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THE EMPIRICAL RELATIONSHIP BETWEEN LIFETIME EARNINGS AND MORTALITY

Julian P. Cristia
Congressional Budget Office
E-mail: julian.cristia@cbo.gov

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Abstract

Researchers have estimated differential mortality across socioeconomic groups by classifying individuals using income in the previous year. The first problem with this strategy is reverse causation. Second, annual income is a noisy measure of permanent income. This paper tackles these two drawbacks by using better measures of lifetime earnings from administrative records to classify individuals. Results indicate that the relationship between mortality and lifetime earnings is very strong, is weaker for women than for men, varies when individual versus household earnings is used, is less pronounced at older ages, and has become substantially stronger in the last 20 years.

I. Introduction

Differential mortality by race, ethnicity, education, marital status, and economic measures has been extensively investigated in the literature (see Hummer et al., 1998). In particular, researchers have estimated differential mortality across socioeconomic groups by measuring differences in mortality rates in a given year across groups defined by income in the previous year (Kitagawa and Hauser, 1973; Duleep, 1989; Sorlie, Backlund, and Keller, 1995). This strategy faces two drawbacks. First, it suffers from reverse causation: Individuals who experience health shocks (which increase their mortality probability) may drop out of the labor market, thus simultaneously suffering a drop in income. As a result, this approach will overstate the true correlation between permanent income and mortality. Second, yearly income is a noisy measure of permanent income. Taking into account only this effect, we should expect that estimates of differential mortality by income in a specific year will underestimate the extent of differential mortality by permanent income.[1]

This paper tackles these two problems by using measures of lifetime earnings to classify individuals. These measures are constructed by using long averages of past earnings. For individuals older than 53, earnings from age 41 to 50 are used to capture the years when the person was most closely attached to the labor market. For younger individuals, averages ranging from five to ten years were computed without including the immediately preceding three years (e.g., for individuals age 43, earnings from ages 31 to 40 are used). In this way, the problem of reverse causation is at least partially addressed by not including, in the computation of the earnings average, years

[1] Evans and Singleton (2007) explore how large this effect is by comparing the correlation between earnings in one year and mortality to the correlation between annual earnings averages of varying length and mortality.

immediately preceding the year when mortality is ascertained. The problem of attenuation bias due to noisy yearly data is tackled by computing long averages of yearly earnings.

Besides the contribution to the differential mortality literature, results from this paper can be used as an input in studies of progressivity of public programs such as Social Security and Medicare. Studies by Garret (1995), Gustman and Steinmeier (2001), and Armour and Pitts (2004) have analyzed how much of the progressivity built into the Social Security benefit formula remains after it is recognized that low earners tend to die at a younger age than high earners. These researchers, in order to incorporate differential mortality, have used estimates of mortality differentials by income in the previous year from Kitagawa and Hauser (1973) and Duleep (1989). However, for reasons mentioned above, these estimates may not accurately represent differences in mortality rates across groups with different permanent incomes.[2]

It is not surprising that there are few studies that estimate differential mortality by some average of lagged earnings. To obtain these estimates, very large micro data sets containing both earnings history and mortality status are required. The National Longitudinal Mortality Study, the data set most widely used in differential mortality studies in the United States, reports only cross-sectional income data. As an exception, Duleep (1986) matched Social Security earnings data to mortality records to predict the death probability in a five-year window (1973 to 1978) using a five-year average of earnings (1968 to 1972). Menchik (1993) used the National Longitudinal Survey of

[2] The Congressional Budget Office (2006) studied the effects of differential mortality on progressivity measures of the U.S. Social Security system using the Congressional Budget Office Long-Term model, which incorporates in its microsimulation estimates of differential mortality by measures of lifetime earnings. Using the same model, Harris and Sabelhaus (2005) analyzed how changing the extent of differential mortality affects progressivity.

Mature Men and constructed a measured of average earnings up to age 61 to use as a control while probing for the effect of poverty on mortality. Finally, McDonough et al. (1997) employed data from the Panel Study of Income Dynamics to construct ten-year panels in which income is averaged over the first five years and mortality status is ascertained over the subsequent five years.

These studies have made important contributions to the literature, but they have been constrained by data limitations. More recently, studies by Waldron (2007) and Duggan et al. (2007) have used large samples from Social Security Administration (SSA) records to provide very precise estimates of mortality differentials by lifetime earnings. Duggan et al. provided estimates of mortality differentials by lifetime earnings for a sample of individuals receiving Social Security benefits. In turn, Waldron presented compelling evidence of increasing differential mortality by lifetime earnings for individuals ages 65 and older.

This paper uses data from SSA records on earnings, beneficiary, and mortality matched to extensive demographics from the 1984, 1993, 1996, and 2001 panels of the Survey of Income and Program Participation (SIPP). The resulting sample used for the analysis contains roughly 130,000 individuals ages 35 to 75 for which the mortality window ranged from 3 to 21 years (depending on the SIPP panel), yielding a total of approximately 1.2 million person-year observations.

The breadth of the SIPP-SSA data set allows improvement upon the set of earlier studies by Duleep (1986), Menchik (1993), and McDonough et al. (1997) in several different dimensions. First, more precise measures of lifetime earnings can be obtained because more than five years of earnings can be used and average earnings can be computed for ages which better reflect earnings potential. Second, this paper addresses the problem of reverse causation by not including earnings in years immediately preceding the time window in which mortality will be ascertained. Third, Duleep focused on white married men ages 35 to 65 and McDonough et al. pooled individuals ages 25 and older; this paper provides separate estimates of the mortality gradient by age and sex groups. Fourth, because the constructed data set spans more than 20 years, this paper can explore recent trends in the relationship between lifetime earnings and mortality. Fifth, given the large sample size of the SIPP-SSA data set, more precise estimates are obtained than those found in the earlier set of studies.

This paper shares the advantages of studies by Waldron and Duggan et al. of using Social Security records on earnings, benefits, and mortality; however this study differs from those studies in terms of the richness of the data and the population studied. Regarding data, this paper also uses earnings information from income tax returns from the Internal Revenue Service (IRS) for the period 1978 to 2003 which. The IRS earnings information, as opposed to Social Security sources, is uncapped and includes earnings from both Social Security covered and noncovered jobs. Furthermore, Waldron and Duggan et al. used Tobit regressions to impute above the Social Security taxable maximum; this paper uses additional information in the data set to infer in which quarter an individual hits the taxable maximum. This translates into a much more precise method of imputing earnings above the taxable maximum.[3] Finally, regarding the population studied, while Waldron and Duggan et al. focused on older populations, this study

[3] In addition, this study has extensive demographic information from the SIPP that allows the observation of how the estimated differentials change when different set of controls are used in the regressions.

analyzes the extent and trends of differential mortality for individuals in three age groups: 35 to 49, 50 to 64, and 65 to 75.[4]

Findings regarding the extent of differential mortality by lifetime earnings can be summarized as follows. First, there are large differentials in age-adjusted mortality rates across individuals in different quintiles of the individual lifetime earnings distribution (e.g., men ages 35 to 49 in the bottom quintile have age-adjusted mortality rates 6.4 times larger than those in the top quintile). Second, controlling for race, Hispanic origin, marital status, and education only slightly reduces these differentials. Third, differentials for men are slightly larger for individual compared with household lifetime earnings, but the opposite is true for women.[5] Fourth, men and women have similar differentials when average household lifetime earnings are used to sort individuals into quintiles. Finally, differentials decrease markedly with age.

With respect to trends in differential mortality by lifetime earnings, there is substantive evidence pointing toward an increase in differential mortality in the period 1983 to 2003. For example, in the period 1983 to 1997 men ages 35 to 49 in the bottom lifetime earnings quintile had mortality 5.9 (1.8 for women) higher than those in the top quintile; in the period 1998 to 2003 this ratio increased to 8.3 (4.8 for women). This increase in differential mortality is also found for all other age-sex groups, when sorting individuals by household earnings and even when using alternative measures of lifetime earnings.

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[4] Still, both Waldron and Duggan et al. use larger sample sizes than the current study and also observe mortality in a longer window than for the 1983 to 2003 period available in the data set used.

[5] "Household lifetime earnings" refers to the average lifetime earnings of the individual and his or her spouse (if he or she is or was married).

It is worth noting that in the data set used, the quality of the earnings information increased over time; this increase in quality of information could bias the results toward finding increasing differential mortality. The increase in data quality is due to the fact that, for the period 1951 to 1979, only Social Security earnings are available, and for 1980 to 2003, IRS earnings are used.[6]

Taking these concerns into account, several robustness checks were performed to explore whether the uncovered pattern expresses a true phenomenon rather than a data artifact. First, as a way to tackle the problem of using years of noncovered employment trends in differential mortality were computed dropping from the calculation of the lifetime earnings measure years with zero earnings. Second, the analysis was repeated using a two-year average of earnings in ages *A*-3 and *A*-4 (where *A* is the person's age) in order to use earnings only from IRS sources. In both cases, the same patterns of increasing differential mortality were observed, giving support to the view of a real increase in mortality differentials across lifetime earnings groups in the last 20 years.

II. Data

This study uses data from the 1984, 1993, 1996, and 2001 panels of the Survey of Income and Program Participation (SIPP), matched to several files administered by the Social Security Administration (SSA) containing information on earnings, disability, and mortality.

The SIPP provides information for a representative sample of the U.S. non-

[6] The coverage of Social Security increase markedly in the early 1950s but it slowed significantly starting in 1957; at that point about 80 percent of the total earnings in the economy corresponded to jobs covered by Social Security (Committee on Ways and Means, *2004 Green Book*). For this reason, this paper uses earnings only for the period 1957 to 2003.

institutional population. It contains information about cash and noncash income, taxes, assets, liabilities, demographics, labor force status, and participation in government transfer programs. The survey is a continuous series of panels, with sample size ranging from 14,000 to 36,700 households, and was conducted annually between 1984 and 1993, and then once in 1996 and once in 2001. Individuals in the SIPP panel were interviewed every four months for the duration of the panel; the surveys ranged in duration from 2.5 years to 4 years, depending on the panel.[7]

Four SSA files were matched to the mentioned SIPP. The Summary Earnings Record (SER) provides yearly Social Security taxable earnings for the period 1951 to 2003. It includes a variable that reports whether the individual paid Social Security taxes in each quarter (this information is useful for reconciling the problem of topcoded earnings, as explained in Section II.2). The Detailed Earnings Record (DER) contains federal income taxable earnings for the period 1978 to 2003. The Master Beneficiary Record (MBR) provides information about Social Security benefits receipt. Finally, the Numident file, which is updated from the State and Territorial Bureaus of Vital Statistics, the Department of Veterans Affairs, SSA offices, and other SSA administrative files, reports year of death.

II.1. Sample Construction

To create the sample for this study (the Mortality sample), I construct a panel data set in which the unit of observation is a person-year, containing basic demographic and economic variables from the SIPP. For time-varying variables (education, marital status, and spouse links), monthly information from the SIPP is used to construct yearly

[7] For more details on the SIPP, see www.bls.census.gov/sipp/index.html.

observations. Observations in which the person was 24 years of age or younger are dropped. Second, information on Social Security annual earnings from 1951 to 2003 (from the SER), federal income taxable earnings from 1978 to 2003 (from the DER), disability status (from the MBR), and year of death (from the Numident) is attached to the sample. Third, the resulting intermediate data set is "aged" forward, completing years outside the SIPP window with information from the last year of available SIPP data up to the year 2003 (or up to the year of death if the person died before 2003).[8] SIPP variables that are time-invariant (birth year, sex, race, and Hispanic origin) are correct for the filled years, those that are time-variant (education, marital status, and spouse links) could be wrong if there are changes in the individual situation. Last, only observations for individuals ages 35 to 75, born in 1909 or later, are kept.[9]

Although this process of filling years with prior information introduces some measurement error in the education, marital, and spouse links variables, the advantage is that it significantly enlarges the number of person-year observations in the data set. In addition, the main variables in this study (mortality and measures of lifetime earnings) are unaffected by this decision. Finally, only 16 percent of the sample is aged more than 10 years. (All are individuals from the 1984 SIPP.)

[8] That is, for an individual with SIPP data in 1984, 1985, and 1986, additional yearly observations for 1987 onward are created using the variable values from 1986.

[9] Individuals younger than 35 are dropped because it is necessary to observe their earnings at ages while they were potentially attached to the labor market to construct the measures of lifetime earnings. Those born before 1908 are dropped because there is no earnings data for ages 48 and younger for them. Finally, given the cohort restriction imposed in the sample, individuals older than 75 are eliminated from the sample to ensure that the sample contains individuals in the same age range across time.

The resulting data set is a panel data where the unit of observation is a person-year. It includes yearly observations for individuals since the year they first entered the SIPP until 2003 (or until their death year, if they died before 2003).[10]

II.2. Measures of Lifetime Earnings

This subsection describes how the measures of lifetime earnings used in the study are constructed. First, total annual earnings for the years 1951 to 2003 are obtained. Second, measures of lifetime earnings are constructed using five- to ten-year averages of past indexed earnings. Last, quintiles of lifetime earnings within sex, five-year age, and five-year cohort groups are computed. Each of these steps is described next.

For the period 1951 to 1977, Social Security taxable earnings from the SER are used. A limitation of this earnings measure is that it is capped at the taxable maximum for each year. This problem is less severe for more recent years because the Social Security taxable maximum has been rising, in real terms, over time. However, for earlier years this problem is significant, especially for men —for example, 68 percent of men in the sample born between 1920 and 1924 have earnings above the taxable maximum in some year between 1960 and 1964. Fortunately, for the years 1953 to 1977, the SER contains a variable, Pattern of Quarters of Coverage, that reports whether an individual paid Social Security taxes for wages and salary in each quarter of the year. For individuals with topcoded earnings, this variable can give bounds on their earnings, assuming that their flow of earnings is constant over the year.[11] Finally, total earnings for this study are set at

[10] Sample statistics are presented in subsection II.3.

[11] For example, if an individual with a constant flow of earnings hit the taxable maximum in a year and he or she paid Social Security taxes only in the first two quarters, then we know that his or her uncapped earnings were at least twice but not more than four times the taxable maximum of that year. If the earnings

the midpoint between these bounds —for example, for individuals hitting the taxable maximum in the second quarter, annual earnings are set at three times the taxable maximum.[12] The procedure used to assign earnings above the taxable maximum, though it is simple, constitutes a major improvement over other studies that have used this data set, given that exploratory analysis of the Patterns of Quarters of Coverage variable reveals that it contains significant information about individuals' uncapped earnings.[13]

For the years 1980 to 2003, three annual earnings variables from the DER are used: IRS taxable income from wages and tips (box 1 of W-2 form), deferred wages (box 13), and Medicare taxable self employment income (1040 SE). The sum of these earnings measures generates the value of total earnings used for this period. For the years 1978 to 1979, information from the DER was not used because researchers familiar with the file believe that the quality of information for this period was not very good. Instead, for individuals who hit the taxable maximum in these years, the total earnings variable was set as the weighted average between total earnings in 1977 and 1980 (provided this amount was higher than the taxable maximum in these years).[14]

To construct the permanent earnings measure, an average of yearly past indexed earnings was computed (earnings are indexed to year 2000 dollars using the Personal Consumption Expenditure deflator). When constructing this measure, the goal was to

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had been more than four times the taxable maximum, he or she would have hit the maximum in the first quarter.

[12] For individuals that hit the taxable maximum in the first quarter, we cannot assign an upper bound. For these individuals I assume that earnings were eight times the taxable maximum. This assumption is somewhat innocuous, given that in the study individuals are assigned to earnings quintiles of lifetime earnings.

[13] On a sample of individuals ages 45 to 55 that hit the Social Security taxable maximum in 1984, regressing uncapped earnings in that year on sets of dummy variables reporting whether the individual hit the taxable maximum in the first, second, third, or fourth quarter or not at all for the years 1969 to 1977 yields an adjusted R-square of about 0.3.

[14] The weight for the year 1977 was 2/3 when imputing for the year 1978 and was 1/3 when imputing for the year 1979.

approximate the permanent earnings level of the individual while he or she had the closest attachment to the labor market. Also, in order to mitigate the problem of reverse causation, the measure does not include earnings received in the three years preceding when mortality was ascertained.

Taking these issues into consideration, for individuals ages 53 and older, the permanent earnings measure was constructed as the ten-year average earnings from ages 41 to 50. For younger individuals, there is a trade-off between using more years (reducing noise in the data) and using fewer years (avoiding inclusion of earnings at younger ages when high earners may still be acquiring educational degrees). For the basic measure in the study, this trade-off is resolved in the following way. For individuals younger than 53 and age *A*, the measure is constructed by averaging earnings between age *A*-3 and the maximum of 28 and *A*-12. For example, for an individual age 35, earnings between ages 28 and 32 will be used; for a 45-year-old person, the measure averages earnings between ages 33 and 42.

Finally, to avoid interactions between earnings levels and sex, age and cohort, I sort all individuals alive in a year into quintiles of the lifetime earnings distribution computed *within* sex, five-year age and five-year cohort groups. Thus, results in the study show differences in mortality rates by lifetime earnings when individuals are compared with others of the same sex and similar age and year of birth.

II.3. Is the Sample Representative?

The Mortality sample constructed for this study constitutes a unique data set for exploring the relationship between lifetime earnings and mortality. However, the way that it was constructed (pooling SIPP panels, matching them to SSA records and filling years forward) may raise doubts about the representativeness of the sample. The question is whether the results are representative of a certain period of time (the period of time when mortality was ascertained). Because individuals in the Mortality data set enter the sample when they first are interviewed in the SIPP and remain in the sample until the year 2003 (or until they die), the sample contains observations for the years 1983 to 2003, but its composition is tilted toward later years.

To tackle this problem, and to make the sample representative for the period 1983 to 2003, I obtained population counts by age, sex, race, Hispanic origin, and year for the period from U.S. Census intercensal estimates.[15] The same age restriction used for constructing the Mortality sample was applied to the Census data (only individuals ages 35 to 75 were kept). Next, I constructed weights to match to the Census data, the distribution of observations in the Mortality sample by sex, five-year age, race, Hispanic origin, and five-calendar-year groups. Table 1 shows that the age, sex, and race distributions in the unweighted Mortality sample are similar to the Census counterparts. However, the distributions by year are quite different (e.g., 42 percent of the observations in the Mortality sample correspond to the period 1998 to 2002; in the Census data, 27 percent of the observations are in this group). Finally, comparing Columns 3 and 4, we see that when the Mortality sample is reweighted, the distributions by age, sex, race, Hispanic origin, and year match closely the distributions in the Census data. Therefore, the constructed weights are used for all results presented in the remainder of the paper.

To ensure that the sample is representative of the population for the period 1983 to 2003, we can also compare, for particular years, the sample distribution by age, sex,

[15] The Census estimated counts were obtained at http://www.census.gov/popest/estimates.php.

race, Hispanic origin, education, and marital status to the distribution from the SIPP. Using the SIPP as the benchmark allows us to compare a larger set of covariates. In this way we can check whether the two key steps in the construction of the data set (matching the SIPP pooled panel to SSA records and filling missing years) made the cross-sectional patterns of the sample diverge compared with those from a national representative sample. Table 2 presents this comparison for selected years 1984 and 1996 (for other years, the same patterns emerge). The table shows that the sample replicates quite closely statistics from the SIPP in a particular point in time and also the changes in these distributions across time.

Another important aspect in determining the reliability of the results from this study regards the quality of the mortality data. To gauge its quality, I compare sample death rates by age and sex to those computed using data from the Human Mortality Database (HMD) as a benchmark.[16] Because mortality rates have decreased substantially for later cohorts, for each age-sex group, HMD death rates were constructed using rates by year of birth and computing the weighted average using as weights the cohort sample distribution. Figure 1 presents the Mortality sample and HMD mortality rates by age and sex. We can see that the sample mortality rates follow quite closely those from the HMD, although the sample rates seems slightly lower for males especially for younger ages.

[16] The Human Mortality Database is a joint project between the Department of Demography of the University of California at Berkeley and the Data Laboratory of the Max Planck Institute for Demographic Research. The constructed database contains original calculations of death rates and life tables for national populations. More information at www.mortality.org.

III. The Extent of Differential Mortality by Lifetime Earnings

This section presents estimates of the extent of differential mortality by lifetime earnings. In the first subsection, mortality ratios are reported for groups defined by race, Hispanic origin, education, marital status, disability status, and lifetime earnings quintiles. The ratios, computed separately for sex, represent the relationship between the mortality rates for each group (compared with the whole population) after the rates have been adjusted for differences in the age distribution between the group and the whole population. The second subsection focuses on differences in mortality rates by lifetime earnings, using logistic regressions to adjust for different sets of covariates. The final subsection presents robustness checks of the main findings in this section.

III.1. Mortality Ratios

The mortality ratio for a group in certain age group (e.g. black men ages 35 to 49) is computed in the following way:

$$Mortality\ Ratio_{BLACK\ MEN} = \frac{\sum_{a=35,\dots,49} weight_a * mortality\ rates\ of\ black\ men_a}{\sum_{a=35,\dots,49} weight_a * mortality\ rates\ of\ all\ men_a}$$

where *mortality rates of black men* $_a$ is the one-year age-specific mortality rate for black men age *a*, *mortality rates of all men*$_a$ is the one-year age-specific mortality rate for all men age *a* and *weight*$_a$ corresponds to the fraction of men age *a* from all men in this age group in the sample.

The numerator is the age-adjusted one-year mortality rate for black men and the denominator is the average mortality rate for all men in the sample. A ratio of 1 for a certain group indicates that, once we adjust for differences in the age distribution, the group has the same mortality rate as all individuals in the sample of that sex. A ratio higher than 1 (e.g., 1.5) means that the group has a higher age-adjusted mortality rate than all individuals of the same sex in the sample (50 percent higher).

Table 3 presents mortality ratios for men. Column 2 reports ratios for all men in the sample; Columns 3 to 5, report ratios for age groups (35 to 49, 50 to 64 and 65 to 75). Ratios by race, Hispanic origin, education, marital status, and Social Security Disability Insurance (DI) status replicate the general patterns documented in previous studies on differential mortality. Focusing on individuals of all ages (Column 2), we see that blacks have a 48 percent higher age-adjusted mortality rate (compared with all men), Hispanics a 6 percent lower rate, and college graduates have a 38 percent lower mortality rate.[17] Being never married, separated/divorced, or widowed is associated with a 51 percent to 57 percent higher mortality rate. Individuals who have ever received Social Security Disability Insurance (DI) have a 270 percent larger mortality risk.[18]

Comparing Columns 3 to 5 of Table 3, we see how male mortality ratios vary across age groups. The results show that mortality differentials by race, education, and marital status tend to dilute over time (i.e. mortality ratios converge toward 1 for older individuals). However, mortality differentials by education tend to persist as individuals age (e.g. college graduates ages 35 to 49 have 45 percent lower mortality rate and this figure falls only to 38 percent for those ages 65 to 75).

Similarly, as with other covariates, the excess mortality rate associated with men ever on DI decreases as we focus on older individuals. However, individuals currently on

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[17] In this subsection, for brevity, mortality rates refer to age-adjusted mortality rates.
[18] Mortality ratios for individuals currently on DI are not computed for age groups 35 to 75 and 65 to 75 because individuals on DI have their status updated to Social Security retirees when they turn 65.

DI ages 50 to 64 have an almost 13 times higher mortality rate (compared with all men in that age group), and those ages 35 to 49 have a mortality rate 8 times higher.

The bottom panel of Table 3 presents mortality ratios by lifetime earnings quintiles computed within sex, five-year age, and five-cohort groups. For quintiles computed by individual or household lifetime earnings we observe similar patterns, although the gradient is slightly stronger when using individual lifetime earnings. Overall, there is a strong relationship between these measures of lifetime earnings and mortality. Individuals ages 35 to 49 in the bottom lifetime earnings quintile have a 125 percent higher mortality rate (compared with all men), while those in the top have a 65 percent lower rate. For a rough sense of the relative predictive power of lifetime earnings on mortality, we see that high school dropouts ages 35 to 49 have a smaller excess mortality risk than individuals in the bottom quintile of the lifetime earnings distribution (similarly, college graduates have a smaller decrease in mortality risk compared with those in the top quintile).

The decrease in mortality differentials by age group is very strong. Because the numerators of the mortality ratios for the different quintiles of lifetime earnings correspond to standardized age-adjusted mortality rates, and the denominators correspond to the average mortality rate in the sample (for the corresponding age group), the ratio of age-adjusted mortality rates between the bottom and top quintiles can be computed by dividing one corresponding mortality ratio by the other. Although this ratio for men ages 35 to 49 is 6.4 (2.25/0.35), it drops to 2.7 for men ages 50 to 64 and to only 1.5 for men ages 65 to 75.[19]

[19] Still, given that overall death rates increase very rapidly with age, decreasing relative mortality rates with age can be accompanied by increases in the differences in absolute mortality rates.

Although a drop in the ratio is expected, given that this pattern is also observed for other economic and demographic characteristics, the fact that the drop is so large suggests that there can be other explanations beyond just an age effect. Given that the sample contains data for the period 1983 to 2003, individuals ages 35 to 49 were born between 1934 and 1968 and those ages 65 to 75 were born between 1909 and 1938. That means that, when comparing mortality ratios across columns, we are comparing individuals from different age groups and different cohorts. Section 4 estimates whether there are cohort effects by exploiting the fact that the sample encompasses 21 years of mortality data.[20]

Table 4 presents mortality ratios for women. Overall, the patterns of differential mortality by race, Hispanic origin, education, marital, and DI status found for men are also present for women except for certain differences. First, Hispanic women have adjusted mortality rates that are generally closer to those of all women compared to mortality differences between Hispanic men and all men. Second, mortality rate differences for all women across marital status are less pronounced than those for men especially for women ages 65 to 75. Third, the mortality "penalty" for being on DI or having ever been on DI is higher than for men but still the patterns are similar.

To compare estimates of differential mortality by lifetime earnings between men and women, we can focus on the bottom panels of Tables 3 and 4. Although the gradient is steeper for men than for women when using individual lifetime earnings, it is strikingly

[20] Another important difference when comparing across columns is that the measure of lifetime earnings for older groups corresponds to earnings further back in the past. For example, for individuals age 53, the measure of lifetime earnings was computed by averaging earnings while the person was ages 41 to 50, and the same age range was used for all individuals older than 53. Then the difference across columns could arise from a waning effect on mortality of earnings differentials measured at a certain age.

similar when using household lifetime earnings.[21] The former result should be expected, given the higher attachment to the labor market for men (which suggests that men are relatively better "sorted" when individual lifetime earnings are used). However, the latter result is a novel finding that deserves further exploration in future work.

III.2. Logistic Results

In this subsection I investigate whether the basic patterns about differential mortality by individual lifetime earnings are affected by adjusting for different sets of covariates. To do that, logistic models are run where the dependent variable is an indicator that equals 1 if the individual died in the next year, and the key independent variable is the quintile of individual lifetime earnings to which the individual is assigned. Odds ratios are estimated relative to individuals in the bottom quintile.

As expected, given that lifetime earnings quintiles are computed within sex, five-year age and five-year cohort groups, results from running models with no covariates are very similar to those when age and cohort are added linearly as controls. Moreover, they are also close to those obtained adding dummy variables for single year of age and cohort. Given this, Figure 2 presents odds ratios from specifications with just three sets of controls: a) age and cohort, b) age, cohort, race, and marital status, c) age, cohort, race, marital status, and education. Results with age, cohort, and race are not presented because they are very similar to those when only age and cohort are added as controls. Table 5 presents the complete regressions results for men and Table 6 for women.

[21] For example, the ratio of age-adjusted mortality rates for the bottom to top quintiles of individual lifetime earnings is just 2.4 for women ages 35 to 49 compared with 6.4 for men in that age group. The analogous ratios using household earnings are 4.0 and 5.2 for women and men, respectively.

The same basic patterns that were revealed when looking at mortality ratios also emerge in the logistic specifications: The relationship is stronger for men than for women and is stronger for younger individuals than for older ones. However, there are certain refinements of these patterns that are noticeable in the graphs. For men ages 35 to 49 and 50 to 64, we observe that the risk of dying (relative to being in the bottom quintile) decreases monotonically as we focus on individuals in higher earnings quintiles. For men ages 65 to 75, the relative risk of dying for individuals in the second and third quintile is not statistically significantly different from 1, but it is significantly lower than 1 for those in higher quintiles. For women ages 35 to 49 and 50 to 64 we also observe a decreasing relationship between relative risk of dying and lifetime earnings quintiles, though for those ages 65 to 75, there is no statistically significant relationship between mortality and lifetime earnings quintiles.

All the patterns are robust when race, marital status, and education controls are added. Figure 2 shows that for men the degree of differential mortality by lifetime earnings slightly decreases when we control for these factors, but for women it slightly increases (when adding only race and marital status) or remains virtually unchanged (when adding all the mentioned controls).

It is difficult to compare these results to those from previous studies that used cross-section income measures instead of multi-year averages, because of differences in income concept used (earnings from employment versus income from all sources, individual earnings versus household earnings, and earnings in categories of levels versus quintiles), age groupings, and time periods used. However, it is interesting to note that although in this study mortality differentials are only slightly affected when adjusting for other covariates, in the study by Sorlie et al. (1995), which used income in a year data from the Current Population survey matched to National Death Index records, differentials were significantly reduced when adjusting for covariates. For example, for men ages 45 to 64, the mortality ratio between those in the top and bottom income groups (more than $50,000 and less than $5,000, respectively) was 0.32 when no covariates were used and was 0.66 when covariates were added to the model (for women, these ratios were 0.43 and 0.69, respectively).[22]

III.3 Robustness Checks

In this subsection I explore how the findings on differential mortality are robust when changes are made in the way the lifetime earnings measure is constructed. In particular, results obtained using two alternative measures are presented. In the first alternative, lifetime earnings are computed in the same way as in the basic measure, but only years with positive earnings are included in the computation of the average. In the second alternative, zero earnings years are included but the six years prior to when mortality is ascertained are excluded.[23]

The motivation for the first alternative measure (dropping zero earnings years) is based on two distinct reasons. First, for the period 1957 to 1977, workers in jobs noncovered by Social Security will not have these earnings reported in the data set used. Second, individuals with zero earnings due to temporary reasons (e.g., women with childbearing-related withdrawals from the labor market) will be classified in the bottom

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[22] Still, the set of covariates added was not identical in both studies; employment status was added as a covariate in Sorlie et al. (1995) but not in the current study.
[23] For example, for an individual age 40, earnings between ages 28 and 34 are used (for a 50-year old, ages 38 to 44 are averaged).

quintile although they could be classified in other quintiles if measures of potential earnings were used.

Figure 3 compares the estimated odd ratios under the main lifetime earnings measure (solid line), the one that excludes zero-earnings years (dashed line), and the measure that excludes the six years prior to when mortality is ascertained (dotted line). Focusing on the first two measures, we see that for individuals ages 35 to 49 the differentials are similar across measures, but for those ages 65 to 75 we observe higher differentials when dropping zero earnings years. These results are consistent with the idea that for older individuals dropping zero earnings years improves sorting across individuals (some of them may be wrongly classified in the bottom quintile); this change does not affect younger individuals because the quality of the earnings data did not change substantially for them. Finally, for men ages 50 to 64 there are no noticeable differences across these two measures, but for women in this age group estimated differentials are greater under the basic measure.

The second alternative measure, which excludes the six years prior to when mortality is ascertained, is motivated by the notion that excluding only the three prior years may not be enough to tackle the problem of reverse causation. To explore this issue, Figure 4 presents average yearly earnings in the ten years prior to death for men that died while ages 45 to 49 (solid line). For comparison purposes, average yearly earnings for ages 37 to 47 are plotted, with a dotted line, for men that survived to age 47, weighting individuals to match the cohort distribution of those who died (the dashed line corresponds to the trajectory when the cohort-education distribution is matched). For the comparison samples average earnings rise during the period, but for the deceased sample they decrease almost continuously. As a result, although earnings between both groups are very different around age 47, they are quite similar ten years earlier.

These results can be interpreted as evidence of reverse causation: The strong correlation between mortality and income in the previous year stems from the fact that some individuals receive health shocks, drop from the labor market, and die. Alternatively, this pattern can emerge if negative exogenous earnings shocks produce an increase in the probability of death.[24]

Nonetheless, Figure 3 shows that excluding the six years prior to when mortality is ascertained does not substantially change the estimated patterns. The estimated differentials slightly decrease for men ages 35 to 49 and somewhat more for women in this age group. Further work is warranted to explore why there is only a small decrease in the estimated differentials despite the strong correlation between mortality and the earnings trajectory.

IV. Trends in Differential Mortality by Lifetime Earnings

IV.1. Main Results

Although there have been several studies that estimated trends in differential mortality by education and previous year income (see Preston and Elo, 1995; Feldman et al., 1989; Duleep, 1989) there has been little work on trends of differential mortality by lifetime earnings in the United States.[25] This section fills this gap by exploring how estimates of differential mortality by lifetime earnings have evolved over time. For each

[24] Duggan et al. (2007) also found evidence of mortality rates correlated with decreasing earnings trajectories.
[25] As an exception, Waldron (2007) presents persuasive evidence of increasing differential mortality by lifetime earnings for individuals 65 and older.

of the six age-sex groups used in the study, I divided observations into two groups defined by time period: 1983 to 1997 (Early sample) and 1998 to 2003 (Late sample).[26]

Figure 5 presents logistic estimates of the one-year probability of dying by individual lifetime earnings quintiles for the Early sample (solid line) and the Late sample (dotted line). The graphs present substantive and consistent evidence of increasing differential mortality for all age-sex groups. For example, the estimated odds mortality ratio of the top relative to the bottom quintile decreased from 0.66 in the period 1983 to 1997 to 0.38 in the period 1998 to 2003.

The evidence of widening mortality when individuals are sorted into quintiles of the lifetime earnings distribution may reflect an increase in the dispersion of the distribution of lifetime earnings (with a constant relationship between earnings and mortality) or, alternatively, an increase in the slope of the earnings-mortality gradient. To shed some light on this issue, Table 7 presents average lifetime earnings by age group, sex, and quintiles for the Early and Late samples. The table shows that, although the distribution of lifetime earnings for women has become more dispersed, the distribution for men has remained quite stable for those ages 35 to 64 (though top earners have gained in this period) and has widened for those ages 65 to 75. Given that differentials have increased for all age-sex groups and that the increase has not been limited to the mortality ratios of the top to bottom quintiles, it seems that the mortality-earnings gradient is becoming steeper.

Table 8 complements the results by presenting the odds ratio of the top quintile relative to the bottom for the six age-sex groups by individual and by household lifetime

[26] The cut-off year was selected to create two samples of roughly the same size.

earnings. Similar to the results when using individual earnings, there is consistent evidence of increasing differential mortality across all age-sex groups when using household lifetime earnings.

IV.2. Robustness Checks

This subsection presents several robustness checks to gauge the reliability of the evidence found on increasing differential mortality in the last 20 years. The basic motivation for this exercise stems from the fact that the quality of the earnings data is increasing over time and, as noted before, this can create an artificial increase in the correlation between earnings and mortality.

The results of the robustness checks are presented in Table 9. The top panel of this table presents odds mortality ratios of the top quintile relative to the bottom by age group, time period and alternative average lagged earnings measures. The first line replicates results from Table 8 (i.e. results obtained using the basic measure of individual lifetime earnings). The second line presents results when including only positive earnings years; the third line shows ratios when at least the six years prior to the mortality window are excluded. The fourth line presents results when averaging the third and fourth year before when mortality is ascertained (e.g., for a person age 50, earnings for ages 46 and 47 are averaged). The advantage of this measure is that it uses only earnings data from IRS sources (uncapped and including noncovered Social Security jobs).

Comparing columns 2 to 3, 4 to 5 and 6 to 7, we see that for all earnings measures there is evidence of increasing differential mortality (that is, the ratio of the top to bottom quintile mortality is decreasing over time). Similarly, the bottom panel of Table 9 shows that the evidence of increasing differential mortality by lifetime earnings is also robust across alternative measures of lifetime earnings for women.

V. Conclusions

This paper estimates the extent and trends of differential mortality by lifetime earnings using a very large panel data set containing information on mortality, earnings history, and demographic and economic characteristics. Measures of lifetime earnings are constructed to deal with the problems of reverse causation and noise in yearly earnings data present in estimates of differential mortality by previous year income. Summarizing the results, the study found a strong negative relationship between one-year mortality and lifetime earnings, robust when controlling for usual covariates, weaker for women than for men, and decreasing with age. Also, evidence points to an increase in differential mortality by lifetime earnings in the period 1983 to 2003.

Given the evidence presented in this study on increasing differential mortality, a wide set of important questions could be addressed —in particular: What are the causes and consequences of increasing differential mortality by lifetime earnings? With respect to causes, the explanations that have been put forward to explain differential mortality can be used to check whether they can explain the rise in this correlation. For example, a potential explanation for increasing differential mortality by lifetime earnings could be that the correlation between poor lifestyle habits (such as smoking, poor diet, and lack of exercise) and low lifetime earnings have increased over time. Another explanation could be that recent advances in medical treatments are more readily available to high earners than to low earners compared to the past.

Increasing differential mortality also has implications for the long-term budget outlook. First, if the "life-expectancy premium" for high-earners is increasing over time, this may worsen the budgetary pressures facing the U.S. Social Security system, given that high earners receiving larger benefits will collect them (on average) for a longer period of time (Diamond and Orszag, 2004) . Second, studies that established the progressivity of Social Security have used historical data on the correlation between earnings and mortality in order to account for the effect of differential mortality on progressivity measures. However, if differential mortality by lifetime earnings continues to increase over time, then we should expect that, holding other factors constant, the progressivity of the system will diminish.

References

Armour, Brian and M. Melinda Pitts. "Incorporating Insurance Rates Estimates and Differential Mortality into the Net Marginal Social Security Tax Rate Calculation." *Public Finance Review*, 32: 588-609, 2004.

Committee on Ways and Means, U.S. House of Representatives. *2004 Green Book*. Ways and Means Committee Publication 108-6. Washington, D.C., 2004.

Congressional Budget Office. "Is Social Security Progressive?" *CBO Economic and Budget Issue Brief*. Washington, D.C., 2006.

Diamond, Peter and Peter Orszag. "Saving Social Security: A Balanced Approach." Brookings Institution Press. Washington, D.C., 2004.

Duggan, James, Robert Gillingham, and John Greenlees. "Mortality and Lifetime Income: Evidence from the U.S. Social Security Records." International Monetary Fund, Working Paper 07/15, Washington, D.C., 2007.

Duleep, Harriet Orcutt. "Measuring Socioeconomic Differentials over Time." *Demography*, 26: 345-51, 1989.

Duleep, Harriet Orcutt. "Measuring the Effect of Income on Mortality using Longitudinal Administrative Record Data." *Journal of Human Resources*, 21: 238-51, 1986.

Evans, William and Perry Singleton. "A Reexamination of the Income and Mortality Gradient." Manuscript. Department of Economics, University of Maryland, 2007.

Feldman, Jacob, Diane Makuc, Joel Kleinman, and Joan Cornony-Huntley. "National Trends in Educational Differentials in Mortality." *American Journal of Epidemiology*, 129: 919-33, 1989.

Garrett, Daniel. "The Effects of Differential Mortality Rates on the Progressivity of Social Security." *Economic Enquiry*, 33: 457-75, 1995.

Gustman, Alan and Thomas Steinmeier. "How Effective is Redistribution under the Social Security Benefit Formula?" *Journal of Public Economics*, 82: 1-28, 2001.

Harris, Amy Rehder and John Sabelhaus. "How Does Differential Mortality Affect Social Security Progressivity and Finances?" Congressional Budget Office, Technical Paper 2005-5. Washington, D.C., 2005.

Human Mortality Database. University of California, Berkeley (U.S.A.), and Max Planck Institute for Demographic Research (Germany). Available at www.mortality.org. Accessed November 28, 2006.

Hummer, Robert, Richard Rogers, and Isaac Eberstein. "Sociodemographic Differentials in Adult Mortality in the United States: Review of Analytic Approaches." *Population and Development Review*, 24: 553-78, 1998.

Kitagawa, Evelyn and Philip Hauser. "*Differential Mortality in the United States: A Study in Socioeconomic Epidemiology*." Harvard University Press. Cambridge, MA, 1973.

McDonough, Peggy, Greg Duncan, David Williams, and James House. "Income Dynamics and Adult Mortality in the United States, 1972 through 1989." *American Journal of Public Health*, 87: 1476-83, 1997.

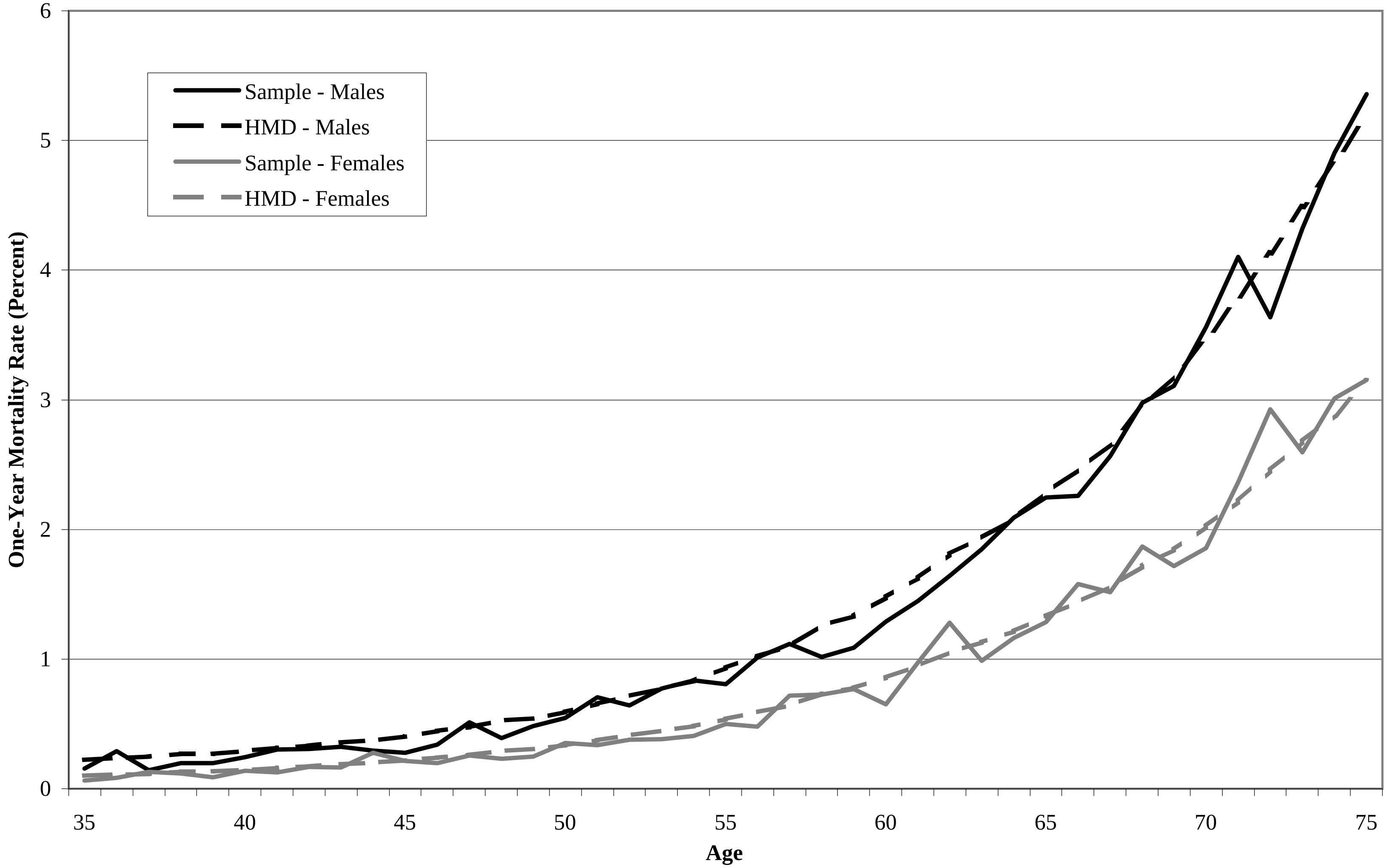
Menchik, Paul. "Economic Status as a Determinant of Mortality among Black and White Older Men: Does Poverty Kill?" *Population Studies*, 47: 427-36, 1993.

Preston, Samuel and Irma Elo. "Are Educational Differentials in Adult Mortality Increasing in the United States?" *Journal of Aging and Health*, 7: 476-96, 1995.

Sorlie, Paul, Eric Backlund, and Jacob Keller. "U.S. Mortality by Economic, Demographic and Social Characteristics: The National Longitudinal Mortality Study." *American Journal of Public Health*, 85: 949-56, 1995.

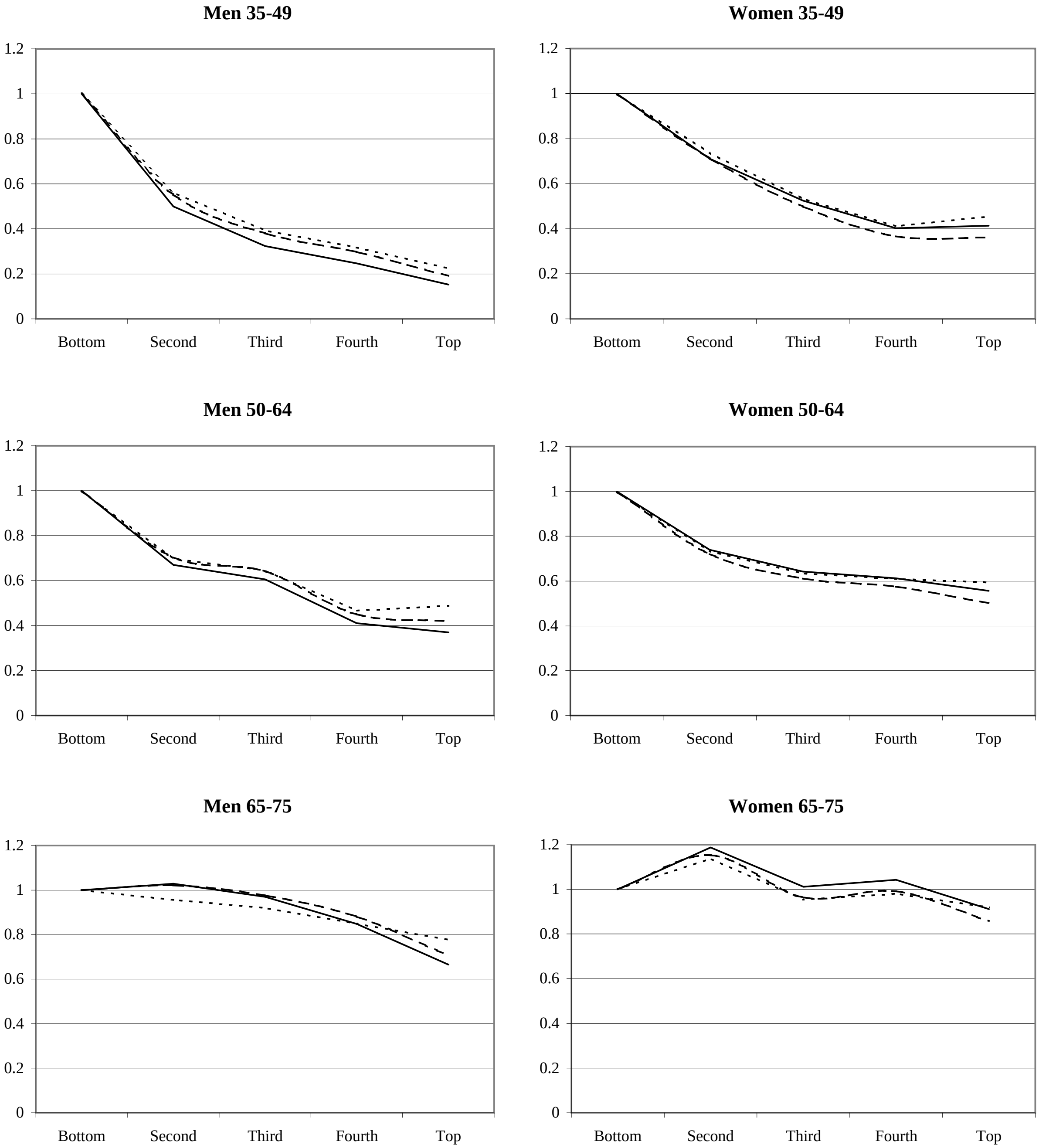
Waldron, Hilary. "Trends in Mortality Differentials and Life Expectancy for Male Social Security-Covered Workers, by Average Relative Earnings." Office of Research, Evaluation, and Statistics (ORES), Office of Policy, Social Security Administration, ORES Working Paper 108. Washington. D.C., 2007.

Figure 1. Comparison of Death Rates in Mortality Sample and HMD by Age and Sex



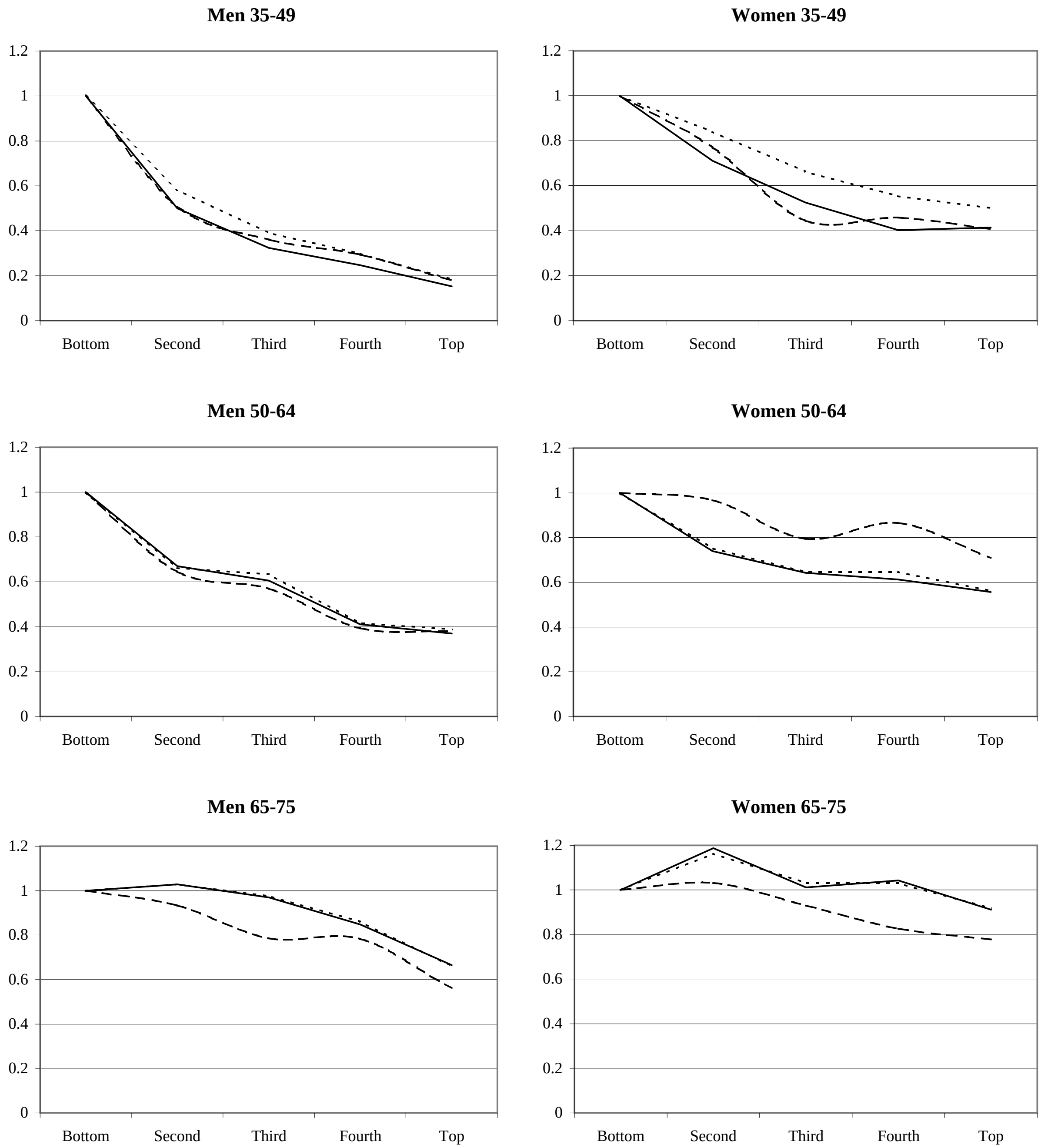
Note: HMD refers to the Human Mortality Database. For each age-sex group, HMD death rates were constructed using rates by year of birth and obtaining the weighted average using as weights the cohort sample distribution.

Figure 2. Adjusted Odds Ratios of One-Year Mortality by Individual Lifetime Earnings Quintiles



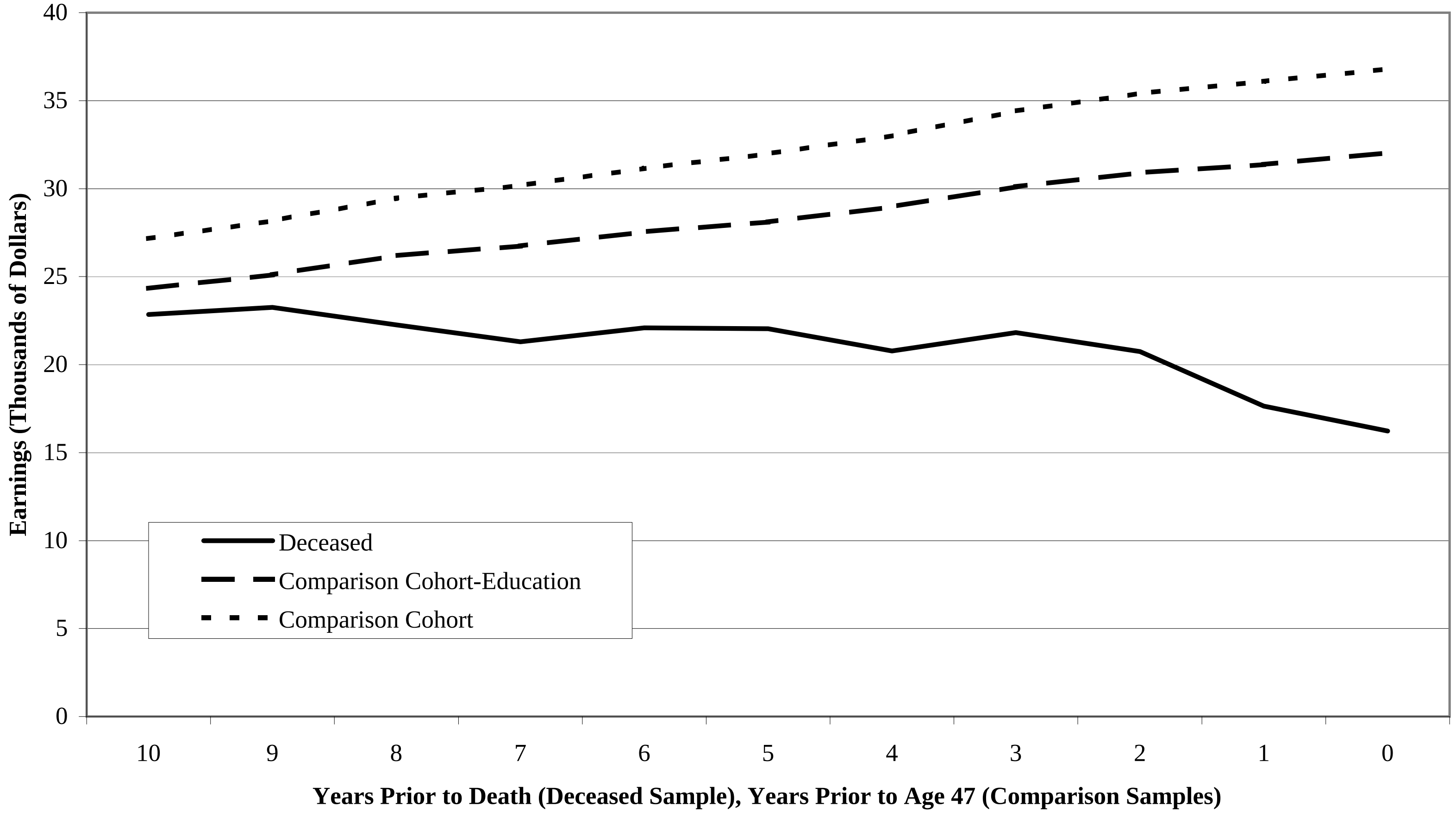
Note: Adjusted odds ratios are obtained from logistic regressions of one-year mortality indicators on individual lifetime earnings quintiles adjusting for age and birth year (solid line); age, birth year, race, and marital status (dashed line); and age, birth year, race, marital status, and education (dotted line).

Figure 3. Adjusted Odds Ratios of One-Year Mortality by Individual Lifetime Earnings Quintiles
Alternative Measures of Lifetime Earnings



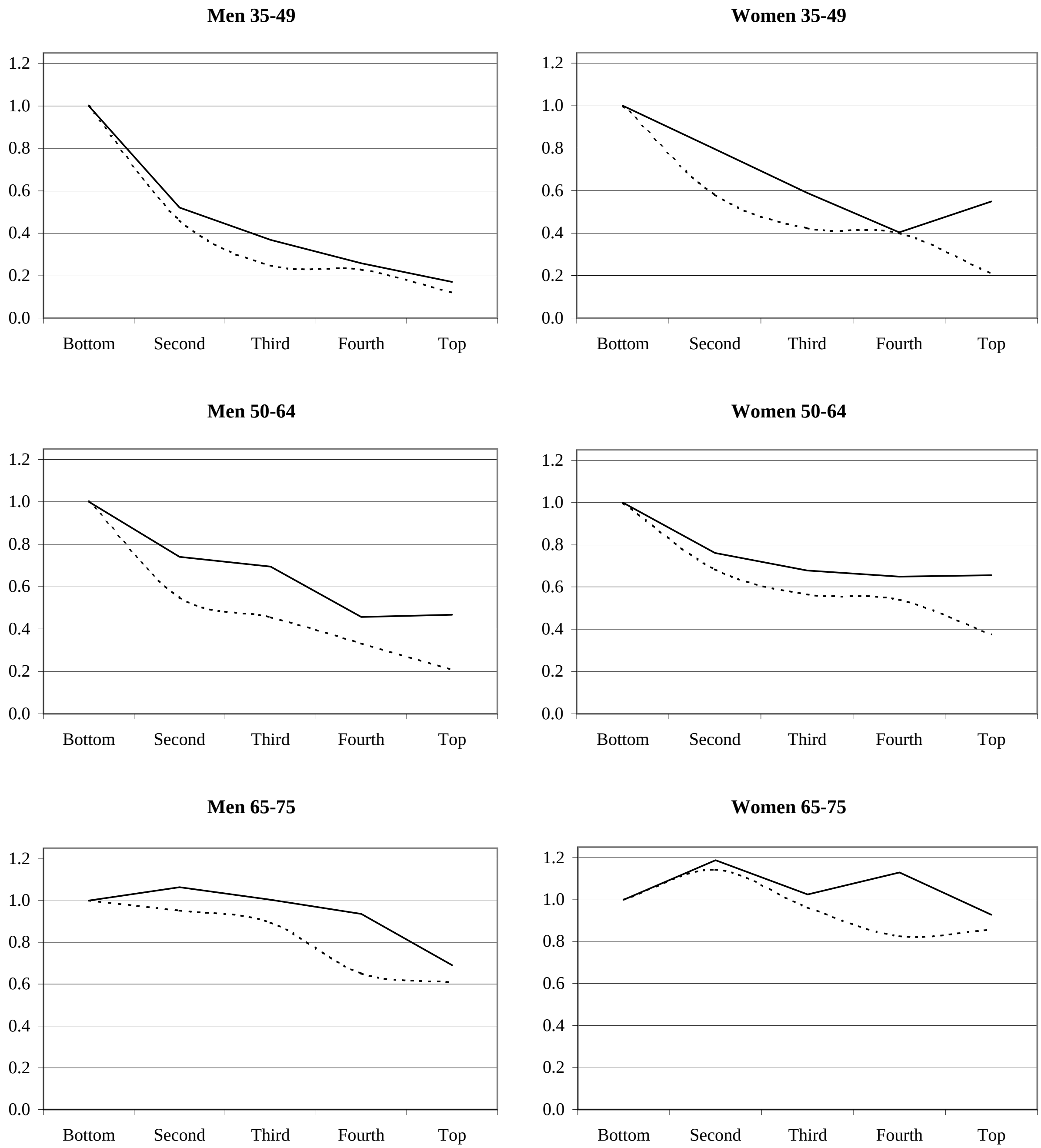
Note: Adjusted odds ratios are obtained from logistic regressions of one-year mortality indicators on moving average of lagged earnings including zero earnings years and excluding at least three years prior to mortality window (solid line); including only positive earnings years and excluding at least three years prior to mortality window (dashed line); including zero earnings year and excluding at least six years prior to mortality window (dotted line). All regressions are adjusted by age and year of birth.

Figure 4. Earnings in the Ten Years Prior to Death for Individuals Who Died While Ages 45 to 49 (Deceased sample) and for Ages 37 to 47 for Comparable Individuals That Survived to Age 47 (Comparison samples)



Note: The Comparison samples were constructed computing average annual earnings for ages 37 to 47, for individuals that survived to age 47. In the Comparison cohort (cohort-education) sample, individuals were weighted to match the distribution by cohort (cohort-education) in the Deceased sample.

Figure 5. Adjusted Odds Ratios of One-Year Mortality by Individual Lifetime Earnings Quintiles 1983-1997 versus 1998-2003



Note: Adjusted odds ratios for the period 1983 to 1997 (solid line) and the period 1998 to 2003 (dotted line) are obtained from logistic regressions of one-year mortality indicators on individual lifetime earnings quintiles, adjusting for age and birth year.

Table 1. Comparison of the Mortality Sample's Descriptive Statistics and Census Data

	Mortality Sample		
	Unweighted	Weighted	Census
% Male	47.4	47.8	47.7
Average Age	51.5	51.4	51.4
% Age 35-49	49.3	49.9	49.9
% Age 50-64	33.9	32.7	32.7
% Age 65-75	16.8	17.4	17.4
Race and Ethnicity			
% White	86.3	85.8	85.7
% Black	10.2	10.5	10.5
% Other Race	3.5	3.7	3.8
% Hispanic	6.7	7.5	7.4
Observation year			
Average	1996.6	1993.7	1993.7
% Year 1983-1987	9.2	20.3	20.3
% Year 1988-1992	11.5	22.2	22.3
% Year 1993-1997	27.4	24.7	24.6
% Year 1998-2002	42.5	27.1	27.1
% Year 2003	9.4	5.7	5.7

Note: Census male, age, and race statistics correspond to average yearly statistics weighted by population counts for each year in the period 1983 to 2003. The weights used in the Mortality Sample Weighted column were constructed to match the sample distribution by sex, five-year age group, race, Hispanic origin, and five-calendar-year group to the U.S. Census counts in the period 1983 to 2003.

Table 2. Comparison of the Mortality's Sample Descriptive Statistics and SIPP Data for Years 1984 and 1996

	Year 1984		Year 1996	
	Mortality Sample	SIPP	Mortality Sample	SIPP
% Male	47.2	46.8	47.9	46.7
Average Age	52.3	52.3	50.9	50.8
% Age 35-49	45.3	45.3	52.4	52.9
% Age 50-64	35.5	35.7	30.6	30.2
% Age 65-75	19.2	19.0	17.0	16.9
Race and Ethnicity				
% White	87.9	88.1	85.3	83.6
% Black	9.7	9.5	10.6	12.1
% Other Race	2.4	2.4	4.1	4.3
% Hispanic	5.3	4.5	7.9	8.3
Education				
% Less than High School	30.7	31.2	20.2	18.6
% High School	34.7	34.6	33.2	32.4
% Some College	17.0	16.7	24.6	26.9
% College	17.5	17.5	22.1	22.1
Marital Status				
% Never Married	5.3	5.3	10.0	8.6
% Married	74.2	73.9	68.3	67.4
% Separated/Divorced	12.1	12.2	15.4	16.9
% Widowed	8.4	8.6	6.3	7.1

Note: Mortality sample statistics where computed using weights to match the sample distribution by sex, five-year age group, race, Hispanic origin, and five-calendar-year group to the U.S. Census counts in the period 1983 to 2003.

Table 3. Mortality Ratios, Men

Age group		35-75	35-49	50-64	65-75
All		1.00	1.00	1.00	1.00
Race and Ethnicity					
White		0.96	0.90	0.95	0.98
Black		1.48	1.74	1.58	1.35
Other Race		0.82	1.13	0.79	0.76
Hispanic		0.94	0.98	0.93	0.93
Education					
Less than High School		1.32	1.56	1.36	1.23
High School		1.02	1.11	1.05	0.98
Some College		0.91	0.97	0.89	0.90
College		0.62	0.55	0.64	0.62
Marital Status					
Never Married		1.57	1.95	1.66	1.42
Married		0.86	0.72	0.85	0.90
Separated/Divorced		1.51	1.56	1.46	1.53
Widowed		1.53	1.53	1.93	1.26
Disability Insurance					
Currently on DI		-	8.22	12.90	-
Ever on DI		3.69	8.24	4.18	2.15
Lifetime Earnings Quintiles					
Top	Own	0.64	0.35	0.61	0.74
	Household	0.77	0.40	0.73	0.90
Fourth	Own	0.80	0.56	0.68	0.94
	Household	0.85	0.54	0.82	0.96
Third	Own	1.00	0.73	0.99	1.08
	Household	0.90	0.83	0.79	0.99
Second	Own	1.12	1.13	1.10	1.14
	Household	1.07	1.16	1.07	1.05
Bottom	Own	1.44	2.25	1.63	1.10
	Household	1.41	2.07	1.60	1.10

Note: The mortality ratio for a group is computed by dividing the weigthed average of the one-year age-specific mortality rate for the group, where the weights correspond to the fraction of men in the sample in that age, by the male mortality rate in the sample. DI corresponds to Social Security Disability Insurance. Mortality ratios for individuals currently on DI are not computed for age groups 35 to 75 and 65 to 75 because individuals on DI have their status updated to Social Security retirees when they turn 65.

Table 4. Mortality Ratios, Women

Age group		35-75	35-49	50-64	65-75
All		1.00	1.00	1.00	1.00
Race and Ethnicity					
White		0.95	0.93	0.93	0.96
Black		1.48	1.53	1.58	1.42
Other Race		0.92	0.89	1.01	0.88
Hispanic		1.03	0.92	0.99	1.07
Education					
Less than High School		1.37	1.61	1.48	1.26
High School		0.93	1.12	0.89	0.91
Some College		0.81	0.78	0.82	0.81
College		0.65	0.58	0.64	0.68
Marital Status					
Never Married		1.39	1.92	1.60	1.16
Married		0.81	0.75	0.81	0.83
Separated/Divorced		1.29	1.35	1.32	1.26
Widowed		1.29	1.53	1.44	1.16
Disability Insurance					
Currently on DI		-	10.12	16.24	-
Ever on DI		4.10	10.86	4.54	2.51
Lifetime Earnings Quintiles					
Top	Individual	0.84	0.68	0.79	0.90
	Household	0.74	0.49	0.71	0.81
Fourth	Individual	0.93	0.66	0.86	1.03
	Household	0.87	0.75	0.76	0.96
Third	Individual	0.95	0.86	0.90	1.00
	Household	1.00	0.79	0.92	1.09
Second	Individual	1.09	1.17	1.03	1.11
	Household	1.02	1.04	1.09	0.99
Bottom	Individual	1.21	1.65	1.41	1.01
	Household	1.36	1.96	1.53	1.15

Note: The mortality ratio for a group is computed by dividing the weigthed average of the one-year age-specific mortality rate for the group, where the weights correspond to the fraction of women in the sample in that age, by the female mortality rate in the sample. DI corresponds to Social Security Disability Insurance. Mortality ratios for individuals currently on DI are not computed for age groups 35 to 75 and 65 to 75 because individuals on DI have their status updated to Social Security retirees when they turn 65.

Table 5. Logistic Regressions. Predicting One-Year Mortality Using Individual Lifetime Earnings
Men

Age Range:	**30-49**		**50-64**		**65-75**	
	(1)	(2)	(3)	(4)	(5)	(6)
Lifetime Earnings Quintiles						
Fifth (Top)	0.153	0.224	0.370	0.488	0.665	0.776
	(11.69)**	(8.61)**	(10.77)**	(7.25)**	(5.54)**	(3.30)**
Fourth	0.247	0.317	0.411	0.466	0.848	0.849
	(10.14)**	(8.19)**	(10.20)**	(8.46)**	(2.37)*	(2.28)*
Third	0.324	0.393	0.606	0.645	0.970	0.919
	(8.82)**	(7.27)**	(6.47)**	(5.56)**	(0.46)	(1.22)
Second	0.499	0.561	0.670	0.697	1.028	0.956
	(6.46)**	(5.21)**	(5.35)**	(4.76)**	(0.42)	(0.66)
Age and Birth Year						
Age	1.072	1.072	1.076	1.074	1.082	1.082
	(5.62)**	(5.58)**	(8.95)**	(8.74)**	(9.94)**	(9.89)**
Birth Year	0.998	0.991	0.986	0.987	0.986	0.991
	(0.20)	(1.19)	(3.26)**	(2.84)**	(3.67)**	(2.47)*
Race and Ethnicity						
Black		1.236		1.258		1.132
		(1.78)		(2.88)**		(1.61)
Other Race		1.077		0.749		0.747
		(0.33)		(1.78)		(1.81)
Hispanic		0.831		0.768		0.815
		(1.07)		(2.05)*		(1.95)
Marital Status						
Never Married		1.871		1.615		1.516
		(5.58)**		(4.70)**		(4.31)**
Separated/Divorced		1.668		1.502		1.687
		(4.62)**		(5.58)**		(7.48)**
Widowed		2.092		2.078		1.341
		(1.95)		(5.89)**		(4.18)**
Educational Attainment						
High School Graduate		0.914		0.886		0.837
		(0.78)		(1.75)		(3.31)**
Some College		0.898		0.799		0.782
		(0.89)		(2.78)**		(3.59)**
College Graduate		0.622		0.618		0.547
		(3.12)**		(5.31)**		(7.86)**
N	275,522	275,522	186,730	186,730	86,809	86,809
Pseudo R-squared	0.036	0.045	0.026	0.034	0.012	0.021

Robust z statistics are in parentheses.
* significant at 5 percent

Table 6. Logistic Regressions. Predicting One-Year Mortality Using Individual Lifetime Earnings
Women

Age Range:	**30-49**		**50-64**		**65-75**	
	(1)	(2)	(3)	(4)	(5)	(6)
Lifetime Earnings Quintiles						
Fifth (Top)	0.414	0.455	0.557	0.594	0.911	0.919
	(5.12)**	(4.20)**	(5.48)**	(4.70)**	(1.21)	(1.06)
Fourth	0.403	0.411	0.613	0.610	1.043	0.980
	(5.64)**	(5.36)**	(4.88)**	(4.92)**	(0.56)	(0.26)
Third	0.525	0.534	0.642	0.634	1.011	0.954
	(4.11)**	(3.92)**	(4.54)**	(4.69)**	(0.15)	(0.61)
Second	0.711	0.737	0.740	0.733	1.187	1.138
	(2.43)*	(2.18)*	(3.20)**	(3.29)**	(2.15)*	(1.60)
Age and Birth Year						
Age	1.096	1.098	1.102	1.098	1.084	1.080
	(6.13)**	(6.13)**	(9.92)**	(9.49)**	(9.12)**	(8.67)**
Birth Year	1.005	1.002	0.999	1.002	0.986	0.990
	(0.58)	(0.20)	(0.28)	(0.37)	(3.25)**	(2.13)*
Race and Ethnicity						
Black		1.157		1.325		1.260
		(1.07)		(2.94)**		(2.93)**
Other Race		0.923		1.022		0.861
		(0.28)		(0.12)		(0.67)
Hispanic		0.687		0.756		0.951
		(1.66)		(1.94)		(0.36)
Marital Status						
Never Married		2.602		2.058		1.462
		(6.62)**		(5.41)**		(2.95)**
Separated/Divorced		1.820		1.656		1.529
		(4.51)**		(6.19)**		(5.24)**
Widowed		1.659		1.598		1.306
		(1.77)		(4.79)**		(4.62)**
Educational Attainment						
High School Graduate		0.843		0.671		0.766
		(1.21)		(4.96)**		(4.52)**
Some College		0.601		0.616		0.687
		(3.33)**		(4.98)**		(4.80)**
College Graduate		0.488		0.487		0.563
		(3.61)**		(5.62)**		(5.64)**
N	295,719	295,719	205,625	205,625	107,817	107,817
Pseudo R-squared	0.017	0.033	0.019	0.032	0.009	0.017

Robust z statistics are in parentheses.
* significant at 5 percent

Table 7. Average Individual Lifetime Earnings by Sex, Age Group, Period, and Lifetime Earnings Quintiles, 1983-1997 versus 1998-2003

	Men					
	35-49		50-64		65-75	
	1983-1997	1998-2003	1983-1997	1998-2003	1983-1997	1998-2003
Average Individual Lifetime Earnings						
Top	76,216	85,207	92,722	110,112	69,695	83,795
Fourth	44,281	44,073	49,913	53,633	39,313	46,862
Third	31,913	30,653	36,367	37,636	29,893	34,852
Second	20,349	19,079	22,373	22,796	16,201	20,325
Bottom	5,940	5,225	5,378	5,706	1,793	3,303

	Women					
	35-49		50-64		65-75	
	1983-1997	1998-2003	1983-1997	1998-2003	1983-1997	1998-2003
Average Individual Lifetime Earnings						
Top	40,033	49,733	35,777	48,327	25,461	30,634
Fourth	20,641	24,794	17,769	24,761	10,809	14,152
Third	11,082	14,259	8,672	13,949	3,352	5,819
Second	4,109	6,057	2,707	5,536	457	1,169
Bottom	372	746	106	425	0	3

Note: Quintiles of individual lifetime earnings in a certain year are computed within five-year age, sex, and five-year cohorts for individuals alive that year.

Table 8. Trends in Differential Mortality by Lifetime Earnings.
Estimated Odds Ratios of One-Year Mortality. Top Relative to Bottom Quintile

		Individual		Household	
		1983-1997	1998-2003	1983-1997	1998-2003
Men	35-49	0.17	0.12	0.23	0.14
	50-64	0.47	0.21 **	0.57	0.26 **
	65-75	0.69	0.61	0.88	0.66 *
Women	35-49	0.55	0.21 **	0.32	0.13 *
	50-64	0.66	0.38 **	0.60	0.23 **
	65-75	0.93	0.86	0.73	0.65

* Significantly different from the 1983-1997 period estimates at the 5 percent level.
** Significantly different from the 1983-1997 period estimates at the 1 percent level.

Table 9. Trends in Differential Mortality by Individual Lifetime Earnings
Estimated Odds Ratios of One-Year Mortality. Top Relative to Bottom Quintile
Using Alternative Average Lagged-Earnings Measures

	Men					
	35-49		50-64		65-75	
	1983-1997	1998-2003	1983-1997	1998-2003	1983-1997	1998-2003
Alternative Average Lagged-Earnings Measures						
Basic measure (includes zero earnings years and excludes at least three years prior to mortality window)	0.17	0.12	0.47	0.21	0.69	0.61
Basic measure but including only positive earnings years	0.20	0.14	0.45	0.24	0.59	0.50
Basic measure but excluding at least six years prior to mortality window	0.23	0.12	0.49	0.22	0.69	0.60
Two-year average of years (age-3) and (age-4). Example: for an individual age 40, this is the average of earnings at ages 36 and 37. Sample: Ages 35-60	0.20	0.12	0.27	0.13	-	-

	Women					
	35-49		50-64		65-75	
	1983-1997	1998-2003	1983-1997	1998-2003	1983-1997	1998-2003
Alternative Average Lagged-Earnings Measures						
Basic measure (includes zero earnings years and excludes at least three years prior to mortality window)	0.55	0.21	0.66	0.38	0.93	0.86
Basic measure but including only positive earnings years	0.52	0.22	0.82	0.50	0.79	0.75
Basic measure but excluding at least six years prior to mortality window	0.70	0.28	0.66	0.38	0.94	0.86
Two-year average of years (age-3) and (age-4). Example: for an individual age 40, this is the average of earnings at ages 36 and 37. Sample: Ages 35-60	0.47	0.18	0.36	0.24	-	-