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Introduction

Courtney Coile, Kevin Milligan, and David A. Wise

Project Overview

Through the coordination of work of a team of analysts in twelve countries for nearly twenty years, the International Social Security (ISS) project has used the vast differences in social security programs across countries as a natural laboratory to study the effects of retirement program provisions on the labor force participation of older persons. This analysis is the seventh phase of the ongoing project, and it is focused on the health capacity to work at older ages.

To summarize the findings of the prior phases: The **first** phase of the project described the retirement incentives inherent in plan provisions and documented the strong relationship across countries between social security incentives to retire and the proportion of older persons out of the labor force (Gruber and Wise 1999).

The **second** phase, which was based on microeconomic analysis of the

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relationship between a person's decision to retire and the social security and other program incentives faced by that person, documented that incentives are a significant determinant of retirement decisions. We also considered the implications of increasing retirement program eligibility ages and showed that these changes would have large effects on employment at older ages (Gruber and Wise 2004).

The **third** phase (Gruber and Wise 2007) demonstrated the consequent fiscal implications that extending labor force participation would have on net program costs—reducing government social security benefit payments and increasing government tax revenues.

In the **fourth** phase (Gruber and Wise 2010) we focused on the concern that removing incentives to retire from social security might reduce job opportunities for youth and lead to higher youth unemployment. We found no evidence to support the "boxed economy" proposition that higher employment of older persons is associated with lower employment of youth.

The **fifth** phase (Wise 2012) shifted the focus to disability insurance (DI) and health. We found that changes in DI participation were more closely linked to DI reforms than to changes in health and that DI reforms often had a very large effect on the labor force participation of older workers.

The **sixth** phase (Wise 2016) extended the methodology used in the second phase to study the effect of DI as well as SS program incentives on retirement. We found that individuals are very responsive to retirement incentives arising from the structure of SS and DI programs and that reducing access to DI benefits would increase labor supply.

As we describe in more detail below, this **seventh** phase of the project explores the health capacity of individuals to work at older ages. Fiscal challenges facing social security and other government programs may lead to policy changes that incorporate the expectation of longer work lives, such as increases in the social security early or normal retirement ages. In this volume we ask: Are individuals healthy enough to increase their labor supply at older ages?

The results of the ongoing project are the product of analyses conducted for each country by analysts in that country. Researchers who have participated in this phase of the project are listed first below; those who have participated in prior phases are listed second in italics.

Belgium: Alain Jousten, Mathieu Lefèbvre, *Sergio Perelman*, *Pierre Pestieau*, *Raphaël Desmet*, *Arnaud Dellis*, and *Jean-Philippe Stijns*

Canada: Kevin Milligan, Tammy Schirle, *Michael Baker*, and *Jonathan Gruber*

Denmark: Paul Bingley, Nabanita Datta Gupta, Peder J. Pedersen, and *Michael Jørgensen*

France: Didier Blanchet, Eve Caroli, Corinne Prost, Muriel Roger, *Luc Behaghel*, *Melika Ben Salem*, *Antoine Bozio*, *Thierry Debrand*, *Ronan Mahieu*, *Louis-Paul Pelé*, and *Emmanuelle Walraet*

Germany: Axel Börsch-Supan, Hendrik Jürges, Lars Thiel, *Tabea Bucher-Koenen*, *Simone Kohnz*, *Giovanni Mastrobuoni*, *Johannes Rausch*, *Reinhold Schnabel*, and *Morten Schuth*
Italy: Agar Brugiavini, Giacomo Pasini, Guglielmo Weber, and *Franco Peracchi*
Japan: Takashi Oshio, Satoshi Shimizutani, Emiko Usui, *Mayu Fujii*, *Akiko Sato Oishi*, and *Naohiro Yashiro*
Netherlands: Adriaan Kalwij, Arie Kapteyn, and Klaas de Vos
Spain: Pilar García Gómez, Sergi Jiménez-Martín, Judit Vall-Castelló, *Michele Boldrín*, and *Franco Peracchi*
Sweden: Per Johansson, Lisa Laun, Mårten Palme, and *Ingemar Svensson*
United Kingdom: James Banks, Carl Emmerson, Gemma Tetlow, *Richard Blundell*, *Antonio Bozio*, *Paul Johnson*, *Costas Meghir*, and *Sarah Smith*
United States: Courtney Coile, Kevin Milligan, David Wise, *Jonathan Gruber*, and *Peter Diamond*

An important goal of the project has been to present results that are as comparable as possible across countries. Thus the chapters for each phase are prepared according to a detailed template that we developed in consultation with country participants. In this introduction, we summarize the collective results of the country analyses and borrow freely from the country chapters. In large part, however, the results presented in the introduction could only be conveyed by combined analysis of the data from each of the countries. The country chapters themselves present much more detail for each country and, in addition to the common analyses performed by all countries, often present country-specific analysis relevant to each particular country.

Introduction to the Seventh Phase

The interaction of health and work at older ages is of high policy concern. Of late, social security normal retirement ages have been raised in many developed countries, with additional increases in progress or under discussion. These reforms will not increase labor supply at older ages if it is the case that health is a strongly limiting factor in older-worker employment decisions. Moreover, on a broader policy scale the funding of retirement consumption through savings of any kind becomes more challenging when longevity is expanding rapidly. A deeper understanding of how we might split the bounty of increased longevity between work years and retirement years can assist policymakers with broad policy issues on labor market and pension regulation and incentives.

In this seventh phase of the International Social Security project, we consider the capacity to work at older ages. In particular, we consider whether the health of older persons would allow them to work longer. It is important to emphasize at the outset that the "health capacity to work" is not

intended to suggest how long people should work or what typical retirement ages should be in various countries. The age at which a person retires is strongly influenced by early and normal legislated retirement ages in his or her country, and also by individual health, employment opportunities, and other circumstances. The health capacity to work, however, might be considered in conjunction with potential increases in a country's statutory retirement age. We will see that the health capacity to work at older ages is typically much greater than actual employment. We begin with background information and then explain the methods that we use to estimate the health capacity to work at older ages.

To help to put the analysis in context, it is useful to have in mind that employment rates in the ISS countries declined very substantially in the decades leading up to the 1990s. As shown in table I.1, a majority of the ISS countries saw the employment rate of men age sixty to sixty-four fall by at least one-third, and sometimes far more, between its peak in the 1960s or 1970s and its trough in the 1990s.[1] Thus, if peak employment rates of men sixty to sixty-four are taken as a measure of the capacity to work, then employment in the 1990s was much less than the capacity to work.

Indeed, employment has increased substantially in each country between the 1990s and the present, as can be seen in the bottom row of table I.1. Increases were greatest, in percentage terms, among those countries with the lowest employment rates at the trough. For example, in four countries with employment rates of 10 to 30 percent at their lowest point—Belgium, France, Germany, and the Netherlands—employment has more than doubled (or risen by 80 percent, in Belgium's case). Most other countries have experienced increases of about 40 percent. In Japan, where employment of men sixty to sixty-four never dipped below 64 percent, employment has risen by about one-sixth; the United States has experienced a similar rise. The trends in employment over this period are also shown in figure I.1.

The key takeaway is that employment of men ages sixty to sixty-four has changed a great deal from the early 1960s and 1970s to 2014, with substantial decline until the mid-1990s and then substantial increases thereafter in many countries. This decline likely reflects a variety of factors. Changes in retirement incentives due to reforms of social security and disability insurance programs may have played an important role. Previous work in the International Social Security project (especially Gruber and Wise 1999, 2004 and Wise 2016) has shown that differences in program incentives can explain much of the differences in aggregate labor force participation across countries at a point in time, and also that individual-level incentives are strongly related to retirement decisions. Many countries have raised eligibility ages

1. Note that the data series used in table I.1 starts in different years for different countries; because employment is generally declining during this period, it is likely that the drop in employment would be larger in some countries if earlier data were available. On a related note, employment declines in the ISS countries typically began before the 1960s, so measuring the decline in employment relative to an earlier period would show an even steeper decline.

Table I.1 **Employment rates of men ages sixty to sixty-four by country, selected years (1963–2014)**

Year	Belgium (%)	Canada (%)	Denmark (%)	France (%)	Germany (%)	Italy (%)	Japan (%)	Nether-lands (%)	Spain (%)	Sweden (%)	United Kingdom (%)	United States (%)
1963	—	—	—	—	—	—	—	—	—	83.1	—	77.2
1968	—	—	—	—	—	—	80.8	—	—		—	
1970	—	—	—	—	70.1	47.8		—	—		—	
1971	—	—	—	—				72.3	—		—	
1972	—	—	—	—					76.4		—	
1976	—	63.7	—	—							—	
1983	27.4			28.2							—	
1984			48.6								51.5	
1987												
1993								20.4			44.8	
1994					26.2							50.5
1995		39.9							36.7			
1996												
1998	16.0		39.7	10.4						50.0		
2002							64.0					
2005						27.6						
2008									46.8		58.4	
2013								58.8		69.6		
2014	28.5	55.4	55.7	25.3	59.4	39.2	74.3					59.0
Percent decline	–41.7	–37.2	–18.3	–63.1	–62.6	–42.3	–20.8	–71.8	–52.0	–39.8	–13.1	–34.6
Percent increase	78.7	38.7	40.4	143.2	126.5	41.9	16.0	187.9	27.6	39.2	30.3	17.0

Source: The OECD (http://stats.oecd.org//Index.aspx?QueryId=67615).

Notes: Dashes indicate years where data is not available. Years displayed on the table show the initial peak, trough, and recent peak in all countries, and are correspondingly divided into three periods. Percent decline is the percent drop in employment between the maximum value observed during the first period (1963–1984) and the minimum value in the second period (1987–2005). Because the data series starts in different years for the various countries and employment is generally declining during this period, it is likely that the percent decline would be larger for some countries if earlier years of data were available. Percent increase is the percentage rise in employment between the minimum value during the second period (1987–2005) and the maximum value in the third period (2008–2014).

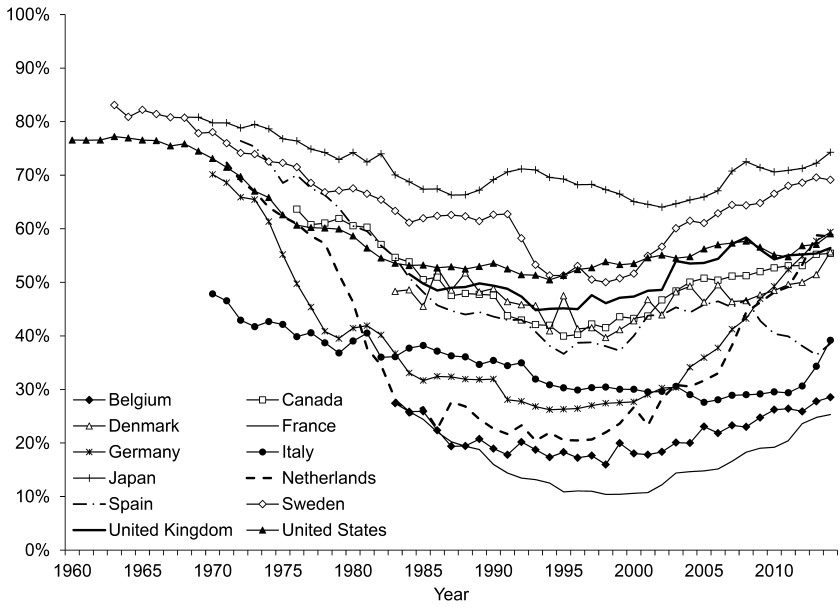


Fig. I.1 Employment rates of men ages sixty to sixty-four by country (1960–2014)
Source: The OECD (http://stats.oecd.org//Index.aspx?QueryId=67615).
Note: Each line shows the employment rate (number employed divided by population) for males between ages sixty and sixty-four.

or reduced benefit generosity for social security and tightened eligibility for disability insurance in recent years. Estimating how much of the increase in participation shown in figure I.1 can be explained by these changes is a promising area for future work. There are other explanations as well, including changes in wages, employer-provided benefits, the return to savings, and other economic factors such as swings in labor demand for older workers. Moreover, the changes might also be related to changes in health. It is this last possibility on which we focus in this phase of the project—how much the changes in employment might be explained by changes in the health capacity to work.

We use two complementary approaches to evaluate the health capacity to work. The first is based on changes in the relationship between mortality and employment over time and is referred to as the Milligan-Wise (MW) method, building on a previous study (Milligan and Wise 2015). In this approach, a decrease in mortality may be thought of as an increase in health and thus as an increase in the capacity to work. The second method is based on a comparison of the health and employment of older and slightly younger individuals and is based on the work of Cutler, Meara, and Richards-Shubik (2013); we refer to this the Cutler et al. (or CMR) method. This approach projects work capacity by first estimating the relationship between health

(and other individual attributes) and employment for individuals age fifty to fifty-four, and then using those estimates along with the actual health (and other) characteristics of older individuals to predict their ability to work. Predicted employment is compared to actual employment in older age groups to estimate the additional capacity to work based on health. A third approach explores improvements in self-assessed health (SAH) over time by level of education. While this method does not yield direct estimates of the health capacity to work like the other two methods, it may be used to infer whether the ability to work at older ages is evolving differentially by socioeconomic status. We discuss the advantages, limitations, and results from each method in turn.

The Milligan-Wise Method

The Milligan-Wise method focuses on the relationship between mortality rates and employment rates. The risk of mortality in a given year at a given age is taken as a proxy for health status. This is obviously a crude proxy, but it does carry two advantages. The first is measurement. The binary nature of mortality lessens the burden of measurement compared to more subtle health measures that might vary across time, across surveys, and across countries. Moreover, because population data can be used, there is no sampling variation to contend with. The second advantage is availability. Few countries have detailed, consistent health surveys extending back to the 1970s. Using mortality, which is available for long time periods across countries, unlocks the potential of longer-run analysis.

While these advantages are clear, it is appropriate to note the limitations of this measure as well. First, the crudeness of mortality risk as a proxy for health capacity may be a concern. Our CMR analysis, described in the next section, complements the MW analysis by providing an alternative method of estimating work capacity that relies on detailed individual health data. Second, the MW approach is not well suited to estimate health capacity for women because cohorts of women reaching retirement ages in the 1970s were much less likely to have had a career than their counterparts today, making them a poor comparison group for calculating work capacity. We therefore do not report results for women using the MW approach, but do report results for women using the CMR analysis in the following section. Finally, given the population-level nature of the MW analysis, we cannot look at the within-country heterogeneity to see if the mortality-employment relationship differs by socioeconomic status. Our work on education levels and self-assessed health and mortality, highlighted in the last section of this introduction, provides some more analysis on that question of heterogeneity.

In figure I.2, we illustrate the MW method using the case of the United States. Beginning with the left-hand figure, the top dark line shows the relationship between mortality and employment that existed for men in the United States in 1977. The lower lighter line shows the relationship between

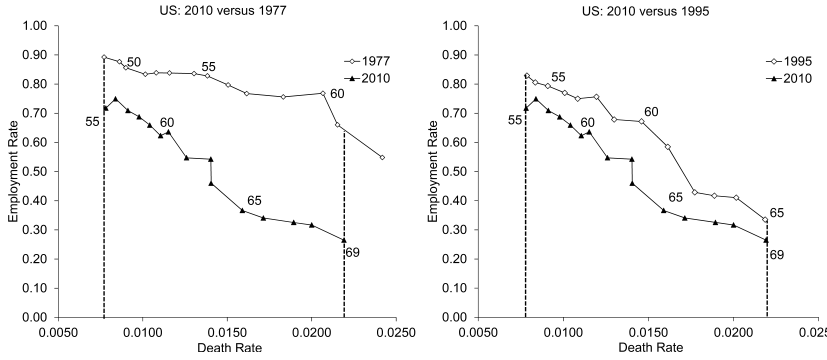


Fig. I.2 Employment versus mortality of men in the United States (selected years)
Source: Chapter 12, this volume (data from the Current Population Survey and the Human Mortality Database).

mortality and employment thirty-three years later, in 2010. In 2010, at age fifty-five, the mortality rate was 0.78 percent and the employment rate was 71.8 percent. In 1977, a mortality rate of 0.78 was experienced at age forty-nine, when the employment rate was 89.1 percent. Thus, if we ask how much more people in 2010 could work if they worked as much as those in 1977 with the same mortality rate, the answer would be 17.3 percent, the difference in the two employment rates. Repeating the calculation at age sixty-nine, in 2010 the mortality rate was 2.19 percent and the employment rate was 26.5 percent. In 1977, a mortality rate of 2.19 percent was experienced at age sixty-one, when the employment rate was 64.4 percent. This suggests that the additional work capacity at age sixty-nine is 37.9 percent.

We make similar calculations at every age and report these values in table I.2, averaging across age groups. We find additional work capacity of 15.6 percent at ages fifty-five to fifty-nine, 27.0 percent at ages sixty to sixty-four, and 41.8 percent at ages sixty-five to sixty-nine. The fact that work capacity is rising with age can be seen on the figure in the increasing divergence of the darker and lighter lines as age increases. On average, total employment of men ages fifty-five to sixty-nine was 28.1 percent lower in 2010 than it would have been if individuals worked as much as those with the same mortality worked in 1977.

The right half of figure I.2 repeats this exercise using the employment-mortality relationship that existed in 1995 rather than 1977 as the basis for comparison. Using the methodology described above, total employment of men ages fifty-five to sixty-nine in 2010 was 12.2 percent lower than it would have been if individuals worked as much as those with the same mortality in 1995. We chose 1995 for a more recent comparison year because, as shown in figure I.1, the employment rate of men ages sixty to sixty-four in the United States declined from 1960 to 1995 and then began to increase, from

Table I.2 **Additional work capacity for men in the United States (MW method)**

Age group	Employment rate in 2010 (%)	Employment rate in 1977 at same death rate (%)	Additional employment capacity (%)
55–59	70.5	86.0	15.6
60–64	56.2	83.2	27.0
65–69	32.3	74.1	41.8
55–69	53.0	81.1	28.1

Source: Chapter 12, this volume (authors' calculations).

51.3 percent in 1995 to 55.1 percent in 2010.[2] Our analysis suggests that even though employment rose between 1995 and 2010, people in 2010 still worked less than their counterparts in 1995 with the same mortality, as employment did not increase by enough to keep up with mortality gains.

Comparable figures for men in the remaining eleven countries are shown in figure I.3, with the earlier comparison year (1977 or similar) on the left-hand side and the more recent comparison year (1995 or similar) on the right-hand side.

A number of findings are apparent from these figures. First, all countries exhibit substantial additional capacity to work when we use the employment of those with the same mortality rate in the earlier period (1977 or similar) as a basis for comparison. To further illustrate this, we take the additional work capacity at each age (measured as the vertical distance between the darker and lighter lines) and sum these values from ages fifty-five to sixty-nine to arrive at an estimate of the total additional years of work capacity over this age range.[3] As reported in table I.3, these values range from 3.2 years for Sweden to 8.4 years for the United Kingdom, with an average of 5.5 years across all countries. These values are quite large when compared to the actual average years of work over ages fifty-five to sixty-nine in 2010—7.9 years in the United States, for example.

A second key finding is that estimated additional work capacity is much smaller when using the more recent period (1995 or similar) as a basis for comparison. The total additional years of work capacity over ages fifty-five to sixty-nine averages only 1.7 years for the countries as a group, and is one year or less in Belgium, the Netherlands, and Sweden. As shown in figure

2. These values do not match those in figure I.1 exactly because the data source is different; see chapter 12 (this volume) for details on this calculation.

3. For example, in the case of the United States, we estimate that an additional 17.3 percent of age fifty-five individuals could be working, which represents a 0.173 increase in years worked (17.3 percent of the population working one additional year). This value is 0.131 years at age fifty-six, 0.144 years at age fifty-seven, and so on, up to 0.379 years at age sixty-nine, and the total across ages fifty-five to sixty-nine is 4.22 years.

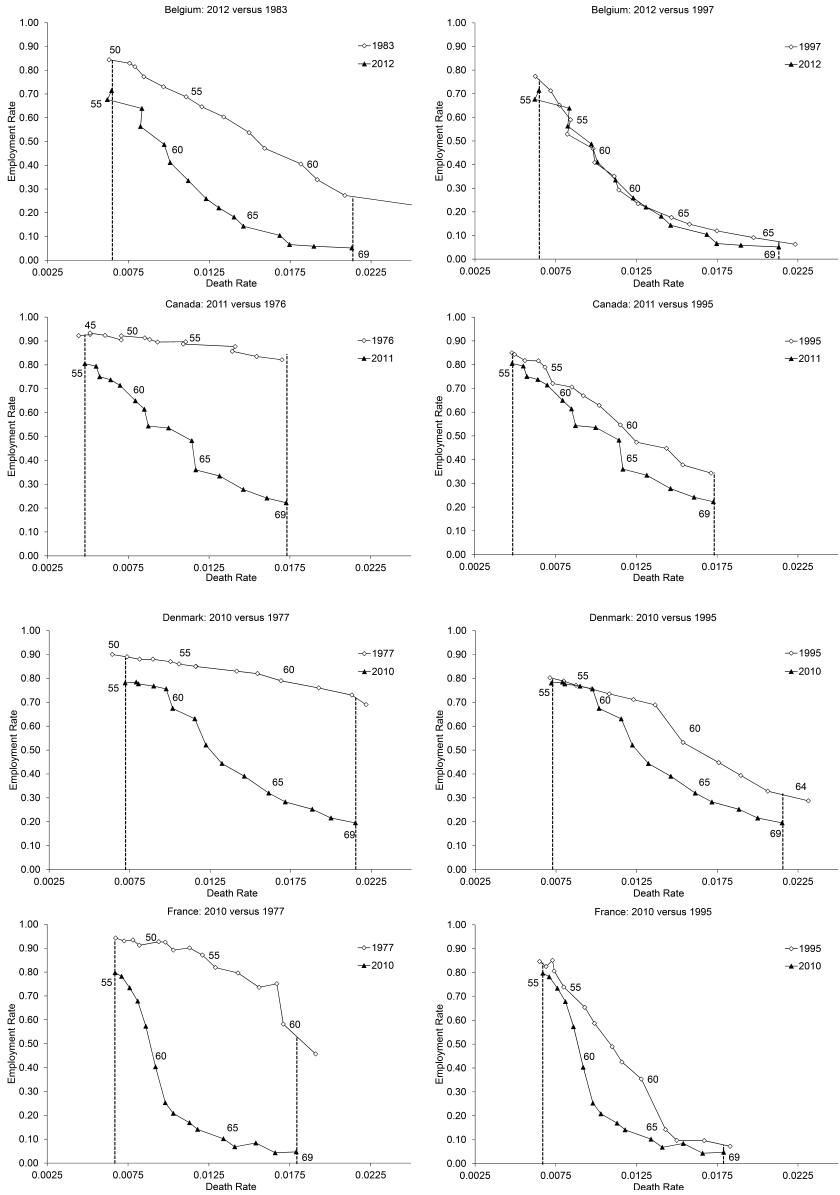
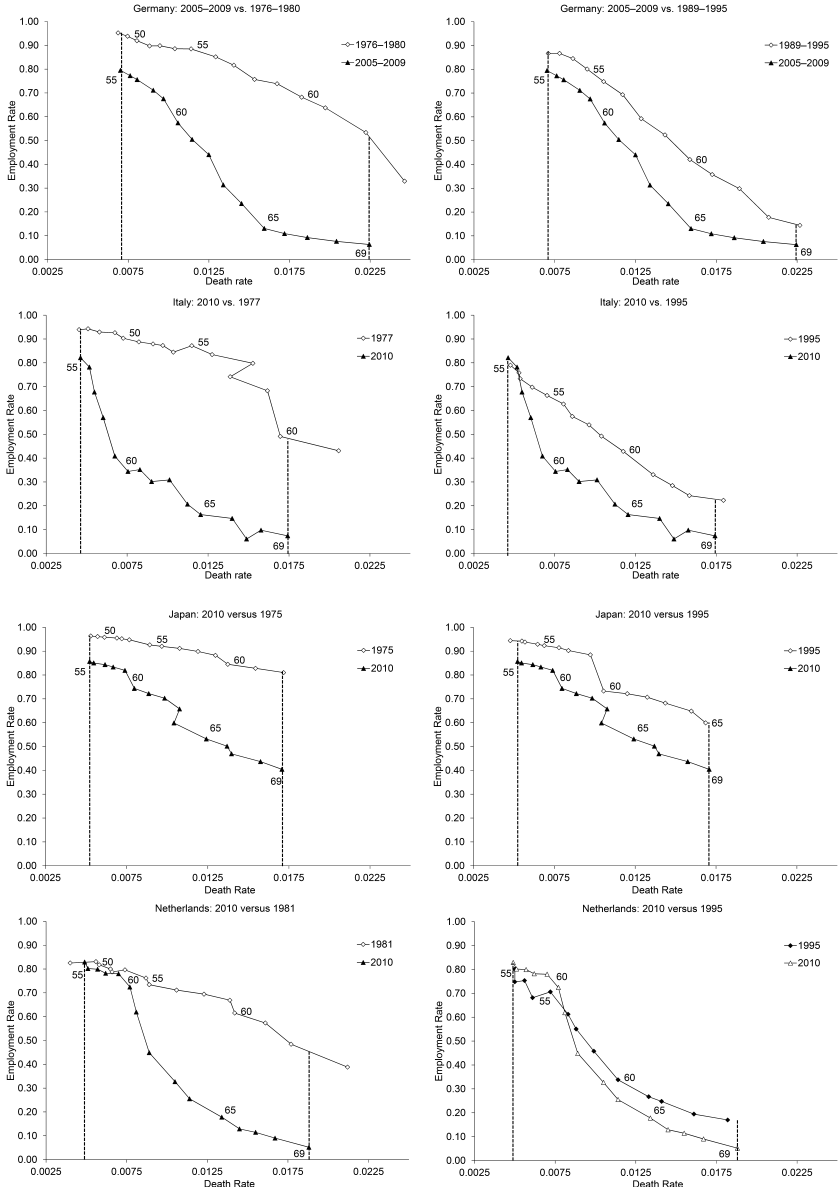


Fig. I.3 Employment versus mortality of men in eleven countries (selected years)

Source: See individual country chapters for the source data for each country.


Germany: 2005–2009 vs. 1976–1980
1976–1980
2005–2009
Germany: 2005–2009 vs. 1989–1995
1989–1995
2005–2009
Italy: 2010 vs. 1977
1977
2010
Italy: 2010 vs. 1995
1995
2010
Japan: 2010 versus 1975
1975
2010
Japan: 2010 versus 1995
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Netherlands: 2010 versus 1981
1981
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Netherlands: 2010 versus 1995
1995
2010
Employment Rate
Death rate
Death Rate

Fig. I.3 (cont.)

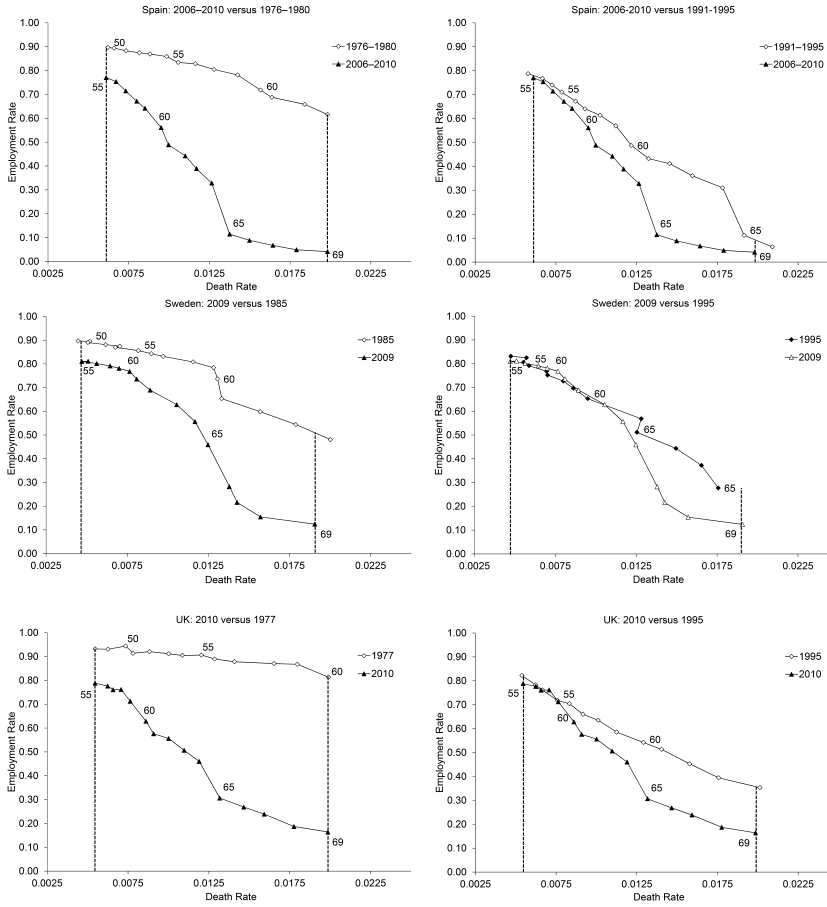

Fig. I.3 (cont.)

I.3, the two employment-mortality curves are barely distinguishable from each other in Belgium's case.

The explanation for the difference between the 1977- and 1995-based results lies in employment trends. Mortality rates fell continuously over the period 1977 to 2010, while employment rates fell between 1977 and 1995 and then rose from 1995 to 2010, as seen in figure I.1. Over the 1995 to 2010 period, increases in employment have been large enough to keep up with increases in mortality in some countries. To take sixty-one-year-olds in the Netherlands as an example, the mortality rate fell from 1.33 percent to 0.81 percent between 1995 and 2010, while the employment rate rose from 26.7 to 61.9 percent. In mortality terms, 2010's sixty-one-year-olds are like 1995's fifty-seven-year-olds, who had an employment rate of 61.2 percent. So the

Table I.3 **Years of additional work capacity for men at ages fifty-five to sixty-nine (MW method)**

Country	2010 versus 1977	2010 versus 1995
Belgium	5.0	1.0
Canada	4.9	1.3
Denmark	4.7	1.6
France	8.0	2.2
Germany	5.9	2.6
Italy	7.7	2.7
Japan	3.7	2.2
Netherlands	3.4	–0.1
Spain	7.0	2.2
Sweden	3.2	0.8
United Kingdom	8.4	1.8
United States	4.2	1.8
Average	5.5	1.7

Source: Individual country chapters.

Note: In some cases, years used differ: Belgium (1983 not 1977); Germany (2005–09 not 2010, 1989–1995 not 1995, 1976–1980 not 1977); Japan (1975 not 1977); Netherlands (1981 not 1977); and Sweden (2009 not 2010, 1985 not 1977).

estimated additional work capacity at age sixty-one, using the employment of those with the same mortality in 1995 as a basis for comparison, is close to zero. The 2010 sixty-one-year-olds are also like 1981's fifty-four-year-olds, who had an employment rate of 79.6 percent, yielding a positive estimate of work capacity (17.7 percent) when 1981 is the basis for comparison. Even though the employment of sixty-one-year-olds rose from 1981 to 2010 (from 57.3 to 61.9 percent), this is small compared with the drop in mortality (from 1.61 to 0.81 percent) and not enough to keep up with mortality gains.

To recap, in this analysis we estimate how much more older men today could work if they worked as much as those with the same level of health—as measured by mortality rates—did in the past. When we use 1977 as a basis for comparison, we estimate that there is substantial additional work capacity at ages fifty-five to sixty-nine—5.5 years on average for our sample of countries. This result can be explained by the fact that mortality rates have fallen substantially since 1977, while employment rates are either similar to or somewhat less than what they were in 1977, as evident from figure I.1. When we use 1995 as the basis for comparison, estimated work capacity shrinks substantially, to an average of 1.7 years in our sample of countries. Over the 1995 to 2010 period, employment has risen substantially in virtually all countries, as seen in figure I.1, and these employment gains have largely, if not completely, kept up with the gains in mortality.

It is not obvious whether 1995, 1977, or some other year is the "correct" comparison year to rely on in drawing inferences about additional work

capacity. Using an even earlier comparison year than we have here, such as 1960 (were the data to be available), would generate even larger estimates, since both mortality and employment rates fell during these earlier decades. It is also useful to remember that our approach implicitly implies that all increases in life expectancy will translate into additional work years. If one prefers to assume that life expectancy increases would be divided between work and retirement years, one could apply some fractional factor to the estimates here. The bottom line, however, is that the Milligan-Wise approach suggests that there is significant capacity to work at older ages in all countries.

Cutler et al. Method

As discussed above, one shortcoming of the MW approach is the crudeness of using mortality as a proxy for health. We now turn to the Cutler et al. (CMR) approach to provide complementary evidence using richer and more subtle information on individual health and how it relates to employment.

Estimation

The CMR method involves two steps. The first is to estimate the relationship between employment and health (controlling for other attributes, such as education) at ages fifty to fifty-four. We choose this age range because it is before workers attain eligibility for social security and other early retirement benefits, and we wish to capture the relationship between health and employment that exists in the absence of access to retirement benefits.

For our measure of health, we employ a health index constructed using the approach described in Poterba, Venti, and Wise (2013), which we call the PVW index. The index is based on twenty-seven questions, including self-reported health diagnoses, functional limitations, medical care usage, and other health indicators. To calculate it, we first obtain the principal component of these indicators, which is the weighted average of indicators where the weights are chosen to maximize the proportion of the variance of the individual health indicators that can be explained by this weighted average. The estimated coefficients from the analysis are then used to predict a percentile score for each respondent. An individual's health index value will vary by survey wave, as updated health information is incorporated. As Poterba, Venti, and Wise (2013) demonstrate, the health index is strongly related to mortality and future health events such as stroke and diabetes onset, though not to future new cancer diagnoses. Some countries also estimate a version of the model including the individual health variables as covariates instead of the PVW index and present these results in their chapters.

To illustrate how we implement this approach, we estimate the model for those countries in our sample that are part of the Survey of Health, Ageing and Retirement in Europe (SHARE)—Belgium, Denmark, France, Germany, Italy, the Netherlands, Spain, and Sweden. We also do so for the

United States, using the Health and Retirement Study (HRS), and for the United Kingdom, using English Longitudinal Study of Ageing (ELSA), as the similarity of all of these data sets allows us to estimate a common specification for all countries.

Results are reported in table I.4. The coefficient on the PVW index is measured precisely for both men and women in each country, although the estimates vary across countries. For men, for example, the lowest estimates are in Italy and Sweden—0.0032 and 0.0027, respectively. In the eight remaining countries the estimates vary from 0.0040 in France to 0.0077 in Spain. The estimate for the United States, for example, indicates that if the health percentile (between zero and 100) increases by 10 points, the probability of employment increases by about 6 percentage points.

Prediction of the Capacity to Work

In the second step of the CMR approach, estimates similar to those in table I.4 (though obtained separately for each country by its team) are used to predict the "capacity" to work at older ages—fifty-five to fifty-nine, sixty to sixty-four, and sixty-five to sixty-nine. In essence, we combine the estimated effect of health (and other characteristics) on employment for those ages fifty to fifty-four with the actual health (and other characteristics) of those ages fifty-five to sixty-nine. This approach assumes that the relationship between health and employment will be the same for two groups, but should generate declining estimates of work capacity with age since health declines with age. We cannot test this assumption directly, but taking estimates from a similar age group makes the approach more plausible. If employment *at a given level of health* is in fact more difficult as workers age, then our estimates would tend to overstate additional work capacity; however, the magnitude of our results (presented below) suggest there is likely substantial work capacity, even allowing for this possibility. Another key assumption is that our health index is a sufficient summary measure of health and that there are no omitted dimensions of health that affect employment; as discussed above, the PVW index is quite comprehensive and strongly correlated to future health events and mortality. A final possible concern is that retirement may have a causal effect on health, although without more clarity from the literature on this point, it is difficult to hazard a guess about the effect of disregarding this pathway. Ultimately, while any empirical method will involve assumptions, to the extent that we obtain similar results using different methods, this may mitigate concerns about the limitations of any one method.

The results for men in the United States are provided in figure I.4 to illustrate the workings of this approach. For each age group, the total height of the bar represents the predicted share of individuals working, based on the estimated relationship between health and employment for those age fifty to fifty-four and the actual health of those in the older age groups. These values

Table I.4 **Estimated relationship between health and employment (men and women ages fifty to fifty-four)**

Dependent variable: Currently working	United Kingdom	United States	ALL SHARE	Belgium	Denmark	France	Germany	Italy	Nether-lands	Spain	Sweden
					Men						
PVW health index	0.0059*	0.0062*	0.0045*	0.0052*	0.0048*	0.0040*	0.0051*	0.0032*	0.0045*	0.0077*	0.0027*
	(0.0003)	(0.0002)	(0.0003)	(0.0008)	(0.0008)	(0.0007)	(0.0009)	(0.0012)	(0.0007)	(0.0010)	(0.0010)
Education											
High school grad	–0.0215	0.0887*	0.0763*	–0.0463	0.0892	0.1729*	0.1871*	0.1348*	0.0647	0.1090*	0.1025*
	(0.0258)	(0.0157)	(0.0164)	(0.0414)	(0.0580)	(0.0400)	(0.1036)	(0.0557)	(0.0415)	(0.0587)	(0.0485)
Some college or more	0.0015	0.1285*	0.1025*	0.0526	0.0770	0.1707*	0.2239*	0.2383*	0.0781*	0.0545	0.1067*
	(0.0179)	(0.0154)	(0.0175)	(0.0402)	(0.0628)	(0.0445)	(0.1083)	(0.0609)	(0.0420)	(0.0603)	(0.0456)
Marital status											
Married	0.1360*	0.1605*	0.1121*	0.1595*	0.0953*	0.0563	0.0029	0.1266*	0.1657*	0.1437*	0.1675*
	(0.0188)	(0.0126)	(0.0169)	(0.0448)	(0.0410)	(0.0370)	(0.0480)	(0.0633)	(0.0563)	(0.0507)	(0.0568)
Occupation											
Blue collar	–0.0252	0.0417*	–0.0543*	–0.0873*	–0.0759	–0.0169	–0.1100*	0.0271	–0.0581	–0.0527	0.0465
	(0.0186)	(0.0119)	(0.0169)	(0.0436)	(0.0466)	(0.0403)	(0.0500)	(0.0688)	(0.0437)	(0.0530)	(0.0438)
Intermediate skill	–0.0074	0.0277*	–0.0064	–0.0224	0.0281	–0.0263	0.0031	0.0147	–0.0073	–0.0165	–0.0173
	(0.0205)	(0.0126)	(0.0152)	(0.0370)	(0.0400)	(0.0351)	(0.0485)	(0.0551)	(0.0420)	(0.0585)	(0.0448)
Constant	0.3461*	0.1352*	0.4027*	0.3666*	0.4301*	0.4401*	0.2999*	0.4046*	0.3995*	0.1170	0.4925*
	(0.0322)	(0.0209)	(0.0313)	(0.0741)	(0.0816)	(0.0750)	(0.1224)	(0.1360)	(0.0798)	(0.0902)	(0.1116)
Observations	**2,166**	**6,199**	**3,211**	**563**	**398**	**523**	**411**	**283**	**427**	**282**	**324**

					Women						
PVW health index	0.0049*	0.0048*	0.0038*	0.0042*	0.0060*	0.0028*	0.0036*	0.0006	0.0054*	0.0028*	0.0055*
	(0.0003)	(0.0002)	(0.0003)	(0.0007)	(0.0007)	(0.0007)	(0.0008)	(0.0009)	(0.0007)	(0.0008)	(0.0007)
Education											
High school grad	0.0805*	0.1326*	0.1830*	0.0253	0.1218*	0.0980*	0.2474*	0.3974*	0.1267*	0.1924*	–0.0364
	(0.0260)	(0.0135)	(0.0181)	(0.0474)	(0.0655)	(0.0447)	(0.0722)	(0.0554)	(0.0472)	(0.0648)	(0.0486)
Some college or more	0.1077*	0.2014*	0.3358*	0.1989*	0.2043*	0.2893*	0.2883*	0.5139*	0.2325*	0.4542*	–0.0214
	(0.0214)	(0.0132)	(0.0183)	(0.0531)	(0.0667)	(0.0471)	(0.0764)	(0.0630)	(0.0515)	(0.0751)	(0.0456)
Marital status											
Married	–0.0215	–0.0175*	–0.0599*	–0.0611	0.0400	–0.0757*	–0.0779*	–0.0453	–0.0983*	–0.1406*	0.0066
	(0.0172)	(0.0098)	(0.0161)	(0.0428)	(0.0392)	(0.0370)	(0.0447)	(0.0535)	(0.0517)	(0.0568)	(0.0402)
Occupation											
Blue collar	–0.0589*	0.1014*	0.0784*	–0.0769	–0.0091	0.1107*	0.0398	0.2963*	–0.0117	0.2276*	–0.2081*
	(0.0234)	(0.0132)	(0.0221)	(0.0569)	(0.0824)	(0.0555)	(0.0698)	(0.0515)	(0.0664)	(0.0507)	(0.0741)
Intermediate skill	–0.0094	0.0816*	0.1300*	0.0670	0.0706*	0.0975*	0.0145	0.3222*	–0.0059	0.2767*	–0.0624*
	(0.0224)	(0.0100)	(0.0158)	(0.0447)	(0.0389)	(0.0425)	(0.0518)	(0.0555)	(0.0444)	(0.0593)	(0.0370)
Constant	0.4288*	0.2063*	0.2275*	0.3234*	0.2335*	0.4328*	0.2902*	0.1458*	0.2896*	0.1136	0.5632*
	(0.0309)	(0.0154)	(0.0257)	(0.0711)	(0.0834)	(0.0662)	(0.0980)	(0.0702)	(0.0719)	(0.0729)	(0.0793)
Observations	**2,478**	**10,435**	**4,067**	**634**	**443**	**591**	**536**	**434**	**578**	**407**	**444**

Notes: ALL SHARE includes all countries except the United Kingdom and the United States. The pooled SHARE coefficients are similar whether or not country dummies are included. Omitted categories are less than HS education, nonmarried, and high skill or missing occupation. Standard errors are below each coefficient.

*Significant at the 10 percent level.

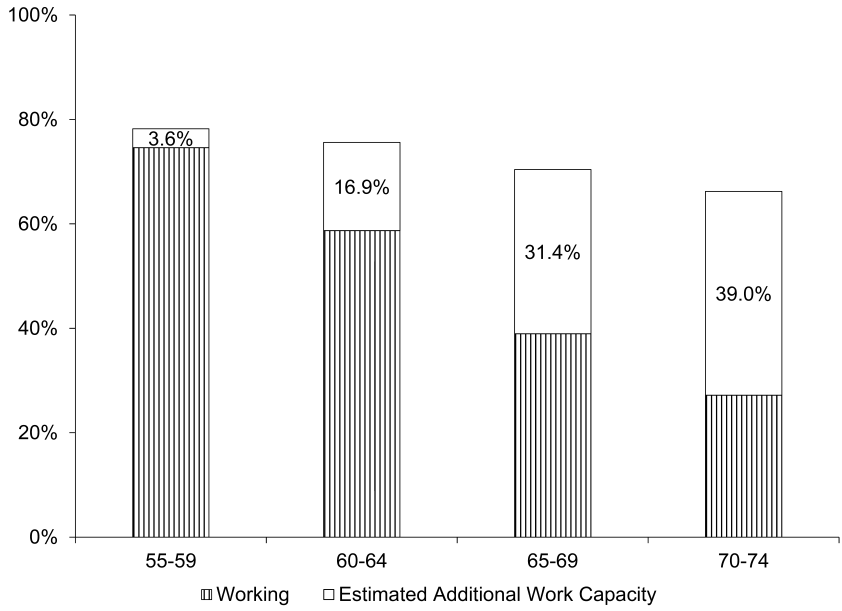

Fig. I.4 Estimated additional work capacity for men in the United States (by age)
Source: Chapter 12, this volume (authors' calculations using Health and Retirement Study).

decrease with age, as expected, reflecting the effect of declining health on employment as predicted by our model. The bar with vertical lines reflects the actual percent employed in each age group, and the white bar—predicted share working minus actual share employed—is our estimate of the additional work capacity. As the actual share employed falls more quickly with age than does the predicted share working, the estimated additional work capacity grows rapidly with age, from 3.6 percent at ages fifty-five to fifty-nine, to 16.9 percent at ages sixty to sixty-four, to 31.4 percent at ages sixty-five to sixty-nine, and 39.0 percent at ages seventy to seventy-four.

In figures I.5A, I.5B, and I.5C, we report the estimated additional work capacity for men ages fifty-five to fifty-nine, sixty to sixty-four, and sixty-five to sixty-nine, respectively, for all countries in our sample. The estimated additional work capacity at age fifty-five to fifty-nine is only 2 percent in Japan and 4 percent in the United States, but values reach 19 percent in France, 21 percent in Italy, and 22 percent in Belgium. In the sixty to sixty-four age range, estimated additional work capacity values are larger and the variance across countries is greater—values range from 14 percent in Sweden to 63 percent in France. This trend continues in the sixty-five to sixty-nine age interval, where the values range from 31 percent in the United States to 84 percent in Germany.

In the two older age groups in particular, it is evident that the differences in

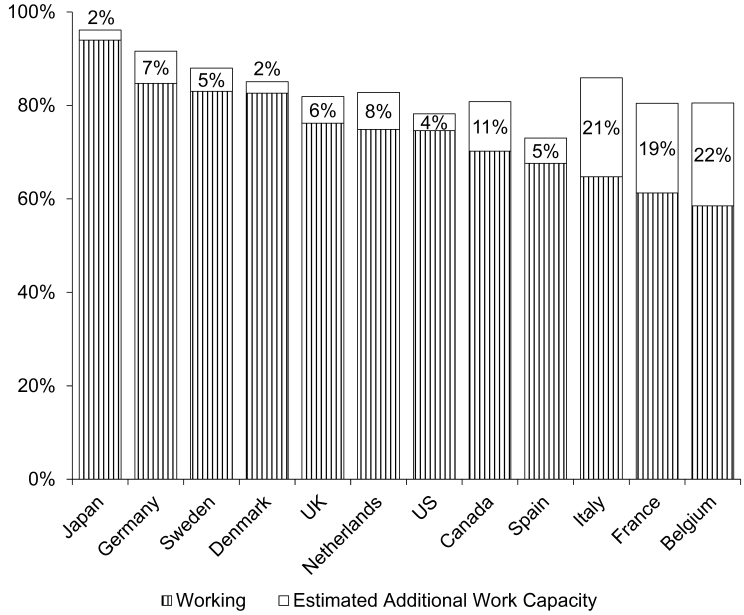

Fig. I.5A Estimated additional work capacity by country (men ages fifty-five to fifty-nine)

Source: Individual country chapters (authors' calculations).

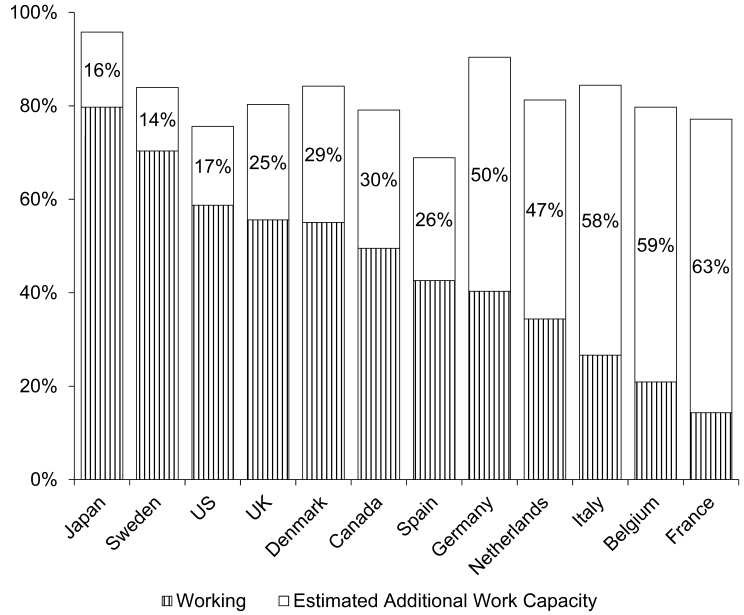

Fig. I.5B Estimated additional work capacity by country (men ages sixty to sixty-four)

Source: Individual country chapters (authors' calculation).

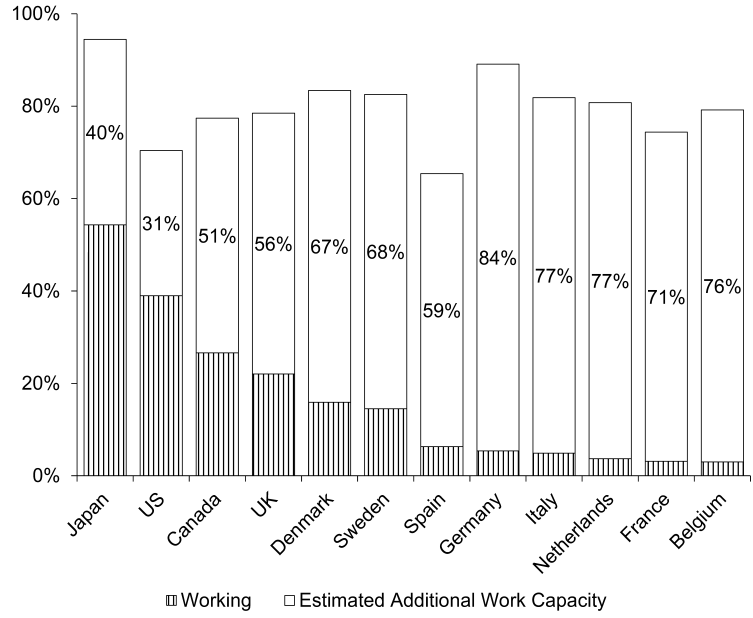

Fig. I.5C Estimated additional work capacity by country (men ages sixty-five to sixty-nine)

Source: Individual country chapters (authors' calculations).

estimated additional work capacity across countries are not driven primarily by differences in the predicted share working. While there are some differences in predicted employment—Spain consistently has the lowest values and Japan and Germany the highest, for example—the differences in work capacity are primarily explained by differences in the actual share working across countries. For example, at ages sixty to sixty-four the predicted share working is nearly identical in the United States and France, while actual employment is much lower in France (14 percent versus 59 percent), and consequently the additional work capacity is nearly four times larger in France (63 percent versus 17 percent).

Put differently, the widely varying levels of estimated work capacity across countries cannot be explained by differences in the rate at which health declines, which would be reflected in how the predicted share working evolves with age. Rather, they are primarily due to differences in the age at which workers retire, a decision that is strongly influenced by social security incentives, as Gruber and Wise (1999) document.

These estimates of the capacity to work may seem large relative to the actual employment rate. In table I.2, however, we showed that by using the MW method for the United States we obtain estimated additional work capacity of 15.6 percent at ages fifty-five to fifty-nine, 27.0 percent at ages

sixty to sixty-four, and 41.8 percent at ages sixty-five to sixty-nine, values in the range of those reported in figures I.5A, I.5B, and I.5C. The results using two very different methods are actually remarkably similar, though results from the Milligan-Wise method will depend on the base year used, as shown above.

It is possible to perform this analysis for women as well, and we report the results of this effort in figures I.6A, I.6B, and I.6C. Women's predicted employment levels (seen in the total height of the bar) are somewhat lower at every age compared to those of men, reflecting the fact that these are estimated based on the relationship between health and employment for women at ages fifty to fifty-four along with actual health of women at older ages, and women ages fifty to fifty-four are less likely to work than are men of the same age. Of greater interest, however, is the estimated additional work capacity (seen in the white bar). These values are quite similar for men and women. Across the twelve countries, for example, these values average 8.7 percent for women at ages fifty-five to fifty-nine versus 9.3 percent for men and 34.4 percent for women at ages sixty to sixty-four versus 36.1 percent for men. The difference is somewhat greater at ages sixty-five to sixty-nine, where estimated additional work capacity is 53.6 percent for women versus

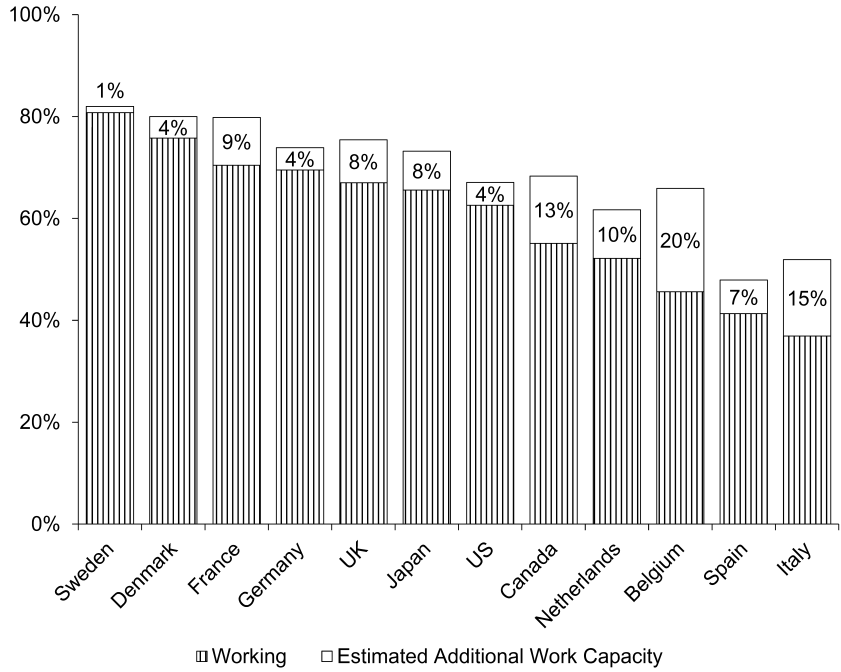

Fig. I.6A Estimated additional work capacity by country (women ages fifty-five to fifty-nine)

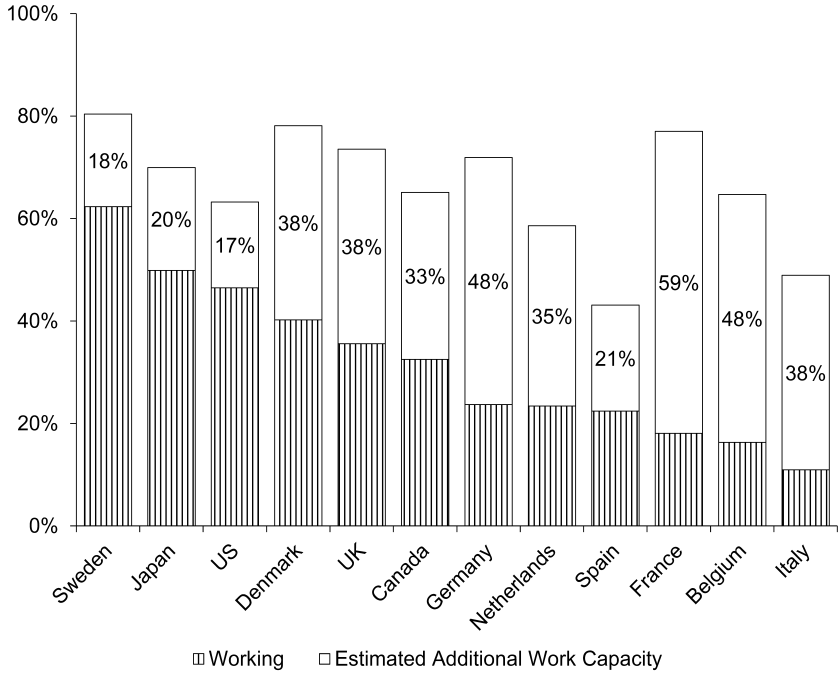

Fig. I.6B Estimated additional work capacity by country (women ages sixty to sixty-four)

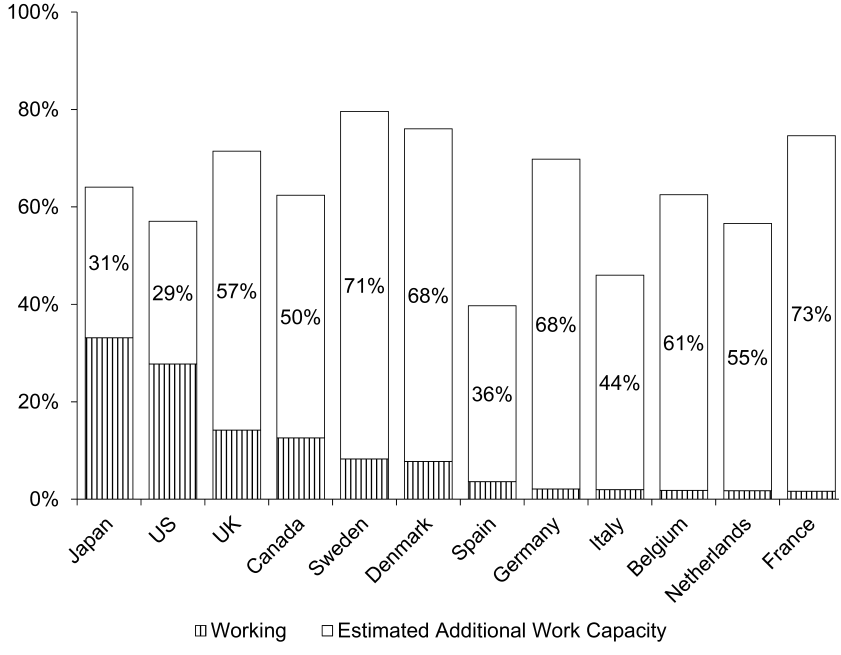

Fig. I.6C Estimated additional work capacity by country (women ages sixty-five to sixty-nine)

63.2 percent for men. Nonetheless, the key conclusion from this analysis is that both men and women have substantial additional work capacity, as estimated using this method.

Self-Assessed Health

In the first section of the chapter, we focused on the mortality rate as a measure of changes in health over time. In this section, we explore the improvement in health over time based on self-assessed health (SAH). An important advantage of SAH is that we can look at it by level of education, as the data sets with SAH virtually always include education, while mortality records often do not. Studies such as Waldron (2007) and the National Academies of Sciences (2015) have established that gains in life expectancy over time are accruing disproportionately to individuals with higher socioeconomic status (SES). By looking at the evolution of SAH by level of SES, we wish to see if this is the case for SAH as well. Unfortunately, data limitations prevented some countries from undertaking this analysis, but we show results for several of the countries where this was possible.

To begin, we discuss trends over time in mortality and in SAH and document their similarity. Figure I.7 shows the relationship between SAH and age for five-year groups from 1972 to 2013 and between mortality and age for five-year groups from 1970 to 2009 for men in the United States. As

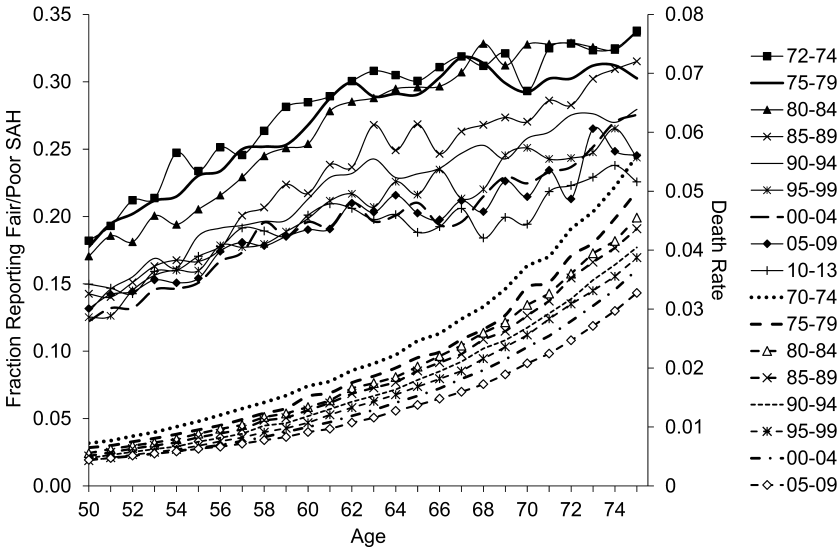

Fig. I.7 SAH and mortality by age for men in the United States (1972 to 2013)

Source: National Health Interview Survey and Human Mortality Database.

Note: Solid lines (graphed against left-hand axis) show self-assessed health for groups of years. Dashed lines (graphed against right-hand axis) show death rates for groups of years.

expected, both mortality rates and the share of men reporting themselves to be in fair or poor health (SAH) rise with age, although this is perhaps less evident for SAH in the sixties in the more recent year groups. The mortality relationships are smooth and show continuous improvement from one group of years to the next. The SAH relationships are more variable due to smaller sample sizes; while improvements over time are sometimes difficult to discern from adjacent year groups, there are large improvements when contrasting the early 1970s with late in the first decade of the twenty-first century.

Of particular interest is the fact that changes in the two series over time are relatively similar. For example, mortality at age fifty declined by 39.3 percent between 1970–74 and 2005–09, while the share reporting fair or poor health at age fifty decreased by 32.8 percent between 1972–74 and 2005–09. Over the same period, mortality at age seventy-five declined by 41.5 percent, while the share in fair or poor health at age seventy-five decreased by 33.2 percent. Alternatively, we can compare how much later certain health benchmarks are reached in later versus earlier periods. The mortality rate experienced at age fifty in 1970–74 was experienced at age fifty-seven in 2005–09, a gain of seven years, while the share of men in fair or poor health at age fifty in 1972–74 was experienced at age fifty-seven in 2005–09, also a gain of seven years. While the correspondence is not always one-to-one as in this example, overall the changes in these two health measures over time are fairly similar.

Looking across countries, there is a fairly strong correspondence between the change in reported SAH health and the change in mortality. Milligan and Wise (2012) show a scatter plot of changes in self-assessed health and mortality across the twelve ISS countries. We reproduce this scatter plot below in figure I.8. The correspondence of the two across countries is very strong, except for the United Kingdom.

Turning our focus to SAH, figure I.9 highlights trends in SAH over time in the United States, showing the relationship between age and the share of men in fair or poor health for three groups of years combined—1972–85, 1986–95, and 1996–13. The graph shows the raw data in the solid lines and quadratic-smoothed dashed lines for each of the year groupings. The reduction in fair-poor SAH seems quite large over this time period. For example, the age at which 20 percent are in fair-poor health occurs at about age fifty-four in 1972–85 and at about age sixty-two in the years 1996–2013, a difference of eight years. The age at which 25 percent of people are in fair-poor health rises by fifteen years, from age fifty-eight to age seventy-three. An alternative comparison is based on the change in the fraction that reports fair or poor health at a given age. At age sixty-five, this value is 35 percent lower in the 1996–2013 period than in the 1972–1985 period; at age sixty the value is 26 percent lower. The overall message is that the health of the population as a whole—as measured by SAH—has improved substantially in recent decades.

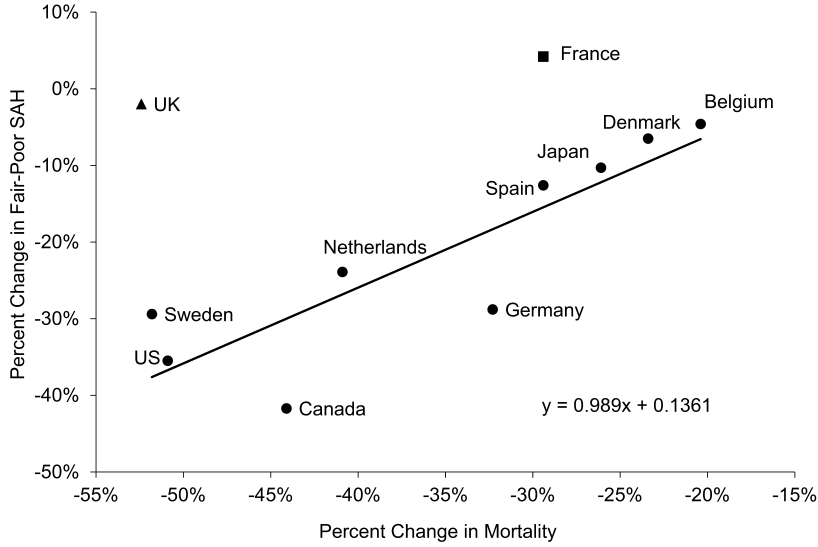

Fig. I.8 Change in SAH versus change in mortality (men ages sixty to sixty-four)

Source: Reproduced from data in Milligan and Wise (2012).

Note: Regression line includes all countries with circle marker, excluding the United Kingdom and France.

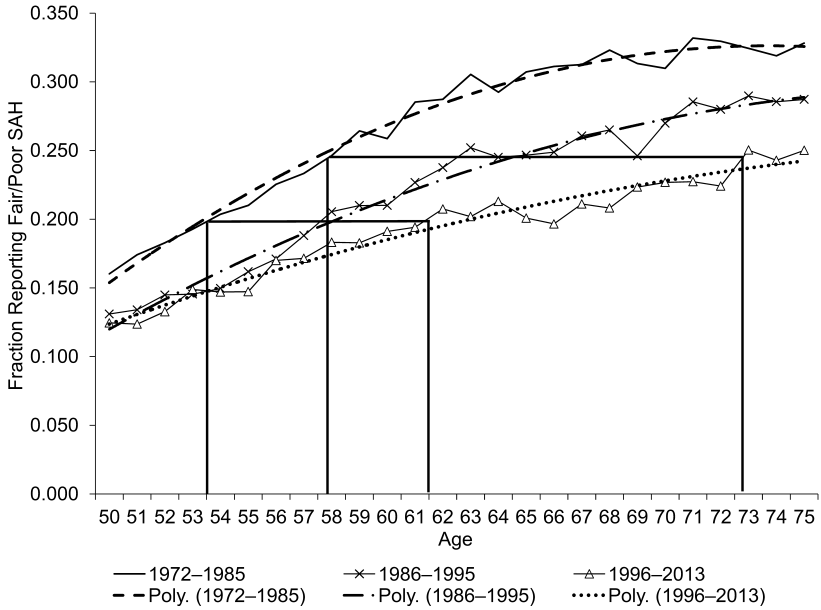

Fig. I.9 SAH by age, men in the United States (selected years)

Source: National Health Interview Survey.

To assess whether these gains in health vary by education level, we first need to define education level in a way that will yield meaningful comparisons over time. Following Bound et al. (2014), we focus on education quartiles. The use of specific categories like high school dropout can generate misleading results because the size of specific groups may be shrinking (or growing) over time, so that the group's members are increasingly negatively (or positively) selected. That is, high school dropouts today may be quite different from their counterparts of the past, making it less useful to compare how the health of people in this group has evolved over time.

Following the approach proposed by Bound et al. (2014), we begin by calculating the distribution of educational attainment for each cohort of fifty-year-olds. The top education quartile will always contain the quarter of the cohort with the highest levels of education; however, which education groups are represented in the top quartile will change over time. Figure I.10 displays these results for men in the United States. The top education quartile for the cohort reaching age fifty in 1950 includes all college graduates as well as most high school graduates; in 2012, the top quartile includes only college graduates.

Figure I.11 shows the relationship between SAH and age by education quartile ranking for men in the United States for three groups of years—

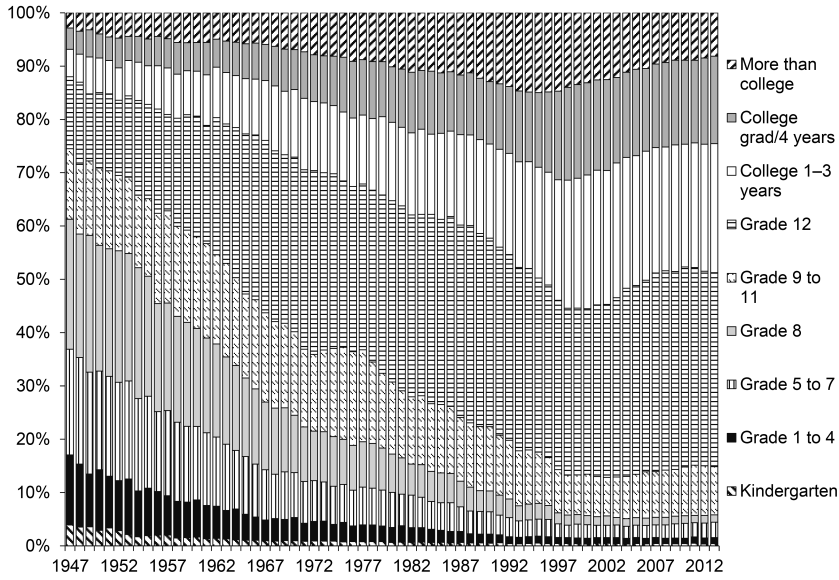

Fig. I.10 Distribution of educational attainment by cohort for men in the United States (by year cohort attained age fifty)

Source: Authors' calculations using National Health Interview Survey (accessed at www.ipums.org).

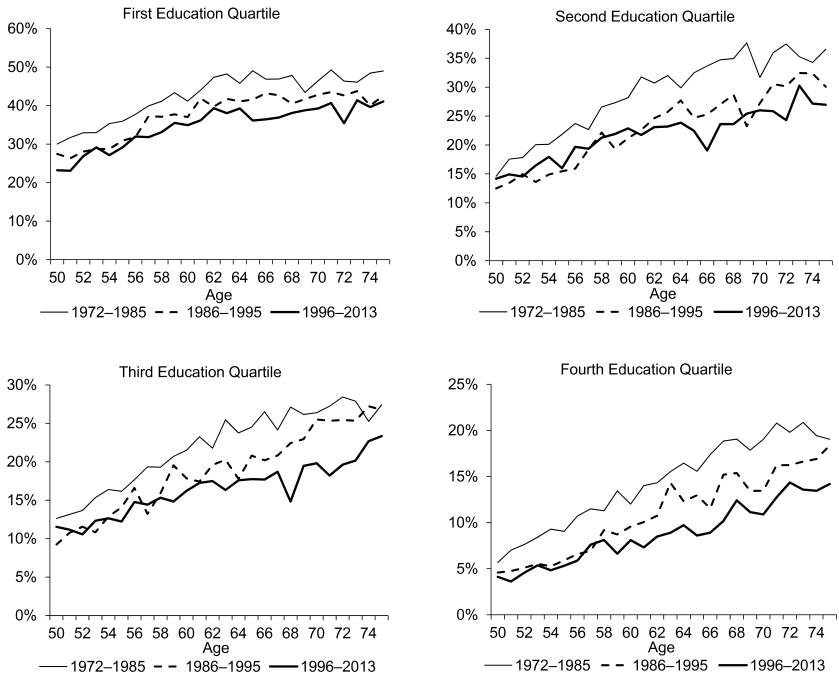

Fig. I.11 Evolution of SAH by education quartile for men in the United States
Source: National Health Interview Survey (accessed at www.ipums.org). The figure shows the share of men reporting fair or poor health.

1972 to 1985, 1986 to 1995, and 1996 to 2013. The results show that health measured by SAH improved over time in each education quartile, with the exception of a reversal in ages in the fifties in the 2nd quartile for the years 1986 to 1995. However, the percent improvement was greatest for those in the top education quartile and the lowest percent improvement was in the bottom education quartile. The percent improvements at age sixty-six, for example, are shown at the end of this section in comparison to three other countries in table I.5.

Figure I.12 is a comparable figure for France. Like the United States, the data for France show better health for higher education levels. Averaged over year intervals at age fifty, the percent in fair-poor health in the United States is about 22 percentile points greater for the 1st education quartile than for the 4th education quartile—27 for the first quartile, 14 for the second, 11 for the third, and 5 for the fourth quartile. Similarly, the difference in France between the first and fourth quartile is about 21 percentile points. But the average number of men reporting fair-poor health at age fifty is much greater in France than in the United States—38 percent in France versus 14 percent in the United States for the 2nd quartile. (This result is consistent

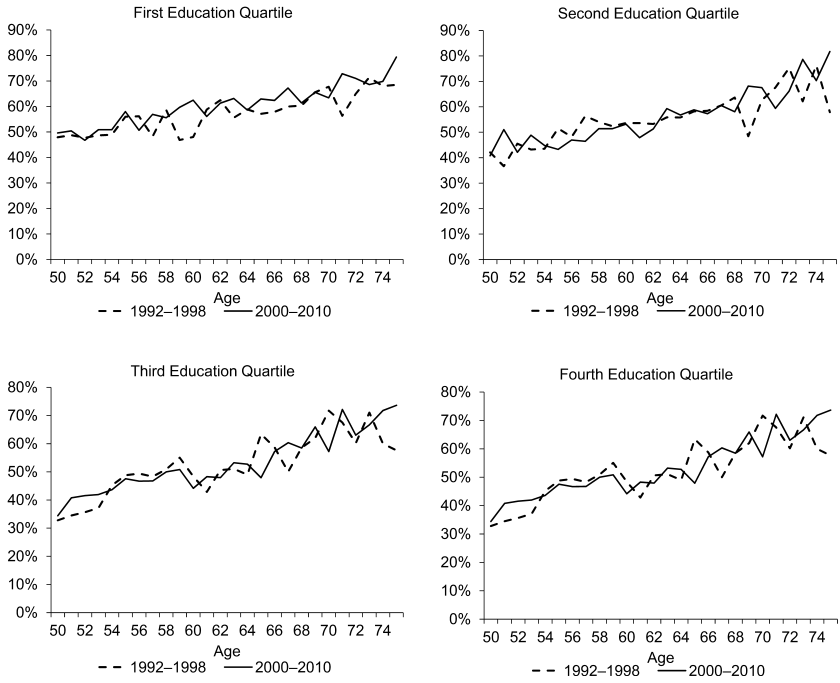

Fig. I.12 Evolution of SAH by education quartile for men in France

Source: Enquête sur la Santé et la Protection Sociale. The figure shows the share of men reporting fair or poor health.

with the well-known country-specific effects in SAH.) There is less evidence for an improvement through time for France, as the 1992–98 results are quite similar to the 2000–10 results, although the time spanned by the data is shorter here than in the United States.

We next turn to the United Kingdom in figure I.13 to see the evolution of poor health across the different education quartiles. Here, the data are pooled for men and women for greater precision and separated into two time periods: 1991 to 1999 and 2004 to 2012. As with France and the United States, those with higher education levels appear to be in better health. There is also a strong gradient with age for poor health. However, the evidence for improvements through time in the United Kingdom is weak, although there is some sign of improvement for the higher two education groups.

Finally, we look at data for Germany in figure I.14. We have data by age of the proportion who report having a chronic illness for more than one year. These data are broken down by education quartile in the manner described above, and presented for three separate years. There appear to be fewer differences across education quartiles than in other countries, with roughly the same age pattern evident in the first and fourth quartiles. However, there

Fig. I.13 Evolution of SAH by education quartile for men and women in the United Kingdom

Source: Health Survey for England, 1991–2012. The figure shows the share of men reporting fair, bad, or very bad self-assessed general health.

does appear to be improvement over time, most noticeably in the third and fourth quartiles.

Our findings for these four countries are summarized in table I.5, taking the results at age sixty-six. Overall, for two of these four countries we highlighted, all education groups (as represented by education quartiles) have experienced gains in health over time. In addition, for three of the countries, gains have been largest for the more highly educated groups, but for France there is no education pattern for the improvements. While the results of this analysis are not directly comparable to the Milligan-Wise and Cutler-Meara results presented above, they are nonethless useful in our assessment of the health capacity to work at older ages, as they suggest that gains in health capacity to work may be biggest for higher socioeconomic status individuals.

Summary

This volume is the seventh phase of our ongoing project on retirement programs around the world. In many countries, normal retirement ages have been increasing and further increases are in progress or under consideration.

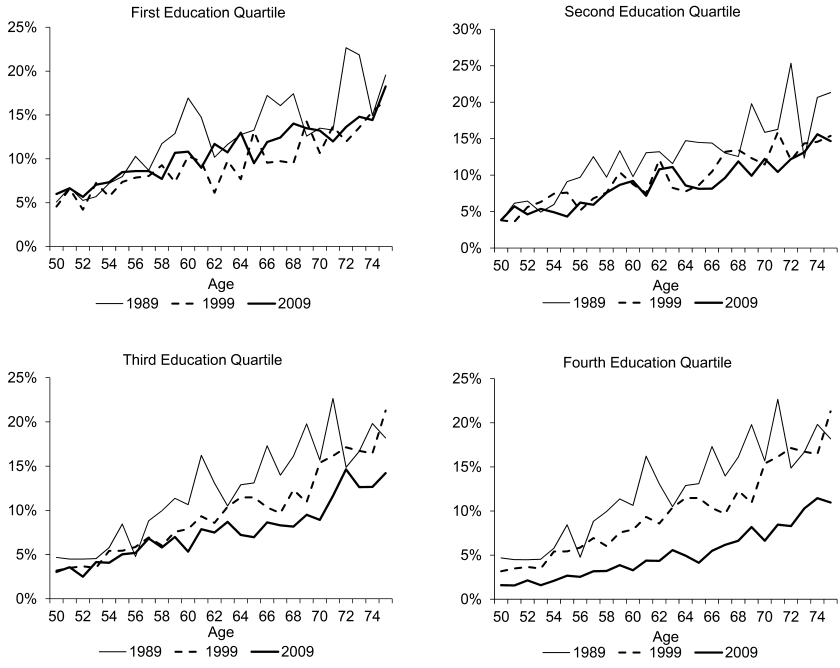

Fig. I.14 Evolution of chronic illness by education quartile for men in Germany
Source: German microcensus data. The figure shows the share of men reporting experiencing a chronic illness lasting more than one year.

Table I.5 Percent improvement in health at age sixty-six by education quintile

	1st (%)	2nd (%)	3rd (%)	4th (%)
United States	22.3	43.4	33.2	48.7
France	–7.8	1.9	2.5	0.3
United Kingdom	3.8	–1.9	23.9	19.2
Germany	30.9	43.4	50.1	42.5

Note: For each country using the results from figures I.10 to I.13, we compare the first group of years to the latest group of years. For the United States: 1972–1985 versus 1996–2013. For France: 1992–1998 versus 2000–2010. For the United Kingdom: 1991–1999 versus 2004–2012. For Germany: 1989 versus 2009.

In this phase of the project, we consider the capacity to work at older ages, particularly whether the health of older persons would allow them to work longer.

We use three approaches to evaluate the capacity to work. The first, which we refer to as the Milligan-Wise method, is based on the reduction in mortality over time. We suggest that a decrease in mortality may be thought of as an increase in health, and thus as an increase in the capacity to work. We find,

however, that mortality declines since the late 1970s have not been met with equivalent increases in employment. That is, at any mortality rate, employment is lower now than it was three to four decades ago. In the United States, for example, we estimate that the additional employment capacity of men ages sixty-five to sixty-nine in 2010 is 42 percent (that is, that the employment rate could be 74 rather than 32 percent), using 1977 as the base year in the calculation and assuming a constant relationship between employment and mortality over time. In most of the ISS countries, the actual employment of men age sixty to sixty-four has been increasing since the mid-1990s, but not by enough to keep up with mortality gains, so we estimate significant additional employment capacity even when we use a base year with low employment, such as 1995. On average across all countries, our estimates suggest that men could work an additional 5.5 years with 1977 as the base of comparison or 1.7 years with 1995 as the base year.

The second method, which we refer to as the CMR method, is based on using the estimated relationship between health and employment of persons age fifty to fifty-four and the actual health of individuals age fifty-five to sixty-nine to predict the work capacity of the latter group. This method also yields predictions of the capacity to work at older ages that substantially exceed the actual proportion of people working at older ages. Based on this method, the share of the male population with the health capacity to work at ages sixty to sixty-four in the United States, for example, is about 17 percent greater than the actual percent working; between sixty-five and sixty-nine, the difference is about 31 percent. The average values for the twelve countries in our sample are 36 and 63 percent, respectively.

A third method is based on improvements in self-assessed health (SAH) over time. This method, however, was possible to implement only in certain countries. The results were mixed across countries. For most, there was a strong education gradient in the incidence of poor health. Only some countries showed improvements in health as measured by self-assessed health through time, though there was some indication that these gains were larger for the higher education quartiles.

In short, all three methods suggest that older men have substantial additional capacity to work beyond their current employment levels. We find similar results for older women using the CMR method. It is important to emphasize again that our concept of the health capacity to work is not intended to suggest how long people should work, nor to suggest what typical retirement ages should be in various countries. As people live longer and healthier lives, it may be appropriate for policymakers to consider how these gains in life expectancy should be divided between years of work and retirement. It is also important to recall that there may be other impediments to longer work lives, such as weak labor demand for older workers. Studies documenting age discrimination in hiring against older women (Neumark, Burn, and Button 2015; Lahey 2008) and higher rates of retirement during

recessions (Coile and Levine 2007) suggest that this is not a trivial issue. The concept of health capacity to work, however, can be important in considering whether continued incremental increases in retirement ages, such as those that have been common in many countries over the past two or three decades, might be constrained by the health of older workers going forward. The results of this phase of the International Social Security project suggest that this is not the case.

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