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SOCIAL SECURITY PROGRAMS AND RETIREMENT AROUND THE WORLD: DISABILITY INSURANCE PROGRAMS AND RETIREMENT -- INTRODUCTION AND SUMMARY

Courtney Coile
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Social Security Programs and Retirement Around the World: Disability Insurance Programs and Retirement - Introduction and Summary
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ABSTRACT

This is the introduction and summary to the sixth phase of an ongoing project on Social Security Programs and Retirement Around the World. The first phase 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. The second phase documented the large effects that changing plan provisions would have on the labor force participation of older workers. The third phase 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. The fourth phase presented analyses of the relationship between the labor force participation of older persons and the labor force participation of younger persons in twelve countries. We found no evidence that increasing the employment of older persons will reduce the employment opportunities of youth and no evidence that increasing the employment of older persons will increase the unemployment of youth. The fifth phase on "Historical Trends in Mortality and Health, Employment, and Disability Insurance Participation and Reforms" was intended to set the stage for this current phase.

This sixth phase of the ongoing ISS project is particularly related to the fifth phase (Wise, 2012) and the second phase (Gruber and Wise, 2004) of the project. This volume continues the focus of the previous volume on DI programs while extending the methodology to study retirement behavior used in the second phase to focus in particular on the effects of the DI programs. The key question this volume seeks to address is: given health status, to what extent are differences in labor force participation across countries determined by the provisions of disability insurance programs?

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Through the coordination of work of a team of analysts in twelve countries for over fifteen 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. A central finding of the project is that in many countries the provisions of social security and related government programs provide strong incentives for workers to leave the labor force at relatively young ages and that reducing the inducement to leave the labor force can lead workers to delay retirement and yield large improvements in the financial position of government budgets. The work to date has also made clear that disability insurance (DI) programs can play a large role in the departure of older persons from the labor force, as many workers pass through DI on their path from employment to retirement.

This is the sixth phase of the ongoing ISS project. This phase is particularly related to the fifth phase (Wise, 2012) and the second phase (Gruber and Wise, 2004) of the project. This volume continues the focus of the previous volume on DI programs while extending the methodology to study retirement behavior used in the second phase to focus in particular on the effects of the DI programs. The key question this volume seeks to address is: given health status, to what extent are differences in labor force participation across countries determined by the provisions of disability insurance programs?

The fifth phase presented an analysis of historical trends in our group of countries to set the stage for the more formal analysis of disability insurance programs in the current volume. In that phase, the countries summarized DI program reforms and considered how DI reforms were related to changes in health, in particular as measured by changes in mortality. We also treated DI reforms as natural experiments—not prompted by changes in the health or employment circumstances of older persons—and showed that these “exogenous” reforms often had a very large effect on the labor force participation of older workers.

The second phase, which was based on microeconomic analysis of the relationship between a person’s decision to retire and the social security and other program incentives faced by that person, documented the large effects that changing plan provisions would have on the labor force participation of older workers. In that phase the country teams considered the employment implications of increasing retirement program eligibility ages, including the eligibility age for DI, and showed that these changes would have very large effects on employment at older ages. As described in more detail below, the current phase of the project differs from the second in incorporating a more careful modeling of the incentives arising from the DI program and simulating how changes in access to DI might affect labor force participation.

To summarize the findings of the remaining 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 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. The analyses in the first two phases, as well as the analysis in the third phase, are summarized in the introduction to the third phase.

In the fourth phase (Gruber and Wise 2010) we directed attention to the oft-claimed proposition that incentives to induce older persons to retire—inherent in the provisions of social security systems—were prompted by youth unemployment. Many have worried that if the incentives to retire were removed and older persons stayed longer in the labor force, the job opportunities of youth would be reduced. We found no evidence to support this "boxed economy" proposition. In short, we concluded: "the overwhelming weight of the evidence, as well as the evidence from each of the several different methods of estimation, is contrary to the boxed economy proposition. We find no evidence that increasing the employment of older persons will reduce the employment opportunities of youth and no evidence that increasing the employment of older persons will increase the unemployment of youth."

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 the project are listed below:

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, Michael Jørgensen, and Peder J. Pedersen
France	Luc Behaghel, Didier Blanchet, Muriel Roger, *Thierry Debrand, Melika Ben Salem, Antoine Bozio, Ronan Mahieu, Louis-Paul Pelé,* and *Emmanuelle Walraet*
Germany	Axel Börsch-Supan, Tabea Bucher-Koenen, Hendrik Jürges, Johannes Rausch, Morten Schuth, Lars Thiel, *Reinhold Schnabel, Simone Kohnz,* and *Giovanni Mastrobuoni*

Italy	Agar Brugiavini and Franco Peracchi
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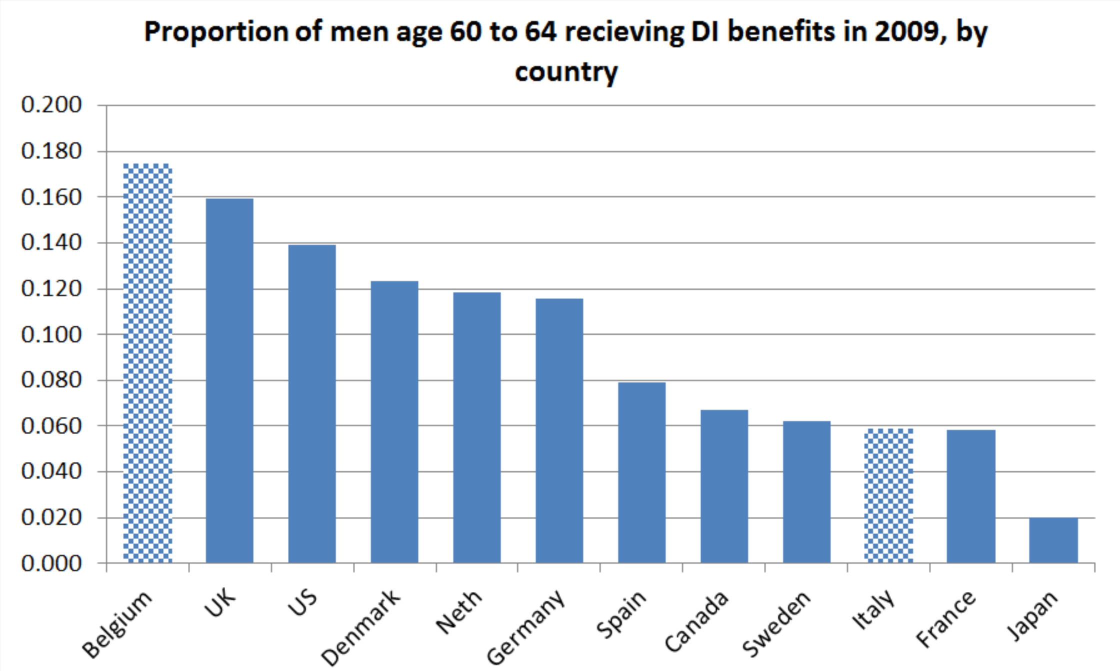
Sweden	Per Johansson, Lisa Laun, Mårten Palme and *Ingemar Svensson*
United Kingdom	James Banks, Carl Emmerson, Gemma Tetlow, *Richard Blundell, Antonio Bozio, Paul Johnson, Costas Meghir,* and *Sarah Smith*
United States	Courtney Coile, *Kevin Milligan*, *Jonathan Gruber,* and *Peter Diamond*

An important goal of the project has been to present results that were as comparable as possible across countries. Thus the papers for each phase were 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 papers. 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 papers 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 a particular country. In addition, the country papers typically present results separately for both men and women.

As we have noted in our past work, the share of the population receiving disability benefits at older ages varies substantially across countries. The figure below shows the share of men ages 60 to 64 collecting DI benefits by country in 2009. This value varies by a factor of eight within the participant countries, from 17 percent in Belgium to 16 percent in the UK to 14 percent in the US to 6 percent in Italy and France to 2 percent in Japan. (It is important to note that the data for Belgium and Italy pertain to the number of DI participants divided by the number of active wage earners plus the number of DI participants, rather than the population 60 to 64. This same caveat applies to Figures 1-1, 1-5, 1-6. 1-7, and 1-8 below.) It seems unlikely that differences of this magnitude would be driven exclusively, or even primarily, by differences in the health status of the population across countries. In the introduction to the prior phase of the project (Milligan and Wise, 2012), we grouped countries according to the share of men collecting disability benefits at age 45, which was 2 to 3 percent in one set of countries and 5 to 6 percent in another. By age 64, both groups of countries were exhibiting large differences in the share of men collecting DI (or similar) benefits – among countries with the lower rates of DI usage at age 45, for example, participation at age 64 ranged from less than 10 percent to over 35 percent. The emergence of these vast differences in the use of DI at older ages among countries with similar rates of disability in middle age strongly suggests that DI usage depends on factors other than health. These statistics also indicate that the DI program serves as a source of retirement income before the social security eligibility age for a sizeable share of the population in some countries. It is these observations that lead us to seek a better understanding of how financial incentives from DI programs affect labor supply.



Note: The data for Belgium and Italy pertain to the number of DI participants divided by the number of active wage earners plus the number of DI participants (rather than the population 60 to 64). Data for Germany are for ages 55-59. Data for France are for 2007 and for ages 55-59 and pertain to inactivity due to health reasons. Data for Italy are for 2004. The value for Japan is an estimate.

This introduction is organized in several sections. Section 1 presents background information on DI participation, including changes over time, participation gradients by education and health status, and other relevant statistics. Section 2 explains the Poterba, Venti, and Wise (PVW) index of health that is used throughout the analysis. Section 3 explains the estimation procedure that is followed. Section 4 discusses the simulations based on the estimation results. While the simulations in the second phase of the project emphasized the implications of increasing program eligibility ages, the simulations here emphasize employment (retirement) effects of incentives inherent in the provisions of the country retirement plans, particularly of changing the accessibility of the DI program.

1. Background

Trends in DI participation: We begin by documenting changes in DI participation over time. Figure 1-1 shows the DI participation rate for men ages 60 to 64 by country for selected years from 1970 through 2012 (years of data available for each country vary; data for France and Germany is for ages 55 to 59). DI participation is not shown for Japan, where DI participation has been extremely low. Similar figures in the individual country papers show results for men ages 50 to 54 and 55 to 59 and for women; trends in these other groups are often similar to those shown here, though participation levels are lower at younger ages.

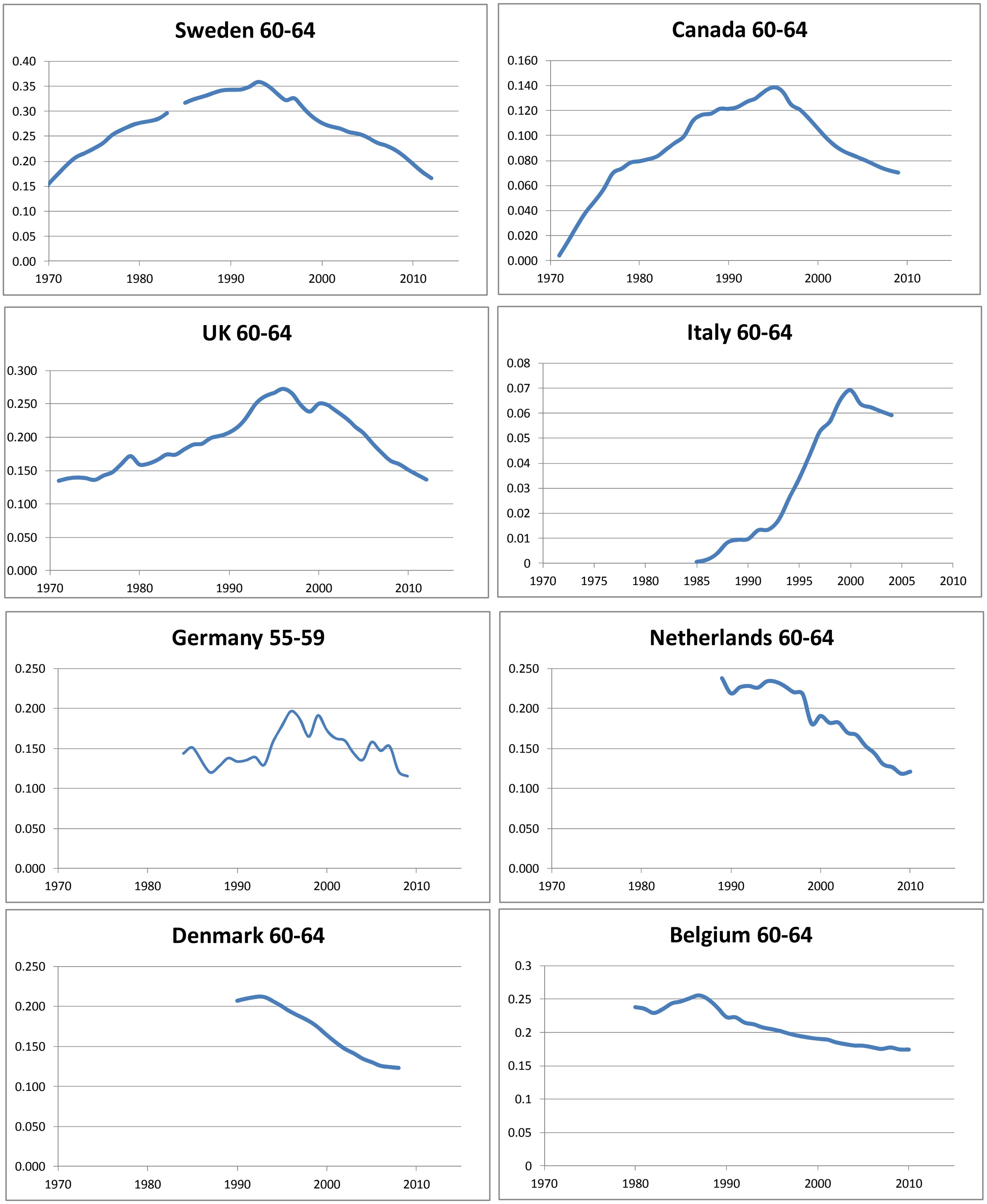
Perhaps the most striking feature of these data is the sharp decline in the DI participation rate for older men in many European countries beginning between the late 1980 and the mid-1990s. In five countries – most striking in Sweden, Canada, and the UK but also in Italy, and Germany – an inverted U-shaped pattern is evident, with DI participation rising until the mid-1990s and falling sharply thereafter. The DI participation rate reached 36 percent in Sweden and 27 percent in the UK before dropping by 53 and 50 percent respectively over the next fifteen to twenty years. The drop was 50 percent from the peak in Canada, 41 percent in Germany, and 15 percent in Italy. In the Netherlands, Denmark, and Belgium there was also a large decline after the late 1980s, ranging from 32 to 45 percent. In these three countries the time series begins too late to see the rise, but the fall in DI participation is quite evident.

In the remaining countries, the pattern is different. In the US, the DI participation rate for men ages 60 to 64 rose from 4.7 to 13.6 percent between 1960 and 1980 and then fell by 3 percentage points during the 1980s, from 13.6 to 10.4 percent. Since that time, while DI participation in many European countries has falling dramatically, the DI participation rate in the US increased by 30 percent in a trend that shows no signs of stopping. Spain too has experienced an increase in the DI participation rate over the past two decades. In France the trend in DI participation between 1990 and 2007 is unclear although there was a decline in DI participation in the last years of available data.

The changes are summarized in Table 1-1. The countries are ordered by the decline in the percent on DI with the greatest decline in Sweden and the greatest increase in the US.

As we discuss subsequently, that the dramatic changes in the DI participation rate over time experienced by many countries cannot be explained by changes in health. This feature of the data is documented in substantial detail in the previous phase of the project—the individual country chapters in that volume (Wise 2012) and the introduction to that volume (Milligan and Wise 2012). The rapid changes in the level of DI participation that can be seen in Figure 1-1 are often associated with reforms in the DI program or in other government programs and are also documented in the prior phase of the project.

Figure 1-1. Share of men age 60 to 64 on DI (55 to 59 in Germany and France), for selected years.



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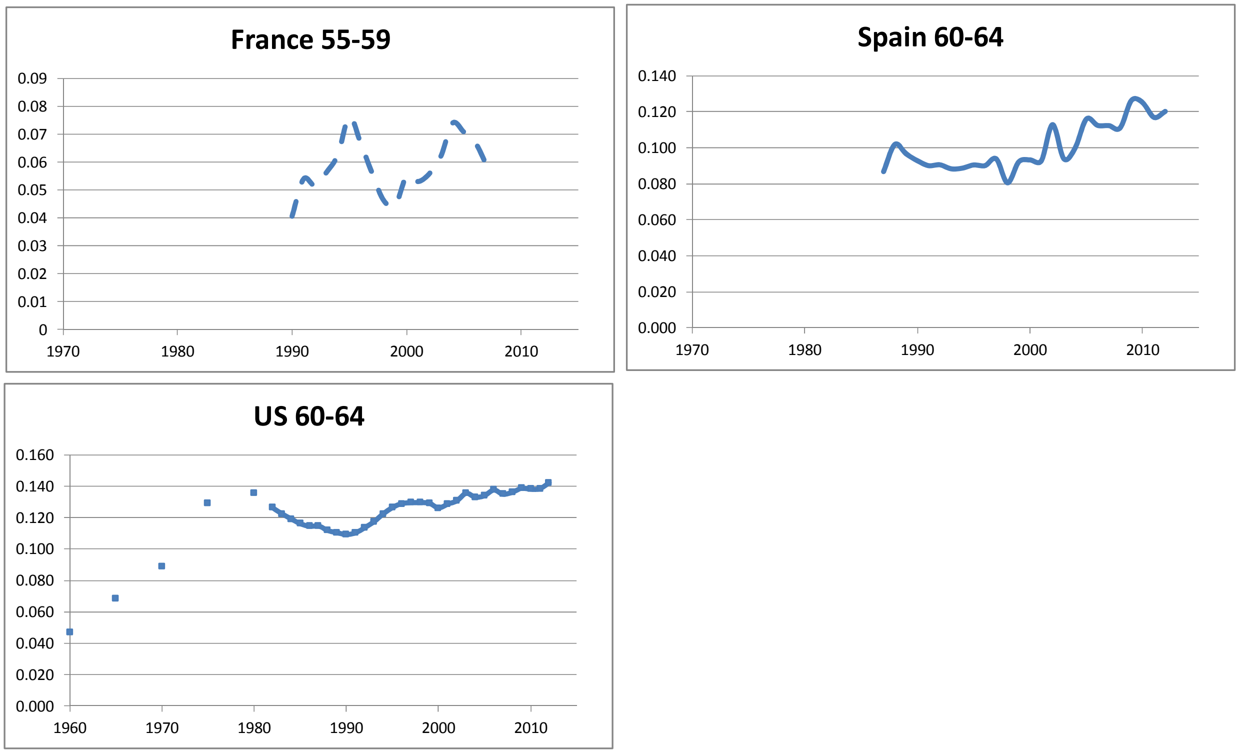
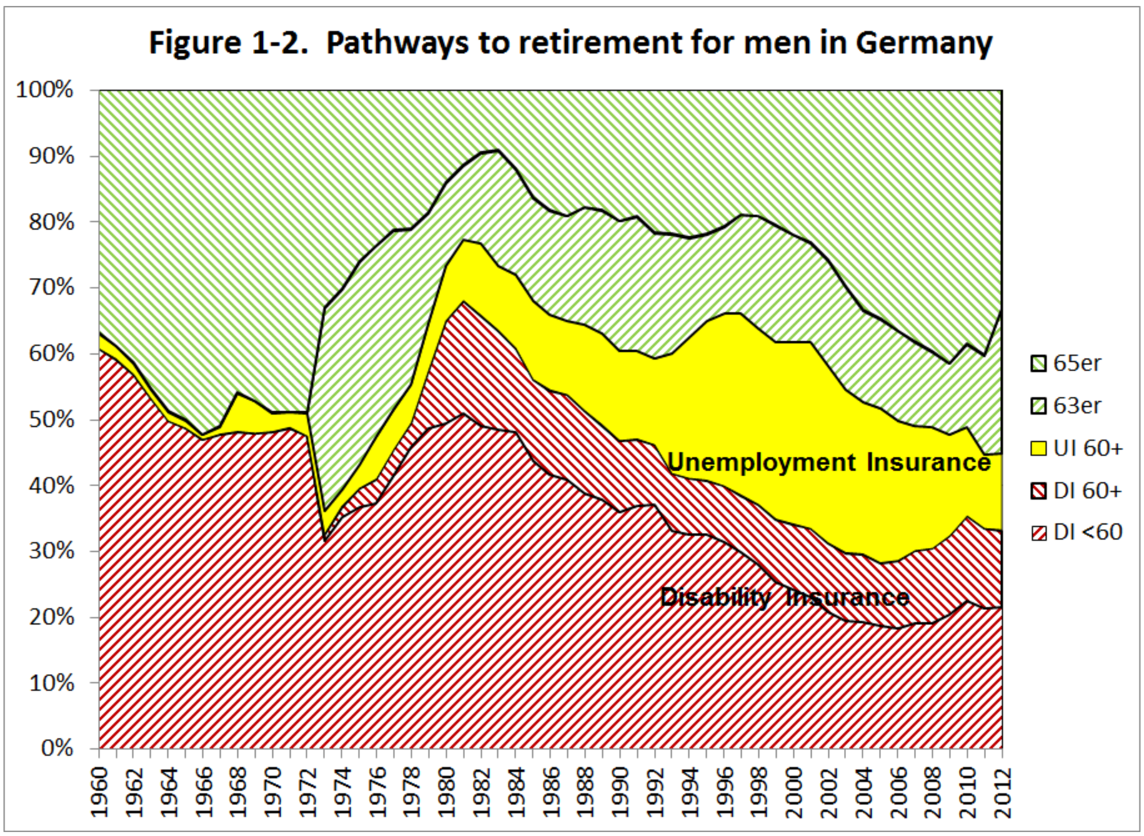


Table 1-1. Change in percent of men on DI from most recent maximum or minimum to year of most recent data, by country.

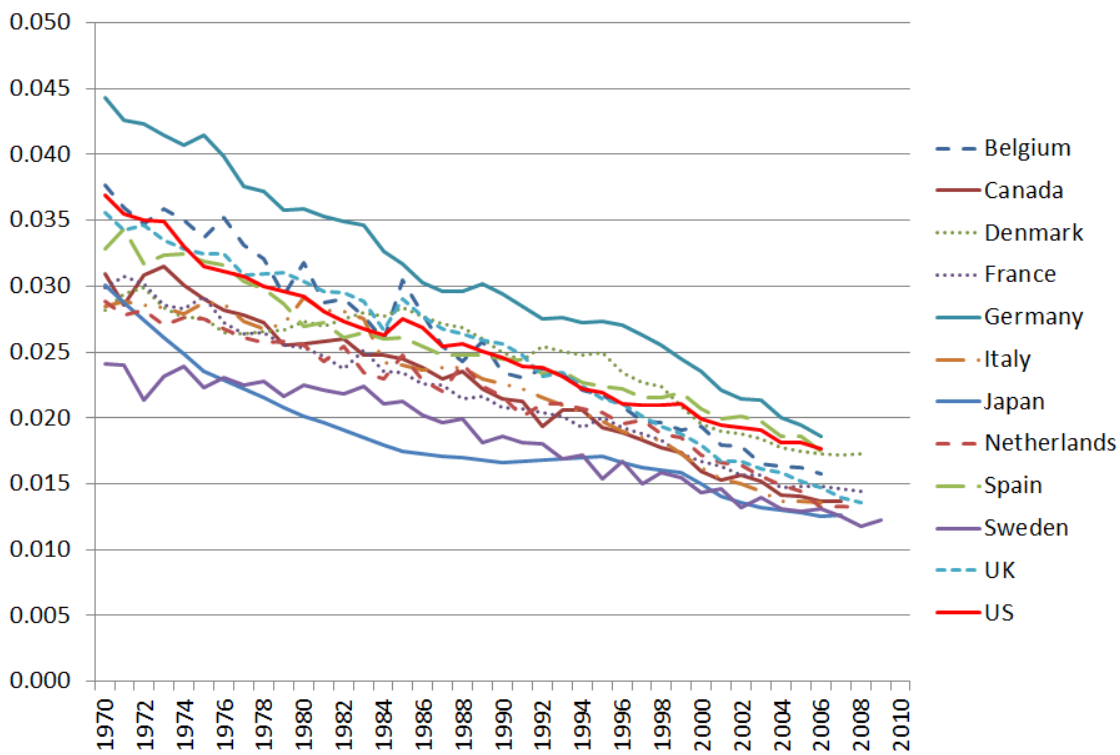
	Year of most recent minimum (or maximum)	Year of most recent data	DI percent in these years		Percent change between years
Sweden	1993	2012	0.360	0.170	-52.8%
Canada	1995	2009	0.139	0.070	-49.6%
UK	1996	2012	0.272	0.137	-49.6%
Netherlands	1994	2010	0.219	0.121	-44.7%
Denmark	1993	2008	0.212	0.123	-42.0%
Germany	1996	2009	0.196	0.115	-41.3%
Belgium	1987	2010	0.255	0.174	-31.8%
France	2004	2007	0.074	0.059	-20.3%
Italy	2000	2004	0.069	0.059	-14.5%
Spain	1988	2012	0.102	0.120	17.6%
US	1990	2012	0.109	0.142	30.3%

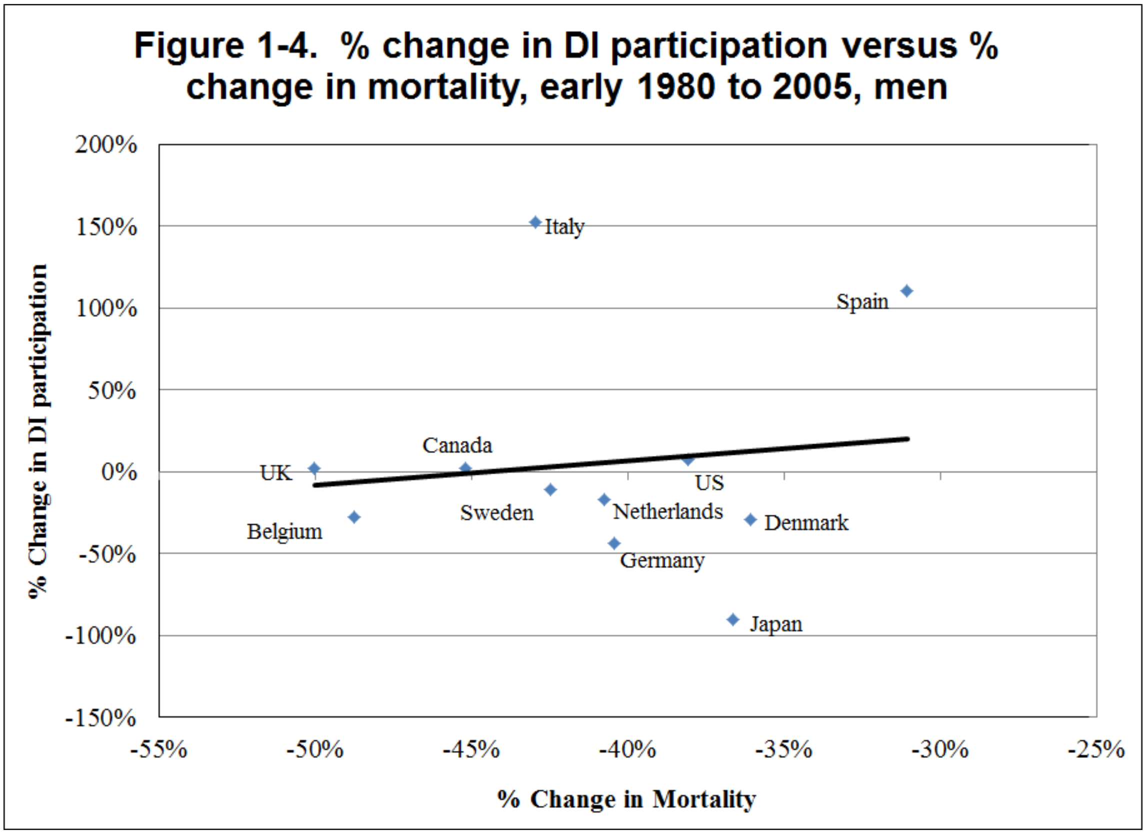
In addition to looking at the DI participation rate in isolation, it is instructive to consider how the use of different benefit programs as pathways from employment to retirement has changed over time. Figure 1-2 provides this information for German men. As the figure makes evident, the proportion of men retiring by way of DI fluctuated widely between 1960 and 2012. For example, the proportion retiring through the two DI programs (for workers under and over 60, respectively) ranged from a high of 68 percent 1981 to a low of 28 percent in 2005—a decline of over 58 percent—and then increased by over 14 percent by 2012. This figure also shows that the decline in retirement through DI coincided with an increase in retirement through a special unemployment insurance program for older workers. The decline in the sum of DI plus UI programs between 1981 and 1999 was a more modest 33 percent. This example suggests that government programs may substitute for one another—a decline in participation in one program may be offset by an increase in participation in another program and may not necessarily be associated with an equal increase in labor supply. Therefore it is important to take a holistic view and model the incentives arising from all programs that are potential sources of (early) retirement income, as we aim to do in the analysis that follows.



Trends in DI Participation versus Trends in Health: In the prior phase of the project (Wise, 2012), we emphasized the absence of a relationship between DI participation and health, as measured by mortality. Figure 1-3, taken from the introduction to this earlier study (Milligan and Wise, 2012), shows the decline in mortality at age 65 between 1970 and the early 2000s for our 12 participating countries. Mortality declined in all of the countries over this period, generally in a similar way. Yet as shown above in Figure 1-1, DI participation fluctuated widely over the same time period. The juxtaposition of these trends casts doubt on the possibility that changes in DI participation within countries over time are driven by changes in health, at least as measured by mortality. This point is made more directly in Figure 1-4, also from Milligan and Wise (2012), which plots the change in mortality and the change in DI participation between 1980 and 2005 for the 12 participating countries and finds little evidence of a relationship between them.

Figure 1-3. Decline in mortality at age 65, by country



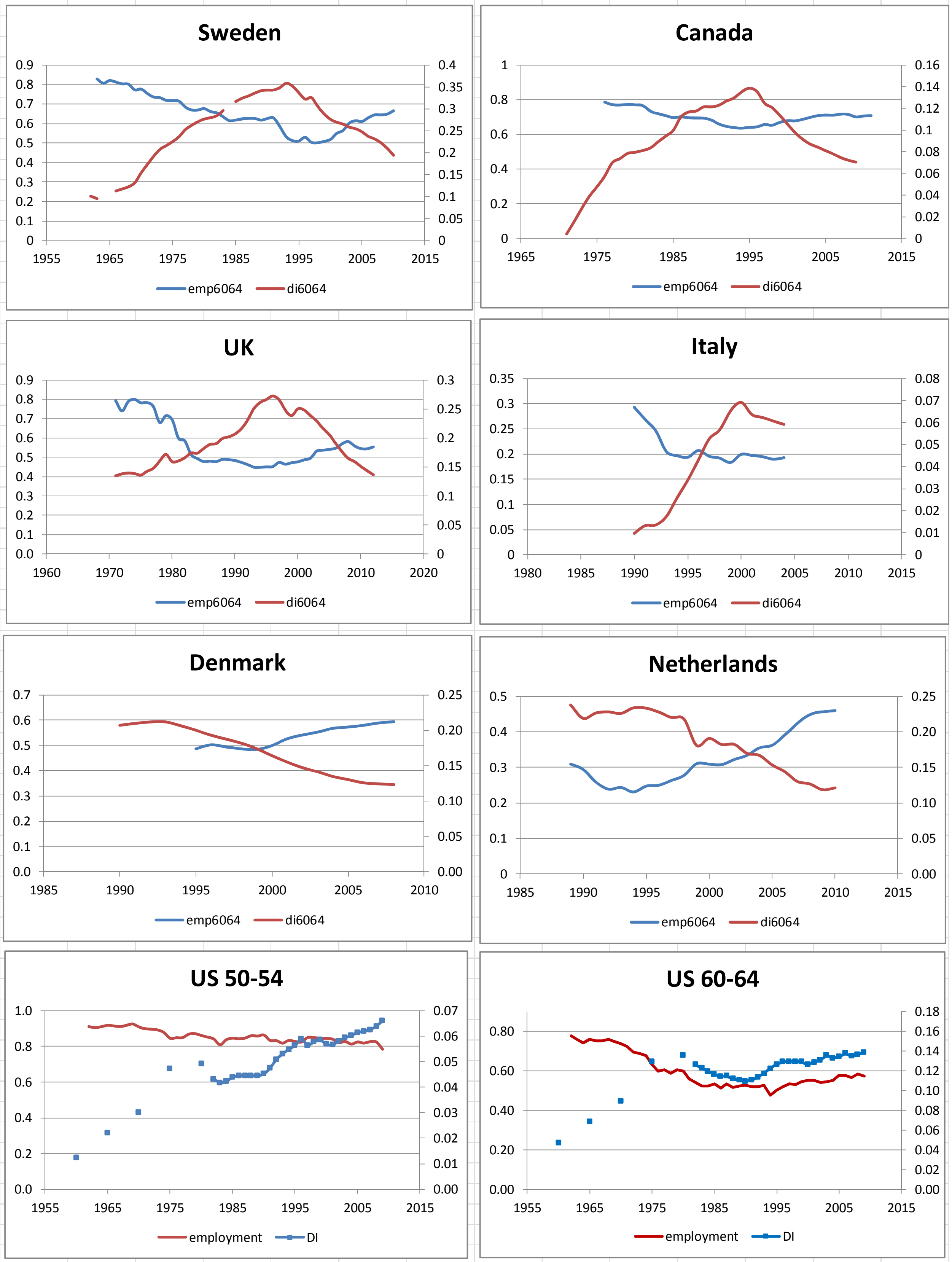


Trends in DI Participation versus Trends in Employment: While there is little evidence that changes in health are associated with changes in DI participation, we anticipate that changes in DI participation are associated with changes in employment at older ages. Here we explore the relationship over time by plotting the evolution of DI participation and employment rates at older ages within each country over time. A central goal of this phase of the project is to explore the relationship between DI programs and labor force participation through microeconomic analysis, as discussed below. The time series data here helps to provide motivation for the formal analysis to follow.

The relationship between DI participation and employment in the participating countries is presented in Figure 1-5. In this figure the left axis measures employment and the right axis measures DI participation. As discussed above with respect to Figure 1-1, the DI participation rate for older men follows an inverted U-shaped pattern in a number of countries, rising until the early-to-mid 1990s and then falling, while several additional countries (for whom earlier data was not available) also have a decline in DI participation over the past several decades. The new insight from Figure 1-5 is that there is an inverse relationship between the DI participation and employment rates in virtually all of these countries. Specifically, in Canada, Denmark, Italy, the Netherlands, Sweden, and the UK, the relationship is quite clear; as DI participation increases the employment rate falls and as DI participation declines employment increases. The relationship is especially striking in Sweden, Canada, the UK, and Italy where the peak in DI participation (with a sharp increase and a sharp fall after the peak) is mirrored by a reverse relationship for employment. A similar relationship is also shown for Germany but with greater fluctuation in the employment and DI trends over time.

In the US, the story is more complex. For men age 60 to 64, the inverse relationship is evident in the 1970s, but over the past two decades both employment and DI participation have been rising. For US men age 50 to 54, however—the ages at which a large number of men first receive DI benefits--the inverse relationship is clear. A similar relationship (not shown) holds for the 55 to 59 age groups in the US. In three additional countries—Belgium, Germany, and Spain—the data are too noisy or the time series too brief to draw strong conclusions, although the data suggest a negative relationship at the beginning and at the end of the time period for which data are available in Belgium, at the end of the period in Germany, and perhaps at the end of the period in Spain. Nonetheless, the fact that we observe that employment moves in the opposite direction of DI participation in most countries, in periods of both rising and falling DI participation and with the peak in DI participation lining up with the trough in employment in several cases, suggests a noticeable relationship between the two series.

Figure 1-5. Employment and DI rates for men, by country, for the age interval 60 to 64 except where noted.



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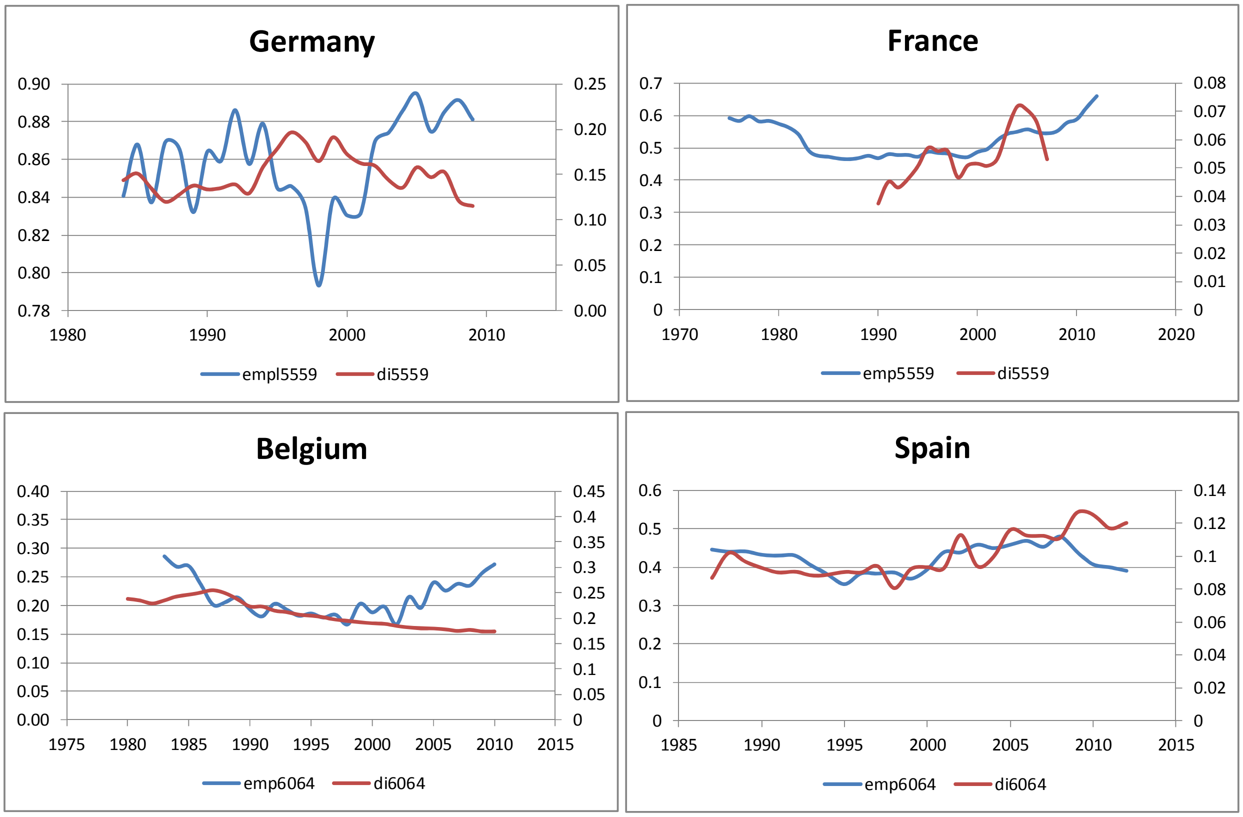
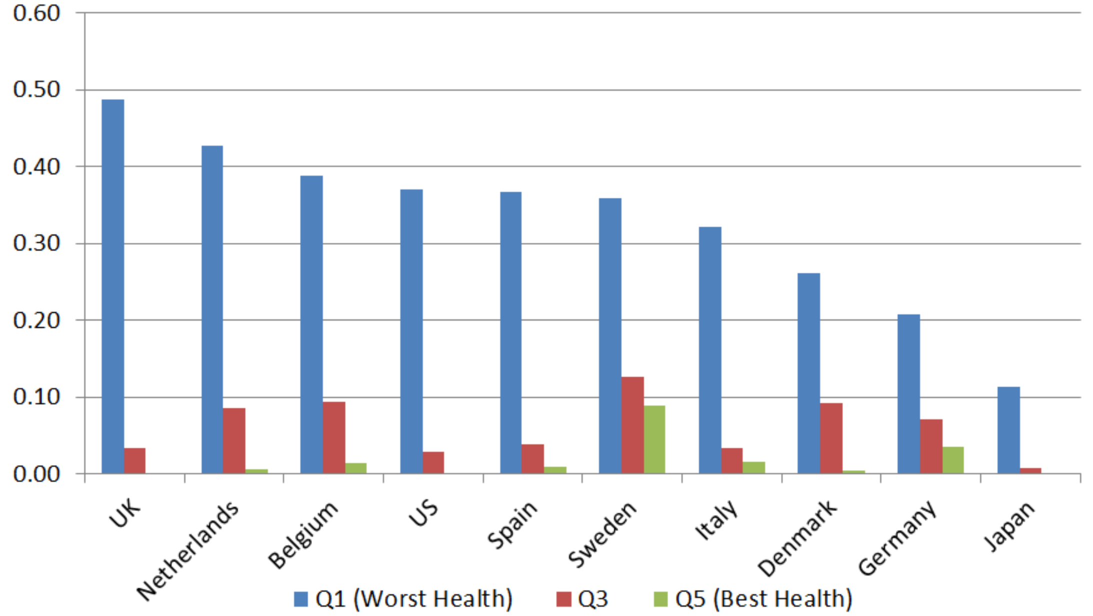


Health and DI participation: Having explored how DI participation varies across countries over time, and with changes in health and employment over time, we next consider how DI participation varies by health quintile. The description of how the health quintiles are constructed is deferred to Section 2 of this chapter.

The results are shown in Figure 1-6 for men age 55 to 64. In all countries, there is a substantial DI gradient with respect to health, with those in the lowest health quintile dramatically more likely to be on DI than those in the middle or highest health quintile. This finding is of course consistent with the intended purpose of DI programs to provide income support to individuals with reduced work capacity. The figure also shows, however, that for people with similar levels of health (for example, those in the lowest health quintile in their own country), there are large differences across countries in the probability of being on DI. In the UK, nearly half of older men in the lowest health quintile are on DI, versus about one-quarter of Danish men and one-tenth of Japanese men in the lowest quintile. Among countries with similar rates of DI in the lowest health quintile—such as the US, Spain, and Sweden—the share of men in the middle health quintile who are on DI ranges from 3 percent in the US to 13 percent in Sweden.

Figure 1-6. Share of Men Age 55-64 on DI in 2010, by Health Quintile

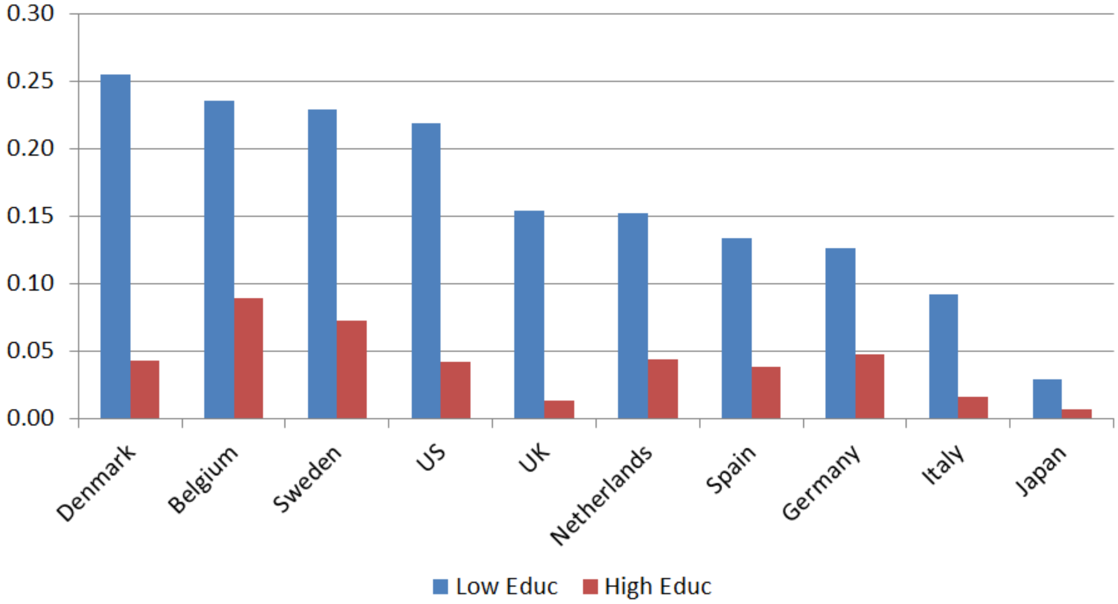


Note: The data are from various years, 2008-2011, depending on the availability for each country. Data for Belgium, Denmark, Italy, the Netherlands, and Sweden are for ages 50 to 64. Data for Germany are for ages 50 to 59. Data for Germany are for ages 55-59.

Education and DI participation: One feature of DI that may not be widely understood is the strong relationship between DI participation and education. Figure 1-7 shows the share of men at ages 55 to 64 who are on DI by level of education across countries; the values for the highest and lowest education groups are shown on the graph, although definition of high and low varies across countries.

In Denmark, Italy, the U.S., and the U.K., those individuals in the lowest education group are at least five times as likely to be receiving DI benefits as those in the highest education group. In other countries, the ratio of probabilities is somewhat lower, but still greater than two in every country. Differences in rates of DI participation by education group may reflect the fact that less educated individuals on average are in poorer health than those with more education – a possibility that we explore in more detail below – but likely also reflect economic circumstances such as weaker job prospects or higher replacement DI rates for workers with low lifetime earnings in systems with progressive benefit formulas.

Table 1-7. Share of men age 55-64 on DI in 2010, by education



Note: Data are from various years, 2008-20011, depending on availability for each country. Data for Belgium, Denmark, Italy, the Netherlands. and Sweden are for ages 50-64. Data for Germany are for ages 50-59. Low and high education groups are defined differently in across countries.

DI Participation by Education and Health: We return to the question of whether differences in DI participation by education are primarily due to health differences by calculating DI participation by health and education for those countries with large enough sample sizes to do so. Figure 1-8 shows the participation percent by education for each health quintile in ten of the participant countries. In the lowest health quintile in the U.S., 50 percent of persons with less than a high school degree are DI participants versus only 34 percent of those with a college degree. For those in the 3rd health quintile, participation rates among college graduates and high school dropouts are 6 percent and 2 percent, respectively. In the UK, there are even larger differences by education in DI use by men in the same health quintile. In the lowest quintile, those in the low education group are over twice as likely to be on DI as those in the high education group (53 versus 22 percent); this is also true in the second quintile (23 versus 4 percent) and third quintile (6 versus 2.5 percent). A similar pattern is evident in the other countries, with Denmark and Sweden having particularly steep gradients, like the UK, and other countries reflecting gradients more similar to those in the US. From these figures, we conclude that differences in DI use by education group are not due exclusively to differences in health. Rather, it appears that there are other factors such as differential labor market prospects or earnings potential that may explain the large differences in DI participation by education, conditional on health.

Figure 1-8. Share of men age 55 to 64 on DI by health and education, by country

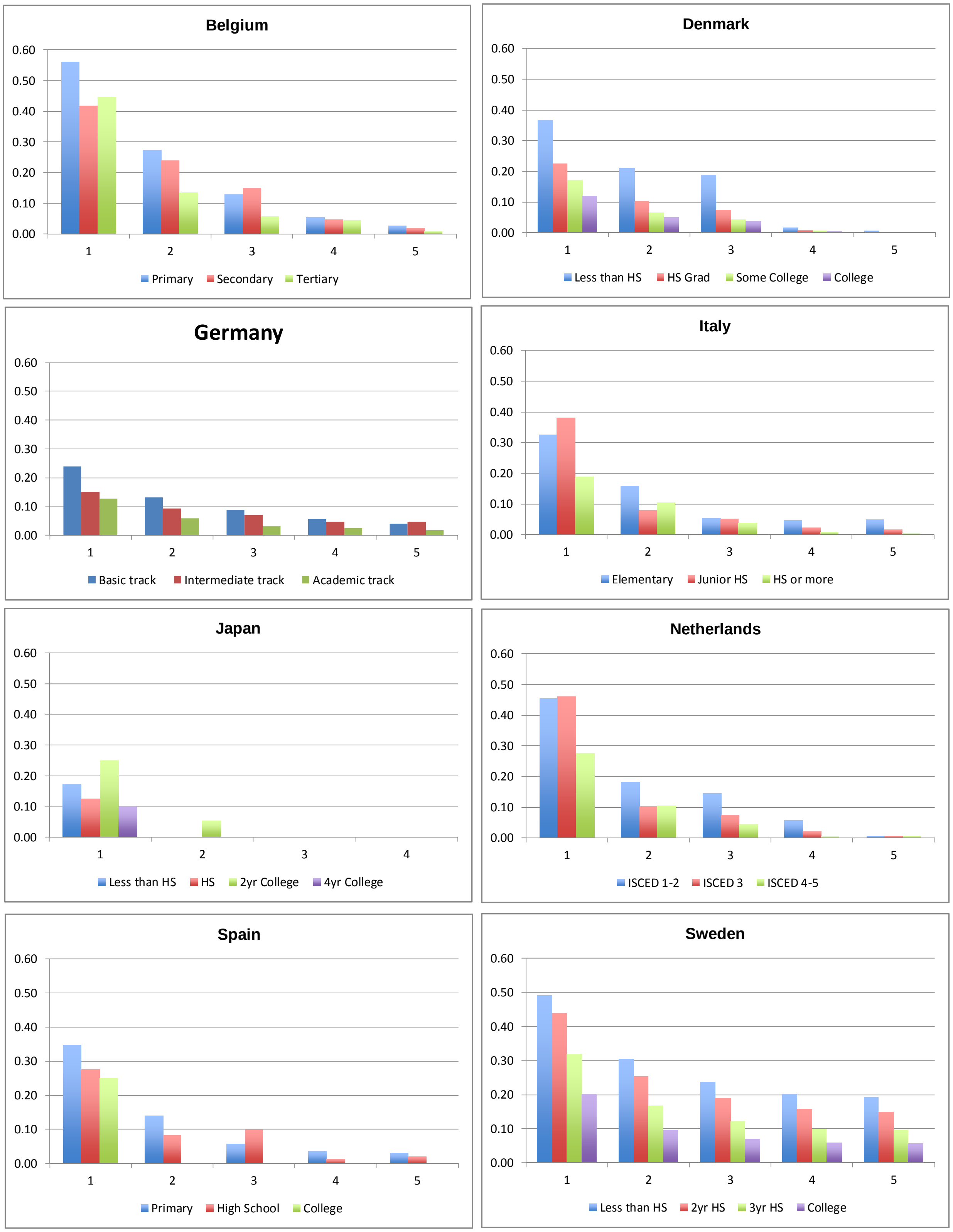
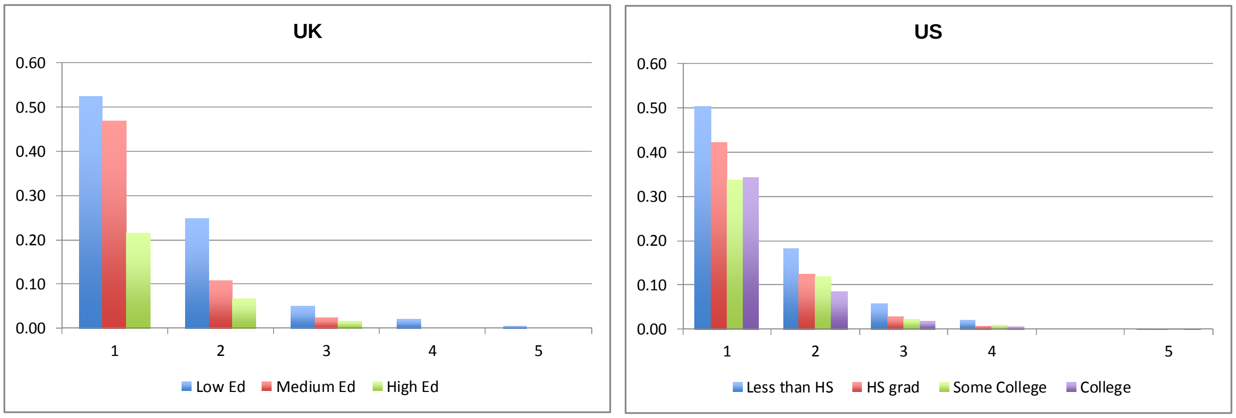
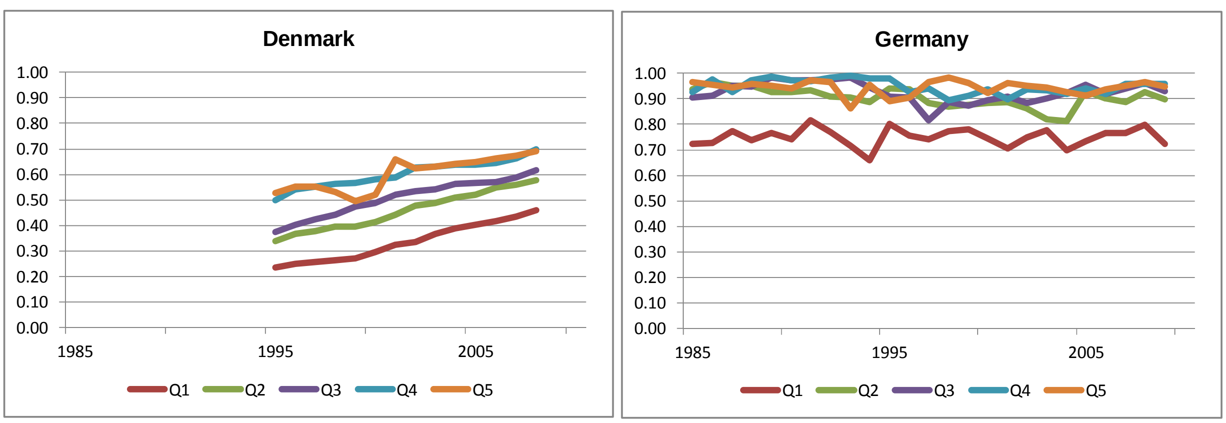


Figure 1-8. Share of men age 55 to 64 on DI by health and education, by country



Employment by Health and by Education: Finally, we explore the relationship between employment and health and employment and education, which are likely to vary across countries depending on the provisions of each country's DI program. Employment rates by health quintiles are plotted for Denmark and Germany only—for other countries the data necessary to compute an equivalent time series are not available. The figure shows that there are very significant differences across health quintiles in the probability that older men are employed. Although employment rates are higher at every level of health in Germany, the difference between the employment rates of those in the lowest and highest health quintiles is roughly the same in both countries, 20 to 25 percentage points.

Figure 1-9. Employment by health quintile, for men age 55-64, by country and year



Note: Data for Denmark are for ages 50-64

Figure 1-10 presents employment rates at ages 55-64 by level of education, country, and year. This figure shows that there are very large differences in employment by education. In most countries, the difference in employment between the highest and lowest education groups (where the definition of these groups varies by country) is at least 20 percentage points. Notably, these differences are of a similar magnitude to those seen across health quintiles in Figure 1-9. Thus education is strongly related to both DI participation and to employment at older ages, consistent with a causal link between employment and application for DI.

Figure 1-10. Employment by education level, men age 55-64, by country and year.

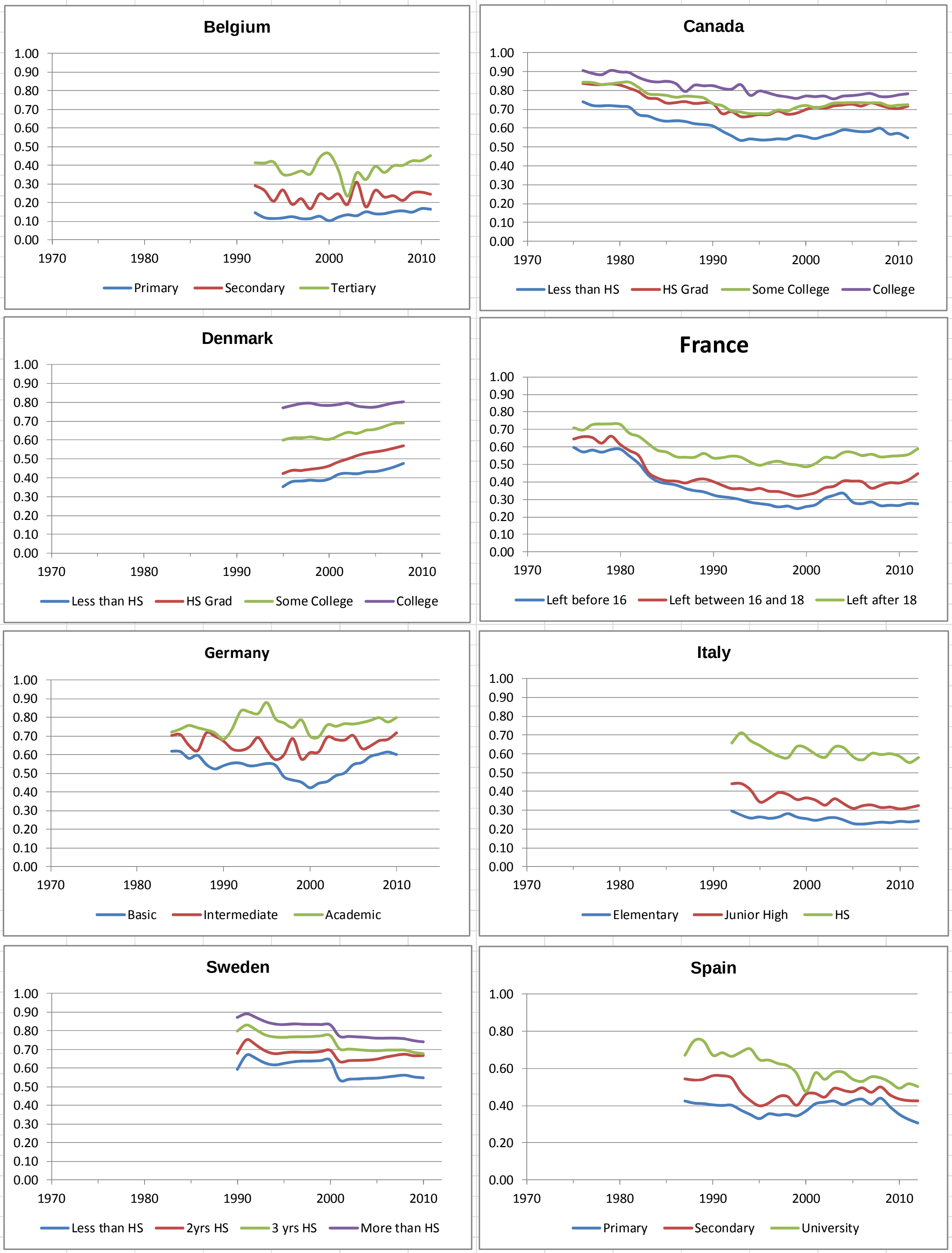
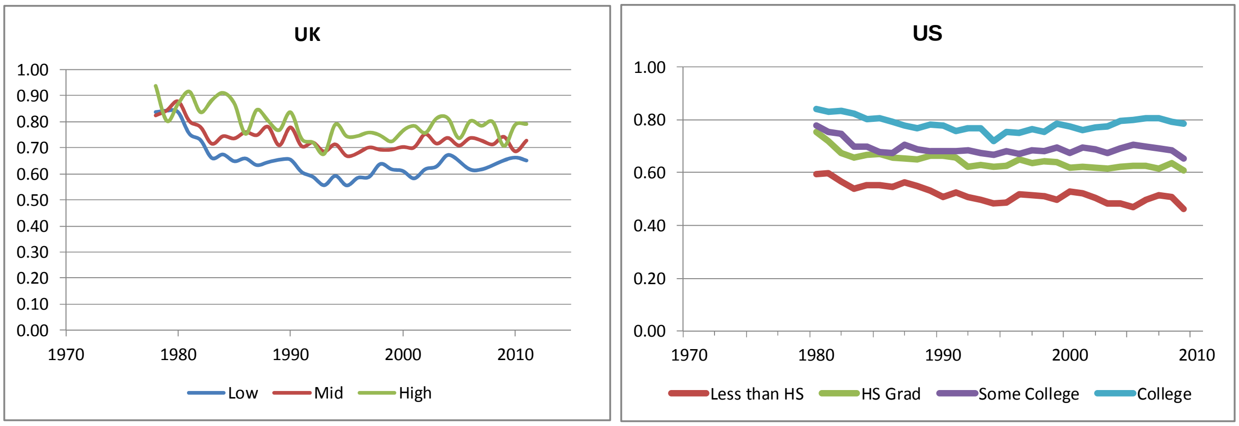


Figure 1-10. Employment by education level, men age 55-64, by country and year



Note: Data for Belgium and for Spain are for the age interval 60-64.

2. Measuring Health

Health is a central component of the analysis. Here we explain briefly the measure that is used and a key property of the measure.

To maintain as much comparability across countries as possible, we use a health index developed by Poterba, Venti, and Wise (PVW) that has previously been used in several contexts—see for example Poterba, Venti, and Wise (2013). The index, as set out by PVW, is the first principal component of 27 health indicators reported in the US Health and Retirement Study (HRS). Much of the analysis reported in this volume makes use of a nexus of comparable studies--the English Longitudinal Study of Aging (ELSA), the Japan Study of Aging and Retirement (JSTAR), and the Survey of Health, Aging and Retirement in Europe (SHARE, which includes 8 of our participant countries: Belgium, Denmark, France, Germany, Italy, the Netherlands, Spain, and the UK). The similarity of these studies allows us to apply the PVW methodology across countries.

To be more specific, in the current project we use a slightly modified version of the PVW index based on 25 indicators that are common to the HRS and to all of the SHARE countries. Japan and the UK lack data on several of the indicators, so they use the same methodology with the remaining indicators. There are four countries that do not employ the PVW method in constructing health measures for their analysis. One is Canada, which lacks detailed data on health in any survey that would meet the other requirements of this project and thus uses a simplified health measure (see country paper for details). The others are Sweden, Denmark, and Germany, who have chosen to use non-SHARE data to obtain a larger sample size for their analyses. For these four countries, therefore, the comparable health measure cannot be used. Nonetheless the comparable health measures for all SHARE countries are included in the discussion below. The health measures in non-health-index-countries are not comparable to the index health measure. Also, in some countries, the precise index used in a country may differ slightly from the index used in this discussion of the properties of the index.

The health measures and the weights ("loadings") given to each measure in the index for each country (except Canada) are shown in Table 2-1a. Comparison of the weights across countries reveals striking consistency among the countries. That is, the ranking of the weights is very similar from one country to the next. This is especially apparent for the US, the eight SHARE countries, and for the UK (based on ELSA data).

Table 2-1b shows the correlation of the weights for each pair of countries. All but 2 of the 32 pairwise correlations for the US and the SHARE countries 0.95 or greater; many are 0.97 or greater. Correlations between the rankings for the UK and each of the other countries and the ranking for Japan and each of the other countries are shown on the right-hand side of the table. These correlations are based on the weights for the health indicators that are common to each country. For example the correlations for Japan are based on the 22 indicators that are common to the US, the SHARE countries, and Japan. The correlations for the UK are based on the 20 variables that are common to the UK, the US, and the SHARE countries. The pairwise correlations between the UK and the other countries for this smaller set of questions are 0.95 or greater for all countries except Japan, with a correlation of 0.92. In general, the correlations between Japan and the other countries are between 0.88 and 0.93 with one exception. When the "exact same" questions are used in each of the countries, the pairwise correlations are close to 1—between .98 and .99—for all of the countries except the pairwise correlations with Japan. The high correlations between the country "loadings" indicate that the relationships among the many health indicator responses are very similar across countries.

Table 2-1a. The PVW 1st principle component index for the U.S. (HRS) and SHARE countries

Question	HRS	Ger-many	Swe-den	Nether-lands	Spai n	Italy	Fran-ce	Den-mark	Bel-gium	UK	Japan
Difficulty walking sev blocks	0.307	0.276	0.271	0.270	0.264	0.288	0.281	0.265	0.280	0.321	0.311
Difficulty lift/carry	0.293	0.271	0.300	0.297	0.298	0.292	0.284	0.302	0.294	0.312	0.337
Difficulty push/pull	0.288	0.277	0.296	0.299	0.292	0.283	0.289	0.281	0.297	0.309	0.340
Difficulty with an ADL	0.281	0.275	0.279	0.260	0.258	0.273	0.272	0.275	0.279	0.302	0.242
Difficulty climbing stairs	0.276	0.289	0.318	0.297	0.303	0.284	0.296	0.313	0.288	0.298	0.315
Difficulty stoop/kneel/crouch	0.275	0.293	0.292	0.309	0.301	0.288	0.304	0.294	0.289	0.290	0.309
Difficulty getting up from chair	0.266	0.285	0.287	0.275	0.291	0.273	0.265	0.274	0.264	0.282	0.304
Self-reported health fair or poor	0.262	0.285	0.259	0.284	0.265	0.259	0.279	0.299	0.276	0.258	0.211
Difficulty reach/extend arms up	0.224	0.244	0.215	0.202	0.236	0.241	0.227	0.184	0.192	0.223	0.269
Ever experience arthritis	0.197	0.153	0.169	0.176	0.196	0.199	0.185	0.189	0.201	0.216	0.122
Difficulty sitting two hours	0.194	0.218	0.204	0.210	0.213	0.200	0.178	0.211	0.186	0.228	0.277
Difficulty pick up a dime	0.164	0.169	0.173	0.124	0.169	0.193	0.152	0.157	0.137	0.174	0.248
Back problems	0.162	0.180	0.176	0.195	0.196	0.182	0.161	0.186	0.177	n/a	
Ever experience heart problems	0.156	0.129	0.153	0.106	0.122	0.142	0.162	0.123	0.159	0.137	0.094
Hospital stay	0.154	0.152	0.154	0.144	0.108	0.132	0.126	0.135	0.132	n/a	0.109
Home care	0.152	0.143	0.177	0.221	0.160	0.134	0.211	0.193	0.204	0.199	
Doctor visit	0.146	0.208	0.168	0.190	0.184	0.203	0.200	0.183	0.236	n/a	0.082
Ever experience psychological	0.137	0.090	0.064	0.059	0.114	0.080	0.067	0.079	0.087	0.062	0.017
Ever experience stroke	0.132	0.125	0.109	0.105	0.098	0.127	0.124	0.120	0.114	0.108	0.126
Ever experience high blood	0.129	0.121	0.094	0.095	0.108	0.121	0.110	0.084	0.087	0.147	0.075
Ever experience lung disease	0.123	0.085	0.088	0.090	0.097	0.119	0.105	0.132	0.097	0.109	0.040
Ever experience diabetes	0.114	0.114	0.083	0.082	0.094	0.110	0.091	0.067	0.089	0.085	0.071
BMI at beginning of period	0.072	0.077	0.062	0.080	0.079	0.065	0.092	0.059	0.071	n/a	0.026
Nursing home stay	0.070	0.042	0.073	0.085	0.020	-0.002	0.024	0.057	0.024	n/a	
Ever experience cancer	0.060	0.076	0.060	0.061	0.035	0.043	0.038	0.050	0.061	0.044	0.035
N	155,595	5,424	5,615	5,431	4,198	5,416	5,844	4,132	6,739	42,352	

Note. The HRS values are based on data for all HRS cohorts for waves 1992 to 2008. The SHARE values are based on data for 2004 and 2006. The Japan index is based on pooled data from the 1st and 2nd waves of JSTAR. The UK values are based on pooled data from 2002, 2004, 2006, and 2008. The precise index used in each country may differ slightly from the indices used here, which are based on the same health measures in each country, with the exception of the UK and Japan.

Table 2-1b. Correlations or priniciple component loadings for each pair of countries.

US	1	0.951	0.961	0.925	0.961	0.962	0.949	0.949	0.939	0.970	0.900
Germany		1	0.968	0.949	0.972	0.974	0.959	0.952	0.953	0.950	0.910
Sweden			1	0.973	0.966	0.955	0.969	0.977	0.961	0.970	0.930
Netherlands				1	0.952	0.919	0.964	0.978	0.964	0.960	0.900
Spain					1	0.978	0.966	0.966	0.961	0.960	0.910
Italy						1	0.965	0.949	0.956	0.970	0.920
France							1	0.968	0.984	0.970	0.880
Denmark								1	0.971	0.960	0.880
Belgium									1	0.970	0.850
UK										1	0.920
Japan											1

For ease of analysis the index measures for each country are converted to percentile scores, with 1 and lowest and 100 the highest. For many comparisons the percentile scores are grouped into five “quintiles.” Many figures based on these quintiles are shown in the background section above.

An important feature of the index is the strong correspondence to survival. For example, based on ELSA data in the UK, given the health index quintile in 2002 the survival rate in 2011 for persons in lowest quintile is 59.7%, it is 72.6% in the second quintile, 81.9% in the third, 88.9% in the fourth, and 93.9% in the highest quintile. Based on HRS data in the US, given the health index decile in 1992 the survival rate in 2008 ranges from 42.8% for those in the bottom decile to 71.4% for those in the fifth decile to 89.6% for those in the top decile. In the US, the index in 1992 is also strongly related to future health events such as diabetes, lung cancer, health disease, stroke, hospital stay in 2008, and poor health in 2008 (Poterba, Venti, and Wise, 2013).

The following example points to the value of a health measure that can be constructed in a comparable way across countries, and provides some added support to the idea that the resulting health index values are reasonable. In Figure 2-1, we report the PVW health index by age and country, as measured relative to the US value. At ages 50 to 54, the health of women in the US is worse than the health of women in most other countries. This finding continues at least through ages 60 to 64, but by the mid 70s, health in the US is better than in all countries (with the exception of the UK). This finding is consistent with the conclusion of many analysts that health in the US improves after Medicare eligibility at age 65 and that expenditure on health care for the oldest old is relatively higher in the US than in other countries. For men, shown in Figure 2-2, the general trend is similar but not as dramatic.

Figure 2-1. The PVW health index by country and age relative to the US, for women

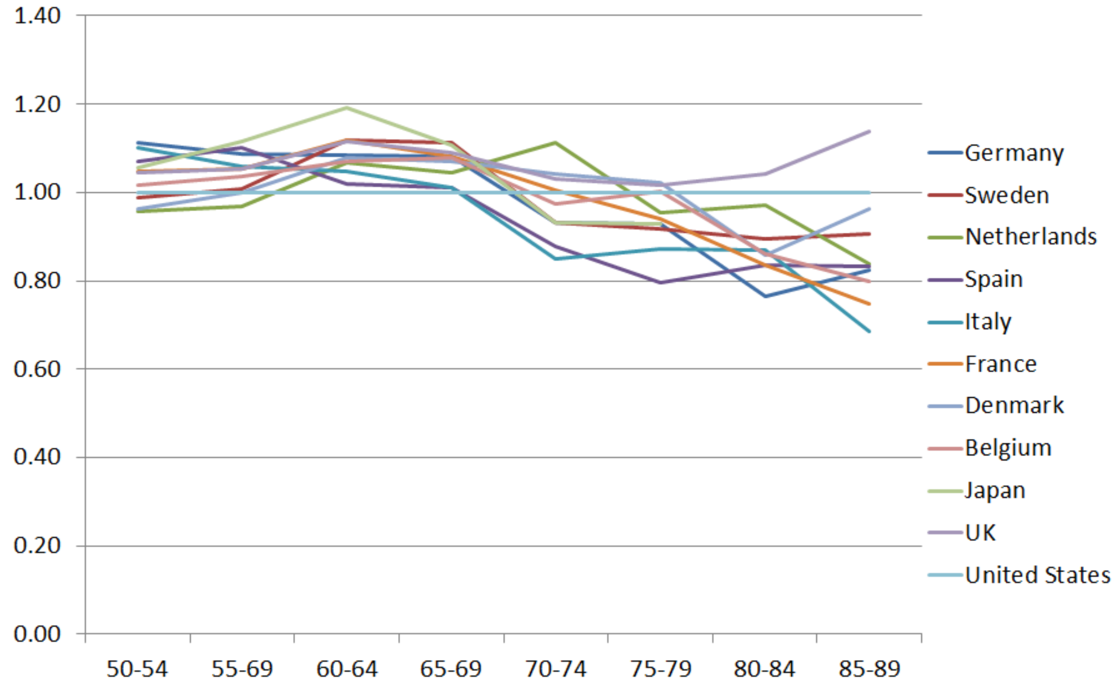
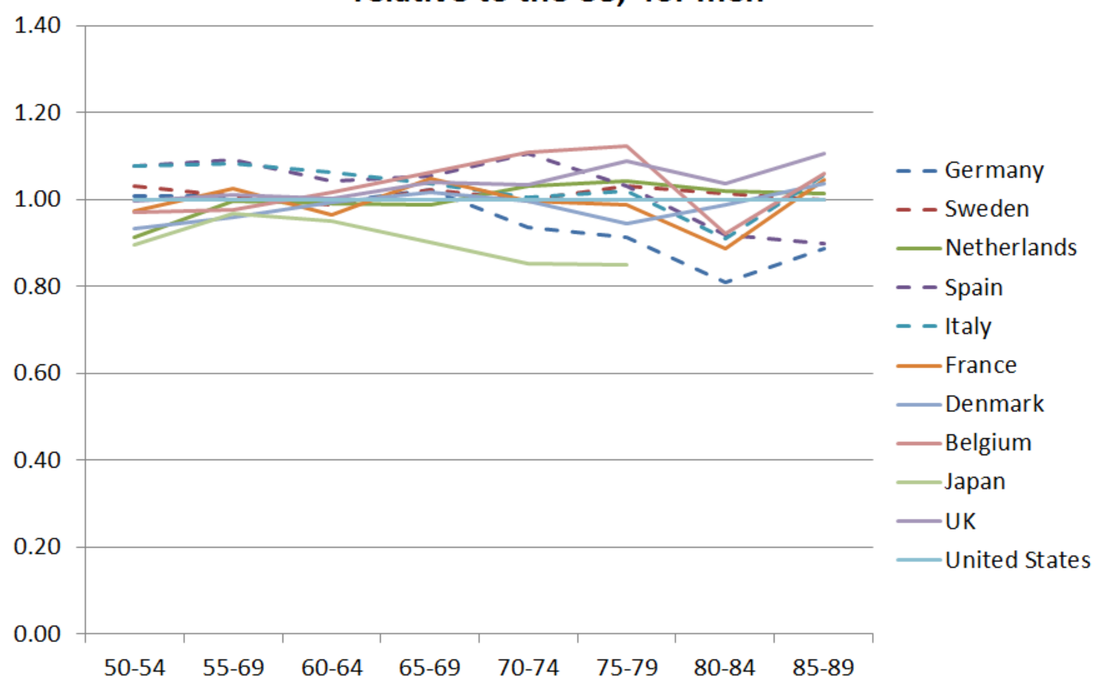


Figure 2-2. The PVW health index by country and age relative to the US, for men



3. Estimation

A central goal of the analysis in this phase of the project is to estimate the relationship between the provisions of each country's retirement programs and the labor supply (or retirement) behavior of older workers in that country. The analysis in this phase of the project is closely related to the analysis in the second phase.[1] Here, however, we give particular attention to the provisions of DI programs, as well as other pathways to retirement.

More specifically, we want to understand how changing the provisions of a country's DI program (and perhaps other programs) would affect retirement. To explore this, we first need to construct a retirement incentive measure that reflects how the provisions of a country's social security, DI, and other relevant programs provide a greater or lesser return to continued work at a given age for each worker. Next, we assess whether this incentive measure is empirically related to retirement behavior. Finally, we use the results of this estimation to simulate how a change to a country's DI program (and the resulting change in the retirement incentive measure) would be expected to affect retirement.

The key idea that underlies our analysis is the potential gain from postponing retirement from today's age until some future age. This is the incentive to delay retirement. We first explain this incentive measure, assuming that there is only one pathway to retirement. We then explain the issues that arise when there are multiple pathways to retirement, for example social security and DI. We then discuss the other covariates included in the country retirement specifications. As the discussion below and in the country papers makes clear, workers may face very different incentives for continued work depending on the provisions of retirement programs in their country as well as on individual characteristics such as potential earnings, earnings history, family structure, and other attributes.

Retirement Incentive and the Option Value: To begin, assume that there is only one retirement program, social security. When a person retires he (or she) will receive a stream of benefits until death. If the person retires at age t, the present discounted value of benefits, or social security wealth, is given by SSW_t. If the person retires one year later the present discounted value of future benefits will be SSW_{t+1}. The social security accrual from one year to the next is given by

$$SSW_{t-1} - SSW_t$$

[1] See in particular the discussion on pages 10-15 of Gruber and Wise (2004)

That is, this measure describes the change in promised future social security benefits from working one additional year. Social security wealth will go up if an extra year of work is translated into a higher flow of benefits in the future, either because of the relationship between social security and lifetime earnings or because of actuarial adjustments that reward later retirement. Social security wealth may go down, though, if the extra benefits that accrue from the extra work are not large enough to compensate for the loss of any retirement benefits in that extra year of work. The net of the future extra benefit entitlement and the loss of benefits in that extra year of work is the one year accrual.

One shortcoming of the accrual as a measure of retirement incentives is that there could be greater increases in social security wealth from delaying retirement by two years, three years, or more rather than by a single year; beyond some age, benefits may decline--depending on the benefit formula in a given country. The gains associated with work beyond the current year will not be captured by this simple measure. Thus to fully appreciate the incentives inherent in the social security program, we must consider the path of benefits many years into the future. The benchmark approach we use for considering the entire future path of accruals is the "option value" model.[2] To summarize, this model evaluates the expected present discounted value of incomes for all possible future retirement ages, and then measures the "value" of retirement today versus the value of retiring at the optimal date (which may be today, but more likely is in the future). If looking ahead suggests gains from work at some time in the future, there is an incentive for the person to remain in the labor force to take advantage of these gains.

A simplified version of the option value measure at age t can be described by:

$$\begin{aligned} &\mathit{Simplified}\ OV_t\ (r^*) \\ &= \left[\begin{pmatrix} \mathit{discounted} \\ \mathit{benefits\ if} \\ \mathit{retire\ at}\ r^* \end{pmatrix} - \begin{pmatrix} \mathit{discounted} \\ \mathit{benefits\ if} \\ \mathit{retire\ at}\ t \end{pmatrix} \right] + \begin{pmatrix} \mathit{discounted} \\ \mathit{future\ wages} \\ \mathit{through\ age}\ r^* \end{pmatrix} \end{aligned}$$

In this formulation, a person considering whether to retire at age t considers the present value of benefits if he retires now (at age t) with the benefits if he retires at some later age. If the person retires at some later age he will gain from future wage earnings and from any gain in future pension benefits. The gain in wage earnings is represented by the last bracket and the gain in pension benefits by the difference between the terms in the first bracket. The age at which the total of the two components is the greatest is

[2] For a more detailed discussion, see Stock and Wise (1990).

denoted by r^*. The option value prescription is that the person will continue to work if this option value is positive. More detail on the option value specification is shown in the appendix on the option value model.

Multiple Pathways to Retirement: The discussion above assumes that there is only one pathway to retirement, but in all countries there are multiple pathways. In the United States there are two pathways—Social Security and Disability Insurance (DI)—but in other countries there are three or more pathways—the social security "normal" retirement, DI, special unemployment insurance programs, or a special early retirement program. To estimate the OV incentive on retirement with multiple programs, we follow an instrumental variables-like approach. For each program, we first estimate the OV measure for that program, essentially assuming that the worker will retire through that program and the only decision is at what age to retire. Next, we estimate the probability that the person assigns to each program as a possible pathway to retirement. Finally, we calculate the "inclusive OV," which is the weighted average of the OVs for each of the possible programs. The probabilities to be assigned to each program are determined by the relationship between individual attributes and the likelihood that a particular program was chosen by similar workers in the past. For example, in the US, the probability weight for the DI plan is determined by the probability that a person in each of four education levels was on DI anytime at ages 60 and 64 in the relevant year (estimated using HRS data for the years 1992 to 2010). The exact method used for each country is described in the country papers. This approach is an "instrumental variable" estimate of the expected OV faced by a given person.

Figure 3-1 shows the OVs by age for each country. The OV calculations are based on the detail in the appendix. For illustration, consider the programs in the US and in Belgium. The US has only two programs, DI and Social Security (SS). Belgium has four programs—Social Security, DI, unemployment insurance (UI), and early retirement (CER). Notice that in the US, the OV of delaying retirement is much larger under the SS program than under the DI program. That is, the gain from delaying retirement is much greater under the SS program. Thus persons who consider the DI program as a route to retirement have a much greater incentive to retire at a young age than persons who consider SS as the only pathway to retirement. The inclusive OV is the weighted average of the SS and DI OVs. In the US, the average DI weight is small so the inclusive OV is close to the SS OV. The OVs in Belgium are quite different. First note that the program OVs in general are much lower in Belgium than in the US. Second, note that the Inclusive OV is much lower in Belgium than in the US. At age 50 for example, the inclusive OV in the US is about 33,200 but is only about 12,500 in Belgium. Thus it would appear that the average gain to delaying retirement is much less in Belgium than in the US.

Figure 3-1. Option values and incluive OV by age, by country

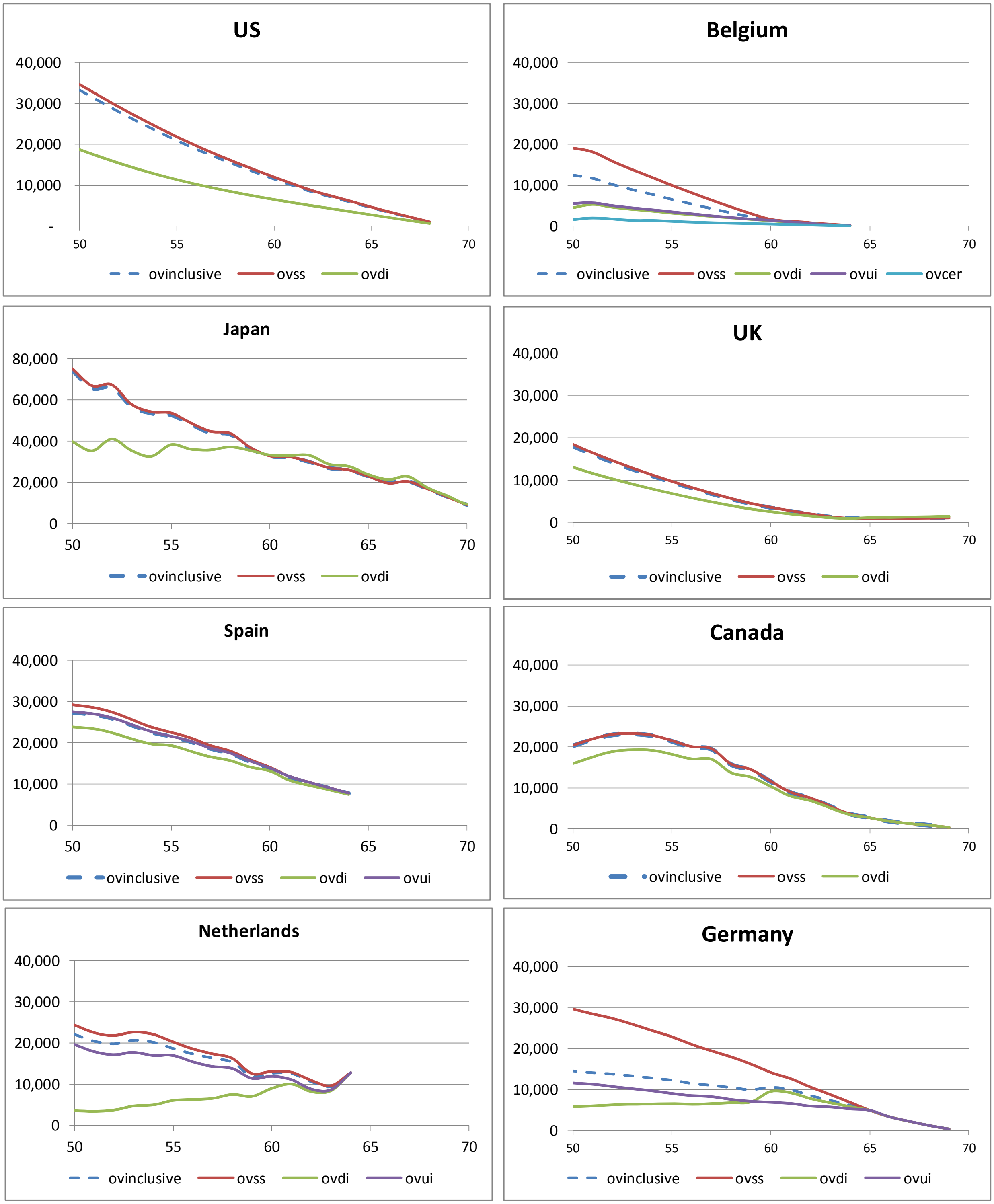
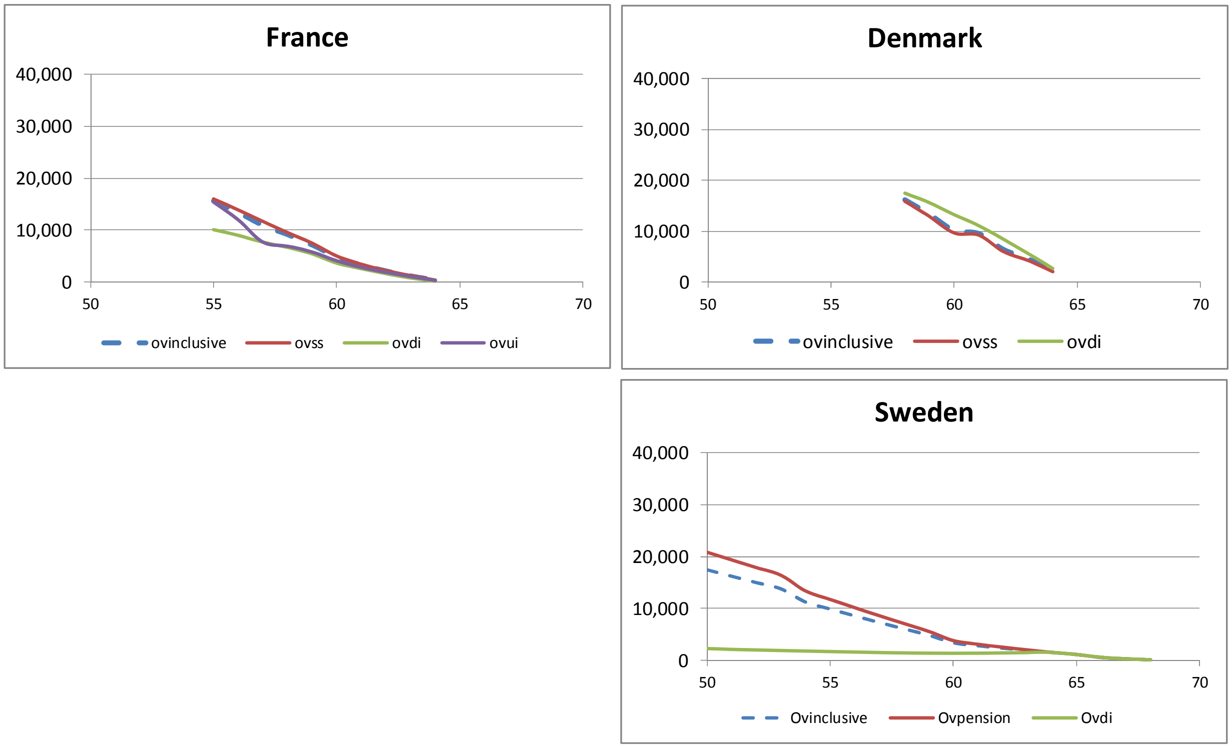


Figure 3-1. Option values and incluive OV by age, by country



It is important to understand that the estimated effect of the inclusive OV on retirement—thought of as an instrumental variable estimate of the OV effect on retirement—is taken as the effect of the OV on retirement and used in all estimates of the effects of program provisions and changes in program provisions on retirement. For example this estimate is used to predict (simulate) the effect on retirement of having access only to the DI versus access only to the social security program.

Estimation and Additional Covariates: Although the inclusive OV incentive measure is the key variable in the estimation, other individual attributes are also included. First recall that the OV depends on estimated individual earnings as described above. In addition the specification for each country includes health—typically controlling for health quintile based on the PVW index described above. One might expect health to be particularly important when contemplating retirement under the DI pathway. The specification also includes education level, gender, whether the person is married, whether the spouse works, total non-social security assets, and occupation indicator variables. There is some variation depending on data availability in each country.

Finally, each specification controls for age. Two versions are included. One includes indicator variables for each age; the other includes age as a single continuous variable. The inclusion of age is particularly important when evaluating the effect of the

OV on retirement. Quoting from the introduction to phase 2 of the project—Gruber and Wise (2004):

> As emphasized above, a crucial issue in the analyses in this volume is identification–that is, determination of the separate effect of each variable on retirement, as distinct from each of the other variables. A key goal is to determine the effect of plan incentives on retirement. But other individual attributes also influence the decision to retire. For example, persons are more likely to prefer retirement to work as they age. A linear age variable will potentially capture this effect, but only if preferences for leisure evolve linearly with age. …

We return to this issue when discussing simulations below.

Parameter Estimates: For each country estimates are reported for several alternative specifications. For example in some specifications separate indicator variables are included for each age; in others a single linear age effect is included. In some specifications health quintile indicators are included; in other specifications a single variable for health percentile is included. For some countries the sample sizes are large enough to obtain separate estimates by health quintile and by education level; in others, including most of the SHARE countries (if the SHARE data are used) the sample sizes are not large enough to estimate separate parameters by health quintile or by education.

The most important coefficient is the estimated effect of the inclusive OV on the probability of retirement. The country estimates of this retirement incentive effect are sensitive to the differential variance in the OVs across countries. To account for this, the estimated effect of a one standard deviation change in the OV is reported in square brackets as well as the effect of a unit (10,000 "utility" units) change in the OV. In addition, in some specifications the percent gain in the OV from delaying retirement is estimated instead of the OV itself--the percent gain from delaying retirement at age a is measured by the OV of delaying retirement at age a divided by the utility associated with retirement at age a.   Like the standard deviation of the OVs, this measure may be more comparable across countries than OV units and thus help to make the results more comparable across countries.

Estimates for each of the countries are reported in the Table 3-1. Estimates are reported for two specifications. The first is the fourth specification in the first table of estimates presented in each of the country papers. The second is the effect of the percent gain in the OV from delaying retirement. Several features of the estimates stand out. First, the estimated option value incentive measure is highly statistically significant in each of the countries with the exception of Spain and Germany (using

SHARE data). In these countries the sample sizes are apparently too small to obtain statistically significant results. The German estimates based on the SOEP much larger data file are highly significant. Second, there is considerable variation across countries in the estimated effects. Even excluding the statistically insignificant estimates for two countries and the smallest estimates for the UK and Sweden, the estimated effects for the remaining countries vary by a factor of seven. In two countries the estimated effect of a unit (10,000) increase in the OV is to reduce the retirement rate by about 11 percent or more. In four countries the effect on retirement is between 3 and 5 percent. In the UK and Sweden the estimated effect is less than one percent. The estimated effect of a standard deviation change in the incentive measure also varies across countries, but less than the unit increase estimate. In eight countries these estimates are between 4 and 9 percent. In the remaining three countries with statistically significant estimates the values are between 1 and 3 percent. Third, in most countries there is very little difference in the estimated effect of the incentive measure in the specification with age indicators compared to the otherwise identical specification but with a single linear age measure—these estimates can be seen in the country papers. Finally, the estimated effects of other covariates vary substantially from one country to the other and many of the estimated effects are not statistically different from zero. The many estimates based on several additional specifications are shown in the Country papers.

Table 3-1. The effect of the retirement program incentive effect--inclusive OV--on retirement, by country and by specification

Specification	**Nether-lands**	**Belgium**	**France**	**Germany SOEP**	**Denmark**	**US**	**Japan**
(1): Specification 4, with age dummies							
Estimate	-0.119	-0.106	-0.046	-0.0423	-0.0433	-0.0331	-0.0217
Standard error	(-0.049)	(-0.033)	(-0.006)	(-0.0031)	(0.0005)	(.0011)	(0.006)
Effect of OV sd change	**[-0.091]**	**[-0.079]**	**[-0.042]**	**[-0.0525]**	**[-0.0438]***	**[-0.056]**	**[-0.045]**
(2): Percent gain: specification 4, with age dummies							
Estimate	-0.060	-0.313	-0.038	-0.0186	-0.0806	-0.0593	-0.0384
Standard error	(-0.072)	(-0.082)	(-0.012)	(-0.0016)	(0.0015)	(.0124)	(0.0122)

Specification	**Canada**	**UK**	**Sweden**	**Italy**	**Spain**	**Germany SHARE**
(1): Specification 4, with age dummies						
Estimate	-0.0166	-0.006	-0.0015	-0.005	-0.005	-0.020
standard error	(0.0021)	(-0.001)	(0.000)	(-0.002)	(-0.017)	(-0.015)
Effect of OV sd change	**[-0.041]**	**[-0.028]**	**[-0.0126]**	**[-0.014]**	**[-0.004]**	[--]
(2): Percent gain: specification 4, with age dummies						
Estimate	-0.0451	-0.148	-0.0315	--	-0.036	--
Standard error	(0.0108)	(0.022)	(-0.0005)	--	(-0.046)	--

Although if is clear that persons in poor health are more likely to retire early through the DI pathway, whether the effect of the incentive measure on retirement should vary in one direction or another with health is not clear a priori. Some evidence, however, is provided in the country data. Table 3-2 shows the estimated incentive measure effect by health quintile for several countries with sample sizes large enough to distinguish estimates by health. In four of the five countries, the estimated effect of the incentive measure declines with health. In the United States the effect declines continuously from -0.0594 for those in the worst health to -0.0197 for those in the best health, in the in Germany from -0.0902 to -0.0219, in Denmark from -0.639 to -0.0373, and in Sweden from-0.0022 to -0.0009. In each these countries the result is also shown clearly by comparing the effect of a standard deviation change in the OV for those in the best versus those in the worst health, shown by the estimates in the square brackets. The UK is an exception, showing essentially no relationship between the incentive measure and health. Recall that the health measures used in Germany, Denmark, and Sweden are based on the few selected health measures in the data files used in those countries and are not comparable to the PVW index measure used the US and the UK. Nonetheless, the health measures used in the other three countries can be used to rank persons by health quintile. Note that the relationship between the incentive measure and health should not necessarily be expected to be the same in all countries. For example, health is the central criteria for eligibility for DI in the US while the relationship may be less strict in other countries which may give more weight to labor market conditions, for example, to determine DI eligibility. The descriptive data above show a strong correspondence between health quintile and DI participation in each country, although the strength of the relationship varies from country to country, as shown in Figure 1-8.

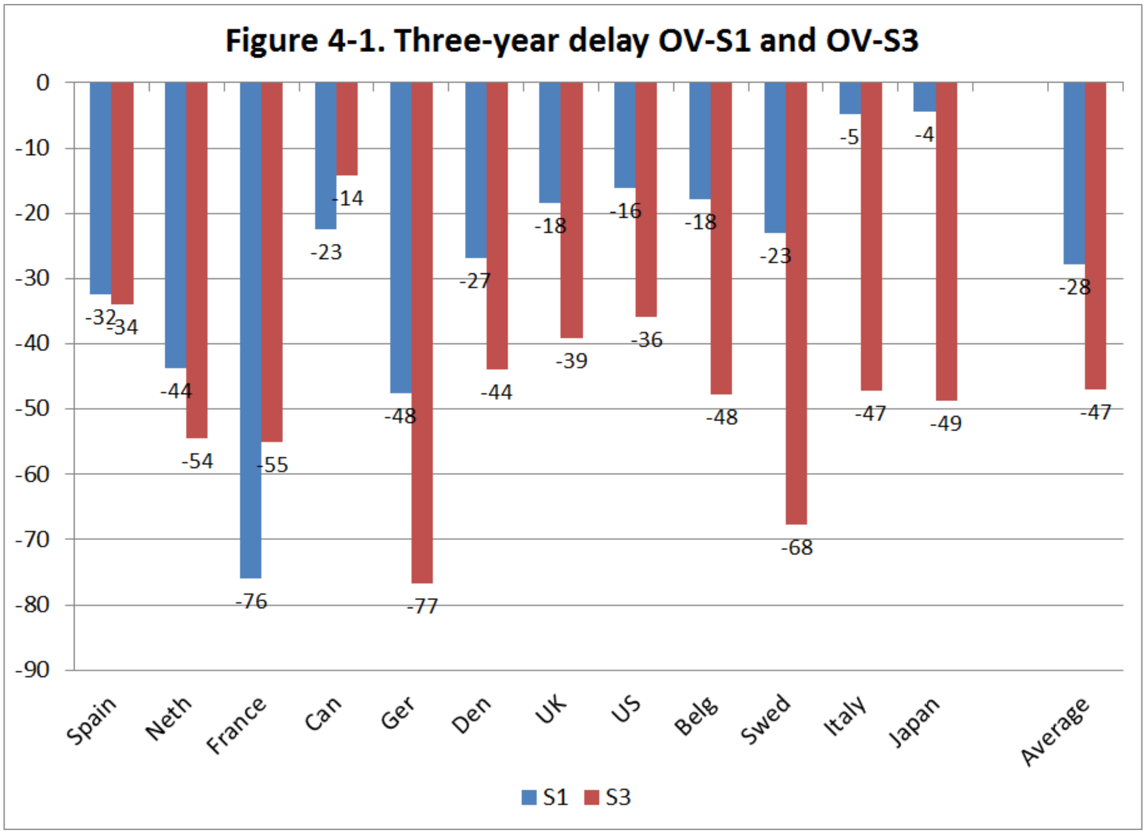
Table 3-2. Estimated incentive measure effects by health quintile for selected countries	**US**	**UK**	**Germany SOEP**	**Denmark**	**Sweden**
OV: Worst Health Quintile	-0.0594	-0.008	-0.0902	-0.0639	-0.0022
Standard error	(.0038)	(0.002)	(0.0105)	(0.0015)	(0.0001)
Effect of OV sd change	[-0.073]	[-0.062]	[-0.0707]	[0.065]	[-0.0145]
OV: 2nd Quintile	-0.0353	-0.006	-0.0453	-0.0490	-0.0018
Standard error	(.0026)	(-0.002)	0.0067	(0.0014)	(0.0000)
Effect of OV sd change	[-0.052]	[-0.040]	[-0.0576]	[0.0285]	[-0.0142]
OV: 3rd Quintile	-0.0336	-0.003	-0.0285	-0.0342	-0.0013
Standard error	(0.0023)	-0.002	-0.0043	(0.0011)	(0.0000)
Effect of OV sd change	[-0.056]	[-0.030]	[-0.0628]	[0.0256]	[-0.0118]
OV: 4th Quintile	-0.0234	-0.005	-0.0195	-0.0282	-0.001
Standard error	(.0018)	(-0.002)	(-0.005)	(0.0009)	(0.0000)
Effect of OV sd change	[-0.044]	[-0.050]	[-0.0628]	[0.0186]	[-0.0098]
OV: Best Health Quintile	-0.0197	-0.007	-0.0219	-0.0372	-0.0009
Standard error	(.0017)	(-0.002)	(-0.005)	(0.0010)	(0.0000)
Effect of OV sd change	[-0.037]	[-0.081]	[-0.0320]	[0.0283]	[-0.0097]

Germany (SOEP), Denmank, and Sweden do not use the PVW health index so that health comparability across all of the countries is not assurred, although in each country the available measures can be used to rank persons by health.

4. Simulations

Each of the country papers includes a series of simulations. Some simulations show the fit of the estimated specifications. For all countries these simulations show that the models predict well the proportion of persons that has retired by age. Other simulations are descriptive—for example, showing employment by education or health by age. The most important simulations are used to predict the effect of the retirement program incentive effects on retirement. It is helpful to recall first the simulations that were done in the second phase of the project.

The most important simulations in the second phase were used to predict the effect of increasing retirement program eligibility ages. We describe here two simulations—S1 and S3--that were reported in the introduction to the second phase: *Social Security Programs and Retirement Around the World: Micro Estimation* (Gruber and Wise 2004). Both simulations show the effect of increasing the eligibility ages. But the estimation specification and the simulation methods differ. Simulation S1 is based on estimation that controlled for a linear measure of age in the specification and only the OV incentive measure (and the associated variables that determine the OV incentive) is used in the simulation.[3] Simulation S3 uses age indicator variables in the estimation, and, in addition uses adjusted age indicators to simulate retirement under the program changes.[4] The percent reduction in the proportion of men out of the labor (OLF) is shown in Figure 4-1. This figure reproduces the data in Figure 16 on page 29 of Gruber and Wise (2004) and the details of the construction of the figure are discussed there.



[3] The estimation in this earlier volume was also based on OV, though as noted above, the current analysis features a more careful modeling of DI and other pathways to retirement (thus, the OV measure used in phase 2 is not exactly the same as the OV inclusive measure used in the new simulations described below).

[4] The estimated age indicator effects, as well as the program incentive effects, are used to predict the effect of the program changes. For example, for the three-year eligibility delay, the age indicator for a given age is taken to be the estimated age indicator three years prior to the given age. The age 60 indicator, for example, is taken to be the estimated age 57 indicator. The result is that under the three-year eligibility delay, the projected retirement rate at age 60 is approximately the same as the current program age 57 retirement rate. The spike at the early retirement age under the current program, for example, shows up three years later under the reform. This approach assumes that all of the estimated age effects can be attributed to the eligibility age program provisions. (The ages include the age at which persons are eligible for one or more programs, as well as the "normal" retirement age.)

For the S1 simulation, the incentive measure for a country (the OV) is recalculated based on the OV that incorporates the implications of the delayed eligibility age. The blue bars show the effect of only the change in the incentive implications of the three-year delay. The average reduction in the proportion of men out-of-the-labor-force (OLF) is large--28 percent. Underlying the average, however, are large differences across countries. For four countries the reduction was greater than 32 percent, for two countries the reduction was less than 4 percent, and was between 16 and 28 percent for the remaining countries. The simulated reduction in the proportion of men OLF is much larger if age indicators are used in estimation and the age effects for each age are moved up three years to correspond with the three-year increase in all program eligibility ages.

It is not surprising that the effects of increases in the eligibility ages are large. For example, this simulation implies that the early retirement age in the US increased from 62 to 65 and under S3 this reduced the OLF proportion by 36 percent. In most countries (although not in the US because DI was not included in the analysis) increasing the eligibility age for retirement would also change the eligibility age for DI by three years as well.

Now, in this phase with emphasis on DI, increasing the eligibility age for DI seems implausible in many if not most countries. Here we don't change the eligibility age, but instead ask how employment is affected differentially by the provisions of the DI pathway compared to the provisions of the regular social security pathway, and we consider the effect of changes in the provisions of DI programs, especially changes in eligibility stringency. The simulations are all based on the country estimates in Table 1a, specification 4. For each simulation the first stage is to calculate OVs corresponding the programs or program changes that are being compared. Then the estimated effect of the OV incentive effect from Table 1a, specification 4 (together with the estimates for other variables in the specification) are used to simulate retirement at each age under each program or program change for each person in the sample. Then the implications for years of employment between ages 50 and 69 are calculated.

Each country has reported the results of three simulations. The first simulation is intended to evaluate the effect of the differential incentive effects inherent in the provisions of each pathway on retirement—if all persons faced only one of the pathway options. For the US there are only two pathways—Social Security or DI. For other countries there are three or more pathways. Each country has used the Table 3-1 specification 4 coefficients to predict each individual's probability of retirement for each pathway—for the US using the DI OVs and then using the SS OVs. These estimates can also be found in the individual country chapters. For the Netherlands, for example, there are three pathways—disability, unemployment, and retirement. The retirement probabilities (hazard rates) by age and the cumulative proportion of persons still working (survival rates) by age are shown in Figure 4-2. Separate lines are shown for each pathway in each country. The distance between the lines for the different pathways varies across countries, depending on the differences in the strength of the retirement incentives across the pathways.

For illustration, consider the retirement rates and the survival rates for the Netherlands compared to the US. The retirement rates are much greater in the Netherlands than in the US—at age 60 the retirement rates are 0.1 or lower for each pathway; in the Netherlands the retirement rates are close to three times as great, all greater than 0.27. Corresponding to the higher retirement rates at each age the survival rate at each age is much higher in the US than in the Netherlands. For example, at age 60 in the US employment is much higher than in the Netherlands—between 0.47 and 0.59 in the US and between 0.21 and 0.38 in the Netherlands, depending on the pathway to retirement. The survival rates are only comparable across countries if the process begins at age 50 and are only shown for these countries. The hazard rates are provided for all countries for which the data are available.

Figure 4-2. Retirement hazard rates and cumulative survival rates by age and by country

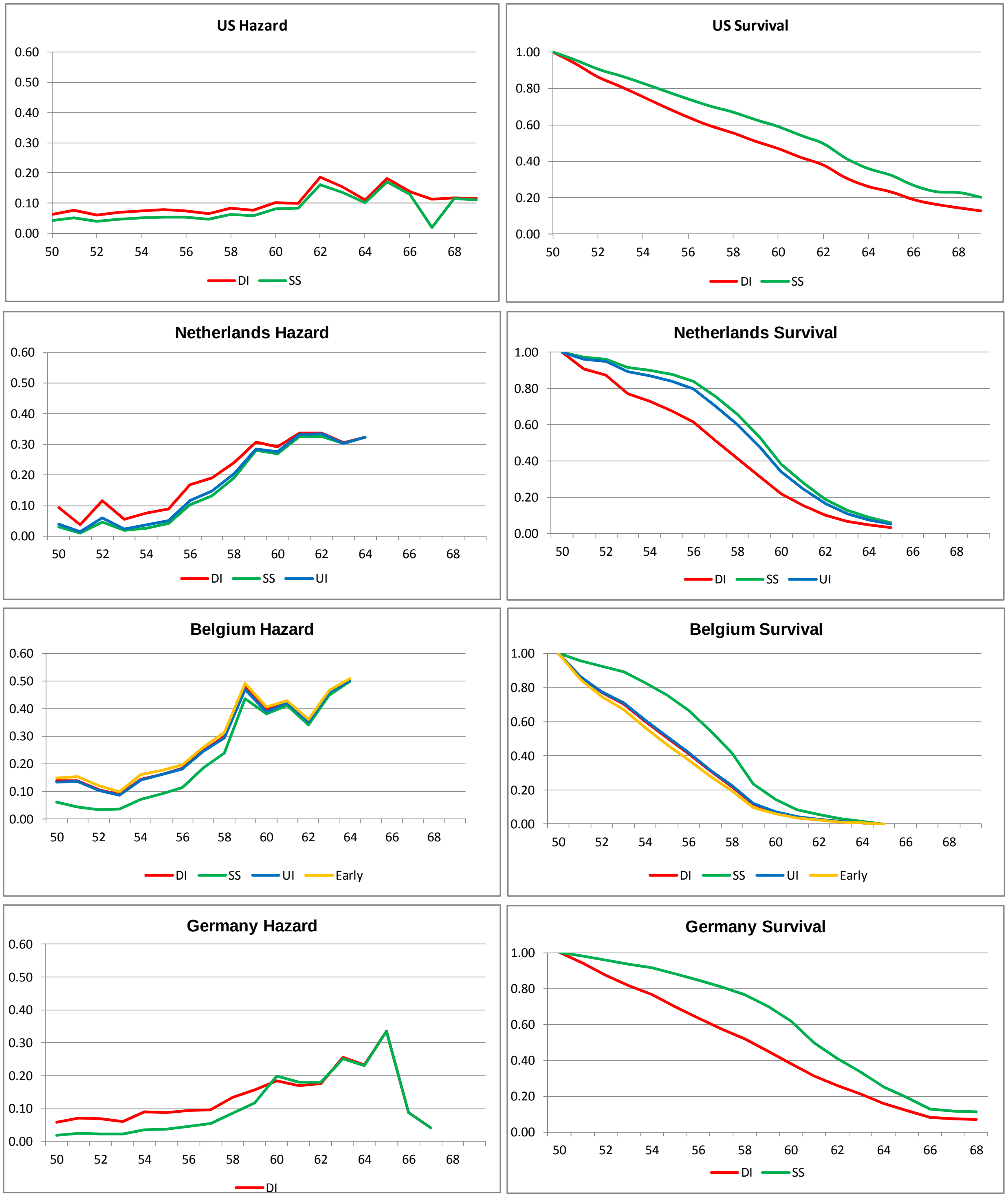


Figure 4-2. Retirement hazard rates and cumulative survival rates by age and by country

For each program the countries have calculated the mean predicted retirement by age and have used these data to calculate the expected years of work between 50 and 59. For the US, for example, the average years of work over the 50-69 age interval is simulated to be 10.18 years if everyone faced the DI OVs and 11.93 years if everyone faced the SS OVs. That is, on average, people work 17.3 percent more years when faced with the incentives inherent in the SS option rather than the incentives inherent in the DI option. In the Netherlands the simulated years of work in the 50-65 age interval is 7.40 under the DI pathway, 9.02 under the unemployment pathway, and 7.47 under the retirement pathway. These simulated years worked between 50 and 69 for other countries are shown by pathway in Table 4-1 below.

It is important to understand that these differences indicate the marginal effect of the DI incentive compared to the regular retirement incentive, holding constant all other individual attributes included in the specification. In particular, it holds constant the estimated age dummies. For countries with multiple pathways the process would be repeated for each of the pathways. To be specific: We estimate the incentive effect of a retirement program—the effect of $OVinclsive$—with an equation like this

$$R = k + aOVinclsive + bAge + cHealth + dEducation +$$

We estimate $\hat{a}, \hat{b}, \hat{c}, \hat{d}$ and so forth. The estimate $\hat{a}$ (the estimates reported in Table 3-1) is an IV estimate of the effect of the OV on retirement. For simulation we take $\hat{a}$ as <u>the</u> estimate of the effect of OV on retirement and use it for all of the simulations. With a one year increase in age the effect on retirement is given by $\frac{dR}{dAge} = \hat{a}\frac{dOV}{dAge} + \hat{b}Age$, where the first term in negative ($\hat{a}$ is negative) and the second term positive—that is the first term reduces the incentive to delay retirement and the second term increases the preference for retirement with advancing age. The likelihood of retiring advances with age because of a reduction in the OV of continuing work is reinforced by the concomitant increase in age. If age is excluded from the specification, then to fit the retirement data the coefficient on OV will have to increase. And if the $OVinclsive$ is eliminated from the specification the coefficient on age will have to increase to fit the retirement data. This is the identification issue mentioned above. In order to identify the correct effect of the incentive measure we must have an age specification that captures the true increase in preference to retire with age. One feature of the estimates that increases our confidence in the incentive estimates is that that are virtually the same whether the single linear age or indicators for each age are used to estimate the effect of age on the preference to retire.

Instead of making calculations for all persons in the sample, the second and third simulations consider only persons who were observed to have chosen the DI option. The second simulation asks how much years of work would have changed for this group had the group faced the OVs of the regular retirement option instead of the OVs of the DI program. For the US, among all those who applied for DI, years worked under the

SS option is 15.7 percent greater than under the DI option (9.64 years versus 8.33 years; these values are lower than those for the full sample likely because DI applicants are less healthy than the population at large). For all those who received DI, work under the SS option would have been 16.2 percent greater under the SS option then under the DI option (9.87 years versus 8.49 years).

Recall again that in Phase 2 of the project we simulated the effect of delaying all program eligibility ages by three years, including the eligibility ages for DI and unemployment programs. In one of these simulations we used estimates with age dummies and in another we used estimates based on continuous age. These simulations suggested very large reductions in retirement, especially the simulations using age dummies in the estimation. The simulations proposed here do not consider raising the DI eligibility age but rather direct attention to the incentive effects—the OVs—of the program provisions, and stringency provisions, conditional on the estimated age "preference" effects. It should not be surprising that the employment effect of changing the OV incentive effects is typically much smaller than changing the program eligibility ages. Increasing the eligibility age for DI for three years, for example means that no one can claim DI benefits for these three years and thus cannot be on the DI program. This would cause great hardship to those who are truly disabled and undermine the insurance role of DI. That is why we do not consider changing age of eligibility for the DI programs as we did in Phase 2.

The aim of the third simulation is to get an idea of the effect on retirement of greater stringency in DI acceptance. As in the second simulation, we focus on DI recipients (or applicants, if available). From that simulation, we have an estimate of expected working life if everyone follows the DI path and if everyone follows the SS path. We now make similar calculations to show the effect of making it harder for this group of people who are interested in using DI to access the program—in effect changing the eligibility stringency. To do this, we first randomly assign 2/3 of the group to the DI path and 1/3 to the SS path, calculate everyone's expected probability of retirement, sum by age, and use that to generate an expected work life from ages 50-69, as described above. We then repeat the process but randomly assign 1/3 to the DI path and 2/3 to the SS path. (If there are more than 2 paths the simulations are done for different combinations of programs, making different assumptions about which program persons use, if not to DI.) In the US, the expected work life is 8.328 years if everyone takes the DI path (from the second simulation described above), 8.749 years with 2/3 on DI path, 9.166 years with 1/3 on the DI path, and 9.635 years with all on the SS path (again from the second simulation). Not surprisingly, shutting down the DI path for 1/3 of this sample has about 1/3 the effect of shutting it down for the full sample of DI applicants/recipients. Again, the idea of this simulation is to simulate the work effect of making DI harder to access for a share of the population.

The results of the simulations for most of the countries are reported in the Table 4-1 below. The retirement programs that are compared for each country are shown in the first column of the table. The countries in the table are ordered by the average number of years worked—between the ages shown—for persons who retire under the “standard” retirement program—ranging from 11.93 years in the US and 11.3 years in the UK to 4.8 years in Denmark.

The second column shows the years of work if all persons faced the same pathway option, using all the pathways available in a given country. For the US, the years of work after age 50 would be 10.18 if everyone faced the DI incentives and 11.93 if everyone faced the social security incentives, a difference of 17.3%. The results differ across countries—for example the change in years of work for Canada is only 6.7%, which is one-third the magnitude of the change in the US. This in part reflects the size of the DI plan in Canada relative to the US.

The next column repeats the exercise, but uses the sample of disabled individuals only. The base number of years worked for this sample is smaller in all countries, and the percent impact of varying the incentives of this sample is smaller than for the entire sample in column 2.

The last two columns show the results of the simulation that randomly assigns the incentives, to simulate the effect of making it more difficult for some DI applicants to access the program. The patterns in the results are expected from the calculations—when two thirds of the sample is assigned to the DI incentives, the results look closer to the column 2 results than when only one third of the sample is assigned DI incentives . Overall, the simulations suggest that DI programs have a noticeable impact on retirement across countries.

Table 4-1. Simulations: Effect of incentive measures alone on years of work between ages specified for each country, three simulations.

Country	Retirement programs compared	Simulations: Yrs of work if all persons faced the same retirement pathway option	Yrs of work if all DI participants had faced the same retirement pathway	Yrs of work if 2/3 to DI and 1/3 to Base pathway	One third to DI and two thirds to SS
US	(1)DI = Base	10.18	8.33	8.75	9.17
50-69	(2)SS	11.93	9.64		
	% Change vs Base	17.3%	15.7%	5.1%	10.1%
Canada	(1)DI Yrs of work	11.31	10.22	10.41	10.61
	(2)SS Yrs of work	11.91	10.83		
	% Change (2)/(1)	5.3%		1.9%	3.8%
UK	(1) DI	10.7	9.13	9.39	9.51
50-69	(2) SS	11.3	9.79		
	% Change (2)/(1)	5.6%	7.2%	2.8%	4.2%
Germany	(1)DI=Base	9.49	8.94	10.19	11.06
50-67	(2)UB	10.32	9.96		
	(3)OA	13.98	13.62		
	% Change (3)/(1)	47.2%			
	% Change (2)/(1)	8.7%			
	% Change (3)/(2)	35.5%			
	% Change vs base			13.0%	23.8%
Netherlands	(1) DI = Base	7.40	7.02	7.56	8.52
50-65	(2) UE	9.02			
	(3) Retire	9.47	8.94		
DI N = 23	% Change (3)/(1)	28.0%			
	% Change (2)/(1)	21.9%			
	% Change (3)/(2)	5.0%			
	% Change vs base			7.69%	21.37%
Belgium	(1) CER	5.36	4.53		
50-64	(2) DI = Base	5.65	4.66	4.68	5.48
	(3) UI	5.71	4.65		
	(4) OAP	7.54	5.51		
	(4)/(1)	40.67%			
	(4)/(2)	33.45%			
	(4)/(3)	32.05%			
	% Change vs base			0.43%	17.60%
France	(1) UE	4.09	4.293		
55-64	(2) DI = Base	4.96	4.188	4.384	4.554
	(3) Normal retireme	5.50	4.766		
	% Change (3)/(1)	34.4%			
	% Change (2)/(1)	21.3%			
	% Change (3)/(2)	10.8%			
	% Change vs base			4.68%	8.74%
Denmark	(1) DI = Base	4.5	3.6	3.67	3.73
57- 69	(2) SS	4.8	3.8		
	% Change vs Base	6.7%	5.6%	1.9%	3.6%
Italy	(1) DI = Base	12.97	9.33		
	(2) Early Retiremen	13.14	9.25		
	(3) Old age	13.38	9.74	9.49	9.56
	% Change (3)/(1)	3.2%			
	% Change (2)/(1)	1.3%			
	% Change (3)/(2)	1.8%			
	% Change vs base			5.06%	10.06%
Sweden	(1)DI = Base	13.17	11.35	11.55	11.73
50-69	(2)Old Age	13.93	11.89		
	%Change vs Base	5.8%	4.8%	1.8%	3.3%

Notes:

Germany: The SOEF does not report DI application. Thus estimates for persons in the worst heatlh quitile are used in the right three columns of the table.

Japan: There are too few DI applicants to simulate reliable estimates.

Spain: None of the incentive estimates is significant; thus the simulations are not reported.

5. Conclusions

This volume is the sixth phase of the ongoing project on Retirement Programs Around the World. The focus is on the importance of disability programs (DI) and in particular the retirement incentive effects of DI programs compared to other retirement programs. This is the second of two phases on DI programs. The first DI phase (the fifth phase of the continuing project) presented analysis of historical trends in our group of countries intended to set the stage for the more formal analysis in the current volume. In the first DI phase, the countries summarized DI program reforms and considered how DI reforms were related to changes in health, in particular measured by change in mortality. We also considered DI reforms as natural experiments that showed that "exogenous" reforms can have a very large effect on the labor force participation of older workers. The current phase is also closely related to the second phase of the project, also based on microeconomic analysis of the relationship between a person's decision to retire and the program incentives faced by that person. In particular, in the second phase the countries considered the employment implications of increasing retirement program eligibility ages, including the eligibility ages for DI programs. The analysis showed that increasing eligibility ages would have very large effects on employment at older ages.

In contrast, the current phase focuses on the retirement incentive effects of program provisions without considering changes in program eligibility ages. We give attention to the provisions of DI programs as well as the provisions of other pathways to retirement. The goal is to understand how changing the provisions of country DI programs in particular would change retirement. Each country estimated the relationship between program provisions and retirement incentives in their country using an extension of the "option value model" used in the second phase of the program.

Several noticeable findings of the paper are based on background summary data. First, the proportion of men 60 to 64 collecting disability benefits ranges widely across countries, ranging from 17 percent in Belgium to 16 percent in the UK to 14 percent in the US to 6 percent in Italy and France to 2 percent in Japan—including Belgium and Italy that use a DI proportion different from the other countries. Second, the data show that in all countries, with the exception of the United States, there was large variation over time in DI participation rates with substantial decline in participation beginning in the early to mid-1990s in many countries. For example, in Canada participation in the 60-64 age group declined 49.6 percent between 1995 and 2009. In the UK, DI participation declined 49.6 percent between 1996 and 2012. In the US on the other hand DI participation between 1990 and 2012 increased by over 30 percent. Third, variation in DI participation over time was unrelated to trends in health, which improved consistently over time based on declines in mortality. Fourth, and perhaps most striking, DI participation in all countries is very strongly related to education level, even controlling for health. Fifth, descriptive data show a noticeable inverse relationship between DI participation and employment over time.

The measurement of health is a central component of the analysis. To maintain as much comparability across countries as possible we use the health index developed by Poterba, Venti, and Wise (PVW). The index as set out by PVW is the 1^{st} principal component of 27 health indicators reported in the United States Health and Retirement Study (HRS). The index can be duplicated approximately through the nexus of comparable studies—the English Longitudinal Study of Aging (ELSA), the Survey of Health, Aging and Retirement in Europe (SHARE), and the Japan Study of Aging and Retirement (JSTAR). These surveys include each of the 12 participating countries except Canada. For reasons of sample size however alternative data sources have been used in Sweden, Denmark, and Germany and these data do not provide sufficient health data to construct the PVW index.

Estimation is based on the regression counterpart to the Stock-Wise option value analysis in which retirement is based on the gain (the option value) of delaying retirement. A unique feature of the estimation in this phase is the “inclusive option value” that allows estimation based on the provisions of all pathways to retirement in each country. Two features of the estimates stand out. First the estimated option value incentive measure is highly statistically significant in each of the countries with the exception of two countries—Spain and Germany-SHARE—where the SHARE country data files were not large enough to support precise estimation.   Second, the estimated effect of the OV incentive measure is substantial in most countries. For example, a one standard deviation increase in the option value (used as a standard measure across countries) reduces the estimated retirement rate by between 4 and 6 percent in six countries by, between 8 and 9 percent in two countries, and between 1 and 3 percent in three countries.

The most important results are in the form of simulations. First simulations show that the model estimates fit the data very well—which is to be expected in specifications in which age indicators are estimated. Second, simulations of retirement rates by age and survival in the labor force show very large variation across countries. Third, perhaps the most important simulations show the importance on retirement of differences in the provisions of each pathway to retirement in each country. These differences are estimated first by simulating the number of years worked between 50 and 69 if all persons faced only one of the pathways to retirement. For example, in the US, years worked would be 10.18 if all persons faced the DI pathway provisions. If all persons faced the Social Security pathway the average would be 11.93 years, an increase of 17.3 percent.   In Belgium there are four pathways with estimated hours of work between ages 50 and 69 of 5.36, 5.65, 5.71, and 7.54 for the CER, DI, UI, and

OAP pathways respectively. Hours of work on the OAP pathway exceed hours on the CER, DI, and UI pathways by 40.67 percent, 33.45 percent, and 32.05 percent respectively.

Fourth, simulations show the effect on retirement of increasing the stringency of admission to the DI program. This simulation is especially relevant given the large reduction in DI participation in many countries since the late 1980s and the mid-1990s. For example, if one third of the persons now on DI in the US instead were eligible only for the Social Security program the hours of work of current DI participants would be increased by 5.1 percent; if two thirds were eligible for the Social Security program only hours of work of current DI recipients would be increased by 10.1%. A comparable increase in the stringency of access to the DI program in the Netherlands would increase the years of work of current DI recipients by 7.69 percent and 21.37 percent respectively.

With large increases in life expectancy in all participating countries there is considerable interest in prolonging working lives. Indeed, there has been a large increase in the employment of men in most of the participating countries since the late 1980s and the mid-1990s—the same period over which DI participation has been declining in most countries. Future increases in working lives will depend on the capacity to work, which may depend on individual attributes such as education. The capacity to work will be the topic of the next phase of the International Social Security Project.

APPENDIX ON THE OV INCENTIVE MEASURE

Under the option value formulation, the value at age t of retirement at age r is given by

$$V_t(r) = \sum_{s=t}^{r-1} \beta^{s-t} E_t(Y_s^\gamma) + \sum_{s=r}^{S} \beta^{s-t} E_t(kB_s(r))^\gamma$$

using the Stock-Wise specification. Here Y is future wage income and B is social security benefit income, which depends on the retirement age r. For simplicity, the probabilities of being alive to collect the income or the benefits have been suppressed. The gain from postponing retirement to r, versus retiring at age t, is given by

If r* is the retirement year that gives the maximum expected gain, the option value is given by

$$OV_t(r^*) = \sum_{s=t}^{r-1} \beta^{s-t} E_t(Y_s^\gamma) + \left[\sum_{s=r^*}^{S} \beta^{s-t} E_t(kB_s(r^*))^\gamma - \sum_{s=t}^{S} \beta^{s-t} E_t(kB_s(t))^\gamma \right]$$

$$= \begin{pmatrix} discounted\ utility \\ of\ future\ wage \end{pmatrix} + \left[\begin{pmatrix} discounted\ utility \\ of\ benefits\ if \\ retire\ at\ r^* \end{pmatrix} - \begin{pmatrix} discounted\ utility \\ of\ benefits\ if \\ retiree\ at\ t \end{pmatrix} \right]$$

Considering this equation, we can see that there are two ways to calculate the option value used in the analyses in this volume: One way is to use prior estimated values for the utility parameters γ, β, and k. Instead, we assume these values: $\gamma = 0.75, \beta = 0.03, \text{and } k = 1.5$, which are somewhat different from estimates obtained by Stock and Wise (1990), especially the assumed value of β which is much smaller than their estimated.

References

Gruber, Jonathan and David A. Wise (1999), Social Security Programs and Retirement around the World. Chicago: University of Chicago Press.

Gruber, Jonathan and David A. Wise (2004), Social Security Programs and Retirement around the World: Micro-Estimation. Chicago: University of Chicago Press.

Gruber, Jonathan and David A. Wise (2007), Social Security Programs and Retirement around the World: Fiscal Implications. Chicago: University of Chicago Press.

Gruber, Jonathan and David A. Wise (2010), Social Security Programs and Retirement around the World: The Relationship to Youth Employment. Chicago: University of Chicago Press.

Milligan, Kevin and David A. Wise (2012), "Introduction and Summary," in Social Security Programs and Retirement around the World: Historical Trends in Health, Employment and Disability Insurance and Reforms, David A. Wise, ed. Chicago: University of Chicago Press.

Poterba, James, Steven Venti, and David A. Wise (2013), "Health, Education, and the Postretirement Evolution of Household Assets," *Journal of Human Capital,* Vol. 7, No. 4, pp. 297-339. NIHMSID #506623.

Stock, James and David Wise (1990), "Pensions, the Option Value of Work, and Retirement" *Econometrica* 58:1151-1180.

Wise, David A (2012), Social Security Programs and Retirement around the World: Historical Trends in Health, Employment and Disability Insurance and Reforms. Chicago: University of Chicago Press.