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Introduction

Axel Börsch-Supan and Courtney C. Coile

Project Overview

Through the coordination of the work of a team of analysts in 12 countries for 20 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 and other questions related to the older workforce. The project's first several phases (Gruber and Wise 1999, 2004, 2007) documented the strong relationship across countries between social security incentives and older men's labor force participation, confirmed this relationship in microeconomic analysis, and estimated the labor market and fiscal implications of social security reform. Later volumes have examined

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the relationship between disability insurance program provisions, health, and retirement (Wise 2012, 2016) and explored whether older employment affects youth unemployment (Gruber and Wise 2010) and whether older workers are healthy enough to work longer (Wise 2017).

Most recently, the project has examined recent trends in labor force participation at older ages and potential explanations for these changes in behavior, such as cohort changes in health and education (Coile, Milligan, and Wise 2019). In the current volume, we explore how the financial incentive to work at older ages has evolved from 1980 to the present. We highlight the important role of reforms in these changing incentives and examine how changing incentives may have affected retirement behavior by comparing trends in incentive measures within and across countries to trends in employment. In future work, we will conduct country-specific econometric analyses to further explore the relationship between pension reforms and the trend toward working longer.

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	Anne-Lore Fraikin, Alain Jousten, Mathieu Lefebvre, *Arnaud Dellis, Raphaël Desmet*, *Sergio Perelman, Pierre Pestieau, and Jean-Philippe Stijns*
Canada	Kevin Milligan, Tammy Schirle, *Michael Baker, and Jonathan Gruber*
Denmark	Paul Bingley, Nabanita Datta Gupta, Malene Kallestrup-Lamb, Peder J. Pedersen, *and Michael Jørgensen*
France	Didier Blanchet, Antoine Bozio, Muriel Roger, Simon Rabaté, *Luc Behaghel, Thierry Debrand, Ronan Mahieu, Louis-Paul Pelé, Corinne Prost, Melika Ben Salem, and Emmanuelle Walraet*
Germany	Nicolas Goll, Johannes Rausch, Axel Börsch-Supan, *Tabea Bucher-Koenen, Irene Ferrari, Hendrik Jürges, Simone Kohnz, Giovanni Mastrobuoni, Reinhold Schnabel, Morten Schuth, and Lars Thiel*
Italy	Agar Brugiavini, Raluca Elena Buia, Giacomo Pasini, Guglielmo Weber, *and Franco Peracchi*
Japan	Akiko Sato Oishi, Takashi Oshio, Satoshi Shimizutani, *Mayu Fujii, Emiko Usui, and Naohiro Yashiro*
Netherlands	Klaas de Vos, Adriaan Kalwij, and Arie Kapteyn
Spain	Pilar García-Gómez, Sílvia Garcia-Mandicó, Sergi Jiménez-Martín, Judit Vall-Castelló, *Michele Boldrín, and Franco Peracchi*
Sweden	Lisa Laun, Mårten Palme, *Per Johansson, and Ingemar Svensson*
United Kingdom	James Banks, Carl Emmerson, *Richard Blundell, Antonio Bozio, Paul Johnson, Costas Meghir, Sarah Smith, and Gemma Tetlow*
United States	Courtney Coile, *Peter Diamond, Jonathan Gruber, Kevin Milligan, and David Wise*

The selection of these countries was guided by four main criteria. On the one hand, they should represent different pension systems that have emerged from diverse cultural-historical backgrounds. On the other hand, however, the countries should be comparable with regard to stages of the demographic transition and of economic development with its associated job composition

and quality of work. Third, the countries were selected based on the availability of the high-quality data required to precisely describe the incentives exerted by their pension systems over a relatively long time horizon. Fourth, and maybe most importantly, the 12 countries have excellent research teams well experienced in this type of analysis.

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 develop in close consultation with country participants. In this introduction, we summarize the collective results of the country analyses and focus on the 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.

I.1 Introduction: Old-Age Employment

While life expectancy has risen dramatically almost everywhere in the world, the average retirement age in industrialized countries declined during much of the 20th century, putting enormous pressures on public pension systems. More recently, however, working in later life has been making a comeback. In a striking reversal of the earlier trend, almost all developed countries have seen substantial increases in the employment of older workers since the mid- to late 1990s.

This is illustrated in figure I.1 for men between ages 60 and 64. We observe a distinct U shape in the employment rate of older workers that is markedly similar across countries. On average, employment rates for men aged 60 to 64 in these countries rose by 14.9 percentage points between 1995 and 2016.

This is a remarkable reversal of the long-standing trend toward ever earlier labor force exit ages, a trend that many viewed as a natural side effect of growing prosperity and that was in contrast to increases in life expectancy. It is also striking that this trend has affected all countries even though the level of old-age employment is very different across countries. France and Belgium feature relatively low employment rates in this age group, while Japan and Sweden have very high employment rates. The trend reversal is most pronounced in Germany and the Netherlands and least in Japan.

Figure I.2 shows the corresponding employment rate for women between ages 60 and 64. While the U shape is less evident due to women's initial low levels of participation, the increase since the mid-1990s is similar to if not larger than that for men, averaging 18.6 percentage points between 1995 and 2016. Again, the cross-national differences in levels of old-age employment are considerable, with Sweden and the US at the top and Belgium and Italy at the bottom. The increase in old-age employment among women—as for men—is strongest in Germany and the Netherlands.

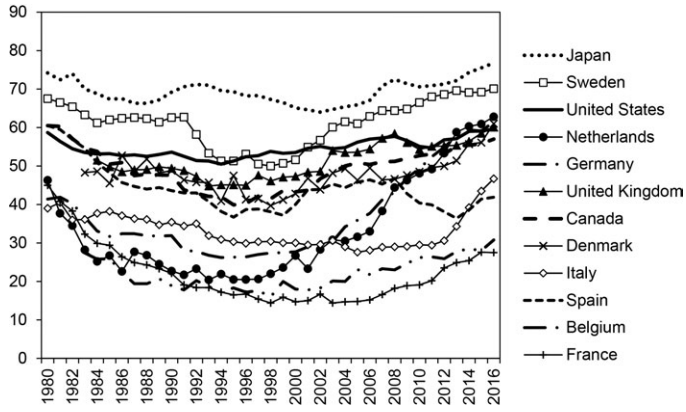

Fig. I.1 Employment rates, men aged 60 to 64, 1980–2016, percentages
Source: OECD. Data extracted on 30 Apr 2018 14:17 UTC (GMT) from OECD.Stat.

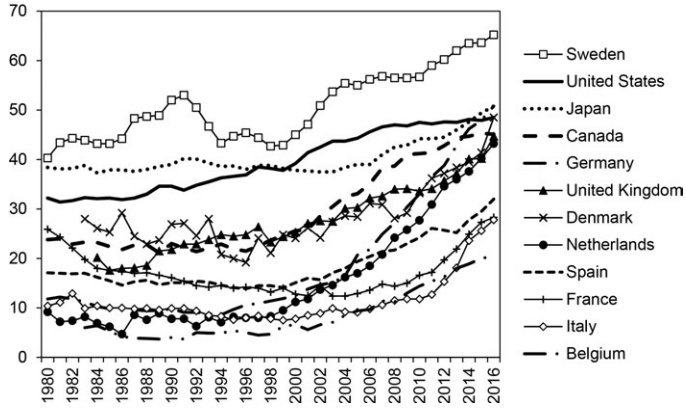

Fig. I.2 Employment rates, women aged 60 to 64, 1980–2016, percentages
Source: OECD. Data extracted on 30 Apr 2018 14:17 UTC (GMT) from OECD.Stat.

This volume is the second of three steps to explain these dramatic increases in employment at older ages. A first step has been conducted in the volume edited by Coile et al. (2019). Their research suggests that while better health, more education, and changes in labor supply behavior of married couples may have played some role in this trend reversal, these factors alone are insufficient to explain the magnitude of the employment increase and its large variation across countries. At the same time, many countries have enacted social security reforms over the past few decades that have changed eligibility ages, actuarial adjustment factors, disability benefit eligibility, and other parameters of public pension systems (Börsch-Supan 2013). Coile et al. (2019) highlight several cases where a specific reform—such as an

increase in the statutory retirement age in Japan or the UK—appears to have affected employment. However, it is not yet well understood how much of the employment trend reversal in this broad set of countries can be attributed to the collective effect of the many social security reforms implemented in recent decades. This volume aims to begin to answer this question.

Past studies suggest that social security program provisions that affect the financial incentive to work at older ages can exert a powerful influence on late-career employment decisions. Gruber and Wise (1999) document that in the mid-1990s, these incentives varied dramatically across countries and were strongly related to employment at older ages. More specifically, they find that over 80 percent of the differences across countries in the share of men aged 55 to 69 who were out of the labor force could be explained by a single measure of the typical worker's incentive to work at older ages. Recent reforms are likely to have dramatically altered the financial incentives to work at older ages and thus may have affected employment.

The key research questions for this volume are therefore the following: how much has the financial incentive to work at older ages changed between 1980 and the present as a result of social security reforms, and how much of the changes in employment over this period can be explained by these changing incentives? In this volume, we will therefore first compute the incentives to work longer in each country and document how they have changed over time, paying particular attention to changes that arise from pension reforms. Next, we will compare trends in incentive measures within and across countries to trends in employment. The aim is to see whether the U-shaped development of employment visible in figures I.1 and I.2 will be matched by a similar U shape of the incentives to work longer.

The richness of our analysis comes from both the cross-country differences in social security policy across the 12 countries represented in this volume (US, Canada, Japan, and nine European countries) and the intertemporal changes in policy that have been adopted within these countries over almost four decades. The key question is whether differences in the incentive to work arising from this policy variation correspond to the large variation in levels and temporal changes that we see in old-age labor force participation among men and women in figures I.1 and I.2.

In the future, as the third and final step of our exploration of the trend of working longer and the role of pensions in that trend, we will conduct a set of formal econometric analyses for each country, similar to the microestimates in Gruber and Wise (2004) and to be published in a separate volume. These analyses will make greater use of the heterogeneity in incentives within the population and compare the role of incentives to that of other potential determinants of retirement.

This introduction starts with a brief characterization of policy changes (section I.2); introduces our key concept, the implicit tax on working longer (section I.3); and summarizes our main results (section I.4). An extended

appendix describes our methodology in more detail, and a glossary defines the technical terms used in this volume.

I.2 Policy Changes

In most of the countries we study, many policy changes have occurred since 1980, and many of them are salient for changes in retirement patterns (OECD 2017; Social Security Administration 2018). A remarkable exception is the US, which has not passed a major social security reform since 1983 (although some changes mandated in the 1983 reform are still being phased in; such phase-in periods are common, though typically of shorter duration). Some countries have experienced major structural reforms (systemic changes) such as the introduction of a notional defined contribution (DC) system (e.g., Sweden and Italy) or the replacement of parts of the pay-as-you-go (PAYG) system by a fully funded system (e.g., Sweden and Germany). In some countries, changes in the private (personal and occupational) pension sector have interacted with changes in public programs or have otherwise influenced retirement behavior (e.g., UK and Netherlands). In most countries, policies followed a long-term trend (e.g., gradually increasing the retirement age, as in the US), but some countries experienced an inconsistent back and forth (e.g., raising and then lowering the statutory retirement age or increasing and then decreasing benefit generosity).

This phenomenon is visible in figure I.3, where we take Germany as an example. Germany introduced actuarial deductions for early retirement in the 1992 reform but canceled them under certain conditions in 1997 only to reintroduce them in 2000. Similarly, a gradual increase in the German statutory retirement age was legislated in 2007, but seven years later, a new pathway was created for early retirement at age 63.

As a first step of our analysis, each of the 12 country chapters starts with a description of these policy changes structured by important reform acts. These changes may include the following:

- raising or lowering the social security early or statutory eligibility ages (or years of contributions required for early claiming of social security benefits)
- introducing partial ("flexible") retirement into social security
- raising or lowering social security benefit generosity (this may include changes to the benefit formula, the number of years of earnings used in the benefit calculation, the use of wage vs. price indexation, etc.)
- strengthening or weakening the actuarial adjustment of social security benefits for early or delayed claiming
- strengthening or weakening the earnings test
- introducing a notional DC system
- strengthening or weakening other public programs that offer a pathway

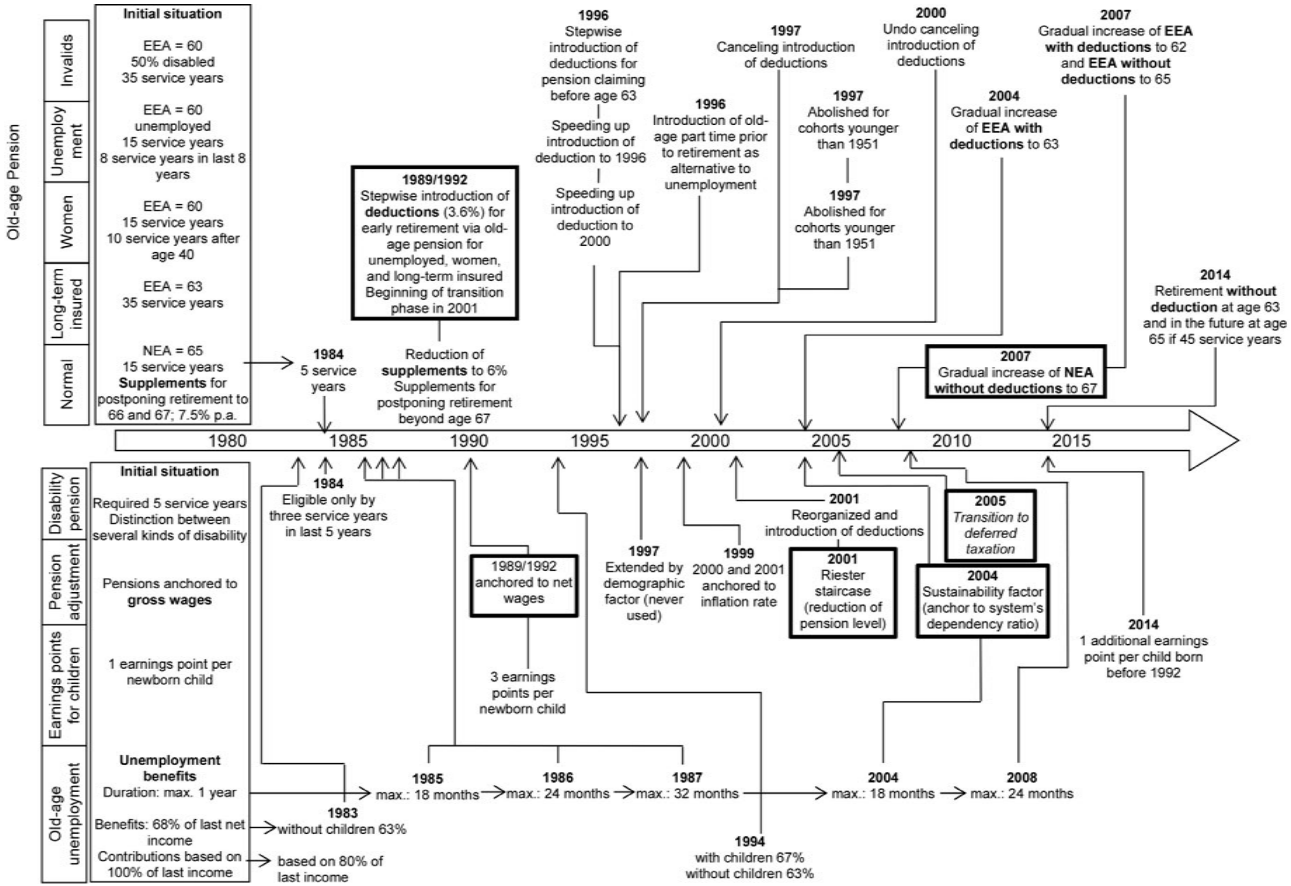

Fig. I.3 Policy changes affecting retirement age in Germany, 1980–2015

to retirement, including non–social security early retirement, disability insurance, and unemployment insurance programs

These policy changes are described verbally in a consistent manner across countries, using a common set of key words (see the glossary in the appendix). Table I.1 summarizes the key policy changes.[1]

Some distinct patterns emerge from table I.1. First, the table shows that the period since 1980 has been one of great pension reform activity. Looking down each column, it is apparent that every country has undertaken multiple types of reform—for example, making changes to social security eligibility ages and also to non–social security programs. Further, as seen in each row, for many broad types of changes, half to three-quarters of the countries have implemented a change of that type over the past 35 years.

Second, comparing across the various rows, it is clear that there have been many more reforms that strengthen the incentive to work at older ages than reforms that weaken the incentive to work. Examples of the former include reducing benefit generosity, raising eligibility ages, strengthening the actuarial adjustment, and weakening non–social security pathways to retirement. More than half of the countries have undertaken each of these reform types, far more than the number that has done the opposite.

Third, the table provides more evidence of the back-and-forth reforms described above, in that some countries have undertaken reforms of opposite types, such as weakening and strengthening the actuarial adjustments at different points in time. There are also countries that have undertaken multiple reforms of the same type, suggesting that it is often necessary to make a larger change in several smaller steps, perhaps for political reasons.

While these reforms are rather complex and not easy to quantify—pointing to the necessity of the individual country chapters in this volume, which explain the reforms in detail and show how they have affected the incentive for continued work at older ages—there are some program parameters that can be more easily quantified, such as eligibility ages.

Since 1980, changes in eligibility ages have been common. Figure I.4 shows how the social security early eligibility age (EEA) has evolved over time for men and women in our countries. The EEA is the first age at which social security benefits are available, often with an actuarial reduction relative to the benefits available at the statutory eligibility age (defined below). While one country, Canada, lowered this age from 65 to 60 for both men and women in 1987, the changes in this parameter otherwise are all in the direction of increases. In Belgium, Germany, Japan, and the UK, the EEA for women was initially lower than that for men, but it has been raised (or is

1. The years listed in the table refer to when reforms were implemented, not when a reform law was passed. A range of years indicates that the reform was phased in over time. Multiple entries in a single cell indicate that there were multiple reforms with similar effects (e.g., that reduced benefit generosity).

Table I.1 **Pension reform implementation by type and country**

Type of reform	Belgium	Canada	Denmark	France	Germany	Italy	Japan	Netherlands	Spain	Sweden	UK	US	Total # Countries
Old-age pension													
Lower early eligibility age (EEA)		1987		2003					2002				3
Raise EEA: women	1991				2012		1987–99, 2006–18				2010–		4
Raise EEA: all	2013–19		2015	2010–15	2006–12	1996–2011	2001–13	2013–	2011	1998	2018–		10
Lower statutory eligibility age (SEA)			2005–6										1
Raise SEA: women	1997–2009					2012	1987–99, 2018–2030				2010–		4
Raise SEA: all			2015	2010–15	2012–29	1994–2000, 2003–12	2013–25	2013–	2013		2018–	2003–8	9
Lower min. years for early claiming				1983									1
Raise min. years for early claiming	1997–2005, 2013–19			1993–2003, 2014		2011–							3
Introduce partial retirement					1992, 1996								
Raise benefit generosity		1980s, 2006–7, 2016			1984, 2014, 2018						2002, 2007, 2011		3
Lower benefit generosity	1997–2009	1997–99		1993	1992, 2001, 2004	1993	1986–2006	2000s	1997, 2011, 2013		1980, 1986, 1995		9
Weaken actuarial adjustment	1991, 2015			2003	1992				1997, 2007				4

(*continued*)

Table I.1 **(continued)**

Type of reform	Belgium	Canada	Denmark	France	Germany	Italy	Japan	Netherlands	Spain	Sweden	UK	US	Total # Countries
Strengthen actuarial adjustment	2007	2011–16	1999	2003, 2005	1996–2010		2005	1990s	2002, 2007			1990–2008	9
Strengthen earnings test							2002, 2005						1
Weaken earnings test	2013, 2015			2009	1992		1989, 1995, 2005		2002		1989	1990, 2000	7
Notional DC						1995–2032				1998			2
Other Pathways													
Strengthen non-SS early retirement	1984		1987, 1992, 1994, 1999	1995	2014								4
Weaken non-SS early retirement	1986–87, 1990, 1994, 2008, 2011–15		1996, 1999, 2006, 2012	1983, 1994, 2003, 2011	1996	1996–2008, 2012–		2006					6
Strengthen DI			1984		2012, 2014, 2018								2
Weaken DI			2003		1984, 2000			1985, 1990s, 1998, 2002, 2004, 2006	1985, 1997, 2004–5	1991, 1997, 2003, 2008	1995, 2008–10, 2011, 2016		6
Strengthen UI	1985, 1989, 1996			1984–2009	1984–87, 2008				1984, 1989, 2002				4
Weaken UI	2004, 2012, 2015			2012	1997, 2002, 2005			2004, 2006	2012				5

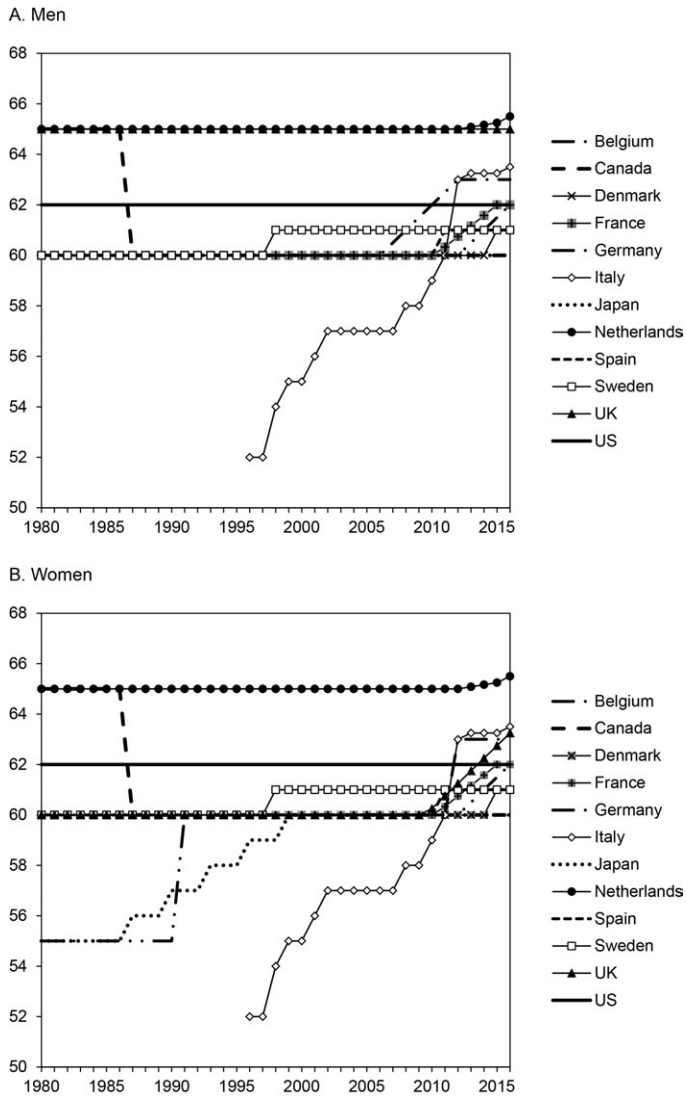

Fig. I.4 Social security early eligibility age, by sex, 1980–2016

being raised, in the case of the UK) to the same level. The US is somewhat of an outlier in not having raised the EEA during this period; only men in Japan and the UK have been similarly unaffected.

Figure I.5 shows the changes over time in the social security statutory eligibility age (SEA). This term refers to the age at which the individual is eligible for full public old-age pension benefits without reduction for early claiming (an age sometimes referred to as the full or normal retirement

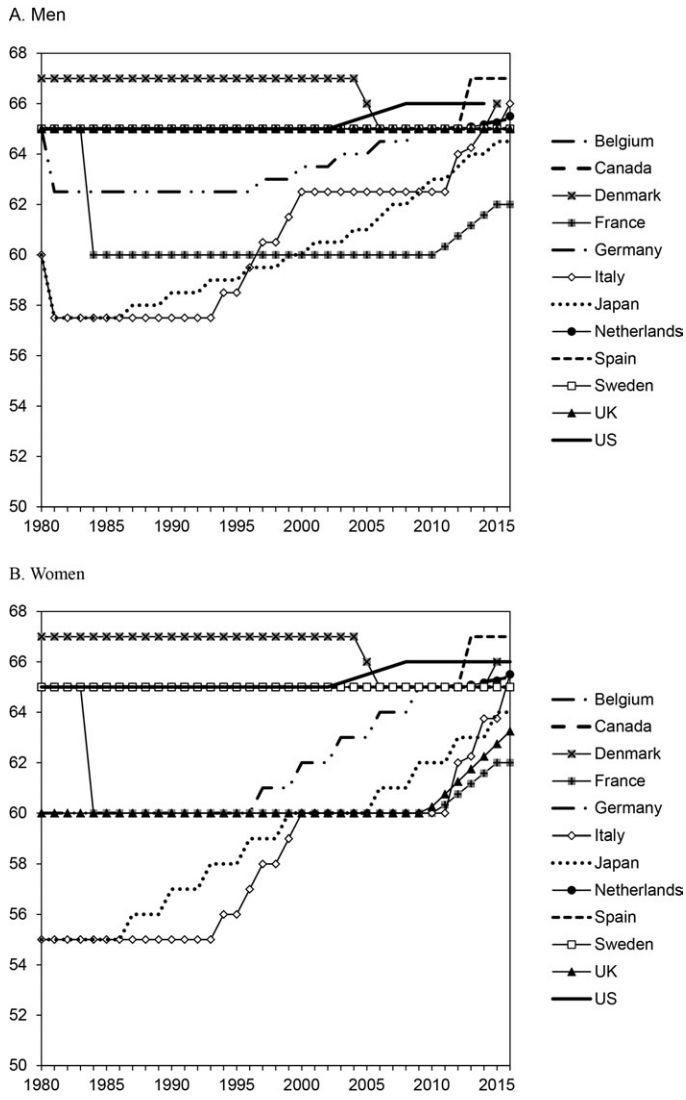

Fig. I.5 Social security statutory eligibility age, by sex, 1980–2016

age). Increases in the SEA have been near universal over this period, with all countries except Canada and Sweden raising this age. Similar to the EEA, the SEA was initially lower for women than for men in Belgium, Italy, Japan, and the UK, but these differences are being eliminated over time. An interesting difference from the EEA is that the SEA for men was cut in 6 of the 12 countries before later being increased. Variation like this in program parameters within a country over time may ultimately be used to help identify the effect of social security programs on retirement.

Actuarial adjustments define how social security benefits relate to the claiming age. They are usually defined as percentage adjustments and typically lower or raise the monthly benefit amount if the worker claims benefits before or after the SEA. Figure I.6 provides information on the actuarial reduction for early claiming, plotting the benefit available if claiming at age 62 as a share of the SEA benefit. This series is undefined for those countries that do not have early claiming prior to the SEA, such as the Netherlands. There are decreases in this series over time for several countries, corresponding to a greater actuarial penalty for early claiming. In Spain, for example, this value fell from about 80 percent in 2011 to under 60 percent in 2013. The US experienced a more modest decline, from 80 percent to 75 percent. At age 62, an actuarial neutral value would have benefits reduced by about 6.5 percent per year of claiming before the SEA (using a discount rate of 3 percent and an average life expectancy for the 12 countries). As most countries currently have an SEA of 65 or 66, a reduction to about 75 or 80 percent of the full benefit for claiming at 62 (some three to four years before the SEA) is roughly actuarially fair.

Most countries feature an earnings test at ages before the SEA. This forces individuals to stop working when they want to receive social security benefits, as benefits are taxed, often dollar for dollar, against earnings (although a small amount of earnings may be allowed without taxation). The decision to claim benefits and the decision to exit the labor force, which are independent decisions from an individual's point of view, are thus intrinsically combined in these countries; this helps explain why the word *retirement* means both decisions in these countries. An earnings test is currently in place before the SEA in Belgium, Canada, Denmark, Germany, Japan, Spain, the UK, and the US; only France eliminated its earnings test during the period we examine.

In figure I.7, we explore changes over time in the generosity of social security benefits by reporting the median earner's replacement rate. We focus on the net replacement rate, which is the average annual social security benefit net of income taxes and social contributions divided by the average annual earnings net of income taxes and social contributions. As the figure shows, replacement rates have been declining over time in a number of countries, although there are a few countries with increases. In part, declining replacement rates reflect reforms that have lowered benefit generosity—for example, increasing the number of years of earnings used in the benefit formula (which reduces the average earnings on which benefits are based by incorporating more low-earning years) or switching from wage indexation to price indexation in the benefit formula. The figure also reveals large differences across countries in the generosity of the social security program.

It is important to note the critical role that non–social security programs play in decisions to retire very early in many countries. These other programs may include disability insurance (DI), unemployment insurance (UI), and other special early retirement programs that are distinct from the social security system. As seen in table I.1, many countries have reformed these

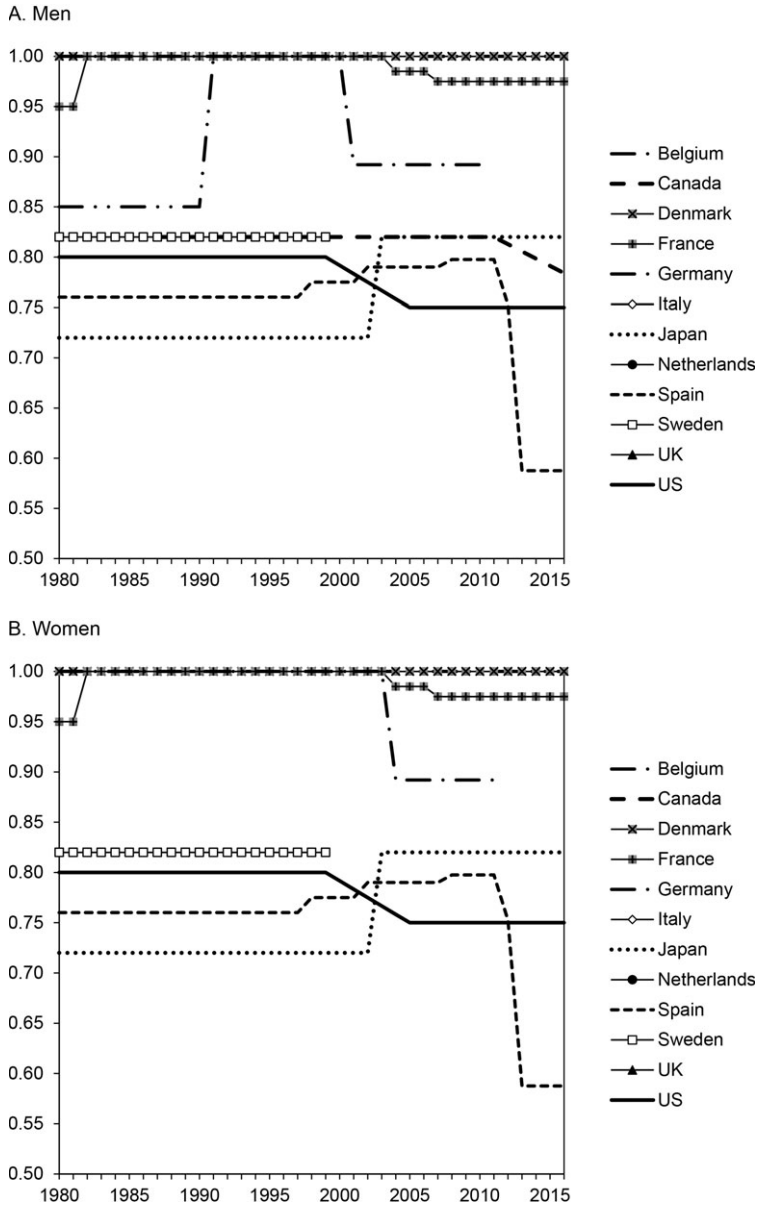

Fig. I.6 Share of SEA benefit if claiming at age 62, by sex, 1980–2016

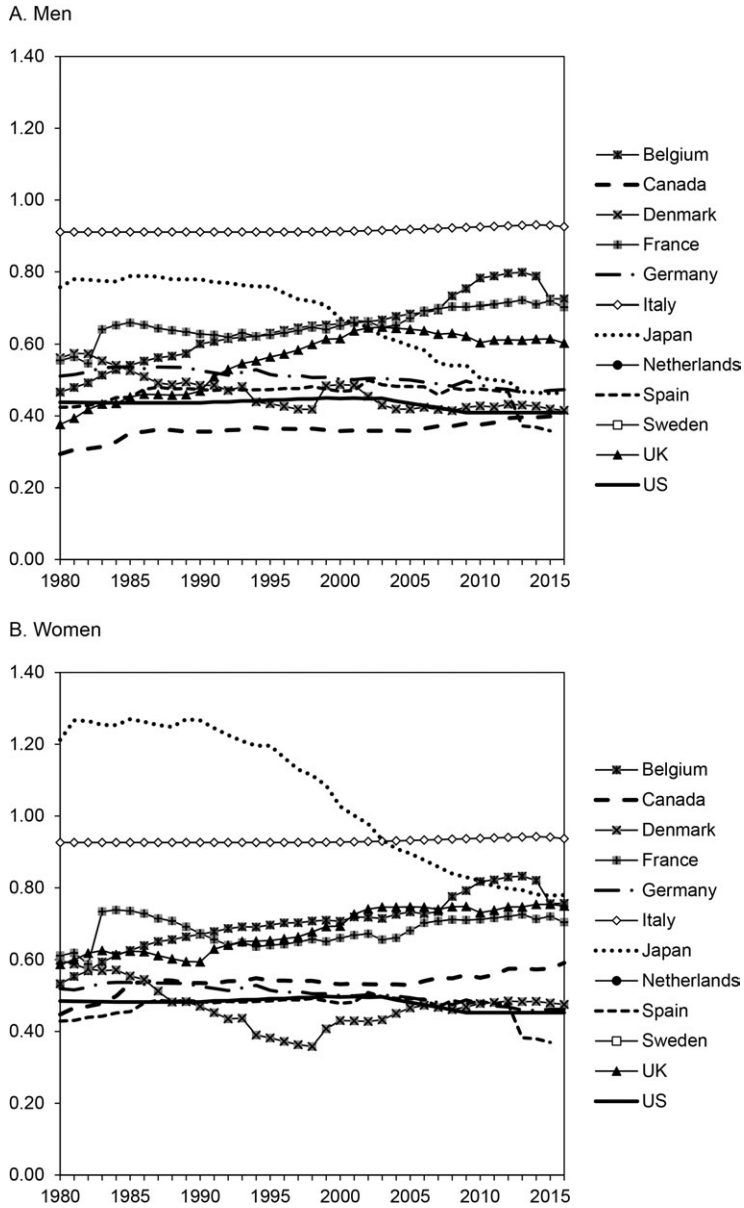

Fig. I.7 Replacement rate, by sex, 1980–2016

Note: Values calculated by authors of country chapters. The replacement rate is calculated as the average after-tax benefit at ages 62–69 relative to the average age-tax earnings at ages 55–62 for the median-earner type (described below).

other programs since 1980, often reducing benefit generosity or tightening eligibility—for example, by reducing age- or occupation-based access to DI or long-term UI benefits. In the case of DI, Wise (2012) concludes that such changes in program parameters are more important than changes in health in explaining changes in DI participation over time. More details on how these non–social security programs have changed over time are available in the country chapters.

In summary, the past three to four decades have been a period of intense pension reform activity. While the reform process sometimes includes a back-and-forth element and not all reforms push in the same direction, the general thrust over this period has been in the direction of raising eligibility ages, lowering benefit generosity, strengthening actuarial adjustments for delayed claiming, and reducing access to non–social security programs that offer alternative pathways out of the labor force. All of these changes are expected to encourage workers to retire later. Thus it is critical to try to estimate how much of the trend toward higher employment at older ages highlighted in the previous section might be driven by these substantial changes in social security and other public programs.

I.3 Pension Benefits and the Implicit Tax on Working Longer

The central piece of work in this volume is to condense the program parameters discussed in the previous section into a comprehensive, one-dimensional indicator that measures how the policy changes in table I.1 have altered the incentives to work longer. To this end, the 12 country teams have set up social security benefit calculators that compute the benefits from each salient social security program ("pathway to retirement") for a few typical benefit recipients who differ by basic socioeconomic characteristics (sex, marital status, and education). The main input for the benefit calculation is the earnings history of the individual. In the set of calculations that we focus on in this chapter, all countries use the same life-course trajectory of net earnings and the same mortality assumptions (fixed at a point in time) but use country-specific, time-varying social security rules. While this is counterfactual, it separates cross-national differences in social security policies and their changes over time from other differences across countries or over time—for example, differences in earnings histories and life expectancies. The appendix precisely defines these common assumptions. In a second set of calculations, the country chapters introduce these cross-national and time-series differences in earnings and mortality and illustrate their importance for the incentive to work at older ages.

For each typical individual, the social security benefit calculation is done for every year from 1980 to 2015, for every possible retirement age, and for every pathway to retirement (such as old-age public pension, early retirement pension, disability pensions, etc.) that is available for the individual.

For simplicity and since most countries feature earnings tests at least at ages before the SEA, we generally assume that retirement means both claiming social security benefits and stopping work, even in those countries in which no earnings tests are in effect. The variation by year captures the many changes in social security laws and regulations that occurred during this time span. The variation of social security benefits by retirement age captures whether it was advantageous for an individual of that age in a given country and year to retire or work longer, something that differs greatly across the 12 countries. Likewise, there are large differences across countries in which pathways are available for retirement, with some pathways accessible substantially earlier than the statutory eligibility age in the old-age pension in some countries.

The first product of this benefit calculation is the social security wealth, denoted by SSW. It sums up the properly discounted social security benefits from the beginning of retirement over the expected remaining life span. Postponing retirement and claiming of social security benefits by one year has several effects on social security wealth. On the one hand, the individual receives one year fewer of benefits, which decreases social security wealth. On the other hand, annual benefits increase with later claiming in most countries due to additional contributions and actuarial adjustments. Additional contributions accrue because the individual now works a year longer, and having an extra year of earnings included in the benefit computation may result in a higher benefit amount. Moreover, in almost all countries, benefits are adjusted upwardly if benefits are taken later through the actuarial adjustment. Finally, additional work results in additional payroll tax payments, the full incidence of which is assumed to fall on the worker. The balance among these mechanisms determines whether social security wealth increases or decreases with earlier or later retirement. We call the numerical increase or decrease of social security wealth the "accrual" of social security wealth. As we will see, this balance has changed between 1980 and 2015, mostly in favor of more positive accruals, favoring later retirement.

If the accrual is negative, the social security system imposes an implicit tax on working longer and claiming later. This is the key concept in this volume, abbreviated as ITAX. The implicit tax on working longer is defined as the (negative of the) accrual of social security wealth relative to the earnings of the individual. More precisely, we relate the accrual of social security wealth when postponing retirement at a given age to the earnings net of income taxes and social contributions that the individual will receive in this additional year of work. A positive value of ITAX means that there is a tax on working longer, that a negative value represents a subsidy for working longer. ITAX collapses all the various dimensions of social security policy—the discussion in the previous section features some of them—into a single dimension. This is as much an advantage as it is a disadvantage. The advantage is that the single dimension of ITAX permits us to easily display

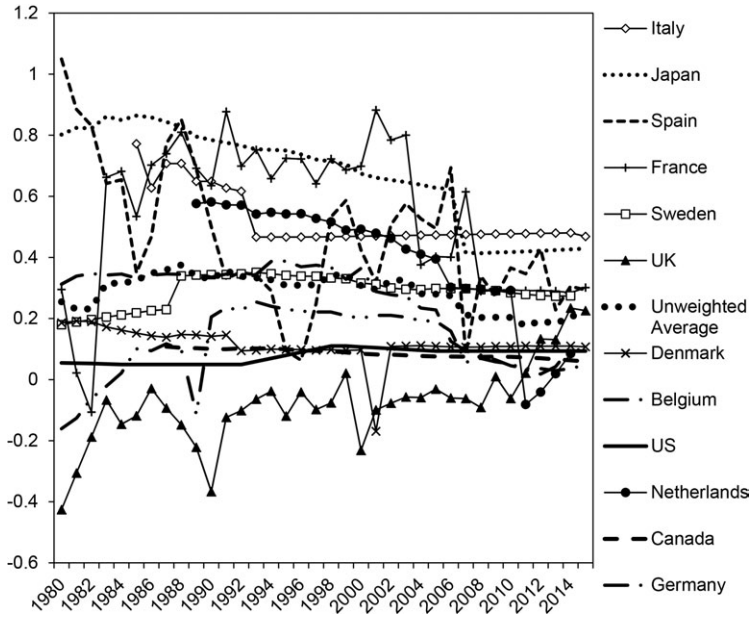

Fig. I.8 Implicit tax on working longer at age 62, men, 1980–2015

associations between policy and potential outcomes such as old-age employment or labor force participation. An obvious disadvantage is that social security policies may be more complex and may even have inconsistencies that are masked by a one-dimensional measure. In addition, different policies may have different degrees of salience for the worker, even if they have the same effect on ITAX.

The main work in this volume is for each country to compute a time series for the years 1980 to 2015 of the implicit tax rate on working longer that governs the decision to retire and claim social security benefits at age R, where R ranges in most countries from 55 to 69. Figure I.8 displays the implicit tax on working at age 62 for a typical man and its change from 1980 to 2015. We chose age 62 because it corresponds roughly to the average retirement age across the 12 countries. A "typical man" has median education and a stylized earnings history, which is common for all 12 countries. He looks forward to the median life expectancy, which again is common for all countries.

Figure I.8 shows that the 12 countries described in this volume have very different initial starting values of the implicit tax on working longer at 62 but a common declining trend. In the late 1980s and early 1990s, the implicit tax was about 35 percent on average (unweighted mean across all countries). In France and Japan, it was more than 75 percent; in Germany, 35 percent; in the UK, even negative. Despite this large heterogeneity, there was a common trend that has reduced the implicit tax substantially to only around

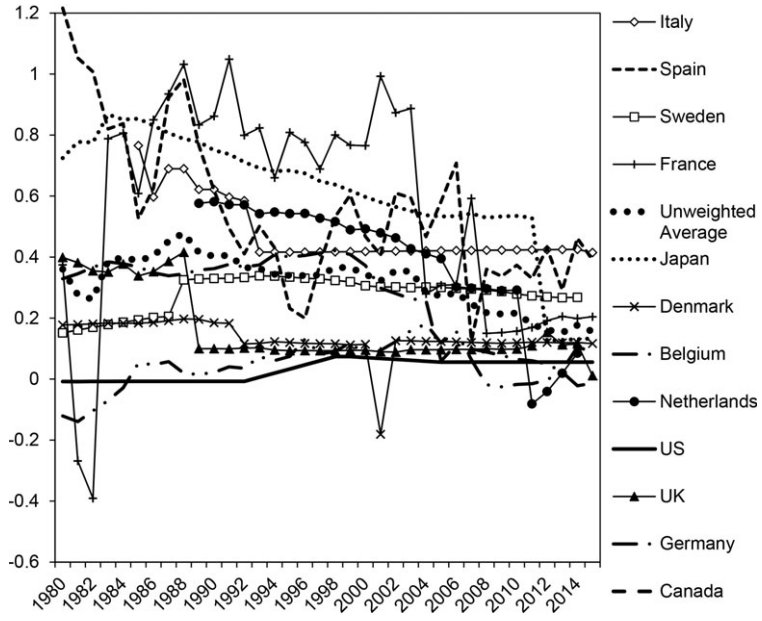

Fig. I.9 Implicit tax on working longer at age 62, women, 1980–2015

20 percent from 2007 onward on average across the 12 countries, a decline of 43 percent relative to the initial value. The decline is particularly steep for Germany, from a tax of about 40 percent in 1995 to an almost neutral value in 2013.

Figure I.9 displays the change of the implicit tax on working longer for a woman of age 62 with median education, earnings, and life expectancy. The implicit tax rates on working longer for women are similar to those for men. The decrease from 1980 to 2015 is a bit larger: the average tax rate across the 12 countries was almost 50 percent in 1988 and only 15 percent in 2015.

In figure I.10, we plot ITAX by age for each country, separately for men and women, in order to show the incentives to work across the full age range of 55 to 69 (and not just at age 62, as in the previous figures). In most cases, the implicit tax on working longer rises with age, which is consistent with declining employment at older ages; Denmark and Sweden are notable exceptions to this pattern.

As we include series for three points in time (1980, 2000, and 2014), these figures also illustrate how ITAX is changing over time. Although the patterns can be complex, in many cases the implicit tax in 2014 is lower than that in 1980. More specifically, the tax rate is more or less lower at every age in Germany, Italy, Japan, the Netherlands, Spain, and the US, falling by 40 to 60 percentage points in most of these cases. In Canada, Sweden, and the UK, the tax rate is lower at some ages and higher at others in 2014 as com-

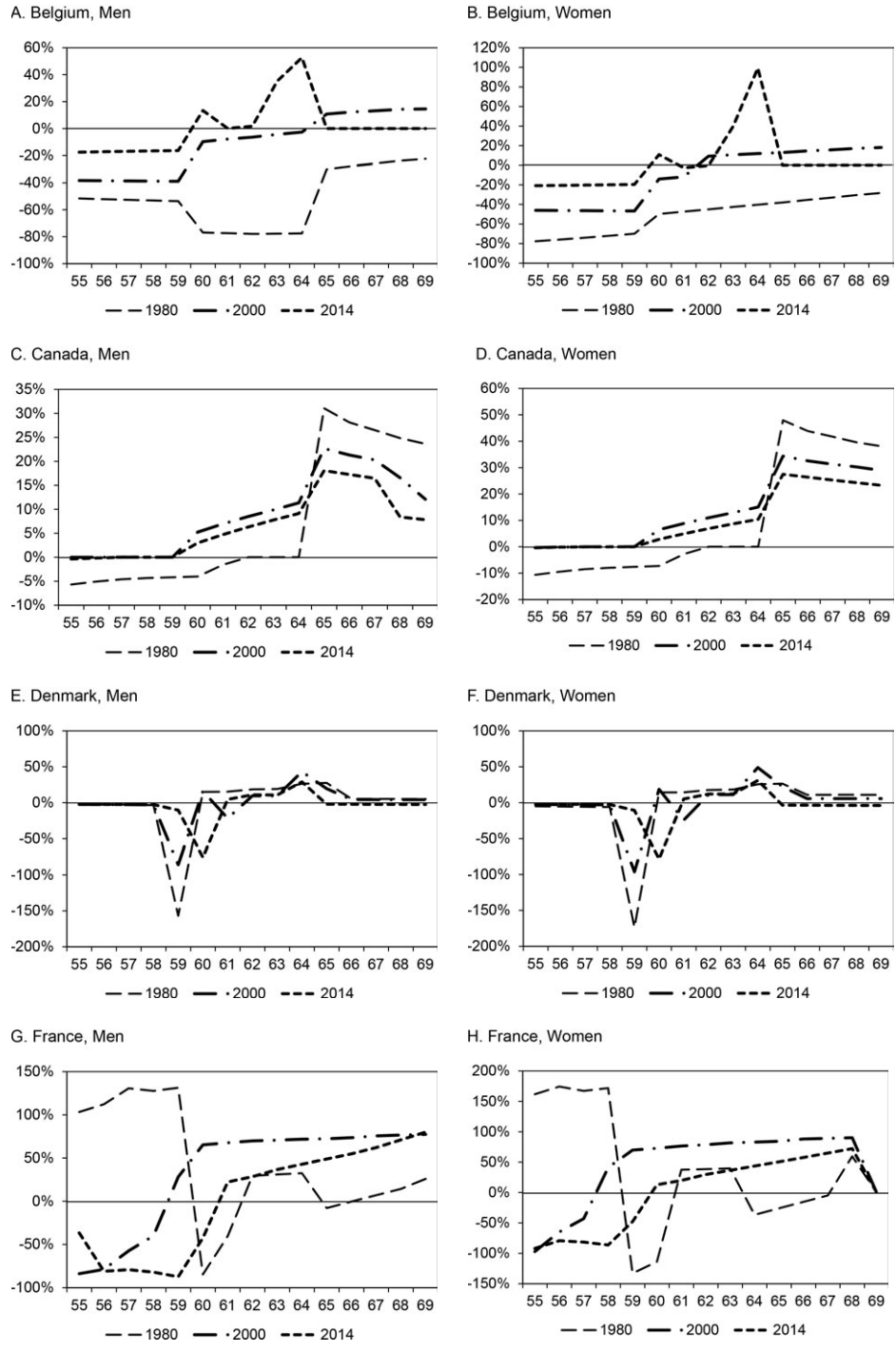

Fig. I.10 Implicit tax on claiming later by claiming age, country, and year

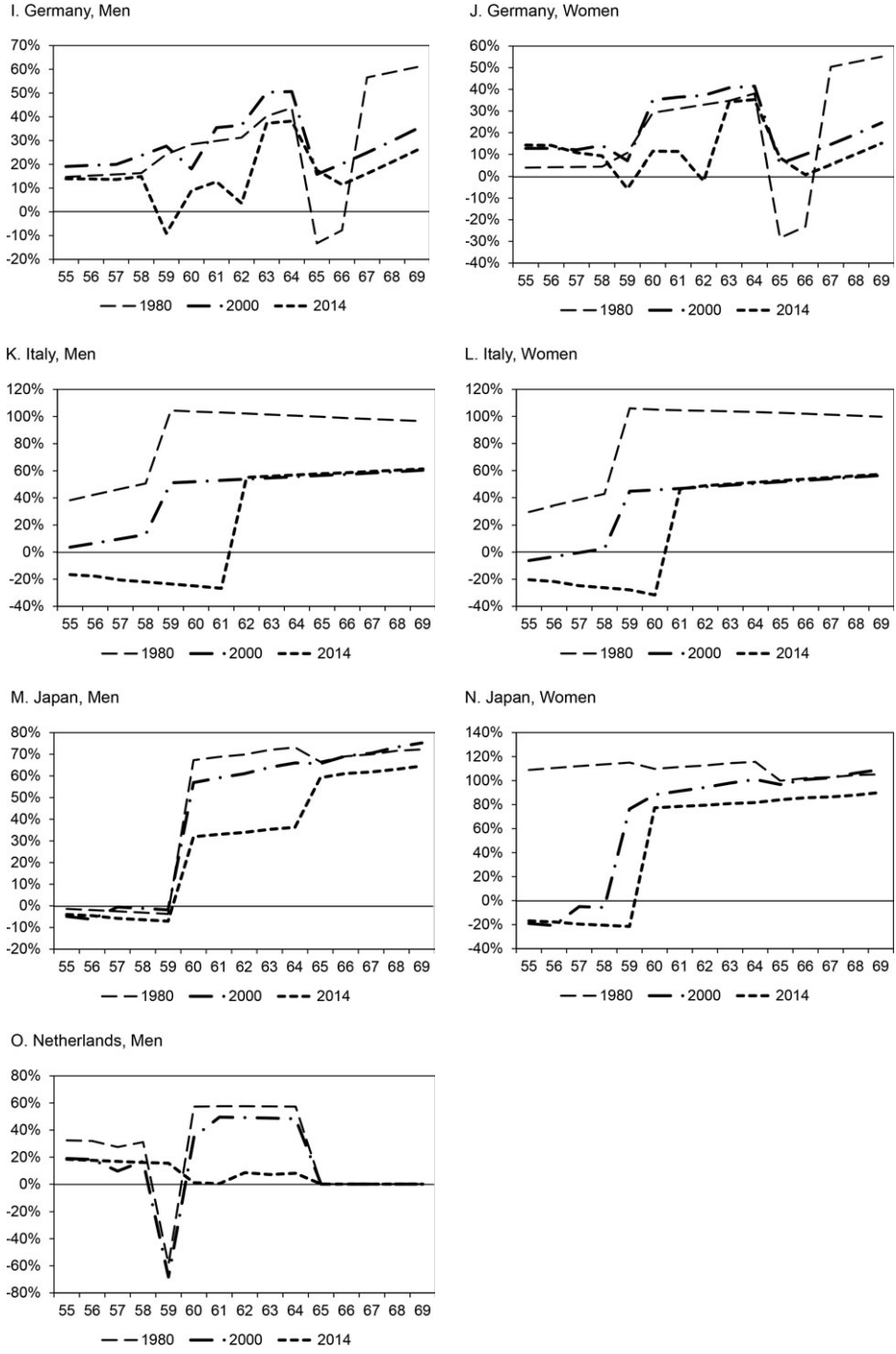
I. Germany, Men
J. Germany, Women
K. Italy, Men
L. Italy, Women
M. Japan, Men
N. Japan, Women
O. Netherlands, Men
1980
2000
2014

Fig. I.10 (cont.)

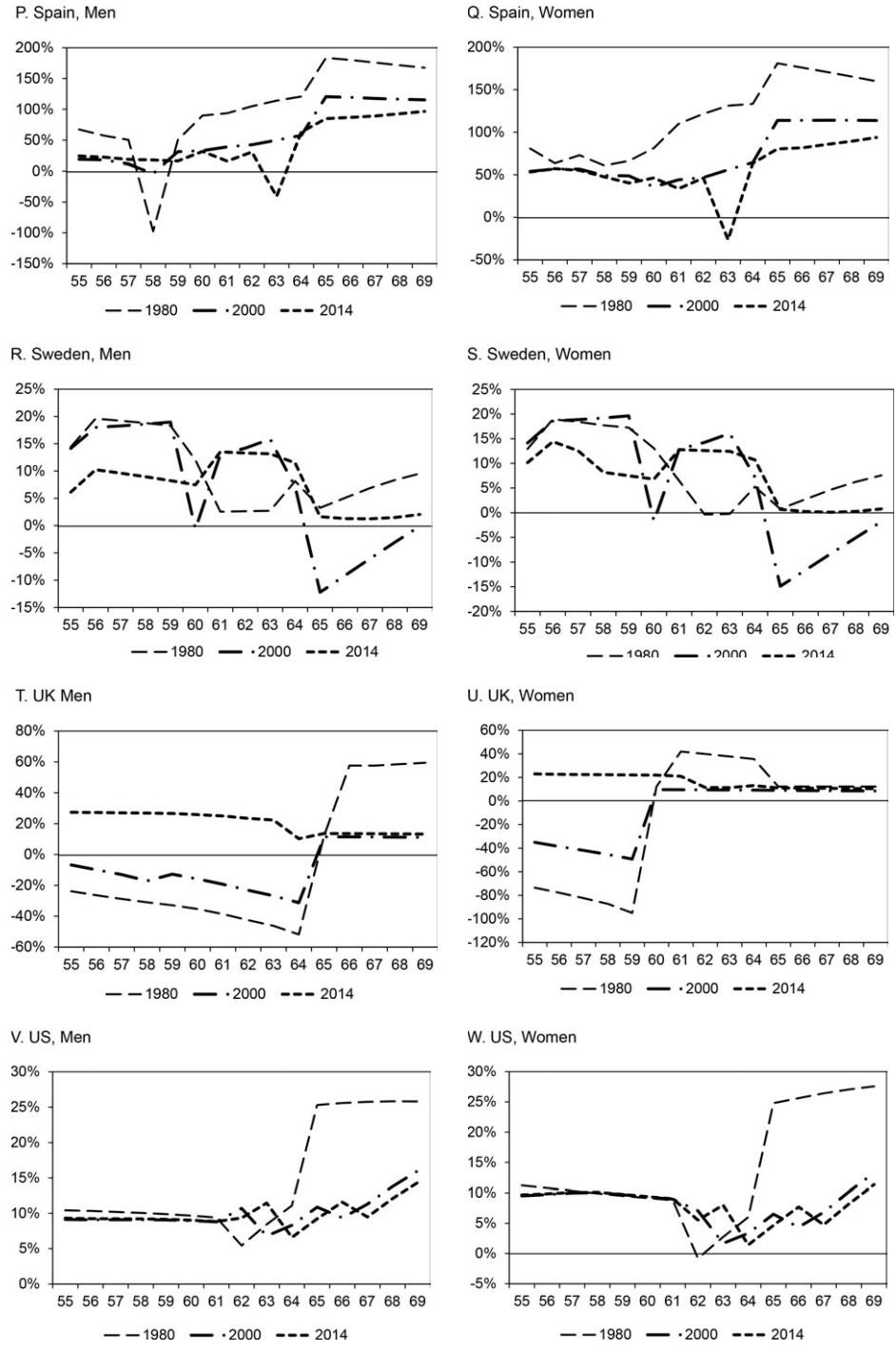
P. Spain, Men
Q. Spain, Women
R. Sweden, Men
S. Sweden, Women
T. UK Men
U. UK, Women
V. US, Men
W. US, Women
55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
1980
2000
2014

Fig. I.10 (cont.)

pared to 1980. The case of France is interesting because very early retirement (i.e., claiming benefits before age 60) was strongly incentivized by high implicit taxes in 1980; due to the reversal of this policy, France now has higher tax rates at older ages than it did in 1980. Belgium is the only country where the tax rate at all ages was higher in 2014 than it was in 1980.

The main policy drivers of these changes over time in ITAX are varied. Changes in the eligibility age or required minimum number of contribution years affected ITAX in Belgium, Italy, Japan, and Spain. Changes in the actuarial adjustment for delayed claiming beyond the EEA and/or SEA were important in Germany, the Netherlands, and the US. Changes in benefit generosity affected incentives in the UK, while the presence of means-tested benefits was critical in Canada. The country chapters provide much more detail on the policy changes that led to these changes in ITAX.

The country chapters show that incentives vary also with other socioeconomic characteristics—for example, education and the resulting earnings profiles. In this volume, we compute social security benefits and their implicit tax on working longer only for a small set of synthetic types of individuals that are standardized across countries, following a strict set of rules that are described in the methodological appendix of this introduction. In future work, we will apply the benefit calculators to real survey data in order to capture the full heterogeneity of life circumstances.

I.4 The Association between Employment and the Implicit Tax on Working Longer

The last step of the analyses in the 12 country chapters is to juxtapose the changes in the incentive variable ITAX with the actual change in old-age employment. Figure I.11 shows this for all participating countries, separately for men and women. Each panel has the employment rate for a specific age group on the vertical axis and the corresponding ITAX on the horizontal axis. The three age groups (55–59, 60–64, and 65–69) are drawn with different line styles; a selection of years is indicated by the size of the dots. Most countries show a negative association, most clearly in Germany and Canada and for Dutch men and Japanese and US women. This is the expected correlation: a higher implicit tax makes working longer a costly decision, since social security wealth is lost by claiming benefits later. The historical reduction of the implicit taxes by the various social security reforms in many countries, visible in figures I.8 and I.9, has made working longer more attractive again.

Not all countries exhibit such systematic associations as seen in the above examples. In the UK, there is no correlation visible, and it is positive in Sweden. There are many reasons why the negative association is weak or not observable in some countries. ITAX is one-dimensional and may not fully capture important aspects of the national social security system, such

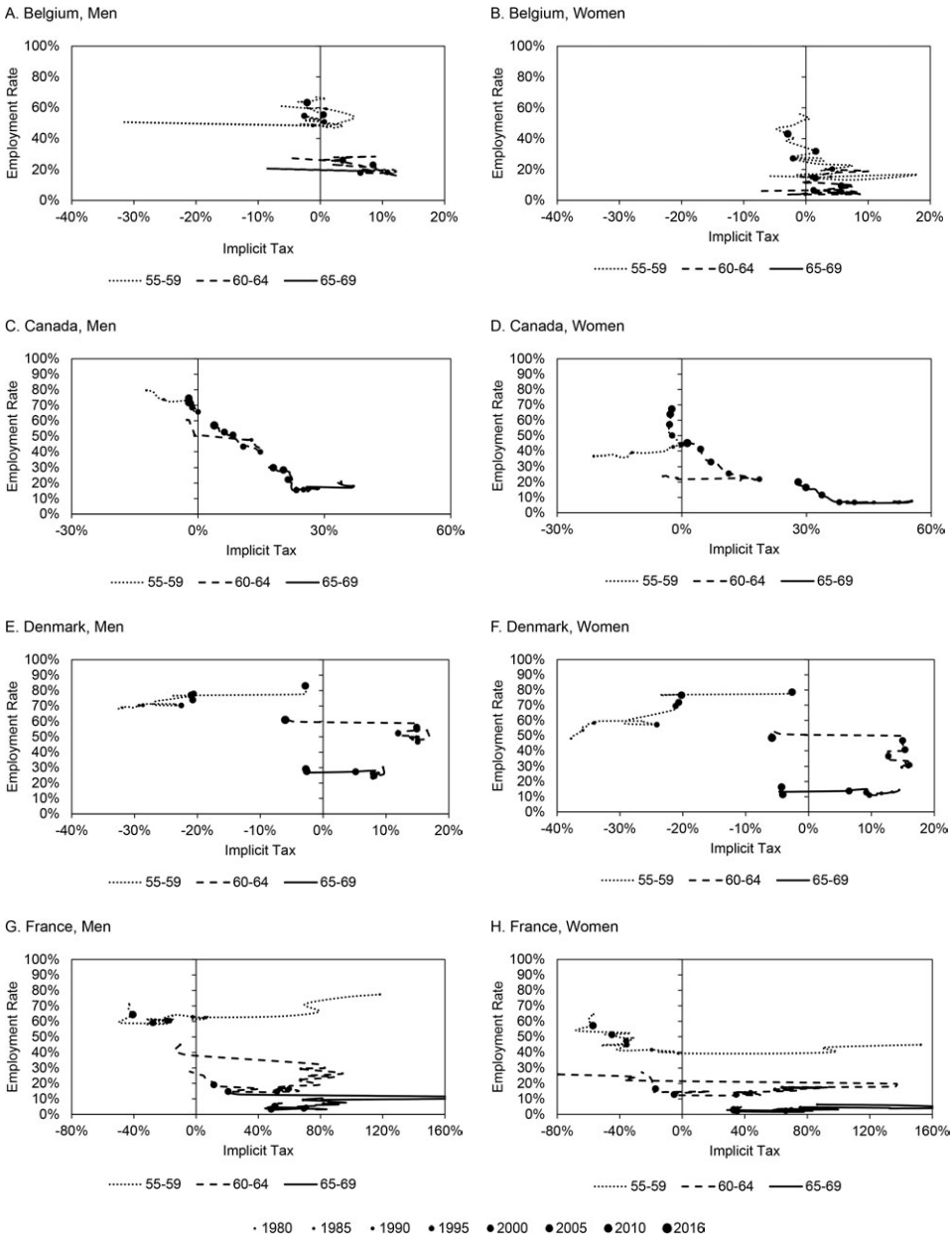

Fig. I.11 Employment rate versus implicit tax rate, 1980–2015

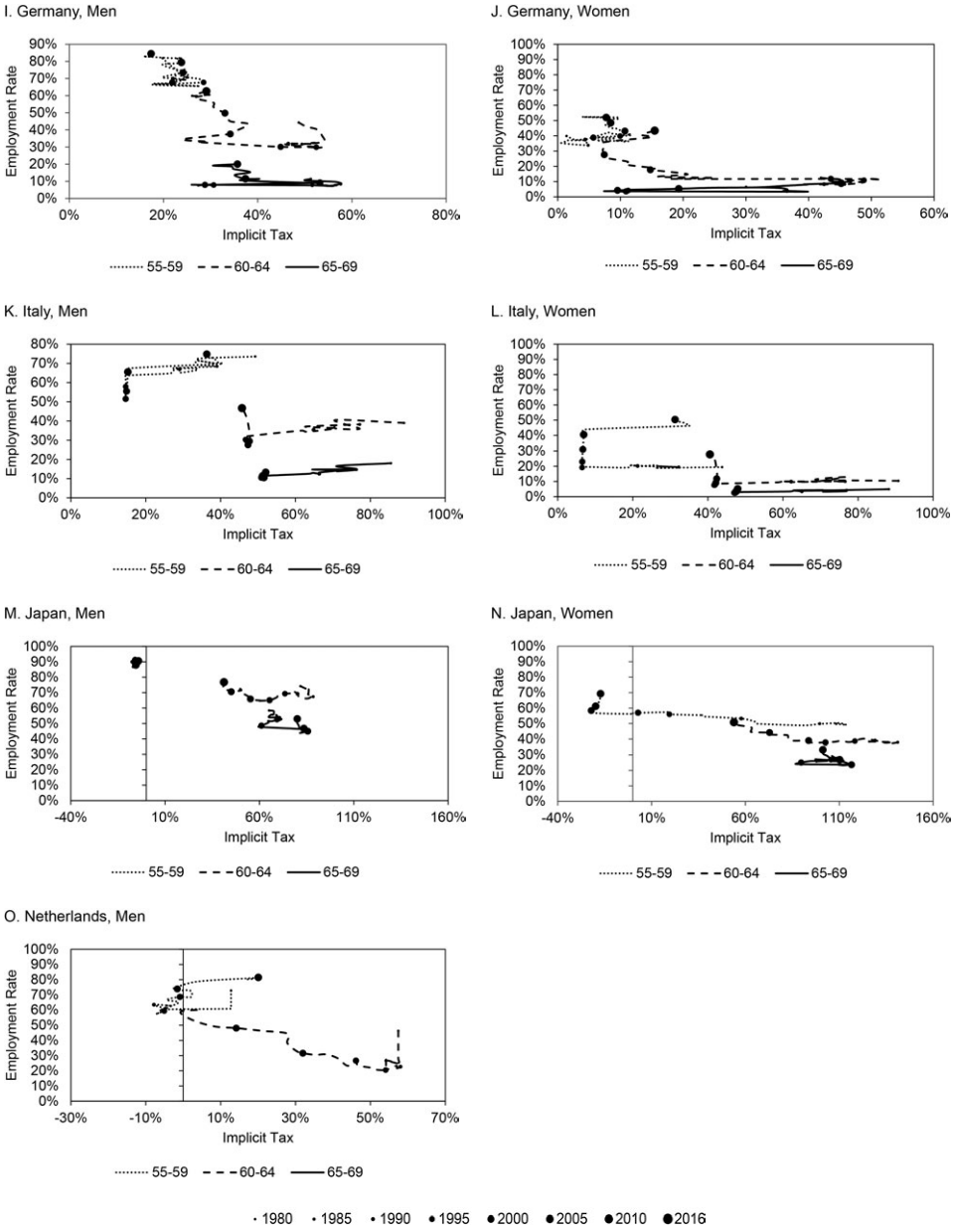
I. Germany, Men
J. Germany, Women
K. Italy, Men
L. Italy, Women
M. Japan, Men
N. Japan, Women
O. Netherlands, Men
Employment Rate
Implicit Tax
55-59
60-64
65-69
1980
1985
1990
1995
2000
2005
2010
2016

Fig. I.11 (cont.)

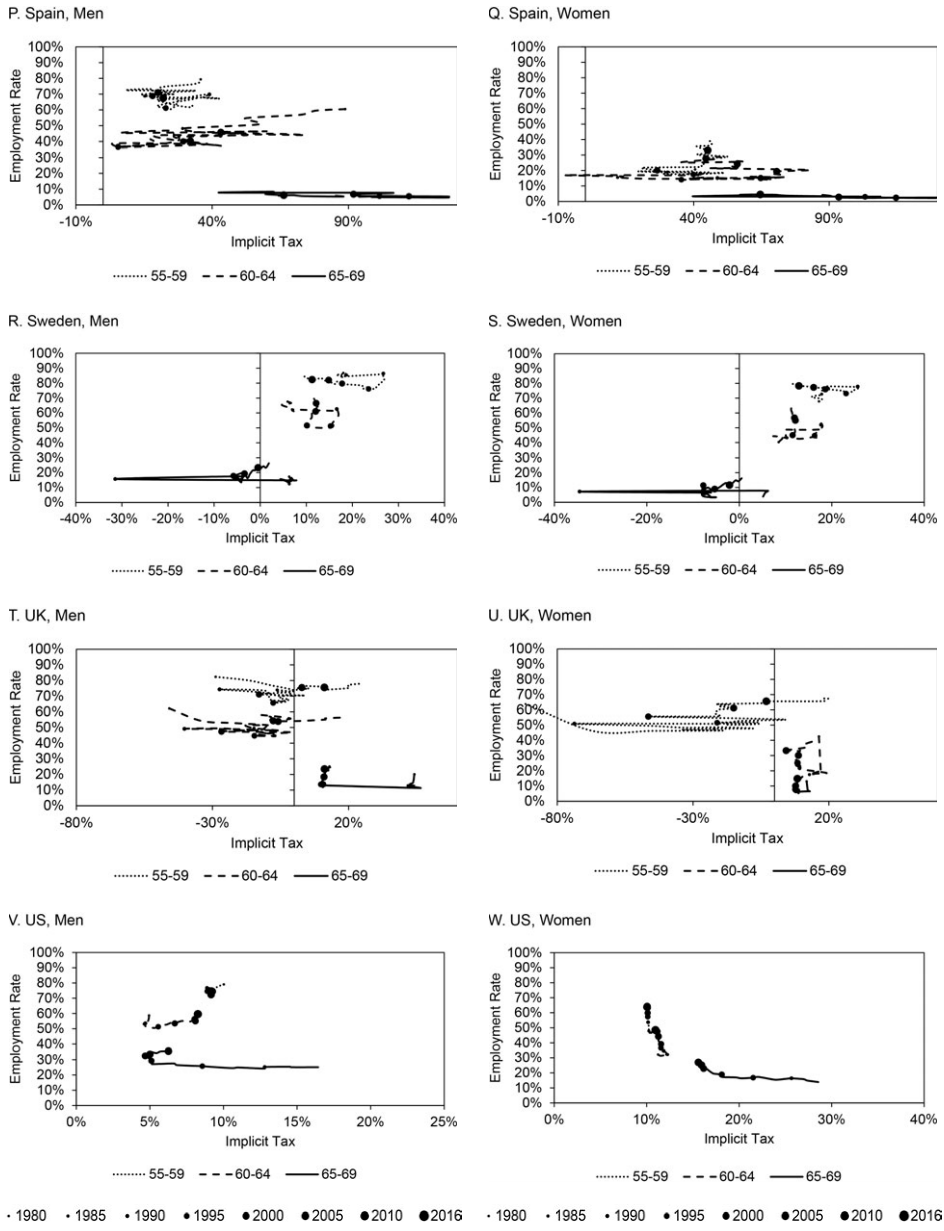
P. Spain, Men
Q. Spain, Women
R. Sweden, Men
S. Sweden, Women
T. UK, Men
U. UK, Women
V. US, Men
W. US, Women
Employment Rate
Implicit Tax
55-59
60-64
65-69
1980
1985
1990
1995
2000
2005
2010
2016

Fig. I.11 (cont.)

Table I.2 **Country-specific regressions of employment rates on implicit tax rates**

	Men				Women			
	Ages 60–64		Ages 65–69		Ages 60–64		Ages 65–69	
	Coeff.	*t*-stat	Coeff.	*t*-stat	Coeff.	*t*-stat	Coeff.	*t*-stat
Belgium	−0.043	−3.7	−0.016	−2.7	−0.049	−4.0	−0.001	−0.6
Canada	−1.437	−11.0	−0.435	−3.0	−1.335	−9.3	−0.397	−5.7
Denmark	−0.446	−9.0	0.076	1.9	−0.746	−9.4	−0.012	−0.6
France	−0.120	−7.5	−0.016	−1.8	−0.043	−5.3	−0.003	−1.1
Germany	−0.914	−12.2	−0.038	−0.6	−0.461	−8.4	−0.020	−0.7
Italy	0.150	2.2	0.119	4.1	0.007	0.2	0.044	4.2
Japan	−0.227	−4.1	0.000	0.0	−0.023	−0.8	0.029	1.1
Netherlands	−0.534	−5.9						
Spain	0.161	9.0	0.007	1.6	0.012	0.7	0.059	4.6
Sweden	−1.293	−7.2	0.141	3.2	−0.358	−1.9	0.109	2.2
UK	−0.045	−0.9	0.077	4.9	0.130	4.0	0.264	2.7
US	11.520	8.4	−0.359	−5.6	11.078	18.3	−0.239	−3.9

Note: The Netherlands provided only data for males in the 60−64 age range.

as changes in the earnings test. In some countries, policies have been inconsistent and/or quickly changing. Moreover, an average ITAX and an average employment rate across a heterogeneous population with different macroeconomic developments (service industry vs. manufacturing) and different regulations in some sectors (civil servants, heavy industry) may not capture the appropriate outcome and correct incentives for important subgroups of the population. Finally, employment of older workers may be driven by factors other than social security regulations—for example, employment in Spain suffered most from the financial crisis among our 12 countries.

Figure I.11 shows that there is heterogeneity across countries in how closely changes in employment over time have tracked changes in incentives, as captured by the ITAX measure. We explore this further in a set of country-specific linear regressions shown in table I.2. We conduct these analyses separately for men and women and for the main early retirement age range 60–64 and the main late-retirement age range 65–69. The dependent variable is the employment rate in a country for that age range and year, which is regressed on ITAX and social security wealth (SSW) for that age range and year, stratified by the three education categories. The unit of observation is thus an education group-year, although only the ITAX and SSW measures (and not the employment rate) vary by education. We include SSW to account for lifetime income effects. We also include dummies for the three education groups. Table I.2 only reports the 48 coefficients and their t-statistics relating to ITAX that have been obtained from the 48 country-

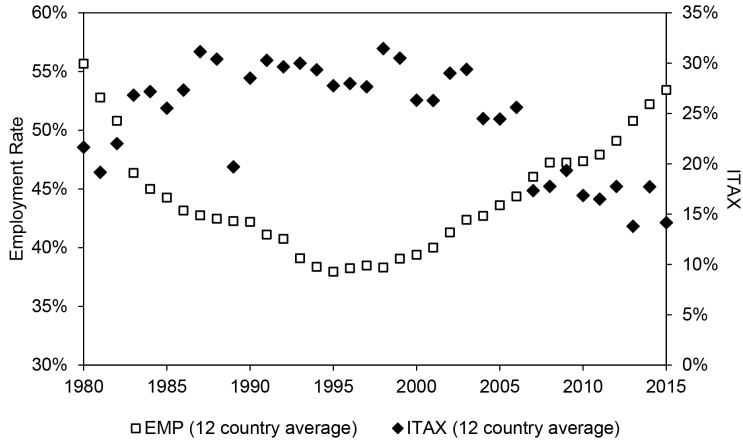

Fig. I.12 Country average employment rate and implicit tax rate over time, men ages 60–64, 1980–2015

specific regression equations. Two-thirds of the coefficients are negative, and almost half are negative and statistically significant at the conventional level ($p < 0.01$).[2] The results are much stronger for the younger age range (60–64) for both women and men. The heterogeneity across countries that was visible in figure I.11 shows up in table I.2 as large differences among the slope coefficients.

While the overall evidence from figure I.11 and table I.2 indicates a negative relationship between employment rates and implicit taxes, we now condense the evidence even further and focus solely on the time-series variation available in our data. Figure I.12 purges country heterogeneity from the data by taking (unweighted) averages across our 12 countries at each point in time. It plots the average employment rate based on data from figure I.1 against this aggregate ITAX measure, which captures the changing disincentive to work over time. The resulting figure reveals a close match between the U-shaped development of employment and the inverse U shape in the evolution of our disincentive measure.

In figure I.13, we produce a scatterplot of these data as another way of showing the association between each year's average employment rate and average ITAX. The correlation between these measures is strong, and the implied effect of ITAX on employment is large. This figure is the time-series

2. The regression results may differ from those in the country chapters. For example, in the case of the UK, the coefficient on ITAX for men is negative and statistically significant in the country chapter. The difference likely arises because that analysis uses data on ITAX and employment that varies by single year of age, education group, and year rather than the more aggregated data we use here.

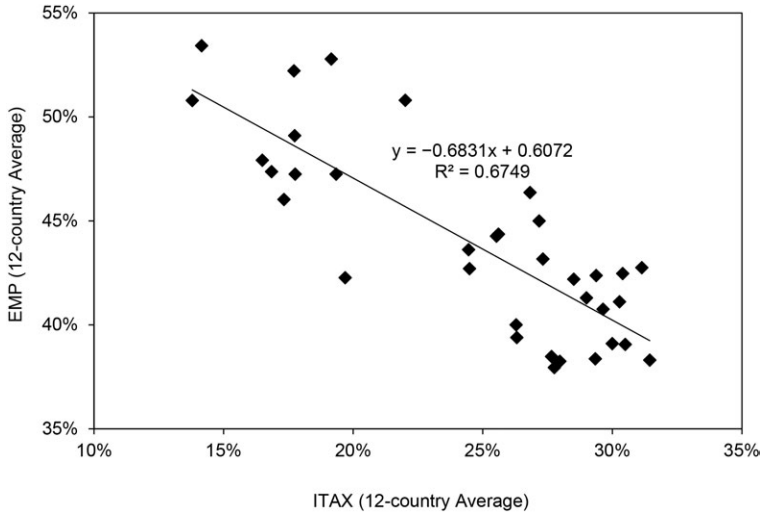

Fig. I.13 Country average employment rate versus country average implicit tax rate, men ages 60–64, 1980–2015

equivalent of the well-known cross-sectional figure in Gruber and Wise (1999) that established a strong positive association between unused capacity (nonemployment at ages 55–65) and the "tax force" to retire (essentially the sum of ITAX values from the early retirement age through age 69).

Naturally, one must exercise great caution in interpreting associations in time-series data as causal, since changes in other relevant factors that are not controlled for in the analysis may also have influenced retirement behavior. To address this concern, we combine the cross-sectional and time-series variations in a pooled regression across all countries and the entire observation period (table I.3). Similar to table I.2, the regressions are separate for men and women and the early and late retirement age range. The unit of observation is now country-year-education group. The dependent and explanatory variables are the same as in table I.2; in addition, we included country fixed effects to account for the different levels of employment in the 12 participating countries. Table I.3 now lists all coefficients and their t-statistics.

The coefficients for the ITAX variable show the statistically highly significant and economically strong relation between the incentive to work longer and the employment rate in the younger age range (60–64). Increasing the implicit tax on working longer from 0 percent to 100 percent reduces the employment of older men by 6.7 percentage points in the early retirement phase and for women by 4.6 percentage points. The effect is much smaller in the older age range (65–69; 1.8 and 0.3 percentage points for men and

Table I.3 Overall regression of employment rates on implicit tax rates

	Men				Women			
	Ages 60–64		Ages 65–69		Ages 60–64		Ages 65–69	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
ITAX	**−0.067**	**−7.0**	**−0.018**	**−2.6**	**−0.046**	**−5.8**	**−0.003**	**−0.6**
SSW	**−0.067**	**−2.0**	**0.042**	**2.2**	**0.201**	**4.3**	**0.070**	**3.6**
High earnings	−0.002	−0.3	−0.003	−1.1	−0.014	−2.9	−0.003	−1.3
Low earnings	−0.002	−0.4	0.002	0.8	0.010	2.0	0.002	1.1
Belgium	0.224	22.0	0.041	7.6	0.034	2.4	0.003	0.5
Canada	0.509	62.7	0.205	46.0	0.265	26.0	0.093	21.8
Denmark	0.541	74.9	0.267	73.0	0.363	46.1	0.133	41.3
France	0.266	20.3	0.061	7.1	0.122	8.1	0.016	2.4
Germany	0.420	49.1	0.099	19.4	0.162	19.3	0.041	11.1
Italy	0.383	33.2	0.128	17.5	0.077	5.3	0.020	3.1
Japan	0.736	84.8	0.519	87.3	0.448	39.8	0.268	46.9
Netherlands	0.381	28.4						
Spain	0.480	43.9	0.068	7.1	0.158	13.4	0.038	5.6
Sweden	0.619	91.0	0.177	50.1	0.506	74.2	0.081	27.0
UK	0.517	69.7	0.166	38.2	0.258	30.1	0.088	25.4
US	0.563	69.6	0.297	66.1	0.372	41.2	0.198	49.8
Number of obs.	1,301		1,264		1,194		1,156	
***R*-squared**	**0.981**		**0.978**		**0.957**		**0.951**	
Mean employment	0.445		0.262		0.180		0.092	
Mean ITAX	0.222		0.271		0.331		0.338	

Note: The Netherlands provided only data for males in the 60–64 age range.

women, respectively) and is insignificant for women.[3] In general, individuals with high SSW—corresponding to higher lifetime income—have a higher employment rate, although this is not true of men in the earlier age range. The country dummies reflect the level of employment, which is particularly low in Belgium and high in Japan, Sweden, and—especially for women—the US.

In conclusion, overall we find strong evidence for the expected negative association between old-age employment rates and implicit taxes on working longer. We base this conclusion on country-specific analyses that use variation within countries over time (figure I.11, table I.2), time-series analysis (figures I.12 and I.13), and panel data models that use variation across

3. We have also estimated versions of these models that include country-specific time trends. Including linear or quadratic time trends strengthens our results for men aged 60–64 in terms of both the ITAX effect magnitude and significance but slightly weakens them for women aged 60–64. The effects for the older age groups are insignificant. Including a full set of year dummies reduces the identification of the reform effects to cross-sectional variation and deviations from common reform trends. The estimated coefficient on ITAX from this specification is negative and significant for men aged 60–64, with about half of the effect magnitude compared to the specification with a country-specific quadratic time trend. It is not identified for the other groups.

countries over time (table I.3). While our results should not themselves be taken as causal, they strongly suggest that there may be a causal influence of incentives on retirement behavior, much as the cross-sectional analysis by Gruber and Wise (1999) did in launching this project.

The next step in this project is therefore to employ microdata in formal regression analyses, which will take other changes over time into account. For instance, the underlying populations are heterogeneous, and their composition may have changed; using data on individuals (rather than a small number of sample worker types, weighted to create a population average) may be important to capture the heterogeneity in incentives. Moreover, many macroeconomic changes took place over the four decades considered—for example, in health and education. These may also have affected employment at older ages and can be incorporated in a more formal analysis. These econometric analyses will be the subject of the next phase of this International Social Security project.

I.5 Summary and Conclusions

We have collected data on changes in social security laws and regulations between 1980 and 2015 in 12 countries around the globe: 9 European countries, the US and Canada, and Japan. We have computed the incentive to claim later and work longer from these laws and regulations and expressed it as the loss of social security wealth when claiming later and working longer divided by the earnings in that additional year of work. We call this the implicit tax on working longer.

While the countries differ greatly in the level of this implicit tax and its changes over time, we find a clear and common trend: the average of the implicit tax has declined substantially from the 1980s to 2015. In the late 1980s and early 1990s, the implicit tax on working longer was about 35 percent on average (unweighted mean across all countries of the tax rate at age 62) for men. In France and Japan, it was more than 75 percent; in Germany, 35 percent; and in the UK, even negative. Despite this large heterogeneity, there was a common trend that has reduced the implicit tax substantially to only around 20 percent from 2007 onward on average across the 12 countries, a decline of 43 percent. The implicit tax rates on working longer for women are similar to those for men, with an even larger decrease between 1980 and 2015: the average tax rate across the 12 countries was almost 50 percent in 1988 and only 15 percent in 2015. These declines can be linked to policy changes, such as increases in eligibility ages and in the actuarial adjustment for delayed claiming.

We then related this decline in the implicit tax on claiming later and working longer to the actual change in the employment rate. From our country-specific regressions, two-thirds of the coefficients are negative, and almost half are negative and statistically significant. Purging the data

from country heterogeneity by taking country averages and focusing on the time-series variation, we find a close match between the U-shaped development of employment and the inverse U shape of our disincentive measure. The results of a pooled regression show a statistically significant and economically strong relation between the incentive to work longer and the employment rate for men and younger women. Increasing the implicit tax on working longer from 0 percent to 100 percent reduces the employment of older men by 6.7 percentage points in the early retirement phase and 1.8 percentage points in the late retirement phase. The equivalent effect for women in the early retirement phase is 4.6 percentage points. This analysis shows that those countries that have experienced larger decreases over time in the implicit tax on work have also experienced a larger increase in employment at older ages.

Overall, our findings in this volume support the hypothesis that social security reforms over the past several decades have strengthened the incentives to work at older ages and that the resulting increase in the financial incentive to work at older ages contributed to the rise in employment at older ages during this period. In future work, we will employ microdata to conduct regression analyses within and across our countries, which will allow for more accurate and causally interpretable measurements of the incentives facing individual workers and for a comparison of the relative effects of social security incentives and other factors on retirement.

Appendix

Methodology

The 12 country teams have set up social security benefit calculators (section A1) that compute the after-tax benefit stream from each salient social security program and pathway as a function of a common synthetic earnings history (section A4), common taxation assumptions (section A5), and common synthetic mortality rates (section A6). This benefit stream starts after "retirement," which may take several "pathways." This is defined more precisely in section A2. We compute the benefit stream for individuals with several stylized socioeconomic characteristics, such as sex, marital status, and education. They are defined in section A3.

I.A1 Computation of ITAX

Section A3 has described the construction of ITAX, our key indicator of retirement incentives. More formally, social security benefit calculators convert an earnings history y up to age $R-1$ into a benefit B from age R onward:

(1) $$B_{k,t,a}(R,i) = f_{k,t,a}[y(R-1,i)],$$

where $B_{k,t,a}(R,i)$ is the after-tax benefit from the social security program and/or pathway k for an individual of type i and at age $a \geq R$, where R is the first year of benefit receipt occurring at calendar time t. Note that potential cohort differences are fully captured in this notation. This benefit has changed over time (index t) due to policy changes, as we know, and it may change as individuals age (index a). The benefit is dependent on the entire earnings history, as expressed by $y(R-1,i)$, which is the vector of earnings from age 15 to $R-1$ for an individual with a specific set of socioeconomic characteristics (index i). In most countries, benefit computations start at $a = 55$ and end at $a = 69$; in some countries, however, it is possible to claim pensions even earlier. Eligibility for a pathway is modeled by setting

(2) $$B_{k,t,a}(R,i) = 0.$$

Summarizing and properly discounting the expected stream of social security benefits for the remaining life span yields the social security wealth, denoted by SSW. For an individual of type i starting to claim benefits from program/pathway k at age R in time t, social security wealth is the present discounted value of all future social security benefits:

(3) $$SSW_{k,t}(R,i) = \Sigma_{a=R,T} B_{k,t,a}(R,i) s_{t,a} \beta^{a-R}.$$

Discounting has two components: $\sigma_{t,a}$ is the survival probability at age a in time t, and β is the usual discount factor for a discount rate of 3 percent.

Postponing claiming by one year has two effects on social security wealth. On the one hand, annual benefits $B_{k,t,a}(R,i)$ increase with later claiming in most countries due to additional contributions and actuarial adjustments. On the other hand, however, benefits are received one year fewer. The accrual of social security wealth

(4) $$ACC_{k,t}(R,i) = SSW_{k,t+1}(R+1,i) - SSW_{k,t}(R,i)$$

can thus be positive, zero, or negative. If the accrual is negative, the social security system imposes an implicit tax on claiming later. This implicit tax rate is the (negative) accrual of social security wealth divided by the after-tax earnings during the additional year of work:

(5) $$ITAX_{k,t}(R,i) = -ACC_{k,t}(R,i) / Y_{t+1,i}.$$

Since most countries feature earnings tests at least at ages before the statutory retirement age, this implicit tax on claiming later is also an implicit tax on working longer. ITAX is the key incentive variable that we model in this volume and associate with the change in labor force participation. A positive value of ITAX means that there is a tax on working longer; a negative value represents a subsidy for working longer. It collapses all the various dimensions of social security policy into a single dimension; this is as much an advantage as it is a disadvantage. The advantage is that the

Table I.A1 Time series of incentive variables

	55	56	. . .	68	69
1980	x(55,1980,i,k)	x(56,1980,i,k)	. . .	x(68,1980,i,k)	x(69,1980,i,k)
. . .	. . .	. . .	. . .	. . .	. . .
2015	x(55,2015,i,k)	x(56,2015,i,k)	. . .	x(68,2015,i,k)	x(69,2015,i,k)

single dimension of ITAX permits us to easily display associations between policy and potential outcomes such as old-age employment or labor force participation. The obvious disadvantage is that social security policies may be more complex and may even have inconsistencies that are masked by a one-dimensional measure.

The main work in this volume is for each country to compute a time series 1980–2016 of the implicit tax rate that governs the decision to claim social security benefits at age R, where R ranges in most countries from 55 to 69:

In this matrix, the entry $x(55,1980,i,k)$ represents the implicit tax of claiming benefits from program/pathway k one year later expressed as a percentage of the earnings in that additional year for a 55-year-old worker of type i under the pension rules that have been legislated in 1980.

I.A2 Definition of Retirement and Pathways

In many languages, there is only one word—*retirement*—for two distinct economic decisions: exiting the labor force and claiming a pension or social security benefits. For the benefit calculator, R is the combination of the age of claiming and leaving the labor force. The matrix in figure I.A1 represents the *implicit tax on working longer* only in the case when social security or other rules enforce the equality of the age of retirement from the labor force (R_L) and the age of claiming benefits (R_C). Most often, this equality is enforced by earnings tests that disallow earning more than Y_{test} and/or by clawback rules in the benefit calculation that tax earnings while receiving benefits at a high rate t in addition to earnings taxation.

In most European countries and Japan, earnings tests are still strict such that claiming benefits forces the individual to give up work for pay. In these countries, the two decisions are equivalent, and working a year longer implies postponing claiming benefits by a year. In the UK, however, earnings tests have been abolished. Hence retiring from work and claiming benefits are separate decisions in principle, although we still observe a strong habitual link between retiring from the labor force and claiming benefits.

More recently, "flexible retirement" models have been introduced by some countries, which permit part-time work and partial retirement. Where relevant, we model them as a separate pathway, using the following procedure:

- As a general rule, the yardstick of comparison (i.e., the denominator in equation 5) is the income that a nonretiring individual is projected to earn in the additional year ($Y_{t+1,i}$).
- We first compute the above matrix of the implicit tax of claiming later. This is an interesting concept per se even in the absence of earnings tests.
- In countries with a strict earnings test ($Y_{test} = 0$ and $t = 100$ percent), this is also the implicit tax on working longer.
- In countries and time periods without earnings tests, the implicit tax on working longer is zero even if the implicit tax of claiming later is not. We will therefore see a jump in the former variable when a country abolishes a strict earnings test.
- In the general case ($Y_{test} > 0$ and $t < 100$ percent), we introduce a new concept of the relative financial loss due to working one year longer and delaying claiming by one year. This financial loss has two components—namely, potential earnings lost due to the earnings test and/or partial retirement rules and the reduction of SSW. If Y_{max} is the maximum allowable net labor income while receiving benefits—that is, after respecting the earnings test, clawback rules, and wage taxation—then this financial loss due to working one year longer and delaying claiming by one year is

$$\text{LOSS}_{k,t}(R,i) = -\text{ACC}_{k,t}(R,i) - [Y_{max} - Y_{t+1,i}]. \tag{6}$$

Set relative to potential earnings, the resulting incentive variable is

$$\text{RFL}_{k,t}(R,i) = \text{LOSS}_{k,t}(R,i)/Y_{t+1,i}. \tag{7}$$

If there is no earnings test, $Y_{max} = Y_{t+1,i}$, and a loss occurs only through a negative accrual. If there is a strict earnings test, $Y_{max} = 0$, and the loss is the negative accrual plus the entire wage that an individual could have earned in this year. In all other cases, $0 < Y_{max} < Y_{t+1,i}$.

For countries in which pathways to retirement via disability or unemployment insurance are important (e.g., Germany and Italy), we construct separate matrices for each pathway. We then compute a weighted mean over these pathways where the weights are the actual proportions in which these pathways have been selected. The country chapters show graphs of how the weights have evolved over time.

I.A3 Definition of Synthetic "Types": Socioeconomic Characteristics

We compute separate matrices for a low-skill/education worker (in countries without skill data, 50 percent of median income), a medium-skill/education worker, and a high-skill/education worker (alternatively, 200 percent of median income), separately for single women, single men, married

women, and married men (index *i*), for a total of 12 matrices. For countries with split social security systems (e.g., France), we have different matrices for private- and public-sector workers (index *k*).

The index *i* distinguishes

- male single, female single, male married, female married
- low, medium, and high skill level or education (if not available, use 50 percent of median income, median income, and 200 percent of median income)

The case of couples retiring at different ages can become very complex. To keep matters simple, we focus on a male (or female) who is married to a partner 3 years younger (or older) of the same skill/education type. We assume that the spouse's retirement behavior is fixed—that is, it will not react to the worker's own retirement decision. In many countries, the case for couples is therefore identical to the unmarried case. One example of an exception is the US with their spousal benefits; other examples include survivor benefits.

I.A4 Construction of Common Earnings Histories

This volume focuses on typical workers with standardized earnings profiles over their life courses. We base the calculation on three different assumptions:

(a) *Common synthetic earnings profiles* in which the slopes are the same across all countries. We have calculated earnings profiles for the three skill/education groups from the US Current Population Survey (CPS), the German Socio-economic Panel (GSOEP), and administrative data from the Italian pension system (INPS). They are scaled such that earnings at age 50 are one. The profiles are fairly similar across the three countries, so we use the simple average of these profiles. They are smoothened to prevent artificial spikes in the implicit taxes and kept flat at higher ages when selection effects dominate the data. They are therefore synthetic profiles for the purpose of standardization. They are then scaled at age 50 to each country's median income at age 50 for the respective sex/education group. Figure I.12 depicts the average across all skill/education groups.

(b) *Country-specific earnings profiles* that are constant over time (based on 2016 or the most recent available data).

(c) *Country- and time-specific earnings profiles*.

Assumption (a) will isolate the effect of social security incentives from international differences in earnings profiles. Assumption (b) will honor the fact that earnings profiles are different across countries and exert their own incentives but isolate them from differences in earnings profiles across cohorts.

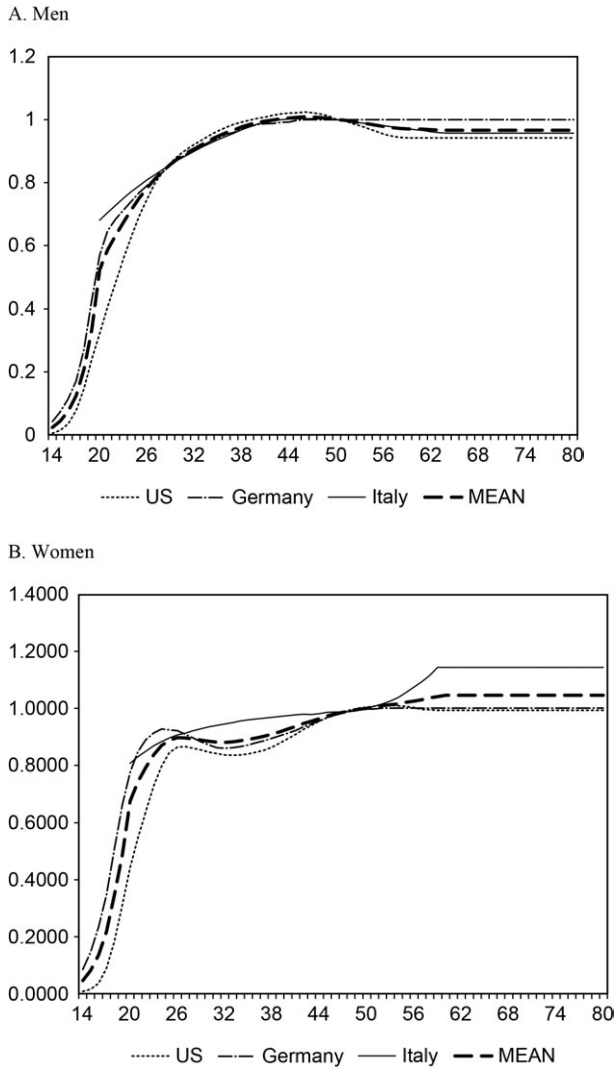

Fig. I.A1 Common earnings profiles

The country-specific earnings profiles are derived from aggregate labor force statistics available in each participating country; to account for cohort effects, these profiles are based on cohort-specific longitudinal data wherever available. With sufficient data, they are aggregated from models of the earnings process that exploit all available information on individuals' earnings histories based on regressions of the form

$$(8)\quad \Delta \ln Y_t = \alpha + X_t\delta + \beta_1 \mathrm{AGE} + \beta_2 \mathrm{AGESQ} + \beta_3 \Delta \ln Y_{t-1} + \beta_4 \Delta \ln Y_{t-2} + \beta_5 \Delta \ln Y_{t-1} * \mathrm{AGE} + \beta_6 \Delta \ln Y_{t-1} * \mathrm{AGESQ} + \beta_7 \Delta \ln Y_{t-2} * \mathrm{AGE} + \beta_8 \Delta \ln Y_{t-2} * \mathrm{AGESQ} + \mathrm{TIME}_t \lambda + \varepsilon,$$

where Y_t is the earnings of individual i in period t; X is a set of human capital control variables for individual i: education, marital status, race, tenure in the labor market, tenure at the firm, region of residence, and so on. AGE is age, AGESQ is its square; and TIME is a set of dummy variables for each year of the sample.

Earnings are deflated by a consumer price index or equivalent. The data are then differenced such that the dependent variable is the percentage change in earnings for the individual. After having run the regression on an individual basis, we aggregate the projected earnings profiles over the lower, middle, and upper tercile of the income distribution, separately for men and women.

Some countries condition the eligibility for a certain pathway (e.g., Germany) or pension benefits in general (e.g., France) to the number of years of contribution. These may include drop-out years for parents during child raising, sometimes also unemployment, further education, care for parents, and so on. In this case, we use a suitable average number of such years derived from national labor statistics.

Regarding the age of entry into the labor force, we also use common assumptions of ages 16, 20, and 25, respectively, for low, medium, and high education/skill levels. In addition, some country teams added analyses based on country-specific profiles—for example, they used the median age of labor force entry in their national data for that type of worker.

I.A5 Common Taxation

Social security benefits are computed net of applicable income taxes. The earnings in the denominator of ITAX are net of payroll taxes—that is, income taxes, mandatory social contributions, and so on.

Common approach. We used constant and flat tax rates provided by the Organisation for Economic Co-operation and Development (OECD). They are the average tax rates on gross labor income, including social security contributions from the OECD ("total tax wedge"), averaged over the years 2000, 2005, 2010, and 2015.

National approach. Some country teams used an income tax calculator (stratified by single vs. couple household) that included the preferred tax treatment of pension benefits. Other country teams used simpler alternatives—for example, applied statutory tax rates stratified by household type and income bracket.

I.A6 Common Survival Probabilities

Similar to the earnings profiles, this phase focuses on typical workers with standardized survival curves in order to isolate the effect of social security incentives from international differences in mortality (case a) plus national specifications (cases b and c):

(a) Identical age and gender-specific survival rates across all countries. We use the average survival rates provided by Eurostat, which refers to the EU-28 countries. The underlying life expectancy at age 15 is 67.8 years for women and 64.7 years for men. In addition, these rates are adjusted to generate a life expectancy that is three years higher (or lower) to reflect the difference in life expectancy across the three income categories. This adjustment is a mixture of a proportional increase (or decrease) of the survival rates and a shift of the survival curve to the right. These values are used to calculate the conditional probability that a 55-year-old will be alive at every future age (56–100) when he or she might receive benefits and so on for workers of different ages represented in the matrix.

Alternative assumptions are analogous to the respective assumptions on earnings histories:

(b) Country-specific survival rates that are constant over time.
(c) Country- and time-specific survival rates.

Assumption (b) will honor the fact that mortality rates are different across countries and exert their own incentives but isolate them from the reduction in mortality over time.

I.A7 Occupational and Private Pensions

In some countries, occupational pensions play a minor role and are simply ignored (e.g., in Italy). In other countries, they are an essential part of the old-age income provision system (e.g., in the Netherlands). If occupational pensions are included, they are treated as an "add on" to public pensions; hence public and occupational pensions are considered as a package. DC pensions are only included when they affect the eligibility for means-tested benefits (e.g., in Canada). Private pensions (e.g., IRAs in the US and Riester pensions in Germany) are not included.

Glossary

This glossary comprises the typical technical terms that are important for consistency among the country chapters. Table I.G1 lists common terms.

Table I.G1 Common terms

Term	Definition
Claiming age	The claiming age denotes the age at which an individual decides to initiate receipt of benefits from a *social security program*.
Earliest eligibility age	The earliest eligibility age is defined as the age at which *early retirement* through a *social security program* is possible, mostly with reduced benefits.
Early retirement	Early retirement is the practice of claiming benefits from a *social security program* before an individual reaches the *statutory eligibility age*. Early retirement is possible after attaining the *earliest eligibility age* and is usually dependent on fulfilling a certain number of insurance years or a specific contribution history (in some cases, more years of contributions are required than at the *statutory eligibility age*). Early retirement benefits are typically reduced relative to the benefits available at the *statutory eligibility age*.
Earnings tests	Earnings tests limit the amount of earnings that can be received by an individual who receives benefits from a *social security program*. Earning tests often apply only before the *statutory eligibility age* or are stricter before than after this age.
Implicit tax rate	The implicit tax rate is the negative of the change in social security wealth arising from an additional year of work (or the negative of the accrual) divided by the after-tax earnings. A positive value means that there is a tax on working longer; a negative value represents a subsidy for working longer.
Labor force exit age	The labor force exit age is the age at which an individual decides to stop working.
Means test	A means test is the practice of determining whether an individual qualifies for benefits from the basic social safety net, usually by comparing the individual's income and/or assets to a threshold value.
Old-age pension	Old-age pension is a government benefit where the primary eligibility requirement is attaining a certain (old) age, though a contribution history may also be required. An old-age pension is one example of a *social security program*, a broader term that encompasses other public transfer programs.
Partial ("flexible") retirement	Partial ("flexible") retirement schemes are models that permit individuals to access benefits from a *social security program* and continue working part-time in order to make a gradual transition from full-time work to full retirement possible.
Retirement age	*Retirement age* is to be avoided because it is ambiguous whether claiming age or labor force exit age is meant.
Social security program	Social security programs encompass *old-age pension* (OA), disability insurance (DI), unemployment insurance (UI), and other public transfer programs available at older ages.
Social security wealth	The social security wealth for an individual who claims benefits at a specific age and in a specific year from a *social security program* is the present discounted value of all future benefits from this social security program.
Statutory eligibility age	The statutory eligibility age is the age at which an individual is eligible for full public old-age pension benefits without reduction for early claiming. There may be a (relatively short) contribution history required, which is sometimes less than the number of years of contributions required in order to claim *early retirement* benefits.

Table I.G2 Country-specific deviations

Term (country-specific)	Definition	Country
Full-rate age	The full-rate age is defined as the age at which an individual is eligible for a full public old-age pension before the *statutory eligibility age* after fulfilling both a minimum contribution history and the *earliest eligibility age*.	France, Germany
Social Security	This is specific US terminology. While the term *social security* (lowercase) in Europe refers to many branches of the welfare system, including also health and unemployment insurance, the term (now capitalized) in the US refers to old age and disability benefits only.	US
State pension age	This is specific UK terminology. The state pension age is the earliest age at which an individual can start receiving the UK state pension—and the age at which the vast majority start receiving it. It varies by several eligibility criteria.	UK

Where it is impossible to harmonize the terms, there are country-specific technical terms displayed in table I.G2.

Terms in *italics* refer to other terms defined in the glossary.

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