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# The expected length of male retirement in the United States, 1850–1990

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**Abstract.** This paper estimates the expected length of retirement for each labor market cohort between 1850 and 1990. Since 1850, the expected length of retirement has increased by more than six-fold and now represents up to 30% of male length of life after entry into the labor force. The rise of the duration of retirement during the twentieth century is analyzed according to the effects of mortality decline and of decreased age of retirement. Implications of the result for a number of economic issues, including the relative importance of life-cycle savings and the potential saving effect of Social Security, are discussed.

**JEL classification:** J11, J26

**Key words:** Retirement, savings

## 1. Introduction

The past century has witnessed a rapid rise in life expectancy and a drastic fall in the labor force participation rate (LFPR) of older males. At the beginning of the twentieth century, life expectancy of males at age twenty was less

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than 42 years (Preston et al. 1972, 724), while it was over 53 years in 1990 (U.S. Department of Health and Human Services 1992a, 34). A century ago, 65 percent of males aged sixty-five or older were in the labor force (Moen 1987a), compared to only 15 percent of men in that age in 1993 (U.S. Bureau of the Census 1994, No. 615). The average duration of retirement should have increased over time as people retired earlier and lived longer than before on average.

The long-run trend of the average length of retirement has useful implications for various economic issues, including the relative importance of life-cycle motives for savings (Modigliani and Brumberg 1954; Munnell 1974; Modigliani 1986), the source of capital formation in the course of industrialization (Ransom and Sutch 1986; Carter and Sutch 1996), and the growing financial burden of old-age security programs (Diamond et al. 1996). In spite of its potential utility, only a few studies have estimated this variable. Darby (1979) has computed the expected retirement duration at age 20 for 1890–1920, suggesting that a twenty-year-old man would have expected to have only a brief retirement period in that period (1.9 years for 1900). For the more recent period, Kotlikoff and Smith (1983) suggested that the expected duration of retirement of 25-year-old males was 5.93 years in 1950 and 11.47 years in 1970.

The calculation methods of these studies are, however, unsatisfactory. For instance, Darby's estimate is subject to a downward bias because he incorrectly assumed that individuals started to retire after age sixty-five.[1] Moreover, all of the above estimates are based on the demographic and labor force features of a synthetic cohort drawn from cross-sectional data. To estimate the expected length of retirement for 25-year-old men in 1950, for example, Kotlikoff and Smith (1983) used the age-specific LFPR as of 1950. This method, however, understates the true duration of retirement for the male cohort who were 25 in 1950, because the average age at retirement decreased over time. Nor do we have comparable estimates of the average duration of retirement for a longer period. The major purpose of the present study is to fill this gap in the literature, providing the estimates of the expected length of retirement of each male cohort for the period between 1850 and 1990. I will also analyze the growth of the duration of retirement over the last century according to the respective contributions of changes in mortality and labor force participation. Finally, some implications of the results will be discussed.

## 2. Estimation of the expected length of retirement, 1850–1990

The average duration of retirement can be defined in a variety of ways. I estimate the expected length of retirement at age of entry into the labor force because that is probably the most relevant variable for exploring life-cycle consumption behavior.[2] Age twenty is chosen here for the mean age of entry into the job market. The average age of entry into the labor force has changed over time, and it is possible that twenty-five is more accurate entry-age for the later periods, as assumed by Kotlikoff and Smith (1983). If age 25 were selected instead of 20, we would have a longer expected length of retirement, because a larger fraction of labor market entrants would remain alive until they retire. However, the difference between choosing 20 and 25 is insignificant, because the mortality rate was very low between those ages.[3]

If a male worker retires at age $x$, the expected duration of his retirement is equal to his life expectancy at age $x$, $e_x$. Among males in a cohort, the proportion of persons who would have a retirement period of $e_x$ is equal to the probability of retiring at age $x$. Therefore, the expected retirement duration of a cohort can be estimated by calculating a weighted average of life expectancy at each age of retirement. The weight assigned to $e_x$ is the probability of retiring at age $x$, which is the product of the following probabilities: the probability of remaining alive to age $x$ ($S_x$), the probability of remaining in the labor force until age $x$ conditional on surviving until age $x$ ($T_x$), and the probability of retiring at age $x$ conditional on remaining in the labor force at age $x$ ($\gamma_x$). Among the men who would retire between age $x$ and $x+1$ ($S_x T_x \gamma_x$), the proportion of those who die is given by the mortality rate within the age interval (${}_1q_x$). If the likelihood of retirement does not vary within the age interval, half of these men would die before they leave the labor force. Therefore, the probability of retirement between age $x$ and $x+1$ is $S_x T_x \gamma_x \cdot [1 - (0.5 \times {}_1q_x)]$. If a man retires between age $x$ and $x+1$, his expected length of retirement is $(e_x + e_{x+1})/2$. Therefore, the expected length of retirement at age 20 (ELRP, hereafter) is:

$$ELRP = \sum_{x=20}^{89} S_x T_x \gamma_x [1 - (0.5 \times {}_1q_x)][(e_x + e_{x+1})/2] \tag{1}$$

The age-specific male labor force participation rates, estimated from Integrated Public Use Microdata Samples (IPUMS) of the U.S. federal censuses (Ruggles and Sobek 1995), indicate that individuals started to leave the labor force permanently after age 50. Assuming for simplicity that the starting age of retirement is 50, based on this pattern, we have the following result:

$$ELRP = \rho^{20-50} \sum_{x=50}^{89} S_x T_x \gamma_x [1 - (0.5 \times {}_1q_x)][(e_x + e_{x+1})/2] \tag{2}$$

where, $\rho^{20-50}$ denotes the probability of surviving until age 50 at age 20.[4]

It is crucial in estimating the ELRP to determine correctly how individuals form expectations about their future health, mortality, and labor force participation. Here, two extreme assumptions are employed to have upper and lower bound estimates. One assumption is that a twenty-year-old man assesses his retirement duration based on the expectation that current patterns of mortality and retirement will remain unchanged in the future. Since individuals may anticipate a decline in mortality and the LFPR of older males based on the past trend, this assumption would lead to a lower bound estimate of the ELRP. Period life tables and cross-sectional age profiles of the LFPR should be used for applying this assumption to the calculation. The resulting estimate will be called the *period estimate* throughout this paper. The other assumption is that the timing of retirement and death is perfectly foreseen by each cohort. In reality, even if people adjust their expectations taking into account past experiences, they would likely fall short of the actual changes.[5] Therefore, the estimate derived from the second assumption may be regarded as upper bound. Cohort life tables and age profiles of the LFPR for each cohort are needed to apply this assumption. This estimate will be referred to the *cohort estimate* hereafter.

The probability of remaining in the labor force among the cohort who survive to age 50 at age $x$ is calculated as:

$$T_x = 1 - R_x$$

where $R_x$ stands for the retirement rate at age $x$. The conditional probability of retirement during each age range ($\gamma_x$) is estimated from $R_x$ in the following manner:

$$1 - R_{x+1} = T_{x+1} = (1 - \gamma_x)T_x$$

$$(1 - R_{x+1})/(1 - R_x) = T_{x+1}/T_x = 1 - \gamma_x$$

$$\gamma_x = 1 - [(1 - R_{x+1})/(1 - R_x)]$$

$R_x$ is estimated from IPUMS of the censuses of 1850 to 1990. For the cohort estimate for younger generations we need the age-specific LFPR in the future. For this we must rely on projections, even though they are not fully satisfactory. The projections of the Social Security Administration (U.S. Department of Health and Human Services 1992b) are used for the years between 1995 and 2055.[6] It should be kept in mind that the cohort estimate for 1950 and later is partly based on projection data and therefore subject to bias. Interpolations are used for estimating the figures for 1890 and 1930, for which micro-samples of the census are not available.[7]

The age-specific mortality rate within 5 years (${}_5d_x$) and life expectancy at each age ($e_x$) are collected from the period life tables reported in Haines (1998) and Preston et al. (1972), and the period and cohort life tables in U.S. Department of Health and Human Services (1992a).[8] The probability of remaining alive among those who survive to age 50 is calculated as follows:

$$S_x = \prod_{j=50}^{x-5} (1 - {}_5d_j)$$

Table 1 presents the period and cohort estimates of the ELRP and their ratios to life expectancy at age 20. The result suggests that since 1850 the expected length of retirement has increased by more than six-fold and now represents up to 30% of men's length of life after entry into the labor force. As clearly seen in Fig. 1, the rise of the ELRP was particularly rapid after 1900. According to the period estimate between 1900 and 1990, the absolute retirement duration more than quadrupled (col. A of Table 1), while its ratio-to-life expectancy tripled (col. D of Table 1). The cohort estimate of the expected length of retirement is much greater than the period estimate throughout the periods under investigation. Between 1880 and 1960, it is about twice as great as the period estimate.

In comparison with the previous estimates, the above results suggest a quite different picture of the long-run change in the ELRP. The present estimate for the early twentieth century is much greater than the estimate suggested by Darby (1979). Even the lower-bound (period) estimate for 1900 (2.9 years) is considerably larger than his result (1.9 years). Darby's underestimation, as noted above, is mainly due to ignoring retirement before age 65.[9] As compared

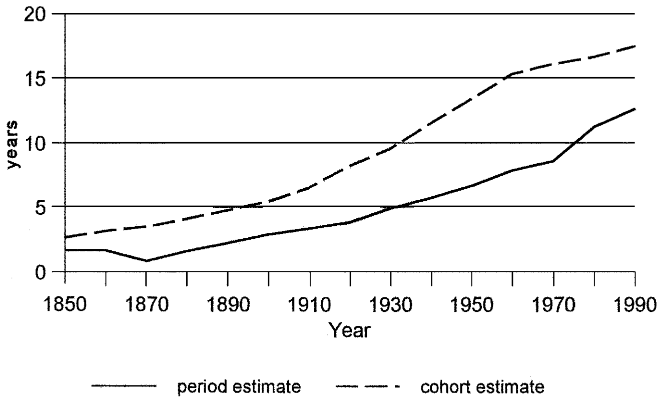


**Fig. 1.** Expected length of retirement at age 20, 1850–1990

**Table 1.** Estimates of the expected length of retirement at age 20, 1850–1990

| Year | (1) Period estimate (Lower bound) | | | | (2) Cohort estimate (Upper bound) | | | |
|---|---|---|---|---|---|---|---|---|
| | (A) ELRP (years) | (B) $e_{20}$ (years) | (C) (B)–(A) (years) | (D) (A)/(B) (percent) | (E) ELRP (years) | (F) $e_{20}$ (years) | (G) (F)–(E) (years) | (H) (E)/(F) (percent) |
| 1850 | 1.68 | 38.41 | 36.73 | 4.4 | 2.65 | 43.70 | 41.05 | 6.1 |
| 1860 | 1.63 | 40.32 | 38.69 | 4.0 | 3.16 | 43.95 | 40.79 | 7.2 |
| 1870 | 0.83 | 41.14 | 40.31 | 2.1 | 3.48 | 44.05 | 40.57 | 7.9 |
| 1880 | 1.62 | 39.65 | 38.03 | 4.1 | 4.13 | 45.65 | 41.38 | 9.0 |
| 1890 | 2.26 | 40.96 | 38.70 | 5.5 | 4.78 | 46.50 | 41.72 | 10.3 |
| 1900 | 2.93 | 41.73 | 38.80 | 7.0 | 5.50 | 47.29 | 41.79 | 11.6 |
| 1910 | 3.38 | 42.63 | 39.25 | 7.9 | 6.55 | 49.26 | 42.71 | 13.3 |
| 1920 | 3.85 | 44.45 | 40.60 | 8.7 | 8.24 | 51.36 | 43.12 | 16.0 |
| 1930 | 4.95 | 45.14 | 40.19 | 10.9 | 9.56 | 53.01 | 43.49 | 18.1 |
| 1940 | 5.76 | 46.77 | 41.01 | 12.3 | 11.59 | 54.32 | 42.73 | 21.3 |
| 1950 | 6.68 | 49.01 | 42.33 | 13.6 | 13.13 | 55.02 | 41.89 | 23.9 |
| 1960 | 7.88 | 49.65 | 41.77 | 15.8 | 14.26 | 55.54 | 41.28 | 25.7 |
| 1970 | 8.59 | 49.63 | 41.04 | 17.2 | 14.98 | 56.33 | 41.35 | 26.6 |
| 1980 | 11.27 | 51.73 | 40.46 | 21.7 | 15.65 | 57.17 | 41.52 | 27.4 |
| 1990 | 12.66 | 52.95 | 40.29 | 23.8 | 16.29 | 57.76 | 41.47 | 28.2 |

*Source:* Public-Use Micro Samples of 1850, 1860, 1870, 1880, 1900, 1910, 1920, 1940, 1950, 1960, 1970, 1980, and 1990 censuses were used for estimating the age-specific retirement rates for these years. The retirement rates as of 1890 and 1930 were calculated by interpolations. Period life-tables are from Haines (1998) for 1850–1890, from Preston et al. (1972) for 1900–1960, and from U.S. Department of Health and Human Services (1992a) for 1970–1990. Cohort life tables for 1900–1990 come from U.S. Department of Health and Human Services (1992a). The cohort death rate in each age range for 1850 to 1890 was calculated from period life tables reported in Haines (1998). The cohort life expectancy at 20 was calculated based on the 10-year cohort life expectancy estimated by Pope (1992: Table 9.2). See text for the calculation method.

with the result of Kotlikoff and Smith (1983) for the mid-twentieth century, my estimate reveals somewhat slower growth of the ELRP between 1950 and 1970.

## 3. Accounting for the growth of the expected length of retirement

Now, we turn to the relative contribution to the growth in the ELRP of the decline in mortality and the fall in labor force participation among older males. To assess the effect of reduced mortality on the growth of the ELRP from 1900 to 1940, for example, I calculate the ELRP of 1940 using the 1940 retirement rates and the 1900 mortality rates. This counterfactual estimate shows how large the increase in the ELRP would have been between 1900 and 1940 had there been no change in mortality during the same period. An underlying assumption of this analysis is that the labor force participation decision is not determined by mortality expectation. In a similar manner, the effect of reduced mortality is further decomposed into the mortality decline among younger adults aged 20 to 49 and among adults aged 50 and older. Additionally, the contribution of the decline in the LFPR is decomposed into the decline in the LFPR among relatively younger (aged 50–62) and older (aged 63 and over) males.

The result of this calculation is presented in Table 2. It turns out that mortality decline became an increasingly important factor in determining the ELRP over time, as compared to the decline of the LFPR. Mortality decline accounts for 41 to 64% of the increase in the ELRP during the first four decades of the twentieth century, and 58 to 79% of the increase between 1940 and 1990. This pattern may in part be explained by the dramatic decline in adult mortality after 1940, which resulted from advances in medical technology.

Compared to the earlier period, mortality decline among males 50 and older accounts for a greater fraction of the rise in the ELRP between 1940 and 1990. This alone explains about 80% of the increase in the ELRP for this period, while the relative contribution of this decline in mortality for the previous 40 years was 35 to 60%. This result may reflect the impressive decline

**Table 2.** The percentage of the increase in the expected length of retirement accounted for by each factor

| Causal factors | | (1) Period estimate | | (2) Cohort estimate | |
|---|---|---|---|---|---|
| | | 1900–1940 (+2.8 years) | 1940–1990 (+5.9 years) | 1900–1940 (+6.1 years) | 1940–1990 (+4.7 years) |
| Mortality decline | Ages 20 and older | 40.8 | 57.6 | 63.7 | 78.7 |
| | Ages 20 to 49 | 26.6 | 12.8 | 25.4 | 12.8 |
| | Age 50 and older | 14.2 | 44.8 | 38.3 | 65.9 |
| LFPR decline | Ages 50 and older | 59.2 | 42.4 | 36.3 | 21.3 |
| | Ages 50 to 62 | 11.3 | 14.2 | 10.9 | 12.8 |
| | Ages 63 and older | 47.9 | 28.2 | 25.4 | 8.5 |

*Note:* See text for the method of calculation. The number in the second row of the first column (mortality decline, ages 20 to 49, 1900–1940) indicates, for example, 26.6% of the increase in the expected length of retirement between 1900 and 1940 resulted from a decline in mortality among men aged 20 to 49.

in mortality among the elderly in the latter half of the twentieth century. The rise of early retirement, as defined as retirement at ages between 50 and 62, became a much more important source of the rise in the ELRP in the period after 1940 as compared to the earlier era. This outcome appears to result from the different pattern of changing labor force participation between the two age groups. The fall in the LFPR among males 63 and older was continuous over the last century. On the other hand, labor force participation at younger ages began to decline only after 1940.[10]

## 4. Some implications

In a simple life-cycle model of savings, individuals determine their life-time paths of labor supply (including the timing of retirement) and consumption based, in part, on their expected age of death. That is, they choose the expected length of retirement and the size of savings which they expect will maximize their life-time utilities. The present values of savings and of retirement consumption should be equalized to satisfy the intertemporal budget constraint. What we observe from the estimated expected length of retirement is the aggregate outcome of such decisions made by individuals in each cohort. If we assume, for simplicity, that life-cycle consumption patterns of individuals remained unchanged across different cohorts, a longer duration of retirement of a cohort indicates a greater retirement consumption, and thus larger life-cycle savings. For this reason, the ELRP estimated above has useful implications for the size of life-cycle savings, as I will now show.

First, the results of this study provide a new clue to the source of capital formation in the early twentieth century. A twenty-year-old male worker would have expected a considerable length of retirement, 7 to 12% of his remaining life, at the turn of the century. Suppose that individuals perfectly smooth consumption over the life cycle. In this case, the result implies that a person would have to save 7 to 12% of their life-time incomes for retirement if the rate of return to their wealth accumulation was zero. If the rate of return was 1.5%, the life-time savings rate required for retirement would have been 5.6 to 9.6%.[11] These estimates may overstate the actual size of life-cycle savings because they are based on the assumption of a constant age-consumption profile. Given that the personal savings rate was about 10% in 1900, however, it appears that life-cycle savings were a considerably important source of wealth accumulation in the early twentieth century.[12] In the mid-nineteenth century, on the other hand, the size of retirement savings was probably small, as indicated by the very brief retirement period. This is consistent with the study of Alter, Goldin, and Rotella (1994) who reported that life-cycle accumulation was not a major motive for savings in mid-nineteenth century Philadelphia.

The long-term increase in the ELRP indicates that individuals should have saved an increasing proportion of their incomes over time to finance retirement. If the rate of return is assumed to be 1.5%, the 1990 labor market cohort should save 19.5 to 22.5% of their life-time incomes to maintain their consumption levels after they retire. If the rate of return is 3%, the required savings rate is still as high as 13.5 to 15%. On the other hand, the actual aggregate private savings rates, defined in various ways, exhibit a stable or even declining trend over the last century (David and Scadding 1974; Maddison

1992; Shafer et al. 1992; Lee 1996). Therefore, the proportion of savings that represent life-cycle savings would have increased over the last hundred years.

The above result also has significant implications for the potential saving effect of Social Security. A number of studies have proposed that Social Security could stimulate retirement savings by enforcing a retirement age of sixty-five and thus increasing the length of retirement (Munnell 1974; Feldstein 1974). However, as shown in Table 2, the LFPR decline among males aged 63 or older accounts for only 9 to 28% of the total growth in the expected duration of retirement between 1940 and 1990. Obviously, not all of this fraction of the decline was caused by Social Security. Therefore, the retirement effect of Social Security, if any, was small in magnitude.

The result of this study also helps forecast the future trend in the ELRP. The current LFPR of males aged 65 and older is under 16%, and it seems that little room remains for further decline. However, it is likely that mortality among the elderly and the LFPR of men under age 65 will continue to fall in the future. The recent trends in demographic features confirm this conjecture. The mortality rate for men 50 and older fell in a steady manner during the last five decades.[13] The LFPR of males aged 64 and younger started to fall rapidly after 1970.[14] In light of these anticipated changes in demographic features, the future generation will probably have a longer period of retirement.

## 5. Conclusions

This paper has estimated the expected length of retirement for each labor market cohort between 1850 and 1990, based on its mortality and retirement experiences. The result shows that since 1850, the expected length of retirement has increased by more than six-fold and now represents up to 30% of men's length of life after entry into the labor force. Mortality decline and the fall in labor force participation were almost equally important in accounting for the increase in the length of retirement between 1900 and 1940. After 1940, in contrast, mortality decline was the dominant factor in the increase in the length of retirement. The result suggests that life-cycle savings were a non-trivial, if not the major, source of wealth accumulation in the early twentieth century. The proportion of savings that represent life-cycle savings should have increased substantially over the last century.

## Endnotes

1 Age-specific labor force participation rates estimated using the Integrated Public Use Microdata Samples (IPUMS) of the censuses of 1900 to 1990 show that a substantial proportion of male workers left the labor force between ages 55 and 64.

2 It is widely assumed in economics literature, particularly in standard overlapping generation models, that a child's consumption is determined by his or her parents; the decisions of resource allocation over the life cycle are made at the beginning of the working period given an individual's preference and the path of lifetime income.

3 Among twenty-year-old males in 1900, 3.4% would die within the following five years, according to the life table. The table suggests that if age twenty-five were chosen instead of twenty, the estimate of the expected retirement duration would increase by 3.4%, because the probability of surviving until the starting age of retirement would fall by 3.4%. This difference between choosing 20 and 25 is even smaller for more recent years because of lower adult mortality.

[4] It is difficult to estimate correctly the LFPR of older males for each single age because the number of men aged over 70 is relatively small in the public-use micro samples. For this reason, a five-year age interval is used in the actual estimation. The underlying assumption is that the age-mortality and age-LFPR associations are linear within each five-year age range. This assumption seems to be a fairly close approximation of the real age profiles of mortality and the LFPR.

[5] Past changes in mortality have never been well predicted even by population experts. In the early seventies, for example, the U.S. Bureau of the Census claimed that no further major gains in life-expectancy would be achieved based on the mortality trend of the preceding decade. Today, scholars in a variety of fields are at odds over the future trend in adult mortality. There is no consensus on the biological limits of the human lifespan (Fogel 1994; Ahlburg and Vaupel 1990).

[6] There are three alternative projections based on different assumptions. I use the upper projections of retirement rates because the purpose of the cohort estimate is to get an upper bound estimate of the ELRP.

[7] The current concept of the labor force has been in use since the 1940 census; the concept of gainful employment was used by the U.S. Census through 1930. For the definition of the labor force for the censuses through 1930 see Ransom and Sutch (1986), Moen (1987b), Margo (1993), and Lee (1998).

[8] The cohort life tables after 1920 are partly based on the projections of mortality and life expectancy of each cohort in the future. The data used for estimating the period and cohort estimates of the ELRP are presented in Lee (1996, Tables D1 to D2).

[9] Though retirement rate was low among males aged 50 to 64, the estimate of the expected length of retirement is greatly affected by considering early retirement in the analysis. A man who retires at age 50 to 64 would have a longer retirement period, and this long retirement would be more heavily weighted, because a larger proportion of a cohort would remain alive in these age ranges. Indeed, the period estimate of the expected length of retirement would have been about two-thirds of my estimate given above (1.98/2.93), had no one retired before age 65.

[10] The LFPR among men 65 and over was 65.4% in 1900, 43.5% in 1940 (Moen 1987a, 29), and only 16% in 1990 (U.S. Bureau of the Census 1994). The LFPR of males aged 50 to 64 was about 92% in 1900; it slightly declined to 88% by 1940, and fell sharply to 74% by 1990 (Calculated from IPUMS of the 1900, 1940, and 1990 censuses).

[11] This calculation is based on the assumption that individuals save a fixed share of their incomes over the life cycle. Otherwise, as long as the rate of return is positive, the proportion of lifetime income required for retirement consumption would depend on the timing of wealth accumulation as well as the length of retirement.

[12] The personal savings rate is defined as the ratio of personal income to disposable personal income. The data on annual income and savings are collected from U.S. Bureau of the Census (1975), F9 and F543. This result does not change much if we consider private savings that include undistributed corporate profits in addition to personal savings. The U.S. private savings rate for 1900 was 12.6%.

[13] The increase in life expectancy at age 60 between 1970 and 1990 (2.2 years) was greater than that gained during the previous seven decades (1.8 years).

[14] The two decades after 1970 saw a greater decline in the LFPR of this age group (10 percentage points) than during the previous seven decades (7 percentage points).

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