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3 Health Capacity to Work at Older Ages in Denmark

Paul Bingley, Nabanita Datta Gupta, and Peder J. Pedersen

3.1 Introduction

Many countries are increasing the ages at which pension benefits are first available, and thereby reducing incentives to retire early. Moreover, with increased life expectancy, the global move from defined benefit toward defined contribution pension plans implies lower per-period consumption, all else equal, unless individuals work longer and retire later. Both of these changes push toward delayed retirement, but it remains to be shown

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that individuals have the health capacity to sustain extended working lives. Indeed, much of the work we have done in previous stages of the International Social Security project (Wise 2015), which relates to retirement age responsiveness to pension incentives (Bingley, Datta Gupta, and Pedersen 2004), health (Bingley, Datta Gupta, and Pedersen 2012), and disability insurance (Bingley, Datta Gupta, Jorgensen, and Pedersen 2015), implicitly assumes that individuals have sufficient unused health capacity to work at older ages. In this study we will estimate how much unused health capacity to work exists.

Among the Organisation for Economic Co-operation and Development (OECD) countries, Denmark has relatively short life expectancy and late age of first eligibility to old age pension. These combined to give Danes the lowest life expectancy after pensionable age (1993–2002; 13.4 years for men and 16.6 years for women). Old age pension benefits could first be received at age sixty-seven until 2004, and this was reduced to age sixty-five by 2006 in six-month steps. In 2011 it was announced that from 2019 to 2022 the age of first eligibility will once again be raised to sixty-seven in six-month steps. Life expectancy after pensionable age jumped by three years during the first decade of the twenty-first century, the largest increase of all countries, but after the 2019–2022 reform is implemented Danes will once again have the shortest expected retirements (OECD 2011).

Denmark was the first country to automatically link pensions to life expectancy in their retirement income system (Whitehouse 2007). Beginning in 2030, Denmark will link changes in age of first eligibility to old age pension to changes in life expectancy from age sixty. The aim is to maintain life expectancy after pensionable age close to the 14.5 years observed in 2004–05, the two years before the automatic linkage reform was announced (Ministry of Integration and Social Affairs 2013). However, the rate of increase due to automatic linkage with life expectancy is capped such that pensionable age can at most increase by one year every fifth year. Projected life expectancy from age sixty in 2025 (minus 14.5 years) is rounded to the nearest half year to give the implied pensionable age in 2030. The projection to 2025 uses life expectancy from age sixty during 2013–14, and assumes a trend that adds 0.6 years. These calculations imply a pensionable age in 2030 of 69.5 years, but since pensionable age can only increase by at most one year, eligibility will be from age sixty-eight in 2030.

In several countries, gains in longevity are expected to outpace announced future delays in pensionable ages. Denmark has among the shortest life expectancies after pensionable age and has a history of policy attention to the measure. This makes Denmark an excellent case for measuring health capacity for extending the working life, since post-retirement longevity itself, regardless of health status, is a greater constraint in Denmark than anywhere else. Finding unused work capacity in Denmark ought to be a greater challenge because of the high base of work capacity used already.

In this chapter we ask to what extent older Danes have the health capacity to extend their working lives. We do this by estimating health-employment relationships in the past, or for younger cohorts today, and predicting how much work capacity there would be for older cohorts in similar health today if those estimated relationships held for today's older cohorts. Ideally, we would like to know what the health-employment relationship might be in the absence of non-health-related social security programs. We take two approaches to obtaining this counterfactual health-employment relationship, by fitting the relationship historically before the introduction of early pension benefit programs, or by fitting the relationship for younger cohorts today who have not yet reached pension benefit eligibility age.

For the first approach following Milligan and Wise (2012), we look at the historical relationship between mortality and employment rates and ask how much older people would work today, given current mortality rates, if they were to work as much as they did at a similar mortality rate in the past. Using published data from Statistics Denmark, we plot the mortality-employment relationship for several years from 1977 to 2010 and find significant unused work capacity compared to today for all baselines up until 2000. We only estimate mortality-employment relations for men for the sake of better comparison with other countries, where increasing older female labor market participation makes estimates for women difficult to interpret.

For the second approach, inspired by Cutler, Meara, and Richards-Shubik (2012), we estimate the relationship between self-assessed health (SAH) and employment for somewhat younger cohorts and ask how much older cohorts, with similar SAH, would work if the same health-employment relationship held. We use microdata from the Survey of Health and Retirement in Europe for Denmark (SHARE-Denmark) collected in 2004–13 to estimate the relationship for those age fifty to fifty-four and to predict work capacity for ages fifty-five to seventy-four. We find significant unused work capacity from age sixty and older for both men and women. Estimated unused work capacity is remarkably similar for the group; we consider using both methods—for men age fifty-five to sixty-nine—when we use a 1977 mortality-employment relationship baseline. The Cutler method implies 4.8 years and the Milligan-Wise method implies 4.6 years unused work capacity, compared to 7.6 years currently working. Women are predicted to have slightly more unused work capacity than men using the Cutler method for ages fifty-five to sixty-nine at 5.1 years, compared to 6.1 years currently working.

The remainder of the chapter is organized as follows: As background, the next section describes trends in labor force participation, health, and mortality. In section 3.3 we estimate work capacity using the historical mortality-employment relationship following Milligan and Wise (2012). In section 3.4 we describe trends in SAH, and in section 3.5 we estimate the SAH-employment relationship for younger cohorts following Cutler, Meara, and Richards-Shubik (2012). Finally, we conclude with a discussion of the implications of our findings in section 3.6.

3.2 Trends in Labor Force Participation and Health

This section summarizes the trends in labor force participation in Denmark over the last fifty years for men and women age sixty to sixty-nine. We split the discussion for those age sixty to sixty-four and sixty-five to sixty-nine because of data availability and differences in eligibility to pension benefits between these two age groups. Figure 3.1 presents the evolution of labor force participation for sixty- to sixty-four-year-olds based on several different sources.

Until the late 1990s, trends in labor force participation by gender are very different from each other, with a 70 percentage point differential in 1960 declining to 18 percentage points by 2013. The initial decline for men in the 1960s reflects structural change with a sectoral shift of employment from agriculture, which was comprised largely of independent farmers, toward industry. The dramatic decline in labor force participation for men in 1980 is the initial impact from the introduction of a non-health-related pension benefit program, the Post Employment Wage ([PEW]; efterløn), with eligibility ages of sixty to sixty-six, depending on the sufficiently long membership

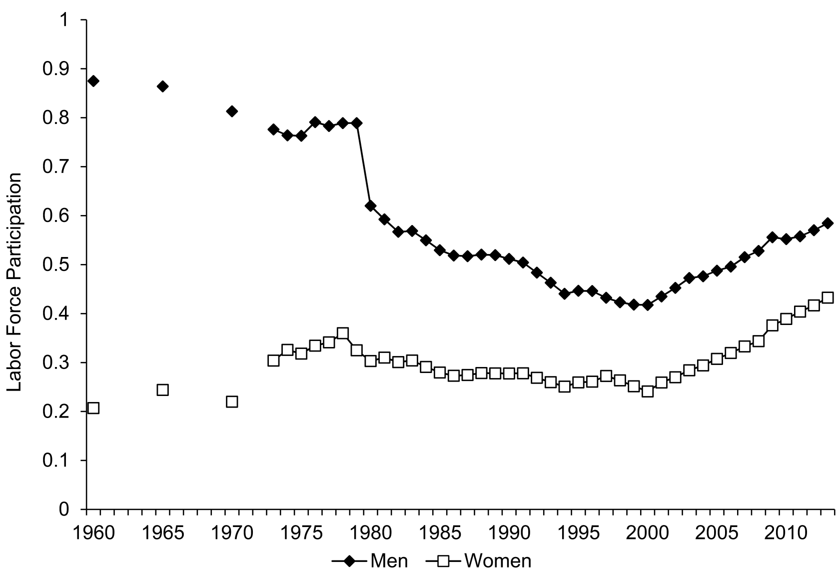

Fig. 3.1 Labor force participation rates for ages sixty to sixty-four by gender over time

Sources: Population census 1960, 1965, and 1970; annual labor force surveys 1973–1975; annual statistics based upon a 10 percent administrative sample 1976–79; and 1980–2013 administrative data on the full population.

of an unemployment insurance fund. For women, the initial impact was much smaller because of lower baseline participation and less PEW eligibility among working women due to insufficient history of Unemployment Insurance fund membership.

The strong upswing in labor force participation rates from the late 1990s, also found in many other OECD countries (see, e.g., Larsen and Pedersen 2013), is the result of several interacting factors. Since 1999 a number of policy changes have been made with the aim of discouraging early retirement. Further, average education and health has improved strongly for this group, with retirement age having a positive gradient in both factors (cf. Larsen and Pedersen 2015). Actually, sixty- to sixty-four-year-olds are the only age group to have experienced an increase in labor force participation rate since the onset of the Great Recession in 2008. For all younger age groups participation rates have fallen since 2008, especially among the young. However, in spite of improvements in health, to which we return below, labor force participation for men age sixty to sixty-four is still 20 percentage points below the level of the late 1970s. Our aim is to estimate the potential work capacity of today's older cohorts in view of reductions in mortality and SAH improvements of recent years.

In figure 3.2 we present the development of labor force participation for those age sixty-five to sixty-nine. For men, the initial level is about

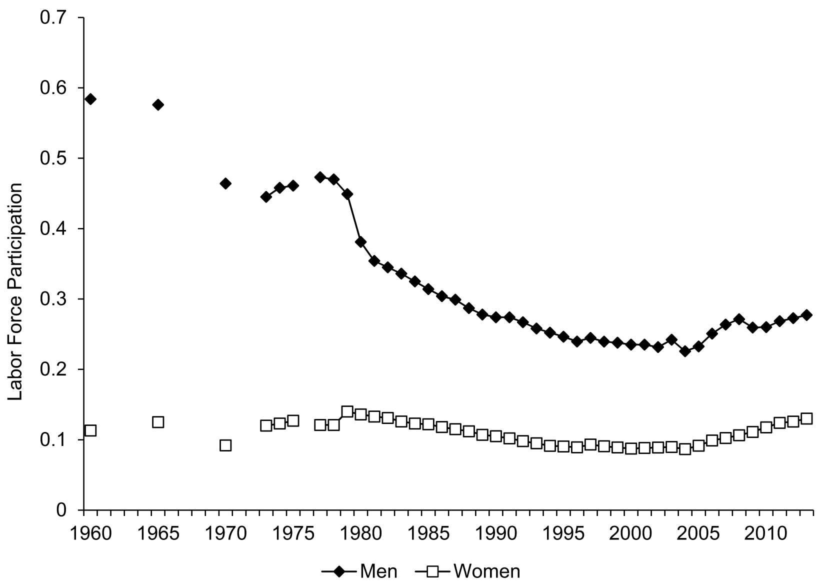

Fig. 3.2 Labor force participation rates for ages sixty-five to sixty-nine by gender over time

Sources: Population census 1960, 1965, and 1970; annual labor force surveys 1973–1975; annual statistics based upon a 10 percent administrative sample 1976–79; and 1980–2013 administrative data on the full population.

30 percentage points lower than for the sixty- to sixty-four-year-olds. We find the same steep decline in labor force participation in the second half of the 1960s as found for the sixty- to sixty-four-year-olds, reflecting the same switch from independent farming. Following the introduction of PEW in 1979, labor force participation falls, although less steeply than for the sixty- to sixty-four-year-olds because, of this older group, only those age sixty-five to sixty-six were eligible for PEW.

The next visible change in labor force participation rates occurs in the years immediately after 2000, which continues the increases in labor force participation for sixty- to sixty-four-year-olds in the preceding period. From 2004 to 2006, sixty-five- to sixty-six-year-olds were no longer eligible for PEW, as the age for first eligibility to Old Age Pension (folkepension) was reduced from sixty-seven to sixty-five. The modest upward trend since 2000 is somewhat diminished for men, reflecting this 2004–06 reform. Nevertheless, labor force participation for men in 2013 was half that of 1960. For women age sixty-five to sixty-nine, we see a very small increase in labor force participation after 2000. Overall, however, the level for women is stationary, around 10–12 percent, since 1960.

Summing up, for sixty- to sixty-nine-year-old men labor force participation over the last thirty to thirty-five years has declined by about 20 percentage points. As longevity has increased along with level of education, there is clearly scope for analyzing the health-related factors behind the potential for reversing this decline as part of accommodating demographic changes in the coming decades.

As an introduction to the analyses of health factors, figure 3.3 collects evidence on the development in mortality and self-assessed health for men age fifty to seventy-five over the last twenty years. Data on self-assessed health are available also for other years, but 1994 and 2013 are the most recent years where the same questions and response categories were used. The decrease in mortality is strong, despite the period being fairly short, in contrast to the years before the mid-1990s where mortality in Denmark was quite stationary at the same time as mortality was decreasing in most comparable countries. The share of men with self-assessed health in the fair-poor categories is lower in 2013 than in 1994, and the gradient with respect to age is more flat in the most recent year.

3.3 Work Capacity Estimates Based on Historical Mortality

We will use two different methods to assess the health-related capacity to work at older ages. The Cutler method is used in section 3.5. In this section we present results from applying the methods in Milligan and Wise (2012) to Danish data. The idea is to look at the relationship between mortality and employment at given ages in some earlier year. Next, we look at the employment-mortality relationship in a current year. Comparing employment at given levels of mortality in the year back in time and the current

Fig. 3.3 Male self-assessed health and mortality by year over age

Sources: Mortality rates per 100,000 from Statistics Denmark. SAH from two surveys by the National Institute of Public Health of 1,100 men age fifty to seventy-five with response categories excellent, very good, good, fair, or poor.

year gives an upper-bound estimate of potential extra work capacity in the current year.

A number of conditions and reservations should be emphasized. First, it is assumed that mortality captures all health factors related to work capacity. One can argue that better measures than mortality could summarize physical and mental capacity for continued work at older ages. However, mortality has the clear advantage of being available over a very long period and being comparable between countries.

Figure 3.4 plots the relationship between mortality and employment rate for men fifty-five to sixty-nine years old in 1977 and 2010. The procedure for calculating the upper bound of the additional capacity for work is based on the lines in figure 3.4. Mortality and employment rates are plotted in figure 3.4 for each age, fifty-five to sixty-nine, in 2010. For instance, in 2010 mortality at age sixty was 1.0 percent and the employment rate was 67.4 percent. At that level of mortality, the employment rate in 1977 was 86 percent. Consequently, the upper bound of the additional work capacity in 2010 with 1977 as the base year was 18.6 percent. Running this procedure over all ages we find, not surprisingly, comparing with figure 3.1, that additional work capacity has a steep gradient in age for people in the first half of their sixties.

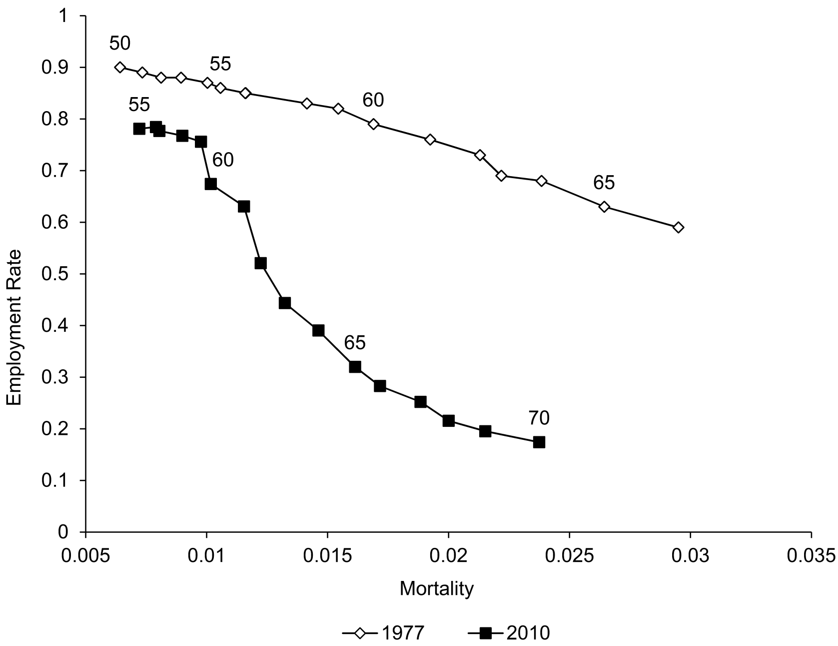

Fig. 3.4 Male employment and mortality by age in 1977 and 2010

Sources: Mortality rates from Statistics Denmark. Employment rates from Statistics Denmark based on annual information from administrative registers using a 10 percent sample in 1977 and the full population in 2010.

The results from the exercise are presented in table 3.1. In 2010, the total number of working years for men fifty-five to sixty-nine years old was 7.8. As a counterfactual, this would correspond to a situation where men fifty-five to sixty-three years old had employment rates of 100 percent and all retired when reaching age sixty-four. The accumulated additional employment capacity in 2010 with 1977 as the base year is 4.7 years, that is, a sizable 60 percent of the actual number of years worked.

In figure 3.5 the same analysis is made comparing 2010 with the much closer year, 1995. While 1977 was two years before the introduction of the PEW program, resulting in a steep decline in male employment rates from age sixty, 1995 was a low point in employment rates (cf. figure 3.1). An obvious consequence is that the two graphs in figure 3.5 are much closer to each other than the corresponding curves in figure 3.4.

Table 3.2 summarizes in the same way as table 3.1 the employment rates and mortality at each age in 2010 along with the employment rate in 1995 at the same mortality rates. A main difference compared with the case using 1977 as the base year is the lack of additional employment capacity at ages fifty-five to fifty-nine. At mortality rates above the age sixty level in 2010, we

Table 3.1 Additional male work capacity in 2010 using 1977 employment-mortality relationship

Age	Mortality in 2010 (%)	Employment rate in 2010 (%)	Employment rate in 1977 at same mortality (%)	Additional work capacity (%)
55	0.72	78.1	89	10.9
56	0.79	78.4	88	9.6
57	0.80	77.7	88	10.3
58	0.90	76.7	88	11.3
59	0.98	75.6	87	11.4
60	1.02	67.4	86	18.6
61	1.15	63.1	85	21.9
62	1.22	52.1	85	32.9
63	1.32	44.4	84	39.6
64	1.46	39.0	83	44.0
65	1.61	32.0	80	48.0
66	1.72	28.3	79	50.7
67	1.88	25.2	77	51.8
68	2.00	21.6	75	53.4
69	2.15	19.5	72	52.5
Total years		7.8		4.7

Note: Own calculations based on mortality rates from Statistics Denmark and employment rates from Statistics Denmark based on annual information from administrative registers using a 10 percent sample in 1977 and the full population in 2010.

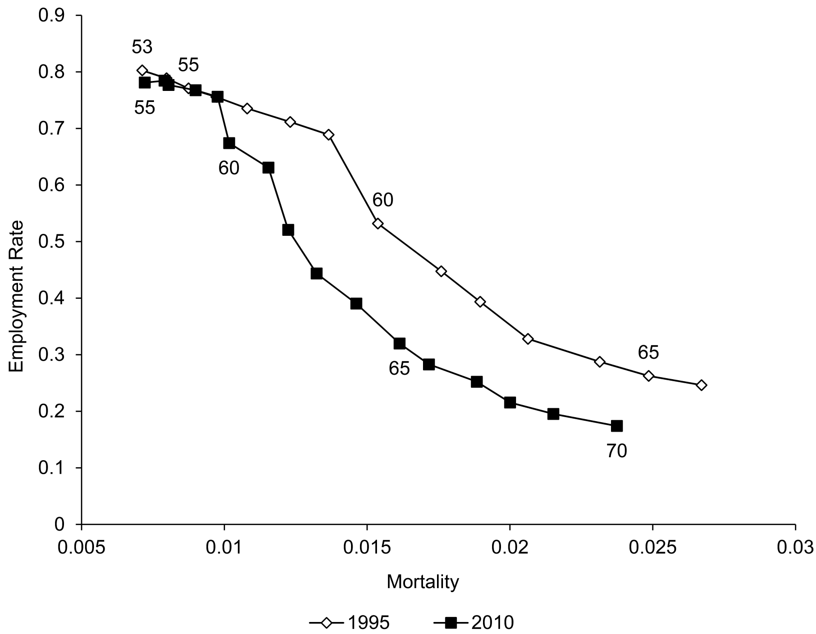

Fig. 3.5 Male employment and mortality by age in 1995 and 2010

Sources: Mortality rates from Statistics Denmark. Employment rates from Statistics Denmark based on annual information from administrative registers for the population.

Table 3.2 Additional male work capacity in 2010 using 1995 employment-mortality relationship

Age	Mortality in 2010 (%)	Employment rate in 2010 (%)	Employment rate in 1995 at same mortality (%)	Additional work capacity (%)
55	0.72	78.1	79.0	0.9
56	0.79	78.4	78.9	0.5
57	0.80	77.7	78.9	1.2
58	0.90	76.7	76.7	0.0
59	0.98	75.6	75.0	–0.6
60	1.02	67.4	74.6	7.2
61	1.15	63.1	72.4	9.3
62	1.22	52.1	71.1	19.0
63	1.32	44.4	69.7	25.3
64	1.46	39.0	60.3	21.3
65	1.61	32.0	50.4	18.4
66	1.72	28.3	46.3	18.0
67	1.88	25.2	40.0	14.8
68	2.00	21.6	35.3	13.7
69	2.15	19.5	31.4	11.9
Total years		7.8		1.6

Note: Own calculations based on mortality rates from Statistics Denmark and employment rates from Statistics Denmark based on annual information from administrative registers for the population.

find additional employment capacity, most pronounced at ages sixty-two to sixty-six. Overall, the additional employment capacity adds up to 1.6 years, or about one-third of the additional employment capacity found in table 3.1, which uses a 1977 baseline.

Figure 3.6 is a summary of the trends in the development of the relationship between mortality and employment rates by including average values for three five-year intervals: the last half of the 1970s (before the PEW program), the first half of the 1990s (when employment rates reached a minimum), and the second half of the first decade of the twenty-first century. A clear illustration of the change over the period is found looking at the pivotal age of sixty. From the late 1970s to the early 1990s, the employment rate drops by 20 percentage points with only a slight decline in mortality. Next, from the early 1990s to late in the first decade of the twenty-first century, employment goes up at age sixty along with declining mortality. From figure 3.5 we know, however, that employment for given levels of mortality is still lower late in the first decade of the twenty-first century compared with the early 1990s at age sixty and older.

Next, in figure 3.7, we have used all the years between 1977 and 2009 as base years comparing with the mortality employment relationship in 2010. As expected, the estimated additional work capacity becomes smaller as we

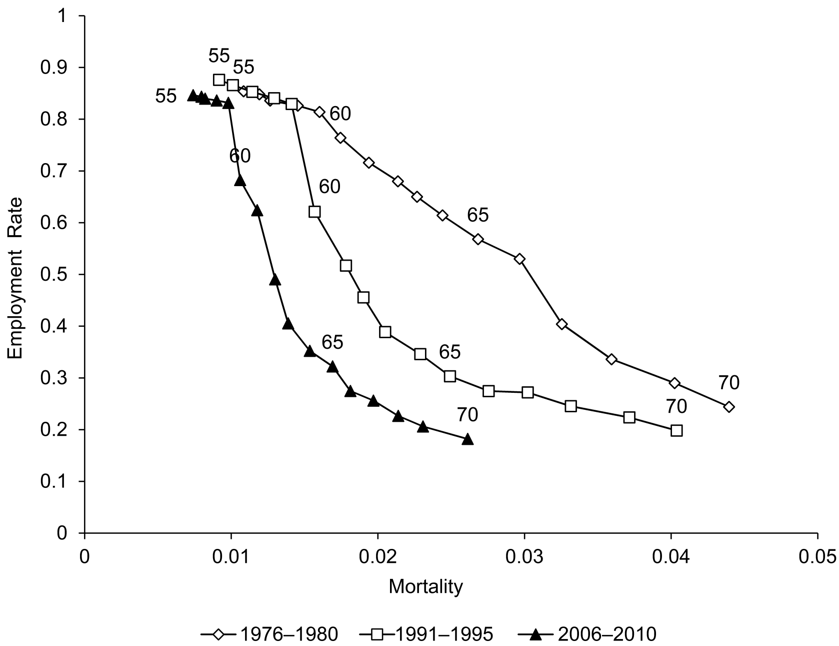

Fig. 3.6 Male employment and mortality 1976–80, 1991–95, and 2006–10

Sources: Mortality rates from Statistics Denmark. Employment rates from Statistics Denmark based on annual information from administrative registers using a 10 percent sample in 1976–79 and the full population in 1980, 1991–95, and 2006–10.

move closer to 2010; that is, differences in mortality rates become smaller and changes in employment rates also become smaller. From about the turn of the century, additional work capacity becomes stationary at a level close to zero as mortality declines faster at the same time as employment rates increase (cf. figures 3.1 and 3.2).

The additional work capacity found by using the Milligan-Wise method does not imply the normative conclusion that older people should continue working in accordance with the increase in employment capacity we find. Our finding should instead be seen as a contribution to the arguments and analyses in the so-called "healthy life debate," that is, to what extent does increasing longevity result in more healthy years with a potential for a longer working life, or is most of the gain spent in poor health and disability. There is a wide-ranging literature on this topic, of which only a few contributions are mentioned here. Mathers et al. (2001) calculate healthy life expectancy for 191 countries in 1999 using the method of Sullivan (1971), which combines surveys of SAH with life tables. They find that healthy life expectancy increases across countries at a faster rate than total life expectancy. Christensen et al. (2009) present as a conditional projection that most children born in Denmark since the turn of the century will survive until

Fig. 3.7 Additional male work capacity in 2010 by base year for comparison

Source: Own calculations based on mortality rates from Statistics Denmark and employment rates from Statistics Denmark based on annual information from administrative registers using a 10 percent sample in 1977–79 and the full population in 1980–2010.

age 100 and older, but it remains to be established whether age of onset of functional limitations and disability increases in a similar way.

Using Danish data for the year 2000, Brønnum-Hansen et al. (2004) consider life expectancy and health expectancy by educational levels. They find a social gradient in both, but the gradient in health expectancy is greater than in life expectancy. Being a cross-section study, it contains only an implicit contribution to answer the question about the development over time. An attempt at an explicit answer is found in Brønnum-Hansen (2005), building on comprehensive Danish surveys from 1987 to 2000 and combined with life table data using the Sullivan (1971) method. Over this period, Brønnum-Hansen (2005) finds disability-free life time increasing more than total life expectancy, and more so for men than for women.

3.4 Self-Assessed Health and Employment by Age over Time

An alternative to the use of mortality as an overall health indicator is to rely on individuals' own evaluation and to study SAH from surveys as an indicator for health-related capacity for work. Denmark does not have a long time series of comparable SAH measures. The National Institute of

Public Health conducted a number of surveys beginning in 1987. We have access to microdata from the 1987 survey (cf. below). For other years data are available in a processed form and the results regarding SAH from two comparable surveys in 1994 and 2013 were included in figure 3.3. Besides the National Institute of Public Health surveys, we can use the European Community Household Panel (ECHP), SHARE, and other smaller surveys. For the purpose of the present study, there are issues regarding lack of comparability between surveys, coverage of only a short span of time consistently within surveys, and small sample sizes.

Below we present SAH from these surveys and relate this to the age of eligibility to the major social security programs. First, figure 3.8 presents the relationship between labor force participation rates and SAH based on a fairly small survey collected in 1977. This provides the only self-assessed health measure before the introduction of PEW. Results from the survey are described and discussed in Olsen and Hansen (1977). The SAH is measured on the horizontal axis as the share reporting their health as fair for my age group to poor. The vertical axis measures average labor force participation rate at each age. In 1977 disability insurance (DI) was the only

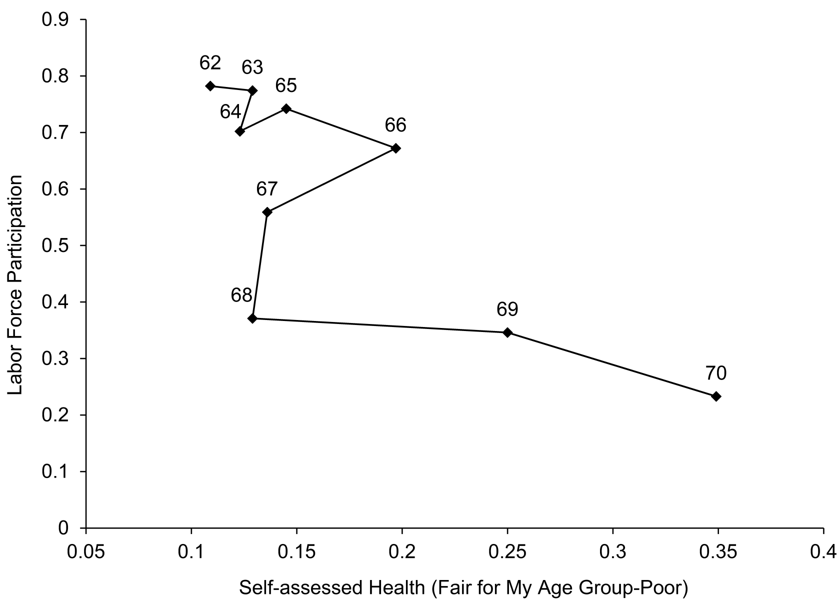

Fig. 3.8 Male SAH and labor force participation rate by age in 1977

Sources: Labor force participation rates from Statistics Denmark based upon a 10 percent administrative sample. The SAH from a survey of 600 men conducted by SFI (Olsen and Hansen 1977). Our SAH means are based on microdata from this survey retrieved from Danish Data Archive Study no. 00232. The SAH response categories are good, good for my age, fair, fair for my age, and poor.

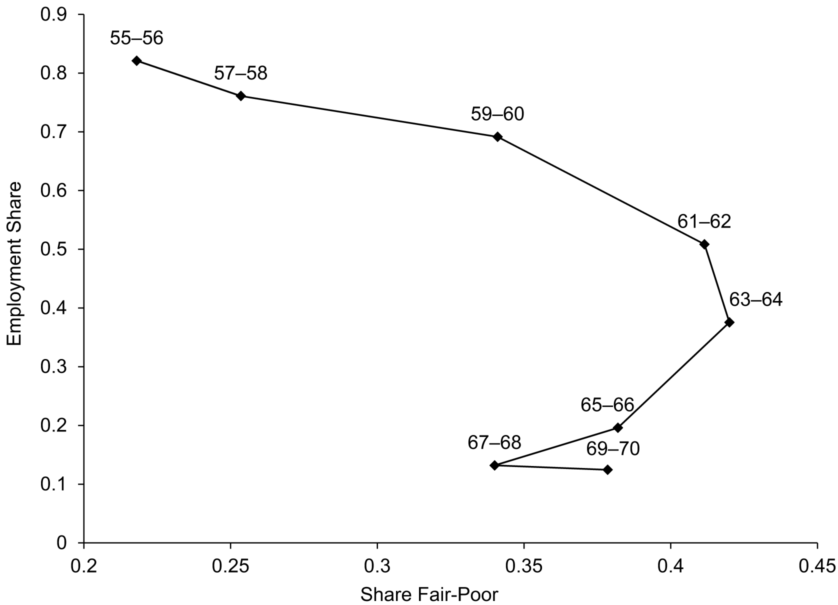

Fig. 3.9 Male SAH and labor force participation rates by age in 1986–87

Sources: Employment rates from Statistics Denmark based upon administrative data for the population. The SAH comes from a survey of 1,000 men conducted by the National Institute of Public Health. Our SAH means are based on microdata from this survey retrieved from Danish Data Archive Study, no. 01435. The SAH response categories are excellent, very good, good, fair, or poor.

early exit route from the labor market before eligibility for old age pension at age sixty-seven. The expected negative slope is found in figure 3.8, and the impact of reaching eligibility for old age pension is seen as a decline in labor force participation of about 30 percentage points without any visible deterioration of SAH—if anything, health improves for a few years right after retirement age.

There is a ten-year gap until the next available SAH measure. Results from a survey conducted by the National Institute of Public Health in 1987 are shown in figure 3.9. The horizontal axis measures the share of respondents at each age reporting health as fair-poor, while the vertical axis measures labor force participation rates. Smoothing results are shown as two-year averages. In 1987 PEW was fully phased in with eligibility from ages sixty to sixty-six, followed by OAP from age sixty-seven. The slope in figure 3.9 is clearly negative with a major deterioration of SAH from age fifty-five to the early sixties. Notice the steep decline in labor force participation from the early sixties until eligibility to old age pension followed by a moderate improvement of self-assessed health in the late sixties.

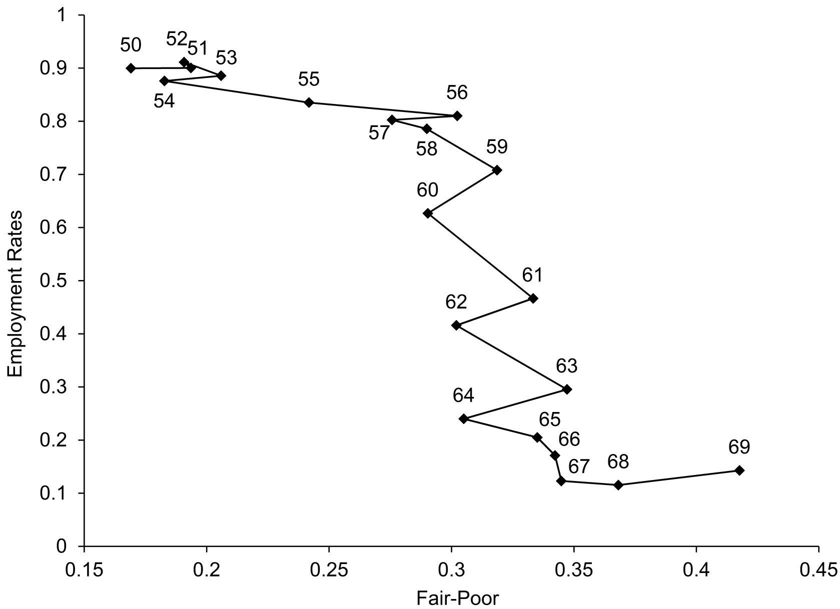

Fig. 3.10 Male SAH and employment rates by age (1994–2001)

Sources: Employment rates from Statistics Denmark based upon administrative data for the population. The SAH comes from ECHP 1994–2001 (waves 1–8) containing 4,000 Danish men age fifty to sixty-nine. The SAH response categories are very good, good, fair, bad, very bad.

Data for Denmark from the ECHP collected in the years 1994–2001 over eight waves makes it possible to construct a relationship between SAH and employment rates based on more observations by pooling over waves. The result is shown in figure 3.10 for men ages fifty to sixty-nine. The SAH deteriorates quite rapidly during the fifties, while the sixties, until age sixty-seven, are characterized by a steep drop in employment rates—more so in the PEW years than close to old age pension—at about the same level of SAH. After reaching pensionable age, SAH deteriorates again while employment rates remain around 10 percent.

In figure 3.11 we show the relationship between SAH and employment rates based on SHARE data from wave 4 collected in 2011. It appears that, after a transition from data points for single years to working with moving three-year age averages, we still have a "noisy" relationship. However, like in figure 3.10, we have a deterioration of health in the fifties followed by another phase of deterioration from the mid-sixties. In between, employment rates drop significantly, first reflecting PEW and at higher-age old age pension where the age of eligibility from 2004 to 2006 has been sixty-five years.

Once again, using Danish data from the ECHP averaged over the eight waves between 1994 and 2001, figure 3.12 shows the relationship between SAH and employment, but now separately for the three education levels classified as ISCED 0–2, ISCED 3, and ISCED 5–7. Lines for different education levels are nearly completely separated. Employment rates are initially at the same level at age fifty. The difference in employment rates has increased to 10 percentage points at age fifty-five, increasing to a difference of 25 percentage points at age sixty-five.

In summary, the general pattern of reducing labor force participation rates and worsening SAH as men age is clear throughout. However, given the infrequency with which SAH has been surveyed in Denmark, and the lack of comparability of SAH between surveys, it is not possible to speak about trends over time. Nevertheless, the relationship is steepest (greatest falls in participation for modest falls in SAH) during ages of eligibility to early pension benefits. There are striking SAH differentials by education, with the SAH deterioration from age fifty to seventy within schooling level (compulsory, high school, and college) roughly equal to mean SAH differences between schooling levels. In the next section we analyze the SAH-employment and schooling relationship in more detail.

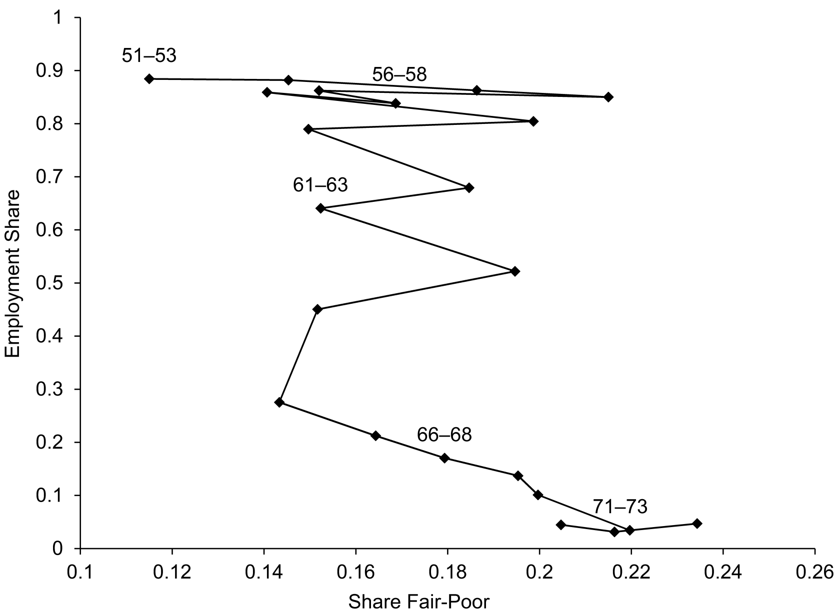

Fig. 3.11 Male SAH and labor force participation rates by age in 2011

Sources: Employment rates from Statistics Denmark based upon administrative data for the population. The SAH are from SHARE-Denmark 2011 (wave 4) containing 900 men age fifty-one to seventy-three. The SAH response categories are very good, good, fair, poor, very bad.

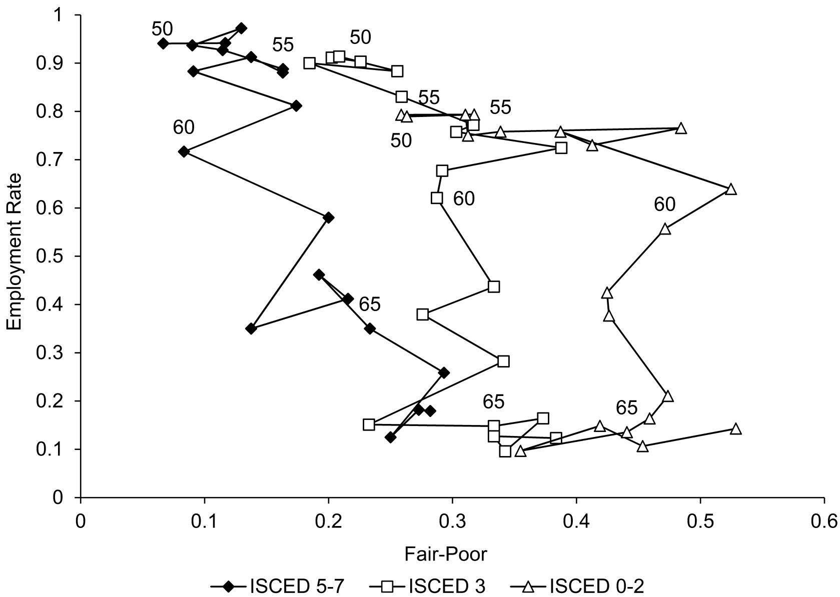

Fig. 3.12 Male SAH and employment rates by age and schooling (1994–2001)

Sources: Employment rates from Statistics Denmark based upon administrative data for the population. The SAH are from ECHP 1994–2001 (waves 1–8) containing 4,000 Danish men age fifty to sixty-nine. The SAH response categories are very good, good, fair, bad, and very bad. The ISCED codes 0–2, 3, and 5–7 correspond to compulsory schooling, high school, and college, respectively.

3.5 Work Capacity Estimates Based on Self-Assessed Health

In a second approach to estimating health capacity to work, we ask how much older cohorts would work today if they had the same relationship between SAH and employment as younger cohorts have today. This approach is inspired by Cutler, Meara, and Richards-Shubik (2012) who use HRS data to estimate the relationship between SAH, retirement, and disability insurance receipt for the near elderly and use estimates to simulate behavior of the elderly.

We use data from SHARE-Denmark, which was collected in 2004, 2006, 2011, and 2013, that is, waves 1, 2, 4, and 5. SHARE-life was conducted as wave 3 and contained retrospective questions about life histories, but not contemporaneous SAH, so we cannot use this wave for the current analysis. SHARE is a longitudinal survey that collects data across nineteen European countries on individuals age fifty or older and their spouses (Börsch-Supan et al. 2013). It has much in common with HRS, Japanese Study of Aging and Retirement (JSTAR), and English Longitudinal Study of Ageing (ELSA), making it an ideal data set for our study, which should be as comparable as possible with similar studies for other countries.

Descriptive statistics for SHARE-Denmark are presented in table 3.3 by age group and gender. Our estimations and simulations will be conducted separately by gender and these age groupings. In total we have 3,273 observations of men and 3,650 observations of women. Proportion working is always higher for men than for women, is high and fairly stable before age sixty, and then falls through age seventy, most of the reduction taking place in the late sixties for men, but evenly throughout the sixties for women. Younger age groups have more schooling, especially at the college margin, and markedly so for women. The SAH worsens with age, but levels and profiles are quite similar by gender. Men are much more likely to be overweight than women and there is a slight age gradient in obesity for men, with younger men being more obese than older. Women have more limitations than men both physically and with regard to activities of daily living. Doctor visits are common for both men and women, though somewhat less for men in their fifties. Men are more likely to have had a hospital stay than women. Nursing home stays are very uncommon. Of the eight specific health conditions considered, back problems are the most common for all ages. Arthritis doubles from the early fifties to the early seventies. Diabetes and hypertension are more common in women, and heart disease and stroke are more common in men.

In order to estimate the relationship between SAH and employment we need to characterize health in a way that allows for comparison with other countries. We calculate a single health index following Poterba, Venti, and Wise (2013), who create an index that is a reasonable predictor of mortality in HRS data. Using the health variables described in table 3.3, SAH, body mass index, types of limitations, care usage, and a set of specific health conditions, we calculate the first principal component for both genders and all age groups pooled. This principal component is used to predict a single health index and we normalize this index to percentiles, where by convention a higher percentile indicates better health. For example, (wo)men age fifty to fifty-four have a mean percentile of 58 (54), and (wo)men age seventy to seventy-four have a mean percentile of 44 (39).

The ordinary least squares (OLS) regression estimates for the dependent variable working are presented in table 3.4. The sample is age fifty to fifty-four and regressions are run separately for men and women. Better health is strongly and positively associated with employment. A move of 10 percentiles up the health distribution is associated with a 4.6 percentage point higher employment probability for women and 3.7 percentage point higher employment probability for men. High school, and especially college, is associated with higher employment probability. Married individuals are more likely to be working. Goodness-of-fit is somewhat better for women than for men.

Using the estimates from table 3.4 for the youngest of our age groups, we simulate work capacity by predicting on the basis of health and demographic characteristics for older age groups. In doing this we are assuming that the health-employment relationship is constant between age groups, so that we can meaningfully combine coefficients estimated on the younger

Table 3.3 **Descriptive statistics for SHARE-Denmark estimation and simulation sample**

	Men					Women				
	50–54	55–59	60–64	65–69	70–74	50–54	55–59	60–64	65–69	70–74
Working	0.862	0.826	0.551	0.159	0.037	0.827	0.758	0.402	0.078	0.019
High school	0.456	0.450	0.448	0.471	0.457	0.272	0.317	0.337	0.368	0.347
College	0.379	0.367	0.350	0.354	0.279	0.544	0.481	0.439	0.323	0.237
Married	0.700	0.684	0.728	0.699	0.659	0.728	0.670	0.666	0.624	0.582
SAH very good	0.343	0.356	0.334	0.339	0.290	0.371	0.343	0.369	0.359	0.274
SAH good	0.229	0.234	0.243	0.262	0.286	0.214	0.223	0.191	0.233	0.265
SAH fair	0.106	0.125	0.133	0.159	0.185	0.107	0.154	0.188	0.141	0.216
SAH poor	0.041	0.060	0.042	0.042	0.073	0.052	0.047	0.043	0.032	0.080
BMI underweight	0.003	0.000	0.001	0.005	0.004	0.021	0.016	0.025	0.023	0.034
BMI overweight	0.415	0.440	0.417	0.421	0.415	0.270	0.283	0.321	0.289	0.310
BMI obese	0.178	0.141	0.139	0.145	0.108	0.118	0.134	0.148	0.129	0.119
Limits any ADL	0.037	0.043	0.053	0.066	0.086	0.049	0.046	0.057	0.050	0.084
Limits any IADL	0.062	0.046	0.045	0.069	0.110	0.075	0.101	0.099	0.095	0.181
Limits physical 1	0.104	0.110	0.152	0.164	0.138	0.096	0.128	0.121	0.160	0.188
Limits physical 2+	0.099	0.116	0.117	0.130	0.213	0.161	0.196	0.257	0.213	0.338
Doctor visit	0.712	0.774	0.808	0.831	0.870	0.839	0.830	0.842	0.887	0.871
Hospital stay	0.064	0.097	0.113	0.122	0.167	0.082	0.096	0.108	0.099	0.134
Nursing home stay	0.000	0.000	0.006	0.000	0.004	0.000	0.000	0.003	0.003	0.002
Back problems	0.442	0.503	0.432	0.444	0.433	0.487	0.523	0.504	0.459	0.498
Arthritis	0.197	0.264	0.312	0.310	0.437	0.211	0.214	0.309	0.386	0.431
Diabetes	0.135	0.168	0.215	0.204	0.240	0.199	0.268	0.333	0.346	0.358
Heart disease	0.058	0.043	0.083	0.087	0.138	0.033	0.046	0.056	0.068	0.080
Lung disease	0.036	0.056	0.069	0.076	0.099	0.050	0.059	0.073	0.081	0.093
Stroke	0.033	0.033	0.032	0.043	0.084	0.021	0.023	0.020	0.023	0.039
Hypertension	0.011	0.021	0.031	0.050	0.044	0.050	0.044	0.055	0.060	0.069
Cancer	0.000	0.001	0.000	0.003	0.011	0.002	0.000	0.001	0.002	0.009
No. observations	747	766	683	622	455	878	833	766	619	464

Note: Own calculations based on SHARE-Denmark waves 1, 2, 4, and 5. Omitted groups are those with compulsory schooling, very poor SAH, normal BMI, no limitations in Activities of Daily Living (ADL), no limitations in Instrumental Activities of Daily Living (IADL), no limitations in physical activity, no doctor visits, no hospital stays, no nursing home stays, and none of the remaining health conditions.

Table 3.4 **OLS regression estimates explaining employment ages fifty to fifty-four**

	Women		Men	
PVW health index	0.0046	*0.0004*	0.0038	*0.0004*
High school	0.1001	*0.0356*	0.0631	*0.0350*
College	0.1826	*0.0325*	0.0884	*0.0366*
Married	0.0629	*0.0268*	0.0522	*0.0267*
2006	0.0049	*0.0351*	0.0734	*0.0335*
2011	0.0215	*0.0360*	0.0628	*0.0346*
2013	0.0215	*0.0360*	0.0628	*0.0346*
Intercept	0.8563	*0.0475*	0.8724	*0.0458*
No. observations/R-sq.	878	0.1861	747	0.1337

Note: Own calculations based on SHARE-Denmark waves 1, 2, 4, and 5. The PVW health index is calculated as first principal component from health conditions listed in table 3.3 (see Poterba, Venti, and Wise 2013). Reference category for education is compulsory schooling. The reference year is 2004.

Table 3.5 **Simulations of work capacity by age**

Age group	No. obs.	Actual working (%)	Predicted capacity (%)	Additional capacity (%)
Men				
55–59	766	82.6	85.4	2.4
60–64	683	55.1	84.7	29.2
65–69	622	15.9	83.7	67.5
70–74	455	3.7	80.2	76.2
Women				
55–59	833	75.8	79.9	4.3
60–64	766	40.2	77.9	37.9
65–69	619	7.8	75.8	68.3
70–74	464	1.9	70.2	68.1

Note: Own calculations based on SHARE-Denmark waves 1, 2, 4, and 5. Simulations are based on estimates presented in table3.4.

group together with observed characteristics of the older groups for simulation. One threat to the stability of this relationship might be differences in skills, occupations, and industry affiliation by age group. Jobs differ in their health demands and we need to assume the health-employment relationship is fixed across age groups for whom different types of jobs might be relevant. Furthermore, while our health index appears quite comprehensive, there may be health conditions we are unable to measure but are negatively correlated with ability to work. Such omitted health factors would bias our work capacity estimates upward—we would be overstating the amount of unused work capacity.

Results from the simulation exercise are presented in table 3.5 by age group and gender. Predicted work capacity changes only slightly with age, falling by 5 percent for men and 10 percent for women from the late fifties through till the early seventies. In order to simulate unused work capacity, we calculate the difference between predicted work capacity and observed employment. When combined with observed employment levels, which are rapidly declining with age, we simulate little unused work capacity in the late fifties, large unused capacity in the early sixties, and very large unused capacity from the late sixties. Women's unused work capacity exceeds men's until the early sixties, whereas men have more unused capacity from their seventies. Figures 3.13A and 3.13B graphically present the simulation exercise from table 3.7.

In table 3.6 we extend our simulation exercise on the basis of the same set

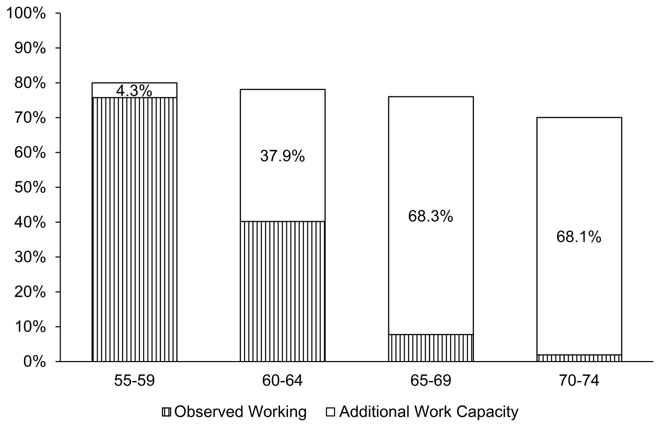

Fig. 3.13A Employment and simulated additional work capacity by age (women)

Note: Own calculations based on SHARE-Denmark waves 1, 2, 4, and 5. Simulations are based on estimates presented in table 3.4. This is an alternative presentation of selected material from table 3.5.

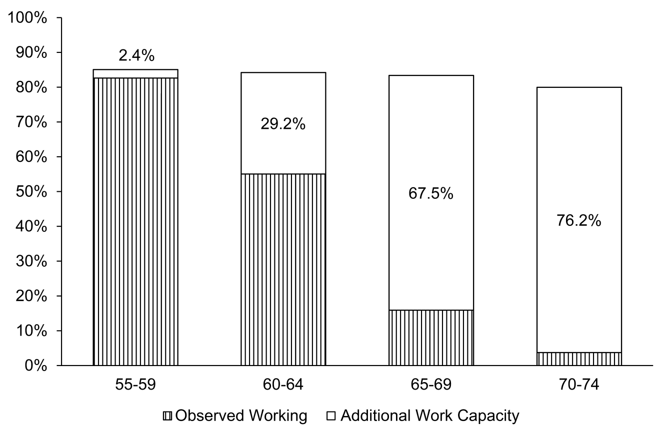

Fig. 3.13B Employment and simulated additional work capacity by age (men)

Note: Own calculations based on SHARE-Denmark waves 1, 2, 4, and 5. Simulations are based on estimates presented in table 3.4. This is an alternative presentation of selected material from table 3.5.

Table 3.6 **Simulations of work capacity by age group and schooling**

	Men				Women			
Schooling	No. obs.	Actual working (%)	Predicted capacity (%)	Additional capacity (%)	No. obs.	Actual working (%)	Predicted capacity (%)	Additional capacity (%)
Age 55–59								
Primary	132	66.4	73.3	6.9	167	53.0	61.9	8.9
High school	348	83.5	85.6	2.1	262	73.9	77.0	3.1
College	286	89.7	90.3	0.6	404	86.5	89.6	3.0
Age 60–64								
Primary	128	42.0	74.1	32.1	187	25.0	63.0	38.0
High school	312	55.2	84.4	29.2	251	30.2	73.8	43.6
College	243	62.3	89.8	27.5	328	55.7	89.1	33.5
Age 65–69								
Primary	116	9.2	74.5	65.3	192	4.2	62.1	57.9
High school	291	9.2	84.3	75.1	227	6.6	77.2	70.6
College	215	28.2	86.6	58.4	200	12.5	88.0	75.5
Age 70–74								
Primary	113	0.0	73.4	73.4	187	1.6	58.9	57.3
High school	217	4.3	79.4	75.1	165	1.9	73.5	71.6
College	125	6.3	87.1	80.8	112	2.7	84.6	81.8

Note: Own calculations based on SHARE-Denmark waves 1, 2, 4, and 5. Simulations are based on estimates from data that is pooled across education groups and presented in table 3.4.

of estimates from table 3.4, but now additionally splitting the simulation by level of schooling. Once again, similar information to that contained in table 3.6 is also presented visually in figures 3.14A and 3.14B. Employment differentials by schooling exceed differences in simulated work capacity across the age range, and especially so for women. Despite the large differences in work

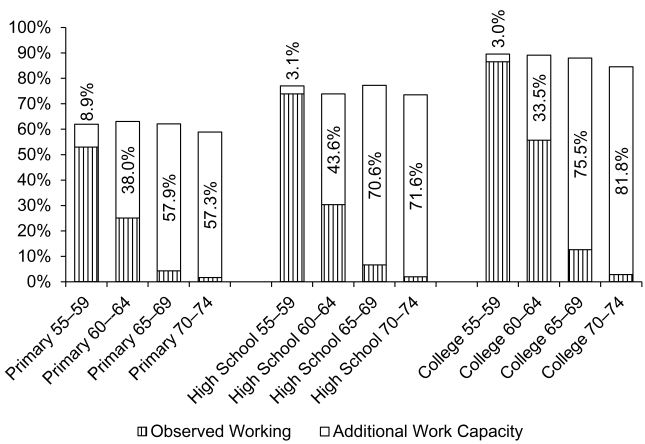

Fig. 3.14A Employment and simulated additional work capacity by schooling and age for women

Note: Own calculations based on SHARE-Denmark waves 1, 2, 4, and 5. Simulations are based on estimates from data that is pooled across education groups and presented in table 3.4. This is an alternative presentation of selected material from table 3.6.

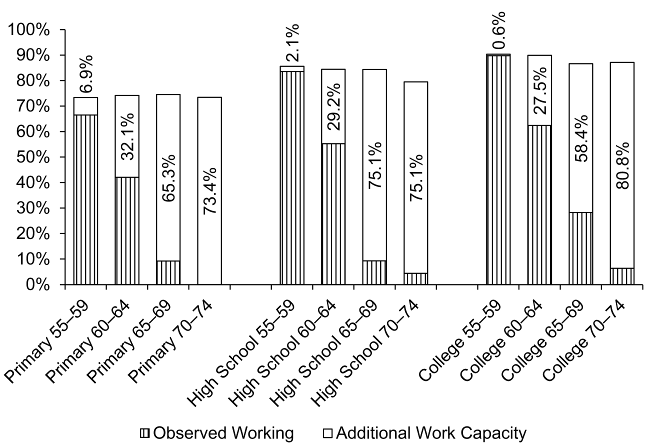

Fig. 3.14B Employment and simulated additional work capacity by schooling and age for men

Note: Own calculations based on SHARE-Denmark waves 1, 2, 4, and 5. Simulations are based on estimates from data that is pooled across education groups and presented in table 3.4. This is an alternative presentation of selected material from table 3.6.

Table 3.7 **Simulated additional years of work capacity based on SAH ages fifty-five to sixty-nine**

	Men		Women	
Schooling	Actual working	Additional capacity	Actual working	Additional capacity
Primary	6.10	4.94	4.15	5.30
High school	7.34	5.35	5.60	5.85
College	8.68	4.63	7.61	5.60
All	7.60	5.03	6.16	5.55

Note: Own calculations based on SHARE-Denmark waves 1, 2, 4, and 5. Simulations are based on estimates from data that is pooled across education groups and presented in table 3.4.

capacity by schooling, simulated unused work capacity is quite similar for the late fifties and early sixties. It is in the late sixties where schooling differences in unused work capacity are most obvious, increasing by 12 percent from primary to high school and 5 percent from high school to college for women, whereas it is increasing by 10 percent from primary to high school but decreasing by 16 percent from high school to college for men. Men in their late sixties with a college degree are much more likely to be employed than men of the same age with a high school diploma, whereas health for the two groups is quite similar, leading to a similar level of simulated work capacity.

A convenient summary measure of unused work capacity that can be computed for this approach and for the previous approach is the total number of simulated years of unused work capacity over the age range fifty-five to sixty-nine. In section 3.3, figure 3.7 presented implied years of unused capacity for different baselines. Our preferred baseline is 1977, which predates the announcement of early pension benefits through the PEW program in 1978. This gives an unused work capacity for men of 4.6 years, which is consistent between methods. In table 3.7 we present simulated years of unused work capacity for our SAH-based approach. For men this is quite close at 5.0 additional years. Women have six more months unused work capacity than men. By level of schooling, women with primary or high school have three to four months more unused work capacity than men, but at the college level women have a year longer unused work capacity than men. Men and women with high school degrees have three to five months more unused work capacity than those with different schooling.

3.6 Conclusion

Already-mandated changes to future pension benefits will reduce incentives to retire early with the aim of extending the length of working lives. The implicit assumption is that older individuals actually have the health capacity to work longer. We have tested this assumption for Denmark using two methods. First, following Milligan and Wise (2012), we ask how much older people would work today, given current mortality rates, if they were to work as much as people did at a similar mortality rate in the past. Next, following Cutler, Meara, and Richards-Shubik (2012), we ask how much would older cohorts work given their SAH, if they were to work as much as younger cohorts today do with similar SAH. Both are ways of estimating health-employment relationships that we then use for predicting how much work capacity there would be for older cohorts in similar health today if those estimated relationships held for today's older cohorts.

With both methods we find substantial unused work capacity. For men we are able to compare simulations between methods and findings are very similar when we consider a 1977 baseline for the mortality-employment relationship, before introduction of an important early pension benefit program. We simulate 4.6–5.0 additional years of health capacity to work for men between ages fifty-five and sixty-nine. This compares to baseline male employment of 7.6 years from 2004 to 2013. For women we simulate 5.5 additional years of work capacity between ages fifty-five and sixty-nine, compared to baseline employment of 6.2 years. There are differences in additional work capacity by level of schooling. Those with a high school degree have the most unused work capacity. Women have more unused work capacity than men across the schooling distribution, especially at the college level, where the difference is one year.

There are several caveats that need to be applied to our simulations. Most importantly, our unused capacity numbers have no implications for how much older individuals should work. It is beyond the scope of our study to discuss whether longer working lives are desirable for society. Health has improved for the older population, whether measured by reduced mortality or better SAH, and this suggests that some additional work capacity is available. Both of the approaches we have followed assume that all health gains can be translated into longer working lives, but there are significant real world constraints on this such as labor demand, workplace discrimination and accommodation, and household and family factors. Our additional work capacity simulations are quite large and these caveats should moderate those somewhat. Nevertheless, our aim was to ask whether Danes have the health capacity to extend working lives by three years over the next fifteen, as currently announced policies assume. Our findings suggest that this additional health capacity to work does indeed exist.

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