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Working Life Expectancy at Age 50 in the United States and the Impact of the Great Recession

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Abstract A key concern about population aging is the decline in the size of the economically active population. Working longer is a potential remedy. However, little is known about the length of working life and how it relates to macroeconomic conditions. We use the U.S. Health and Retirement Study for 1992–2011 and multistate life tables to analyze working life expectancy at age 50 and study the impact of the Great Recession in 2007–2009. Despite declines of one to two years following the recession, in 2008–2011, American men aged 50 still spent 13 years, or two-fifths of their remaining life, working; American women of the same age spent 11 years, or one-third of their remaining life, in employment. Although educational differences in working life expectancy have been stable since the mid-1990s, racial differences started changing after the onset of the Great Recession. Our results show that although Americans generally work longer than people in other countries, considerable subpopulation heterogeneity exists. We also find that the time trends are fluctuating, which may prove troublesome as the population ages. Policies targeting the weakest performing groups may be needed to increase the total population trends.

Keywords Working life expectancy · Health and Retirement Study · Great Recession · Multistate life table

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Introduction

Population aging is one of the major global challenges of the twenty-first century. In the coming decades, the number of people aged 65 and older will grow substantially in the vast majority of countries (United Nations 2015). The U.S. Census Bureau predicts an increase in the proportion of the population aged 65 and older, from 15 % in 2014 to 24 % in 2060 (Colby and Ortman 2015). The main concerns that arise in discussions about population aging in the United States and elsewhere are related to the long-term sustainability of social security systems because the proportion of the population who remain economically active is projected to decrease. Yet, because the length of working life is of critical importance to the long-term sustainability of these systems, policies aimed at encouraging people to work longer are being implemented. In the United States, the Social Security retirement age has been increased from age 65 to 66 for individuals born in 1943–1954, and it will increase further for cohorts born in 1955 and later (Behagel and Blau 2012).

However, in addition to policies, macroeconomic conditions likely play a key role in determining how long people work. In 2007–2009, the United States was hit by the Great Recession, the most severe economic downturn the country had experienced since World War II (Goodman and Mance 2011). In the years following that recession, the unemployment rate more than doubled, from 4.6 % in 2007 to 9.6 % in 2010 (U.S. Bureau of Labor Statistics 2016). Although this shock likely had an impact on the average length of working life in the United States, both the direction and magnitude of the effects are unknown given the evidence of trends toward both decreasing employment and postponed retirement. Moreover, nothing is known about the heterogeneity of the effects of the Great Recession on the average length of working life across subpopulations with varying degrees of attachment to the labor market and vulnerability to labor market fluctuations.

Most research on the length of working life in the United States, or working life expectancy (WLE), has focused on a single period (see Skoog and Ciecka 2009 for an overview of some of the literature). An exception is Skoog and Ciecka (2010), who analyzed data from the Current Population Survey (CPS). They found that between 1970 and 2003, WLE measured at age 20 changed little among men but increased somewhat among women. Differences in WLE by gender, race/ethnicity, and education have received more attention in the literature than the overall trends. Generally, males have a higher WLE than females (e.g., Warner et al. 2010). Using period working life tables, Smith (1986) found that the differences between whites and nonwhites are relatively small among women and are larger among men. Applying a similar methodology in their analysis of 1990–2000 CPS data, Millimet et al. (2003) came to the same conclusion, noting that the differences between white and nonwhite males diminish with age. Hayward and Grady (1990) used cohort data to compare black and nonblack males, finding only a small gap in WLE, whereas the difference between white and black males reported by Hayward et al. (1996) is relatively large. Several of these studies have also uncovered differences that suggest that people who are better educated work longer than people with less education (Hayward and Grady 1990; Millimet et al. 2003; Smith 1986).

In this study, we use 20 years of data from the Health and Retirement Study (HRS) to calculate period working life tables for five-year intervals. We use these tables to analyze recent developments in WLE at age 50 in the United States, with a focus on the

changes in WLE following the Great Recession. As the previous literature has observed that WLE levels differ considerably across subpopulations defined by sex, education, and race/ethnicity, we provide detailed results on the trends among these populations. Moreover, we present a methodology that allows us to match our period working life tables with external life tables. Our study contributes to the literature in several ways. First, the topic of how economic downturns affect WLE has received little attention. Second, we present findings for whites, blacks, and Hispanics; by contrast, most studies have compared whites and nonwhites. Moreover, we assess the interaction of race/ethnicity and education. Third, unlike in the previous literature, our approach to matching the period working life tables with external life tables does not assume constant mortality across labor force states and educational levels.

Analyzing trends in WLE might yield valuable insights, especially in the context of the 2007–2009 recession. Expectations regarding the impact of the Great Recession on older age groups are not clear-cut, and the overall effect of the drastic increase in unemployment mentioned earlier is uncertain. Engemann and Wall (2009) reported that employment increased when measured by the number of workers aged 55 and older, but both Farber (2011) and Cahill et al. (2015) found sharp increases in the unemployment rates of older workers. Moreover, Coile and Levine (2011) found that during the recession, unemployed workers had a higher probability of retiring than employed workers. On the other hand, Hurd and Rohwedder (2010) presented findings suggesting that the recession may have led to the postponement of retirement because of the negative effects of the downturn on wealth—especially on home equity (also see Ondrich and Falevich 2016). Thus, the net impact of the recession on WLE at older ages remains unclear, and it is hard to predict whether the crisis has led to an increase or a decrease in WLE.

Although the overall impact of the recession on older individuals is uncertain, the effects can be expected to differ by gender, education, and race/ethnicity. Research on the impact of the recession on (un)employment across the population has reached a general consensus that men were more affected than women, the less-educated were more affected than the better-educated, and whites were less affected than blacks (Engemann and Wall 2009). Given that males had a higher WLE than females before the crisis, we might expect to find that the gap between men and women narrowed. In contrast, evidence suggests that the educational differences in WLE levels may have intensified: the less-educated were more vulnerable to unemployment than the better-educated (Coile and Levine 2011). The effects of the recession by race/ethnicity are more difficult to gauge. First, as the literature on the recession has uncovered gender differences in the impact of the recession by race/ethnicity, it is clear that different variables cannot simply be summed (also see Browne and Misra 2003). For example, it appears that male Hispanics were hit hard by the recession, while female Hispanics were affected little (Engemann and Wall 2009). Second, most previous studies on WLE focused on the differences between whites and nonwhites, while disregarding the heterogeneity of minority groups. An exception is the study by Hayward et al. (1996), who found that white males have a higher WLE than black males. Given that whites were seemingly less affected by the recession than blacks (Engemann and Wall 2009), WLE might have decreased less for whites, potentially making the gap in WLE bigger.

To the best of our knowledge, no previous study has analyzed WLE by education within racial/ethnic groups. The results of prior research suggest that the educational

gradient in mortality at working ages (Jemal et al. 2008) and older ages (Meara et al. 2008) is strongly dependent on the racial/ethnic group analyzed, with black men having the steepest mortality gradient, and Hispanic men and women having a relatively flat mortality gradient. The association between education and the probability of being employed has also been shown to vary greatly by race/ethnicity. For example, the employment rate gradient by education has been found to be steepest among blacks and flattest among Hispanics (U.S. Bureau of Labor Statistics 2015). These findings suggest that the educational differences in WLE differ markedly by racial/ethnic group. How this intersection of education and race/ethnicity was affected by the recession is hard to assess, especially given its differential impact by gender and by race/ethnicity.

Data and Methods

Data

The Health and Retirement Study (HRS) is a panel study that has been conducted since 1992, focusing on Americans aged 50 or older (Juster and Suzman 1995). The survey 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 (NIA) and the Social Security Administration (SSA).

The interviews are conducted approximately every two years. In the interviews, several questions capture the labor force state at the time of the interview. Moreover, retrospective questions cover the time between two consecutive interviews. The year of death is obtained from either interviews with relatives or from the National Death Index. In addition to respondents aged 50 or older, their spouses and partners are also interviewed. We include them in our analyses if they were aged 50 or older.

We measure employment based on self-reported labor force state. We distinguish between three states: "employed," "retired," and "out of the labor force (but not retired) or unemployed." Respondents who report that they are working or are on leave (e.g., sick leave) are classified as employed. Respondents classified as retired are those who (1) report that they are retired, or (2) report that they are out of the labor force or unemployed and are over age 70. The latter case does not occur often: after age 70, few respondents report being out of the labor force or being unemployed. Similar to Warner et al. (2010), we classify individuals who reported to be disabled as retired when they reach full retirement age, which depends on the birth cohort. Finally, the last category of unemployed or out of the labor force comprises nonretired individuals younger than age 70 or full retirement age who report that they are unemployed, disabled, a homemaker, or doing something other than working. Although this last group is heterogeneous, this diversity is acceptable because our focus is on WLE.

We construct a working history for each respondent, focusing on annual transitions. To achieve this, we exploit the fact that labor force state is recorded to the nearest month. We use the status in the month of December to define the individual's labor force state. For example, if a respondent was employed in December 1996 and retired in December 1997, we use the state employed for 1996 and the state retired for 1997. A detailed description of the constructed working histories is given in Dudel (2016).

Race/ethnicity is assigned based on two questions. All respondents who identify as Hispanic are classified accordingly. Respondents who do not identify as Hispanic are assigned a race/ethnicity based on another set of questions in which they are asked whether they primarily identify as white, black, American Indian/Alaskan Native, Asian/Pacific Islander, or something else. The latter three groups are subsumed in the category "other." Because the number of respondents in this category is rather small, no analysis was conducted for this group. Educational status is measured using the highest degree the respondent obtained and is broken down into the following categories: no degree (i.e. some high school but no diploma, or less); a high school diploma or GED; and a college or university degree. This roughly corresponds to the educational levels analyzed by Skoog and Ciecka (2001) and Krueger (2004), except that we do not further break down college/university education because this is a relatively small group in the cohorts that we consider.

Modeling Approach

We use Markov models to model the transitions between labor force states (Hoem 1977; Skoog and Ciecka 2010). The starting point is transition probabilities $p(i|x, j)$, which give the probability that an individual aged x and in labor force state j will be in state i at age $x + 1$. Our state space consists of the transient labor force states "employed," "retired," and "out of the labor force or unemployed"; and of the absorbing state "dead." The starting age is 50, and the maximum age is age 99, whereby those individuals who are still alive die with a probability of 1. We assume for individuals aged 70 and older that they are either employed or retired, and that the state "out of the labor force or unemployed" is no longer relevant. Figure 1 depicts the state space ignoring age.

Transition probabilities are used to construct period working life tables, assuming that transitions occur mid-interval. Period working life tables are calculated for the years 1993–1997, 1998–2002, 2003–2007, and 2008–2011. For each period, the results are differentiated by gender; by gender and race/ethnicity; by gender and education; and by gender, race/ethnicity, and education jointly. We use weighting to obtain working life expectancies without conditioning on the initial state. More formally, if $\mathrm{WLE}(x, j)$ denotes the WLE for individuals aged x and in state j, the WLE by age, $\mathrm{WLE}(x)$, can be calculated as $\mathrm{WLE}(x) = \Sigma_j \mathrm{WLE}(x, j) w_j(x)$, where $w_j(x)$ denotes some weight for age x and state j. We use weights for age 50 only, and otherwise report the results by age and state otherwise. Weights $w_j(50)$ were calculated from the empirical distribution of labor force states at ages 45–54 in all years by gender; gender and race/ethnicity; gender and education; or gender, race/ethnicity, and education. We combined the ages 45–54 and all years to increase the sample size for the initial distributions. The weights are time-constant so that differences between results by period are not due to differences in the distribution of states.

Estimation of Transition Probabilities

To estimate transition probabilities, we use multinomial logistic regression (Allison 1982; Greene 2012). This entails estimation of three logistic regression equations: one for survival, one for transitions to inactivity, and one for

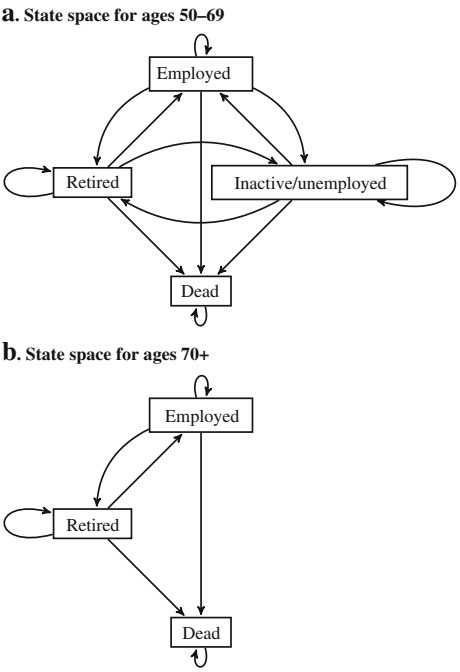

Fig. 1 State space of the Markov model for ages 50 to 69 (panel **a**) and state space of the Markov model for ages 70+ (panel **b**)

transitions to retirement (see Online Resource 1 for coefficients). Because transition probabilities sum to 1, no regression for transitions to employment needs to be estimated. Taken together, the three regressions essentially model the state at time $t + 1$ as the dependent variable. We use the state at time t as one of the explanatory variables, as well as age recorded to the nearest month, which comes close to exact age. Age is modeled using a smoothing spline (Debón et al. 2006; Yee and Wild 1996). In addition, dummy variables were included to capture discontinuities in the age schedules (Behagel and Blau 2012): two dummy variables were used to capture peaks in retirement at ages 65 and 66, respectively; another dummy variable covers ages 62 to 64; and a fourth dummy variable covers ages of 67 and older. Education was used as an explanatory variable as well as interactions of education and period. Estimates by gender and by gender and race/ethnicity are achieved by stratifying the sample into subsamples (e.g., Hispanic females). This also introduces implicit interactions of gender and race/ethnicity with all other variables.

The HRS includes the states of respondents in each December from 1992 to 2011. Because the HRS interviews are usually conducted midyear, the state in December 2012 is not observed for most observations and is thus dropped from the analysis. December 1992–December 1996 is used as the reference period and corresponds to transitions in the 1993–1997 period. Three dummy variables were included that correspond to the 1998–2002, 2003–2007, and 2008–2011 periods, respectively. The 1998–2002 period includes the 2001 recession (Hall 2007), and the 2008–2011 period covers the most recent recession. This period starts with December 2007, which is usually seen as marking the beginning of the recession (Goodman and Mance 2011).

Correction of Mortality Estimates

In some cases, the survival probabilities estimated using the HRS are higher than those in the vital statistics. For example, for 2008–2011, the unadjusted (period) life expectancy of women aged 50 is 34.3 years, whereas the equivalent figure for 2010 reported by the Centers for Disease Control (CDC) is 33.2 years (Arias 2014). Although the direction of the difference is not unexpected, because poor health status may correlate with nonresponse, earlier studies using the HRS reported smaller differences (of less than one year; e.g., Warner et al. 2010). The larger difference that we find can be attributed to the annual data set we use, while data collection is approximately biennial. For example, assume that a respondent reported being retired in July 1998 at the time of interview and died in March 2000 before giving another interview. Because of this, the labor force states in December 1998 and December 1999 are not known, and the state in December 2000 is "dead." In this example, the transition to death cannot be included in the estimation of transition probabilities because the state before death and thus one of the explanatory variables in the multinomial logistic regression is unknown. In many cases, the missing labor force states can be recovered from exit interviews in which relatives provide information on the time before death since the last interview, but these interviews are not always possible or complete. Because the magnitude of the gap between our life expectancy estimates and CDC life tables is not negligible, we need to correct it before we can make population-level estimates of WLE. We do this by matching the survival probabilities of our period working life tables with the CDC period life tables. This adjustment affects our estimates of WLE only slightly, but it makes a relatively big difference for WLE relative to life expectancy.

Using external data on survival is common in the construction of period working life tables (Skoog and Ciecka 2010; Smith 1986). In contrast to earlier studies, in which it was assumed that survival does not vary by labor force state or education, we match life expectancy by gender and race/ethnicity with CDC life tables, allowing for variation by education and labor force state. The basic idea of the approach is that if survival probabilities by age, gender, and race are averaged over all labor force states and potentially educational level, they should equal survival probabilities obtained from the CDC. To achieve this, we first calculate these averages and compare them with the CDC life tables. These comparisons are used to calculate scaling factors, which are used to increase or decrease the survival estimates obtained from the HRS. A detailed explanation is given in Online Resource 1.

This procedure is applied to all working life tables. Figure 2 illustrates the educational gradient in survival for the period 2008–2011, obtained using the full HRS sample and after matching. Higher education is found to be associated with longer life among both men and women, with the exception of males in their early to mid-60s, for whom our results show no educational differences. This is caused by our mortality correction algorithm (see Online Resource 1). Given that mortality for these ages is low, it does not affect our main findings. Table B8 in Online Resource 1 shows the racial/ethnic survival gradient by level of education and over time. The results are consistent with those of prior literature, which showed racial/ethnic differences at each educational level and improving survival for all groups except for whites with low education (Brown et al. 2012; Hendi 2015; Sasson 2016).

Weighting and Resampling

For all calculations, we use the survey weights of the HRS at the respondent level, including spouses and partners (HRS 2001). Because weights are provided only for survey years—and not for the years between surveys—we use weights of survey year t for year $t + 1$ as well. For respondents who died, we use the weight of the last wave when the respondent was interviewed given that the weights supplied in the HRS are 0 for dead respondents. To estimate confidence intervals, we use a bootstrap approach (Skoog and Ciecka 2004). We apply a bootstrap procedure suggested by Cameron and Trivedi (2005) and resample individual working life trajectories, mimicking the complex sampling process of the HRS and accounting for both the cohort structure and oversampling in the HRS. We use 1,000 bootstrap replications to derive percentile bootstrap confidence intervals. Testing relies on 95 % confidence intervals of differences.

Results

Transitions and Transition Probabilities

Table 1 describes the data. We use data on 30,254 respondents. The number of transitions is 287,632. Two-thirds of the respondents are white, 17 % are black, and 9 % are Hispanic. Because only 348 males and 412 females fall in the category "other," no analyses were conducted for this group. Of the sample, roughly one-half have a high school education, approximately one-quarter have a college/university education, and

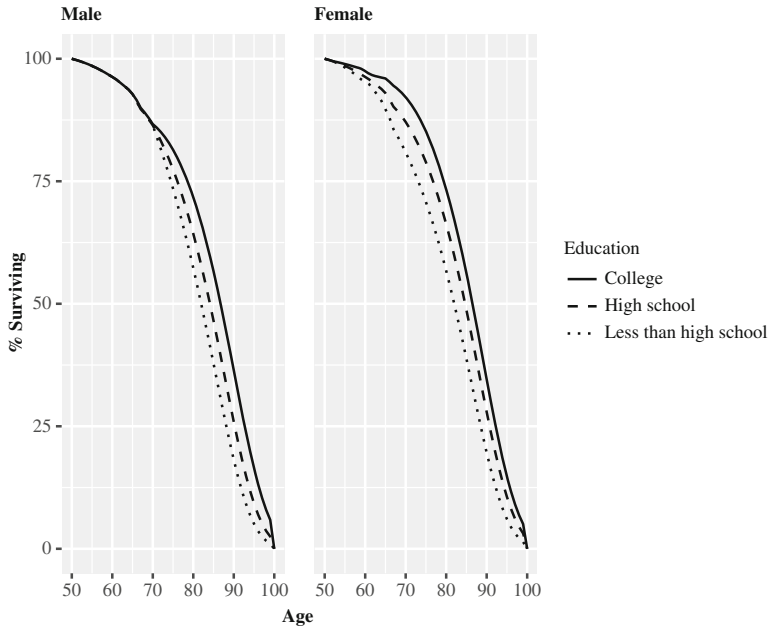

Fig. 2 Life table survivor functions by education and gender, 2008–2011. *Source:* Own calculations based on the Health and Retirement Study, years 1992–2012

Table 1 Number of observations and transitions by race/ethnicity and gender, education and gender, and by type of transition

	Respondents	%	Transitions	%
Male Race/Ethnicity				
White	9,632	32	94,949	33
Black	1,999	7	15,398	5
Hispanic	1,243	4	9,819	3
Other	348	1	2,578	1
Female Race/Ethnicity				
White	11,944	39	122,305	43
Black	3,064	10	25,757	9
Hispanic	1,612	5	13,598	5
Other	412	1	3,228	1
Total Race/Ethnicity	30,254	100	287,632	100
Male Education				
Less than high school diploma	3,512	12	31,158	11
High school/GED	6,319	21	59,059	21
College or higher	3,391	11	32,527	11
Female Education				
Less than high school diploma	4,605	15	42,980	15
High school/GED	9,039	30	90,968	32
College or higher	3,388	11	30,940	11
Total Education	30,254	100	287,632	100
Transition From Employed				
To employed	–		88,583	87
To retired	–		6,281	6
To out of labor force/unemployed	–		5,569	5
To dead	–		839	1
Total	–		101,272	100
Transition From Retired				
To employed	–		2,465	2
To retired	–		136,977	93
To out of labor force/unemployed	–		1,766	1
To dead	–		6,578	4
Total	–		147,786	100
Transition From Out of Labor Force				
To employed	–		3,755	10
To retired	–		5,550	14
To out of labor force/unemployed	–		28,627	74
To dead	–		642	2
Total	–		38,574	100

Source: Authors' own calculations based on the Health and Retirement Study, 1992–2012.

another one-quarter have less than a high school education. The distribution of the number of transitions by sex, race/ethnicity, and education closely matches the number of observations. The number of transitions by type of transition shows that most of the time, people retain the labor force state they reported the previous year. When this state changes, the individuals who had been employed or outside the labor force are most likely to retire (6 % and 14 % of the transitions, respectively), whereas those who had been retired are most likely to die (4 %). Importantly, however, significant shares of the individuals who are retired or are outside the labor force reenter employment (2 % and 10 % of the transitions, respectively), which demonstrates that retirement is not a straightforward transition (for transitions by gender, race/ethnicity, and education, see Online Resource 2).

Figure 3 gives an overview of the age schedule of selected transition probabilities by gender for the recession period 2008–2011 (see Online Resource 1 for figures showing transition probabilities by period). The left panel shows that the probability of staying employed was declining with age. Up to age 60, leaving employment mostly meant becoming either inactive or unemployed. Although older women had a lower level of labor force attachment and a higher probability of becoming inactive than men, their probability of becoming unemployed was lower than that of men during the Great Recession (Sahin et al. 2010), which may explain their lower levels of employment exits for this age group. Sharp declines in the probability of staying employed are observed among individuals aged 61–67, with the sharpest drop occurring at age 64; thus, a high proportion of the individuals who were employed at age 64 were out of employment at age 65.

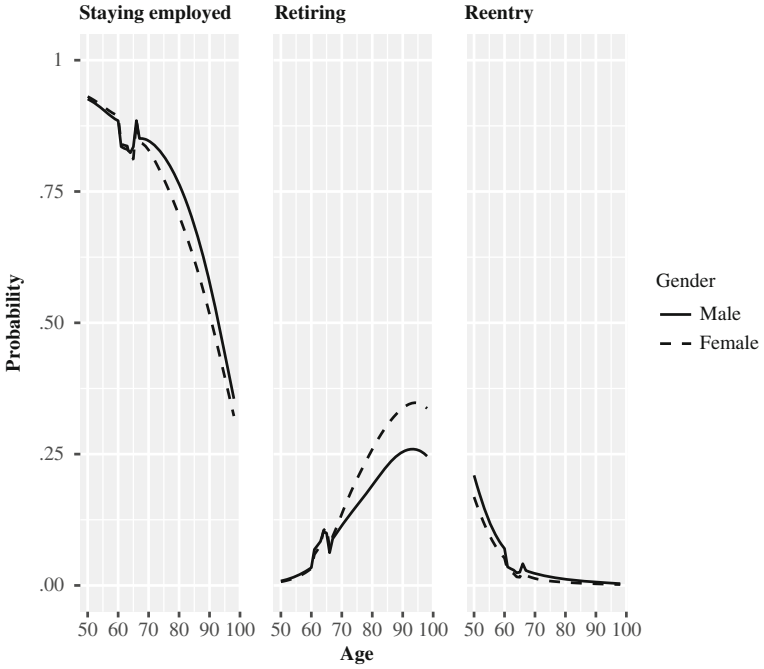

Fig. 3 Age-specific probabilities of staying employed, retiring, and reentry to the labor market for males and females; 2008–2011. *Source:* Own calculations based on the Health and Retirement Study, years 1992–2012

The high probability of exiting employment at age 64 was mirrored by the probability of transitioning to retirement (middle panel, Fig. 3), which peaked at age 64.[1] This result is in line with that of previous studies finding that people still commonly retire at age 65 (Behagel and Blau 2012; Coe et al. 2013). Among individuals older than age 70, the probability of staying employed declined sharply, but the probability of retiring increased steadily. In both cases, males exhibited higher labor force attachment than females.

The right panel of Fig. 3 shows the probability of returning to employment after retiring, which was high among relatively young retirees (Cahill et al. 2011) but declined with age, with a sharp drop occurring at age 65. This may be because large numbers of people retire at age 65, and newly retired individuals seldom reenter the work force immediately (Hayward et al. 1994).

Working Life Expectancy

Table 2 shows the WLE and the proportion of remaining life expectancy at age 50 that is spent working (relative WLE) by gender, race/ethnicity, and education. More detailed results, including estimates of remaining life expectancy, are given in Online Resource 1. Figures 4 and 5 (upcoming) illustrate the results by race/ethnicity and education, respectively.

In 1993–1997, the average WLE was 14.5 years for men and 11.4 years for women. These figures represent, respectively, 54.1 % and 36.5 % of the total remaining life expectancy. WLE fluctuated for both men and women over the observation period, decreasing by approximately one year in the period 1998–2002 and then bouncing back in the 2003–2007 period. In the 2008–2011 period, which captures the Great Recession, WLE for men decreased statistically significantly and fell below the levels observed in any other period, to 12.7 years; WLE for women declined less sharply and not statistically significantly, to 10.9 years. As total life expectancy increases for both men and women, the fraction of remaining life at age 50 that is spent working can decline without a proportional increase in WLE. Indeed, the fraction of remaining years spent working at age 50 decreased between 1993–1997 and 2008–2011 from 54.1 % to 42.9 % for men, and from 36.5 % to 33.0 % for women. The smaller decline for women may be attributed to the fact that the recession had a smaller impact on women than on men, and that remaining life expectancy at age 50 increased at a slower pace for females than for males. These patterns are similar for most educational and racial/ethnic groups, albeit at different levels of WLE.

Working Life Expectancy by Race/Ethnicity and Gender

Figure 4, clearly shows marked racial/ethnic differences in WLE. An overview of which comparisons are statistically significant at the 5 % level is given in Table 3. White males have the highest WLE across all observation periods, and Hispanic females have the lowest WLE in most periods.[2] The difference in WLE between these two groups is

[1] The probability of retiring was calculated by averaging the probabilities for employed individuals and individuals out of the labor force using weights, as described in the previous section.

[2] Results for Hispanics may be influenced by selective migration: individuals in poor health have a higher probability of returning to their country of origin than those in good health (Turra and Elo 2008).

Table 2 Working life expectancy and relative working life expectancy by gender; by race/ethnicity and gender; and by race/ethnicity, gender, and education

	WLE (in years)				Relative WLE (%)			
	1993–1997	1998–2002	2003–2007	2008–2011	1993–1997	1998–2002	2003–2007	2008–2011
Total Males	14.5	13.1	14.2	12.7	54.1	47.1	50.0	42.9
Total Females	11.4	10.6	11.4	10.9	36.5	33.3	35.5	33.0
White Males								
Total	15.1	13.5	14.8	13.2	53.5	46.6	49.5	42.6
Less than high school diploma	11.8	10.4	10.0	7.9	47.1	43.3	40.5	32.3
High school or GED	14.4	13.0	13.6	13.2	53.8	46.4	48.0	44.6
College or higher	17.9	15.8	19.4	16.3	62.5	51.6	61.0	49.3
White Females								
Total	11.8	11.1	12.0	11.3	36.1	33.1	35.3	32.9
Less than high school diploma	8.5	6.2	6.5	6.4	28.3	20.9	22.6	21.6
High school or GED	11.7	11.4	12.2	11.5	37.1	35.5	37.3	34.3
College or higher	13.6	13.8	15.6	14.4	40.9	40.5	45.3	40.2
Black Males								
Total	10.5	9.0	10.8	9.1	63.8	54.2	57.3	47.7
Less than high school diploma	8.5	8.3	7.6	7.5	37.2	35.6	33.5	32.5
High school or GED	10.9	9.2	11.5	8.2	48.2	40.2	45.2	28.5
College or higher	15.0	9.1	19.1	17.6	69.2	29.2	64.1	57.4
Black Females								
Total	10.3	9.0	9.6	8.8	40.6	36.6	38.4	35.2
Less than high school diploma	7.1	6.0	5.9	5.9	26.3	22.0	20.6	19.7
High school or GED	11.3	10.0	10.9	9.9	38.9	33.1	36.2	31.5
College or higher	13.3	11.2	13.8	10.3	47.3	39.5	43.8	31.5
Hispanic Males								
Total	12.2	12.5	12.8	10.3	49.5	43.3	45.8	40.3
Less than high school diploma	10.5	10.9	10.5	8.9	36.8	36.2	33.7	28.6
High school or GED	12.5	12.5	13.5	11.0	42.4	42.6	42.3	35.3
College or higher	16.1	17.0	19.4	14.3	51.4	50.1	66.5	43.9
Hispanic Females								
Total	9.1	7.8	7.9	9.2	34.3	31.2	32.9	31.0
Less than high school diploma	7.3	5.8	5.4	7.3	21.7	17.9	16.2	22.0
High school or GED	11.4	9.7	11.8	11.2	34.7	25.6	31.3	29.1
College or higher	10.2	14.1	10.7	12.9	34.4	46.1	31.4	32.7

Note: WLE = Working life expectancy.

Source: Authors' own calculations based on the Health and Retirement Study, 1992–2012.

up to 6.9 years, and the largest difference between white males and females is considerably smaller, at approximately 3.4 years. Black males and females have a low WLE, but the gender differences among blacks are not as strong as they are among whites and Hispanics, and—unlike among whites and Hispanics—

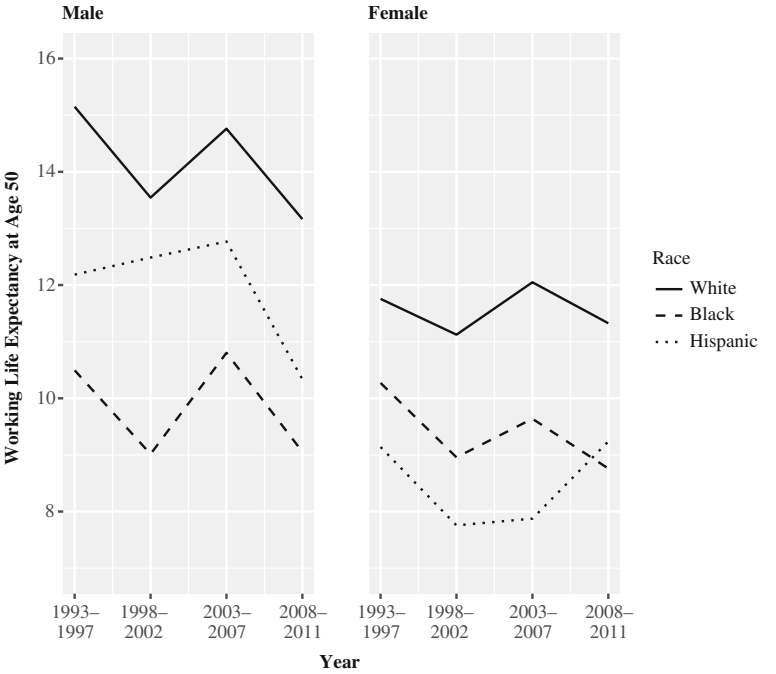

Fig. 4 Working life expectancy at age 50 by race/ethnicity and gender. *Source:* Own calculations based on the Health and Retirement Study, years 1992–2012

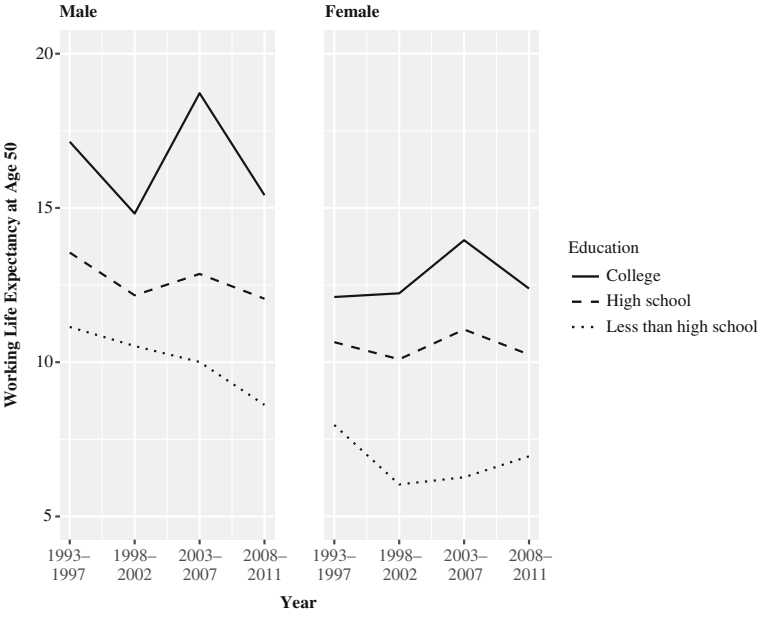

Fig. 5 Working life expectancy at age 50 by education and gender. *Source:* Own calculations based on the Health and Retirement Study, years 1992–2012

Table 3 Comparison of levels of working life expectancy by race/ethnicity and gender

	1993–1997	1998–2002	2003–2007	2008–2011
Male/Female				
White	*	*	*	*
Black				
Hispanic	*	*	*	
White/Black				
Male	*	*	*	*
Female	*	*	*	*
White/Hispanic				
Male	*		*	*
Female	*	*	*	*

Note: Comparisons for which the 95 % confidence intervals of WLEs do not overlap are marked with an asterisk.

Source: Authors' own calculations based on the Health and Retirement Study, 1992–2012.

the gender differences are not statistically significant. WLE is also significantly higher for white males than for black males. A similar pattern emerges for the differences between white males and Hispanic males, except for the period of 1998–2002. The differences in the level of WLE by race/ethnicity are always significant for females; however, controlling for education in addition to race/ethnicity, this is not the case (see the upcoming section, Working Life Expectancy by Race/Ethnicity, Gender, and Education).

For both white 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 both males and females. The decreases from 1993–1997 to 1998–2002, and in particular from 2003–2007 to 2008–2011, were smaller for females than for males (0.7 for females vs. 1.6 for males). These results are in line with findings that show that the recessions in 2001 and 2007–2009 had a more severe impact on males than on females (Wood 2014).

Although the results for blacks show patterns of increase and decrease similar to those of whites, the results for Hispanics show very different patterns. For Hispanic males, WLE increased by 0.3 years between 1993–1997 and 1998–2002, and by 0.3 years between 1998–2002 and 2003–2007; WLE, however, decreased statistically significantly by 2.4 years between 2003–2007 and 2008–2011. For Hispanic women, by contrast, WLE increased 1.4 years between 2003–2007 and 2008–2011, even as it decreased for all other groups. Moreover, the gender differences in WLE between 2003–2007 and 2008–2011 were statistically significant for Hispanics but not for whites and blacks. These results are consistent with the findings of Engemann and Wall (2009), who argued that the gender differences in the effects of the Great Recession have been more pronounced among Hispanics and that female Hispanics were not strongly affected.

Working Life Expectancy by Education and Gender

Figure 5 shows a clear educational gradient in WLE: individuals with a college or university degree have the highest WLE, while those with less than a high school diploma have the lowest WLE. All these differences are statistically significant at the 5 % level. For each educational level, males have a higher WLE than females. These differences are statistically significant except for the period 2008–2011, during which the gender gap was not significant for individuals with less than a high school diploma. Apart from these similarities, we see marked differences between educational groups. Although the gender gap in WLE has been closing for both individuals with high school education and individuals with less than a high school diploma, it has been highly volatile for individuals with a college/university degree.

Over the study period, WLE was volatile among individuals with college/university education, especially among males. For example, the WLE of males with a college degree increased by 3.9 years between 1998–2002 and 2003–2007, and decreased by 3.3 years thereafter; both changes are statistically significant. The changes were less pronounced for females with college education, a finding that further confirms the assumption that females have been less affected by the Great Recession than males (Wood 2014).

The changes in WLE among males and females with high school education roughly matched those among individuals with a college/university degree, but the fluctuations were not as pronounced. For instance, among males with high school diploma, WLE declined by just 0.8 years between 2003–2007 and 2008–2011. Although WLE among males with less than a high school diploma decreased steadily, the difference between 2003–2007 and 2008–2011 amounted to 1.4 years—a considerably smaller decline than that among males with a college education. WLE among females with less than a high school diploma actually increased by 0.7 years during this period. This result is quite remarkable given the general consensus that individuals with low levels of education have been more affected by the recent recession than others (Coile and Levine 2011; Engemann and Wall 2009). A potential explanation for this finding is the added worker effect: women with less than a high school diploma may have (re-)joined the labor force to compensate for a partner's job loss. Moreover, they may compensate for reductions in working hours and wages, which declined during the recession (OECD 2010).

Working Life Expectancy by Race/Ethnicity, Gender, and Education

The results that combine all three variables under study partly mirror our aforementioned findings. When interpreting results, keep in mind that some groups are rather small, especially for black males with a college/university degree (273 individuals), male and female Hispanics with a college/university degree (136 and 154 individuals, respectively), and male Hispanics with a high school diploma (413 individuals). All other groups have sample sizes of more than 500 individuals. Generally, whites had a higher WLE than blacks and Hispanics, and WLE increased with educational attainment.

However, there were also important differences in WLE by race/ethnicity and gender when conditioned on education (Table 4). For white and Hispanic males, the differences were of mixed signs and magnitudes. At the beginning of the observation period, there were relatively large differences between white and black males, with white males having a higher WLE at all educational levels; but by 2008–2011, the differences

between white and black males with a college education and those with less than a high school education had disappeared. The differences in WLE between whites and Hispanics also disappeared during the observation period. Because the sample size of blacks with a college degree is rather small, the results for this educational level should be viewed with care.

White females had a higher WLE than black or Hispanic females, irrespective of educational level or year; the differences, however, were often small and not significant, especially for those with less than a college degree. These findings are in line with the results of Millimet et al. (2003: table 5), which indicated that the differences between white and nonwhite women aged 50 were negligible when educational attainment was controlled for.

The Differential Contributions of Mortality and Employment to Differences in WLE

Differences in WLE are driven by differences in the likelihood of being and staying employed if alive, and in the probability of being alive. For some comparisons, the differences in mortality and in the probability of being employed reinforce each other; for other comparisons, they may work in the opposite direction. We therefore analyze for selected key contrasts the extent to which the observed differences are attributable to probabilities of employment and the extent to which they are attributable to mortality rates. In this analysis, we focus on the 2008–2011 period and on comparisons across subpopulations because within-population trends

Table 4 Differences in working life expectancy by educational attainment by gender and race/ethnicity

	1993–1997	1998–2002	2003–2007	2008–2011
White/Black Females				
Less than high school	1.4	0.1	0.6	0.5
High school/GED	0.4	1.3	1.3	1.6
College or higher	0.3	2.6	1.9	4.1*
White/Hispanic Females				
Less than high school	1.1	0.4	1.1	–0.8
High school/GED	0.3	1.7	0.4	0.2
College or higher	3.4	–0.4	5.0*	1.5
White/Black Males				
Less than high school	3.2*	2.1*	2.4	0.4
High school/GED	3.5*	3.9*	2.2	5.0*
College or higher	2.9	6.7*	0.3	–1.3
White/Hispanic Males				
Less than high school	1.3	–0.5	–0.4	–1.0
High school/GED	1.9	0.6	0.1	2.2
College or higher	1.9	–1.1	0.0	2.0

Source: Authors' own calculations based on the Health and Retirement Study, 1992–2012.

*$p < .05$

are almost exclusively driven by changes in labor force participation patterns, not by changes in mortality.

A description of the methodology and detailed results are given in Online Resource 1, and we summarize these findings here. In case of gender gaps by race/ethnicity, we find that the effects of higher life expectancy for females and higher employment rates for males cancel each other out to some degree for blacks and Hispanics. In contrast, the gender gap in WLE for whites can be largely explained with employment. Racial/ethnic differences by gender and educational differences by gender are also both strongly driven by differential employment rates. In case of the former, the contribution of mortality is low; for Hispanics, racial/ethnic differences by gender actually reduce the difference compared with whites. For educational differences by gender, the contribution of mortality is larger in absolute terms but is still considerably smaller than the contribution of employment and explains only a small proportion of the differences (approximately 20 %).

Discussion

Main Findings

Although working life expectancy (WLE) was rather volatile over the study period, our results suggest that the Great Recession has had a negative impact on the WLE of older males and, to a lesser extent, on the WLE of females. But despite one- to two-year declines in WLE, American men who have reached age 50 still spend 13 years, or more than two-fifths of their remaining life, working; and 50-year-old American women work 11 years, or one-third of their remaining life. Compared with the prerecession period, the gender gap in WLE has dropped from three to two years, in line with earlier analyses suggesting that women were less affected by the recession than men (Engemann and Wall 2009). Although adverse labor market conditions seem to have outweighed the incentives to stay in the labor force longer for the U.S. population as a whole, our findings also show considerable heterogeneity across subpopulations, both in trends and levels of WLE.

We found that variation in WLE by racial/ethnic groups is large. Over the 20-year observation period of 1992–2012, the WLE of men at age 50 was consistently between four and five years lower among blacks than among non-Hispanic whites, and this gap did not increase during the recession. Even though the gap did not increase, the recession hit black males harder than whites in relative terms, with decreases in WLE between 2003–2007 and 2008–2011 of 16 % and 11 %, respectively. This finding is in line with a study by Engemann and Wall (2009), who reported that whites were affected less by the recession than were blacks. Among Hispanics, WLE was between the WLE values of the other two groups. Among women, however, blacks had a WLE that was only approximately two years lower than that of non-Hispanic whites. In the 15 years prior to the Great Recession (1992–2007), black women also had higher WLE levels than Hispanic women. However, this difference was reversed in 2008–2011 as Hispanic women caught up with black women.

Racial/ethnic differences in WLE are mostly due to differences in transition probabilities (e.g., staying employed, returning to the labor market, retiring). The differences

between blacks and whites might be explained by the relative disadvantages of blacks and discrimination against blacks in the labor market (Altonji and Blank 1999; Pager 2009). Moreover, blacks are less healthy, on average, and have a higher risk of being disabled than whites, which is reflected in a lower active life expectancy (Hayward and Heron 1999). The finding that Hispanics have a lower WLE than non-Hispanic whites cannot be explained by health because Hispanics compare favorably with blacks and whites in terms of both health and life expectancy (Lariscy et al. 2015). Indeed, our decompositions suggest that mortality contributes negatively to (i.e., narrows) WLE differences between whites and Hispanics, and that the WLE difference is fully explained by lower levels of labor market attachment among the Hispanic population.

Of the groups studied, the Great Recession had the strongest negative impact on WLE among male Hispanics, whereas Hispanic females experienced an increase in WLE in 2008–2011. This differential impact by sex among Hispanics is consistent with Engemann and Wall's (2009) early analyses, which indicated that the decline in employment has been particularly small among Hispanic women. It is possible that as the labor force participation of female Hispanics had been relatively low, there was a large potential for the *added worker effect*, whereby inactive individuals enter the labor market when their partner becomes unemployed (Starr 2014).

Educational differences in WLE were found to be large and persistent. Among men in 2008–2011, those with a college/university education could expect to have 16 more working years, whereas those with less than a high school education could expect to have only 8 years. Among women, the difference was similar: 14 years for those with a college education versus 6 years for those with a high school education. The direction of the difference is not surprising given the well-known educational differences in labor market opportunities, health (Crimmins and Saito 2001; Dupre 2008), and life expectancy (Montez et al. 2011; Olshansky et al. 2012). However, our decompositions show that mortality contributes relatively little (less than 20 %) to the educational differences in WLE and that the remainder of the differences is attributable to weaker labor force attachment among the less-educated.

We found a strong negative impact of the Great Recession on WLE for those with a college/university education. This result is unexpected, given that the lesser-educated are generally considered to have been hit harder by the recession than the better-educated (Engemann and Wall 2009), but may be due to the fact that these individuals have a higher probability of retiring if they become unemployed than other groups, possibly because they can more easily afford to leave the labor force (Rutledge 2015). Indeed, additional calculations show that the probability that a 50-year-old employed male would be retired at age 65 increased considerably for males with a college/university degree: conditional on surviving, the probability was 27 % in 2003–2007 and 37 % in 2008–2011. For males with a high school diploma or less, the probability increased by 1 percentage point and 4 percentage points, respectively. For women, the differences were qualitatively similar, with the differences between 2008–2011 and 2003–2007 amounting to 7 % (college/university), 5 % (high school diploma/GED), and 6 % (less than high school).

Our findings are largely consistent with earlier findings on WLE in the United States. Smith (1986) estimated the WLE at age 50 to be 12.3 years for men and 9.8 years for women in the 1979–1980 period. This estimate for women is lower than our estimates, which are between 10.7 and 11.6 years, but the Smith study covered an earlier period in

which female labor force participation was lower. Millimet et al.'s (2003, 2010) findings, covering the 1992–2000 period, are qualitatively similar with respect to the differences between groups. For instance, they found that nonwhite males had a lower WLE than white males, whereas the differences between white and nonwhite females were small. Skoog and Ciecka (2002) estimated WLE at age 50 to be 13.1 years for men in 1997–1998, and Warner et al. (2010) reported an estimate of 13.8 years for the period 1992–2004 using HRS data. If we restrict our analysis to the period 1992–2004 and do not control for year, we find a WLE estimate of 13.4 years for males. The small difference is probably due to different definitions of WLE; we focus on employment, but Warner et al. (2010) examined both time spent in employment and unemployment. Moreover, Warner et al. (2010) used biennial data, whereas we employed annual data, which also could cause small differences (Wolf and Gill 2009).

It is worth noting that although the variation in WLE by level of education and race is very large in the United States, even the subpopulations with low working life expectancies tend to have higher WLEs than people in the UK (Butt et al. 2008), Spain (Dudel et al. 2016), and Finland (Leinonen et al. 2015). For example, in 2012 in Finland, male WLE at age 50 was 9.1 years (Leinonen et al. 2015). White, black, and Hispanic men in the United States in 2008–2011 all had a WLE of at least 9.1 years. Across educational groups, only those individuals with less than a high school education had less than 9.1 years of WLE. For women, WLE among subpopulations, as defined by race, was close to the Finnish average of 10 years (Leinonen et al. 2015). Females with a high school education also had a WLE close to Finnish females, whereas females without a high school diploma and females with a college/university degree, respectively, were three years below and two years above female Finns.

Methodological Considerations

When interpreting our results, it is important to acknowledge the period perspective that we employ. This perspective allows us to assess the impact of the recession by showing how individuals older than age 50 would fare if transition probabilities remained constant—that is, if the conditions of the recession prevailed over a period spanning old age. Our findings are not directly comparable with those of cohort studies, though.

Several other studies focusing on WLE defined it in terms of labor force activity (e.g., Millimet et al. 2003; Skoog and Ciecka 2010; Warner et al. 2010)—that is, covering both employment and unemployment—whereas we focus on employment only. This different definition of the state space hampers the comparability of findings but only to a small degree. If we combine employment and unemployment in one state, our estimates of WLE increase by an average of roughly 0.5 years. For instance, WLE including both employment and unemployment for males with a college/university education amounts to 13.3 years (1995), 12.5 years (2000), 13.3 years (2005), and 12.6 years (2010). If we include only employment, these numbers are 13.3, 12.2, 12.8, and 12.0 years, respectively.

A potential limitation of our analysis is bias due to panel attrition. Although we adjust our estimates of transition probabilities to match CDC life tables, this can be considered only a partial solution. For instance, assume that individuals who were employed at time t and who are not in the survey anymore at time $t + 1$ have a higher probability of retiring than those who remain in the panel. This would lead to underestimation of the

probability of retiring and would bias estimates of WLE upward. To assess how panel attrition might affect our results, we conducted two experiments for those transitions in which the state at time t is known but the state at $t + 1$ is not. In the first experiment, the state at $t + 1$ was set to "employed" if the individual was below age 75 and to "retired" otherwise. In a second experiment, the state at $t + 1$ was set to "out of the labor force or unemployed" if the individual was younger than age 75 and to "retired" otherwise. In the first scenario, WLE of males and females is up to 1.5 years higher; in the second scenario, it is up to 1.5 years lower. These differences are not small, but they are based on rather extreme assumptions. Furthermore, in both scenarios, trends and differences between males and females remain mostly unchanged, suggesting that panel attrition can be expected to bias mainly the level of our estimates. For differences over time or between groups to be biased would require rather strong selection in different directions.

We assess the impact of the Great Recession by analyzing the differential levels in WLE before and after it. However, changes in WLE may be caused not only by the crisis but by other factors as well, such as policy changes or preexisting trends in WLE. Both the heterogeneity of WLE across subpopulations and the variability of WLE over time point in this direction. Although we cannot rule out other factors, the crisis can be seen as an exogenous shock, and it seems unlikely that other factors contributed substantially to the key patterns we observed, such as the increase in WLE among female Hispanics and the decrease in WLE among male Hispanics, which are consistent with other findings from the literature. How persistent the effect of the crisis will be remains to be seen, and WLE might have recovered to pre-recession levels after the period we study.

Our analysis has other limitations. First, our results are for individuals at age 50 and thus may not give a complete picture of WLE over the whole life course. For example, differences in WLE by education might be different at age 20 than at age 50. Second, our analyses ignore working hours and wages. Accounting for working hours—for example, differentiating between full-time and part-time employment (Krueger et al. 2006)—could potentially change our results but would also increase the size of the state space. Third, our results by gender, race/ethnicity, and education are in some cases based on rather small sample sizes, making some of our findings difficult to interpret. Small sample size also limits the number of covariates and interaction terms that we can include when estimating transition probabilities. Fourth, we assign labor force states based on self-reported labor force state, similar to, for example, Warner et al. (2010). This circumvents the problem of deciding when an individual is, for instance, retired based on other indicators, which is more complicated than it may seem at first sight (Denton and Spencer 2009). Still, using other indicators could lead to different results.

Conclusion

Using data from the U.S. Health and Retirement Study to construct period working life tables by gender, race/ethnicity, and education, we analyzed the impact of the Great Recession. We found strong differences by gender, race/ethnicity, and education. These differences were mostly driven by differences in transitions between labor force state, and not by differences in mortality. At age 50, men had a remaining working life expectancy (WLE) that was approximately two years longer than that of women. Individuals with a college/university education could expect to work more than two

times longer than those with less than a high school education, and non-Hispanic whites could expect to work more than one-third longer than blacks. However, these differences mostly disappeared if education was controlled for, with the exception of differences between white and black males; this may be due to small sample sizes for some groups, such as black males with a college degree. Gender gaps varied strongly by race. For example, except during the Great Recession, the gap between males and females was largest among Hispanics but was small among blacks.

Our findings point to the importance of gender and racial differences, the intersection of these differences, economic conditions, and the interaction of all of these factors in determining the length of working life. Trends over time show no clear expansion of working life. If the shares of the U.S. population who earn a high school diploma or a college or university degree continue to grow (Ryan and Bauman 2016), average WLE may increase; however, this effect may be at least partially offset by later entry into the labor market. A concern is the heterogeneity of WLE in general and the consistently low WLE of some groups, particularly blacks and individuals with less than a high school education. Policies that better address this heterogeneity may be needed. Moreover, a better understanding of how differences are shaped by inequalities in health, health behaviors, and disability is needed to design effective policies that encourage a productive prolongation of working life, without an accompanying compromise in well-being.

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