Recent Trends in US Working Life Expectancy by Sex, Education, and Race and the Impact of the Great Recession

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Abstract

We use data from the US Health and Retirement Study to analyze differences in working life expectancy by sex, race, and education. Moreover, we report findings on the impact of the Great Recession on working life expectancy and on trends in the timing of retirement. Analyses are based on period working life tables. We find strong differentials along all three studied dimensions. Working life expectancy is highest among white males and males with a college degree, while it is lowest for Hispanic females and females with no degree. The impact of the Great Recession generally was strong, although results show some heterogeneity. It had a strong negative effect on working life expectancy of males with college education, whereas working life expectancy of female Hispanics increased. The recession had no impact on the gap between first and final retirement, which shows an upward trend for all groups.

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1 Introduction

Population aging is one of the major challenges developed countries have to face in the 21st century. For example, projections of the U.S. Census Bureau predict an increase in the proportion of the population aged 65 and older from 15% in 2014 to 24% in 2060 (Colby and Ortmann, 2015). It is often expected that population aging will lead to a decrease of the economically active population. As a reaction, Social Security retirement age has been increased in the US (e.g. Behagel and Blau, 2012), introducing incentives to stay longer in the work force and thus to expand working life. Despite its importance surprisingly little is known about how working life expectancy at older ages has developed in recent years, where working life expectancy is understood as the remaining life expectancy which is spent being employed.

Moreover, there is little research on racial variations in working life expectancy at older ages, despite marked differences between racial groups in labor force participation (Flippen and Tienda, 2000), life expectancy (Lariscy et al., 2015), and disability and active life expectancy (Hayward and Heron, 1999). In addition, the few existing studies only analyze differences between whites and non-whites, while minority groups are heterogeneous. Estimating period working life tables Smith (1986) finds that differences between white and non-white females are relatively small, while race has a stronger impact for males. Millimet et al. (2003) apply a similar methodology to more recent data and come to the same conclusions, while noting that the difference between white and non-white males diminishes with age (also see Millimet et al., 2010). Hayward and Grady (1990) use cohort data to compare white and black males and report only a small gap in working life expectancy. In contrast to race, all studies find strong differentials in working life expectancy by education.

While working life expectancy has been observed to increase in other countries (e.g. Myrskylä et al., 2013) most US related studies focus on a single period (for an exception see Skoog and Ciecka, 2010). Analyzing recent trends in working life expectancy at older age might yield valuable insights, especially in regard to the impact of the 2007-2009 recession, which was the most severe economic downturn since World War II and is aptly called the Great Recession (Goodman and Mance, 2011). For the total population there is general consensus that men were more affected than women, whites more than blacks, and less educated more than the educated (Engemann and Wall, 2009). Results on the impact on older age groups are less clear cut. While Engemann and Wall (2009) report that employment measured in number of jobs increased for workers aged 55 and older, both Farber (2011) and Cahill et al. (2015) report sharp increases in the unemployment rate of older workers. Moreover, Coile and Levine (2011) find that during the recession unemployed workers had a higher probability of retiring than employed workers. On the other hand, Hurd and Rohwedder (2010) present findings that suggest that the recession may have lead to postponement of retirement, due to the negative impact on wealth and especially on home equity. The net impact of the recession on older individuals and on working life expectancy in particular remains somewhat unclear.

This paper uses data from the Health and Retirement Study (HRS) to calculate period working life tables which are used to analyze recent developments in working life expectancy (WLE) at age 50 in the US, focusing on differences by sex, education, and race. In doing so, we add to the literature in several ways. First, as outlined above the literature on WLE has focused mostly on educational and gender differences, leaving racial differences aside. In addition to findings on WLE by gender and education we present detailed results for whites, blacks, and Hispanics, including results for the Great Recession, and we report findings on the interaction of education and race. Second, from a methodological perspective we add to the literature by generalizing the Markov chain approach of Skoog and Ciecka (2010) building on suggestions of Sericola (2000), such that the approach can be used with an arbitrary number of states, and we derive formulas for the calculation of the distribution of the first visit to any subset of states. Third, our methodological contribution allows us to calculate the time between first and final retirement (retirement timing gap; RTG) and to focus on the transition phase from first to final retirement, as retirement in the US does not necessarily mean permanent withdrawal from the labor force and retirees may start to work again (Hayward and Grady, 1990; Cahill et al., 2015). Suppose, for instance, that age at first retirement increases, while at the same time age at final retirement decreases. While typical working age careers would last longer, the transition phase from first to final separation from the labor force would be shorter. Studying either age at first retirement or age at final retirement would obscure these changes, while they will be captured by RTG.

The remainder of this paper is structured as follows. Section 2 describes the data and gives a non-technical description of the methods used for analysis. Results on working life expectancy by sex, race, and education are presented in section 3. Section 4 concludes. Technical details of the methods and additional results are given in the appendix.

2 Data and methods

2.1 Data

The Health and Retirement Study (HRS) is a panel study that has been running since 1992 and focuses on Americans over the age of 50. It covers a broad range of topics, including employment and working life. The HRS is conducted by the Survey Research Center of the Institute for Social Research of the University of Michigan and is supported by the National Institute on Aging and the Social Security Administration.[1] For an introduction to the HRS see Juster and Suzman (1995).

The first wave of the HRS covered the birth cohort of 1931 to 1941. New cohorts were added in 1998, 2004, and 2010. Moreover, the Aging and Health Dynamics (AHEAD) study which started in 1993 was integrated into the HRS in 1998. Interviews are conducted every two years. In addition to questions on the labor force status at the time of interview, several retrospective questions cover the time between two consecutive interviews. If a respondent dies, year and month of death are obtained from either interviews with relatives or from record matching with the National Death Index. We adjust mortality such that life expectancy matches life tables reported by the Center for Disease Control and Prevention (CDC; see section 2.3 for details).

[1] For researchers data is available at no costs and can be obtained from `http://hrsonline.isr.umich.edu`. The website also hosts an extensive documentation.

Table 1: Number of observations and transitions by race and sex.

	Respondents	Transitions
White, female	12,179	129,979
White, male	9,847	100,176
black, female	3,126	27,031
black, male	2,051	16,254
Hispanic, female	1,647	14,495
Hispanic, male	1,257	10,439
Other, female	426	3,432
Other, male	359	2,754

The variables we use are based on self-reported labor force status recorded to the nearest month. We distinguish three different states: employed, retired, and out of the labor force (but not retired) or unemployed. The latter category is comprised of persons who report being unemployed, disabled, being a homemaker, or as doing something other but not working. Respondents who classify as working or being on a leave (e.g. sick leave) are counted as being employed. Finally, respondents are classified as being retired if they either report being retired or if they are out of the labor force or unemployed and above age 65. That is, a 54 year old homemaker counts as being out of the labor force, while a 71 old homemaker counts as retired, whether retirement is reported by the respondent or not. Changing the age threshold, e.g. to age 70, does slightly affect the level of some of the results which will be reported in section 3, but it does not change trends and differences by sex, education, and race.

We construct a working history for each respondent, focusing on the transitions between states on a yearly basis. To achieve this, we exploit the fact that labor force status is recorded to the nearest month and for each year and respondent we use the status in December. For example, if a respondent was employed in December 1996 and retired in December 1997, we use the status employed for 1996 and the status retired for 1997 (also see section 2.3).[2]

The HRS includes data on $30,892$ respondents. The number of observed transitions amounts to $304,560$. The number of respondents and transitions by sex and race is given in table 1. Race is assigned based on two questions. All respondents who identify as Hispanic are classified correspondingly. Respondents who do not identify as Hispanic are assigned race based on another questions on whether they primarily identify as white, black American, American Indian/Alaskan Native, Asian/Pacific Islander, or something else. The latter three groups are subsumed in the category "other". As both the number of observations and the number of transitions for this category are small, no analysis was conducted for this group. Furthermore, analyses include educational degree of respondents and we distinguish between no degree, GED or high school diploma, and college or university degree.

[2]Using another month instead of December, e.g. April, or using the state which is occupied most often during a year changes results only slightly.

2.2 Modelling approach

To model the transitions between labor force states we use Markov models, which are one of the main tools to construct working life tables (e.g. Hoem, 1977; Millimet et al., 2003). This section gives a non-mathematical description while technical details and formulas are given in appendix A.

The starting point are transition probabilities $p(i|x, j)$ which give the probability that an individual aged x and in labor state status j will be in status i at age $x + 1$. More technically speaking, the state space consists of the labor force states "employed", "retired", and "out of the labor force or unemployed", each combined with each age in the age range of 50 to 99. This includes, for example, the states "aged 50 and employed", "aged 51 and employed", and so on. In addition to these transient states the state space includes the absorbing state "dead". We assume that age 99 is the maximum age and everyone aged 99 will die with probability 1.[3] As already noted in the previous section for ages 65 and older it is assumed that individuals are either employed or retired and the state "out of the labor force or unemployed" does not occur anymore. This is shown in figure 1, which depicts a simplified state space ignoring age. The upper part shows the state space for ages below 65 and the lower part shows the state space for ages 65 and older.

Transition probabilities are used to construct working life tables which are calculated for the years 1993 to 1997, 1998 to 2002, 2003 to 2007, and 2008 to 2011. For each period results are derived differentiating by sex, by sex and race (white, black, Hispanic), by sex and education (no degree, high school, college), and by sex, race, and education jointly. Several measures will be studied, all based on transition probabilities. First, we combine the approaches of Sericola (2000) and Skoog and Ciecka (2010) to calculate the distribution of the time spent in employment. This distribution can be used to calculate the expected time in employment (working life expectancy), but it also allows for additional measures like the probability of ever returning to employment after retirement. Second, we calculate the distribution of time to last exit from employment and interpret this as the time to final retirement (also see Skoog and Ciecka, 2010). Moreover, we also calculate the distribution of time to first retirement. This allows us to derive the difference between the expected time to first retirement and the expected time to final retirement.[4] For most of the results we focus on age 50, e.g. the remaining WLE at age 50.

The measures described above can all be calculated for each state. For example, WLE can be reported for employed individuals aged 50. To derive the WLE or any other measure for a certain age x without conditioning on a labor force status j requires some weighting procedure. More formally, if WLE(x, j) denotes the workling life expectancy for individuals aged x and in state j, the working life expectancy

[3] Age 99 may seem relatively low, but we choose it for three reasons. First, the oldest old do not add much to working life expectancy. Second, sample size for old ages is quite limited in the HRS, as has to be expected. Third, the CDC life tables we use to adjust mortality end with age 99.

[4] Note that time to first retirement is only defined for individuals which actually retire. It is, for example, not defined for individuals which die while being employed. A similar restriction applies to age at final retirement. If, for instance, an individual is first employed, then retires, then picks up work again, and finally dies without retiring again, age at final retirement is not defined. Also note that age at first and age at final retirement may be the same, e.g. if an individual retires and does not return to work.

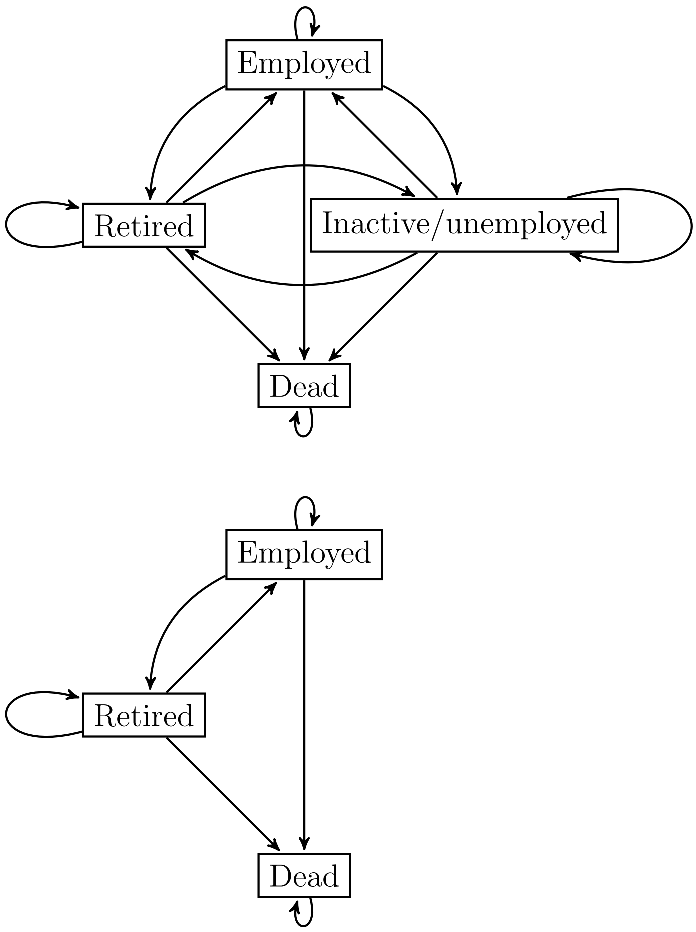

Figure 1: State space of the Markov model (upper figure) and state space of the Markov model for ages 65+ (lower figure).

by age, WLE(x), can be calculated as $\text{WLE}(x) = \sum_j \text{WLE}(x,j)w_j(x)$, where $w_j(x)$ denotes some weight for age x and state j. We will only use weights for age 50 and report results by age and state otherwise. Weights $w_j(50)$ were calculated from the empirical distribution of labor force states at ages 45 to 54 in all years by either sex, sex and race, sex and education, or sex, race, and education. Combining all years and using more than a single age leads to a reasonable sample size. The weights are time-constant and applied to all corresponding period working life tables, such that differences between results by period for one group are not due to differences in the distribution of states.

The period perspective we choose allows to directly assess the demographic impact of the Great Recession. It shows how individuals above age 50 would do if the conditions of the recession prevailed not just during a few years but during a period spanning old age. From a cohort perspective the impact will most probably be less strong. Moreover, our analyses are different from studies which investigate the impact of the Great Recession on specific age groups and outcomes, e.g. retirement. Such studies give details on the impact on a subset of relevant behaviors, while our study shows the net impact.

2.3 Estimation of transition probabilities

To estimate transition probabilities, we use multinomial logistic regression. Each transition is treated as an observation with state at time $t+1$ as the dependent variable and state at time t as one of the explanatory variables. More specifically, we use the state occupied in December of year t and the state occupied in December of year $t+1$. This allows us to use age to the nearest month as an explanatory variable, which comes close to exact age. Age is modeled as a cubic smoothing spline. In addition, several age dummies were included to capture discontinuities in the age schedule of transition probabilities like peaks in retirement at ages 62, 65, and 66 (see, e.g., Behagel and Blau, 2012). Education was also used as an explanatory variable as well as interactions of education and period. Estimates by sex and by sex and race are achieved by splitting the sample into subsamples, e.g. Hispanic females.

The HRS includes states of respondents in December from 1992 to 2011.[5] The year of transition is modeled using dummy variables pooling several years together, where year of transition means the year which relates to the starting state, i.e. t and not $t+1$. The period from December 1992 to December 1996 is used as reference and corresponds to transitions in the period of 1993 to 1997, as, for instance, the first transition is from December 1992 to December 1993 and thus will be mostly affected by what happened in 1993. Three dummy variables were included which correspond to the periods from 1998 to 2002, 2003 to 2007, and 2008 to 2011, respectively. The period from 1998 to 2002 includes the 2001 recession, while the period from 2008 to 2011 covers the most recent recession. Note that as described above this period starts with December 2007, which is usually seen as the beginning of the recession (e.g. Goodman and Mance, 2011).

Parameter estimates are used to calculate transition probabilities. This includes survival probabilities which lead to unrealistic high life expectancy in some cases. For example, for the period of 2008-2011 remaining life expectancy of women aged 50 is estimated to be about 36.6 years, while the CDC reports a value of 33.2 years for 2010. Because of this we adjust transition probabilities using CDC life tables. Using life table estimates of survival in combination with transition probabilities estimated from sample data is common practice for the construction of working life tables (e.g. Smith, 1986; Skoog and Ciecka, 2010). In contrast to earlier studies which assumed that survival does not vary by labor force state or education, we use a procedure which guarantees that life expectancy by sex and race matches CDC life tables while allowing for differences in mortality by education and labor force status. Technical details and a discussion of other minor adjustments can be found in the appendix. We use CDC life tables for the years 1995, 2000, 2005, and 2010 for the periods of 1993-1997, 1998-2002, 2003-2007, and 2008-2011, respectively. Because the CDC does not supply life tables for Hispanics for the years 1995, 2000, and 2005, we used the life tables for Hispanics of 2006 and 2010 and assumed that mortality differentials between Hispanics and whites and blacks for 2005/2006 and 2010 also prevailed in 1995 and 2000. This allows us to estimate life tables for Hispanics for these years.

[5] As HRS interviews are usually conducted midyear, the state in December 2012 is not observed for most observations and thus is dropped from analysis.

For all calculations we use the survey weights of the HRS. As weights are only provided for survey years and not for years between surveys we use weights of survey year t also for year $t + 1$. For example, weights are provided for 1998 and 2000, but not for 1999, and the weights for 1998 are used for 1999. Running analyses without weights changes results only slightly. To estimate confidence intervals we apply a bootstrap procedure. Following a suggestion by Cameron and Trivedi (2005) our bootstrap procedure is based on resampling individuals. For example, if an individual was included in the HRS from 1998 to 2006 and is randomly selected to be in a bootstrap sample, the whole working history of this individual from 1998 to 2006 is included. Moreover, the procedure also mimics the sampling process of the HRS and thus accounts for both the cohort structure and oversampling in the HRS. 1000 bootstrap replications are used to derive percentile bootstrap confidence intervals. Testing will rely on comparison of 95% confidence intervals.[6] All calculations were conducted using R (R Core Team, 2015) and the `VGAM` and the `Biodem` packages (Boattini and Calboli, 2012; Yee, 2010). R code is available upon request from the authors.

3 Results

3.1 Population by race and sex

Results on working life expectancy by race and sex are shown in figure 2. Detailed results are given in the appendix. An overview of which comparisons are statistically significant at the 5% level is given in table 2.

Racial differences in WLE are quite marked. The highest WLE is observed for white males, while Hispanic females have the lowest WLE. The difference in WLE between these two groups amounts up to 6.7 years, while the largest difference between white males and females is considerably smaller and is about 3.2 years. As Hispanic women have the highest life expectancy this leads to the smallest relative WLE, i.e. the smallest ratio of working life expectancy divided by life expectancy. Blacks have the lowest life expectancy and a low WLE. Moreover, gender differences are not as strong as for whites and Hispanics and are not statistically significant, while they are for whites and Hispanics. WLE is also significantly higher for white males than for black males, while differences between white males and Hispanic males are only significant in the periods of 1993-1997 and 2008-2011. For females differences in the level of WLE by race are mostly significant, except the difference between white and Hispanic females in the period of 2008-2011.

For whites the WLE of males is 1.8 to 3.2 years higher than the WLE of females, despite their lower life expectancy, and for all periods differences are statistically significant at the 5% level. For both males and females there is no clear trend in WLE and the differences between years seem to be mostly driven by period effects, which affect males and females alike, as can be seen from the similar patterns of increase and decrease. Nevertheless, the decrease from 1993-1997 to 1998-2002 and the decrease from 2003-2007 to 2008-2011 have been smaller for females than for

[6] Note that this testing procedure may be conservative, as slight overlap of 95% confidence intervals often still implies a significant difference at the 5% level, but it avoids distributional assumptions, e.g. normality, which may be hard to justify.

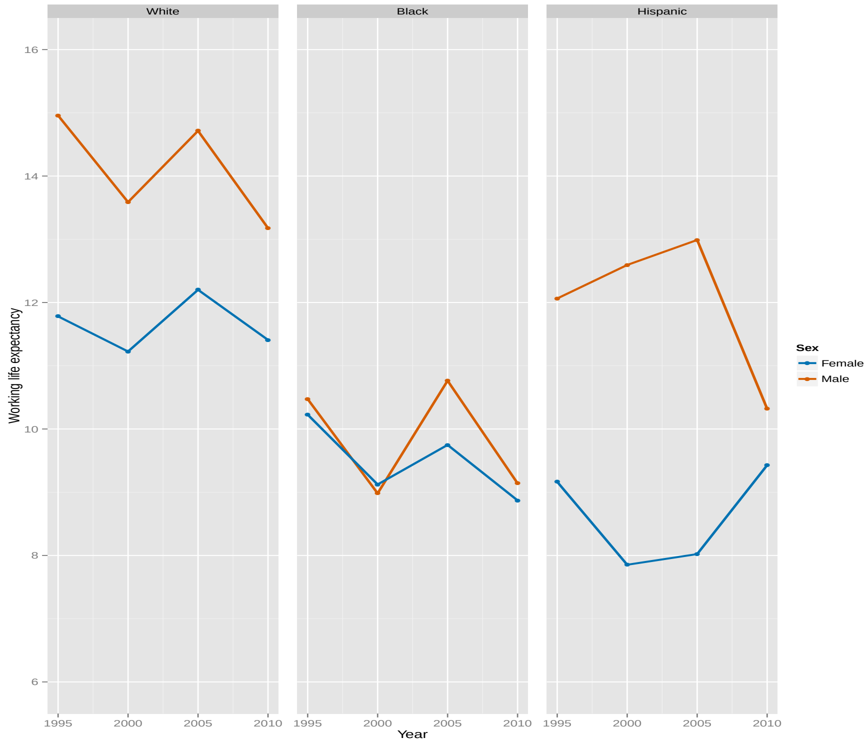

Figure 2: Working life expectancy at age 50 by race and sex.

Table 2: Comparison of levels of WLE by race and sex. Comparisons for which the 95% confidence intervals of WLEs do not overlap are marked with an asterisk.

	1995	2000	2005	2010
White male/white female	*	*	*	*
Black male/black female				
Hispanic male/Hispanic female	*	*	*	
White male/black male	*	*	*	*
White male/Hispanic male	*			*
White female/black female	*	*	*	*
White female/Hispanic female	*	*	*	

males, while the increase from 1998-2002 to 2003-2007 was of the same magnitude. This is in line with findings which show that the recessions in 2001 and 2007-2009 had a more severe impact on males than on females (e.g. Wood, 2014), albeit the differences in differences are not statistically significant at the 5% level.[7]

While results for blacks show patterns of increase and decrease similar to those of whites, patterns for Hispanics differ considerably. For Hispanic males WLE increased between the periods of 1993-1997 and 1998-2002 and between 1998-2002 and 2003-2007 by roughly 0.4 and 0.5 years, respectively, while it decreased by 2.7 years between 2003-2007 and 2008-2011. The WLE of Hispanic women on the other hand increased between 2003-2007 and 2008-2011 by 1.4 years, while WLE decreased for all other groups. Moreover, the difference between males and females in the difference between WLE of 2003-2007 and 2008-2011 is statistically significant for Hispanics, but not for whites and blacks. These results are consistent with findings by Engemann and Wall (2009), who argue that gender differences in the effect of the Great Recession are strong for Hispanics, while female Hispanics were not affected strongly. Moreover, one might speculate that as labor force participation of female Hispanics is relative low, there may be a large potential for the added worker effect, which means that inactive individuals enter the labor market when their partner or spouse becomes unemployed (Starr, 2014).

Differences in WLE may be driven by differences in life expectancy. To assess the impact of life expectancy on racial differences in WLE we rerun calculations assuming that all males follow the mortality patterns of the Hispanic male population in 1995, i.e. the male group with the highest life expectancy. A similar assumption was made for females and the life table for female Hispanics in 1995 was used. Detailed results are given in the appendix. WLE of male Hispanics and white males remains mostly unchanged, while the WLE of black males now is about 1 year higher. WLE of females is less affected by this experiment and remains mostly unchanged for Hispanic and white females and increases only slightly for black females. Thus, for males racial differences are at least partly affected by mortality, while this is not the case for females.

Results on timing of retirement are shown in figure 3, while detailed results are given in the appendix, again. For white males and females and black males the RTG is relatively similar, while first and final retirement occur earlier for blacks males than for whites. Black females have the highest RTG. From 1995 to 2010 the RTG increased by 1 year for both black males and females and for white males and stayed relatively constant for white females. White males are the only group for which all differences between periods are statistically significant, though. The difference in RTG between males and females increased steadily for whites, while it increased only slightly for blacks. The difference is not statistically significant in both cases, though. The smallest RTG is observed for Hispanic females and males. Moreover, the difference in RTG between males and females is higher for Hispanics than for whites and blacks, while again not statistically significant.

Additional evidence on differences in retirement is given in table 3, which shows

[7] Note that statistical significance of a difference in differences does not follow directly from comparison of confidence intervals of point estimates, as these are correlated. Thus, while the difference between two point estimates for a given period t may not be statistically significant, the difference in differences between periods $t-1$ and t may well be.

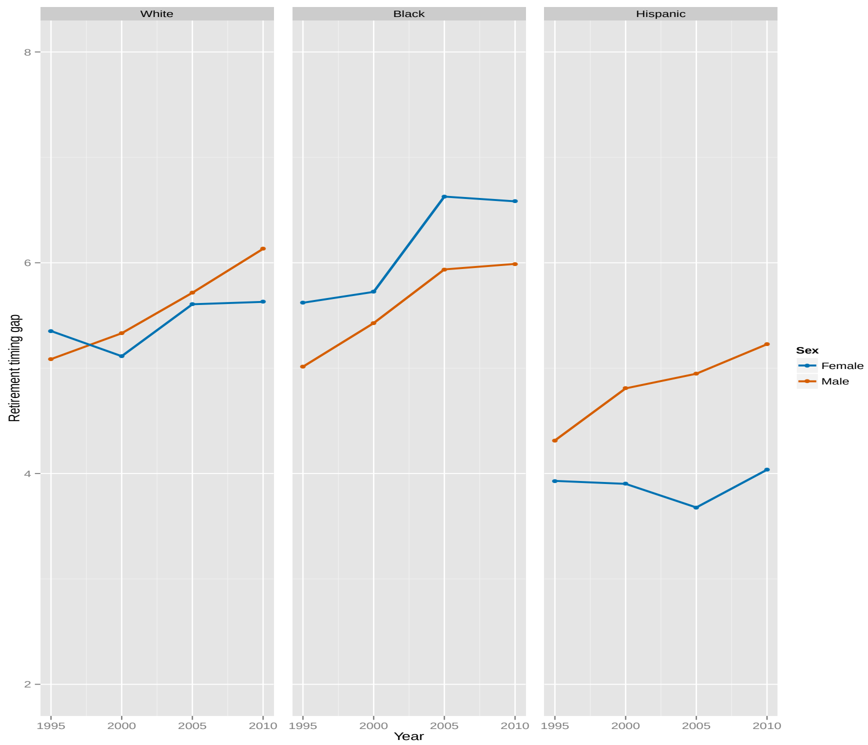

Figure 3: Retirement timing gap by race and sex.

the probability that a 65 year old retired individual will reenter employment. Results mirror above findings. White males have the highest probability of returning to work, while Hispanic females have the lowest probability. Probabilities for Hispanic males are slightly lower than that of white males. The probability of returning to employment is relatively low for blacks, with only small differences between black males and females.

Overall, white males have the highest WLE and work the longest, while Hispanic females have the lowest WLE and have a low probability of returning to employment, despite having the highest life expectancy. Male Hispanics have a higher WLE than females, which is low compared to their relatively high life expectancy, though. Black males and females have a relatively low WLE and gender differences are

Table 3: Probability of reentering employment for 65 year old retired individuals; by sex and race

	1995	2000	2005	2010
White males	0.32	0.29	0.34	0.32
White females	0.22	0.19	0.23	0.22
Black males	0.23	0.22	0.27	0.24
Black females	0.22	0.21	0.26	0.24
Hispanic males	0.26	0.30	0.32	0.27
Hispanic females	0.14	0.13	0.12	0.15

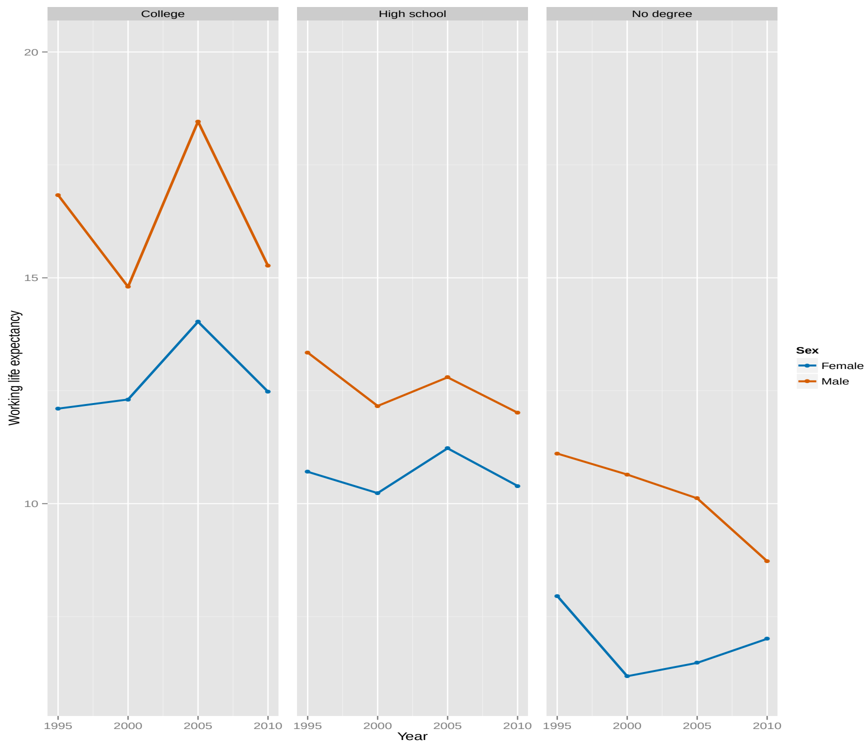

Figure 4: Working life expectancy at age 50 by education and sex.

less pronounced than for whites and Hispanics. Differences between blacks and whites can be explained with the relative disadvantage of blacks in the labor market. Moreover, blacks are on average less healthy and have a higher risk of being disabled than whites, which is reflected in a lower active life expectancy (Hayward and Heron, 1999). In addition, it was shown above that the relatively low WLE of black males is partly due to differences in mortality. Results for Hispanics are more surprising, as Hispanics compare favorably to blacks and whites in terms of health and life expectancy (e.g. Lariscy et al., 2015).

The Great Recession had a clear impact on WLE, mostly in line with previous knowledge from the literature, and differences by sex and race are quite marked. Although point estimates show a clear upward trend in the RTG, findings are only statistically significant for white males. Differences in the RTG could be due to differences in reporting of labor force status. For instance, if Hispanic women would report being retired and white women would report being inactive, this could at least partly explain differences, but this does not seem to be the case, as 33% of 63 year old Hispanic women and 38% of 63 year old white women report being retired.

3.2 Population by education and sex

WLE by educational attainment and sex is shown in figure 4. Additional results can be found in the appendix. An overview of which comparisons are statistically significant at the 5% level is given in table 4.

Generally, there is a clear educational gradient and individuals with a college or university degree have the highest WLE while individuals with no degree have the

Table 4: Comparison of levels of WLE by education and sex. Comparisons for which the 95% confidence intervals of WLEs do not overlap are marked with an asterisk.

	1995	2000	2005	2010
No degree, male/no degree, female	*	*	*	
High school, male/high school female	*	*		
College, male/college, female	*	*	*	*
College, male/no degree, male	*	*	*	*
College, male/high school male	*	*	*	*
College, female/no degree, female	*	*	*	*
College, female/High school female		*	*	*

lowest, both in absolute and in relative terms. Moreover, for each educational level males have a higher WLE than females. Most of these differences are statistically significant. Apart from these similarities, there are also marked differences between educational groups. While the gender gap in WLE has been closing for both individuals with high school education and individuals with no degree, it was highly volatile for individuals with a college degree. WLE of individuals with college education is volatile in general, especially for males. For example, WLE of males with a college degree increased by 3.7 years between 1998-2002 and 2003-2007 and decreased by 3.2 years afterward. Changes have been less pronounced for females with college education, which comes as no surprise, as females have been less affected by the Great Recession than males (Wood, 2014).

Changes of the WLE of males and females with high school education roughly match those of individuals with a college degree, while being less strong. For instance, the WLE of males with high school education dropped by only 0.8 years between 2003-2007 and 2008-2011. The WLE of males with no degree has been steadily decreasing, while the difference between 2003-2007 and 2008-2011 amounts to -1.4 years and is considerably smaller than for males with college education. Moreover, the WLE of females with no degree actually increased during this period by 0.5 years. This result is quite remarkable, as there is a general consensus that individuals with low education have been affected more by the recent recession than others (Engemann and Wall, 2009; Coile and Levine, 2011).

Results on the retirement timing gap by education and sex are shown in figure 5. Again, additional results can be found in the appendix. There are some differences in the levels of results by educational attainment, but differences are mostly neither strong nor statistically significant and general patterns are relatively similar. The RTG has steadily increased for males, while the increase was steepest for males with college education. The RTG of females shows both increases and decreases, while there also seems to be an upward trend.

Table 5 shows the probability of returning to work for 65 year old retirees by sex and education. Overall, males with a college degree have the highest probability of returning to work. Results for this group also show the greatest volatility, again. For example, between 2003-2007 and 2008-2011 the probability of returning to work dropped by 6 percentage points, while it only dropped by 2 percentage points for

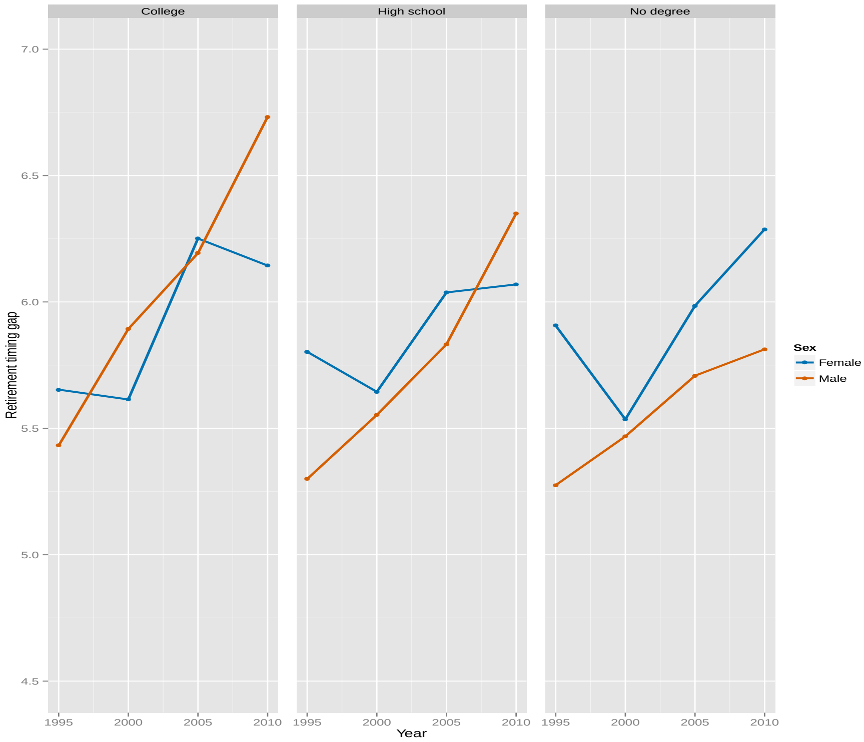

Figure 5: Retirement timing gap by education and sex.

Table 5: Probability of reentering employment for 65 year old retired individuals; by sex and education

	1995	2000	2005	2010
No degree, males	0.28	0.28	0.28	0.26
No degree, females	0.20	0.16	0.18	0.19
High school, males	0.30	0.28	0.30	0.31
High school, females	0.21	0.20	0.23	0.21
College, males	0.37	0.32	0.43	0.37
College, females	0.22	0.22	0.28	0.24

Table 6: Differences in WLE by educational attainmaint by sex and race. Differences which are statistically signifcant at the 5% level are marked with an asterisk.

	1995	2000	2005	2010
White/black females no degree	1.5	0.1	0.9	0.5
White/Hispanic females no degree	1.2	0.5	1.2	-1.1
White/black females high school	0.4	1.3	1.3	1.6
White/Hispanic females high school	0.2	1.7	0.5	0.1
White/black females college	0.1	2.4	1.7	3.8*
White/Hispanic females college	3.1	-0.4	4.9	1.4
White/black males no degree	3.2*	2.5	2.5	0.6
White/Hispanic males no degree	1.3	-0.1	-0.5	-0.9
White/black males high school	3.1*	3.7*	2.0*	4.6*
White/Hispanic males high school	1.5	0.2	-0.1	2.4
White/black males college	2.8	6.7*	-0.1	-1.3
White/Hispanic males college	2.0	-1.8	-0.1	2.3

males with no degree and slightly increased for males with a high school degree.

Overall differences come as no surprise, because of educational differences in labor market opportunities, health (Crimmins and Saito, 2001; Dupre, 2008), and life expectancy (Olshansky et al., 2012). The effect of the Great Recession is more puzzling. The strong effect on males with a college degree may be due to the fact that they have a higher probability of retiring when becoming unemployed than other groups, because they can more easily afford it. Indeed, the probability that a 50 year old employed male is retired at age 65 increased considerably for males with a college degree. In the period of 2003-2007 the probability was 34% conditional on surviving, while it amounted to 46% for 2008-2011. For males with a high school degree and no degree the probability increased by 5 percentage points and 4 percentage points, respectively. Note that these findings are not at odds with an increase in RTG, as for males with college education both age at first retirement and age at final retirement actually decreased between 2003-2007 and 2008-2011, while the decrease was stronger for the former than for the latter.

3.3 Population by race, sex, and education

Results which combine all three variables under study partly mirror the findings already discussed above – whites have a higher WLE than blacks and Hispanics and WLE increases with educational attainment. Nevertheless, there are still differences in WLE by race when conditioned on education, which are presented in table 6. It shows the differences in WLE for each educational level by sex and race. For example, the first line gives the differences in WLE between white females with no degree and black females with no degree. Detailed results can be found in the appendix, as well as a decomposition of remaining life expectancy at age 50 into three components: working life expectancy, life expectancy in retirement, and life expectancy out of the labor force.

White females mostly have a higher WLE than black or Hispanic females irrespective of educational level or year, with few exceptions. The only difference significant at the 5% level is between black and white females with college education, though. This is mostly due to the fact that either differences between groups or sample sizes of groups are small. For example, for the relatively old cohorts in the HRS only a small fraction of Hispanic females holds a college or university degree (approx. 11% or 180 respondents). Nevertheless, these findings are in line with previous research. For example, results reported by Millimet et al. (2003, table 5) show only negligible differences between white and non-white women aged 50.

For white and Hispanic males differences are of mixed signs and magnitudes and in no case significant. The comparison of black males and white males leads to significant differences at all educational levels, albeit only the differences for individuals with high school degree are significant for all years. Sample size for blacks with college degree is small, so results for this educational level should be viewed with care.

4 Conclusions

Using data from the US Health and Retirement Study we calculated period working life tables, studied differences in working life expectancy (WLE) by sex, race, and education, and analyzed the impact of the Great Recession. We find strong differences by sex, race, and education. White males and males with a college degree have by far the highest WLE, while it is lowest for Hispanic females and females with no degree. Racial differences mostly disappear if education is controlled for, though, with the exception of differences between white and black males. Gender gaps by race vary strongly. For example, the gap between Hispanic males and females is the largest, except during the Great Recession, while gender differences are small for blacks. The Great Recession had a strong impact on WLE, but findings show great heterogeneity. For example, the Great Recession had a strong negative impact on WLE of males with college education, while it had a positive impact on WLE of Hispanic females. In addition to WLE we studied the retirement timing gap, defined as the difference between age at first retirement and age at final retirement. Results are more homogeneous than in case of the WLE and there is a general upward trend, while differences by gender, race, and education are mostly small and not statistically significant.

Overall, our findings point to the importance of racial differences, economic conditions, and the interaction of both for WLE. While racial differences can partly be explained by differentials in life expectancy, it remains for future research to study how they are shaped by inequalities in health and disability.

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A Markov state methods

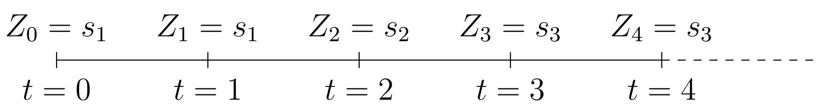
A.1 Notation

Let $\{Z_t\}$ denote a homogeneous Markov chain indexed by time $t \in \mathcal{T} = \mathbb{N}_0$. Given some variables $X_1, \ldots, X_k$ each with state space $\mathcal{X}_1, \ldots, \mathcal{X}_k$ the state space $\mathcal{S}$ of $\{Z_t\}$ is assumed to consist of elements of $\mathcal{X}_1 \times \cdots \times \mathcal{X}_k$, i.e. $\mathcal{S} \subseteq (\mathcal{X}_1 \times \cdots \times \mathcal{X}_k) \cup \mathcal{K}$, where $\mathcal{K}$ is a set of additional absorbing states. The number of elements of $\mathcal{S}$ will be denoted by n and each element of $\mathcal{S}$ will be numbered, i.e. $N : \mathcal{S} \to \mathcal{N}$ with N being a one-to-one mapping and $\mathcal{N} = \{1, \ldots, n\}$ such that $N(\mathcal{S}) = \{1, \ldots, n\}$. One step transition probabilities $\Pr(Z_t = i|Z_{t-1} = j)$ with $i, j \in \mathcal{N}$ will be written as p_{ij} and are estimated as described in section 2 of the paper. $\mathbf{P} = [p_{ij}]$ denotes the transition matrix of the Markov chain. Note that $\mathbf{P}$ is written in column orientation as is customary for projection matrices in demography (e.g. Caswell, 2001), while the literature on stochastic processes most often uses a row orientation, i.e. p_{ji} (e.g. Kemeny and Snell, 1971). Let $\mathcal{A}$ and $\mathcal{B}$ be a partition of $\mathcal{S}$, i.e. $\mathcal{A} \cap \mathcal{B} = \emptyset$ and $\mathcal{A} \cup \mathcal{B} = \mathcal{S}$. For example, an element of the state space of some variable X_l could be used to generate a partition of $\mathcal{S}$ by setting $\mathcal{A}_x = \{s' \in \mathcal{S}|x \in s'\}$ and $\mathcal{B}_x = \{s'' \in \mathcal{S}|x \notin s''\}$ for some $x \in \mathcal{X}_l$. Moreover, define $\mathcal{N}_\mathcal{A} = N(\mathcal{A})$ and $\mathcal{N}_\mathcal{B} = N(\mathcal{B})$ such that $\mathcal{N}_\mathcal{A} \cap \mathcal{N}_\mathcal{B} = \emptyset$ and $\mathcal{N}_\mathcal{A} \cup \mathcal{N}_\mathcal{B} = \mathcal{N}$. $n_\mathcal{A}$ denotes the number of elements of $\mathcal{N}_\mathcal{A}$ and $n_\mathcal{B}$ denotes the number of elements of $\mathcal{N}_\mathcal{B}$. D will denote the random variable which captures the time spent in subset $\mathcal{A}$, V denotes the random variable which captures time to first visit of $\mathcal{A}$, and E denotes time to last visit of $\mathcal{A}$.

In our analysis the state space is based on age, $\mathcal{X}_1 = \{50, \ldots, 99\}$, and labor force status, $\mathcal{X}_2 = \{$*employed*, *retired*, *out of the labor force or unemployed*$\}$. Moreover, $\mathcal{K} = \{\text{dead}\}$, such that $\mathcal{S} = \{(50, \textit{employed}), \ldots, \textit{dead}\}$. Depending on the measure of interest, $\mathcal{A}$ is defined in different ways. For example, for calculations regarding the WLE it is defined as $\mathcal{A} = \{(50, \textit{employed}), (51, \textit{employed}), \ldots, (99, \textit{employed})\}$.

A.2 Transitions and counting conventions

Transitions are assumed to occur mid-interval and counting conventions follow Skoog and Ciecka (2010). A simple example is depicted below.



The process starts at time $t = 0$ in state s_1. At $t = 1$ the process is still in state s_1, at $t = 2$ it is in state s_2, and so on. The time spent in subset $\mathcal{A} = \{s_1, s_2\}$ develops as follows. D_0 equals 0, because the process has just started and no time has passed. $D_1 = 1$ as the whole time span between $t = 0$ and $t = 1$ was spent in state s_1. A transition occurs between $t = 1$ and $t = 2$, but to state s_2, which is also in $\mathcal{A}$, such that $D_2 = 2$. D_3 equals 2.5, as the transition between $t = 2$ and $t = 3$ is to a state not in $\mathcal{A}$ and transitions are assumed to occur mid-interval. Finally, D_4 also equals 2.5, because the time from $t = 3$ to $t = 4$ is spent in s_3 and thus does not contribute to D. Time to first entry and time to last exit follow similar rules, although the interpretation of results differs somewhat. $D_t = 0$ simply means that $\mathcal{A}$ has not been visited up to time t. $V_t = 0$ will mean that the first entry already has occured, while $E_t = 0$ means that the last exit either has already occurred or will never occur, due to technical reasons which will be explained below. Also note that both V and E can only take on values $0, 0.5, 1.5, 2.5, \ldots$ For example, if we define $\mathcal{A}$ as $\{s_2\}$ V_0 will equal 1.5, V_1 equals 0.5, and V_3 is 0, while $E_0 = 2.5$, $E_1 = 1.5$, $E_2 = 0.5$, and $E_3 = 0$.

A.3 Time spent in state

The formulas for time spent in a subset of states are modified versions of the formulas given by Sericola (2000) and are closely related to first step analysis, one of the basic tools of Markov chain analysis (e.g. Taylor and Karlin, 1984). They are modified such that they follow the conventions regarding counting and transitions of Skoog and Ciecka (2010) as outlined above.

Decompose $\mathbf{P}$ with respect to $\mathcal{A}$ and $\mathcal{B}$,

$$\mathbf{P} = \begin{pmatrix} \mathbf{P}_{\mathcal{A}} & \mathbf{P}_{\mathcal{BA}} \\ \mathbf{P}_{\mathcal{AB}} & \mathbf{P}_{\mathcal{B}} \end{pmatrix}, \tag{1}$$

where $\mathbf{P}_{\mathcal{A}}$ includes the transition probabilities p_{ij} for $i, j \in \mathcal{N}_{\mathcal{A}}$, $\mathbf{P}_{\mathcal{BA}}$ includes transition probabilities p_{ij} for $i \in \mathcal{N}_{\mathcal{B}}$ and $j \in \mathcal{N}_{\mathcal{A}}$, and so on. The matrix $\mathbf{D}(t, d) = [\Pr(D_t \leq d, Z_t = i|Z_0 = j)]$ includes the probabilities that D is less or equal d at time t and that Z_t equals i, conditional on starting in state j. $\mathbf{D}(t, d)$ can be decomposed the same way as $\mathbf{P}$, i.e.

$$\mathbf{D}(t, d) = \begin{pmatrix} \mathbf{D}(t, d)_{\mathcal{A}} & \mathbf{D}(t, d)_{\mathcal{BA}} \\ \mathbf{D}(t, d)_{\mathcal{AB}} & \mathbf{D}(t, d)_{\mathcal{B}} \end{pmatrix}, \tag{2}$$

where $\mathbf{D}(\mathbf{t}, \mathbf{d})_{\mathcal{A}}$ includes $\Pr(D_t \leq d, Z_t = i|Z_0 = j)$ for $i, j \in \mathcal{N}_{\mathcal{A}}$ and so on.

$\mathbf{D}(t, d)$ is calculated recursively. For $t = 0$ initial conditions are given by

$$\mathbf{D}(t, 0) = \mathbf{I}_n \tag{3}$$

where $\mathbf{I}_n$ is a $n \times n$ unity matrix, meaning that no time has been spent in subset $\mathcal{A}$ before the process starts. For $t > 0$ initial conditions are

$$\mathbf{D}(t, 0) = \begin{pmatrix} \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{P}_{\mathcal{B}}^t \end{pmatrix} \tag{4}$$

and

$$\mathbf{D}(t, d) = \mathbf{P}^t \qquad \text{for } d > t. \tag{5}$$

(4) simply states that no time spent in $\mathcal{A}$ up to time t requires not leaving subset $\mathcal{B}$. Condition (5) means that after t time units the time spent in $\mathcal{A}$ will always be t or less.

Using these initial conditions and the decomposition of $\mathbf{P}$, $\mathbf{D}(t,d)$ is computed as

$$\begin{aligned}\mathbf{D}(t,d) &= \mathbf{D}(t-1,d-1)\begin{pmatrix}\mathbf{P}_{\mathcal{A}} & \mathbf{0}\\ \mathbf{0} & \mathbf{0}\end{pmatrix} + \mathbf{D}(t-1,d)\begin{pmatrix}\mathbf{0} & \mathbf{0}\\ \mathbf{0} & \mathbf{P}_{\mathcal{B}}\end{pmatrix} \\ &+ \mathbf{D}(t-1,d-0.5)\begin{pmatrix}\mathbf{0} & \mathbf{P}_{\mathcal{BA}}\\ \mathbf{P}_{\mathcal{AB}} & \mathbf{0}\end{pmatrix}\end{aligned} \tag{6}$$

for $d = 0.5, 1, 1.5, 2, \dots$ and $t > 0$. The proof follows directly from Sericola (2000) and exploits homogeneity and the Markov property. More specifically, $\Pr(D_t \le d, Z_t = i|Z_0 = j)$ can be decomposed into $\sum_{k\in\mathcal{N}} \Pr(D_t \le d, Z_t = i|Z_1 = k)\Pr(Z_1 = k|Z_0 = j)$ which equals $\sum_{k\in\mathcal{N}} \Pr(D_{t-1} \le d - \mathrm{I}(k,j), Z_{t-1} = i|Z_0 = k)p_{kj}$, where

$$\mathrm{I}(k,j) = \begin{cases} 0 & \text{if} \quad k,j \in \mathcal{N}_{\mathcal{B}} \\ 0.5 & \text{if} \quad k \in \mathcal{N}_{\mathcal{B}}, j \in \mathcal{N}_{\mathcal{A}} \\ 0.5 & \text{if} \quad k \in \mathcal{N}_{\mathcal{A}}, j \in \mathcal{N}_{\mathcal{B}} \\ 1 & \text{if} \quad k,j \in \mathcal{N}_{\mathcal{A}} \end{cases}. \tag{7}$$

Recursion (6) restates these simple equations in matrix notation.

$\Pr(D_t \le d|Z_0 = j)$ can be obtained from $\mathbf{D}(t,d)\mathbf{e}_j^T$, where $\mathbf{e}_j$ is a column vector for which $e_l = 1$ if $l = j$ and $e_l = 0$ else and T denotes transposition. $\Pr(D_t = d|Z_0 = j)$ is given by $\Pr(D_t \le d|Z_0 = j) - \Pr(D_t \le d-1|Z_0 = j)$ and $\Pr(D_t = d)$ can be obtained by combining $\Pr(D_t = d|Z_0 = j)$ with a starting distribution Z_0.

A.4 Time to first entry

Formulas for time to first entry (and time to last exit) differ somewhat from those for time spent in a subset of states, because for the latter it suffices to consider the history of the process, i.e. how many times a subset of states has been visited up to time t, while the former needs to consider both what happened before t and how the process develops after t.

Let $\mathbf{V}(t,v) = [\Pr(V_t = v, Z_t = i|Z_0 = j)]$ denote the matrix which entries capture the probability of having to wait v time units to enter subset $\mathcal{A}$ and of being in state i conditional on starting in state j. Moreover, let $\mathbf{W}(t,v) = [\Pr(V_t \ge v, Z_t = i|Z_0 = j)]$ be defined similar to $\mathbf{V}(t,v)$ except that it captures the probability of waiting at least v time units.

Initial conditions are given by

$$\mathbf{W}(t,0) = \mathbf{P}^t \tag{8}$$

and

$$\mathbf{W}(t,0.5) = \begin{pmatrix}\mathbf{0} & \mathbf{0}\\ \mathbf{0} & \mathbf{P}_{\mathcal{B}}^t\end{pmatrix}. \tag{9}$$

These formulas capture the history of the process and can be interpreted like the initial conditions for the time spent in subset $\mathcal{A}$ given by equations (4) and (5).

To account for the future of the process for $v = 1.5, 2.5, \dots$ the following formula is used:

$$\mathbf{W}(t,v) = \left[\begin{pmatrix}\mathbf{0} & \mathbf{0}\\ \mathbf{0} & \mathbf{1}_{n_{\mathcal{B}}}\end{pmatrix}\begin{pmatrix}\mathbf{0} & \mathbf{0}\\ \mathbf{0} & \mathbf{P}_{\mathcal{B}}^{v-0.5}\end{pmatrix}\right]^T \circ \mathbf{W}(t,0.5) \tag{10}$$

$\mathbf{1}_{n_\mathcal{B}}$ is a $n_\mathcal{B} \times n_\mathcal{B}$ matrix with all entries equal to 1 and $\circ$ denotes the Hadamard product. The matrix on the left side of the Hadamard product is simply a calculation of the probability of staying in a sate in subset $\mathcal{B}$ starting from a state in subset $\mathcal{B}$ for v or more steps, formally $\sum_{k \in \mathcal{N}_\mathcal{B}} \Pr(Z_{t+v-0.5} = k | Z_t = i)$ for $i \in \mathcal{N}_\mathcal{B}$. For $v = 1, 2, \ldots$ $\mathbf{W}(t, v)$ will simply equal $\mathbf{W}(t, v + 0.5)$ due to the fact that transitions between states are assumed to occur mid-interval.

$\mathbf{V}(t, v)$ is calculated as

$$\mathbf{V}(t, v) = \mathbf{W}(t, v) - \mathbf{W}(t, v + 1) \tag{11}$$

for $v = 0.5, 1.5, \ldots$ and

$$\mathbf{V}(t, 0) = \mathbf{W}(t, 0) - \mathbf{W}(t, 0.5). \tag{12}$$

The probability $\Pr(V_t = v | Z_0 = j)$ can be calculated as $\mathbf{V}(t, v)\mathbf{e}_j^T$. Note that the process may never visit the subset $\mathcal{A}$ such that $V = \infty$. This will usually be the case when one or more of the states in $\mathcal{B}$ are absorbing. In this case both $\Pr(V_t \geq v | Z_0 = j)$ and $\Pr(V_t = v | Z_0 = j)$ will be non-zero for arbitrarily large values of v. Similar issues occur for the recursive schemes of Skoog and Ciecka (2010). If for some t' and v' only entries of $\mathbf{V}(t', v')$ are non-zero for which i denotes an absorbing state calculation can be stopped. Alternatively, a prespecified time t'' may be used. If one is interested in the distribution of V conditional on V being finite, it suffices to condition on $V < v'$.

A.5 Time to last exit

$\mathbf{E}(t, v)$ denotes the matrix with entries $\Pr(E_t = e, Z_t = i | Z_0 = j)$ which capture the probability of exiting $\mathcal{A}$ for the last time in exactly e time units and being in state i conditional on starting in state j. Let τ_E be the last time after which an exit of subset $\mathcal{A}$ is possible, i.e. there can be a transition from $\mathcal{A}$ to $\mathcal{B}$ between τ_E and τ_{E+1}, but not afterwards. In this case

$$\mathbf{E}(\tau_E, e) = \mathbf{0} \quad \text{for} \quad e \geq 1, \tag{13}$$

which simply formalizes the assumption stated above. Moreover, at time τ_E time to last exit can only equal 0 or 0.5. The corresponding probabilities are given by

$$\mathbf{E}(\tau_E, 0.5) = \left[\begin{pmatrix} \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{1}_{n_\mathcal{B}} \end{pmatrix} \begin{pmatrix} \mathbf{0} & \mathbf{0} \\ \mathbf{P}_{\mathcal{AB}} & \mathbf{0} \end{pmatrix} \right]^T \circ \mathbf{P}^{\tau_E} \tag{14}$$

and

$$\mathbf{E}(\tau_E, 0) = \left[\mathbf{1}_n \begin{pmatrix} \mathbf{P}_\mathcal{A} & \mathbf{P}_{\mathcal{BA}} \\ \mathbf{0} & \mathbf{P}_\mathcal{B} \end{pmatrix} \right]^T \circ \mathbf{P}^{\tau_E}. \tag{15}$$

As in case of the time to first entry the right side of the Hadamard product keeps track of the history of the process up to τ_E while the left side accounts for the future development up to $\tau_E + 1$.

More generally, we will write

$$\mathbf{P}_E = \begin{pmatrix} \mathbf{0} & \mathbf{0} \\ \mathbf{P}_{\mathcal{AB}} & \mathbf{0} \end{pmatrix} \quad \text{and} \quad \mathbf{P}_S = \begin{pmatrix} \mathbf{P}_\mathcal{A} & \mathbf{P}_{\mathcal{BA}} \\ \mathbf{0} & \mathbf{P}_\mathcal{B} \end{pmatrix}. \tag{16}$$

For $e = 0, 1, \ldots$ we then have

$$\mathbf{E}(t, e+0.5) = (\mathbf{1}_n \mathbf{P}_S^{\tau_E - t - e} \mathbf{P}_E \mathbf{P}^e)^T \circ \mathbf{P}^t \quad (17)$$

Moreover,

$$\mathbf{E}(t, 0) = (\mathbf{1}_n \mathbf{P}_S^{\tau_E - t + 1})^T \circ \mathbf{P}^t \quad (18)$$

and for $e = 1, 2, \ldots$

$$\mathbf{E}(t, e) = \mathbf{0}. \quad (19)$$

Finally

$$\mathbf{E}(t, e) = \mathbf{0} \quad \text{for} \quad e \geq \tau_e - t + 1. \quad (20)$$

$\Pr(E_t = e | Z_0 = j)$ can be calculated as $\mathbf{E}(t, e)\mathbf{e}_j^T$. Note that $e = 0$ has to be interpreted differently than $v = 0$ from the preceding section. $v = 0$ means that first entry already has occurred. If first entry has not occurred so far and will not occur in the future $v = \infty$. $e = 0$ on the other hand means that the last exit either already has occurred or that it will never occur.

In case of last exit it may be desirable to not just specifiy which subset is left, but also if the exit is directed to a specific subset. As before $\mathcal{A}$ denotes the subset which is left. Let $\mathcal{B}$ denote the exit subset and $\mathcal{C}$ is the subset of all remaining states of $\mathcal{S}$, which are not of special interest. $\mathbf{P}_E$ and $\mathbf{P}_S$ can now be written as

$$\mathbf{P}_E = \begin{pmatrix} \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{P}_{\mathcal{AB}} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{0} \end{pmatrix} \quad \text{and} \quad \mathbf{P}_S = \begin{pmatrix} \mathbf{P}_{\mathcal{A}} & \mathbf{P}_{\mathcal{BA}} & \mathbf{P}_{\mathcal{CA}} \\ \mathbf{0} & \mathbf{P}_{\mathcal{B}} & \mathbf{P}_{\mathcal{CA}} \\ \mathbf{P}_{\mathcal{AC}} & \mathbf{P}_{\mathcal{BC}} & \mathbf{P}_{\mathcal{C}} \end{pmatrix}. \quad (21)$$

Otherwise the same formulas as before can be used which now give the time to last exit to subset $\mathcal{B}$.

B Mortality adjustment and estimation

B.1 Mortality adjustment

In some cases survival probabilities estimated using the multinomial logit model described in section 2.3 lead to unrealistic estimates of life expectancy. Because of this, survival probabilities were adjusted using life tables provided by the Centers for Disease Control and Prevention (CDC). The procedure works as follows. Let $p(x,e) = p(e|x,e) + p(o|x,e) + p(r|x,e)$ denote the probability that an employed individual aged x survives, where e represents the labor force status employed, o represents out of the labor force or unemployed, and r represents retired. $p(x,o)$ and $p(x,r)$ denote the survival probabilities for individuals out of the labor force and retired persons, respectively, which can be decomposed in a similar manner. $p_{\text{CDC}}(x)$ denotes the survival probability for age x reported by the CDC. $d(x,e)$, $d(x,o)$, and $d(x,r)$ denote the proportion of individuals in age x which are employed, out of the labor force or unemployed, and retired, respectively. Given a starting distribution for the youngest age $d_S(50,\cdot)$, the proportions $d(x,\cdot)$ for any age x can be calculated by repeated application of the transition probabilities.

To achieve that the working life tables imply the same life expectancy as the life tables of the CDC requires that

$$p(x,e)d(x,e) + p(x,o)d(x,o) + p(x,r)d(x,r) = p_{\text{CDC}}(x) \tag{22}$$

holds. This simply means that average survival follows the CDC life table. To achieve this, the following algorithm was applied, where p_{est} is used to indicate estimated probabilities derived from the multinomial logit model and p_{adj} is used to denote adjusted values:

1. Set $d(50,e) = w_e(50)$, $d(50,o) = w_o(50)$, $d(50,r) = w_r(50)$, where $w_{\cdot}(50)$ denotes the weights described in section 2.2.

2. For each $x = 50, \cdots, 98$:

   (a) Calculate

   $$a = \frac{p_{est}(x,e)d(x,e) + p_{est}(x,o)d(x,o) + p_{est}(x,r)d(x,r)}{p_{\text{CDC}}(x)}$$

   (b) Calculate $p'(x,\cdot) = p_{est}(x,\cdot)/a$ for e,o,r

      i. If any $p'(x,\cdot) > 1$ set $p_{adj}(x,\cdot) = p_{\text{CDC}}(x)$ for e,o,r

      ii. Else set $p_{adj}(x,\cdot) = p'(x,\cdot)$ for e,o,r

   (c) Calculate

   $$b(\cdot) = \frac{p_{est}(e|x,\cdot) + p_{est}(o|x,\cdot) + p_{est}(r|x,\cdot)}{p_{adj}(x,\cdot)}$$

   for e,o,r

   (d) Set $p_{adj}(e|x,\cdot) = p_{est}(e|x,\cdot)/b$, $p_{adj}(o|x,\cdot) = p_{est}(o|x,\cdot)/b$, and $p_{adj}(r|x,\cdot) = p_{est}(r|x,\cdot)/b$ for e,o,r

(e) Set $d(x+1,\cdot) = d(x,e)p_{adj}(\cdot|x,e) + d(x,o)p_{adj}(\cdot|x,o) + d(x,r)p_{adj}(\cdot|x,r)$ for e, o, r

3. Set $p_{adj}(99,\cdot) = 1$ for e, o, r

This procedure was applied to all working life tables. Because step 2.b) may result in probabilities above 1 step 2.b)i is introduced. In some cases this may lead to life expectancies which slightly differ from those reported by the CDC. For example, for 2010 remaining life expectancy at age 50 as derived from our adjusted working life tables equals 29.7 for white males and 33.2 for white females, while the CDC reports values of 29.7 and 33.3, respectively.

As already noted overall life expectancy by sex and race will follow the estimates reported by the CDC, while life expectancy by education and labor force status may differ. An example can be seen in tables A6, A7, and A8, which give remaining life expectancy at age 50 by education. For instance, life expectancy for females with no degree has been declining, while it increased for females with a high school or college degree (also see Olshansky et al., 2012).

B.2 Mortality estimation

Mortality adjustment as described above requires life tables by race and sex for the years 1995, 2000, 2005, and 2010, but the CDC started publishing life tables for Hispanics only in 2006. Because of this, the life tables for male and female Hispanics of 2006 were used for the year 2005. Life tables for 1995 and 2000 were estimated using the following approach. The logarithm of age-specific probabilities of dying for the years 2005 and 2010 were used as a dependent variable in a linear regression, with a cubic age polynomial and log probabilities of dying of whites and blacks as explanatory variables. Regressions were run separately for males and females. These models exhibit good predictive qualities. For example, in the regression model for women R^2 is close to 1 and the relative prediction error is less than 0.01. Parameter estimates were used to estimate log probabilities of dying for the years 1995 and 2000.

Before the regression approach outlined above could be applied another estimation step was needed, as the CDC life tables for whites and blacks for 1995 end with age 85. In this case also a regression approach was used to estimate probabilities of dying for ages 85 to 99. Log probabilities of dying for ages 85 to 99 of the years 2000, 2005, and 2010 were used as dependent variables. Explanatory variables included a cubic age polynomial and survival at age 85. Parameter estimates were used to estimate log probabilities of dying for 1995.

C Additional tables

This section includes detailed tables, supplementing the results presented in section 3 of the paper. Tables A1 to A5 add to the results presented in section 3.1 on racial differences. Tables A6 to A9 show results by sex and education. Results by race, sex, and education are given in tables A10 to A21. Finally, tables A22 to A24 show how remaining life expectancy at age 50 is distributed among work, retirement, and being out of the labor force. Results not accounting for any of these dimensions (race; sex; education) and relating to the total population are available upon request from the authors.

Table A1: Remaining life expectancy at age 50, working life expectancy at age 50, and proportion of remaining life expectancy spent working; whites;

	1995	2000	2005	2010
White females				
Life expectancy at age 50	31.5	31.9	32.4	33.2
Working life expectancy at age 50	11.8	11.2	12.2	11.4
95% confidence interval, lower bound	11.3	10.7	11.7	10.7
95% confidence interval, upper bound	12.3	11.7	12.7	12.1
% of life expectancy spent working	37.4%	35.2%	37.7%	34.4%
95% confidence interval, lower bound	35.7%	33.6%	36.1%	32.3%
95% confidence interval, upper bound	38.9%	36.5%	39.4%	36.4%
White males				
Life expectancy at age 50	27.1	28.2	28.8	29.7
Working life expectancy at age 50	15.0	13.6	14.7	13.2
95% confidence interval, lower bound	14.5	13.1	14.2	12.5
95% confidence interval, upper bound	15.4	14.0	15.2	13.8
% of life expectancy spent working	55.3%	48.2%	51.1%	44.4%
95% confidence interval, lower bound	53.5%	46.6%	49.5%	42.1%
95% confidence interval, upper bound	57.0%	49.8%	52.9%	46.5%
Difference relative WLE male/female	17.9%	13.1%	13.4%	10.0%

Table A2: Remaining life expectancy at age 50, working life expectancy at age 50, and proportion of remaining life expectancy spent working; blacks;

	1995	2000	2005	2010
Black females				
Life expectancy at age 50	28.1	28.8	29.7	31.0
Working life expectancy at age 50	10.2	9.1	9.7	8.9
95% confidence interval, lower bound	9.3	8.1	8.6	7.7
95% confidence interval, upper bound	11.3	10.2	10.9	10.1
% of life expectancy spent working	36.4%	31.6%	32.8%	28.6%
95% confidence interval, lower bound	33.3%	28.2%	29.0%	24.8%
95% confidence interval, upper bound	40.1%	35.2%	36.8%	32.6%
Black males				
Life expectancy at age 50	22.7	24.2	24.9	26.6
Working life expectancy at age 50	10.5	9.0	10.8	9.1
95% confidence interval, lower bound	9.4	7.9	9.3	7.8
95% confidence interval, upper bound	11.5	10.2	12.2	10.6
% of life expectancy spent working	46.2%	37.1%	43.3%	34.4%
95% confidence interval, lower bound	41.5%	32.6%	37.4%	29.2%
95% confidence interval, upper bound	50.8%	42.1%	48.9%	39.8%
Difference relative WLE male/female	9.8%	5.5%	10.4%	5.8%

Table A3: Remaining life expectancy at age 50, working life expectancy at age 50, and proportion of remaining life expectancy spent working; Hispanics;

	1995	2000	2005	2010
Hispanic females				
Life expectancy at age 50	33.2	33.8	34.7	35.2
Working life expectancy at age 50	9.2	7.9	8.0	9.4
95% confidence interval, lower bound	8.0	6.5	6.8	7.7
95% confidence interval, upper bound	10.6	9.1	9.2	11.1
% of life expectancy spent working	27.6%	23.2%	23.1%	26.8%
95% confidence interval, lower bound	23.9%	19.3%	19.5%	22.0%
95% confidence interval, upper bound	32.0%	27.0%	26.6%	31.6%
Hispanic males				
Life expectancy at age 50	29.2	30.3	31.1	31.4
Working life expectancy at age 50	12.1	12.6	13.0	10.3
95% confidence interval, lower bound	10.6	10.9	11.5	8.5
95% confidence interval, upper bound	13.4	14.3	14.5	12.1
% of life expectancy spent working	41.3%	41.5%	41.8%	32.9%
95% confidence interval, lower bound	36.3%	35.9%	37.0%	27.2%
95% confidence interval, upper bound	45.8%	47.2%	46.5%	38.7%
Difference relative WLE male/female	13.7%	18.3%	18.7%	6.1%

Table A4: Mortality counterfactual assuming constant life expectancy for females and males: remaining life expectancy at age 50, working life expectancy at age 50, and proportion of remaining life expectancy spent working; by sex and race

	1995	2000	2005	2010
White females				
Life expectancy at age 50	33.1	33.1	33.1	33.1
Working life expectancy at age 50	11.1	10.5	11.4	10.5
% of life expectancy spent working	33.5%	31.6%	34.4%	31.8%
White males				
Life expectancy at age 50	29.2	29.1	29.1	29.2
Working life expectancy at age 50	15.0	13.3	14.3	12.6
% of life expectancy spent working	51.5%	45.7%	49.1%	43.3%
Difference relative WLE male/female	18.0%	14.1%	14.7%	11.5%
Black females				
Life expectancy at age 50	33.2	33.2	33.2	33.2
Working life expectancy at age 50	10.4	9.1	9.7	8.7
% of life expectancy spent working	31.4%	27.3%	29.3%	26.1%
Black males				
Life expectancy at age 50	29.3	29.2	29.2	29.2
Working life expectancy at age 50	12.2	10.0	11.9	9.8
% of life expectancy spent working	41.8%	34.2%	40.8%	33.5%
Difference relative WLE male/female	10.4%	6.9%	11.5%	7.4%
Hispanic females				
Life expectancy at age 50	33.2	33.2	33.2	33.2
Working life expectancy at age 50	9.2	7.8	8.0	9.3
% of life expectancy spent working	27.6%	23.6%	24.0%	28.1%
Hispanic males				
Life expectancy at age 50	29.2	29.2	29.2	29.2
Working life expectancy at age 50	12.1	12.5	12.8	10.1
% of life expectancy spent working	41.3%	42.6%	43.6%	34.5%
Difference relative WLE male/female	13.7%	19.0%	19.7%	6.4%

Table A5: Mean age at first retirement, mean age at final retirement, and difference between age at first and at final retirement; by sex and race

	1995	2000	2005	2010
White females				
Age at first retirement	63.7	63.2	64.1	63.6
Age at final retirement	69.0	68.3	69.7	69.2
Retirement timing gap	5.4	5.1	5.6	5.6
95% confidence interval, lower bound	5.0	4.8	5.3	5.3
95% confidence interval, upper bound	5.7	5.4	5.9	5.9
White males				
Age at first retirement	63.8	63.1	63.9	63.3
Age at final retirement	68.9	68.4	69.7	69.4
Retirement timing gap	5.1	5.3	5.7	6.1
95% confidence interval, lower bound	4.8	5.1	5.5	5.8
95% confidence interval, upper bound	5.4	5.6	6.0	6.5
Difference in RTG male/female	-0.3	0.2	0.1	0.5
Black females				
Age at first retirement	62.4	62.2	63.2	62.7
Age at final retirement	68.0	67.9	69.8	69.3
Retirement timing gap	5.6	5.7	6.6	6.6
95% confidence interval, lower bound	4.9	5.0	5.8	5.7
95% confidence interval, upper bound	6.2	6.3	7.3	7.3
Black males				
Age at first retirement	61.8	61.7	62.7	61.9
Age at final retirement	66.8	67.1	68.6	67.9
Retirement timing gap	5.0	5.4	5.9	6.0
95% confidence interval, lower bound	4.2	4.6	5.1	5.1
95% confidence interval, upper bound	5.7	6.1	6.7	6.8
Difference in RTG male/female	-0.6	-0.3	-0.7	-0.6
Hispanic females				
Age at first retirement	63.8	63.4	63.2	63.8
Age at final retirement	67.7	67.3	66.9	67.9
Retirement timing gap	3.9	3.9	3.7	4.0
95% confidence interval, lower bound	2.9	2.8	2.7	3.1
95% confidence interval, upper bound	5.0	4.9	4.7	5.1
Hispanic males				
Age at first retirement	63.9	64.6	64.9	64.0
Age at final retirement	68.2	69.4	69.8	69.2
Retirement timing gap	4.3	4.8	4.9	5.2
95% confidence interval, lower bound	3.5	4.0	4.0	4.3
95% confidence interval, upper bound	5.0	5.6	5.7	6.1
Difference in RTG male/female	0.4	0.9	1.3	1.2

Table A6: Remaining life expectancy at age 50, working life expectancy at age 50, and proportion of remaining life expectancy spent working; no degree

	1995	2000	2005	2010
No degree, females				
Life expectancy at age 50	30.1	29.7	29.3	31.2
Working life expectancy at age 50	8.0	6.2	6.5	7.0
95% confidence interval, lower bound	8.0	6.3	6.5	6.7
95% confidence interval, upper bound	9.7	7.7	8.2	9.1
% of life expectancy spent working	26.4%	20.8%	22.1%	22.5%
95% confidence interval, lower bound	26.8%	21.2%	22.4%	21.7%
95% confidence interval, upper bound	31.9%	26.0%	28.1%	29.1%
No degree, males				
Life expectancy at age 50	25.5	25.8	25.8	26.2
Working life expectancy at age 50	11.1	10.6	10.1	8.7
95% confidence interval, lower bound	10.2	9.8	9.1	7.6
95% confidence interval, upper bound	11.9	11.5	11.2	10.0
% of life expectancy spent working	43.6%	41.3%	39.3%	33.3%
95% confidence interval, lower bound	40.5%	38.2%	35.6%	29.2%
95% confidence interval, upper bound	46.5%	44.3%	42.9%	37.6%
Difference relative WLE male/female	17.2%	20.5%	17.2%	10.9%

Table A7: Remaining life expectancy at age 50, working life expectancy at age 50, and proportion of remaining life expectancy spent working; high school

High school, females				
Life expectancy at age 50	31.3	32.1	32.5	33.2
Working life expectancy at age 50	10.7	10.2	11.2	10.4
95% confidence interval, lower bound	10.8	10.4	11.3	10.4
95% confidence interval, upper bound	12.0	11.4	12.5	11.8
% of life expectancy spent working	34.2%	31.9%	34.6%	31.3%
95% confidence interval, lower bound	34.5%	32.4%	35.1%	31.4%
95% confidence interval, upper bound	38.3%	35.7%	38.7%	35.7%
High school, males				
Life expectancy at age 50	26.3	27.4	28.0	29.3
Working life expectancy at age 50	13.3	12.2	12.8	12.0
95% confidence interval, lower bound	12.7	11.6	12.1	11.2
95% confidence interval, upper bound	13.9	12.7	13.4	12.8
% of life expectancy spent working	50.7%	44.5%	45.7%	41.0%
95% confidence interval, lower bound	48.4%	42.3%	43.5%	38.2%
95% confidence interval, upper bound	52.9%	46.4%	47.8%	43.6%
Difference relative WLE male/female	16.5%	12.6%	11.2%	9.7%

Table A8: Remaining life expectancy at age 50, working life expectancy at age 50, and proportion of remaining life expectancy spent working; high school

College, females				
Life expectancy at age 50	32.3	32.7	34.3	34.7
Working life expectancy at age 50	12.1	12.3	14.0	12.5
95% confidence interval, lower bound	11.8	12.1	13.8	12.2
95% confidence interval, upper bound	13.9	13.8	15.7	14.1
% of life expectancy spent working	37.4%	37.7%	41.0%	36.0%
95% confidence interval, lower bound	36.6%	36.9%	40.4%	35.3%
95% confidence interval, upper bound	43.2%	42.6%	45.8%	40.8%
College, males				
Life expectancy at age 50	28.2	30.1	31.1	32.0
Working life expectancy at age 50	16.8	14.8	18.5	15.3
95% confidence interval, lower bound	15.8	13.9	17.6	14.3
95% confidence interval, upper bound	17.9	15.5	19.3	16.3
% of life expectancy spent working	59.6%	49.2%	59.3%	47.6%
95% confidence interval, lower bound	56.2%	46.3%	56.6%	44.4%
95% confidence interval, upper bound	63.4%	51.7%	62.0%	50.7%
Difference relative WLE male/female	22.2%	11.5%	18.3%	11.7%

Table A9: Mean age at first retirement, mean age at final retirement, and difference between age at first and at final retirement; by sex and education

	1995	2000	2005	2010
No degree, females				
Age at first retirement	63.2	62.6	63.1	63.2
Age at final retirement	69.1	68.2	69.1	69.5
Retirement timing gap	5.9	5.5	6.0	6.3
95% confidence interval, lower bound	5.0	4.6	5.0	5.3
95% confidence interval, upper bound	6.1	5.7	6.2	6.6
No degree, males				
Age at first retirement	62.9	62.9	63.0	62.6
Age at final retirement	68.2	68.4	68.8	68.4
Retirement timing gap	5.3	5.5	5.7	5.8
95% confidence interval, lower bound	4.8	5.0	5.2	5.3
95% confidence interval, upper bound	5.7	5.9	6.2	6.5
Difference in RTG male/female	-0.6	-0.1	-0.3	-0.5
High school, females				
Age at first retirement	63.4	63.0	63.8	63.4
Age at final retirement	69.2	68.6	69.8	69.4
Retirement timing gap	5.8	5.6	6.0	6.1
95% confidence interval, lower bound	5.1	5.0	5.4	5.4
95% confidence interval, upper bound	5.9	5.6	6.0	6.1
High school, males				
Age at first retirement	63.0	62.5	63.0	62.9
Age at final retirement	68.3	68.1	68.9	69.2
Retirement timing gap	5.3	5.6	5.8	6.3
95% confidence interval, lower bound	5.0	5.2	5.5	5.9
95% confidence interval, upper bound	5.6	5.9	6.2	6.7
Difference in RTG male/female	-0.5	-0.1	-0.2	0.3
College, females				
Age at first retirement	63.2	63.2	64.7	63.6
Age at final retirement	68.8	68.9	70.9	69.8
Retirement timing gap	5.7	5.6	6.3	6.1
95% confidence interval, lower bound	4.7	4.7	5.4	5.2
95% confidence interval, upper bound	5.8	5.7	6.4	6.3
College, males				
Age at first retirement	64.8	63.5	66.0	64.2
Age at final retirement	70.2	69.4	72.2	70.9
Retirement timing gap	5.4	5.9	6.2	6.7
95% confidence interval, lower bound	5.0	5.5	5.8	6.3
95% confidence interval, upper bound	5.8	6.3	6.6	7.2
Difference in RTG male/female	-0.2	0.3	-0.1	0.6

Table A10: Remaining life expectancy at age 50, working life expectancy at age 50, and proportion of remaining life expectancy spent working; whites, no degree;

	1995	2000	2005	2010
White females, no degree				
Life expectancy at age 50	30.4	29.7	28.7	30.8
Working life expectancy at age 50	8.5	6.3	6.8	6.4
95% confidence interval, lower bound	7.4	5.5	5.6	4.8
95% confidence interval, upper bound	9.7	7.3	8.0	8.1
% of life expectancy spent working	28.0%	21.4%	23.7%	20.6%
95% confidence interval, lower bound	24.6%	18.3%	19.5%	15.7%
95% confidence interval, upper bound	31.5%	24.7%	27.8%	26.1%
White males, no degree				
Life expectancy at age 50	25.4	25.6	25.4	25.7
Working life expectancy at age 50	11.7	10.8	10.2	8.1
95% confidence interval, lower bound	10.6	9.6	8.5	6.5
95% confidence interval, upper bound	12.8	12.0	11.7	10.0
% of life expectancy spent working	46.2%	42.2%	40.1%	31.5%
95% confidence interval, lower bound	42.3%	38.0%	34.3%	25.1%
95% confidence interval, upper bound	50.0%	46.2%	45.8%	38.0%
Difference relative WLE male/female	18.2%	20.8%	16.4%	10.8%

Table A11: Remaining life expectancy at age 50, working life expectancy at age 50, and proportion of remaining life expectancy spent working; whites, high school degree;

	1995	2000	2005	2010
White females, high school degree				
Life expectancy at age 50	31.4	32.1	32.5	33.3
Working life expectancy at age 50	11.7	11.5	12.3	11.6
95% confidence interval, lower bound	11.0	10.9	11.7	10.8
95% confidence interval, upper bound	12.3	12.0	13.0	12.3
% of life expectancy spent working	37.2%	35.7%	37.9%	34.8%
95% confidence interval, lower bound	35.1%	33.9%	36.0%	32.3%
95% confidence interval, upper bound	39.3%	37.5%	39.9%	37.2%
White males, high school degree				
Life expectancy at age 50	26.5	27.6	28.3	29.3
Working life expectancy at age 50	14.2	13.0	13.5	13.1
95% confidence interval, lower bound	13.5	12.4	12.8	12.2
95% confidence interval, upper bound	14.9	13.5	14.2	14.0
% of life expectancy spent working	53.4%	46.9%	47.9%	44.6%
95% confidence interval, lower bound	51.0%	44.9%	45.5%	41.7%
95% confidence interval, upper bound	55.7%	49.0%	50.2%	47.5%
Difference relative WLE male/female	16.1%	11.2%	10.0%	9.8%

Table A12: Remaining life expectancy at age 50, working life expectancy at age 50, and proportion of remaining life expectancy spent working; whites, college degree;

	1995	2000	2005	2010
White females, college degree				
Life expectancy at age 50	32.6	33.1	34.4	34.7
Working life expectancy at age 50	13.5	13.7	15.6	14.4
95% confidence interval, lower bound	12.4	12.8	14.6	13.3
95% confidence interval, upper bound	14.6	14.6	16.7	15.4
% of life expectancy spent working	41.3%	41.4%	45.3%	41.4%
95% confidence interval, lower bound	38.1%	38.6%	42.7%	38.4%
95% confidence interval, upper bound	45.1%	44.4%	48.3%	44.4%
White males, college degree				
Life expectancy at age 50	28.6	30.1	31.2	32.1
Working life expectancy at age 50	17.6	15.7	19.1	16.1
95% confidence interval, lower bound	16.6	14.8	18.1	15.0
95% confidence interval, upper bound	18.8	16.5	20.0	17.1
% of life expectancy spent working	61.6%	52.2%	61.3%	50.1%
95% confidence interval, lower bound	58.0%	49.4%	58.5%	46.8%
95% confidence interval, upper bound	65.4%	54.7%	64.1%	53.3%
Difference relative WLE male/female	20.3%	10.7%	15.9%	8.7%

Table A13: Remaining life expectancy at age 50, working life expectancy at age 50, and proportion of remaining life expectancy spent working; blacks, no degree;

	1995	2000	2005	2010
Black females, no degree				
Life expectancy at age 50	26.4	27.5	28.5	29.6
Working life expectancy at age 50	7.1	6.2	5.9	5.9
95% confidence interval, lower bound	5.8	4.9	4.5	4.1
95% confidence interval, upper bound	8.4	7.8	7.7	8.2
% of life expectancy spent working	26.7%	22.6%	20.8%	19.9%
95% confidence interval, lower bound	22.2%	17.8%	15.7%	14.0%
95% confidence interval, upper bound	31.9%	28.2%	27.1%	27.0%
Black males, no degree				
Life expectancy at age 50	22.7	23.1	22.9	22.7
Working life expectancy at age 50	8.5	8.3	7.7	7.5
95% confidence interval, lower bound	7.1	6.7	5.8	5.4
95% confidence interval, upper bound	9.9	9.8	9.9	9.9
% of life expectancy spent working	37.4%	35.8%	33.6%	33.2%
95% confidence interval, lower bound	31.8%	28.9%	25.4%	23.4%
95% confidence interval, upper bound	43.4%	42.5%	42.6%	42.1%
Difference relative WLE male/female	10.7%	13.3%	12.7%	13.3%

Table A14: Remaining life expectancy at age 50, working life expectancy at age 50, and proportion of remaining life expectancy spent working; blacks, high school degree;

	1995	2000	2005	2010
Black females, high school degree				
Life expectancy at age 50	29.6	30.1	30.0	31.4
Working life expectancy at age 50	11.3	10.2	11.0	10.0
95% confidence interval, lower bound	9.9	8.7	9.7	8.6
95% confidence interval, upper bound	12.9	11.7	12.5	11.6
% of life expectancy spent working	38.2%	33.7%	36.8%	31.9%
95% confidence interval, lower bound	33.3%	28.8%	32.0%	27.7%
95% confidence interval, upper bound	43.7%	38.9%	41.9%	36.7%
Black males, high school degree				
Life expectancy at age 50	22.8	23.7	24.9	28.8
Working life expectancy at age 50	11.1	9.3	11.5	8.5
95% confidence interval, lower bound	9.4	7.6	9.3	6.8
95% confidence interval, upper bound	12.7	11.1	13.6	10.4
% of life expectancy spent working	48.6%	39.3%	46.3%	29.6%
95% confidence interval, lower bound	42.2%	32.2%	38.2%	23.9%
95% confidence interval, upper bound	55.7%	46.8%	54.3%	36.5%
Difference relative WLE male/female	10.4%	5.5%	9.5%	-2.3%

Table A15: Remaining life expectancy at age 50, working life expectancy at age 50, and proportion of remaining life expectancy spent working; blacks, college degree;

	1995	2000	2005	2010
Black females, college degree				
Life expectancy at age 50	27.7	28.3	31.5	33.1
Working life expectancy at age 50	13.4	11.3	13.9	10.6
95% confidence interval, lower bound	10.4	8.8	11.0	8.7
95% confidence interval, upper bound	16.5	14.1	17.0	12.6
% of life expectancy spent working	48.1%	40.1%	44.1%	31.9%
95% confidence interval, lower bound	37.9%	31.4%	35.4%	26.5%
95% confidence interval, upper bound	58.7%	50.9%	54.5%	38.9%
Black males, college degree				
Life expectancy at age 50	22.3	28.5	29.9	30.0
Working life expectancy at age 50	14.8	9.1	19.2	17.3
95% confidence interval, lower bound	10.3	6.3	15.4	13.0
95% confidence interval, upper bound	20.8	12.7	22.6	21.4
% of life expectancy spent working	66.5%	31.7%	64.2%	57.8%
95% confidence interval, lower bound	48.8%	22.3%	53.5%	45.0%
95% confidence interval, upper bound	84.4%	46.4%	74.1%	70.2%
Difference relative WLE male/female	18.4%	-8.4%	20.1%	26.0%

Table A16: Remaining life expectancy at age 50, working life expectancy at age 50, and proportion of remaining life expectancy spent working; Hispanics, no degree;

	1995	2000	2005	2010
Hispanic females, no degree				
Life expectancy at age 50	33.4	32.5	33.5	33.3
Working life expectancy at age 50	7.3	5.9	5.6	7.5
95% confidence interval, lower bound	5.9	4.5	4.3	5.4
95% confidence interval, upper bound	9.1	7.3	7.1	9.8
% of life expectancy spent working	21.9%	18.1%	16.8%	22.4%
95% confidence interval, lower bound	17.7%	13.9%	12.8%	16.3%
95% confidence interval, upper bound	27.6%	22.8%	21.1%	29.2%
Hispanic males, no degree				
Life expectancy at age 50	28.1	29.4	31.7	31.3
Working life expectancy at age 50	10.4	10.9	10.6	9.0
95% confidence interval, lower bound	8.6	9.1	8.6	6.7
95% confidence interval, upper bound	12.2	12.7	12.7	11.5
% of life expectancy spent working	36.9%	37.1%	33.6%	28.7%
95% confidence interval, lower bound	30.2%	31.2%	27.5%	21.3%
95% confidence interval, upper bound	43.3%	44.1%	40.8%	37.3%
Difference relative WLE male/female	15.0%	19.0%	16.8%	6.3%

Table A17: Remaining life expectancy at age 50, working life expectancy at age 50, and proportion of remaining life expectancy spent working; Hispanics, high school degree;

	1995	2000	2005	2010
Hispanic females, high school degree				
Life expectancy at age 50	32.7	37.4	37.3	37.5
Working life expectancy at age 50	11.5	9.7	11.8	11.5
95% confidence interval, lower bound	9.4	7.6	9.3	9.2
95% confidence interval, upper bound	14.2	12.1	14.5	13.9
% of life expectancy spent working	35.1%	26.1%	31.8%	30.6%
95% confidence interval, lower bound	28.0%	20.5%	25.1%	24.5%
95% confidence interval, upper bound	44.2%	32.6%	39.5%	37.8%
Hispanic males, high school degree				
Life expectancy at age 50	30.2	30.3	30.9	31.5
Working life expectancy at age 50	12.7	12.8	13.6	10.7
95% confidence interval, lower bound	10.2	9.4	11.4	8.1
95% confidence interval, upper bound	15.2	16.2	16.3	13.9
% of life expectancy spent working	41.9%	42.1%	44.0%	33.9%
95% confidence interval, lower bound	33.7%	30.3%	36.5%	25.0%
95% confidence interval, upper bound	51.5%	53.8%	52.3%	43.5%
Difference relative WLE male/female	6.8%	16.1%	12.2%	3.3%

Table A18: Remaining life expectancy at age 50, working life expectancy at age 50, and proportion of remaining life expectancy spent working; Hispanics, college degree;

	1995	2000	2005	2010
Hispanic females, college degree				
Life expectancy at age 50	34.0	29.5	34.1	41.0
Working life expectancy at age 50	10.3	14.1	10.7	12.9
95% confidence interval, lower bound	8.0	9.8	7.7	9.3
95% confidence interval, upper bound	13.8	19.2	14.7	17.9
% of life expectancy spent working	30.5%	47.9%	31.5%	31.5%
95% confidence interval, lower bound	22.4%	29.1%	21.3%	22.6%
95% confidence interval, upper bound	44.2%	63.9%	45.1%	44.4%
Hispanic males, college degree				
Life expectancy at age 50	31.1	34.3	29.1	31.6
Working life expectancy at age 50	15.7	17.5	19.2	13.8
95% confidence interval, lower bound	11.7	13.5	15.4	11.5
95% confidence interval, upper bound	20.5	21.6	22.9	17.5
% of life expectancy spent working	50.4%	51.1%	65.9%	43.7%
95% confidence interval, lower bound	36.3%	38.6%	51.2%	34.1%
95% confidence interval, upper bound	66.7%	65.3%	78.7%	58.8%
Difference relative WLE male/female	19.9%	3.1%	34.4%	12.2%

Table A19: Mean age at first retirement, mean age at final retirement, and difference between age at first and at final retirement; whites by sex and education

	1995	2000	2005	2010
No degree, white females				
Age at first retirement	63.3	62.4	62.9	62.7
Age at final retirement	69.7	68.0	68.8	68.9
Retirement timing gap	6.4	5.7	6.0	6.2
95% confidence interval, lower bound	5.6	4.9	5.3	5.4
95% confidence interval, upper bound	7.2	6.3	6.7	7.1
No degree, white males				
Age at first retirement	62.8	62.5	62.5	61.9
Age at final retirement	68.4	68.4	68.5	67.9
Retirement timing gap	5.7	5.8	6.0	6.1
95% confidence interval, lower bound	5.1	5.3	5.3	5.2
95% confidence interval, upper bound	6.3	6.4	6.7	7.0
Difference in RTG male/female	-0.7	0.2	-0.0	-0.1
High school, white females				
Age at first retirement	63.7	63.4	64.1	63.7
Age at final retirement	69.1	68.5	69.7	69.3
Retirement timing gap	5.3	5.2	5.6	5.6
95% confidence interval, lower bound	5.0	4.8	5.2	5.2
95% confidence interval, upper bound	5.7	5.5	5.9	6.0
High school, white males				
Age at first retirement	63.4	62.8	63.2	63.2
Age at final retirement	68.3	67.9	68.7	69.2
Retirement timing gap	4.9	5.2	5.5	6.0
95% confidence interval, lower bound	4.6	4.8	5.1	5.5
95% confidence interval, upper bound	5.3	5.5	5.9	6.4
Difference in RTG male/female	-0.4	0.0	-0.1	0.4
College, white females				
Age at first retirement	63.8	63.8	65.3	64.5
Age at final retirement	68.7	68.7	70.8	69.9
Retirement timing gap	4.9	4.9	5.6	5.4
95% confidence interval, lower bound	4.3	4.3	5.0	4.9
95% confidence interval, upper bound	5.5	5.4	6.1	6.0
College, white males				
Age at first retirement	65.2	64.0	66.2	64.5
Age at final retirement	70.2	69.3	72.0	70.8
Retirement timing gap	5.1	5.4	5.8	6.3
95% confidence interval, lower bound	4.6	5.0	5.3	5.8
95% confidence interval, upper bound	5.5	5.8	6.2	6.8
Difference in RTG male/female	0.1	0.5	0.2	0.9

Table A20: Mean age at first retirement, mean age at final retirement, and difference between age at first and at final retirement; blacks by sex and education

	1995	2000	2005	2010
No degree, black females				
Age at first retirement	61.9	62.2	63.1	63.0
Age at final retirement	67.5	68.1	70.1	70.0
Retirement timing gap	5.6	5.9	7.1	7.1
95% confidence interval, lower bound	4.5	4.9	5.8	5.7
95% confidence interval, upper bound	6.7	7.0	8.2	8.5
No degree, black males				
Age at first retirement	61.3	61.9	62.2	62.0
Age at final retirement	66.3	67.2	67.6	67.0
Retirement timing gap	5.0	5.3	5.4	5.0
95% confidence interval, lower bound	3.9	4.3	4.4	4.0
95% confidence interval, upper bound	6.1	6.3	6.5	6.3
Difference in RTG male/female	-0.6	-0.7	-1.7	-2.1
High school, black females				
Age at first retirement	62.8	62.3	63.2	63.1
Age at final retirement	68.8	68.3	69.8	70.0
Retirement timing gap	6.0	6.0	6.6	6.9
95% confidence interval, lower bound	5.1	5.1	5.5	5.7
95% confidence interval, upper bound	6.8	6.8	7.4	8.0
High school, black males				
Age at first retirement	61.9	61.7	62.8	61.2
Age at final retirement	67.1	67.2	68.7	67.4
Retirement timing gap	5.2	5.5	6.0	6.3
95% confidence interval, lower bound	4.1	4.5	4.9	5.1
95% confidence interval, upper bound	6.2	6.6	7.0	7.5
Difference in RTG male/female	-0.8	-0.5	-0.6	-0.6
College, black females				
Age at first retirement	62.7	61.7	63.8	60.7
Age at final retirement	67.9	67.1	70.5	66.3
Retirement timing gap	5.3	5.3	6.8	5.6
95% confidence interval, lower bound	4.1	4.1	5.3	4.4
95% confidence interval, upper bound	6.4	6.5	8.2	6.8
College, black males				
Age at first retirement	63.9	60.1	66.1	65.3
Age at final retirement	68.2	65.5	72.2	71.8
Retirement timing gap	4.3	5.3	6.1	6.5
95% confidence interval, lower bound	2.7	3.5	4.4	4.9
95% confidence interval, upper bound	5.7	7.2	7.7	8.1
Difference in RTG male/female	-0.9	0.0	-0.7	1.0

Table A21: Mean age at first retirement, mean age at final retirement, and difference between age at first and at final retirement; Hispanics by sex and education

	1995	2000	2005	2010
No degree, Hispanic females				
Age at first retirement	63.8	63.3	63.0	63.8
Age at final retirement	68.5	67.5	66.7	68.3
Retirement timing gap	4.6	4.2	3.8	4.5
95% confidence interval, lower bound	3.1	2.8	2.4	3.3
95% confidence interval, upper bound	6.2	5.5	5.1	5.8
No degree, Hispanic males				
Age at first retirement	63.9	64.4	64.6	64.0
Age at final retirement	68.1	69.0	69.7	69.0
Retirement timing gap	4.2	4.6	5.1	5.0
95% confidence interval, lower bound	3.1	3.6	4.0	3.9
95% confidence interval, upper bound	5.1	5.5	5.9	5.9
Difference in RTG male/female	-0.5	0.5	1.3	0.5
High school, Hispanic females				
Age at first retirement	64.0	63.4	64.1	63.7
Age at final retirement	67.6	67.3	67.9	67.2
Retirement timing gap	3.5	3.8	3.8	3.5
95% confidence interval, lower bound	2.3	2.4	2.6	2.3
95% confidence interval, upper bound	4.9	5.1	5.0	4.7
High school, Hispanic males				
Age at first retirement	62.9	63.5	63.7	63.6
Age at final retirement	68.3	69.4	69.4	70.4
Retirement timing gap	5.4	5.9	5.7	6.7
95% confidence interval, lower bound	4.1	4.3	4.2	5.2
95% confidence interval, upper bound	6.8	7.3	7.1	8.1
Difference in RTG male/female	1.9	2.1	1.9	3.2
College, Hispanic females				
Age at first retirement	61.5	65.7	63.9	64.3
Age at final retirement	63.6	68.2	66.8	67.1
Retirement timing gap	2.2	2.5	2.9	2.8
95% confidence interval, lower bound	1.3	1.5	1.7	1.7
95% confidence interval, upper bound	4.2	5.3	5.5	6.2
College, Hispanic males				
Age at first retirement	64.9	67.7	68.9	64.3
Age at final retirement	68.3	72.6	73.0	68.1
Retirement timing gap	3.4	4.9	4.1	3.8
95% confidence interval, lower bound	1.9	3.0	2.5	2.7
95% confidence interval, upper bound	5.5	7.3	6.3	6.1
Difference in RTG male/female	1.2	2.4	1.2	0.9

Table A22: Decomposition of life expectancy into working life expectancy, life expectancy in retirement, and life expectancy out of the labor force; whites by sex and education

	1995	2000	2005	2010
No degree, white females				
Working life expectancy	8.5	6.3	6.8	6.4
Life expectancy in retirement	15.4	16.0	14.5	16.7
Life expectancy out of the labor force	6.5	7.4	7.4	7.7
No degree, white males				
Working life expectancy	11.7	10.8	10.2	8.1
Life expectancy in retirement	10.7	11.4	11.3	12.4
Life expectancy out of the labor force	2.9	3.4	3.9	5.2
High school, white females				
Working life expectancy	11.7	11.5	12.3	11.6
Life expectancy in retirement	16.0	17.1	16.6	17.8
Life expectancy out of the labor force	3.7	3.5	3.6	3.9
High school, white males				
Working life expectancy	14.2	13.0	13.5	13.1
Life expectancy in retirement	11.0	12.8	12.8	13.8
Life expectancy out of the labor force	1.4	1.8	1.9	2.4
College, white females				
Working life expectancy	13.5	13.7	15.6	14.4
Life expectancy in retirement	17.1	17.5	16.9	18.2
Life expectancy out of the labor force	2.1	1.9	2.0	2.1
College, white males				
Working life expectancy	17.6	15.7	19.1	16.1
Life expectancy in retirement	10.5	13.5	11.3	14.6
Life expectancy out of the labor force	0.5	1.0	0.7	1.4

Table A23: Decomposition of life expectancy into working life expectancy, life expectancy in retirement, and life expectancy out of the labor force; blacks by sex and education

	1995	2000	2005	2010
No degree, black females				
Working life expectancy	7.1	6.2	5.9	5.9
Life expectancy in retirement	12.9	13.6	13.7	14.9
Life expectancy out of the labor force	6.4	7.6	8.8	8.8
No degree, black males				
Working life expectancy	8.5	8.3	7.7	7.5
Life expectancy in retirement	10.2	10.0	9.6	9.5
Life expectancy out of the labor force	4.0	4.8	5.6	5.6
High school, black females				
Working life expectancy	11.3	10.2	11.0	10.0
Life expectancy in retirement	14.7	15.9	14.7	16.2
Life expectancy out of the labor force	3.6	4.1	4.2	5.2
High school, black males				
Working life expectancy	11.1	9.3	11.5	8.5
Life expectancy in retirement	9.3	10.4	10.1	15.7
Life expectancy out of the labor force	2.5	4.0	3.3	4.6
College, black females				
Working life expectancy	13.4	11.3	13.9	10.6
Life expectancy in retirement	12.9	14.6	15.0	20.6
Life expectancy out of the labor force	1.5	2.4	2.6	1.9
College, black males				
Working life expectancy	14.8	9.1	19.2	17.3
Life expectancy in retirement	6.9	17.1	10.2	11.0
Life expectancy out of the labor force	0.6	2.4	0.5	1.6

Table A24: Decomposition of life expectancy into working life expectancy, life expectancy in retirement, and life expectancy out of the labor force; Hispanics by sex and education

	1995	2000	2005	2010
No degree, Hispanic females				
Working life expectancy	7.3	5.9	5.6	7.5
Life expectancy in retirement	18.5	18.2	19.5	18.4
Life expectancy out of the labor force	7.6	8.4	8.3	7.4
No degree, Hispanic males				
Working life expectancy	10.4	10.9	10.6	9.0
Life expectancy in retirement	13.6	13.9	16.0	16.3
Life expectancy out of the labor force	4.2	4.5	5.1	6.0
High school, Hispanic females				
Working life expectancy	11.5	9.7	11.8	11.5
Life expectancy in retirement	17.5	22.8	22.0	22.7
Life expectancy out of the labor force	3.6	4.8	3.5	3.3
High school, Hispanic males				
Working life expectancy	12.7	12.8	13.6	10.7
Life expectancy in retirement	15.3	14.8	15.3	15.8
Life expectancy out of the labor force	2.3	2.7	2.0	5.0
College, Hispanic females				
Working life expectancy	10.3	14.1	10.7	12.9
Life expectancy in retirement	22.0	13.2	19.4	25.7
Life expectancy out of the labor force	1.6	2.1	4.0	2.4
College, Hispanic males				
Working life expectancy	15.7	17.5	19.2	13.8
Life expectancy in retirement	14.8	15.4	8.9	16.1
Life expectancy out of the labor force	0.6	1.4	1.0	1.6