

## REFORMS AND RETIREMENT INCENTIVES:

### INTRODUCTION AND SUMMARY

by

Axel Börsch-Supan and Courtney Coile

### ABSTRACT

This is the introduction and summary to the ninth phase of an ongoing project on *Social Security Programs and Retirement Around the World*. This project, which compares the experiences of a dozen developed countries, was launched in the mid-1990s, following decades of decline in the labor force participation rate of older men. The first several phases of the project document that social security program provisions can create powerful incentives for retirement that are strongly correlated with the labor force behavior of older workers. Subsequent phases of the project have explored how disability program provisions affect retirement, whether there is a link between older employment and youth unemployment, and whether older individuals are healthy enough to work longer.

In the two decades since the project began, the dramatic decline in men's labor force participation has been replaced by sharply rising participation rates. Older women's participation has increased dramatically as well. Over this same period, countries have undertaken numerous reforms of their social security programs, disability programs, and other public benefit programs available to older workers. In this ninth phase of the project, 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.

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## Project Overview

Through the coordination of work of a team of analysts in twelve countries for twenty years, the International Social Security (ISS) project has used the vast differences in social security programs across countries as a natural laboratory to study the effects of retirement program provisions on the labor force participation of older persons and other questions related to the older workforce. The project's first several phases (Gruber and Wise, 1999, 2004, and 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 the relationship between disability insurance program provisions, health, and retirement (Wise, 2012 and 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 examined recent trends in labor force participation at older ages and potential explanations for these changes in behaviour (Coile, Milligan, and Wise, forthcoming). 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.

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 Lefèbvre, <i>Arnaud Dellis, Raphaël Desmet, Sergio Perelman, Pierre Pestieau, and Jean-Philippe Stijns</i>
Canada	Kevin Milligan, Tammy Schirle, <i>Michael Baker and Jonathan Gruber</i>
Denmark	Paul Bingley, Nabanita Datta Gupta, Malene Kallestrup-Lamb, Peder J. Pedersen, <i>and Michael Jørgensen</i>
France	Didier Blanchet, Antoine Bozio, Simon Rabaté, Muriel Roger, <i>Luc Behaghel, Thierry Debrand, Ronan Mahieu, Louis-Paul Pelé, Corinne Prost, Melika Ben Salem, and Emmanuelle Walraet</i>
Germany	Axel Börsch-Supan, Nicolas Goll, Johannes Rausch, <i>Tabea Bucher-Koenen, Irene Ferrari, Hendrik Jürges, Simone Kohnz, Giovanni Mastrobuoni, Johannes Rausch, Reinhold Schnabel, Morten Schuth, and Lars Thiel</i>
Italy	Agar Brugiavini, Raluca Elena Buia, Giacomo Pasini, Guglielmo Weber, <i>and Franco Peracchi</i>

Japan	Akiko Sato Oishi, Takashi Oshio, Satoshi Shimizutani, <i>Mayu Fujii, Emiko Usui, and Naohiro Yashiro</i>
Netherlands	Klaas de Vos, Adriaan Kalwij, and Arie Kapteyn
Spain	Pilar García-Gómez, Silvia Garcia-Mandico, Sergi Jiménez-Martín, Judit Vall-Castelló, <i>Michele Boldrín, and Franco Peracchi</i>
Sweden	Lisa Laun, Mårten Palme, <i>Per Johansson, and Ingemar Svensson</i>
United Kingdom	James Banks, Carl Emmerson, <i>Richard Blundell, Antonio Bozio, Paul Johnson, Costas Meghir, Sarah Smith, David Sturrock, and Gemma Tetlow</i>
United States	Courtney Coile, <i>Peter Diamond, Jonathan Gruber, Kevin Milligan, and David Wise</i>

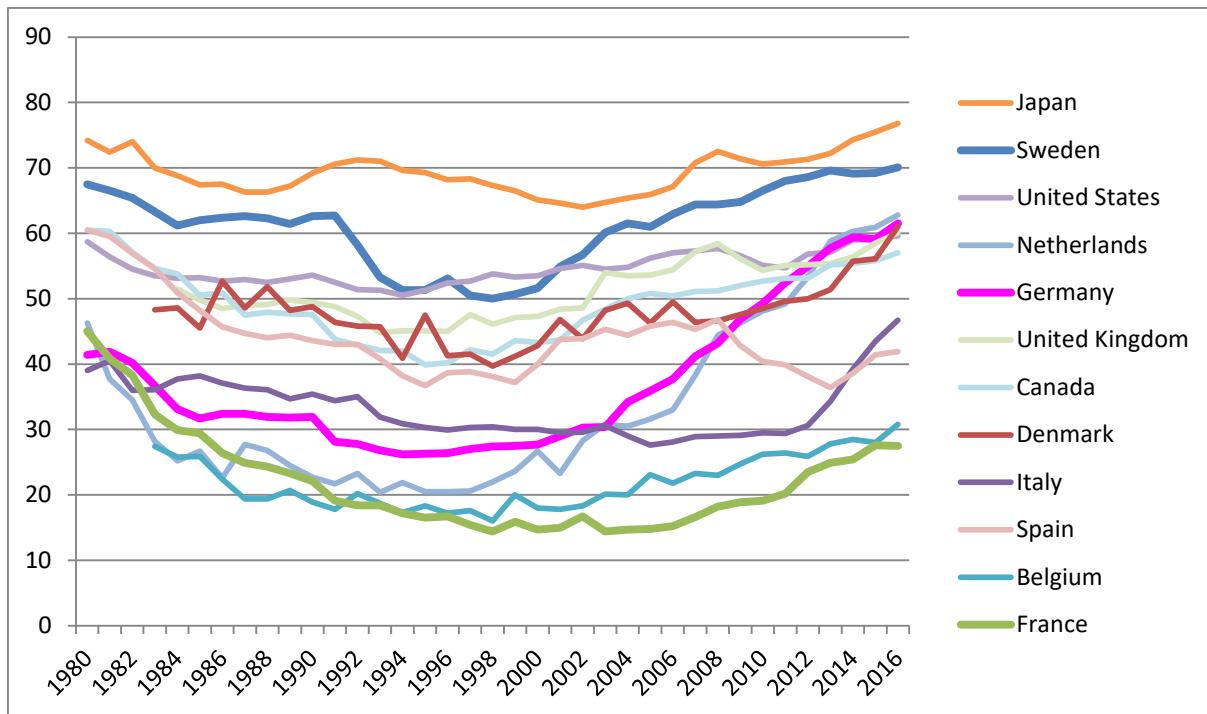
An important goal of the project has been to present results that are as comparable as possible across countries. Thus the papers for each phase are prepared according to a detailed template that we develop in close consultation with country participants. In this introduction, we summarize the collective results of the country analyses and focus on the combined analysis of the data from each of the countries. The country 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 each particular country.

## 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 20<sup>th</sup> 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 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 ages 60 to 64 in these countries rose by 14.9 percentage points between 1995 and 2016.

**Figure 1: Employment rates, Men Ages 60 to 64, 1980-2016 [percentages]**

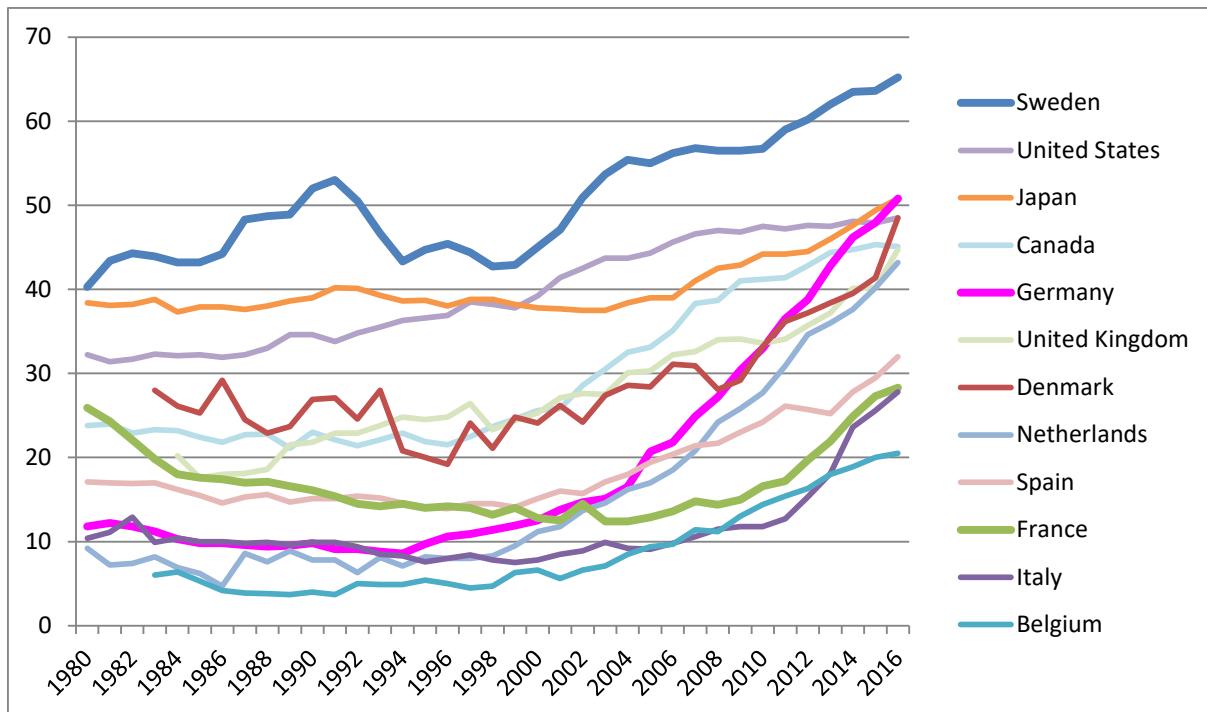


Source: OECD. Data extracted on 30 Apr 2018 14:17 UTC (GMT) from OECD.Stat.

This is a remarkable reversal of the long-standing trend towards ever earlier labor force exit ages, a trend which many viewed as a natural side effect of growing prosperity and which was in contrast to the 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 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.

**Figure 2: Employment rates, Women Ages 60 to 64, 1980-2016 [percentages]**



Source: OECD. Data extracted on 30 Apr 2018 14:17 UTC (GMT) from OECD.Stat.

What explains these dramatic increases in employment at older ages? Research in Coile et al. (2018) 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. (2018) 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.

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 ages 55 to 69 that 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: 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?

The richness of our analysis comes from both the cross-country differences in social security policy across the twelve countries represented in this volume (US, Canada, Japan and nine European countries) and from the inter-temporal 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 1 and 2.

This introduction starts with a brief characterization of policy changes (Section 2), introduces our key concept, the implicit tax on working longer (Section 3), and summarizes our main results (Section 4). An extended appendix describes our methodology in more detail, and a glossary defines the technical terms used in this volume.

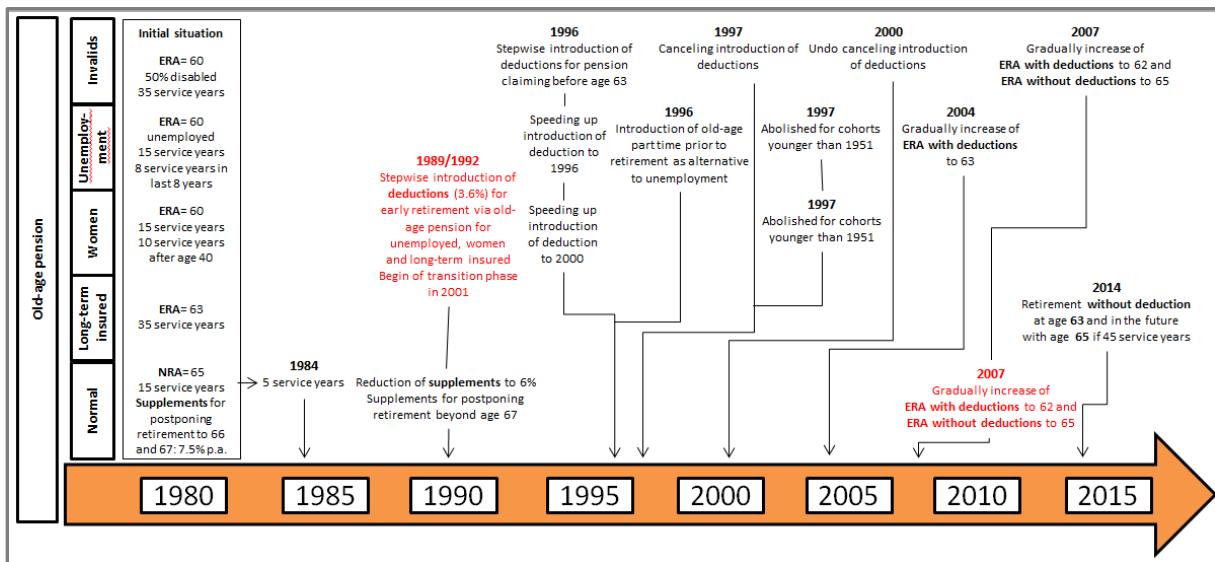
## **2. Policy changes**

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, various issues; Social Security Administration; various issues). 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 then lowering the statutory retirement age or increasing then decreasing benefit generosity).

This phenomenon is visible in Figure 3 where we take Germany as an example. Germany introduced actuarial deductions for early retirement in the 1992 reform but cancelled them under certain conditions in 1997 only to re-introduce 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.

**Figure 3: Policy changes affecting retirement age in Germany, 1980-2015**



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

- 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 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 1 summarizes the key policy changes.<sup>1</sup>

<sup>1</sup> 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 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
<b>Old Age Pension</b>													
Lower early eligibility age (EEA)		1987		2003					2002				3
Raise EEA-women	1991				2012		1987-1993, 2006-2018				2010-		4
Raise EEA-all	2013-19		2015	2010-2015	2006-2012	1996-2011	2001-2013	2013-	2011	1998	2018-		10
Lower statutory elig age (SEA)			2005-06										1
Raise SEA-women	1997-2009					2012	1987-1993, 2018-2030				2010-		4
Raise SEA-all	[2025, 2030]		2015	2010-2015	2012-2029	1994-2000, 2003-2012	2013-2025	2013-	2013		2018-	2003-2008	9
Lower min yrs for early claiming				1983									1
Raise min yrs for early claiming	1997-2005, 2013-2019			1993-2003, 2014		2011-							3
Introduce partial retirement					1992, 1996								1
Raise benefit generosity		1980s, 2006-07, 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
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
<b>Other Pathways</b>													
Strengthen non-SS early ret	1984			1987, 1992, 1994, 1999	1995	2014							4
Weaken non-SS early ret	1981, 1987, 1991, 1994, 2010, 2012, 2015, 2018			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							6
Strengthen UI	1985, 1989, 1996			1984-2009	1984-87, 2008				1984, 1989, 2002	1997, 2001, 2002, 2015			5
Weaken UI	2004, 2012, 2015			2012	1997, 2002, 2005				2012	1993, 1996, 2007			6

Some distinct patterns emerge from Table 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 thirty-five years.

Second, comparing across the various rows, it is clear 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 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 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 4: Social Security Early Eligibility Age, by Sex, 1980-2016**

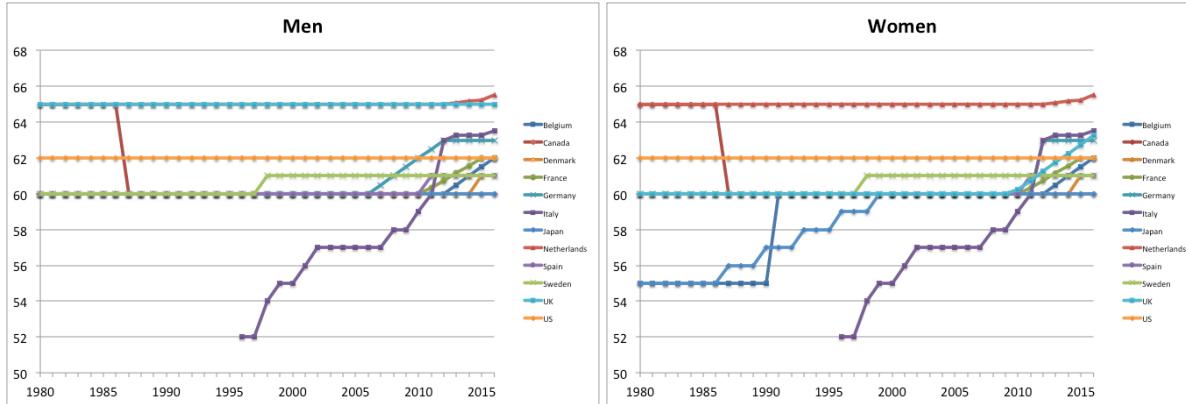
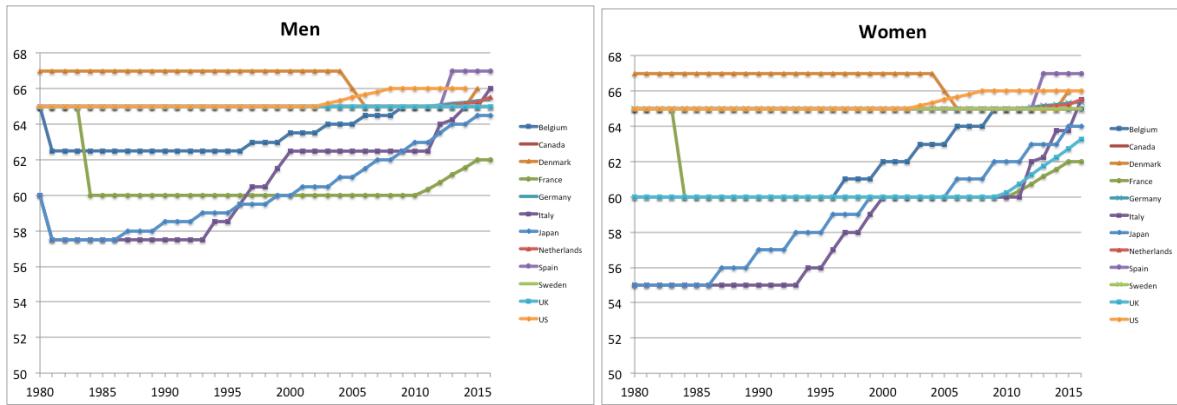


Figure 5 shows the changes over time in the social security statutory eligibility age (SEA). This term refers to the age at which the individual is eligible for full public old-age pension benefits without reduction for early claiming (an age sometimes referred to as the full or normal retirement age).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

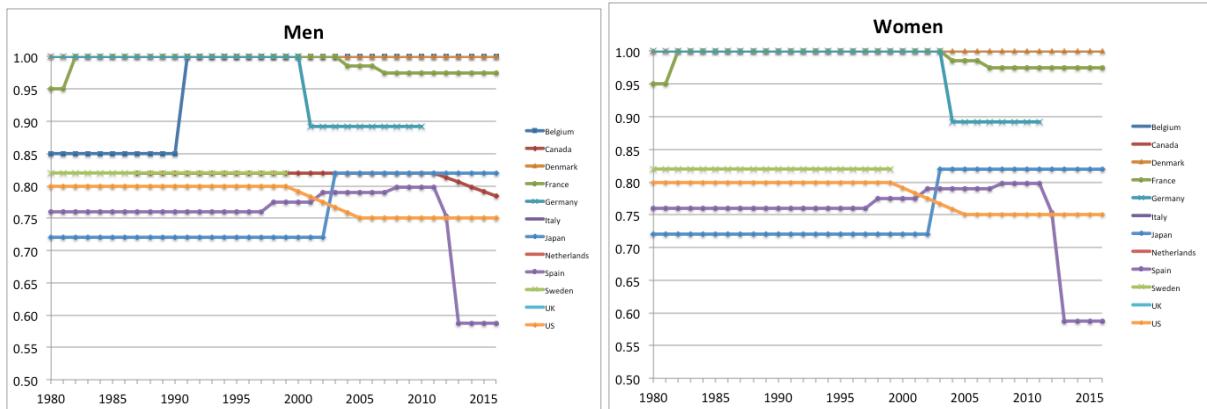
**Figure 5: Social Security Statutory Eligibility Age, by Sex, 1980-2016**



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 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% in 2011 to under 60% in 2013. The U.S.

experienced a more modest decline, from 80% to 75%. 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% and 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% of the full benefit for claiming at 62 (some three to four years before the SEA) is roughly actuarially fair.

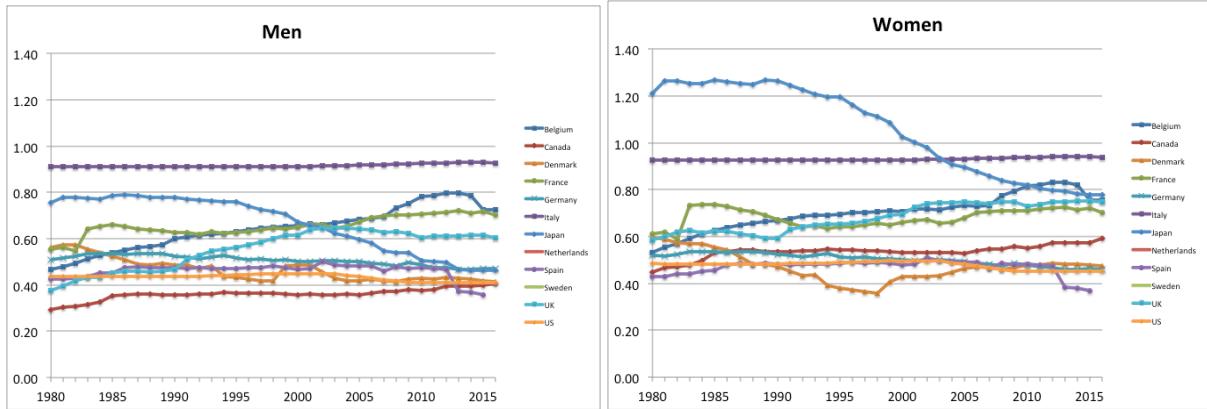
**Figure 6: Share of SEA Benefit if Claim at Age 62, by Sex, 1980-2016**



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 to 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, and the UK; only France eliminated its earnings test during the period we examine.

In Figure 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.

**Figure 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).

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 Figure 1, many countries have reformed these 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 has 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 towards higher employment at older ages highlighted in the previous section might be driven by these substantial changes in social security and other public programs.

### 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 1 have altered the incentives to work longer. To this end, the twelve 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 socio-economic 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 this in chapter, all countries use the same life-course trajectory of net earnings and the same mortality assumptions, but country-specific 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, e.g., 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 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 (Table 2), 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 a given type of individual in a given country and year to retire earlier or later, something which 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.

A 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 claiming social security benefits by one year has two effects on social security wealth. On the one hand, the individual receives one year less 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. The balance between 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 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 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, 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 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 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 8 displays the implicit tax on working at age 62 for a typical man and its change from 1980 to 2015. We choose age 62 as 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 twelve countries. He looks forward to the median life expectancy which again is common for all countries.

**Figure 8: Implicit tax on working longer at age 62, Men, 1980-2015**

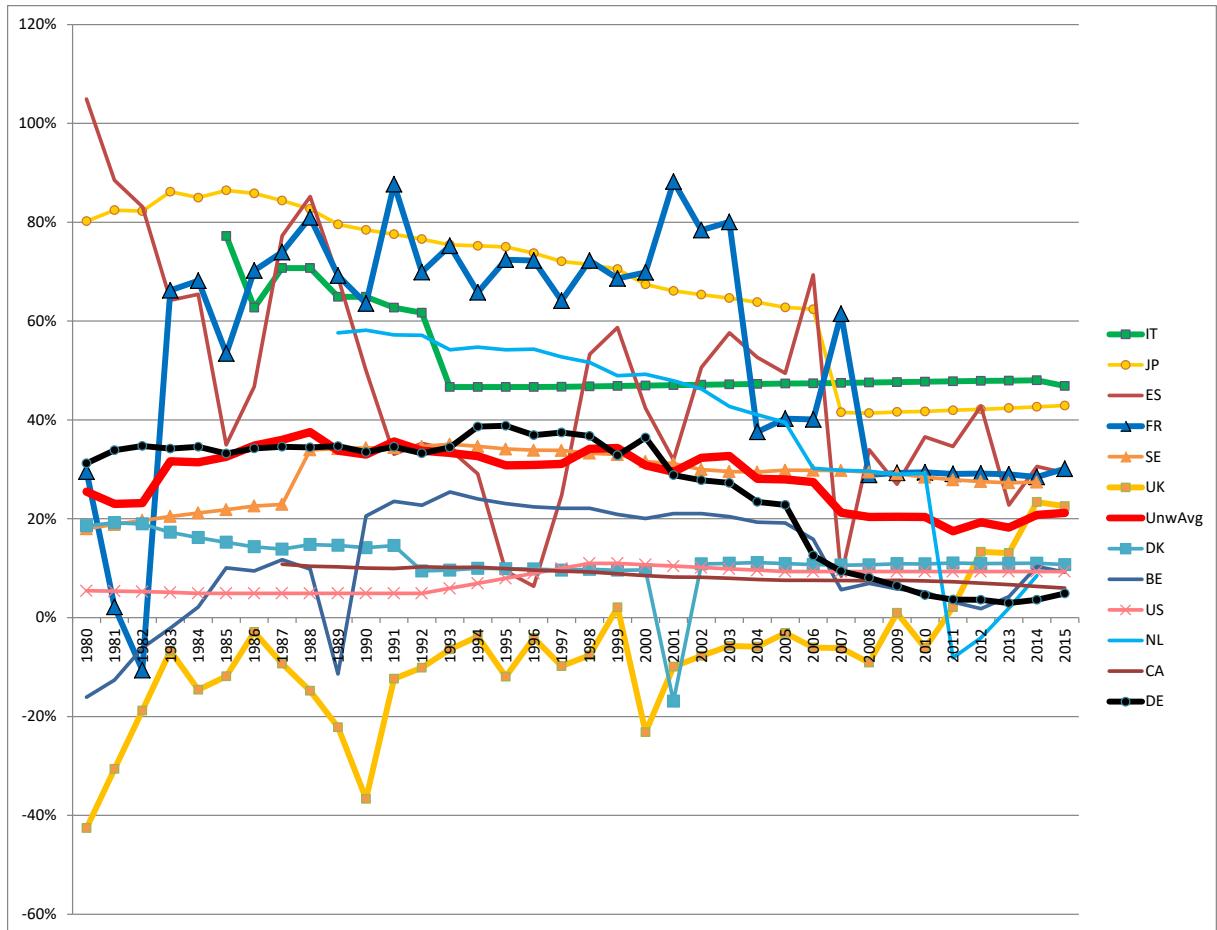
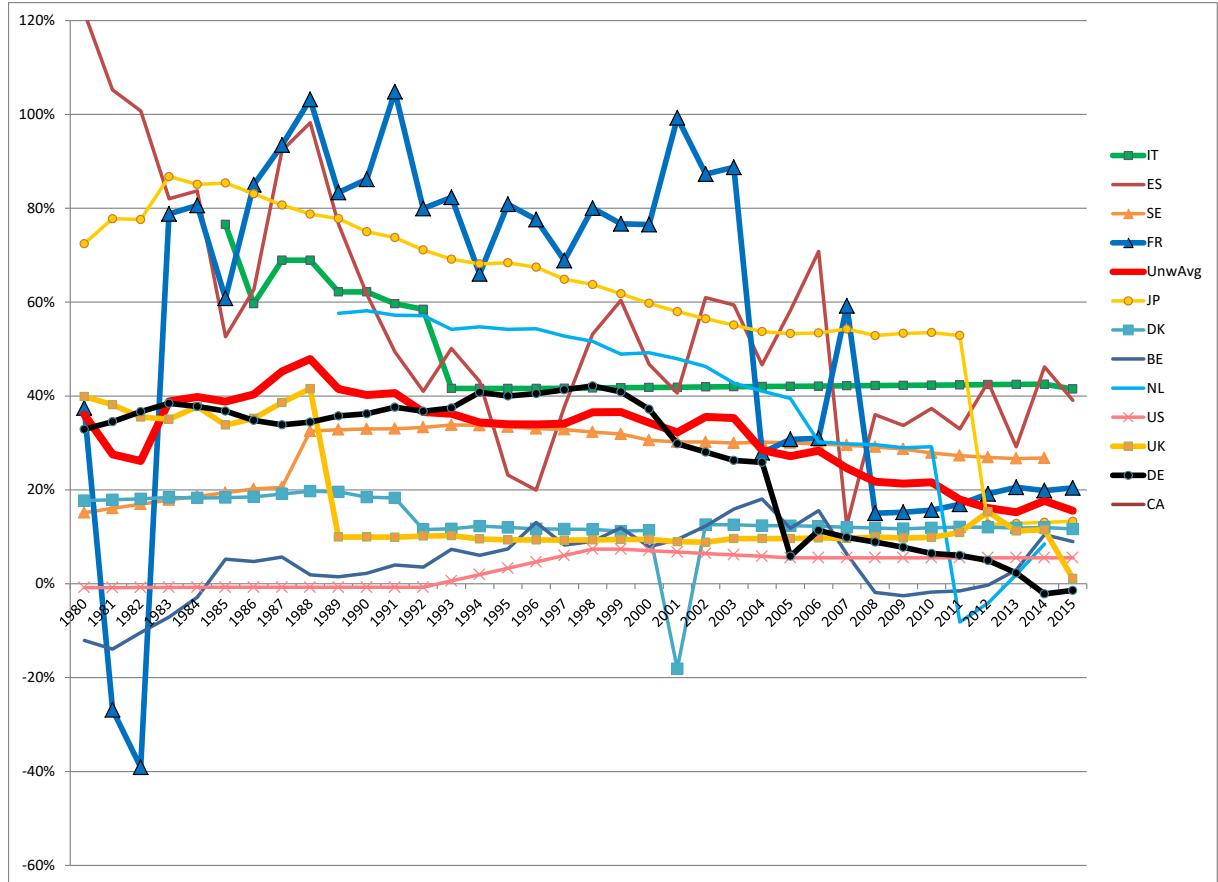


Figure 8 shows that the 12 countries described in this volume have very different initial starting values of the implicit tax on working longer at 62 but a common declining trend. In the late 1980s and early 1990s, the implicit tax was about 35% on average (unweighted mean across all countries). In France and Japan it was more than 75%, in Germany 35%, in the UK even negative. Despite this large heterogeneity, there was a common trend which has reduced the implicit tax substantially to only around 20% from 2007 onwards on average across the 12 countries, a decline of 43 percentage points. The decline is particularly steep for Germany from a tax of about 40% in 1995 to an almost neutral value in 2013.

Figure 9 displays the change of the implicit tax on working longer for a woman of age 62 with median education, earnings and life expectancy.

**Figure 9: Implicit tax on working longer at age 62, Women, 1980-2015**

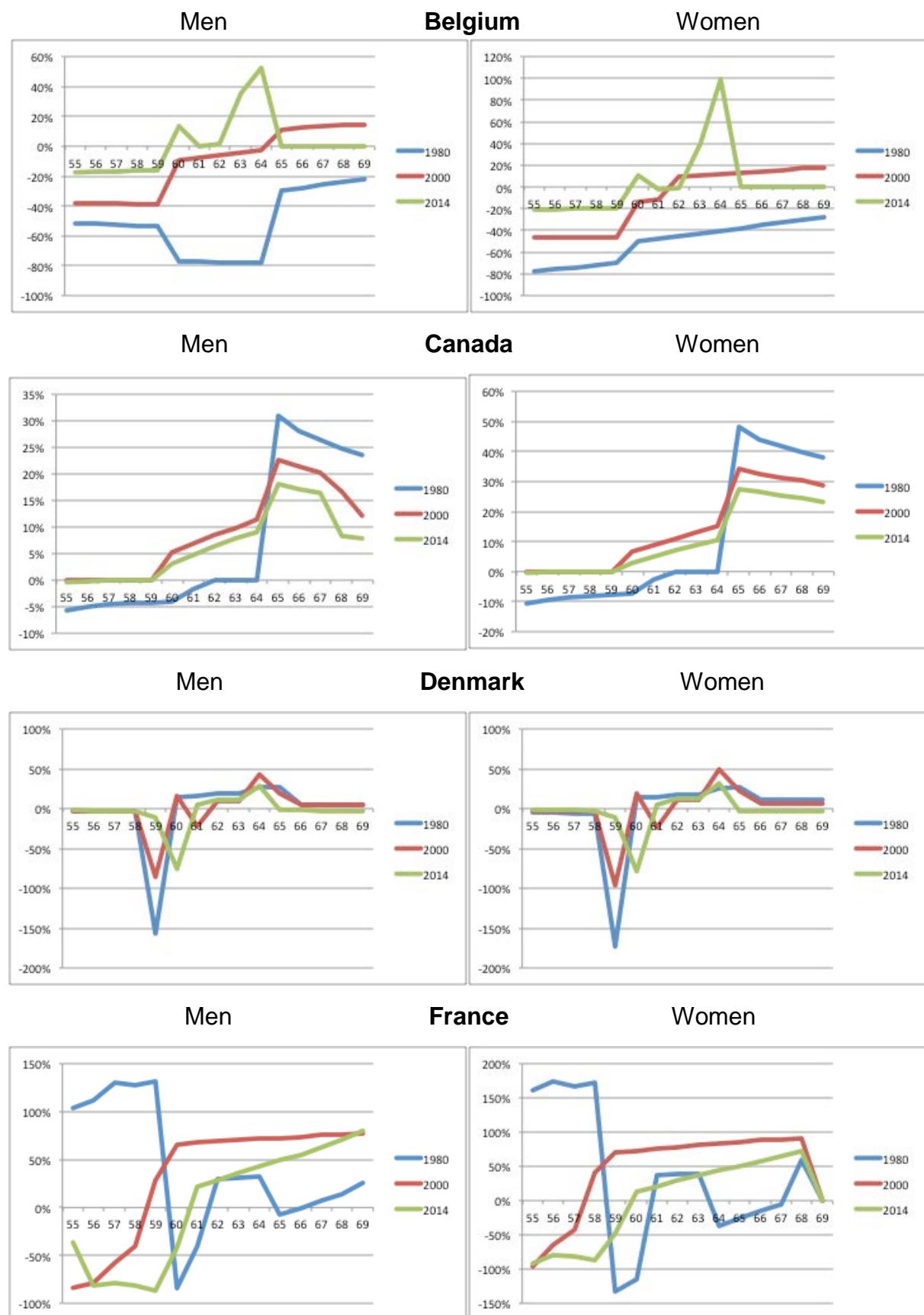


The implicit tax rates on working longer for women are similar to those for men. The decrease from 1980 to 2015 is a bit larger: the average tax rate across the 12 countries was almost 50% in 1988 and only 15% in 2015.

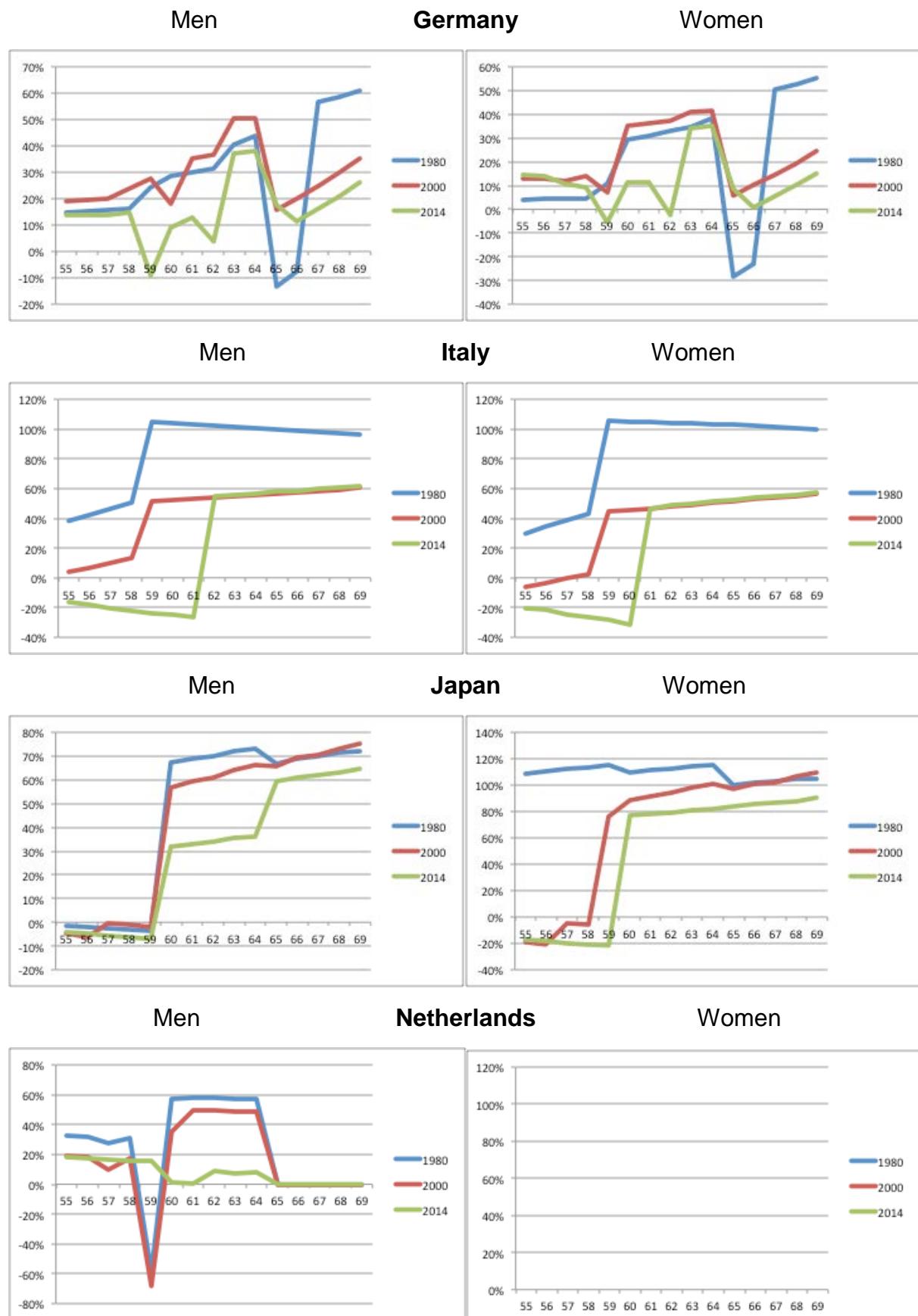
In Figure 10, we plot ITAX by age for each country, separately for men and women, in order to show the incentives to work across the full age range 55 to 69 (and not just at age 62, as in the previous figures). In most cases, the implicit tax on working longer rises with age, which is consistent with 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 compared 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.

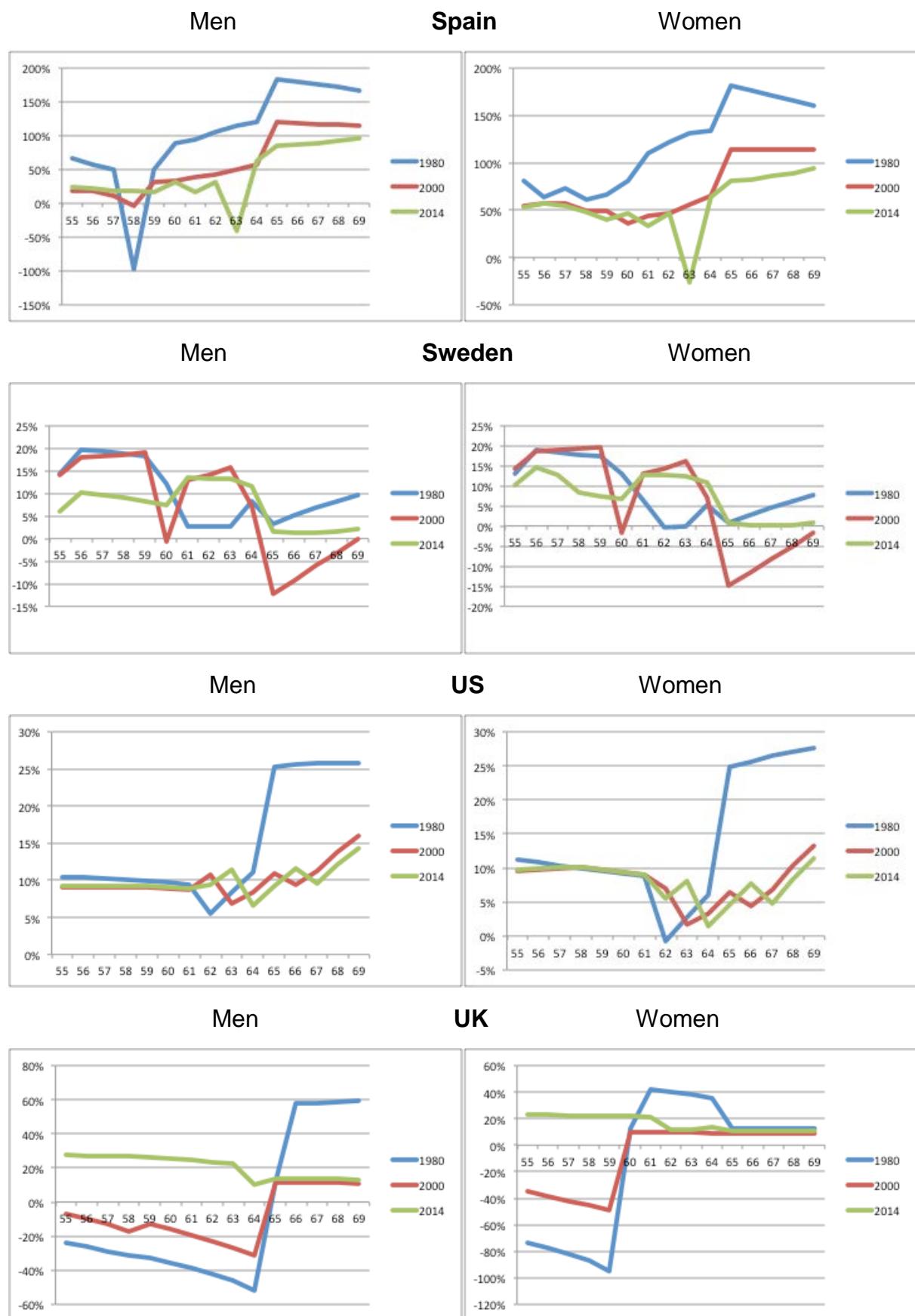
**Figure 10: Implicit tax on claiming later by claiming age, country, and year**



**Figure 10: Implicit tax on claiming later by claiming age, country, and year**



**Figure 10: Implicit tax on claiming later by claiming age, country, and year**



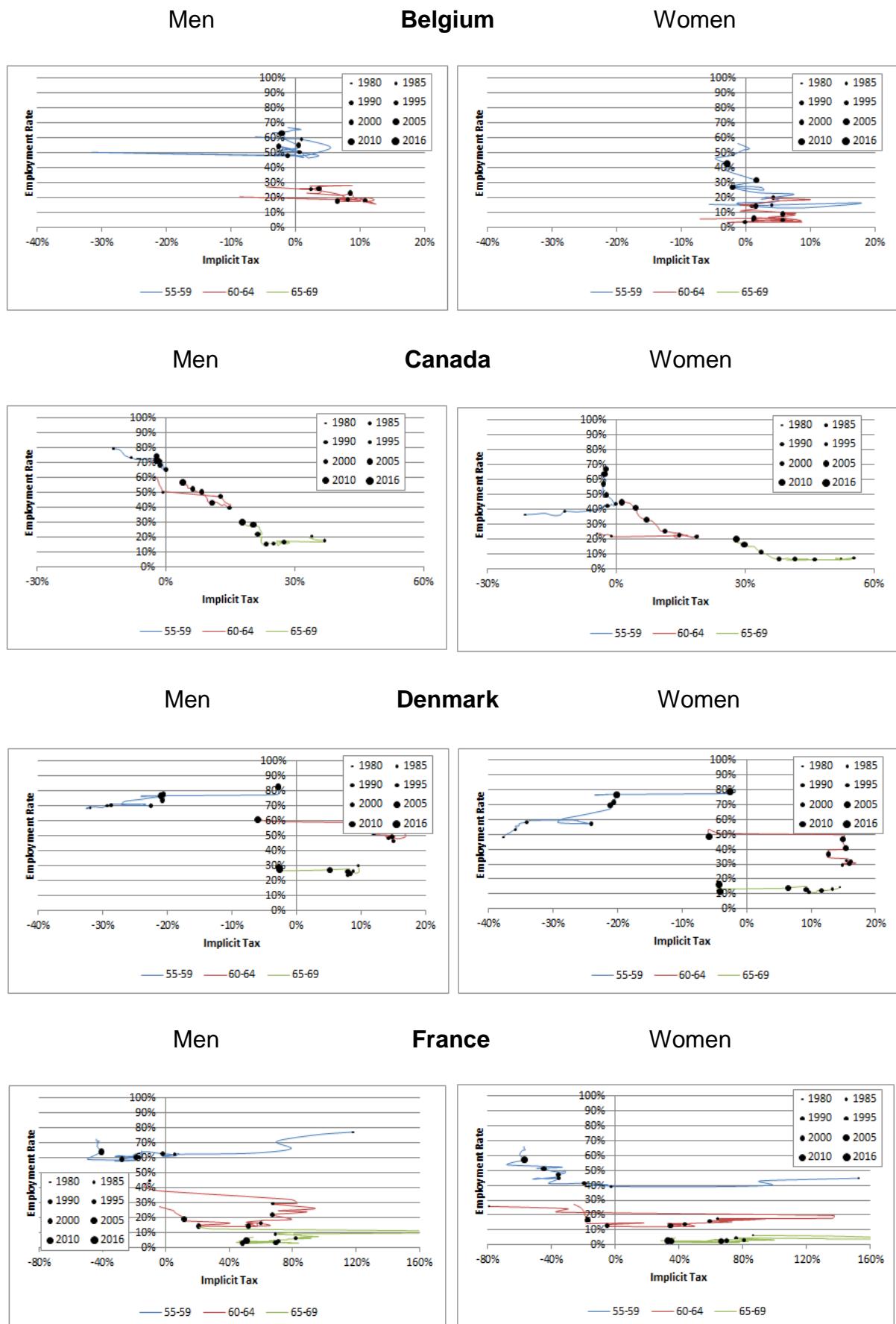
The country chapters show that incentives vary also with other socio-economic characteristics, e.g. education and the resulting earnings profiles. In this volume, we compute social security benefits and their implicit tax on working longer only for a small set of synthetic types of individuals that are 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.

#### **4. The association between employment and the implicit tax on working longer**

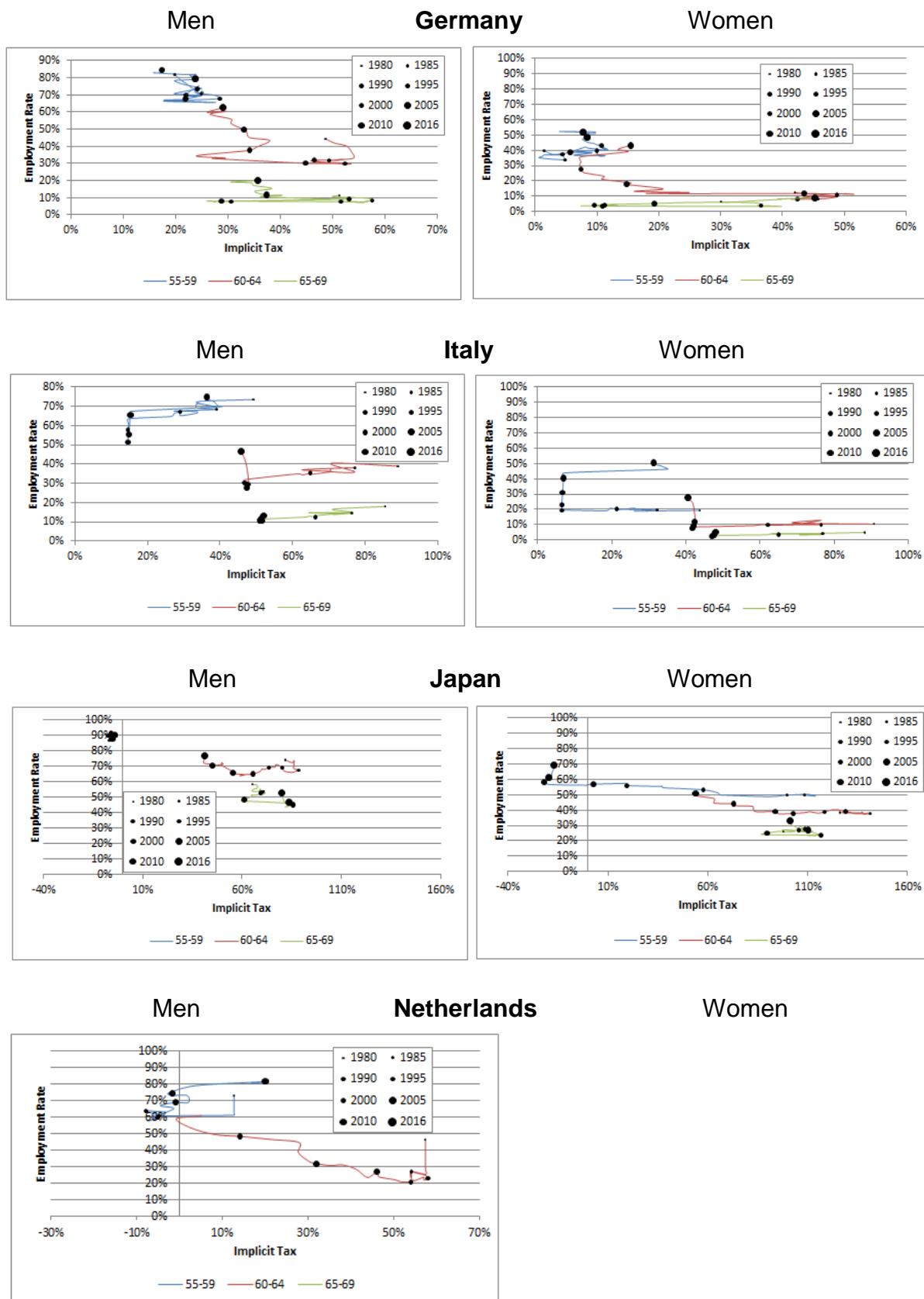
The last step of the analyses in the twelve country chapters is to juxtapose the changes in the incentive variable *ITAX* with the actual change in old-age employment. Figure 11 shows this for all participating countries, separately for men and women. Each panel has the employment rate for a specific 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 in different colors; 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 US women. This is the expected correlation: a higher implicit tax on claiming later and not contributing longer 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 8 and 9, has made working longer more attractive again.

Not all countries exhibit such systematic associations as seen in the above four 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 as changes in the earnings tests and changes in labor regulations. 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 other factors than social security regulations, e.g., employment in Spain suffered most from the financial crisis among our twelve countries.

**Figure 11: Employment rate versus implicit tax rate, 1980-2015**



**Figure 11: Employment rate versus implicit tax rate, 1980-2015, continued**



**Figure 11: Employment rate versus implicit tax rate, 1980-2015, continued**



Nevertheless, the overall evidence is quite clear. Table 2 summarizes the data in Figure 11 by a set of country-specific linear regressions, separately for men and women and by 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 life-time income effects. We also include dummies for the three education groups. Table 2 only reports the 48 coefficients and their t-statistics relating to ITAX that have been obtained from the 48 country-specific regression equations. Two thirds of the coefficients are negative and almost half are negative and statistically significant at the conventional level ( $p<0.01$ ).<sup>2</sup> The results are much stronger for the younger age range (age 60-64) for both women and men.

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

	Men				Women			
	Age 60-64		Age 65-69		Age 60-64		Age 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.

Condensing the evidence even further, Table 3 provides a pooled regression across all countries and the entire observation period, again separately 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 2; in addition, we included country fixed effects to account for the different levels of employment in the 12 participating countries. Table 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

<sup>2</sup> There 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.

to work longer and the employment rate in the younger age range (age 60-64). Increasing the implicit tax on working longer from 0% to 100% reduces the employment of older men by 6.7 percentage points in the early retirement phase, for women by 4.6 percentage points. The effect is much smaller in the older age range (age 65-69) (1.8 and 0.3 percentage points for men and women, respectively) and is insignificant for women. 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 – in the US.

**Table 3: Overall regression of employment rates on implicit tax rates**

	Men				Women			
	Age 60-64		Age 65-69		Age 60-64		Age 65-69	
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
ITAX	<b>-0.067</b>	<b>-7.0</b>	<b>-0.018</b>	<b>-2.6</b>	<b>-0.046</b>	<b>-5.8</b>	<b>-0.003</b>	<b>-0.6</b>
SSW	<b>-0.067</b>	<b>-2.0</b>	<b>0.042</b>	<b>2.2</b>	<b>0.201</b>	<b>4.3</b>	<b>0.070</b>	<b>3.6</b>
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	1301		1264		1194		1156	
R-squared	<b>0.981</b>		<b>0.978</b>		<b>0.957</b>		<b>0.951</b>	
Mean employm	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.

In conclusion, there is suggestive evidence for the expected negative association between old-age employment rates and implicit taxes on working longer. The correlations, however, should be interpreted with care. While they suggest a causal influence of incentives on retirement behavior, there are also competing explanations that need to be ruled out. For instance, the underlying populations are heterogeneous and their composition may have changed. Moreover, many macroeconomic changes took place over the four decades considered. The next step in this project is therefore to employ micro data in a formal regression analysis which will take care of other changes over time.

## 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 2016. In the late 1980s and early 1990s, the implicit tax on working longer was about 35% 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%, in Germany 35%, in the UK even negative. Despite this large heterogeneity, there was a common trend which has reduced the implicit tax substantially to only around 20% from 2007 onwards 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% in 1988 and only 15% in 2015.

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 of them negative and statistically significant. The results of a pooled regression are even stronger and show a statistically significant and economically strong relation between the incentive to work longer and the employment rate for men and for younger women. Increasing the implicit tax on working longer from 0% to 100% 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.

Overall, our findings in this volume support the hypothesis that social security reforms over the past several decades have strengthened the incentives for 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.

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## Appendix: Methodology

The twelve country teams have set up social security benefit calculators (Section A1) which 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 socio-economic characteristics such as sex, marital status and education. They are defined in Section A3.

### A1: Computation of *ITAX*

Section 3 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  $R$  onwards:

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

where  $B_{k,t,a}(R,i)$  is the after tax benefit from 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 socio-economic 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. In eligibility for a pathway is modeled by setting  $B_{k,t,a}(R,i) = 0$ .

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:

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

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

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 less. The accrual of social security wealth

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

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:

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

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 which 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 single dimension of  $ITAX$  permits 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:

**Figure 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	$x(55,2015,i,k)$	$x(56,2015,i,k)$	...	$x(68,2015,i,k)$	$x(69,2015,i,k)$

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-old worker of type  $i$  under the pension rules that have been legislated in 1980.

## 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 A1 represents the *implicit tax of 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 which disallow earning more than  $Y_{test}$  and/or by clawback rules in the benefit calculation which tax earnings while receiving benefits at a high rate  $\tau$  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 US and 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 non-retiring 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 ( $Y_{\text{test}} = 0$  and  $\tau = 100\%$ ), this is also the implicit tax of 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 abolished a strict earnings test.
- In the general case ( $Y_{\text{test}} > 0$  and  $\tau < 100\%$ ) 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  $Y_{\text{max}}$  is the maximum allowable net labor income while receiving benefits, i.e. 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

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

Set relative to potential earnings, the resulting incentive variable is

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

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

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 how the weights have evolved over time.

### A3. Definition of synthetic “types”: socio-economic characteristics

We compute separate matrices for a low skill/education worker (in countries without skill data: 50% of median income), a medium skill/education and a high skill/education worker (alternatively: 200% 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% of median income, median income, and 200% of median income

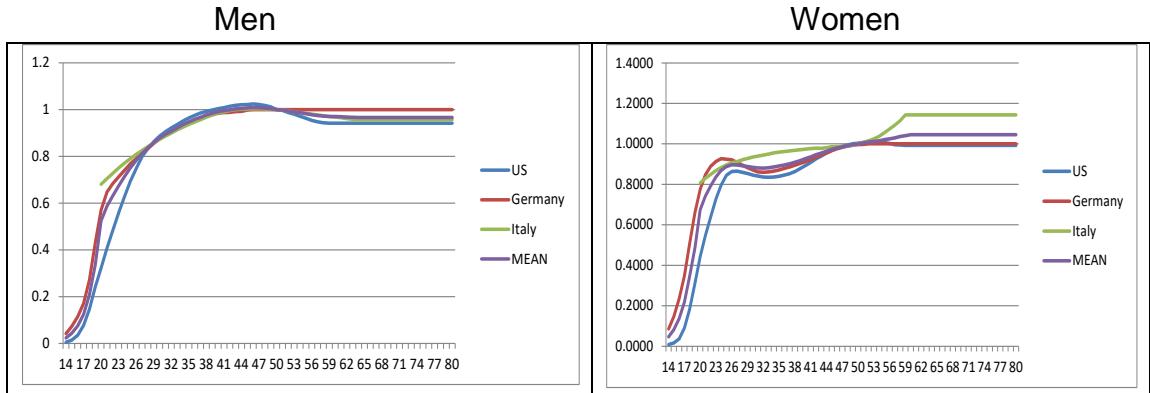
The case of couples retiring at different ages can become very complex. To keep matters simply, we focus on a male (female) who is married to a partner 3 years younger (older) of the same skill/education type. We assume that the spouse's retirement behavior is fixed, i.e., will not react to the own retirement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

### 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 smoothed 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 12 depicts the average across all skill/education groups:

**Figure 12: Common earnings profiles**



(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.

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 which exploits all available information on individuals' earnings histories, based on regressions of the form:

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

where  $Y_t$  is 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, etc.

AGE is age, AGESQ is its square

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 is 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 etc. 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 level. In addition, some country teams added analyses based on country-specific profiles, e.g., used median age of labor force entry in their national data for that type of worker.

## **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, i.e., income taxes, mandatory social contributions etc.

Common approach: We used constant and flat tax rates provided by the OECD. They are the average tax rates on gross labor income incl. 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) which included the preferred tax treatment of pension benefits. Other country teams used simpler alternatives, e.g., applied statutory tax rates stratified by household type and income bracket.

## **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 Eurostat which refers to the EU28 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 which is 3 years higher (lower) to reflect the difference in life expectancy across the three income categories. This adjustment is a mixture of a proportional increase (decrease, resp.) 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 alive at every future age (56-100) when he/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.

#### **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 which are important for consistency between the country papers. Table G1 lists common terms. Where it is impossible to harmonize the terms, there are country-specific technical terms displayed in Table G2 further below.

Terms in *italics* refer to other terms which are defined in the Glossary.

**Table 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 <i>social security program</i> .
Earliest eligibility age	The earliest eligibility age is defined as the age at which <i>early retirement</i> through a <i>social security program</i> is possible, mostly with reduced benefits.
Early retirement	Early retirement is the practice of claiming benefits from a <i>social security program</i> before an individual reaches the <i>statutory eligibility age</i> . Early retirement is possible after attaining the <i>earliest eligibility age</i> 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 <i>statutory eligibility age</i> ). Early retirement benefits are typically reduced relative to the benefits available at the <i>statutory eligibility age</i> .
Earnings tests	Earnings tests limit the amount of earnings that can be received by an individual who receives benefits from a <i>social security program</i> . Earnings tests often apply only before the <i>statutory eligibility age</i> or are stricter before than after this age.
Implicit tax rate	The implicit tax rate is the negative of the change in <i>social security wealth</i> 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	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 <i>social security program</i> , a broader term that encompasses other public transfer programs.
Partial ("flexible") retirement	Partial ("flexible") retirement schemes are models which permit individuals to access benefits from a <i>social security program</i> and continue working part-time in order to make a gradual transition from full-time work to full retirement possible.
Retirement age	To be avoided because it is ambiguous whether claiming age or labor force exit age is meant.
Social security program	Social security programs encompass <i>old-age pension</i> (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 <i>social security program</i> is the present discounted value of all future benefits from this <i>social security program</i> .
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 <i>early retirement</i> benefits.

**Table 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 <i>statutory eligibility age</i> after fulfilling both a minimum contribution history and the <i>earliest eligibility age</i> .	France, Germany
Social Security	This is a specific US terminology. While the term social security in Europe (in lower case spelling) refers to many branches of the welfare system, including also health and unemployment insurance, the term in the US (now capitalized) refers to old age and disability benefits only.	US
State pension age	This is a 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