The Life Expectancy of Older Couples And Surviving Spouses

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Abstract: Individual life expectancies provide useful summary measures for individuals making retirement decisions and for policy makers. For couples, analogous measures are the expected years both spouses will be alive (joint life expectancy) and the expected years the surviving spouse will spend as a widow or widower (survivor life expectancy). Using individual life expectancies to calculate summary measures for couples yields misleading results because the mortality distribution of husbands and wives overlap substantially. To illustrate, consider a wife aged 60 whose husband is 62. In 2010, the wife's life expectancy was 24.5 years and her husband's 20.2 years. It is incorrect to infer from these individual life expectancies that the wife is overwhelmingly likely to outlive her husband and, if she does, that her life expectancy as a widow is relatively brief. The couple's joint life expectancy is 17.7 years, the probability that the wife will outlive her husband is 0.62 and, if she does, her survivor life expectancy is 12.5 years. We calculate trends and patterns in joint and survivor life expectancy in each census year from 1930 to 2010. Using 2010 data, we also investigate differences in joint and survivor life expectancy by race and ethnicity and by education.

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1. Introduction

Using male and female life expectancy data from the National Center for Health Statistics (NCHS), we calculate the joint life expectancy of older couples entering their retirement years and the life expectancy of the surviving spouse. We calculate joint and survivor life expectancy for each census year beginning in 1930, and analyze trends in joint and survivor life expectancy from 1930 to 2010. We also use 2010 data to calculate these measures for non-Hispanic whites, blacks, and Hispanics and by educational attainment.[1]

We illustrate our measures of joint and survivor life expectancy by considering a non-Hispanic white couple in which the wife was 60 and the husband 62 in 2010 -- that is, the wife was born in 1950 and her husband in 1948. We focus on 60 year old wives and their husbands because these are ages at which many couples make crucial retirement-related decisions such as leaving career employment and claiming social security benefits. Thus, these are ages at which we would expect joint and survivor life expectancies to be especially salient. Census data show that in 2010 the average age gap between 60 year old non-Hispanic white women and their husbands was about 2 years. The 2010 NCHS life tables show that the life expectancy of a 60 year old non-Hispanic white woman was 24.5 years and that of a 62 year old non-Hispanic white man was 20.2 years. A naïve approach may conclude that the couple's joint life expectancy is 20.2 years (the minimum of the husband's and the wife's life expectancies), that the wife will outlive her husband, and that her life expectancy as the surviving spouse is 4.3 years (the difference between the wife's and the husband's life expectancies). These conclusions would be correct if 60 year old women lived for exactly 24.5 years and 62 year old

[1] We ignore unmarried individuals but it is important to bear in mind that marriage rates differ substantially by race and ethnicity. The marriage rate among 60 year old non-Hispanic white women in 2010 was 65.2 percent. For black women the corresponding rate was 36.8 percent and for Hispanic women 55.0 percent.

men lived exactly 20.2 years. More generally, they would be correct if the mortality distributions of the men and the women did not overlap. And, if the overlap were small, they would be good approximations. But the overlap is substantial. The probability that a 60 year old wife will predecease her 62 year old husband is .38, a surprisingly high probability that reflects the substantial overlap of their mortality distributions.

We call measures calculated using individual life expectancies "N-measures" because they depend on the assumption that the spouses' mortality distributions are **N**on-overlapping. We call the corresponding measures of joint and survivor life expectancies “N-joint life expectancy” and “N-survivor life expectancy.” The virtue of N-measures is that they are easy to calculate. The calculation of N-joint life expectancy assumes that the wife will be the surviving spouse (because she has the greater life expectancy) and calculates her N-survivor life expectancy as the difference between her life expectancy and that of her husband. The N-survivor life expectancy of the spouse with the lower life expectancy is 0, implying that if spouses have equal life expectancies, then N-survivor life expectancies for both spouses is 0. Unfortunately, the N-measures provide poor approximations of joint life expectancy and very poor approximations of survivor life expectancy. The .38 probability that the wife will predecease her husband is a strong indication that N-measures are seriously misleading.

We use the NCHS life tables for men and women to construct mortality distributions and life tables for couples to calculate O-measures (for “**O**verlapping measures”) of joint life expectancy (“O-joint life expectancy”).[2] We then calculate the probability of becoming a widow or widower at each age and use the individual life tables to calculate "O-survivor life expectancy." Using these probabilities, we calculate O-survivor life expectancies conditional on the identity of the surviving

[2] We provide details of the joint life expectancy calculations in Appendix 1.

spouse (e.g., if the wife is the surviving spouse, we calculate her expected number of years as a widow.)

The construction of mortality distributions for couples is straightforward but tedious. To illustrate, we continue to focus on the case in which the wife was 60 and the husband 62 in 2010. From the individual life tables for men and for women, we calculate the probability that one or both spouses will die in 2010. This probability is the sum of the probabilities of three mutually exclusive events:

(a) the husband will die between 62 and 63 AND the wife will not die between 60 and 61

(b) the wife will die between 60 and 61 AND the husband will not die between 62 and 63, and

(c) the husband will die between 62 and 63 AND the wife will die between 60 and 61.

The sum of these three probabilities is, of course, equal to one minus the probability that neither spouse will die in 2010. Thus, if our only aim were to calculate O-joint life expectancy, it would be easier to focus on the probability that neither spouse would die at each age or in each year. The drawback of proceeding in this way is that to calculate O-survivor life expectancies we need to calculate the probability that the wife (husband) will become a widow (widower) at each age.

For couples that survive into 2011, we proceed in the same way, calculating the probability that the husband will die between 63 and 64 and the wife will not die between 61 and 62, etc. These calculations give "mortality rates" for the couple for each year, and from these we can construct a "couple life table." More specifically, beginning with a cohort of 100,000 couples with the wife aged 60 and the husband aged 62, we can calculate expected transitions to widows, widowers, and "couple death" in each year. This corresponds to the L(X) column in the standard individual life table, with X denoting year rather than age.

From the couple life table, we calculate the couple's O-joint life expectancy using the standard life expectancy calculation typically applied to individuals. The vertical lines in Figure 1a show the O-joint and individual life expectancies for a non-Hispanic white couple in which the wife was 60 and the husband 62 in 2010. Figure 1b shows the focal couple transitions. For our focal couple, O-joint life expectancy is 17.7 years (recall that their N-joint life expectancy is 20.2 years).

The O-survivor life expectancy answers questions such as: "If the wife is the surviving spouse, how many years can she expect to live after her husband's death?" The O-survivor life expectancies are appropriately weighted averages of individual life expectancies at each age, where the weights are the probabilities of couple death in each year, conditional on couple survival to that year and conditional on the identity of the surviving spouse.

The differences between the O- and N-measures of survivor life expectancy are dramatic. The probability that the wife will be the surviving spouse is .62 and, if she is the surviving spouse, her O-survivor life expectancy is 12.5 years (recall that her N-survivor life expectancy is only 4.3 years). The probability that the husband will be the surviving spouse is .38 and, if he is the surviving spouse, his O-survivor life expectancy is 9.5 years (recall that his N-survivor life expectancy is 0).

Although Goldman and Lord (1983) proposed what we have called O-measures more than three decades ago, these measures have not been widely discussed or adopted.[3] In models of intra-household decision making (e.g., regarding the timing of retirement and the claiming of social security benefits), the difference between wives' and husbands' life expectancies is sometimes treated as a

[3] Goldman and Lord (1983) estimated joint and survivor life expectancies at the time of marriage, using median age at marriage (first and higher order) for white and non-white men and women in 1970, and for brides and grooms at ages 20-50 for 1977-78. Within the literature on life insurance, calculations of joint life expectancy are available. For example, Brown and Poterba (2000) investigate an alternative notion of "joint life expectancy" -- the number of years that at least one spouse is expected to be alive. Similarly, the IRS provides race-ethnicity-gender-neutral tables of this measure in reference to distributions of IRAs (https://www.irs.gov/publications/p590b).

measure of survivor life expectancy.[4] Browning (1995, 2000) and Lundberg (1999) allude to the difference between husbands' and wives' life expectancies to motivate their discussions of saving and other retirement related decisions.

To the extent that demographers, economists, gerontologists, and sociologists have considered couples and surviving spouses, they have focused on age-specific joint and survivor mortality rates rather than on summary measures such as life expectancies (Hurd (1999), Mitchell et al. (1999), van der Klaauw and Wolpin (2008), Lancaster (2015)). Although age-specific mortality rates are the basic building blocks, they are more complex and thus less accessible than summary measures such as joint and survivor life expectancy and the probability that the wife will predecease the husband. We focus on couples approaching retirement age because we think this is most relevant to policy makers and to couples.

The differences between the N-measures and the O-measures demonstrate the potential mistakes policy makers, couples, and researchers may make if they use inappropriate measures of joint and survivor life expectancy. Although the patterns are similar across the N- and O-measures, the levels differ substantially. In particular, the easily calculated N-survivor life expectancies dramatically underestimate years spent as a widow or widower, and this underestimate could have large consequences for savings, retirement, and long-term care decisions.

Evidence suggests that the life expectancy of married individuals is greater than that of unmarried individuals both because healthier individuals select into marriage and because marriage has protective effects; see Goldman (1993), Hu and Goldman (1990), Frees, Carriere and Valdez (1996), Drefahl (2010), Sanders and Melenberg (2016). Our calculations ignore these effects and

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[4] Uhlenberg (1980) is an early example of the used of N-measures.

assume that individuals' age-specific mortality probabilities are independent of marital status.[5] We also assume that spouses' mortality probabilities are independent of each other, although we expect that shared environments and behavioral habits would create correlations in mortality probabilities. We make these assumptions because publicly available life tables do not provide the information that would allow us to condition on marital status or take account of the correlations between spouses' mortality probabilities.[6]

In the following sections, we use O-measures to describe the joint life expectancies of couples nearing normal retirement age and the life expectancies of surviving spouses. In section 2 we describe trends in the life expectancies of older white and black couples from 1930 to 2010.[7] We use census data to calculate the age gap between 60 year old wives and their husbands in each census year. Using the 1930-2010 NCHS life tables for white men, white women, black men, and black women, we calculate joint life expectancy and survivor life expectancies. The proximate causes of the trends we describe are changes in the age gaps between spouses and changes in the mortality distributions of older men and women, but the trends are driven by changes in the mortality distributions.

In section 3 we use 2010 Census and NCHS data to analyze joint and survivor life expectancy separately for non-Hispanic white couples, black couples, and Hispanic couples.[8] Bound et al. (2015)

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[5] To estimate the relationship between marital status and individual life expectancy or individual mortality rates requires longitudinal data on individuals. It is reasonable to compare the survival probabilities of married and unmarried individuals on a year-to-year basis – the probability that a married 60 year old woman survives to 61 may differ from the probability that an unmarried 60 year old woman survives to 61. However, calculating the life expectancy of a married 60 year old woman based on survival probabilities that are specific to marital status adds a bias, in that doing so assumes that the woman is continually married until death.

[6] To estimate the relationship between the life expectancies or mortality rates of spouses requires longitudinal data on married couples.

[7] Unfortunately, we are unable to calculate the historical trends separately for Hispanics, as the NCHS life tables only began providing separate life tables for Hispanics in 2006.

[8] We treat Hispanic blacks as blacks rather than as Hispanics.

calculate individual mortality rates by education for non-Hispanic whites and for blacks, and we use their calculations to calculate joint and survivor life expectancies for non-Hispanic white couples and for black couples.

2. Trends in the Life Expectancies of Older Couples: 1930-2010

We begin by describing the trends in joint and survivor life expectancies for white and black couples from 1930-2010.[9] Before doing this, however, we need to generalize our analysis beyond focal couples consisting of 60 year old women married to 62 year old men. Retaining our focus on 60 year old women, suppose some of them are married to 61 years old men, others to 62 year old men, and still others to 63 year old men. The obvious generalize is first to calculate the joint and survivor life expectancies of these three types of couples and then to compute the appropriately weighted average.

The census provides information about the age gap between 60 year old married women and their husbands, and we use this information to calculate joint and survivor life expectancy in each census year as the appropriately weighted average. Thus, the changes we report in joint and survivor life expectancy between 1930 and 2010 reflect changes in both age-specific mortalities and changes in the age gaps between 60 year old women and their husbands. In Table 1a we present joint and survivor life expectancies for white couples in which the wife was aged 60, and in Table 1b we present the corresponding life expectancies for black couples.[10] Figure 2a shows the N-joint

[9] We begin in 1930 because the mortality data for older individuals from 1920 and before is not comparable with the data from 1930 and after. The difficulty is that prior to 1930, the survivor tables end at age 89 (i.e. the probability of death between ages 89 and 90 is one). The tables from 1930 onwards extend to 101.

[10] The tables and Figures are labeled by the race of the wife, but interracial marriages are rare for these cohorts. For all years, the percentage of white married women aged 60 who are married to white men exceeds 99 percent. For black married women aged 60, the percentage married to

and N-survivor life expectancies for white and black couples, Figure 2b shows the corresponding O-measures for white couples, and Figure 2c shows them for black couples. Joint life expectancy increases steadily for white couples and stalls slightly in 1990 for black couples, thus increasing the gap between the two. N-survivor life expectancy (which is for all intents and purposes the wife's N-survivor life expectancy) follows an inverted u-shaped pattern for both white and black couples – peaking in 1980 for white couples and 1990 for black couples. With the O-survivor life expectancies for white couples (Figure 2b), we observe the wife's life expectancy shifted up, while the husband's O-survivor life expectancy exhibits the opposite shape, dipping in 1980 and 1990 and increasing thereafter. The O-survivor life expectancies of black couples (Figure 2c) exhibit an upward trend, with the wife's O-survivor life expectancy falling slightly after 1990.

The effect of increasing male life expectancy is evident in Figures 2b and 2c. Until 1980, a white woman of age 60 who outlived her husband could expect to spend as much of her remaining life in widowhood as years with her husband. By 2010, her expected remaining years with her husband increased to 17.7 while her expected years as a widow declined to 12.5 (from a peak of 13.4 in 1980). The shift for black women is even more pronounced: not until 2010 could a black woman of age 60 who outlived her husband expect to spend more of her remaining years with her husband than as a widow.

The probability that the wife will be the surviving spouse follows an inverted u-shaped pattern similar to her O-survivor life expectancy. In 1930, the probability that a 60 year old white woman would outlive her husband was .56. This probability increased steadily, reaching a peak of .69 in 1980 before falling to .63 in 2010. The pattern for black women is similar: the probability of being the surviving spouse was .58 in 1930, rose to .70 in 1990, and then fell to .63 in 2010.

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black men exceeds 98 percent prior to 2010; for 2010 the percentage was 96.4 percent.

Two factors underlie these observed patterns. In recent decades, male life expectancy has increased faster than female life expectancy, implying an increase in joint life expectancy and a decrease in her survivor life expectancy. The age gap between spouses has also fallen, and fell markedly between 2000 and 2010, but the change in female and male life expectancies, not changes in the age gap, are the primary drivers of the observed patterns.[11] We performed counterfactual calculations of joint life expectancy holding the age gap fixed at its 2010 level. Because the average age gap exceeds two years in all census years except 2010, replacing the actual age gaps with the 2010 age gap raises the joint life expectancy and lowers survivor life expectancy. With one exception, however, the decade to decade patterns noted above remain.

Over the past century, the joint life expectancy of these couples has increased, but the increase has been much less than the increase in individual life expectancies. From 1930 to 2010, the life expectancy of 60 year old white women increased from 16.1 years to 24.5 years; over this period, O-joint life expectancy for white couples increased from 10.0 to 17.7 years, and O-survivor life expectancy of widows increased from 10.9 to 12.5 years. Over this period, the life expectancy of 60 year old black women increased from 14.2 years to 23.1 years; O-joint life expectancy for black couples increased from 8.4 to 15.5 years, and O-survivor life expectancy of black widows increased from 11.3 to 13.5 years.

[11] The only exception is for black couples between 2000 and 2010. For these couples, the change in the age gap is responsible for an increase in joint life expectancy of 2.2 years and a fall in survivor life expectancy of 0.1 years. Survivor years as a proportion of joint life expectancy as well as the probability that the husband will die first both fell slightly. When we hold the age gap constant, however, the increase in joint life expectancy is only 1.6 years and there is an increase in survivor life expectancy of 0.5 years. Applying the 2010 age gap would have resulted in an increase in ratio of survivor life expectancy to joint life expectancy, as well as the probability that the husband dies first.

3. Patterns in the Life Expectancies of Older Couples: 2010

In this section we first discuss the 2010 joint and survivor life expectancy measures by race and ethnicity and then discuss patterns by education. Our discussion here differs from our discussion of trends in section 2 because the NCHS life tables for 2010 included mortality distributions for Hispanics, enabling us to distinguish among non-Hispanic whites, blacks, and Hispanics. Using the Bound et al. (2015) data linking educational attainment with mortality, we then discuss differences in joint and survivor life expectancy patterns by education.

3a. Race and Ethnicity

Table 2 shows the 2010 measures of life expectancy for non-Hispanic white, black, and Hispanic couples.[12] We present both N-measures and O-measures of joint and survivor life expectancy for the appropriately weighted average of couples in which the wife was aged 60.

Both Hispanic men and Hispanic women have longer life expectancies than their white and black counterparts, and higher N-joint and N-survivor life expectancies. For all races, the O-joint life expectancies are approximately two years shorter than the N-joint life expectancies but show a slightly different pattern. For women, N-survivor life expectancies indicate that Hispanic women at age 60 can expect to spend more years in widowhood compared with their white and black counterparts. However, conditional on becoming a widow, black women have longer O-survivor life expectancy (13.5 years), than Hispanic women (13.1 years), and white women (12.5 years). Hispanic men have

[12] As before, couples are defined by the race of the wife. There is little intermarriage observed in the 2010 census for women aged 60. Fully 99 percent of married non-Hispanic white women are married to non-Hispanic white men, and over 97 percent of married black women are married to black men. Hispanic women are more likely to intermarry. In 2010, 79.2 percent of married Hispanic women were married to Hispanic men, 19.5 percent were married to non-Hispanic white men, and 1.4 percent were married to black men. When we limit the sample to exclude interracial couples, the results do not change substantially.

the shortest O-survivor life expectancies (9.3 years), followed by white men (9.5 years), with black men having the longest expected survivor life expectancies (10.1 years).

3b. Education

The Bound et al. (2014) adjustments of individual mortalities for education allow us to calculate couple-based life expectancy measures by education for non-Hispanic white couples and black couples, but not for Hispanic couples.[13] We classify couples into four education categories, using the "power couples" terminology introduced by Costa and Kahn (2000) and modified by Compton and Pollak (2007). Couples are defined as "low-power" if neither spouse has a college degree; "half-power-her" if only the wife has a college degree; "half-power-him" if only the husband has a college degree; and "full-power" if both spouses have college degrees.[14]

For both men and women, education is associated with lower mortality and substantially

[13] NCHS life tables do not condition on education. Bound et al. (2014) provide survival probabilities by education categories, conditional on survival to age 25, for non-Hispanic white men and women and for black men and women. Estimates are provided for four education categories -- less than high school, high school graduate, some college, and college graduate. We have extended the Bound et al. estimates in two ways. First, we convert their five year estimates to one-year age estimates using a cubic spline. Second, we extend their estimates for ages above age 85 using the NCHS data for the full population and assuming that all four education groups follow the proportional increases in mortality for ages above 85.

[14] The estimates from Bound et al. (2014) are based on administrative data that have been criticized for underestimating education. Rostron (2010), Hendi (2016), and Sasson (2016) have shown that when education is reported by next-of-kin (as in administrative data) there is substantial undercounting of the population with high school diplomas and an over-counting of the population with less than high school, compared to the self-reports in survey data. Use of the administrative data to code education leads to greater reported disparities in life expectancy by education, compared to the results using self-reported survey data. However, this discrepancy in is concentrated at the lower end of the education scale (a high proportion of those with high school diplomas are listed as less than high school). Since we combine these two groups and focus on the differences between college graduates and non-college graduates, the concerns about the administrative data used in Bound are less relevant.

greater life expectancy.[15] Due to positive assortative mating on education, the education differences in individuals' life expectancies translate into substantial differences in joint and survivor life expectancies. Table 3 presents the life expectancy measures by education. Consider first the joint life expectancy measures. For both non-Hispanic white couples and black couples, O-joint life expectancy is approximately three years lower than the N-joint life expectancy, although the patterns across education groups are similar for both measures. As we move from low power couples, to half-power (her), to half-power (him), to power couples, joint life expectancy increases steadily. For white couples, joint life expectancy increases across education categories from 18.5 to 22 years for the N-joint measure and from 15.5 to 19.0 years for the O-joint measure. For black couples, joint life expectancy increases from 16.6 to 19.6 years using the N-joint measure and from 13.6 to 16.4 years using the O-joint measure.

Although the N-joint life expectancies are approximately three years greater for non-Hispanic white couples than for black couples for each education group, N-survivor life expectancies are very similar for non-Hispanic whites and for blacks. This is because the difference in the probability that the husband dies first is greater across education categories than the differences between blacks and non-Hispanic whites. For black couples and for non-Hispanic white couples, the probability that the husband will die first is lowest for couples in which only the husband has a college degree (half-power him couples, at 0.59), and highest for couples in which only the wife has a college degree (half-power her, at 0.68). This pattern across education groups continues to hold when we fix the age gap at two years and consider only differences in life expectancies between blacks and non-Hispanic whites. The

[15] For more discussion on this topic, see Meara, Richards, and Cutler (2008), Olshansky et al. (2012), Bound et al. (2014), and Chetty et al. (2016). We do not speculate on what portion of this association is causal and what portion reflects correlations between education and other factors, both genetic and environmental.

N-survivor life expectancy depends on the difference between the wife's and the husband's life expectancies. It is highest (at 6.6 and 6.7 years) for couples in which the wife has a college degree and the husband does not, and lowest (at 3.6 and 3.9 years) for couples in which the husband has a college degree and the wife does not.

The O-survivor life expectancies for the wife follow the same pattern across education groups as the N-measure, shifted up by approximately seven years. While the O-joint life expectancies are approximately three years longer for non-Hispanic white couples in each category, the O-survivor life expectancies are slightly higher for black men and women compared with non-Hispanic white men and women. For non-Hispanic white couples and for black couples, the husband's O-survivor life expectancy is highest when he has a college degree and she does not (10.1 and 10.5 years). For these half-power (him) couples, his life expectancy is higher than average and hers is lower than average, which results in a higher expected years of widowhood for the husband. The husband's O-survivor life expectancy is lowest when she has a college degree and he does not (9.0 for non-Hispanic white couples and 9.4 years for black couples). For these half-power (her) couples, his life expectancy is lower than average and hers is higher than average, resulting in lower expected years of widowhood for the husband.

4. Conclusion

We have defined and calculated measures of the joint and survivor life expectancies of older couples. The non-overlapping or N-measures can be calculated directly from men's and women's life expectancies, but they are misleading because they fail to take account of the substantial overlap in spouses' mortality distributions. The overlapping or O-measures of joint and survivor life expectancy are more complicated to calculate than the N-measures because they take account of the overlap.

While N-measures provide some insight into the relative life expectancies of men and women, they overstate joint life expectancy and dramatically understate survivor life expectancy. We calculate O-measures using historical data from 1930 to 2010 and also calculate O-measures using 2010 data disaggregated by race and ethnicity and by education. Our calculations are based on individual life tables and therefore ignore the possibilities that (a) healthier individuals may select into marriage, (b) marriage may itself increase life expectancy, and (c) mortality rates of husbands and wives may be correlated. We leave these refinements for future research.

Measures of joint and survivor life expectancy are potentially useful to those designing or evaluating policies affecting older couples, and to couples making savings, retirement, and long-term care decisions. Policy makers need to forecast future social security claims and assess future demand for nursing-home care. To do this they need estimates of the number of years both spouses will be alive and the number of years the widow or widower will survive after the spouse's death. Couple life expectancy matters for long-term care because when one spouse becomes disabled, the other typically provides care; after the death of one spouse, adult children or nursing homes paid for by Medicaid usually provide care for the disabled surviving spouse. Couples making saving and retirement decisions and deciding when to claim social security benefits need estimates of their joint life expectancy and the life expectancy of the surviving spouse. With the exception of Goldman and Lord (1983), demographers, economists, gerontologists, and sociologists have generally ignored the joint life expectancies of married couples and the life expectancies of surviving spouses.

For definiteness, we have focused on trends affecting women aged 60 and their husbands but the implications of our analysis hold for couples regardless of age. Although the O-measures are difficult to calculate, tools such as the "Life Expectancy Calculator" on the Social Security website could easily be augmented to allow individuals and couples to calculate their O-joint and O-survivor life expectancies.[16]

[16] https://www.ssa.gov/oact/population/longevity.html

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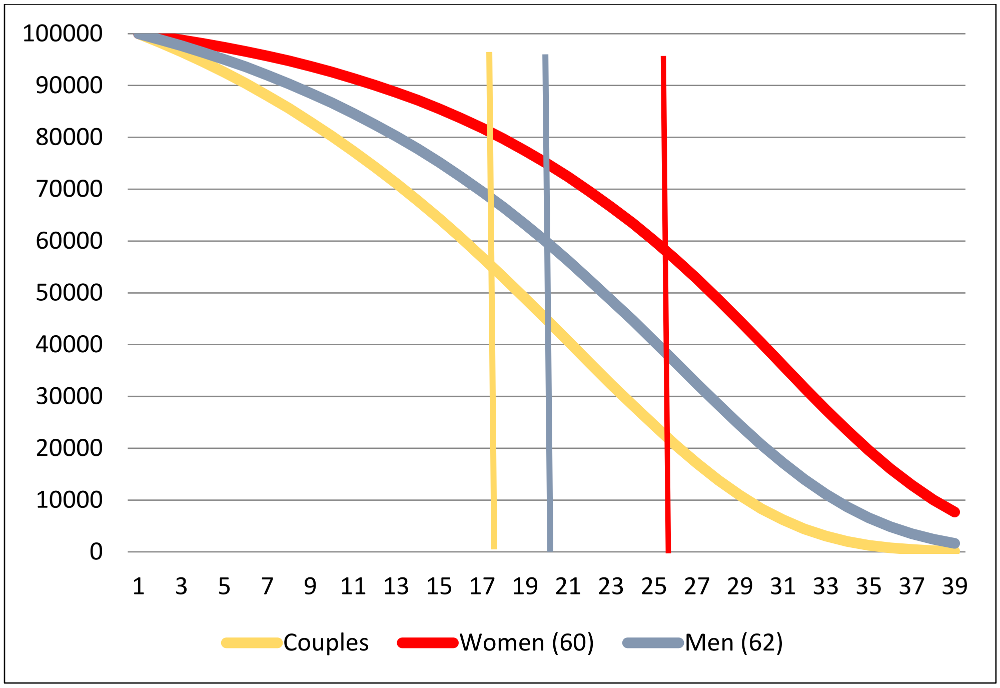
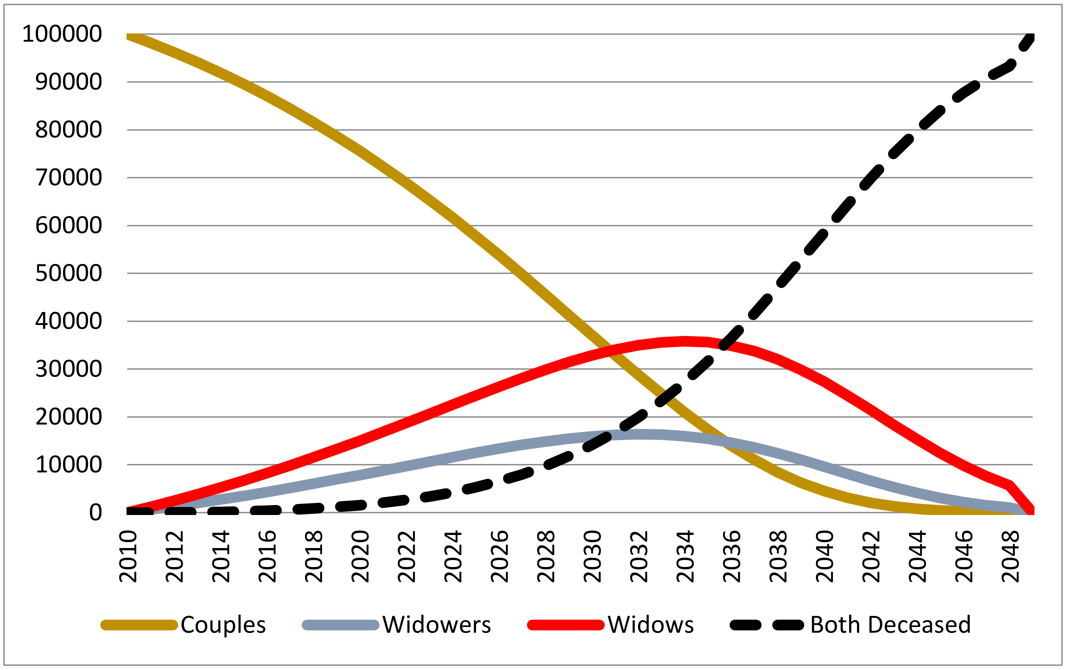
Figure 1a: Individual and Focal Couple Survival Probabilities: Woman 60 Years Old and Man 62 Years Old in 2010.



The Figure shows the joint survival probabilities of a focal couple consisting of a 60 year old non-Hispanic white woman and a 62 year old non-Hispanic white man as well as their individual survival probabilities. The calculations are based on the 2010 NCHS life table.

Figure 1b: Projected Mortality Experience, 2010-2048, of Focal Couple: Woman 60 Years Old and Man 62 Years Old in 2010.



The Figure shows the projected mortality experience each year from 2010 to 2048 of a focal couple consisting of a 60 year old non-Hispanic white woman and a 62 year old non-Hispanic white man. The calculations are based on the 2010 NCHS life table.

Table 1a: Life Expectancy Measures, White Couples, Wife is Aged 60

			N-Life Expectancies		O-Life Expectancies					
	Her Life Expectancy	His Life Expectancy	N-Joint	N-Survivor	0-Joint	O-Survivor (Him)	O-Survivor (Her)	Probability that She is Survivor	Age Gap	Sample
1930	16.05	12.93	12.62	3.73	9.98	8.59	10.88	0.56	3.35	12,638
	(0.00)	(3.23)	(2.57)	(2.50)	(1.48)	(1.93)	(0.73)	(0.10)	(5.71)	
1940	17.00	13.27	13.05	4.17	11.05	8.26	11.02	0.63	3.22	3,172
	(0.00)	(3.16)	(2.65)	(2.55)	(1.69)	(1.76)	(0.82)	(0.10)	(5.59)	
1950	18.64	14.16	14.02	4.77	12.06	8.48	11.74	0.65	2.85	3,587
	(0.00)	(3.03)	(2.64)	(2.54)	(1.71)	(1.61)	(0.87)	(0.09)	(5.25)	
1960	19.69	14.43	14.24	5.65	12.57	8.31	12.09	0.67	2.89	22,264
	(0.00)	(3.46)	(2.92)	(2.78)	(1.99)	(1.73)	(1.05)	(0.10)	(5.75)	
1970	20.79	14.54	14.44	6.49	12.88	8.43	12.90	0.69	2.71	11,537
	(0.00)	(3.28)	(2.90)	(2.78)	(2.00)	(1.70)	(1.10)	(0.10)	(5.72)	
1980	22.45	15.88	15.80	6.74	14.16	8.79	13.44	0.69	2.73	35,164
	(0.00)	(3.22)	(2.94)	(2.84)	(2.02)	(1.47)	(1.18)	(0.09)	(5.08)	
1990	23.09	16.83	16.73	6.50	15.00	9.02	13.37	0.68	2.77	36,509
	(0.00)	(3.26)	(2.81)	(2.75)	(1.99)	(1.70)	(1.18)	(0.09)	(5.04)	
2000	23.20	18.04	17.86	5.52	15.85	9.20	12.88	0.65	2.85	34,381
	(0.00)	(3.54)	(3.07)	(2.95)	(2.12)	(1.53)	(1.25)	(0.10)	(5.00)	
2010	24.49	20.17	19.91	4.84	17.68	9.46	12.49	0.63	1.92	11,589
	(0.00)	(3.65)	(3.05)	(2.92)	(2.12)	(1.57)	(1.23)	(0.10)	(4.92)	

Calculations by authors. Standard errors in parentheses.

Table 1b: Life Expectancy Measures, Black Couples, Wife is Aged 60

	Her Life Expectancy	His Life Expectancy	N-Life Expectancies: N-Joint	N-Survivor	O-Life Expectancies: O-Joint	O-Survivor (Him)	O-Survivor (Her)	Probability that She is Survivor	Age Gap	Sample
1930	14.22	11.36	11.09	3.40	8.41	8.65	11.31	0.58	4.30	981
	(0.00)	(3.01)	(2.48)	(2.38)	(1.38)	(2.13)	(0.52)	(0.09)	(7.38)	
1940	16.10	12.47	12.22	4.15	9.42	9.37	12.52	0.60	4.49	240
	(0.00)	(3.02)	(2.49)	(2.26)	(1.42)	(2.15)	(0.57)	(0.09)	(7.71)	
1950	16.95	13.08	12.80	4.42	9.99	9.58	12.82	0.61	4.69	270
	(0.00)	(3.21)	(2.54)	(2.40)	(1.45)	(2.19)	(0.61)	(0.08)	(7.08)	
1960	17.83	14.15	13.75	4.49	10.98	9.87	12.67	0.61	2.95	1,424
	(0.00)	(3.70)	(2.79)	(2.66)	(1.75)	(2.35)	(0.83)	(0.10)	(7.34)	
1970	18.66	13.64	13.54	5.30	11.01	9.71	13.51	0.63	2.80	845
	(0.00)	(3.00)	(2.65)	(2.48)	(1.70)	(2.00)	(0.82)	(0.09)	(7.63)	
1980	20.42	14.38	14.27	6.25	12.03	9.43	14.02	0.67	3.28	2,439
	(0.00)	(3.23)	(2.89)	(2.80)	(1.79)	(1.83)	(0.90)	(0.08)	(6.23)	
1990	20.71	14.45	14.35	6.51	11.62	9.64	14.38	0.70	3.09	2,128
	(0.00)	(3.28)	(2.86)	(2.74)	(1.91)	(1.97)	(1.01)	(0.09)	(6.44)	
2000	21.00	15.89	15.72	5.44	13.36	9.57	13.32	0.65	2.99	2,315
	(0.00)	(3.39)	(2.97)	(2.84)	(1.90)	(1.77)	(1.01)	(0.09)	(5.81)	
2010	23.05	18.21	17.96	5.33	15.45	10.05	13.53	0.63	1.81	848
	(0.00)	(3.72)	(3.18)	(2.97)	(2.11)	(1.77)	(1.19)	(0.10)	(5.61)	

Calculations by authors. Standard errors in parentheses.

Figure 2a: N-joint and N-survivor Life Expectancies, 1930-2010. White couples and black couples, wife is aged 60.

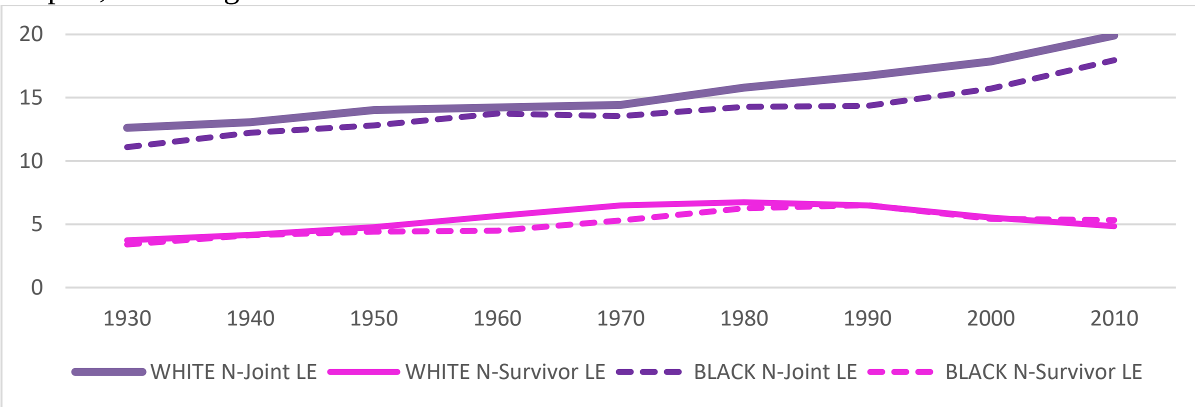


Figure 2b: O-joint and O-survivor Life Expectancies, 1930-2010. White couples, wife is aged 60.

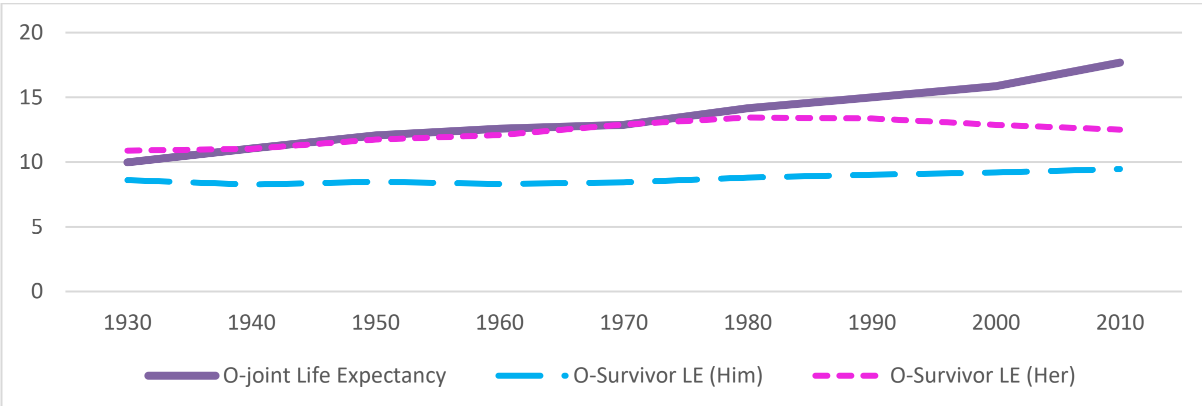


Figure 2c: O-joint and O-survivor Life Expectancies, 1930-2010. Black couples, wife is aged 60.

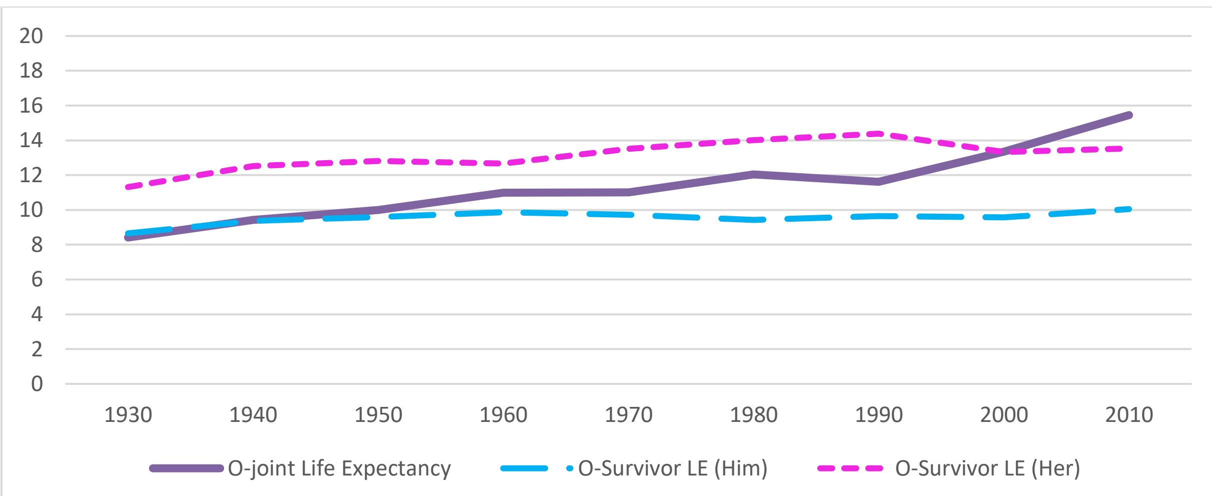


Table 2: Life Expectancy Measures, 2010, by Race, Wife is Aged 60

	Non-Hispanic White	Black	Hispanic
Wife's Life Expectancy	24.40	23.05	26.40
	(0.00)	(0.00)	(0.00)
Husband's Life Expectancy	20.17	18.22	21.05
	(3.59)	(3.74)	(4.59)
N-Joint Life Expectancy	19.91	17.96	20.73
	(3.00)	(3.18)	(3.91)
N-survivor Life Expectancy	4.75	5.34	5.98
	(2.87)	(2.97)	(3.73)
O-Joint Life Expectancy	17.66	15.45	18.79
	(2.08)	(2.12)	(2.82)
O-Survivor Life Expectancy (Wife)	12.48	13.52	13.13
	(1.21)	(1.19)	(1.77)
O-Survivor Life Expectancy (Husband)	9.48	10.05	9.34
	(1.51)	(1.77)	(1.85)
Probability that Wife is the Surviving Spouse	0.63	0.63	0.65
	(0.10)	(0.10)	(0.12)
Age Gap (Husband – Wife)	1.91	1.81	2.25
	(4.79)	(5.61)	(5.90)
Sample	10,967	848	620

Calculations by authors. Standard errors in parentheses.

Table 3: Life Expectancy Measures, by Education 2010. Wife is Aged 60

	Non-Hispanic White Couples					Black Couples				
	Low Power	Half Power (Her)	Half Power (Him)	Power	All	Low Power	Half Power (Her)	Half Power (Him)	Power	All
Wife's Life Expectancy										
	23.68	26.07	24.73	26.07	24.61	21.70	23.79	22.51	23.79	22.26
	(1.79)	(0.00)	(1.84)	(0.00)	(1.83)	(1.43)	(0.00)	(1.50)	(0.00)	(1.53)
Husband's Life Expectancy										
	18.71	19.82	22.06	22.12	20.13	16.95	17.46	19.45	19.76	17.57
	(4.17)	(4.39)	(3.47)	(3.46)	(4.25)	(4.36)	(4.22)	(3.77)	(3.68)	(4.36)
N-Joint Life Expectancy										
	18.46	19.72	21.60	21.98	19.88	16.60	17.28	19.00	19.56	17.25
	(3.62)	(4.03)	(2.82)	(3.00)	(3.76)	(3.64)	(3.88)	(3.17)	(3.31)	(3.76)
N-Survivor Life Expectancy										
	5.58	6.63	3.63	4.31	5.07	5.52	6.69	3.96	4.43	5.37
	(3.47)	(3.80)	(2.95)	(3.00)	(3.44)	(3.43)	(3.63)	(3.09)	(3.20)	(3.47)
O-Joint Life Expectancy										
	15.53	17.17	18.31	18.99	16.91	13.61	14.84	15.59	16.39	14.26
	(3.04)	(3.42)	(2.52)	(2.82)	(3.32)	(2.68)	(2.59)	(2.23)	(2.26)	(2.78)
O-Survivor Life Expectancy (Wife)										
	13.24	13.50	11.70	11.93	12.71	13.40	13.99	12.61	12.87	13.33
	(1.58)	(1.79)	(1.36)	(1.38)	(1.68)	(1.45)	(1.52)	(1.36)	(1.44)	(1.49)
O-Survivor Life Expectancy (Husband)										
	9.69	8.96	10.07	9.27	9.59	9.89	9.36	10.47	10.05	9.90
	(1.71)	(1.48)	(1.43)	(1.28)	(1.59)	(2.06)	(1.70)	(1.76)	(1.42)	(1.94)
Probability that Wife is the Surviving Spouse										
	0.65	0.68	0.59	0.63	0.64	0.64	0.68	0.59	0.62	0.64
	(0.12)	(0.12)	(0.11)	(0.10)	(0.12)	(0.12)	(0.12)	(0.11)	(0.10)	(0.12)
Age Gap (Husband – Wife)										
	1.96	1.93	1.89	1.83	1.91	1.47	2.28	2.79	2.59	1.81
	(5.14)	(5.16)	(4.18)	(4.20)	(4.79)	(5.81)	(5.10)	(5.31)	(4.85)	(5.61)
Sample	5,828	994	1,703	2,442	10,967	573	89	72	114	848

Calculations by authors. Standard errors in parentheses.

Appendix 1: Outline of Couple Life Expectancy Calculation

Years	Wife's Age	Husband's Age	FQX	HQX	CQX	CMX	CLX	CDX	CL*X	CTX	CEX
1	60	63	0.006	0.012	0.018	0.018	100000	1784	99108	1684712	16.847
2	61	64	0.006	0.013	0.019	0.019	98216	1893	97269	1585604	16.144
3	62	65	0.007	0.014	0.021	0.021	96323	2011	95317	1488335	15.452
4	63	66	0.008	0.015	0.023	0.023	94312	2143	93240	1393018	14.770
5	64	67	0.008	0.017	0.025	0.025	92169	2285	91026	1299777	14.102
6	65	68	0.009	0.018	0.027	0.027	89883	2430	88668	1208751	13.448
…..			…..	…..	…..	…..	…..	…..	…..	…..	…..
34	93	96	0.164	0.262	0.382	0.482	1559	596	1261	2876	1.844
35	94	97	0.181	0.282	0.412	0.531	963	397	765	1615	1.676
36	95	98	0.199	0.303	0.442	0.583	566	250	441	850	1.500
37	96	99	0.218	0.325	0.472	0.638	316	149	242	409	1.292
38	97	100	0.238	0.346	0.501	0.696	167	84	125	167	0.999
39	98	101	0.258	1.000	1.000	1.000	83	83	42	42	0.500

FQ(X): Female probability of dying between ages X and X+1 (from CDC Life Tables)
MQ(X): Male probability of dying between ages X and X+1 (from CDC Life Tables)
CQ(X) = Probability that couple "dies"
= FQ(X)*MQ(X)+ FQ(X)*(1-MQ(X)) + (1-FQ(X))*MQ(X)
CM(X) = Mortality rate = -ln(1-CQ(X))
CL(X) = Cohort. CL(X+1) = CL(X)*EXP(-CM(X))
CD(X) = Deaths per age = CL(X) – CL(X+1)
CL*(X) = Couples lived between X and X+1 = CL(X+1) + 0.5CD(X)
T(X) = Person years remaining $=\sum_{X=1}^{X=39} CL*(X)$
CEX = Couple longevity = T(X)/L(X)