Today, experiences with early death are relatively rare; 95% of the 1980 birth cohort is expected to reach age 45, while only 68% of the 1900 cohort did. Life expectancy has increased and length of life is much more equally distributed today than it was in the past.

In this paper, I use some of the standard tools of the inequality literature to examine changes in the distribution of *lifetimes*. There are several reasons for doing so. Many people think, at least implicitly, that length of life affects their well-being independently of income, so lifetimes may provide a good, if also incomplete, measure of welfare. Lifetimes provide a welfare measure better suited to comparisons across time and space; the unit of account is naturally consistent. And, measurement is unaffected by the extent to which productive activity flows through the market. For this reason, lifetimes may provide insights which are difficult to tease out of financial accounts in developing economies – both today and in the past.

Income data are also poorly suited to documenting welfare changes resulting from extreme (i.e. life and death) outcomes. The Soviet Union apparently generated reasonable aggregate economic performance which may have been evenly distributed, yet it was also responsible for the early deaths of tens of millions of its citizens over the course of its several decade existence (Dyadkin 1983), (Courtois 1999). Income data, by their nature, focus attention on survivors. Ignoring the dead is implicit, perhaps natural, and even unavoidable in this context. It is also woefully incomplete.

A final reason to consider distributions of lifetimes is that lifetimes may enrich our understanding of distributions of income. We know that income inequality in the United States has been increasing for some time (Levy and Murnane 1992). Yet Julia Lehan's America was one in which inequality of *lifetimes* was much larger than it is today. And because length of life is a major component of lifetime income, changes in the distribution of mortality have affected the distribution of lifetime income. The distribution of lifetimes augments the understanding of the distribution of welfare that we would reach from considering the distribution of income alone.

I present evidence here that the welfare of individuals in developed economies, as measured by the distribution of lifetimes, has become substantially more equal over the past century. The Gini coefficient of lifetimes declined from 0.355 for the cohort of Americans born in 1900 to 0.113 for the cohort of Americans born in 2000. Furthermore, unlike some income distribution comparisons in which measures of average income and inequality may be in conflict, changes in mortality distributions over the twentieth century provided increases in life expectancy *and* reductions in inequality. This is not simply an artifact of improvements in mortality. Cutler and Meara (2001) show that while mortality declines in the early part of the century were concentrated in the early years of life, those in later decades primarily benefited the old.

The distribution of lifetimes also provides a caution in interpreting differences in the distribution of welfare across groups. Much like income data, lifetimes data suggest that white Americans face less inequality and a higher mean level of welfare than do other (e.g. black) Americans. However, unlike incomes, lifetimes suggest that male Americans have a lower mean level of welfare and experience more inequality than do female Americans. For the birth cohorts of the 20th century, life expectancy at birth was five to eight years less for males than for females and lifetime inequality has been 10-25% higher for males. Interestingly, the smallest differences in relative inequality were for the earliest cohorts.

I also calculate Gini coefficients for several populations separated in time and space:

- 19th century United States
- 19th and 20th century Europe
- various European and Mediterranean populations from 20,000 BC to 12th century AD

These estimates suggest two lessons. First, lifetimes data capture important variations in welfare. In addition to measuring substantial improvements in the distribution of longevity over time, lifetimes data corroborate other data which show for instance, the declines of the late 19th century in the U.S. (Steckel 1995). Second, although there are interesting differences across countries, the similarities are striking. At the risk of appearing to conclude, like Pangloss, that "everything is for the best, in this, the best of all possible worlds," the changes in life experiences over the past century have been extraordinary. Residents of developed countries live longer, and more of us live longer, than in the past.

The distribution of lifetime income has plausibly become more even as a result of improvements in the distribution of mortality, even as the distribution of annual income became more unequal. For the first three of the four birth cohorts I consider (1900, 1920, 1940, and 1960), mortality improvements may have been enough to outweigh the increasing concentration of annual income. For the 1960 cohort however, lifetime income appears to be more unequally distributed despite continued mortality improvements.

Income and earnings inequality *has* increased (Levy and Murnane 1992), (Atkinson 2001). The mortality declines which drive much of what I present predate some of these recent increases. However, the forest of well-being over the last century and a half is one in which welfare inequality declined, even if many of the trees suggest that inequality of incomes has recently increased. Over the longer term, these gains are even more impressive. For preindustrial populations, life in the "state of nature" really was "poor, nasty, brutish, and short." And, not only was life typically short (roughly 21 years), but it was also very unequally distributed. In contrast to the 0.113 lifetime Gini coefficient for the 2000 U.S. birth cohort and the 0.355 lifetime Gini for the 1900 birth cohort, the calculated figure for a Maghreb population of roughly 20,000 BC is 0.593.

The paper is organized as follows: Section II discusses some of the related literature. Section III briefly explores the data used. Section IV considers the evolution of lifetime inequality over the 1900-2000 U.S. birth cohorts. Section V presents estimates of differences in inequality across races and sexes in the United States and Section VI presents a (somewhat eclectic) comparison of inequality of lifetimes across time and space. Finally, Section VII considers how changes in the distribution of mortality may have affected the distribution of lifetime income.

II Literature

Economists and others have long been fascinated by inequality. Some of the interest is invidious: curiosity about and envy of others. Some has been prompted by an underlying interest in the possibility of welfare-improving redistribution from the rich to the poor. More recently, there has been interest in the possibility that the distribution of rewards may influence the levels of outcomes. For instance, Murphy, Shleifer, and Vishny (1989) consider distribution and growth in a simple model of market development. In a related vein, there is concern in the health literature about the possibility that income inequality adversely affects health outcomes.

Levy and Murnane (1992) document the increasing U.S. earnings inequality after the early 1970s. Given the limits of available Census and CPS data, they focus on the post-WWII period. They find consistent evidence that earnings inequality increased in the 1980s after remaining stable or slightly increasing in the immediate post-war period. Much of the urgency which was prompted by these findings is due to the observation that earnings growth slowed in the early 1970s and so the gains at the top end of the distribution came as the bottom end was losing ground.

Piketty and Saez (2002) present estimates of the concentration of U.S. income dating back to the early years of the 20th century. They use U.S. income tax returns to infer income percentiles at the top of the distribution. They document interesting changes in the levels and sources of incomes accruing to those at the top (and particularly the very top) of the income distribution. Inequality was high before WWII, fell sharply during the war, remained stable through the 1970s, and has steadily increased since then. Their interpretation of the income tax data emphasizes the role of WWII wage and price controls as a shock to the incomes of "coupon-clipping rentiers." After the war, they conjecture that labor market institutions and social norms combined to prevent incomes at the top end of the distribution from recovering quickly.

Margo (1999) sketches a picture of inequality in the U.S. over a longer time horizon; his goal is to place the post-1970 increase in context. He uses inter-group differences to gauge how changes in the economy affected different classes of workers and using a variety of data, looks at earnings from 1820-1970. Roughly, he finds good evidence that wages increased through the 1840s and then declined in the late 1840s and 1850s. Inter-group inequality seems to have increased between 1860 and 1880 and fallen from 1900 to 1940. There was an increase in inequality in the early years of the Great Depression, but this increase seems to have disappeared by the end of the 1930s. In the post-war period, inequality declined through the early 1950s, remained flat through the mid-1960s, and then fell again somewhat in the early 1970s. Margo (1999) concludes that although the post-1970 increase in inequality looks surprising considered relative to Census income data which date to the 1940s, in longer-term context, earnings inequality may be similar to what it was just before the second World War and lower than it was in the early years of the twentieth century.

Income inequality may also relate to inequality in other dimensions. Deaton (1999) considers the relationship, or more accurately, the relationships, between income inequality and health. His interest is in the growing literature relating health outcomes to income inequality, in particular Wilkinson (1996)'s conjecture that health status is a function of relative income. Deaton (1999) finds little evidence of a direct link between income inequality and health, but does find that greater inequality is associated with a larger slope in a regression of mortality on income. He observes that although income inequality is a useful concept, there is no comparable cardinal measure of health status. However, he notes that there is a large literature on the gradient of health relative to socio-economic status. Life expectancy, for instance, is positively related to income, although health status may *not* be affected by access to health care. This leads him to emphasize the potential for both income to affect health and health to affect income.

Cutler and Meara (2001) consider how the experience of mortality changed over the 20th century. Their interest is two-fold: first, understanding what ages experienced mortality reductions when and second, relating these mortality reductions to mortality categories, health technology, and public health efforts. Perhaps contrary to expectations, mortality improvements have varied over the past century, both in pace and in affected age groups. In the early part of the century (roughly through 1940), mortality declines primarily benefited the young and resulted largely from improvements in public health and nutrition and consequent reductions in infectious disease. Interestingly, much of this early reduction in mortality predates the development of antibiotics. Improvements in mortality over the middle decades, 1940-1960, appear to be related to the diffusion of antibiotics and improvements in medical treatments; mortality fell for many ages. In the post 1960 period, mortality improvements were concentrated among the very young and the old: low birth weight infants benefited from regular improvements in medical technology, while technological improvements also contributed to improvements in the prospects of the old as well.

Steckel (1995) provides a useful introduction to the use of another non-economic measure to infer welfare, stature. The economic history literature has developed insights into assessing levels of and changes in aggregate welfare using measures of physical well-being such as height and body mass index[1] (BMI). Steckel (2003) proposes using skeletal remains to analyze morbidity over the long-term, particularly among preindustrial populations. He introduces a health index constructed from seven measures of distress observable in human remains and argues that these data provide a useful measure of past material well-being.

Le Grand (1988) compares distributions of age at death across countries. His objective is somewhat different than the one here. In the context of an effort to examine the success of post-war European welfare state health policy, he compares inequality of age at death. He uses the most recent data then available on the age distribution of deaths (generally the early 1980s) to rank countries. He finds that relative inequality rankings are little affected by choice of measure between Gini coefficient, absolute mean difference (AMD, or Gini coefficient times mean), or coefficient of variation. Nor are his relative inequality rankings much changed by looking at post-infant deaths.

In a recent paper, Becker, Philipson, and Soares (2003) make an argument related to mine, although their primary interest is in the cross-country convergence literature. They note that although there is little evidence of income convergence across countries, length of life is also valuable, and we *do* observe "mortality convergence." By valuing increases in life expectancy, they calculate "full income" measures of world welfare; these measures do show convergence from 1965-1995.

The literature more explicitly oriented toward distribution *per se* has tended to use distribution measures based on (or justifiable in terms of) social welfare functions (Atkinson 1970). Even so, the most common measure tends to be the Gini coefficient, rather than a decomposable measure such as the Theil index (Cowell 1998). I follow this convention here. I use lifetime as a measure of welfare, use the Gini coefficient for comparability, and assess how the distribution of welfare has varied over long periods of time. What I measure is inequality in years of life lived, rather than in annual income.

III Data

The data I use are from life tables, which describe the mortality experiences of a population. For each age, the tables indicate who, out of a standard sized group, is living and who is not. My first set of data is from life tables for cohorts of Americans born from from 1900 to 2000. Basic mortality data in the United States originates in the issuance of death certificates. There are significant individual and organizational incentives which suggest that almost all deaths in the U.S. are currently recorded (Bell and Miller 2002). The National Center for Health Statistics (NCHS) collects information from state death certificates and generates data describing mortality by several characteristics (for recent years, micro data is also available), primarily by age, sex, and cause of death. From these data, NCHS produces *period* life tables. Each of these characterizes the mortality experience of the population in a given year; it describes the experiences of a synthetic cohort characterized by the the mortality experiences of the individuals living and dying in a given year. The Social Security Administration (SSA) also generates life tables describing its actuarial assessment of the distribution of life experiences for Americans. These estimates, needed to assess likely future payments, are based on NCHS and Census Bureau data. Periodically, SSA produces *cohort* life tables which describe mortality by birth cohort.

In steady state, period tables would provide a reasonable description of the experiences of the population and of each birth cohort. Away from steady state, cohorts may experience mortality profiles which differ from those described by the period tables. For one thing, we do not completely know what a cohort's experiences will be until all of its members have died. Nonetheless, actuaries generate reasonable predictions about forthcoming experiences. Given the market need (e.g. life insurance) for good forecasts, the actuarial predictions of the mortality likelihoods of American cohorts over as least the medium term are likely to be good. However, because I use projections of the future mortality experiences of the birth cohorts (currently, not even the 1900 birth cohort's mortality experiences have been entirely observed), my estimates are necessarily speculative.

The data I use are primarily from the SSA: (Bell and Miller 2002) and (Bell 1998). Both of these reports provide estimates of the mortality experiences of Americans by cohort. I use the overall (both sexes) cohort estimates from (Bell 1998) and the sex-specific estimates from (Bell and Miller 2002). Bell and Miller (2002) present, for each cohort, only sex-specific estimates, so even though their estimates are more recent, I use the (Bell 1998) data for overall mortality experiences.

In what follows, I consider three sets of lifetimes data. The first set, for the 1900-2000 U.S. birth cohorts, has probably the best data. These data likely provide accurate pictures of changing mortality experiences for the 20th century birth cohorts and do so with a fair amount of age detail. The second set of data, from several sources, comprises period life tables for 19th and 20th century populations in the U.S. (Haines 1994) and in Europe (Human Life-Table Database 2003), (Preston, Keyfitz, and Schoen 1972). These data are likely to be accurate, but have two drawbacks. They are period rather than cohort life tables, and the age detail is (sometimes) limited. The last set of data is a series of life tables prepared for several populations from 20,000 BC to the 12th century AD based largely on anthropological data (Acsádi and Nemeskéri 1970). These data are the most speculative, but given the limitations, appear surprisingly good. Together, these sets of data sketch a rough picture of levels and changes in inequality over a long period of time. This picture, most complete for the past century and a half, clearly suggests that welfare has increased on average and has become more equally distributed. To provide a frame of reference, the declines in lifetime inequality dwarf recent increases in U.S. earnings inequality.

A Life and death in 20th century America

Figure 1 shows how U.S. life expectancy has varied by birth cohort;[2] for the 1900 cohort, life expectancy at birth was just under 55 years. Although the curve describing changes in life expectancy at birth over the past 101 birth cohorts climbs slowly, improvements were steady. For the 2000 cohort, (ex-ante) life expectancy at birth was almost 81 years. By any measure, this improvement of living circumstances is dramatic.

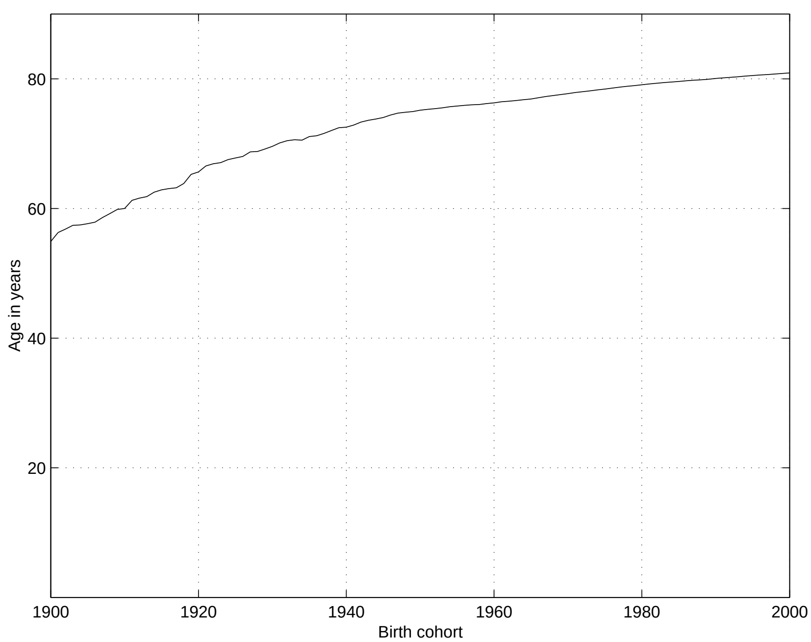

Figure 1: Cohort life expectancy at birth

One of the reasons that the 1900 cohort, on average, was so much "poorer" than the 2000 cohort (is) is that more than 13% of the 1900 cohort never reached their first birthday. Roughly one out of seven newborns died before their first birthday; in this respect, Julia Lehan and her siblings were entirely typical. Today, most members of a birth cohort survive well past their first birthdays; just under 99% of the 1995 birth cohort is expected to reach age 19. By comparison, only 76% of the 1900 cohort did so. Figure 2 shows survivorship curves (i.e. $1 -$ the mortality cdf) for the 1900, 1930, 1960, and 1990 cohorts. The curve for the 1900 cohort dips dramatically in the first year of life. The 1930 and 1960 cohorts still face significant, but much reduced risks of dying in the first years of life. The 1990 cohort, by contrast, faced little risk of immediate death.

A perfectly "rectangular" survival curve in which everyone lives to age $\overline{a}$ and then dies would describe perfect lifetime equality, so my measure of inequality is *ex post*. The observed survival curves *could* describe perfectly equal *ex ante* mortality risks, even though they are not rectangular (the income-mortality gradient literature suggests that identical risks are unlikely).

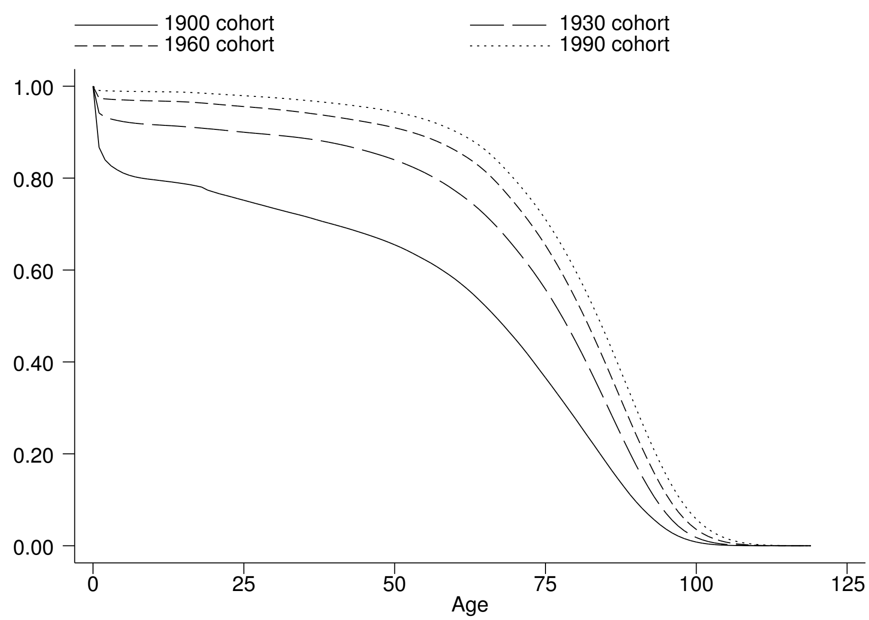

Figure 2: Birth cohort survival, 1900-1990

When we consider the lifetime inequality experiences of a cohort of individuals, the risks of early death have a substantial influence. The reduction in infant mortality after 1900 suggested by Figure 2 is similar to moving individuals up from the low end of the income distribution. Because the event here is literally life or death, the effects of these changes on measured inequality would be missed in cross-sectional income distributions. The "individuals" who die in the 1900 cohort, but not in the later cohorts, are never part of samples which one might use to calculate income inequality measures.

IV The evolution of lifetime inequality

The SSA cohort life tables can be used to generate lifetime Lorenz curves. Much like Lorenz curves for incomes, these curves plot the proportion of cohort years lived against the proportion of the cohort. Figure 3 presents Lorenz curves for the 1900, 1930, 1960, and 1990 cohorts. Not surprisingly, the inequality experienced by the 1900 cohort is substantial. The 1900 curve is everywhere below the curves for the other three birth cohorts, in part because such a substantial fraction of the cohort died very young. The curve initially remains along the x-axis; more than 13% of the cohort died before the age of 1. The biggest apparent change in the Lorenz curves is between the 1900 and 1930 birth cohorts, but there is substantial movement from 1930 to 1960, and a discernible, if slight, improvement from the 1960 to 1990 cohort.

Table 1 presents the calculated values of the Gini coefficients of lifetimes for decennial birth cohorts from 1900 to 2000. The Gini coefficient values shown in Table 1 are generally lower than

Cohort	Gini	Cohort	Gini	Cohort	Gini
1900	0.355	1940	0.173	1980	0.123
1910	0.300	1950	0.149	1990	0.118
1920	0.239	1960	0.143	2000	0.113
1930	0.200	1970	0.133		

Table 1: Birth cohort lifetime Gini coefficients

values calculated for earnings in the U.S. For instance, Levy and Murnane (1992) present estimates from several studies; for males, the earnings estimates range from 0.324-0.439 over the period

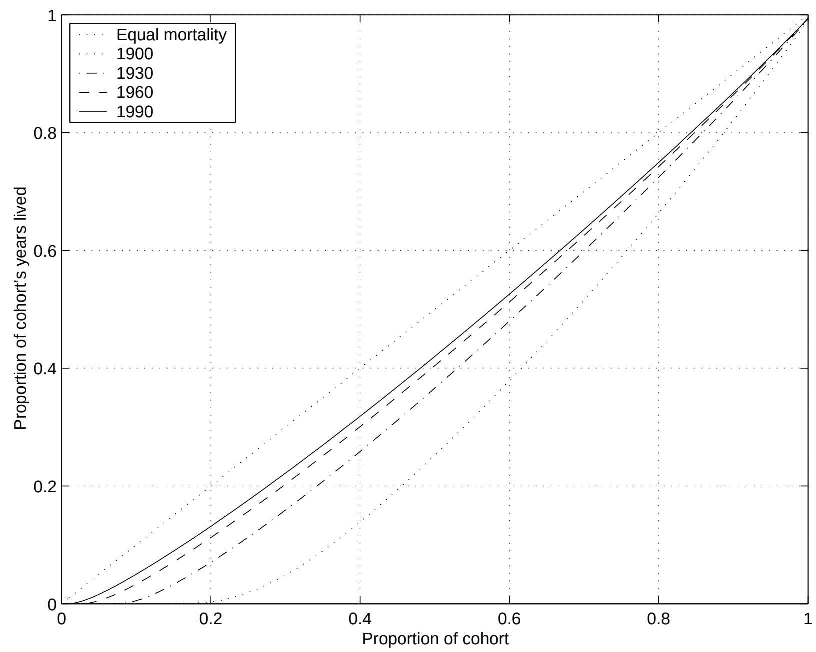

Figure 3: Birth cohort lifetime Lorenz curves, 1900-1990

1967-1986. U.S. Census Bureau estimates of the Gini coefficients of family income have similar magnitudes; Table 2 shows values for the decennial years 1950-2000. The income estimates are

	Gini		Gini
1950	0.379	1980	0.365
1960	0.364	1990	0.396
1970	0.353	2000	0.430

Table 2: Gini coefficients for families - income (U.S. Census)

larger than the lifetime estimates, although the 1900 and 1910 cohort lifetime figures of 0.355 and 0.300 are in the same ballpark as the income figures for the second half of the 20th century. What is particularly notable is that the *changes* in lifetime inequality dwarf the changes, up and down, in income inequality observed over the past few decades.

Over the century, inequality of lifetimes has declined substantially. The measured levels for the later cohorts are small and result from regular declines, even if the rate of decline has varied. Table

3 shows the decade to decade differences in the logs of the Table 1 Gini coefficient values.

Cohort	Δ ln(Gini)	Cohort	Δ ln(Gini)	Cohort	Δ ln(Gini)
1900	-	1940	−0.145	1980	−0.078
1910	−0.168	1950	−0.149	1990	−0.041
1920	−0.227	1960	−0.041	2000	−0.043
1930	−0.178	1970	−0.072		

Table 3: Relative changes, birth cohort Gini coefficients

The largest proportional declines were for the early cohorts, but inequality declined by large (relative) amounts for each of the succeeding (decennial) cohorts from 1900-1950. After the 1950 birth cohort, declines are smaller; instead of the 15-20% declines of the cohorts born in the first part of the century, the cohorts born after 1950 experience declines of 4-8% relative to their immediate predecessors. However, the cumulative effects of even these smaller declines are substantial; the (expected) mortality experiences of the 2000 cohort suggest that inequality, as measured by the Gini coefficient, will be only three quarters of the level experienced by the 1950 cohort. And, the level experienced by the 1950 cohort is likely to be less than half that experienced by the 1900 cohort.

V Race and sex

The distribution of mortality experiences varies over demographic groups, just as income does. In some respects, the mortality data suggest conclusions similar to those implied by income data about the distribution of welfare across groups in the United States. Whites and non-whites have experienced differences in mortality over the 20th century which mirror the differences they have faced in incomes. White Americans have had higher mean lifetimes and less inequality in lifetimes than have non-white Americans.

For men and women however, the mortality data present a different picture. Income data have long suggested that men have a higher welfare level than do women. The mortality data suggest otherwise. Men have had shorter lifetimes and have had greater inequality in lifetimes than women have had. To the extent that lifetime matters, these data suggest that we reconsider the stylized "fact" that women are disadvantaged relative to men.

A Racial inequality

Given the *de facto* and *de jure* differential treatment of racial groups at various times over the past centuries, differences between racial groups are important in the consideration of the distribution of welfare in the American economy. White and non-white Americans (primarily, although not exclusively black Americans) have had, over the years, substantially different access to material goods and to health services. Mortality distributions reflect these differences. Figure 4 presents estimates of life expectancy at birth for American in the years 1900-1999 (Anderson and DeTurk 2002).[3]

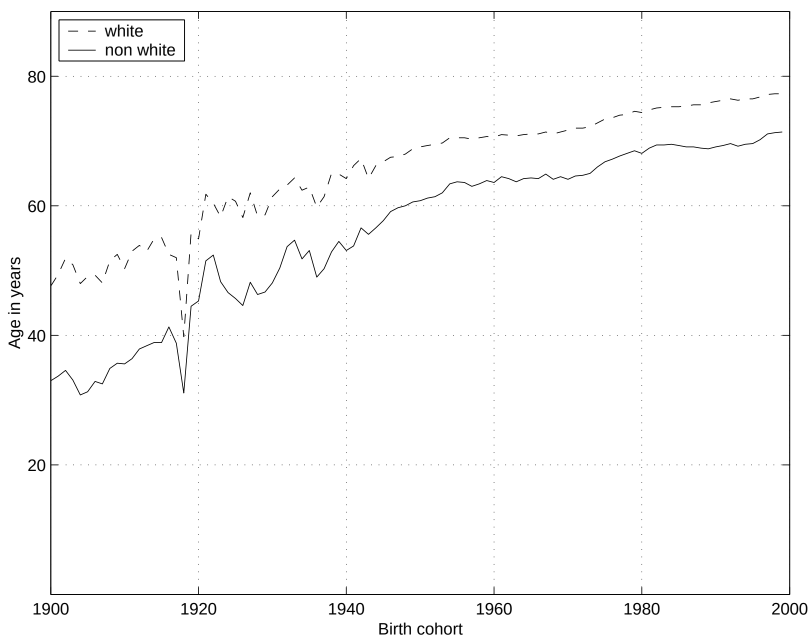

Figure 4: Life expectancy by race, 1900-2000

Unfortunately, the SSA mortality data for birth cohorts do not include separate estimates for racial or ethnic groups. NCHS however, has generated period life tables for some racial groups.

A major disadvantage of these data is that in addition to representing period rather than cohort experiences, they only allow us to look back to mid-century. The earliest available data are for 1949-1951. Nonetheless, they may give us a rough indication of differences in inequality for white and non-white Americans over time.

The Lorenz curves (not shown) for white and non-white Americans for these "cohorts" appear to be relatively close, although the curves for white Americans lie slightly within (up and to the left) of the curves for non-white Americans. Table 4 shows the Gini coefficients white and non-white Americans for decennial years 1950-1990. Non-white Americans have experienced greater lifetime

	All	White	Non-white	W / Non-w
1950	0.159	0.150	0.216	1.440
1960	0.147	0.139	0.195	1.403
1970	0.145	0.138	0.190	1.377
1980	0.132	0.127	0.160	1.260
1990	0.126	0.120	0.153	1.275

Table 4: Lifetime Gini coefficients by race

inequality over the past 50 years than have white Americans, although the relative inequality level has been (mostly) falling since 1950. The difference in logs from 1950-1990 is -0.223 for white Americans and -0.345 for non-white Americans. The increase in relative inequality from 1980 to 1990 is notable. Inequality of lifetimes declined by a smaller relative amount for non-white Americans from 1980 to 1990 than for white Americans.

B The evolution of male-female inequality

Figure 5 shows life expectancy at birth for both sexes by birth cohort. To a first approximation, the gap has remained constant, perhaps narrowing slightly for recent cohorts. It actually ranges from 5.5 to 7.7 years; from the 1934 cohort on, the gap narrows monotonically, if very gradually. Figure 6 shows how cohort survival patterns have changed for men over the twentieth century. For the 1900 birth cohort, not only was the first year of life quite risky, but there remained a substantial likelihood of dying in subsequent years. The survival curve has not only a sharp initial

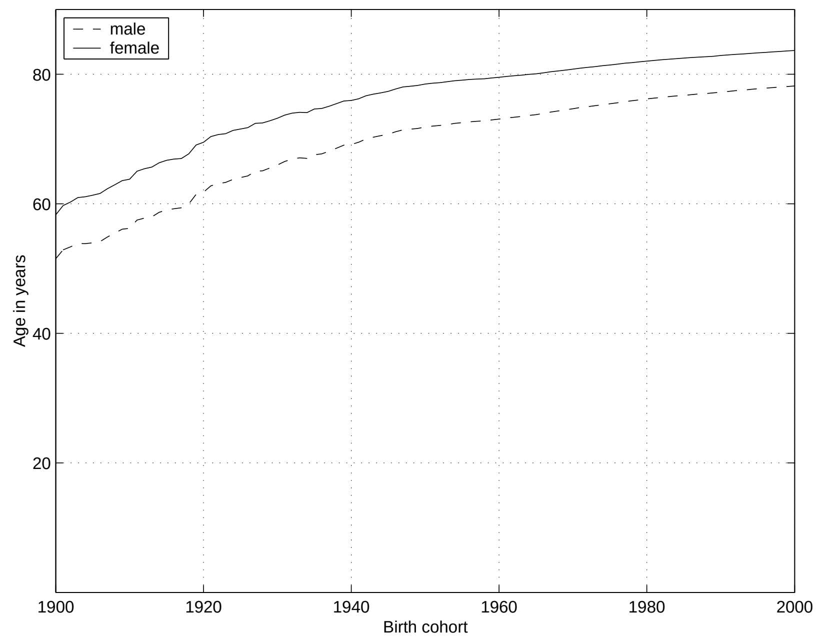

Figure 5: Life expectancy by sex, 1900-2000

drop, but a steady downward slope afterwards. Even the survival curves for later birth cohorts retain something of this regular downward slope, although the later cohorts face significantly less risk of early death.

By contrast, although the age survival pattern for cohorts of women born at different points over the century is similar to that of men, the probability of death at almost every age is higher for men. Let $p_i(a)$ be the probability of death at age a for sex $i \in \{M, F\}$. For the 1900, 1930, 1960, and 1990 birth cohorts, $\Delta p(a) \equiv p_M(a) - p_F(a)$ is positive for all ages less than 78, *except* for the 1900 cohort. For the 1900 birth cohort, the probability of dying at ages 19-27 was larger for women than for men. This highlights both the high levels of maternal mortality in the early part of the 20th century and the large declines in the succeeding years. The maternal mortality rate in the years 1915-1919 was not far from one percent: 728 women died per 100,000 live births. By the year 2000, this had fallen by close to two orders of magnitude to 9.8 per 100,000 live births. The discussion of maternal mortality in a recent NCHS report even notes that because the absolute

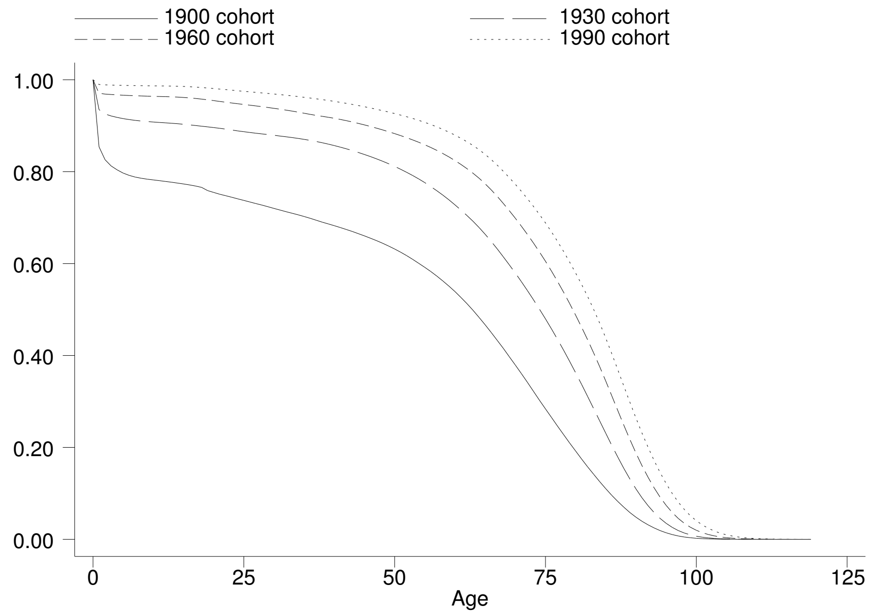

Figure 6: Cohort survival, 1900-1990 (male)

number of deaths related to child birth is small (396 in 2000), the rate fluctuates substantially from year to year. Even if $\Delta p(a)$ is positive at younger ages (higher risk for men), it must eventually become negative, since at some point the men have (mostly) died off. That crossover age increased for later cohorts; for the 1900 cohort, it was 78, for the 1930 cohort, it is expected to be 81, for the 1960 cohort, it is expected to be 86, and for the 1990 cohort, it is expected to be 88.

Even with the high levels of maternal mortality (and high levels of fertility) experienced by early 20th century women, their life expectancy exceeded that of their husbands and brothers, while the inequality in lifetimes they experienced was less.

The same cohort to cohort pattern is evident for females as for males; the later cohorts have a more equal distribution of lifetimes. Table 5 presents estimates of lifetime Gini coefficients by sex. The last column of the table shows the ratio of the cohort's male lifetime Gini coefficient to the cohort's female lifetime Gini coefficient. The distributions of male lifetimes are always more unequal than the distributions of female lifetimes.

Cohort	Overall	Male	Female	M/F
1900	0.355	0.369	0.335	1.101
1920	0.239	0.256	0.217	1.182
1940	0.173	0.188	0.155	1.213
1960	0.143	0.156	0.127	1.231
1980	0.123	0.132	0.111	1.188
2000	0.113	0.119	0.102	1.162

Table 5: Birth cohort lifetime Gini coefficients

In the first half of the 20th century, male lifetimes became *more* unequal relative to female lifetimes. By this measure, the 1960 cohort of men appears to be relatively more disadvantaged than others. It is not clear how much one would want to make of this, since the lifetime distributions for both men and women were becoming substantially more equal over the entire century. Although inequality for males in 1960 was high relative to their female counterparts, these men face substantially less inequality (and longer life expectancy) than did their predecessors. The interesting aspect of these figures is the contrast to income and earnings data which suggest that American women are disadvantaged relative to men. The lifetime data suggest that *men* are disadvantaged; their life expectancy is and has been lower than that of women. And, they experience greater lifetime inequality.

VI Variation over time and space

One of the advantages of the lifetimes data is that we can make comparisons across time and space with a natural and consistent measure of welfare. Below I present several comparisons of lifetime inequality across time and space. First, I use the estimated life tables of (Haines 1994) to describe changes in average lifetimes and inequality in lifetimes in the U.S. over the latter half of the 19th century. Second, I present some international inequality estimates for the 19th and 20th centuries based on life tables from (Human Life-Table Database 2003) and (Preston, Keyfitz, and Schoen 1972). Finally, I use estimated life tables for several populations based on anthropological data (Acsádi and Nemeskéri 1970) to calculate lifetime Gini coefficients for preindustrial populations.

A 19th century America

There is limited systematic data available describing the experiences of American birth cohorts prior to 1900. However, Haines (1994) presents period life table estimates. Table 6 shows the life expectancy at birth from these data. A noticeable aspect of the life expectancy figures is that the 1900 period life expectancy, 48, is lower than that reported for the 1900 birth cohort, 55. The period life table is based on the experiences of all those alive in 1900, not those born then, so it is not surprising that the "expected" life at birth would be lower. Expected (period) lifetimes increased from 1850 through 1870, fell in 1880, and increased again after 1880. As in the 20th century, American women, on average, lived longer in the 19th century than did men. The differences were substantial and fluctuated. The last column of Table 6 shows the log difference of the log life expectancy.

	Both sexes	Men	Women	$\Delta \ln(\overline{x})$
1850	40.2	37.8	42.6	−0.120
1860	43.2	41.8	44.6	−0.065
1870	45.4	43.4	47.5	−0.090
1880	41.4	40.2	42.6	−0.058
1890	45.9	44.5	47.5	−0.065
1900	47.8	46.1	49.5	−0.071

Table 6: Life expectancy at birth; (Haines 1994), Appendix A, II (West model)

I use these life tables, describing mortality experiences every 10 years from 1850-1900 to generate lifetime Gini coefficients (Table 7) by assuming that the period life tables reflect the experiences of synthetic cohorts. The Gini coefficients also vary considerably over this period: from decade to decade and between men and women. Note that both the life expectancy at birth and Gini coefficient measures suggest a deterioration in welfare around 1880. This is consistent with other indications of economic distress in the latter part of the 19th century (Steckel 1995), (Margo 1999).

The last column of Table 7 shows the ratio of the Gini coefficient calculated for men relative to the value calculated for women. The middle of this half century again looks interesting; inequality apparently declines until 1880, increases, and then declines again. Although men experienced greater lifetime inequality than women, the relative differences are generally smaller than those calculated for the 20th century birth cohorts.

	Both sexes	Men	Women	M/F
1850	0.374	0.398	0.349	1.140
1860	0.337	0.349	0.322	1.084
1870	0.309	0.328	0.286	1.147
1880	0.360	0.368	0.348	1.057
1890	0.302	0.315	0.285	1.105
1900	0.277	0.294	0.258	1.140

Table 7: Gini coefficients; (Haines 1994), Appendix A, II (West model)

The calculated absolute inequality levels for the 19th century data are also generally lower than the 20th century cohort levels (Table 7 versus Table 5). There are likely to be two sources of differences between the cohort and the period Gini coefficients. The first difference is likely to make the period figures larger than the cohort figures. Because the period figures are calculated from the mortality experiences of individuals from prior cohorts, the synthetic cohort's experiences are likely to be worse than those of the birth cohort for the same year. Table 8 compares cohort

Year	Cohort	Period
1950	0.149	0.159
1970	0.133	0.145
1990	0.118	0.126

Table 8: Birth cohort - period Gini coefficient comparison

and period Gini coefficients from Tables 1 and 4. This effect, in the latter part of the 20th century, is roughly equivalent to a delay of less than a decade.

The other effect, which is likely to make the calculated 19th century period-based figures *smaller* is due to the fact that these life tables present more aggregated data. The (Haines 1994) life tables have single year entries for the first five years of life and multiple year entries for each five year period after that (e.g. age 5-9). Because of this, the calculated Gini coefficients will be smaller in magnitude than those calculated from life tables with finer detail. But, as long as this distortion is proportionate, the relative inequality (male-female) measured in a given year should be comparable to the relative inequality measurements from the birth cohort data. Table 9 compares the effects of aggregation on the calculated Gini coefficients from the same set of life tables, but with different levels of aggregation. The more aggregated tables (those with five year entries) lead to lower calculated Gini coefficients; for these years, the effect is roughly equivalent to a decade. These data describe mortality in the United Kingdom (U.K.) in the 19th and 20th centuries (see below).

Period	5 year entries	1 year entries
1850-74	0.382	0.431
1875-99	0.324	0.378
1900-24	0.229	0.294
1925-49	0.134	0.212

Table 9: Effect of life table aggregation level (U.K., male)

B 19th and 20th century Europe

The Human Life-Table Database (2003) provides access to a growing collection of international life table data. At present the cohort data is minimal and coverage across time and space is spotty. For several European countries however, the data is quite good. Preston, Keyfitz, and Schoen (1972) also provide internationally comparable life tables for several countries and time periods. Tables 10 and 11 present calculated lifetime Gini coefficients and mean lifetimes for several countries over the second half of the 19th and the 20th centuries. Since the data available varies by country, I have presented rough temporal groupings. For each country, I have chosen data as close to the middle of the indicated time period as possible (see Appendix A). The calculated inequality values are roughly similar to the U.S. values presented earlier. These estimates are most comparable to the U.S. values calculated from period life tables, such as those in Table 7.

The male-female differences in Europe are similar to those in the U.S. and appear to be of long standing, although there is an interesting (small) *increase* in calculated female lifetime inequality in Denmark at the end of the 20th century. The calculated Gini coefficient for German women for

	1850-74	1875-99	1900-24	1925-49	1950-74	1975-99
Denmark			0.254 (56.2)	0.193 (62.0)	0.104 (70.4)	0.096 (71.8)
France	0.418 (41.8)	0.407 (42.2)	0.309 (49.6)	0.232 (56.1)	0.126 (67.0)	0.102 (72.1)
Germany	0.480 (35.6)	0.464 (37.2)	0.342 (47.4)	0.208 (59.9)	0.128 (67.6)	0.085 (72.5)
Ireland				0.232 (58.2)	0.116 (68.1)	0.084 (71.0)
Italy		0.414 (38.5)	0.317 (45.9)	0.286 (53.8)	0.140 (67.2)	0.087 (74.1)
Norway	0.379 (45.9)	0.351 (48.6)	0.262 (56.3)	0.185 (63.8)	0.106 (71.0)	0.089 (73.1)
Switzerland		0.377 (43.3)	0.290 (50.6)	0.194 (59.2)	0.115 (68.7)	0.088 (74.2)
United Kingdom	0.431 (39.9)	0.378 (43.7)	0.294 (51.5)	0.212 (58.7)	0.108 (68.1)	0.082 (73.4)

Table 10: Male lifetime inequality: Gini (expected life at birth)

the 1975-99 period is quite low (0.030); this appears to be a result of the interaction of increasing survival to older ages and life tables which end at age 90. By comparison, recent U.K. tables continue to age 112; the U.S. cohort tables continue to age 119. Although within any period one can highlight differences within Europe or between the U.S. and Europe, more interesting are the large, common declines across all of these populations.

C Long and longer term lifetime inequality

Acsádi and Nemeskéri (1970) develop life tables for several populations of prehistoric peoples based on analysis of skeletal remains and grave inscriptions. For some peoples and some times, they have reasonably complete data (given the context) and argue that the resulting descriptions of mortality are relatively accurate.[4] Table 12 presents calculated Gini coefficients for five populations covering a wide range of time and for which the (Acsádi and Nemeskéri 1970) data appear to be good. These populations were located in the Mediterranean and central European areas. The Maghreb-type mortality data is based on the remains of from a population which lived in a given area over

	1850-74	1875-99	1900-24	1925-49	1950-74	1975-99
Denmark			0.229 (59.2)	0.174 (63.8)	0.075 (74.3)	0.079 (77.6)
France	0.406 (43.0)	0.386 (44.8)	0.282 (53.8)	0.199 (62.1)	0.092 (73.9)	0.063 (80.3)
Germany	0.451 (38.5)	0.435 (40.2)	0.314 (50.7)	0.184 (62.8)	0.099 (72.9)	0.030 (79.0)
Ireland				0.223 (59.6)	0.099 (71.9)	0.067 (76.7)
Italy		0.401 (38.8)	0.306 (46.8)	0.270 (56.0)	0.109 (72.3)	0.056 (80.5)
Norway	0.360 (48.4)	0.332 (51.0)	0.238 (59.6)	0.164 (66.6)	0.073 (76.0)	0.062 (79.7)
Switzerland		0.353 (45.7)	0.266 (53.9)	0.171 (63.0)	0.084 (74.1)	0.058 (81.0)
United Kingdom	0.414 (41.9)	0.349 (47.2)	0.269 (55.4)	0.188 (62.9)	0.087 (74.0)	0.070 (79.0)

Table 11: Female lifetime inequality: Gini (expected life at birth)

perhaps 1500 years. The resulting mortality distribution is believed to be representative for that area in the 20,000-30,000 BC period. The Alsonónémedi population dates from roughly 2,000 BC. The Intercisa and Brigetio population mortality data is based on grave inscriptions from the Roman era in the 1st-4th centuries. The last two populations date from the Middle Ages. The Sopronkohida Avarian-Frankish population dates from the 9th century, while the final data are based on a model life table developed from 10th-12th century Hungarian data.

Population	Gini coefficient (life expectancy at birth)	
Maghreb-type, Epipalaeolithic, $\sim 20,000-30,000$ BC	0.593	(21.1)
Alsonónémedi, Copper Age, $\sim$ 2000 BC	0.444	(28.9)
Intercisa and Brigetio, Roman era, 1st-4th centuries	0.486	(27.8)
Sopronkohida, 9th century Avarian-Frankish	0.510	(26.6)
Model life table, 10th-12th century Hungarian	0.477	(28.7)

Table 12: Inequality in the longer term

Lifetime inequality for these populations is substantially higher than for the modern populations in the U.S. and Europe. Along with substantial inequality, these populations faced very low life expectancy at birth. Interestingly, the data suggest that progress in pushing back mortality to later ages and sharing this progress across populations has not been monotonic. Both Gini coefficients and life expectancy at birth rise and fall across these populations and eras. Although these data are far from systematic, it appears that neither stagnation nor steady progress appears to provide a good summary description of changes in material well-being prior to the industrial revolution as many explanations of long-run growth assume (Hansen and Prescott 1998), (Galor and Weil 2000), (Jones 1999). Of course, "roughly constant" is in the eye of the beholder. But these variations may suggest a more important role for local institutions and the consequent incentive structure (Mokyr 1990).

In some ways, there is little surprising in the low levels of welfare suggested by these figures. Although the comparisons with contemporary data are stark, Hobbes' claim about life in the state of nature:

> In such condition there is no place for industry, because the fruit thereof is uncertain: and consequently no culture of the earth; . . . no arts; no letters; no society; and, which is worst of all, continual fear and danger of violent death; and the life of man solitary, poor, nasty, brutish, and short. (Hobbes 1651), p. 107.

contains a considerable grain of truth. The lifetimes data reflect this[5] Whether from violence, disease, or deprivation, death was clearly omnipresent, although some societies managed to generate better outcomes than did others.

VII Lifetime income inequality

Differences in lifetimes also affect income inequality once we move from measuring inequality in a cross-section of survivors to measuring inequality in lifetime incomes. Those whose lives are cut short have only brief periods in which to earn and consume; their more fortunate brothers and sisters can earn and consume more. Here, I consider a simple example of how changes in mortality *may have* affected the distribution of lifetime income in the U.S. I say "example" and "may have" because the assumptions here are many – and heroic. Nonetheless, the calculations are suggestive and indicate that, as a result of mortality improvements, the distribution of lifetime income in the United States is more equal today than it would have been with the mortality experiences of a century ago.

A Distribution of lifetime income

Suppose that welfare is a function of lifetime income y; this income is accrued annually over a life of l years with no discounting. Income is fixed from year to year;[6] annual income x_t in year t of life is $x_t = x$ for $t \in \{1, \ldots, l\}$. Lifetime income is then $y = xl$.

If, over the population of individuals in a birth cohort, l and x are random variables with known continuous joint probability density function $f(l, x)$ then the distribution of lifetime income is a function of y, l, and $f()$. So, given the joint distribution of lifetimes and annual income, we can derive the distribution of lifetime income. Unfortunately, this joint distribution is difficult to observe. Here, I make a heroic simplifying assumption: mortality and annual income are independent.[7] The joint distribution is simply the product of the marginal distributions.

Appendix B provides details on the calculation of lifetime income and the lifetime income distributions, but a brief overview follows. I generate a discrete approximation to the pdf of life income using data from the 1940, 1960, 1980, and 2000 Censuses. I focus on the birth cohorts of 1900, 1920, 1940, and 1960, which I observe at age 40 in the respective Census years. I use age 40 because labor force participation is high and we would expect individuals' earnings (men here) to be indicative of their productivity. I estimate the distribution of lifetime income in two stages. First, I calculate the distribution of annual permanent income and second, use the observed mortality distributions to determine over what periods these permanent incomes would have been earned. The figures are all in real $2000 dollars with no discounting.

For a given Census year, I calculate permanent earned income for the 40 year olds from the residuals of a regression of log earned income on age, age squared, age cubed, and a constant. In each case, the regression sample is men age 16-65 (see Table 17, Appendix B). The distribution of the incomes of the "40 year olds" is constructed from the permanent incomes of those aged 36-45.

Table 13 shows mean annual permanent earned income at age 40 for each cohort. Because I calculate a discrete distribution of lifetime income (see below), I also show the means calculated from 25 evenly spaced percentiles of the annual income distribution to give a sense for how much information is lost from the discrete approximation to the full distribution.

	Birth cohort (Census year at 40)			
	1900 (1940)	1920 (1960)	1940 (1980)	1960 (2000)
Sample individuals	17.6	36.2	48.9	48.8
25 percentiles	17.3	35.2	47.9	43.6

Table 13: Mean annual permanent income (age 40) in 000s of $2000

The experiences of these cohorts suggest that incomes were increasing over the century, particularly for the first three cohorts. Mean permanent income remains high for the 1960 cohort, although it is slightly lower than for the 1940 cohort. The Gini coefficients calculated for these four distributions are more varied (Table 14); interestingly, the Gini coefficient for the 1960 cohort is considerably larger than that for the 1940 cohort, suggesting that although the means are similar, the shapes of the distributions differ significantly.

	Birth cohort			
	1900 (1940)	1920 (1960)	1940 (1980)	1960 (2000)
Sample individuals	0.400	0.342	0.356	0.487
25 percentiles	0.368	0.303	0.322	0.409

Table 14: Gini coefficient of annual permanent income

Roughly, the income distributions have been shifting to the right and spreading out over time. Figure 7 presents kernel density estimates[8] of the the distributions of annual permanent income for each birth cohort. The differences between the 1940 and 1960 cohort distributions are interesting.

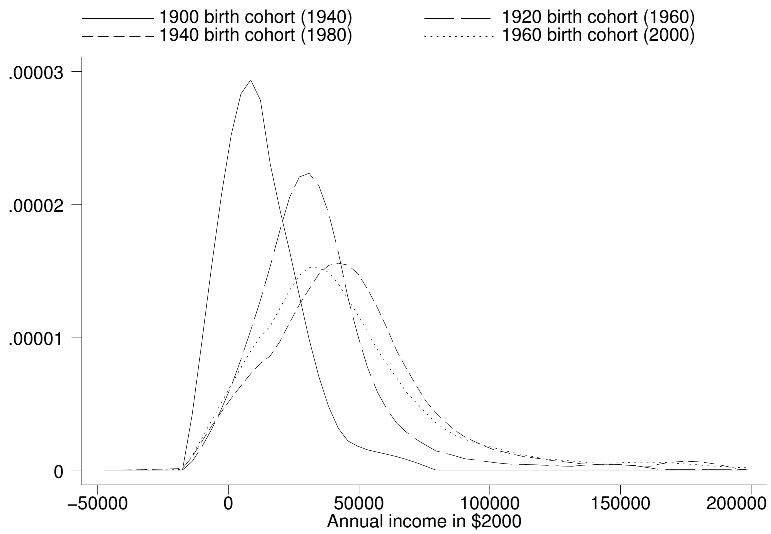

Figure 7: Kernel density estimates - distribution of annual permanent income

The 1960 distribution has more probability mass both below the mode and at high levels. Note that these density estimates are for descriptive purposes and are not used to generate the distributions of lifetime income.

To measure how lifetime income inequality has changed across these cohorts, I assume that individuals live lifetimes which last either for 0-15, 16-25, 26-35, 36-45, 46-55, 56-65, or 66+ years. Individuals who live less than 16 years have no lifetime income. Individuals who live 16-25 years accrue their permanent income for each of ten years. Individuals living 26-35 years receive 20 times annual income and so on. Income is zero after age 65. Table 15 shows how the income distributions and the mortality distributions interact to generate different levels of inequality. The table shows the calculated Gini coefficients of lifetime income; each row presents the results for a given mortality profile, while each column presents the results for a given cohort's permanent income distribution. The distribution of lifetime income is calculated by accumulating the calculated lifetime income amounts into equal sized ($500,000) categories (the lowest category is 0 for those cohort members who live less than 16 years). The last line in the table indicates the number of (consecutive, possibly empty) categories required to describe the lifetime income distribution. The aggregation of lifetime income into categories is likely to understate the calculated inequality levels.

	Birth cohort income distribution			
Mortality experience	1900	1920	1940	1960
1900 cohort mortality	0.382	0.413	0.456	0.555
1920 cohort mortality	0.306	0.328	0.377	0.493
1940 cohort mortality	0.258	0.277	0.330	0.456
1960 cohort mortality	0.235	0.253	0.308	0.439
Lifetime income bins	(8)	(17)	(25)	(46)

Table 15: Gini coefficient of lifetime income

The diagonal shows the calculated "actual" level of inequality experienced by these cohorts. Inequality declined from the 1900 to the 1920 cohort and then increased slightly for the 1940 birth cohort. For the 1960 cohort, lifetime inequality increased sharply. These changes are the result of the interplay between changes in the income distributions, which were becoming less equal, and the lifetime distributions, which were becoming more equal. The rows of the table suggest that, given mortality, inequality was increasing across all cohorts. But, given an annual income distribution, the improvement in mortality lowered inequality (moving down the columns).

These figures almost certainly provide an incomplete, and perhaps even a misleading picture of the distribution of lifetime income. In particular, the distribution of annual permanent income for the 1900 birth cohort is based on a smaller group of survivors than are the distributions of the other cohorts. In addition, the Census income data in 1940 is not as rich as (and not entirely comparable to) the data from the other years as one would like. However, the rough picture is instructive. Inequality in lifetime incomes *is* likely to be less than it would have been under earlier mortality regimes and a focus solely on income cross sections would miss this change in the distribution of welfare.

VIII Conclusions

One of the major achievements in the course of the development of modern economies has been the decline in mortality. Death is still just as certain as taxes, but it comes later now than it did formerly, and it comes later for more of us. This has not only increased life expectancy, but has also reduced the inequality of lifetimes experienced by individuals. This improvement in welfare and in the distribution of welfare can be seen in 20th century U.S. birth cohorts, in cross-sections of 19th century Americans, and in other developed economies. Standard tools for analyzing income inequality show that lifetime inequality has declined dramatically over the past century and a half. Looking farther back in time, improvements are even more dramatic.

Inequality inferences based on lifetimes are surely not perfect. Many of the changes in the U.S. labor market which have led to the earnings distributions of the past few decades would be missed or observed only with delay in the lifetimes data. Both income and lifetime are likely to be important determinants of individual welfare; because income and mortality are negatively correlated, lifetime inequality is likely to understate welfare inequality.

Nonetheless, lifetimes provide a useful complement to incomes in our attempt to assess the levels and the distributions of welfare of individuals. And, the data describing lifetimes offer some important advantages over income data. Lifetimes are readily comparable across time and space. Lifetimes better describe the full range of welfare outcomes across members of a population. Lifetimes measurement is not clouded by the extent to which economic activity is market based. Lifetimes can also be more readily measured, particularly for preindustrial and prehistoric populations.

Lifetimes data can also help to interpret the distribution of income. If income is a reasonable measure of welfare, then lifetime welfare is a function of lifetime income. In a world with differential mortality, length of life is a major component of lifetime welfare, both because of its direct impact on lifetime income and because it is important to individuals independently of income. Using annual income to measure inequality of welfare is problematic in part because death removes people from our samples. The 13% of Julia Lehan's contemporaries who died in their first year of life and the 20% who died by age 12 are simply not present in later years. Even with good income data from the early part of the century, income inequality would not fully capture cohort welfare inequality.

Julia Lehan's America was one in which fundamental life circumstances were very unequal. Her great-grandsons, born a century after she was, were born into a different world. One of them, like her older brother, died young; other members of recent cohorts will as well. Overall however, those born today in developed economies are likely to experience a much more equal distribution of lifetimes. Many young people today will reach adulthood without encountering death at close hand. This is a blessing, surely. But, it makes it hard to appreciate how much circumstances have changed. It makes it hard to appreciate just how far we have come.

A Data - 19th and 20th Europe

The Gini coefficient calculations for Europe are based on data from (Human Life-Table Database 2003), denoted by HLD and from (Preston, Keyfitz, and Schoen 1972), denoted by PKS (Table 16). For all countries except France, I use Type 3 life tables. Type 3 tables are not available for France, so I use Type 1 tables. All the tables have one year intervals, but the ending points vary. The reported figures for Germany in 1950-74 are the means of the corresponding figures for FRG (1960-62) and GDR (1963-64).

	1850-74	1875-99	1900-24	1925-49	1950-74	1975-99
Denmark			1911-1915 (HLD)	1931-1935 (HLD)	1961-1962 (HLD)	1986-1987 (HLD)
France	1862-1862 (HLD)	1887-1887 (HLD)	1912-1912 (HLD)	1937-1937 (HLD)	1962-1962 (HLD)	1987-1987 (HLD)
Germany	1871-1881 (HLD)	1881-1890 (HLD)	1910-1911 (HLD)	1932-1934 (HLD)	(HLD)	1991-1993 (HLD)
Ireland				1935-1937 (HLD)	1960-1962 (HLD)	1985-1987 (HLD)
Italy		1891 (PKS)	1910 (PKS)	1930-1932 (HLD)	1960-1962 (HLD)	1993-1993 (HLD)
Norway	1861-1865 (HLD)	1881-1885 (HLD)	1911-1915 (HLD)	1931-1935 (HLD)	1961-1965 (HLD)	1986-1990 (HLD)
Switzerland		1881-1888 (HLD)	1910-1911 (HLD)	1929-1932 (HLD)	1958-1963 (HLD)	1988-1993 (HLD)
U.K.	1838-1854 (HLD)	1881-1890 (HLD)	1910-1912 (HLD)	1930-1932 (HLD)	1960-1962 (HLD)	1990-1992 (HLD)

Table 16: European data: years and sources

B Permanent income data

The lifetime income estimates are based on samples from the 1940, 1960, 1980, and 2000 U.S. Censuses (Ruggles and Sobek 1997). For each year, I estimate permanent income from the residuals of:

$$\ln(\text{earned income}) = \beta_0 + \beta_1 \text{age} + \beta_2 \text{age}^2 + \beta_3 \text{age}^3 + u \quad (1)$$

(see Table 17). Earned income is as close as possible to the sum of wage and salary income plus farm and business income. In each case, the sample is the non-institutional male population aged 16-65. Dollar figures are converted to $1967 using the CPI for all urban consumers.

For the 36-44 year olds in each year ("40" year olds), I calculate the percentiles of the permanent log earnings distribution. For each year, the bottom $x_t\%$ of the distribution is extrapolated; x_t is the fraction not in the labor force. The extrapolation is simply linear, based on the five lowest

	Birth cohort (Census year at age 40)			
	1900 (1940)	1920 (1960)	1940 (1980)	1960 (2000)
`age`	0.428	0.555	0.474	0.562
	(0.0103)	(0.0027)	(0.0023)	(0.0093)
`age`^{2}	−0.009	−0.012	−0.010	−0.012
	(0.0003)	(0.0001)	(0.0001)	(0.0002)
`age`^{3}	6.10×10^{-5}	8.35×10^{-5}	6.08×10^{-5}	7.75×10^{-5}
	(2.32×10^{-6})	(5.87×10^{-7})	(5.36×10^{-7})	(2.10×10^{-6})
`constant`	1.358	0.546	1.522	0.164
	(0.1202)	(0.0315)	(0.0269)	(0.1099)
N	39,352	442,919	598,153	101,213
F	2,486	42,252	78,002	6,240
R^2	0.159	0.223	0.281	0.276
pr(LF)	0.97	0.97	0.95	0.90

Table 17: Permanent earned income regressions

observed percentiles. The percentile values are converted to $2000 using the CPI and assuming everyone is age 40.

Men are assumed to live for discrete periods of time: 0-15, 16-25, 26-35, 36-45, 46-55, 56-65, or 66+ years of age. I aggregate the observed mortality distributions to these categories. Then, for each percentile of the permanent earned income distribution, lifetime income is the product of the number of earnings years (e.g. 0, 10, 20, . . .) and annual permanent income. The probabilities of these lifetime income amounts are aggregated in $500,000 categories. The calculated Gini coefficients assume that everyone in a category accumulates a lifetime income equal to the mid-point of the category (except in the first category, which includes those with 0 earnings years who accumulate a lifetime income of $0).

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Notes

[1] BMI = (weight in kg)/(height in m)^2.

[2] All data used in this paper are available upon request.

[3] These data are not entirely comparable to the other life expectancy data presented here; the estimates for many of the years are not generated from life table data. This contributes to the different appearance of the life expectancy figures here as compared to Figures 1 and 5 and to the fact that I am unable to generate inequality measures by race for earlier years.

[4] See also (Steckel 2003) for similar arguments in a different context.

[5] Although the skeletal remains analyzed by (Acsádi and Nemeskéri 1970) and others indicate that death was not always, and perhaps not even frequently, violent.

[6] I consider only permanent income; there is no age-earnings profile and no transitory component of incomes.

[7] See (Deaton and Paxson 1999) among others for evidence that the true relationship is likely to be more complex.

[8] The estimates were generated using an Epanechnikov kernel with a halfwidth of 7,500; this window size means the estimates are smoothed a great deal. These descriptions are likely to be poor descriptions of the local variations in a given year's distribution. For each cohort, the graph is based on estimates at 100 income points, chosen based on the 1920 birth cohort (1960 Census) distribution. The graph is truncated below at -$50,000 and above at $200,000. The major effect of this truncation is on the 1960 birth cohort; the density estimates for the 1960 cohort extend further to the right than do the estimates for the other cohorts.

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