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REFORMS, INCENTIVES AND FLEXIBILIZATION

Five Essays on Retirement

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To my parents

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Contents

List of abbreviations

AEA	Average exit age
DC	Defined contribution
DB	Defined benefit
DRV	*Deutsche Rentenversicherung Bund*
EEA	Earliest eligibility age
EP	Earnings points
FRA	Full rate age
GDP	Gross domestic product
GRV	*Gesetzliche Rentenversicherung*
GSOEP	German Socio-Economic-Panel
ISSP	International Social Security Project
ITAX	Implicit tax on working longer
LFP	Labor force participation
NBER	National Bureau of Economic Research
OECD	Organization for Economic Co-operation and Development
PAYG	Pay-as-you-go
pp(s)	Percentage point(s)
SEA	Statutory eligibility age
SHARE	Survey of Health, Ageing and Retirement in Europe
SSW	Social security wealth
SUF	Scientific use file
TLS	Total labor supply
VSKT	*Versichertenkontenstichprobe*
WH	Working hours

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1. Reforms, Incentives and Flexibilization: General Introduction

Demographic change is one *megatrend* of the twenty-first century.[1] Demographic change holds the potential for substantial social, political and economic change around the world throughout the next decades. Most industrialized countries currently undergo such a change in demographic patterns which is mainly caused by two developments: First, life expectancy has substantially risen in almost all parts of the world. Second, low fertility rates have evolved since the 1970s, even if there is some variation across countries. Both developments taken together have led to aging populations in many countries. At the same time, the average retirement age in industrialized countries declined throughout most of the twentieth century. In combination, these developments put enormous pressure on pension systems, many of which have proven to be financially unsustainable. In particular, an aging population jeopardizes Pay-as-you-go (PAYG) pension systems where the contributions of current employees finance pension benefits of current pensioners. This has caused a long-lasting debate on how to make old-age provision systems more sustainable (see e.g. Gruber and Wise 1999, 2004). Most governments in developed countries have implemented fundamental pension reforms in order to stabilize the pension systems.[2]

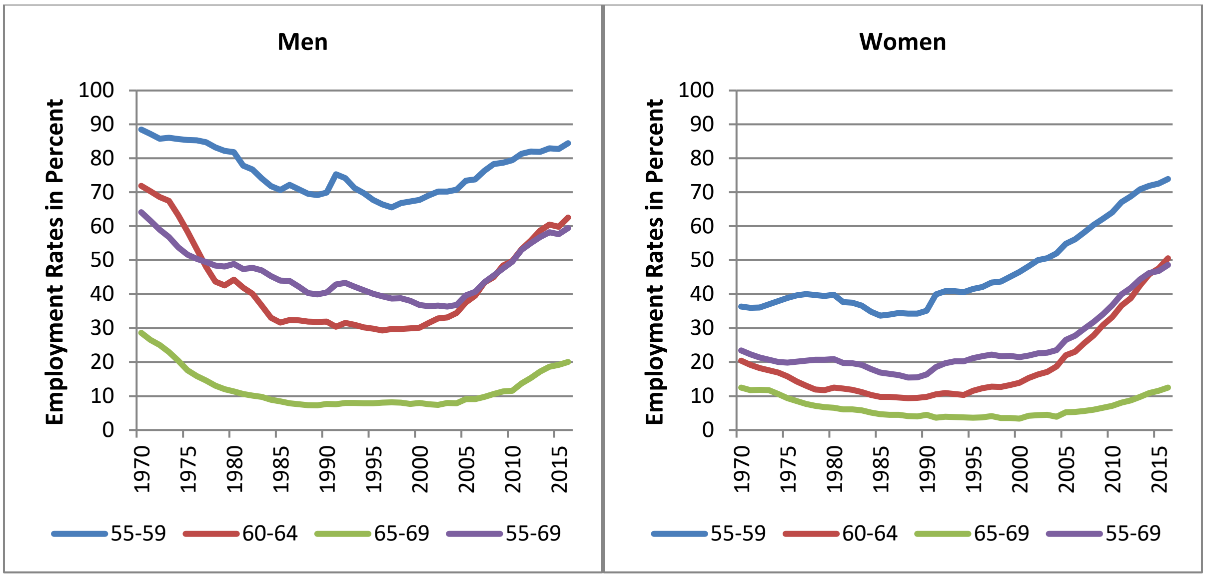
Germany is in particular confronted with demographic change. While life expectancy is constantly increasing, the country experienced an extraordinary sequence of large birth cohorts born in the second half of the 1950s and the 1960s (*baby boomers*) and subsequent low fertility rates since the 1970s.The slightly increasing birthrates in the last years will overall not be able to counteract

[1] John Naisbitt, a futurologist and best-selling author, coined the term *megatrend* for long-term processes of transformation with a broad scope and a fundamental impact. See, e.g., Naisbitt (1982) and Naisbitt and Aburdene (1990).
[2] The extent of those large reform efforts around the globe are for instance described in the country chapters in Börsch-Supan and Coile (2019) presenting in great detail the reform process in 12 Western industrialized countries over the past almost four decades. Besides, Barr and Diamond (2010) give an introduction to the economics of pension reforms.

population aging. Moreover, the baby boomers will reach eligibility ages for pension benefits over the next years, which leads to one million individuals more retiring within the next five years in comparison to the last five years. Already in the near future, this will dramatically change the ratio between the working age population and pension benefit recipients. However, there will not be demographic easing in the longer run either: The old-age dependency ratio – the number of individuals aged 65 and over per 100 people in the working age (aged 20 to 64) – will almost double from 35.3 in 2015 to 65.1 in 2050 (OECD 2015).

The German public pension system (*Gesetzliche Rentenversicherung*) is organized as PAYG system and features a very broad coverage. About 85% of the German workforce are part of the system.[3] For most insurants pension benefits from the public pension system form the most important source of income in old age. Therefore, the financial imbalance of the public pension system is particularly alarming.

Figure 1.1: West German employment rate by age group and gender



Source: Own calculations based on OECD (2018a), *Statistisches Bundesamt* (German Federal Statistical Office) (2016), see also Chapters 2 and 3.

[3] Chapter 2 and Chapter 3 of this dissertation will present in detail the history of the German public pension scheme, the core features and a comprehensive analysis of the reforms process which has taken place over time.

While demographic change has constantly continued in Germany, working later in life has been undergoing a remarkable change throughout the last decades (see Figure 1.1). The employment rate of older men experienced a long declining trend that began in the early 1970s. Since about 2000, employment rates of both older men and older women have been stunningly increasing. For males, the overall picture shows a U-shaped pattern with a reversal at the end of the 1990s. The employment rates of women aged 55 to 59 experienced a rather constant increase and a mild reversal for the older age groups. Whether the recent increase in employment rates of older workers can help to permanently reduce the negative consequences of aging on fiscal sustainability depends on whether the trend will continue. Consequently, it is important to understand the causes for this recent increase.

Promising candidates for an explanation of the trend reversal are secular developments like younger cohorts with improved health and better education, and the different role of women in society. However, previous literature has shown that these developments have contributed surprisingly little (Coile et al. 2019 for an overview; Börsch-Supan and Ferrari 2019 for Germany). Hence, the causes of the trend reversal have to be found elsewhere. Another promising explanatory factor could be found in institutional changes such as reforms of the pension system. After the pension reforms in Germany in the 1960s and 1970s had led to one of the world's most generous public pension systems, the acknowledgement of demographic change initiated a series of reforms meant to foster the sustainability of the system in times of demographic pressure. The most important reform measures aiming at more sustainability were:

- Introduction of actuarial adjustment factors for early retirement
- Increase of eligibility ages for drawing pension benefits
- Abolishment of pathways to early retirement
- Introduction of a self-regulating factor in the pension adjustment formula that links the benefits to the system's dependency ratio ("sustainability factor")
- Introduction of flexible retirement options

Recently, however, the reform process toward a sustainable public pension system ended and Germany experienced a phase of reform backlashes. "Bridges to early retirement" outside the public pension system were strengthened and new and generous early retirement options inside the public pension system were created which already have led to behavioral responses. For instance, the 2014 reform increased the generosity of a specific early retirement pathway for individuals with long insurance careers by reducing the eligibility age for full pension benefits from 65 to 63 ("retirement at 63"). The reform aimed at individuals who have worked in burdensome employment for many years (Deutscher Bundestag 2014). Dolls and Krolage (2019) showed that individuals who are eligible for the generous early retirement pathways claim benefits on average 5.4 months earlier than non-eligible individuals with identical characteristics. Moreover, they illustrated that the reform involves enormous additional costs for the pension system.[4]

This dissertation aims at investigating the role of structural policy changes in explaining the employment trend reversal of older individuals. The reforms have constantly altered the incentives to stay in the labor force and to claim pension benefits, respectively. The first central objective of the dissertation is to analyze how these reforms have influenced retirement incentives over time and consequently, whether they have set the stage for increasing employment rates. The second aim is to investigate how much of the German trend reversal in employment rates later in life can be attributed to these varying retirement incentives. This eventually reflects the collective effect of the many reforms.

Turning away from the conglomeration of reforms and focusing on one specific reform device, the third central aim of the dissertation is to examine the role of flexibilization in connection to retirement choices and labor supply decisions of older individuals. Not only in Germany but also in other countries flexible retirement options have been enacted as part of reform processes. The idea of flexible retirement is to insert a transition period with reduced work effort between the phases of full-time employment and full retirement. The income loss resulting from the work reduction is supposed to be compensated by drawing (partial) pension benefits or by other compensatory sources (e.g. governmental subsidies, unemployment insurance funds, occupational pension funds etc.). One objective of flexibilization has been to better tap into the pool of older workers in order to increase the number of contributors to the pension system. For policy makers, flexible retirement appears to be an elegant alternative to increasing eligibility ages for claiming pension benefits, which is usually not a very popular policy. In contrast, flexibilization may have intuitive appeal as

[4] Börsch-Supan et al. (2019a) analyze the targeting success of the generous early retirement pathway ("retirement at 63"). They find that those individuals who are eligible for the generous early retirement pathway are on average not in worse health in comparison to a group with a similar working career but which does not qualify. This contradicts the intended aim of the policy. In addition, the authors examine a reform on disability insurance and the potential target quality of a recent reform on supplemental pension benefits which will come into effect on January 1st 2021 (*Grundrente,* see Deutscher Bundestag 2020). Ye (2018) has shown that an earlier reform on supplemental pension benefits implemented in Germany in 1992 induced female recipients to claim pension benefits earlier. Future research has to show whether the recent reform (*Grundrente*) will also lead to earlier claiming dates.

increasing the flexibility of retirement seems beneficial on paper. This dissertation scrutinizes this assessment by investigating flexible retirement reforms enacted in different OECD countries between 1992 and 2006. The central question in the analysis is whether these reforms could actually help to ease the burden of demographic change by strengthening the labor supply of older workers. In the final chapter of the dissertation, I examine the role of pension systems in fostering or hampering working pensioners across European countries. The term “working pensioner” refers to individuals who combine pension income and income from work at the end of their working career to aim at a more flexible transition into retirement.

Following this general introduction, the dissertation comprises five chapters: While the first two chapters focus on public pension *reforms* and retirement *incentives* in Germany, the latter three chapters employ an internationally comparative view to study the effect of *flexibilization* in the retirement process.

The tool for investigating structural policy changes in Germany from 1980 to 2015 is the calculation of time series for the “implicit tax on working longer” (ITAX). ITAX is a well-known incentive measure and collapses various dimensions of social security policy into a single dimension. Following Börsch-Supan and Coile (2019), the single dimension has both advantages and disadvantages: On the one hand, the single ITAX variable can easily display associations between policy and outcome variables such as employment rates. On the other hand, this comes at the risk of oversimplification: Social security policies may be too complex for ITAX to comprise potential inconsistencies that are masked by this one-dimensional measure.

In Chapter 2, ITAX time series are calculated based on aggregate data and for stylized model households to then relate ITAX rates to the changes in employment rates and pension benefit claiming behavior over the same study period. However, the correlations between these synthetic numbers and employment rates do not control for the many other potential explanatory factors and the heterogeneity in the population. Therefore, Chapter 3 uses survey data and the exogenous policy changes to draw causal inference on the effect of public pension rules on labor supply choices at older ages.

Overall, this dissertation contributes to the literature studying older individuals’ labor market responses to varying incentives in the old-age security system. Chapters 2 and 3 are closely related to the work done by Gruber and Wise (1999, 2004), who investigated the effect of retirement incentives on the downturn of labor force participation of older individuals by the end of last century. They found that retirement incentives had a strong effect on retirement decisions. More recent empirical literature has shown that specific reform devices have changed individual labor force behavior of older workers and evaluated for instance the reform effect of the introduction of actuarial adjustments for early retirement (Hanel 2010, Engels et al. 2017, Giesecke 2018), the increase of the statutory eligibility age (Hanel and Riphahn 2012), the increase of the earliest eligibility age for early retirement (Geyer and Welteke 2017 and Geyer et al. 2020), a reform on disability insurance (Hanel 2012), or whether in Germany the 2006 unemployment insurance reform affected older workers' labor market transitions (Riphahn and Schrader 2019). These investigations found that the reforms have led to substantial reactions of older individuals' labor market behavior, albeit at varying magnitudes. The key novelty of Chapter 3 lies in investigating the effect of primarily public pension reforms on retirement and employment choices at older ages over almost four decades with a considerable reversal of employment rates and several structural policy changes. Chapter 2 sets the stage for this effort by constructing the machinery that can be applied in the analyses of longitudinal developments then. However, limitations and questions for future research remain (see Chapter 1.6 "Closing Remarks").

The remaining Chapters 4, 5, and 6 focus on flexible retirement: In Chapter 4, a model of a stylized flexibility reform is established to provide the theoretical reasoning of flexibilization within the retirement process. The chapter also includes an empirical analysis of different flexibility reforms by, *inter alia,* using the synthetic control method. Chapter 5 takes a more comprehensive review of this method and contains a validation of the results of Chapter 4. Eventually, Chapter 6 deals with the role of pension systems in explaining working pensioner shares across European countries.

Chapters 4 and 5 thus contribute to the existing literature by assessing the effectiveness of flexible retirement reforms. There is overall not much research on this topic, especially not when it comes to cross-country studies. Previous work has focused on the reform effects of a particular reform in a specific country (see e.g. Graf et al. 2011 for evidence on Austria, Huber et al. 2013 for evidence on Germany, Ilmakunnas and Ilmakunnas 2006 for evidence on Finland, and Brinch et al. 2015 for evidence on Norway). By way of contrast, this chapter employs an internationally comparative view to study the effect of different flexibility reforms. Moreover, Chapter 4 provides the theoretical reasoning by establishing a model of a stylized flexibility reform. Further, a particular novelty of the empirical analysis lies in estimating the reform effect on total labor supply, measured as the product of labor force participation (extensive margin) and working hours of older workers (intensive margin). The distinction between the intensive and the extensive margin in an international context is an important feature of this chapter that eventually makes it stand out from the literature. Most of the previous studies have focused on the effect on labor force participation only. However, the relevant factor for the financial base particularly of PAYG pension systems is total labor supply.

One method in the empirical analysis is the synthetic control method, which has been more and more applied in the literature in particular over the last 15 years. To evaluate the significance of the estimates, placebo tests are conducted. Taken Chapters 4 and 5 together, this dissertation adds to the very few studies to date that compares the results of exploiting two different placebo dimensions ("space" and "time").

Finally, Chapter 6 adds to the few existing cross-country studies on working pensioners. The chapter contributes by, first, employing an internationally comparative view on the determinants of being a working pensioner and the variation across countries in Europe. Second, the investigation explicitly integrates the pension system into the analysis. To the best of my knowledge, none of the existing cross-country studies so far have done so.

The dissertation contains to a large extent empirical analyses based on different data. While Chapters 2, 4, and 5 are based on data by the German Statutory Pension Insurance Scheme *(Deutsche Rentenversicherung Bund)* and on aggregate macro data from various sources, Chapters 3 and 6 mainly use survey data. Chapter 3 uses data from the German Socio-Economic Panel (GSOEP), which started in 1984. This comparably long time horizon facilitates exploring the trend reversal of employment rates of older individuals. Chapter 6 uses data from the Survey of Health, Ageing and Retirement in Europe (SHARE), a multidisciplinary and cross-national panel database of individuals aged 50 and above. SHARE covers micro data on individuals in 27 European countries and Israel. The cross-national survey character is explicitly opportune for cross-country studies like the analysis of working pensioners in Europe in Chapter 6.

In the course of my research I had the good fortune to cooperate with several other economists. Chapters 2 to 4 are co-authored with current colleagues at the Munich Center for the Economics of Aging (MEA) or MEA Fellows. In addition, Chapters 2 and 3 are part of the International Social Security Project under the auspices of the National Bureau of Economic Research (NBER) based in Cambridge, Massachusetts. Chapter 2 is the country chapter of the ninth phase and Chapter 3 of the tenth phase of this long-term international research program. The project involves researchers from 12 Western industrialized countries (nine countries of the European Union, the United States, Canada and Japan) and was founded by Jonathan Gruber and David Wise. It is now led by Axel Börsch-Supan and Courtney Coile. The key objective of the project is to use the vast differences in social security programs across countries as a natural laboratory to study the effects of retirement program provisions on several questions related to the older workforce.

In the following, I will briefly outline the five respective articles which compose the remainder of this dissertation. The appendix contains additional material referred to in the chapters. The complete bibliography concludes this dissertation.

1.1 Social Security Reforms and the Changing Retirement Behavior in Germany

Joint work with Axel Börsch-Supan and Johannes Rausch

Objective. The objective of Chapter 2 is to examine the role of structural policy changes in explaining the trend reversal of older individuals' employment rates. We focus on West Germany and analyze the period from 1980 to 2015.

Methodology. The key concept in our analysis is the "implicit tax on working longer" (ITAX), an extensively used measure that captures monetary incentives to retire. To link the role of policy reforms to the employment trend reversal, we construct time series for ITAX from 1980 to 2015. Based on aggregate data, we compute ITAX rates for a set of synthetic individuals differing by gender, household demographics and education. We subsequently associate the ITAX numbers to the changes in employment rates and pension benefit claiming behavior over the study period.

Main findings. Our main finding is that for both men and women the increase in the employment rates coincides with a reduction in the early retirement incentives expressed by lower ITAX rates. The introduction of actuarial deductions for early retirement starting in the mid-1990s substantially decreased ITAX rates. Lower ITAX rates mean a reduction of early retirement incentives. The decreasing generosity coincides with the increasing employment rates at the beginning of the 2000s. We find similar correlations between the development of the implicit tax and actual pension claiming behavior. Overall, there has been a positive ITAX for almost all ages in the age group 55 to 69 ("retirement window") throughout almost the whole observation period with only very few exceptions. This means that there has always been an incentive to claim pension benefits early in nearly all periods.

This chapter has been published as a preliminary draft for the NBER book "Social Security Programs and Retirement around the World: Reforms and Retirement Incentives", Börsch-

Supan, A. and C. Coile (2019), forthcoming from University of Chicago Press. See Börsch-Supan et al. 2019b.

1.2 Retirement Decisions in Germany: Micro-Modelling

Joint work with Axel Börsch-Supan, Irene Ferrari and Johannes Rausch

Objective. The evidence in Chapter 2 is highly suggestive since the bivariate correlations do not control for the many other potential explanatory factors and the heterogeneity in the population. The objective of Chapter 3 is to conduct a much more elaborate multivariate analysis of the effect of public pension policies on retirement and labor force participation choices later in life.

Our main data source is survey data from the GSOEP. GSOEP was started in 1984 and we use waves up to 2015 included. With that, we can count on 32 consecutive years of data. This is particularly convenient for the current analysis as this time span includes the reversal of older men's labor force participation since around 2000. Furthermore, several pension reforms were implemented during these years, which provide variation in pension incentives necessary for the identification of our retirement model.

Methodology. We use the micro data and the exogenous policy changes to draw causal inference on the effect of public pension rules on employment choices at older ages. We construct, for each individual, time series of the implicit tax. These incentive variables, other macro variables and further determinants on the individual level then serve as explanatory variables in an econometric analysis. The outcome variable of interest is labor force status in old age. The variable takes the value zero if the individual is in the labor force and one when she/he is retired. We calculate predicted retirement probabilities for each sample person and how they have changed from 1985 to 2015. Subsequently, we compute counterfactual retirement probabilities, i.e., how retirement probabilities would have changed if no reforms had taken place after 1985. The difference between these counterfactual retirement probabilities and the predicted baseline probabilities can be interpreted as the causal effect of the pension reforms that took place between 1985 and 2015.

Main findings. Our main finding is that for men in couple households the predicted and counterfactual retirement probabilities begin to diverge after about the year 2000. This coincides with the introduction of actuarial adjustments for early retirement as legislated in the 1992 reform. In addition, our model credits an increase of about 0.3 years in the average retirement age to the public pension reforms that took place. The actual increase was around 1.5 years. This means that our model indeed relates less than the actual increase to the reform-driven change of the ITAX. One reason may be that the one-dimensional ITAX does not capture all dimensions that explain individuals’ retirement behavior.

This chapter is a preliminary draft for the NBER Book Series – International Social Security, forthcoming from University of Chicago Press. See Börsch-Supan et al. (2020a).

1.3 Dangerous Flexibility – Retirement Reforms Reconsidered

Joint work with Axel Börsch-Supan, Tabea Bucher-Koenen and Vesile Kutlu Koc

Objective. In order to reduce the negative consequences of an aging population on fiscal sustainability of pension systems, a common aim of governments around the world has been to strengthen the pool of older workers. However, increasing eligibility ages for drawing pension benefits is usually not a very popular policy. Therefore, many governments have implemented flexible retirement schemes that allow workers to gradually reduce work effort with increasing age. In this way, older workers should stay active at the labor market longer. Flexibilization may have intuitive appeal as more flexibility seems to always be a good thing. However, this chapter argues that these schemes are dangerous instruments because flexibilization can have ambiguous effect on total labor supply from a theoretical point of view. On the one hand, flexibilization is likely to increase labor force participation among older workers. On the other hand, it may decrease their working hours. Therefore, the effect on total labor supply is *ex ante* unclear and remains an empirical question.

Methodology. We first build a model of a stylized flexibility reform to show that the reform effect on total labor supply is *ex ante* unclear from a theoretical perspective. In an empirical analysis, we estimate the effect of the flexibility reforms on labor force participation, average weekly working hours and total labor supply of workers in the age group 55-64. We use aggregate time series data for a subsample of nine OECD countries, which introduced flexible retirement reforms between 1992 and 2006. We employ two different methods: We at first use pooled Ordinary Least Squares (OLS) to obtain an average effect of the flexibility reforms over all countries and time periods. To refine the investigation, we secondly apply the synthetic control method proposed by Abadie and Gardeazabal (2003) for each country individually.

Main findings. Our main finding is that the flexibility reforms enacted so far have failed to be an effective policy to increase total labor supply of older workers. Both econometric approaches yield similar results: Labor force participation of older men aged 55-64 has very little if at all increased in some countries and years due to the flexibility reforms. At the same time, older workers have decreased their weekly working hours. In sum, the reforms have produced zero to negative effects on total labor supply. We conclude that if the objective of these flexibility reforms was to increase labor supply of older workers, they have failed to reach this aim.

This finding is qualitatively in line with the results of Graf et al. (2011) for Austria. The authors found that the subsidized old-age part-time scheme (OAPT) introduced in 2000 led to an increase of the employment probability of one percentage point for males and 1.6 pps for females, respectively. Over a five year period, however, the treatment effect is significantly positive only in the first two years after individuals entered the OAPT. For the fourth and fifth year they even find negative effects. This results in a cumulative negative effect of OAPT on employment figures if one considers a five-year period. Moreover, they found that OAPT significantly reduces total hours worked. Once a four-year period is taken into account, employment in full-time equivalents are reduced by 29 pps for males and 25 pps (females), respectively.

This chapter has been published as an article in the journal 'Economic Policy' (2018, Vol. 33, Issue 94, pp. 315–355).

1.4 Dangerous Flexible Retirement Reforms – A Supplementary Placebo Analysis across Time

Objective. To study the effects of flexibility reforms on total labor supply, Chapter 3 introduced and applied the synthetic control method. The results in Chapter 3 are based on "in-space" placebo studies. Chapter 4 scrutinizes these results by applying "in-time" placebo studies.

Methodology. In the context of the synthetic control method applied to flexible retirement reforms the number of comparison units is small. Therefore, large sample inference techniques are problematic to comparative case studies. To perform inference, Abadie and Gardeazabal (2003) proposed placebo studies. Using the time dimension means an artificial reassignment of the flexibility reforms to placebo reform dates earlier than the actual reform year. The rationale behind this exercise is the following: If I found significant effects assigned to dates when the reform did not actually happen, the confidence in the result of Chapter 3 would diminish.

Main findings. The supplementary analysis reveals that the results found in Chapter 3 are valid to this robustness check. Overall, the supplementary analysis sustains the result that the reforms have produced zero to negative effects on total labor supply. The synthetic control method requires a large amount of data thus making data availability the key challenge for the application of the method.

1.5 Working Pensioners in Europe

Objective. Over the past decades, many countries in the European Union have made it easier for pensioners to combine pension benefits with work income. However, working pensioners are not a broad phenomenon in Europe, even if previous survey evidence revealed that substantial shares of individuals prefer flexible retirement. The objective of Chapter 6 is to find explanations for the mismatch between what workers wish and standard labor market theory predicts on the one side, and low take-up rates of flexible retirement schemes on the other side.

Methodology. The empirical analysis in Chapter 6 follows a two-step procedure: First, I study variable sets that determine whether individuals actually decide to become working pensioners. In the second step, I investigate which of those variable sets explain variation across countries by applying counterfactual simulations. The counterfactual simulations are executed with specific sets of variables (i.e. demographics, health, economic variables, pension system) which are set to the average across all countries. This way, I predict working pensioner shares as if everybody had the same average characteristics in a specific set of variables.

The main data source is Wave 6 data from SHARE. Additionally, I use detailed information on characteristics of the pension systems in the 13 countries under investigation. Moreover, I use macro data from the OECD’s database to control for the economic situation.

Main findings. The regression analysis reveals that demographic variables, health variables, economic variables as well as the pension system are important determinants for individuals’ choice of a flexible transition into full retirement at the end of their working career. Applying counterfactual simulations reveals that variation in working pensioner proportions between countries can be explained by economic differences as well as differences in pension systems. The results indicate that countries with more flexible pension systems exhibit higher working pensioner shares. Therefore, systems that are more flexible facilitate what individuals have reported as their preferences.

1.6 Closing Remarks

Demographic change promises both risks and opportunities in many countries around the world. To be prepared for the social, political and economic changes that come with it, it is essential to understand the consequences of demographic developments. In the near future, aging populations will steadily weaken the ratio of working age population to pension benefit recipients. Together with the looming retirement of the baby boomers, these developments will put more and more pressure on the sustainability of pension systems. This especially holds true for PAYG pension systems like the public pension system in Germany (*Gesetzliche Rentenversicherung*) where the contributions of current employees finance the benefits of current pensioners. Therefore, employment of older workers is a crucial factor for the financial base of the public pension system. Strengthening labor supply of older workers is one way to ease the burden of demographic change. This dissertation contains five studies that investigate the role of pension systems and the effects of public pension reforms in explaining labor supply decisions of older individuals. With this dissertation, I hope to contribute to painting a picture of the world we currently see and to adding new knowledge for future responsible reforms.

This dissertation has found that the employment trends of older workers throughout the past almost four decades is partly caused by the various public pension reforms that took place over time. In addition, this dissertation has shown that flexible retirement reforms are dangerous instruments when the aim is to increase older workers' labor supply. The flexibility reforms enacted so far have failed to actually increase total labor volume of older men aged 55 to 64. The reform effects indicate dependence on the institutional environment in which they have taken place. While the evidence is still outstanding, it seems to be more likely that flexible retirement reforms increase total labor volume if they are not substitutes but complements to other accompanying measures. Eventually, the dissertation detected that pension systems play an important role in explaining the different shares of working pensioners that chose a flexible transition into retirement across countries. Overall, more flexible pension systems seem to support flexible transitions into retirement. Systems that are more flexible facilitate what individuals have reported in previous surveys namely that workers actually want flexibility. There seems to be demand for flexibility which, accompanied by appropriate reforms, is more likely to increase older worker's labor supply.

However, limitations and open questions of future research remain:

- The model in Chapter 3 does not fully explain the actual increase of the average retirement age. The increase that the model does not link to the public pension reforms is most likely due to the one-dimensional character of the applied incentive measure. This measure captures only part of the changed policy environment and misses, e.g., the changing general awareness of demographic change and potentially varying preferences for work vs. leisure. Seibold (2019) found that retirement patterns of older individuals cannot be explained by financial incentives alone. He investigates reference point effects like *presenting* a threshold as eligibility age or *framing* of eligibility ages as potential explanation of what shapes retirement patterns beside financial incentives. Moreover, we only observe labor supply reactions until 2015. Future research has to show how already legislated reforms, such as, e.g., the gradual increase of the statutory eligibility age until 2030, will influence actual retirement ages.
- Moreover, the analyses in this dissertation primarily focus on how the structural policy changes influence labor market behavior of the *average* older individual. However, the reforms may affect heterogeneous groups of individuals differently, depending on, e.g, the individuals' income situation, employment history or health. Giesecke (2018) for instance investigates the effect of actuarial deductions for early retirement on the timing of pension benefit claiming of manual and non-manual workers. He finds that manual workers postponed pension benefit claiming by about 50 percent less compared to non-manual workers. Future similar studies can help to better understand the heterogeneity of reform effects.
- A research area that additionally should gain attention in the future is the question how pension reforms influence inequality within society. Heterogeneous groups of individuals may be affected differently by pension reforms with effects on inequality.
- Furthermore, the analysis of welfare effects goes beyond the scope of this dissertation. The effects of pension reforms on welfare for a society as a whole depend on the demographic structure and general equilibrium effects. Besides, welfare effects also depend on the institutional environment the reforms have taken place in. New evidence on the topic of flexibilization and welfare could help to better understand potential effects.
- The cross-sectional perspective of working pensioners in Chapter 6 does not allow a complete explanation of the transition process from full-time work to full retirement with a phase in which individuals combine pension benefits and employment income. An

extension to a panel perspective could help to better understand the actual transition choices, namely what individuals report and later do or what they do not do, respectively. Future research could focus on employment possibilities of older workers, legal obstacles and a more comprehensive analysis of the employers' role.

- Another question yet to be answered in this context is whether working pensioners ensure adequate pension income for themselves by further increasing their pension entitlements with the contributions stemming from employment income.

2. Social Security Reforms and the Changing Retirement Behavior in Germany

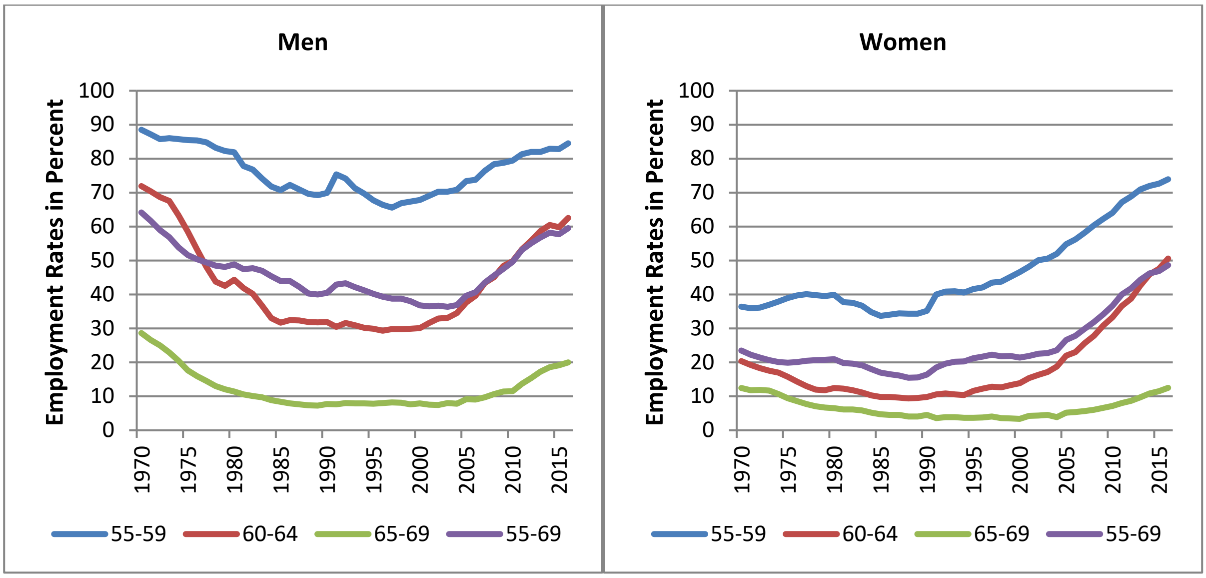
This chapter was written in co-authorship with Axel Börsch-Supan and Johannes Rausch.

2.1 Introduction

Much like other industrialized countries around the world, the retirement age in Germany has declined for a long time. This has put enormous fiscal pressures on Germany's pension system. Since about 2000, however, working later in life has been making a stunning comeback. Among the 12 countries involved in the International Social Security Project (ISSP), Germany has experienced the largest increase in the employment rate of the 55-69 age group, see Figure 2.1. This figure and the remainder of the chapter refer to West Germany in order to avoid confounding pension policy effects with the strong unification effects in East Germany after 1989. West Germany used to feature a relatively low level of old-age employment with a rate of only 36.8/21.5% (men/women) in 2000 for the 55-69 age group. 16 years later, this rate has reached a stunning 59.5/48.6% (OECD 2018a). The trend reversal is particularly pronounced among men, see Figure 2.1, while the picture is a bit more complex for women who experienced a rather constant increase for the 55-59 age group and a mild reversal for the other age groups. The trends in labor force participation (LFP) are very similar (not shown). Understanding the causes for this recent increase in employment and LFP is important if one wants to assess whether the current rising trend will continue, thus reducing the negative consequences of aging on fiscal sustainability. If the reversal is mainly caused by transitory or one-off events old-age labor force participation may slow down again in the near future. However, if it is caused by a structural change, we may expect a lasting impact on fiscal sustainability.

One set of causes for the trend reversal in employment could be historical trends. Younger cohorts are healthier and have been better educated, permitting longer working lives. Moreover, the role of women in society has dramatically changed, affecting LFP of both genders. The previous phase of the ISSP has shown that these secular developments have contributed astonishingly little to the trend reversal (Coile et al. 2019 for an overview; Börsch-Supan and Ferrari 2019 for Germany). In fact, even if many of the historical trends studied earlier may have contributed to the overall level of labor force participation, their trend does not show the U–shape pattern observed for labor force participation.

Figure 2.1: West German employment rate by age group and gender



Source: Own calculations based on OECD (2018a), *Statistisches Bundesamt* (German Federal Statistical Office) (2016).

This study therefore investigates the role of structural policy changes since 1980. Our evidence presented suggests that much of the trend reversal of older men's labor force participation may be explained by changes in Germany's public pension rules, in particular by the phasing in of actuarial adjustments for early retirement. Regarding women's LFP, it is less clear how much public pension rules play a role. Most probably, the secular change of women's role in society is the main driver of the steadily increasing LFP among the younger West German women while we observe more of a trend reversal among older women.

This evidence is highly suggestive. However, such a bivariate correlation does not control for the many other potential explanatory factors and the heterogeneity in the population. This requires a much more elaborate multivariate analysis which will be done in the subsequent Chapter 3. The analysis in Chapter 3 comprises a causal analysis of the role of public pension policies in shaping LFP. Chapter 2 is contributing to this effort by constructing time series of the implicit tax for a small set of stylized household types. The next step will then be to apply this machinery to real households in a population-representative survey, and to embed our incentive variables, the macro variables considered in Börsch-Supan and Coile (2019) and other determinants into an econometric analysis of retirement and labor force participation.

Overall, Chapter 2 and Chapter 3 taken together contribute to the large empirical literature studying individual retirement responses to varying incentives in the old-age security system. Both studies are closely related to the work that was done by Gruber and Wise (1999, 2004), who investigated the effect of retirement incentives on the downturn of labor force participation of older individuals at the end of last century. They found that retirement incentives had a strong effect on retirement decisions. More recent empirical investigations have shown that specific reform devices have led to substantial reactions of older individuals' labor market behavior, albeit at varying magnitudes. Existing studies evaluated specific reforms such as the introduction of actuarial adjustments for early retirement (Hanel 2010, Engels et al. 2017, Giesecke 2018), the increase of the earliest eligibility age for early retirement (Geyer and Welteke 2017 and Geyer et al. 2020), the reform that increased the generosity of a specific early retirement pathway for individuals with at least 45 insurance years (Dolls and Krolage 2019), an earlier reform on supplemental pension benefits (Ye 2018), a reform on disability insurance (Hanel 2012), and whether the 2006 unemployment insurance reform affected older workers' labor market transitions (Riphahn and Schrader 2019). The key novelty of Chapter 2 and Chapter 3 lies in investigating the effect of structural policy changes on retirement and employment choices at older ages over almost four decades. Within this period, Germany experienced a considerable reversal of employment rates and several reforms.

Chapter 2 of this dissertation is organized as follows. Section 2.2 describes the changes in the German labor force participation and pension claiming behavior between 1980 and 2016. Section 2.3 provides a summary of the institutional changes and pension reforms in Germany that may be the causes for the stunning trend reversal. Section 2.4 is the main methodological part of the chapter and describes how we boil down the institutional changes into a few key statistics, especially the "implicit tax on working longer". Section 2.5 presents our results. We show how the implicit tax on working longer has changed between 1980 and 2016, using several alternative specifications and robustness checks. We then graphically relate the implicit tax on working longer to the prevailing employment rate. Section 2.6 concludes. We find a negative correlation between the employment rate and the incentives to claim benefits early. In other words, as the implicit tax on working longer decreased, employment at older ages increased.

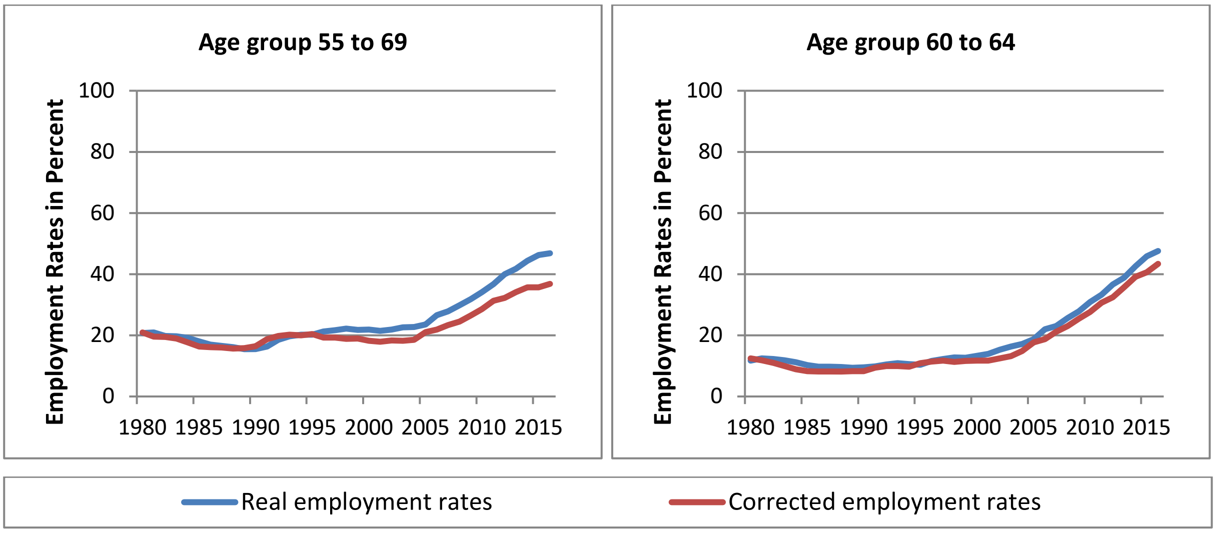
2.2 Employment rate among older individuals and pension claiming behavior

In this section, we will take a closer look at the development of the employment rate of older workers and their actual pension claiming behavior. It is important to note that labor market exit and the beginning of pension benefit claiming may not take place at the same time. We therefore avoid the term "retirement" as much as we can since in many languages it ambiguously refers to both decisions which may be driven by different considerations and determinants. We also take care to distinguish between the group of older workers and the group of insured individuals. They do not precisely overlap. For instance, homemakers and emigrated workers do not belong to the German labor force but often have earned pension claims in Germany. We therefore first look at changes in employment and later at changes in claiming behavior.

Employment rate. West Germany shares with other industrialized countries a "U-shape" pattern in the employment rate (labor force participation rate) of older workers over time. In its downward-phase from 1970 into the 1990s[5] the employment rate of older men (age group 55-69) declined by 23.7 percentage points (pps) to 40.5% until 1990 (see Figure 2.1). Even more pronounced was this decline for the age group 60 to 64 with a decrease by 40 pps to 31.8% until 1990. The decline was much smaller for women with 7.1 (10.6) pps for the age group 55 to 69 (60 to 64). However, their employment rate was with 23.5% already rather small in 1970.

[5] The employment rate of whole Germany includes another drop in 1991. However, this drop results mainly from the unification of Germany and the small employment rates in East Germany. For younger age groups we also observe an increase in the employment rate after 1990 due to the unification.

Figure 2.2: West Germany older women's employment rate with and without correction for general trend in younger women's employment rates



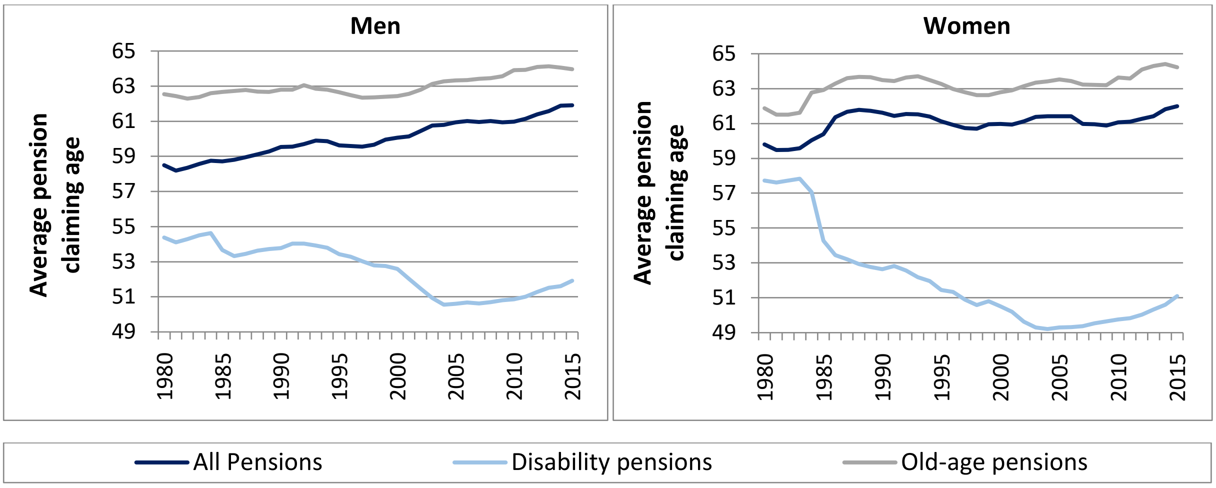
Source: Own calculations based on OECD (2018a), Statistisches Bundesamt (German Federal Statistical Office) (2016).

Most studies (e.g. Börsch-Supan 1992, Siddiqui 1997, Börsch-Supan and Schnabel 1999, Hanel 2010) identified the introduction of early retirement opportunities as main reason for the decline. The downward-phase ended in the 1990s. A stagnation phase followed with more or less constant employment rates before the employment rates started to increase around the year 2000. The older men's employment rate then began to rise at a rather fast pace. Until now the employment rate of older men has increased by 22.7 (32.5) pps for the age group 55 to 69 (60 to 64). The women's employment rates started to increase earlier and stronger. However, in the women's case the increase of labor force participation among younger women has to be taken into account. If we correct the development of the older women's employment rates for this general trend we receive a similar pattern as for men.[6] So adjusted, the employment rate for women increased between 2000 and 2016 by approximately 18.7 (31.4) pps for the age group 55 to 69 (60 to 64) (see Figure 2.2).

Pension claiming behavior. As already mentioned, the labor force is not identical to the insured population. Consequently, the development of the employment rate may vary from the actual pension claiming behavior. Figure 2.3 depicts the average pension claiming age of West German men and women separately for old-age pensions, disability pensions and overall pensions.

[6] We correct for the general trend by subtracting from the growth rate of the employment rate of the 60 to 64 year old workers the growth rate of the employment rate of the 50 to 54 year old worker. We consider thereby the growth rates of the same cohorts. The correction is consequently kept quite simple.

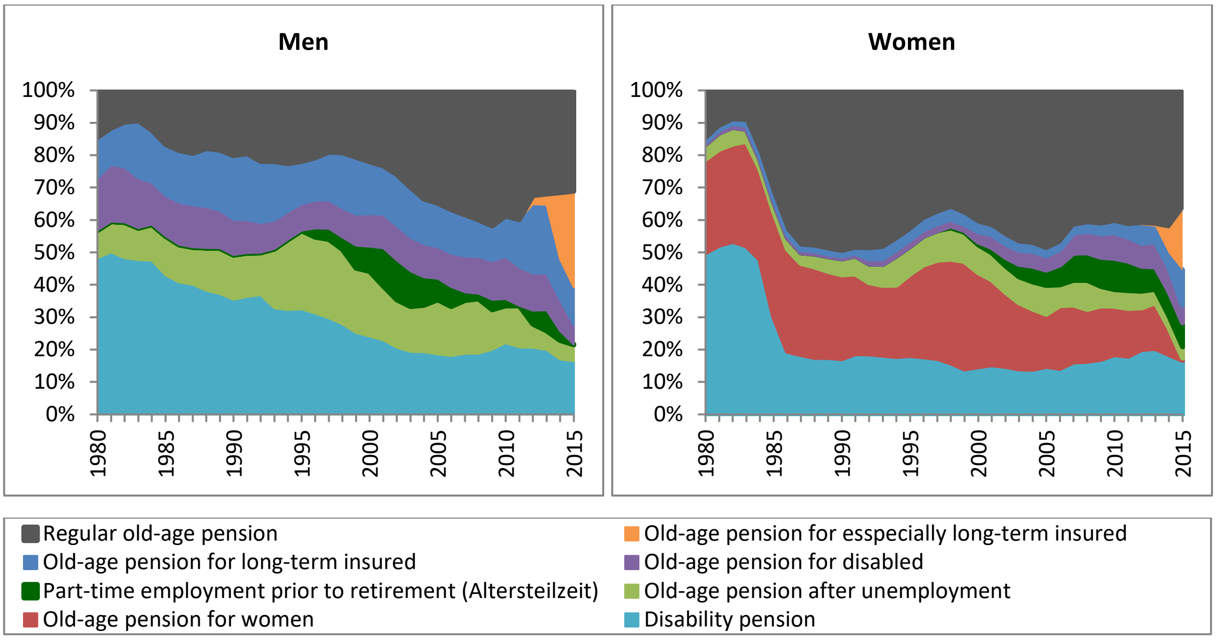
Figure 2.3: Average pension claiming age by gender (West Germany)



Source: Own calculations based on *Deutsche Rentenversicherung Bund* (DRV) (2017).

In the men’s case, we observe that the general average claiming age increased between 1980 and 2015 steadily from 58.2 to 61.9. On the other hand, the average claiming age for old-age pension remained similar to the employment rate constant until 2000. The average pension claiming age stayed, thereby, slightly below 63. Afterward it increased by 1.6 years to the age 64. While the pension claiming ages increases over all pensions, the claiming age of disability pensions dropped in 1984 by 1.3 years and decreased after 1992 with an accelerating pace by another 2.7 years. At first glance, the drop in the claiming ages of disability pension seems strange since the requirements for disability pensions were tightened in 1984 and 2001 (see next section). However, due to the tighter requirements the misuse of the disability pension as early retirement pathway for healthy individuals had been blocked. Hence, the average claiming age decreased since fewer older but healthy workers misused the disability pension and the share of younger but disabled workers increased in all variants of the German disability pension. The overall pension claiming age increased since the share of individuals who claimed a regular old-age pension among all new pension claims increased (see Figure 2.3).

Figure 2.4: Coverage of pathways to retirement on annual newly claimed pensions

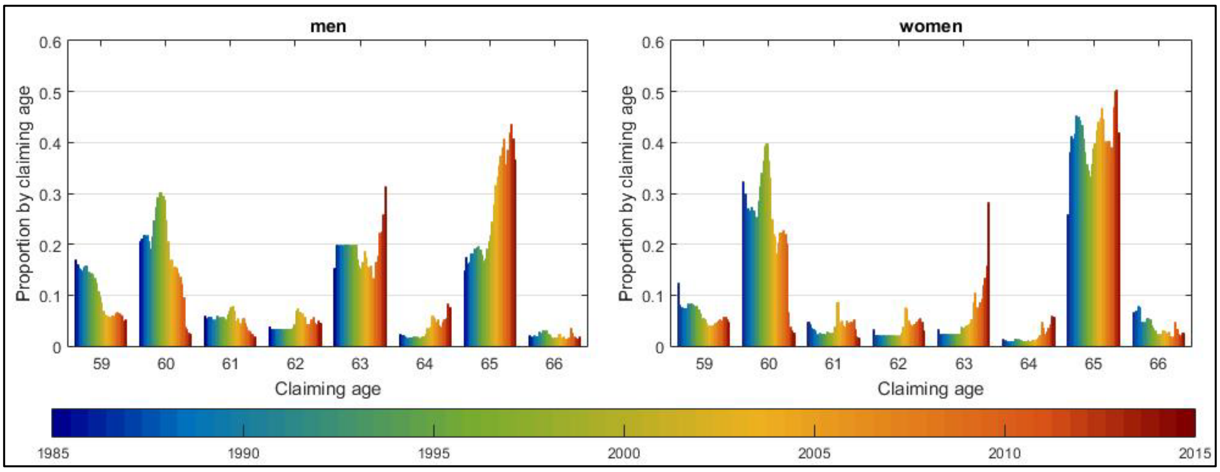


Source: Own calculations based on DRV (2017).

For women, the development of the average pension claiming age for old-age pensions is nearly identical with the development of the average pension claiming age over all pensions. We observe merely a one year gap between both variables. At least after 1984 the average pension claiming age of disability pensions seems to play a secondary role due to its small fraction on all pension claims (see Figure 2.4). The pension claiming age over all pensions (as well as all old-age pensions) rose after 1984 by 2.1 years while the claiming age of disability pensions dropped by 4.5 years. As we will see in the following section, this pattern can be explained by the 1984 pension reform which changed the requirements for a disability pensions and for regular old-age pensions. It seems that many women older than 61 did not fulfill the old vesting period for a regular old-age pension of 15 years while they did fulfill the shorter five years waiting time of a disability pension. Since at the same time the requirements for disability pension were tightened, older women switched from claiming disability pensions to claim (regular) old-age pensions. As a consequence, the average claiming age for disability pension dropped while the claiming age for regular old-age pension rose. After 1990 the claiming ages of old-age pensions remained first at an almost constant level before it decreased by one year until 2000. However, similar to the development of the employment rate, the women's claiming age increased again since 2000. On the other hand, the women's average pension claiming age of disability pensions decreased by another four years until 2004 before it rose again by two years.

All in all, the development of the men's average claiming age of old-age pensions is consistent with the observed development of their employment rate. Only the decline in the employment rate between 1980 and 1985 cannot be observed in the considered time period. For women the comparison between the pension claiming behavior and the employment rate is less straightforward, especially until 2000. One reason may be the differences in the considered groups. While the employment rate only includes the share of women working (in Germany) the average pension claiming age takes the claiming ages of all insured women into account. The employment rate could, therefore, miss certain changes in the pension claiming patterns of women.

Figure 2.5: Pension claiming by age and year (1985-2015) in West Germany



Source: Own calculations based on DRV (2017).

In a last step, we study the distribution of the pension claiming age by ages and its development over time (see Figure 2.5). In the men's case we observe three major pension claiming ages, 60, 63 and 65. These ages reflect the earliest claiming ages for the most important pension pathways (see next section and Table 2.1). Between 1980 and 2002 most individuals claimed a pension at age 60. However, the relevance of the age decreased rapidly with the introduction of actuarial deduction in 1999 and the abolishment of old-age pension due to unemployment in 2012. At the same time, pension claiming at the statutory eligibility age of 65 increased. The share of pension claimed at the eligibility age of 63 remained at first nearly constant. However, in the last years it got more relevant for two reasons. First, the old-age pension with lower eligibility ages were abolished, second, the actuarial deductions for claiming a pension at 63 were temporarily abolished for certain individuals ("pension with 63"). For the remaining ages, we can further observe a shifting process from early to later ages.

For women two major pension claiming ages can be observed. First, the eligibility age for the old-age pension for women at age 60 and second the statutory eligibility age at 65. Similar to the men's case the share of pension claiming at age 60 declined after 1999 in two steps. The first drop after 1999 reduced the share on all pension claiming by almost 20 pps while the second drop, which occurred 2012 (abolishment of the old-age pension for women), covered a decline of 15 pps. At the same time the earliest eligibility age for long-term insured (age 63) became more relevant. In total, the share of women claiming a pension at age 63 increased from 2.4% to 28.2%. Nonetheless, with over 40 percent, most women claimed their pension at the statutory eligibility age. Similar to the men's case, between the ages 60 and 63, a shifting process can be observed – which moves the pension claiming from younger to older ages.

2.3 Institutional changes: German pension policy and its development

The main hypothesis of this study is that the reversals in labor supply and pension claiming behavior around the year 2000 are to a large extent driven by changes in pension policies. To this end, this section presents the policy changes that occurred since 1980 and are salient for changes in retirement behavior. We start with a brief summary of the structure of the German pension system in 1980 in order to assess the initial situation of the system at the beginning of the time span considered in this study.

2.3.1 German pension system until 1980

The German pension system originally began as a funded disability insurance scheme in 1889. In the beginning, “old age” was classified as a subcategory of disability. “Disability benefits due to old age” were lower compared to real disability benefits and were granted starting from age 70. With further reforms in the following years (in particular in 1899, 1911, 1913, 1916), the scheme was broadened into a general old-age security system with disability pensions and mere old-age pensions. Benefits of disability pensions and old-age pensions were set on the same level and the coverage among workers and employees was increasingly enlarged. The eligibility age was lowered to 65, first for employees in 1913 and for workers in 1916 (DRV 2020). After two world wars and a period of hyperinflation about half of the capital stock was lost and the system was transformed into a pay-as-you-go (PAYG) system in 1957. Benefits from this public PAYG system were designed to maintain the living standard that was achieved during the working life to the time of retirement. Therefore, individual pension benefits were set to be proportional to the individual labor income averaged over the entire working career such that the relative income position of an individual during the working life would be preserved during retirement. While the absolute level of pension benefits has been reduced in the subsequent reforms, the principle of maintaining the relative income position has been preserved until today. The German public pension system therefore features only few redistributive properties, much less than, e.g., the US Social Security system. The main redistribution instrument to prevent old-age poverty is a kind of minimum pension at the social assistance level that was introduced in 2001. The system is mandatory for all workers except for most self-employed, civil servants and workers with earnings below the official minimum earnings threshold. In the case of the main earner’s death spouses and children are additionally protected through survivor benefits.

After anchoring the public pension benefits to gross wages in 1958, several pathways to claim a public pension before the statutory eligibility age were introduced in the 1960s and 1970s. These policy changes enabled especially women, unemployed and disabled persons to claim a pension at age 60 and individuals with long service lives (i.e. at least thirty-five insurance years) to claim a pension at age 63, see Table 2.1. These early retirement pathways permitted an earlier claim of pension benefits but were based on the already earned pension claims with exactly the same benefit calculations as a regular old-age pension (see Table 2.1, Börsch-Supan and Jürges 2012). Until 1992, there were no actuarial deductions for claiming a pension before the statutory eligibility age. However, actuarial supplements of 7.5% (15%) were granted for postponing the pension claiming by one (two) years.

Table 2.1: Pathways to retirement. Eligibility criteria

Pathway	Earliest eligibility age (EEA)	Years of service	Actuarial deductions*	Earnings tests	Other
(1) Regular OAP	Until 2012 After 2029 65 67 (i.e. SEA) (i.e. SEA)	Until 1984 Since 1984 15 5	None	None	
(2) OAP for long-term insured	63	35	Yes	Yes	
(3) OAP for especially long-term insured	Increase from 63 to 65 until 2029	45	None	Yes	
(4) OAP for invalids	Until 2011 After 2025 60 62	35	Yes	(Yes)	At least 50% disabled
(5) OAP due to unemploym.	Until 1996 After 2002 60 63	15 (8 in last 10 years)	Yes	Yes	At least 52 weeks unemployed; Born before 1952
(6) OAP after part-time employ.	Until 1996 After 2002 60 63	15 (8 in last 10 years)	Yes	(Yes)	Two years part-time; Born before 1952
(7) OAP for Women	60	15 (10 after age 40)	Yes	Yes	Born before 1952
(8) Disability pension	–	Until 1984 Since 1984 5 5 (3 in last 5)	Yes	Yes	Medical exams

Note: * Actuarial deductions for early retirement were introduced between 1992 and 2004. *Source*: Own table.

The reforms in the 1960s and 1970s led to one of the world's most generous pension system with various opportunities to claim a pension at the age of 60 (Table 2.1) and net replacement rates around 70% (Table 2.2).[7] The "standard net replacement rate" in this table refers to a German convention which relates the net pension income to the net earnings of a synthetic pensioner who constantly earned the average wage during the entire service life of 45 years. Replacement rates relating to the last earnings are presented in Section 2.5.

Table 2.2: Standard net replacement rate and standard net replacement rate before taxes[8]

Year	Standard net replacement rate	Standard net replacement rate before taxes	Year	Standard net replacement rate	Standard net replacement rate before taxes
1980	70.3	57.6	**1998**	70.9	53.6
1981	69.9	57.4	**1999**	70.5	53.3
1982	71.5	58.4	**2000**	69.7	52.9
1983	71.3	57.9	**2001**	68.6	52.6
1984	72.0	58.1	**2002**	69.0	52.9
1985	71.8	57.4	**2003**	69.6	53.3
1986	70.2	56.4	**2004**	67.9	53.0
1987	70.6	56.2	**2005**		52.6
1988	70.3	56.3	**2006**		52.2
1989	70.7	56.1	**2007**		51.3
1990	67.6	55.0	**2008**		50.5
1991	67.4	53.9	**2009**		52.0
1992	67.1	53.1	**2010**		51.6
1993	67.0	53.4	**2011**		50.1
1994	69.5	54.8	**2012**		49.4
1995	70.1	53.9	**2013**		48.9
1996	70.2	53.4	**2014**		48.1
1997	71.5	54.0	**2015**		47.7

Note: Standard net replacement rates base on the regular old-age pension of an individual with 45 earning points (called *Eckrentner)*. It is the official stated replacement rate.

Source: Own table based on DRV (2017).

[7] According to Börsch-Supan and Schnabel (1999), the corresponding U.S. net replacement rate at that time was with about 53 percent substantially lower.

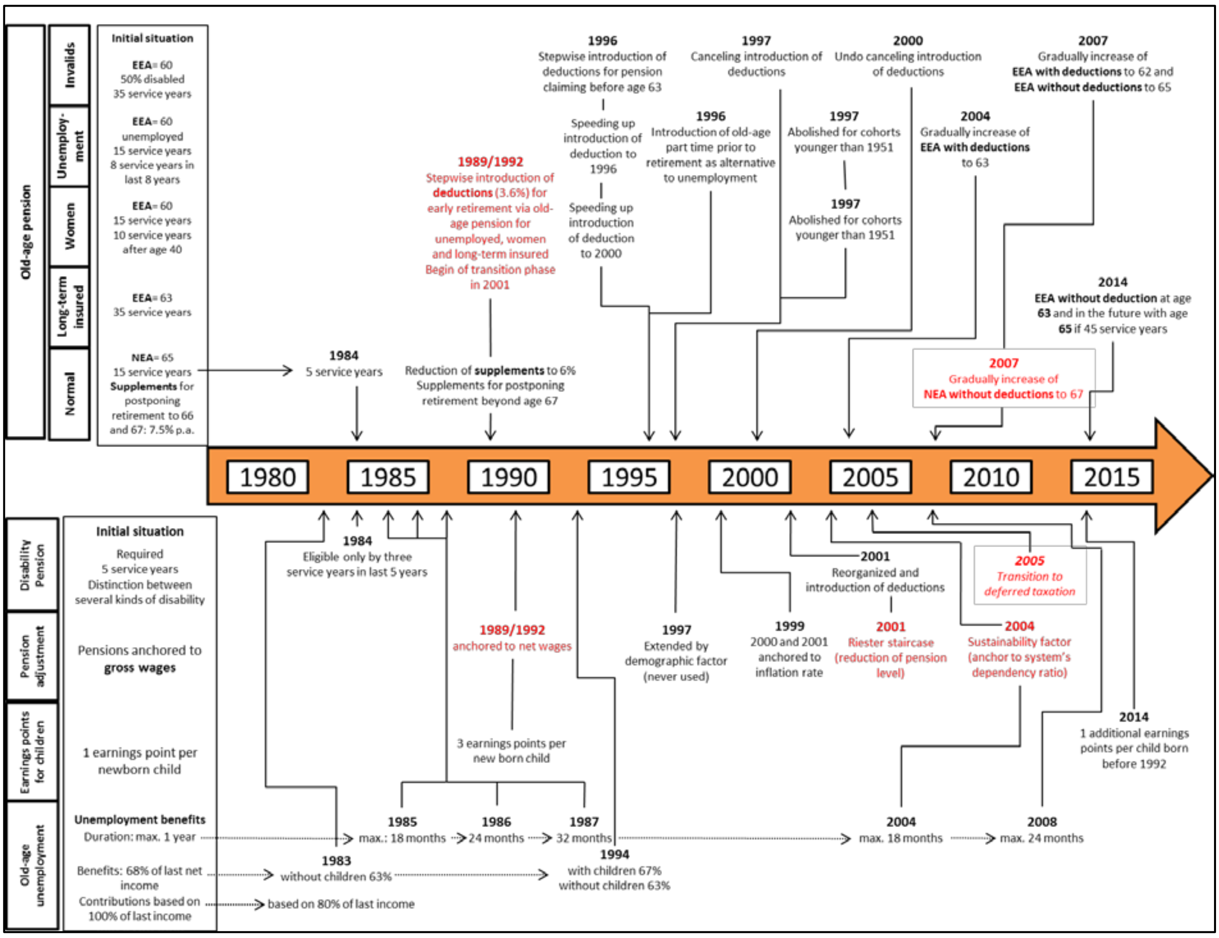
[8] The standard net replacement rate before taxes considers the contributions to the social security system but no tax payments. It is used in Germany since 2005 instead of the standard net replacement rate as pension benefits are not anymore taxed consistently due to a stepwise introduction of a deferred taxation regulation (see reforms 2004, Section 2.3.2.2, *Step 2.4*).

2.3.2 Reform process since 1980

The generous German public pension system proved to be financially unsustainable. This precipitated a sequence of reform steps starting around 1980, see Figure 2.6.

Elements of reform included the introduction of actuarial adjustments to the claiming age, a gradual increase of the eligibility ages, the closure of many early retirement pathways, a significant reduction of benefit generosity, the abolishment of earnings tests and the introduction of partial ("flexible") retirement. The reform process can be divided in three phases. The first phase lasted until 1992 and can be described as a very cautious, limited and at times contradictory departure away from the previous era of increasing generosity. The second phase took place between 1992 and 2007 and consisted of several incisive reforms leading to a sustainable pension system. The third phase covers the time since 2007 and entails some reform backlash such as the introduction of a new early retirement pathway.

Figure 2.6: Timeline of the reforms to the social security system



Source: Own diagram.

2.3.2.1 Phase 1 (1980 to 1992): modest retrenchment within the pension system/increasing generosity outside the pension system

In the **1984** reform, the requirements for disability pensions were tightened by making a minimum of three contribution years in the last five years a necessary condition. Moreover, stricter medical examinations were introduced. As kind of compensation, the vesting period for regular old-age pensions was reduced from 15 to five service years. Together this gravely changed the balance between newly claimed old-age pension and disability pension in favor of old-age pensions. As Figure 2.4 depicts, this was especially the case for the women's pension claiming behavior. The share of claimed disability pensions on all newly claimed pension dropped for women by over 30 pps while the share of regular old-age pension increased by the same amount. This strong effect has two reasons. First, the number of women fulfilling the new requirements for disability pensions dropped, as many women stopped working after marriage or childbirth and had therefore paid no contributions in the last five years. Second, due to similar reasons, women may have only been able to claim disability pensions as they did not fulfilled the former vesting period of 15 service years for a regular old-age pension.

In a contradictory move, the opportunity to leave the labor market early was widened between **1984** and **1987** by extending the maximal duration time of unemployment benefits for older workers (age 56 and above) from 12 months to 32 months. In fact, since unemployment benefits are neither means-tested nor do they require job search attempts they are often used "to build a bridge to retirement". The extension of the duration time widened this "bridge". Moreover, severance pay became tax advantageous for employers. This further facilitated a mutual agreement among employers and employees regarding ending the employment relationship with the right to claim unemployment benefits.

2.3.2.2 Phase 2 (1992 to 2007): sustainability reforms

Step 2.1 (1992): Toward actuarial adjustments and more flexibility

The **1992** pension reform, which passed the parliament in 1989, represents a significant landmark in the German pension policy as it marks the leap into an era of reforms striving to increase the system's sustainability. As a first step of this process, the 1992 pension reform introduced two significant changes to the pension system's framework. First, it switched the benefit adjustment from gross wage growth to net wage growth. This measure got rid of an odd situation where increasing social contribution rates would have led to a circle of rising net replacement rates.

Second, starting in 2001 it provided a phased introduction (by cohorts) of actuarial adjustments for an early pension claiming. This measure started a long sequence of changes in the system of pathways to retirement and their eligibility ages with and without actuarial adjustments. They are graphically displayed in Figure 2.7 at the end of this section; each panel a) through h) presents an element in this sequence.

The stepwise introduction of actuarial adjustments dealt with the strong incentives to claim a pension early as they reduce pension benefits by 3.6% per year of early pension claiming (counted from the statutory eligibility age or a respective earlier adjustment-free eligibility age, see Table 2.6). However, these actuarial adjustments are not actuarial neutral as several studies showed (see Werding 2007, 2012 and Gasche 2012); hence an incentive to claim a pension early remains. Proper actuarial neutral adjustment would have to be at least twice as large as the current ones. Parallel to the introduction of actuarial deduction, the actuarial supplements for postponing the pension claiming beyond the statutory eligibility age were changed. From 1992 onward actuarial supplements were granted for each year of later pension claiming (not only for the first two years). However, at the same time the actuarial supplements were reduced to six percent per year of later retirement (actuarial deduction of 20%).

Beside these sustainability-increasing measures, the 1992 pension reform contained two additional components. First, the number of earnings points parents receive for newborn children were increased from one to three. Second, a partial old-age pension was introduced which enabled individuals to compensate an income loss due to a reduction in working hours (part-time work) by drawing a partial pension. The partial pension could be drawn, however, only for certain proportions of the split between work and retirement: one third, one half, or two thirds. The earning limits were calculated individually based on the labor income of the last three years before drawing the partial pension. In the end, this pension scheme was not overly successful as very few individuals used it.

In 1996, the timetable for the introduction of the actuarial adjustment was moved up to 1997 for the old-age pension due to unemployment and to 2000 for the old-age pension for women (see Figure 2.7c). Moreover, it was decided to phase in actuarial adjustments for the old-age pension for disabled persons (see Table 2.6).

Parallel, the old-age pension due to unemployment was expanded to also include part-time workers prior retirement for employees over 55 (*Altersteilzeit*).[9] This represented the so far most widely used model of pre-retirement work reduction. The scheme is based on a bilateral agreement between employee and employer and required a reduction of working hours by half in the last five years before the public pension is claimed. The remaining “half” working time could be distributed either consistent over the whole period of five years or could be fulfilled entirely in the first two and a half years without a reduction in working, the “block model”. In both cases, the employee receives an ongoing payment composed of their part-time work income and a supplementary income of 20% by the employer. Additionally, the employer pays pension contributions for 80% of the part-time work income. The scheme is subsidized in the sense that the supplementary compensation by the employer is tax exempted (see Börsch-Supan et al. 2015).

Step 2.2 (1997): Closing early retirement schemes and the demographic factor

In December **1997** a reform package passed the German parliament which (would have) included three crucial components to further increase the sustainability of the Germen pension system. First, the old-age pension due to unemployment and for women were abolished for cohorts born after 1952 (see Figure 2.7d); second, the pension adjustment indexation formula was amended by a demographic factor which would have adapted the benefit growth to the demographic development; and third, actuarial adjustments were introduced for disability pensions. Other than for the old-age pensions the actuarial adjustments were, however, limited to 10.8% and depended on the distance between the claiming of a disability pension and the age 63. Moreover, the pre-adjusted disability pension benefits were enlarged if the act of disability happened before the age of 60, which compensated for a major part of the newly introduced actuarial adjustments. The reform package itself should have become effective in 1999. However, the 1998 new elected government of Social Democrats and Green Party suspended the second and third component of the reform package (demographic factor and changes to the disability pension) in order to find a more social regulation. For 2000 and 2001, the benefit adjustment was aligned to the inflation rate.

Step 2.3 (2000 till 2001): Toward a genuine multipillar system

The new government presented the revised pension plan in **2000** and **2001**. Regarding the disability pension, the new government adopted the plans of the former government, meaning the introduction

[9] For readability reasons we will continue to call this pension scheme old-age pension due to unemployment.

of actuarial adjustments combined with an improvement of the disability benefits (see Table 2.6 and Figure 2.7e). The previous version of the disability pension covered vocational disability *(Berufsunfähigkeit, BU)* and "real" disability *(Erwerbsunfähigkeit, EU).* This distinction was abolished in favor for a two-step disability pension (partial/full earning incapacity) with strict health tests. Whether a disabled individual is eligible for a partial or full disability pension depends on his maximal working capacity (less than six hours per day for a partial disability pension or less than three hours per day for a full rate disability pension). The new disability pension became effective in **2001**.

In the same year, the *Riester* reforms took place which entailed a major reorganization of the German pension system by converting the formally monolithic pay-as-you-go pension scheme into a genuine multi-pillar system. With this reform, the pay-as-you-go financed system was partial substituted by a (not mandatory) subsidized private funded system (*Riester-Rente*). The benefits of the original system were therefore gradually reduced in proportion to the maximal subsidized contribution rate of the newly created supplementary pension scheme (see decreasing replacement rates in Table 2.2). This was done by adding an appropriate component into the pension benefit indexation formula.[10] The side effect of this rearrangement was that the pay-as-you-go system was relieved. This corresponded with the second aim of the *Riester* reform to stabilize the contribution rate by reducing the pension level. Actually, the *Riester* reform law stated that the contribution rate to the public retirement insurance must stay below 20% until 2020 and below 22% until 2030, while the standard net replacement rate must stay above 67%. Failure must precipitate further government actions.

Step 2.4 (2004): Toward Sustainability (sustainability factor)

It quickly became obvious that the contribution rate thresholds could not be fulfilled without further cost-cutting measures. As a consequence, the Commission for Sustainability in Financing the German Social Insurance Systems was established to develop appropriate reform plans at the end of 2002. In the following year, the commission proposed an entire reform package (Commission 2003) with two key components. First, the commission encouraged the government to anchor the

[10] The new component represented solely the growth rate of the pension system's contribution rate. This component replaced the former one introduced with the 1989 reform that had linked benefits to net wage growth. Due to this novelty, changes in the balance between the fiscal burden of pensions and wages had no longer an influence on the adjustment of the pensions.

statutory eligibility age to the expected change of the life length after retirement. To ensure a real increase in the actual retirement age, the reform plan further suggested to rise the earliest eligibility ages of all retirement schemes and to introduce higher actuarial fair adjustments. Second, an additional factor for the pension benefit indexation formula was proposed which links the benefits to the system's dependency ratio, called the "sustainability factor".[11] Taking into account the lower bound for the replacement rates, this factor will further reduce the pension benefits thus that the contribution rate's thresholds are fulfilled. Most of the commission's proposals, and most significantly the introduction of the sustainability factor, quickly passed the German parliament in **2004**. An exception includes the adaptation of the eligibility ages to life expectancy. It was argued that an increase of the retirement age would lead to higher unemployment as it takes jobs away from the young.

Parallel to the pension reform, the government passed in 2004 the *Hartz* reforms and reorganized the pension taxation. The *Hartz* reforms replaced, *inter alia*, the unemployment assistance by the lower "unemployment benefit II" (commonly called *HARTZ IV*). Table 2.3 states the development of the unemployment benefits. Moreover, the pension claims granted while receiving unemployment benefit II were stepwise reduced after 2004 from 16% to zero percent of the last income (see Table 2.4). The duration time of normal unemployment benefits were furthermore reduced for older workers from maximum 32 months to 18 months. Both measures made unemployment less attractive as a substitute for early old-age pension benefits and disability pension benefits.

Table 2.3: Unemployment benefits as percentage of last net income

		1975-1983	1984-1993	1994-2000	2005
ALG	with children	68	68	67	
	without children	68	63	60	
ALH	with children	58	58	57	ALH replaced by earning unrelated ALGII
	without children	58	56	53	

Note: ALG = unemployment benefits from the public unemployment insurance; ALH= unemployment assistance; ALGII = unemployment benefits II; since 1996 annual reduction of unemployment assistance by three percent.

Source: Own table.

[11] The sustainability factor is to a certain degree similar to the demographic factor of 1997. However, the demographic factor did only consider the increase of the life expectancy while the sustainability factor considers the development of the ratio between beneficiaries and contributors.

Table 2.4: Contribution to public pension system for unemployed as percentage of last gross income

	until 1978	1979-1982	1983-1999	2000-2004	2005-2006	2007-2010	since 2011
ALG	80	100	80	80	80	80	80
ALH/ALGII	80	100	80	ca. 32	ca. 16	ca. 8	none

Note: ALG = unemployment benefits from the public unemployment insurance; ALH = unemployment assistance replaced by the unemployment benefits II (ALG II) in 2005; paid contributions indicates collected pension claims (earnings points) while unemployed.

Source: Own table.

Due to a decision by the Federal Constitutional Court, which was prompted by differential taxation of public pension benefits and the pensions of civil servants, the pension taxation system was reorganized (see Börsch-Supan and Quinn 2015). Until 2004 public pensions were only taxed if they surpassed a quite large allowance. Actually, this only applied to relative few cases. With the new regulations, a deferred taxation of pension was introduced. Hence, the contributions to the pension insurance became tax exempt and the pension benefits taxable. To prevent a double taxation the reform included a generous transition period.[12]

Step 2.5 (2007): Toward later retirement ages

In the end, population aging remained high on the political agenda and so the yet not implemented reform proposal of the commission, namely the increase of eligibility ages. Finally in **2007** the then Federal Minister of Labor and Social Affairs Franz Müntefering surprisingly unilaterally announced the increase of the statutory eligibility age similar to the suggestion of the commission until 2029 (see Figure 2.7g black and blue line).[13] Parallel, the benchmarks for adjustment free disability pensions should be raised from 63 to 65. In contrast, the adoption of the earliest eligibility scheme (old-age pension for workers with a long service history) to life expectancy (see Figure 2.7g blue dotted line) as well as the introduction of actuarial fair adjustments (see Table 2.6 for cohort-specific actuarial adjustments) remained unrealized.

2.3.2.3 Phase 3 (2007 to 2016): reform backlash, the "pension with 63"

In the 2007 pension reform the process toward a sustainable pension system ended and a phase of moderate reform backlashes followed. This process actually already began within the 2007 pension reform as the decision to increase the statutory eligibility age was weakened by exemptions for those workers who have forty-five years with active contribution payments (see Figure 2.7g orange line). This new type of old-age pensions ("old-age pension for especially long careers") could be claimed at the age 65 or older, but not earlier, even with actuarial adjustments. The next backlash

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[12] The transition included, on the one hand side, an implementation of the tax exemption between 2005 and 2025 and, on the other hand, a constant tax allowances on pension claimed before 2040. The tax exemption increases stepwise from 60% to 100%. For pension claimed before 2005 the tax allowance was set to 50% of the gross pension benefits in 2005. For pensions claimed between 2005 and 2040 the allowance is a fraction of the first received gross pension whereby the fraction itself depends on the pension claiming year and decreases from 50% to zero percent.

[13] Note that the statutory eligibility age was not automatically linked to life expectancy.

happened 2008 as the duration of unemployment benefits were increased for older workers (older than 57) to 24 month (see Table 2.5).

Table 2.5: Maximal duration time of unemployment benefits for older workers in months

Age\Year	until 1985	1985	1986	1987-2003	2004-2007	since 2008
51-55	12	18	20	26		15
56					18	18
57			24	32		
58						24

Source: Own table.

The largest backlash so far took place in 2014 when, among other things, the Great Coalition enlarged the group of workers with forty-five years of contributions by softening the definition of contribution year. Even more significantly, this group of individuals was now granted an adjustment-free retirement at the age of 63 (see Figure 2.7h orange line), called “retirement at 63”. The claiming age of 63 increased in parallel to the statutory eligibility age, such that the claiming age for this type of pensions was set to two years before the statutory eligibility age. This type of early retirement became very popular and led to a standstill in the average retirement age which had increased since the turn of the century. Finally, the rigid earning limits of the partial pension (see the 1992 pension reform) were substituted by more flexible limits in 2016, coming into force in July 2017. Within the new system, each additional earned Euro in excess of 6,300 € per year is only counted by 40% towards the pension. The employee can retain 60%. With the new regulation, the German government tried to encourage partial pensioners to extend their labor supply. However, as actuarial adjustments are still not actuarial fair it has yet to be shown whether this new regulation will meet their expectation or not.

Even though the most recent process clearly denoted a reform backlash, the reforms were still moderate. The main reform measures for the sustainable pension system remained untouched. However, the current political discussion on the topic is at least worrisome, as the voices demanding a complete rollback are becoming louder.

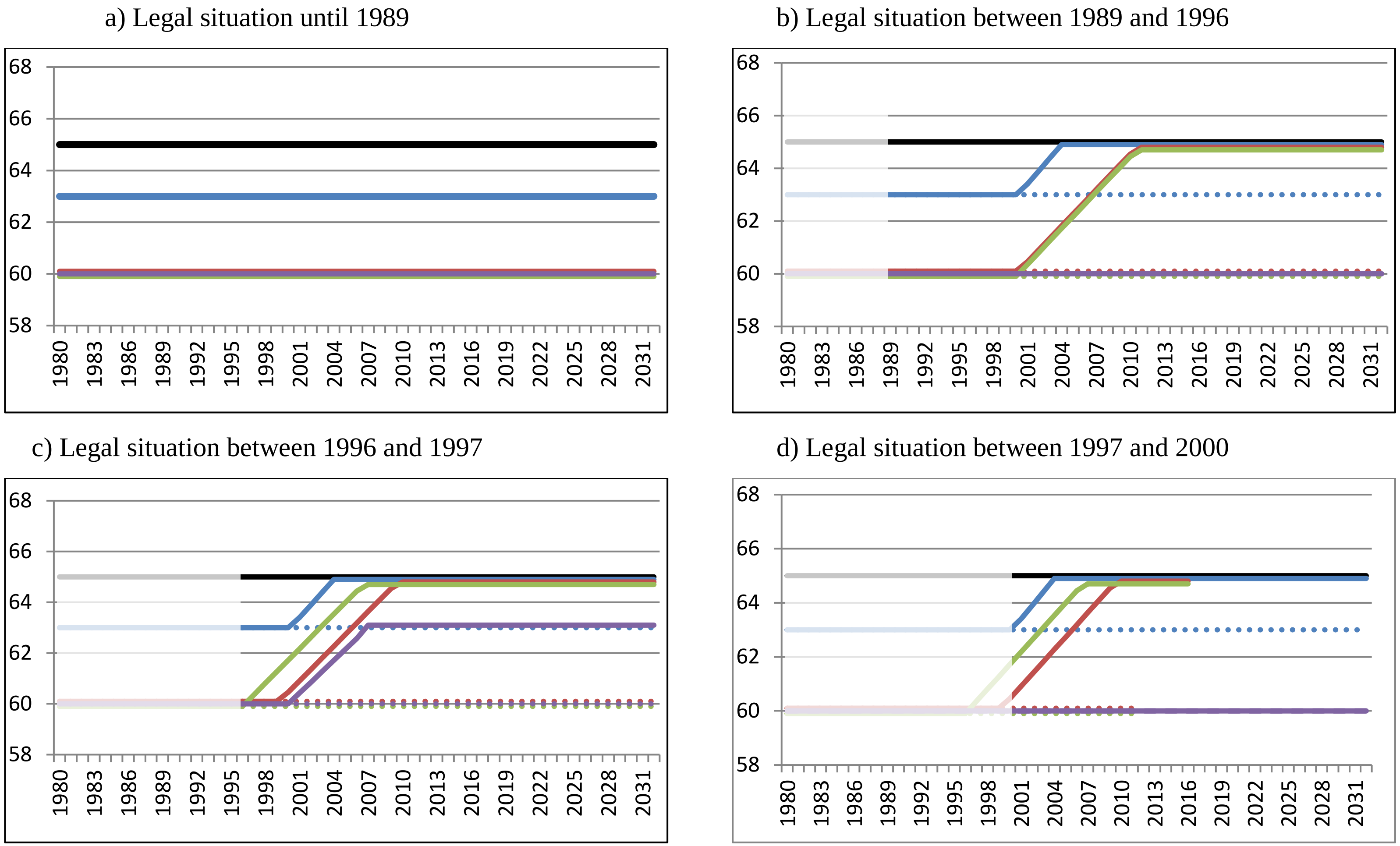
Table 2.6: Actuarial adjustment factor for early/late pension claiming in percentage by pathway to retirement, pension claiming age and cohort/pension claiming year

		Pension claiming age									
		60	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**
Long-term insured	**Cohort**										
	<1937	-	-	-	100	100	100	107.2	114.4	114.4	114.4
	1937	-	-	-	96.4	100	100	106	112	118	124
	1938-1948	-	-	-	92.8	96.4	100	106	112	118	124
	1948-1964	stepwise increase of statutory eligibility age									
	>1963	-	-	-	85.6	89.2	92.8	96.4	100	106	112
Women	**Cohort**										
	<1937	100	100	100	100	100	100	107.2	114.4	114.4	114.4
	1937-1939	100	100	100	100	100	100	106	112	118	124
	1940	96.4	100	100	100	100	100	106	112	118	124
	1941	92.8	96.4	100	100	100	100	106	112	118	124
	1942	89.2	92.8	96.4	100	100	100	106	112	118	124
	1943	85.6	89.2	92.8	96.4	100	100	106	112	118	124
	1944-1951	82	85.6	89.2	92.8	96.4	100	106	112	118	124
Unemployed and part-time retirement	**Cohort**										
	<1937	100	100	100	100	100	100	107.2	114.4	114.4	114.4
	1937	96.4	100	100	100	100	100	106	112	118	124
	1938	92.8	96.4	100	100	100	100	106	112	118	124
	1939	89.2	92.8	96.4	100	100	100	106	112	118	124
	1940	85.6	89.2	92.8	96.4	100	100	106	112	118	124
	1940-1945	82	85.6	89.2	92.8	96.4	100	106	112	118	124
	1946	-	85.6	89.2	92.8	96.4	100	106	112	118	124
	1947	-	-	89.2	92.8	96.4	100	106	112	118	124
	1948-1951	-	-	-	92.8	96.4	100	106	112	118	124
Disabled	**Cohort**										
	<1937	100	100	100	100	100	100	107.2	114.4	114.4	114.4
	1937-1940	100	100	100	100	100	100	106	112	118	124
	1941	96.4	100	100	100	100	100	106	112	118	124
	1942	92.8	96.4	100	100	100	100	106	112	118	124
	1943-1947	89.2	92.8	96.4	100	100	100	106	112	118	124
	1948-1964	parallel increase of statutory eligibility age and disableds' eligibility age									
	>1963	-	-	89.2	92.8	96.4	100	100	100	106	112
Disability pension	**Year**										
	<1992	100	100	100	100	100	100	107.2	114.4	114.4	114.4
	1992-2001	100	100	100	100	100	100	106	112	118	124
	2001-2011	89.2	92.8	96.4	100	100	100	106	112	118	124
	2012-2024	stepwise increase of disability pension's eligibility age and statutory eligibility age									
	>1963	-	-	89.2	92.8	96.4	100	100	100	106	112

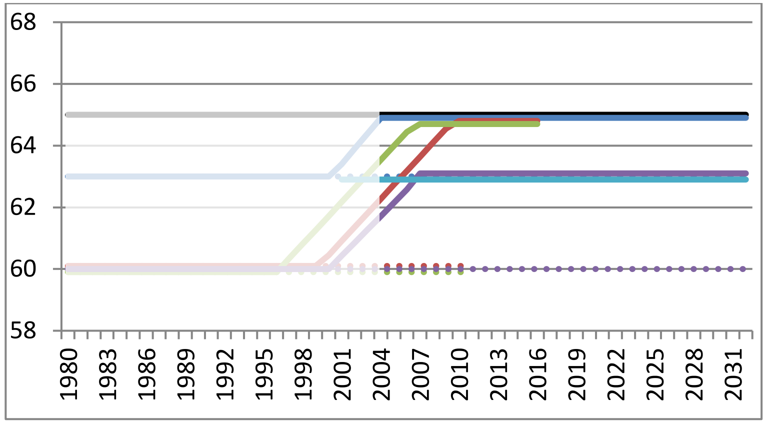
Source: Own table.

Figure 2.7: Eligibility ages with and without actuarial deductions for each pathway to retirement in respect to legal situation

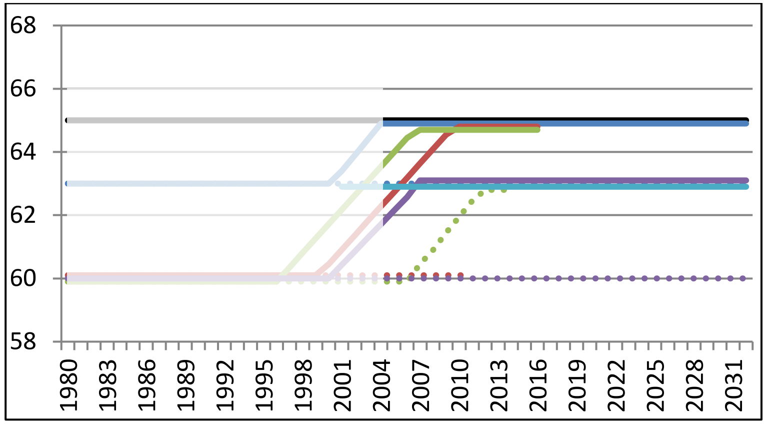
Note: The figures summarize three dimensions of policy changes regarding the eligibility age to claim pension benefits: the introduction of actuarial adjustments, the introduction and closure of entire pathways, and finally the gradual increase of the eligibility ages. Each panel a) through h) represents the legal status as seen from a specific year. The horizontal axis displays the time horizon of a worker making a decision about claiming her pension. The vertical axis displays the eligibility age pertaining to the year on the horizontal axis, and the colored graphs represent the pathways with (dotted) and without actuarial deductions (solid). Each panel thus presents the announced future development of the future legal situation. We assume that they correspond to the expectations of workers pondering a claiming decision. Past years are shown in light colors. *Source*: Own diagrams.



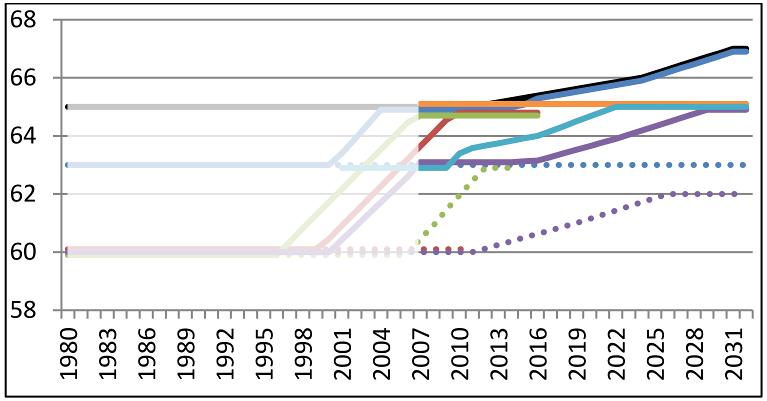
e) Legal situation between 2000 and 2004



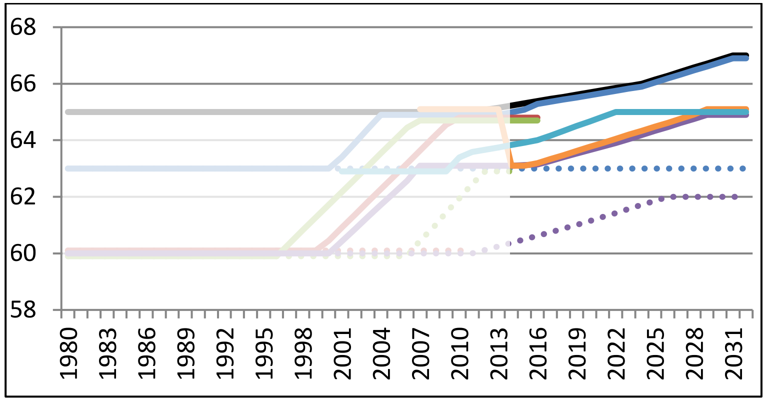
f) Legal situation between 2004 and 2007

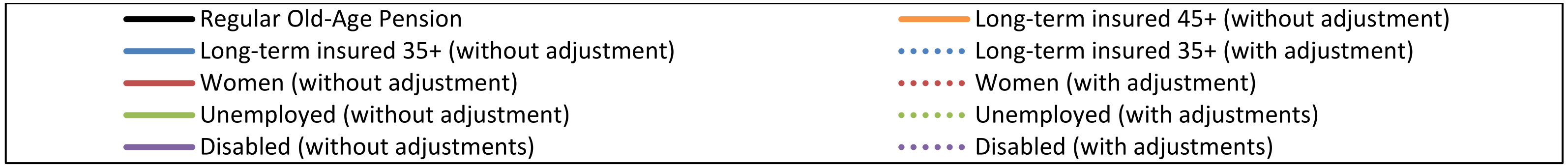


g) Legal situation between 2007 and 2014



h) Legal situation since 2014





2.4 The implicit tax on working longer

2.4.1 Definition

As described in the previous sections, the German retirement insurance creates strong incentives to claim a pension and exit the labor force relatively early in life through a variety of mechanisms. These mechanisms can be summarized compactly in terms of a loss in social security wealth when postponing claiming and retiring from the labor force. Germany applies a relatively strict earnings test for ages below the statutory eligibility age. This forces individuals to leave the labor force when they want to receive social security benefits, as benefits are counted against earnings (although a small amount of earnings may be allowed without being counted against benefits). Therefore, claiming pension benefits intrinsically implies stop working at those younger ages, and we simply refer to "retiring" for this joint decision.

Social security wealth is the expected net present value of social security benefits minus contributions to the public pension and unemployment insurance during the retirement window, here defined as the age range from 55 to 69. Contributions before age fifty-five are sunk. Future contributions and benefits depend on the legal situation *l* at the planning age *S* and the used pathway to retirement *k* (e.g. via unemployment or disability pension). Seen from the perspective of a worker who is *S* years old and plans to retire at age *R* *social security wealth* is given by:

$$SSW_{S,k,l}(R,i) = \sum_{t=R}^{T} B_{t,k,l}(R,i) \cdot \sigma(i)_{S,t} \cdot \beta^{t-S} - \sum_{t=S}^{R-1} c_{t,l} \cdot Y_t(i) \cdot \sigma(\mathrm{i})_{S,t} \cdot \beta^{t-S} \quad (2.1)$$

with

SSW:	net present discounted value of retirement/unemployment benefits
S:	planning age
R:	benefit claiming age
i:	gender and skill type
k:	pathway to retirement
l:	legal situation at planning age S
$Y_t(i)$:	gross labor income at age t
$B_{t,k,l}(R,i)$:	net benefits from pathway k at age t for benefit claiming age R and legal situation l
$c_{t,l}$:	contribution rate to pension and unemployment system at age t for legal situation l
$\sigma(i)_{S,t}$:	probability to survive at least until age t given survival until age S
β:	discount factor $\delta = 1/(1+r)$. We choose the usual discount rate r of three percent.

Postponing retirement by one year has two negative effects on social security wealth: the worker must give up one year of (net) pensions, and they must continue to pay contributions to the pension system of about ten percent of their gross earnings. On the other hand, postponing retirement raises pension benefits due to these additional contributions by roughly one-fortieth and due to the actuarial adjustments by 3.6% per year of postponement (after the 1992 reform has been fully phased in).

The incentives to leave the labor market and claim a pension can be expressed conveniently by the *implicit taxes* which are based on the *accrual of social security wealth*. In this study, *accrual* is defined as the expected gain in social security wealth by postponing the labor market exit by one year. The implicit tax is the negative accrual of social security wealth (*ACC*) divided by the after tax earnings *(Y^{Net})* during the additional year of work:

$$ITAX = -\frac{ACC}{Y^{Net}} \qquad (2.2)$$

As long as the implicit tax is negative, it is rational to postpone the withdrawal from the labor market unless labor/leisure preferences or similar considerations dominate the expected gain in social security wealth. Negative implicit taxes from a certain age on are sufficient (although not necessary) for leaving the labor market and claiming a pension at that age.

2.4.2 Empirical implementation

We compute the accrual of social security wealth and the implicit taxes for each year between 1980 and 2016. Individuals are assumed to anticipate the future development of the contribution rates and pension benefits based on the legal situation of the planning year *S* according to Figure 2.7. We do not expect that individuals anticipate future reforms. For the past, the pension system's contribution rates and replacement rates are estimated for each relevant legal situation based on historical data. For the future, we predict the development of the German public pension system's key parameters for each reform stage separately with the simulation model MEA-PENSIM (see Holthausen et al. 2012). The (future) pension benefits depend on the earning history of the individual, the chosen pension claiming age/pathway to retirement (actuarial adjustments, unemployment benefits) and the future replacement rate (pension value). The last two components may change with pension reforms.

We compute social security wealth, its accrual and the implicit tax on working longer for 18 idealized constellations. We distinguish three gender groups (single female, single male, couple), three skill groups (low, medium and high education/skill) and two macro environments (common environment across all 12 countries involved in the ISSP, German environment). For each of these 18 idealized constellations, we construct a matrix of 38x15 values (i.e. social security wealth, its accrual and the implicit tax) where the 38 rows refer to the years of the time series (1980 to 2016) and the 15 columns refer to the claiming ages *S* (55 to 69). Moreover, each value is based on separate computations for each six pathways which are then aggregated using as weights the frequency for each pathway.

In more detail, we calculate social security wealth for gender-specific synthetic income profiles of low, medium and high education/skilled single households. Low skilled individuals are expected to enter the labor market at age 16, medium skilled at age 20 and high skilled at age 25. For couples, we assume a rather simple case: a male (female) who is married to a partner three years younger (older) of the same skill/education type. We assume furthermore that the spouse's retirement behavior is fixed, i.e., it will not react to the partner's retirement decision.

The macro environment is represented by assumptions on (a) the age-earnings profile, (b) the payroll taxation including social security contributions and (c) age and gender-specific survival probabilities. We specify a common synthetic environment in order to avoid confounding cross-national differences in pension policy with other determinants of social security wealth such as different age-earnings profiles, different taxation and different survival probabilities. More specifically:

a) Common macro environment:

Common synthetic earnings profiles for the three skill/education groups are calculated with data from the USA, Germany and Italy.[14] They are depicted in Figure 2.8 (dotted lines).

Common survival rates for 2010 were provided by Eurostat (average of EU28 countries). The underlying life expectancy at age 15 is 67.8 years for women and 64.7 year for men. For men the life tables are adjusted to generate life expectancies which are 2/4 years higher/lower to reflect the higher/lower life expectancy of high/low-educated men. Similarly, the life tables for women are adjusted, however here it is assumed that low-educated women have a 4.5 lower life expectancy.

Common payroll taxes are taken from the OECD tax data base (see OECD 2018b) and refer to all income taxes and employee and employer social security contributions.

[14] The data sources are the US Current Population Survey (CPS, taken from Coile 2018) and administrative data from the German (SUF-VSKT 2011, see DRV 2011) and Italian (*Istituto Nazionale della Previdenza Sociale* (INPS), taken from Brugiavini et al. 2019a) pension system.

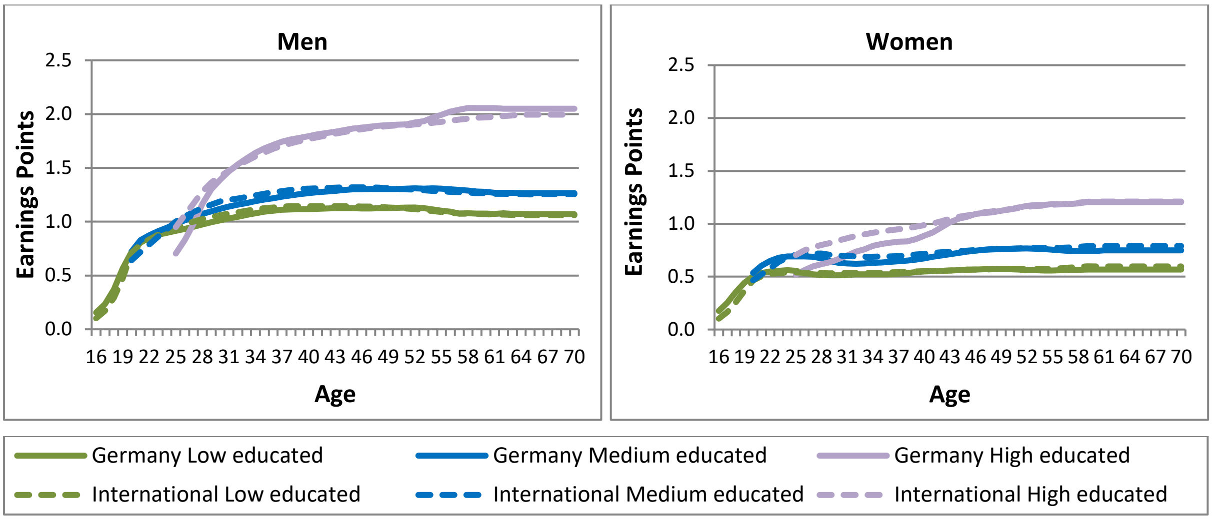
b) National macro environment:

In order to compare the actual German retirement behavior with the prevailing implicit taxes, we calculate implicit taxes for German earnings profiles, life tables and payroll taxes. The earnings profiles are calculated with administrative data of the German pension insurance (SUF-VSKT 2011, see DRV 2011). For women we find only small differences between the income profiles of younger and older cohorts. As a consequence, we only consider cohort-specific income profiles for men. The average income profiles are depicted in Figure 2.8.

The cohort-specific life tables are provided by the German Federal Statistical Office *(Statistisches Bundesamt)* (2015). Similar to the common cases we adjusted the life tables for high/low-educated individuals in order to control for the differences in life expectancy.

In terms of taxes, we use our own tax calculator which calculates the tax rate accordingly to the prevailing legal situation. To illustrate the influence of the stepwise introduced deferred taxation, we show additionally results which exclude this reform.

Figure 2.8: (Synthetic) Earnings profiles by gender and education



Source: Own calculations based on US CPS (see also Coile 2018) and administrative data from the German (SUF-VSKT 2011, see DRV 2011) and Italian INPS (see also Brugiavini et al. 2019a) pension system.

The matrices of outcome values are aggregated over six pathways:

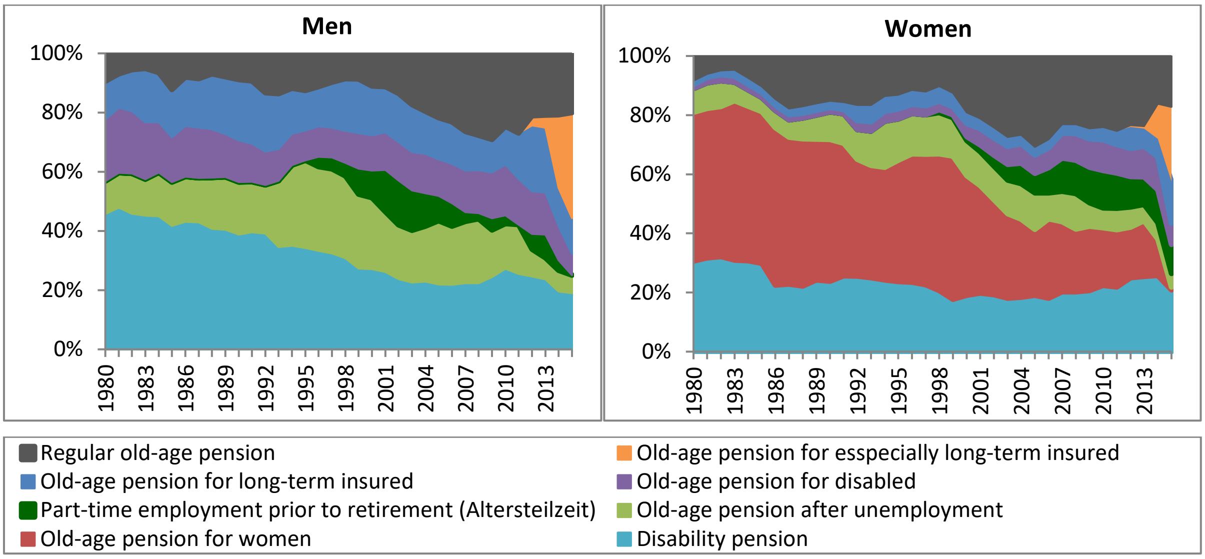
- Regular old-age pension (at the statutory eligibility age),
- Early pension claiming via old-age pension for long-term insured or for women,
- Leaving the labor market via unemployment,
- Part-time employment prior to retirement,
- Early pension claiming via old-age pension for disabled, and
- Disability pension

It is important to notice that all of these pathways pay the same benefit once a person is eligible. They differ, however, by their eligibility criteria (see Table 2.1). Among those, "strict" and "soft" eligibility rules can be distinguished. The first are tied to objective variables, such as age, gender, and previous contribution history while the second are subject to discretionary decisions, notably the determination of workers' disability status.

However, in our case the conditions for the various retirement programs are only relevant to a certain degree, as the social security wealth is computed for synthetic individuals. As a consequence, we calculate the social security wealth for each pathway separately and aggregate the resulting implicit taxes afterwards by weighting them with the observed frequency of the corresponding pathway among all pension claims. We assume, accordingly, that the actual distribution of the various pathways reflects the probability to fulfill the eligibility requirements of the respective pathways. These probabilities vary between the group of insured individuals and the subgroup of insured individuals who did not drop out of the labor market at younger ages. We therefore consider two different weighting approaches. The first approach uses the distribution of the pathways on all public pension claims as depicted in Figure 2.4. The second approach considers the distribution of the pension claims of those individuals who only paid contributions in the year before they claimed their pension (see Figure 2.9). This second approach excludes "passively insured" individuals (e.g. homemakers).

This alternative frequency is used if the implicit taxes should be compared with the employment rate. Essentially, we aim to exclude those effects on the frequency derived from insured individuals who do not belong to the labor market before claiming the public pension (e.g. homemakers). Actually, the 1985 shift in the balance between regular old-age pensions and disability pensions is much smaller under this approach (compare Figure 2.9 with Figure 2.4). The annual frequencies are used to combine the implicit taxes with the same labor exit ages. By definition, these are the implicit taxes with the same planning age S. In the following, this approach represents our basic weighing procedure.

Figure 2.9: Coverage of pathways to retirement on annual newly claimed pensions without passively insured individuals



Source: Own calculations based on DRV (2017).

The frequencies displayed in Figure 2.4 are only used when the implicit taxes are compared with the development in the overall pension claiming behavior. Under this approach, the implicit taxes with the same underlying pension claiming age have to be combined. For most cases, these are again the implicit taxes with the same planning age *S*. Exceptions are the pathways via unemployment and part-time work. Here, the pension claiming age is later than the labor exit age: for the unemployment pathways one or two years (depending on the maximal duration of unemployment benefits) and for the pre-retirement pathway via part-time work (by assumption) up to five years.

2.5 Results

In the following, we will present the results of our calculations in a stepwise fashion. Section 2.5.1 presents individualized replacement rates and social security wealth, i.e., the elements from which the implicit tax will be computed, on a scale more often used in the economics literature than the German-specific “standardized replacement rates” in Section 2.3 (Table 2.2). For comparability, we apply the German payroll taxes.

In Section 2.5.2, we introduce the common macro environment. We first present general outcome variables such as replacement rate, social security wealth and its accrual. Section 2.5.3 follows with the implicit tax on working longer for median educated men, women and couples. Section 2.5.4 shows how these implicit taxes vary between different skill groups.

Section 2.5.5 uses the differences between the common environment and the national case for a discussion how the implicit taxes depend on specific national taxation, income profiles and life tables.

Finally, Section 2.5.6 and Section 2.5.7 are devoted to a graphical juxtaposition of our computed implicit taxes with the actual development of employment and the changes in the distribution of the pension claiming age.

2.5.1 Replacement rates and social security wealth, scaled for Germany

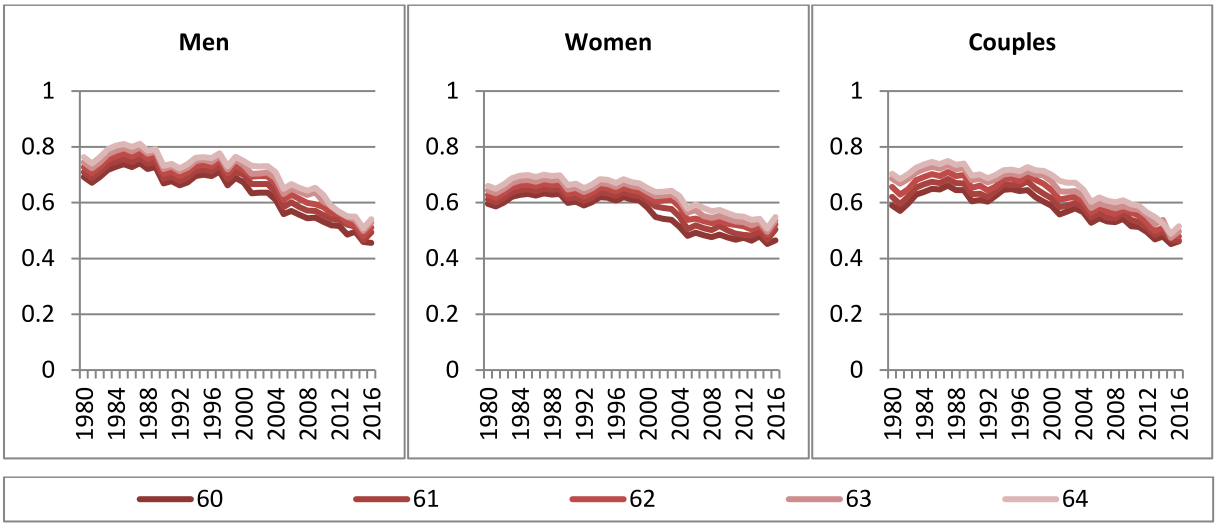
2.5.1.1 Replacement rate

The standardized replacement rates shown in Table 2.2 of a pensioner with constant average earnings over the entire work life do not reflect actual earnings profiles which typically increase with age. Moreover, these standardized replacement rates do not take the introduction of the deferred taxation on pension benefits into account. As a consequence, we analyze in the following individualized net replacement rates (pension benefits as share of last earnings by the types of individuals and households defined in the previous section) which were computed in the calculation process of the implicit taxes.

In order to maintain some comparability to the official German figures, the calculations in this section are based on the tax rate calculations of the German macro environment (see Section 2.4) but use the income profiles and survival probabilities of the common macro environment. The most critical difference is the fact that the common taxation does not only tax labor income but also pension income, though German public pension benefits were not taxed until 2005. The common taxation therefore leads to much smaller net replacement rates than it was actually the case. The net replacement rates are depicted in Figure 2.10 for median educated men, women and couples at the planning age 60 to 64 between 1980 and 2016. In the couples case the replacement rate is shown from the men's perspective while the women's claiming age is three years younger.

First of all, we observe in all cases nearly constant replacement rates until 2004. The smaller fluctuations result from changes in the tax rates on the last labor income. As shown in Section 2.5.2, these fluctuations do not appear in the case of common tax rates. After 2004, both the standardized replacement rates (Table 2.2) and the individualized net replacement rates decrease. This is due to the introduction of the sustainability factor. The decrease, however, is more moderate for the standardized replacement rates, especially for men. This steeper decrease is due to the stepwise introduction of the deferred taxation since the increasing taxation reduces the net pension benefits additionally to the sustainability factor.

Figure 2.10: Replacement rate for median educated men, women and couples by age

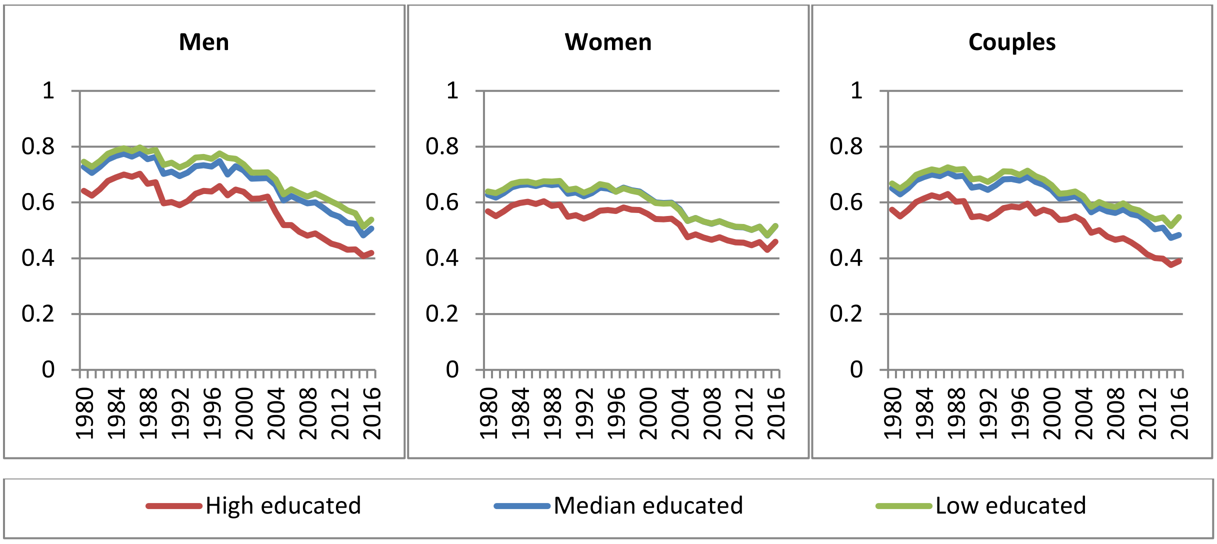


Source: Own calculations.

The individualized replacement rates increase with age since individuals earn additional pension claims while their labor income remains constant at older ages. Moreover, we observe in the past higher replacement rates for men than for women. This is due to lower taxation of women's last labor income, hence due to the progressivity of the tax system, and the now past tax exemption for public pension benefits. As a consequence, the gap disappeared in recent years due to the abolishment of the tax exemption for public pension benefits (i.e. introduction of the deferred taxation). Moreover, the progressivity of the tax system has led to a larger reduction of high pensions benefits (typically men) than for small pension benefits (typically women). As the replacement rates of couples is a product of the spouses replacement rates they lie somewhere between the replacement rate of single men and women and have a similar development.

Higher skilled individuals have smaller replacement rates than less/median educated individuals (see Figure 2.11). The replacement rates of higher educated individuals are lower due the higher share of their last income on their lifetime income. This is mainly a result from the shorter labor history of higher educated individuals. Lower and median educated individuals accumulated, on the other hand, their pension claims over a longer time period such that their pension benefits are less strongly linked to their last income. There is a similar but smaller divergence between low and median educated individuals.

Figure 2.11: Average replacement rate of age group 60-64 by education group

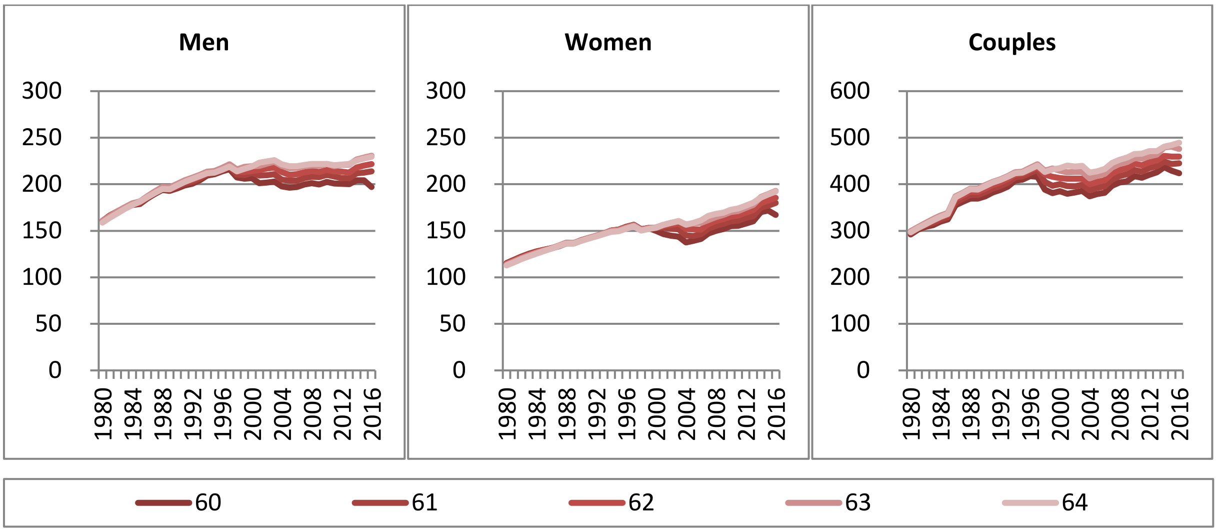


Source: Own calculations.

2.5.1.2 Social security wealth

Figure 2.12 depicts the social security wealth that would be attained if the worker were to leave the labor market and claim a pension immediately. As before, it is based on common earnings profiles, common survival probabilities but German tax rates, and the figures show median educated single men, single women and couples at claiming ages between 60 to 64 years. The level of social security wealth depends on lifetime income; hence men's social security wealth is larger than women's. Social security wealth increased for all groups between 1980 and 1996. The growth rate reflects the annual pension increase which was first anchored to the average gross wage and after 1989 to the average net wage. After 1996, the increasing trend was reduced by the implementation of different reforms. The strongest effect was generated by the introduction of actuarial deductions for early retirement. Before their introduction, social security wealth increased only marginally with the claiming age.[15] This changed afterwards since the actuarial deduction reduced the social security wealth (pension benefits) of younger claiming ages/pension claiming ages. This led to gaps between the social security wealth of different claiming ages.

Figure 2.12: Median educated men's, women's and couple's social security wealth of leaving the labor market immediately in 1,000€ by age



Source: Own calculations.

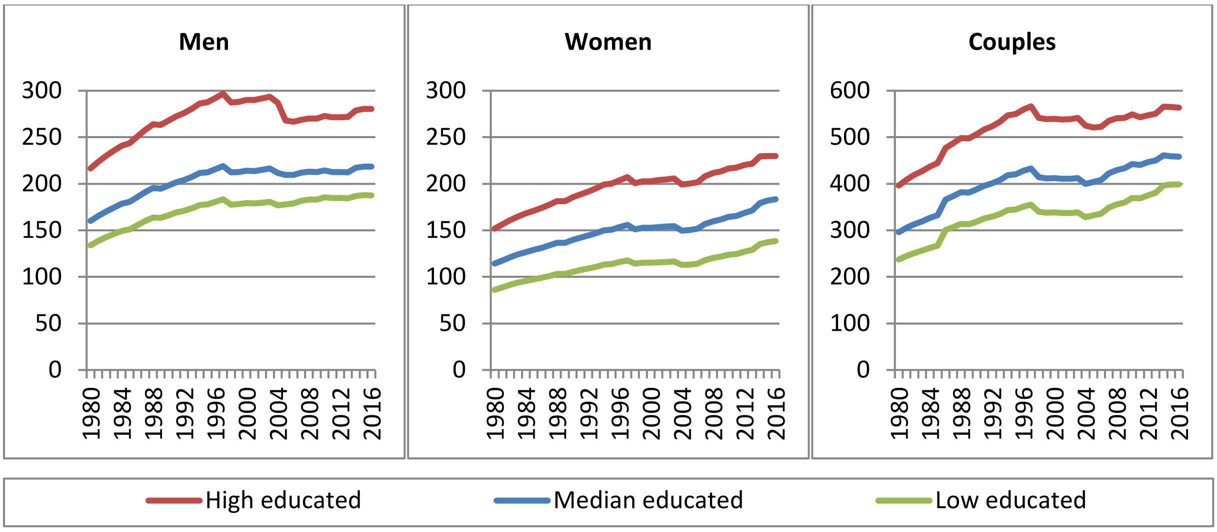
[15] It is important to not mix up this with the incentive to postpone the labor market exit. For instance, remember that previous contributions to the social security system are sunk at a given plaining age but not the further contributions.

Moreover, there were two reforms which reduced the social security wealth in general: first, the introduction of the demographic factor in 1998 which was later replaced by the sustainability factor and second, the introduction of the deferred taxation. The influence of the deferred taxation depended, however, on the amount of the pension income. The social security wealth of pensioners with higher benefits (e.g. highly educated men, see Figure 2.13) dropped stronger than those with low benefits. At last, the growth rate of the social security wealth decreased or even disappeared after 2005 for those groups with higher pension benefits, again due to the stepwise introduction of deferred taxation.

Couples' social security wealth results from the spouse's social security wealth and the possibility of receiving a survivor's pension. As a consequence, couples' social security wealth is larger than the sum of the social security wealth of a single men and women.

The social security wealth increases with the skill level (see Figure 2.13) since higher educated individuals have both larger pension claims and a higher life expectancy, thus a longer expected duration of pension benefits.

Figure 2.13: Average social security wealth of age group 60-64 in 1,000€ by education



Source: Own calculations.

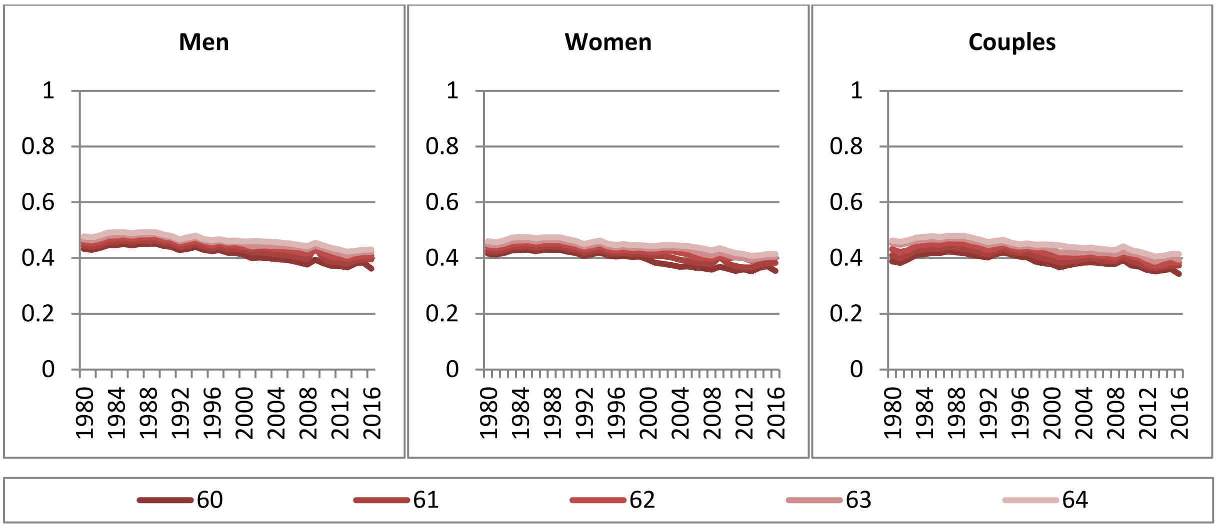
2.5.2 Common macro environment: replacement rates, social security wealth and its accrual

2.5.2.1 Replacement rate

As a next step, we apply common taxation in order to maintain comparability across all countries involved in the project.

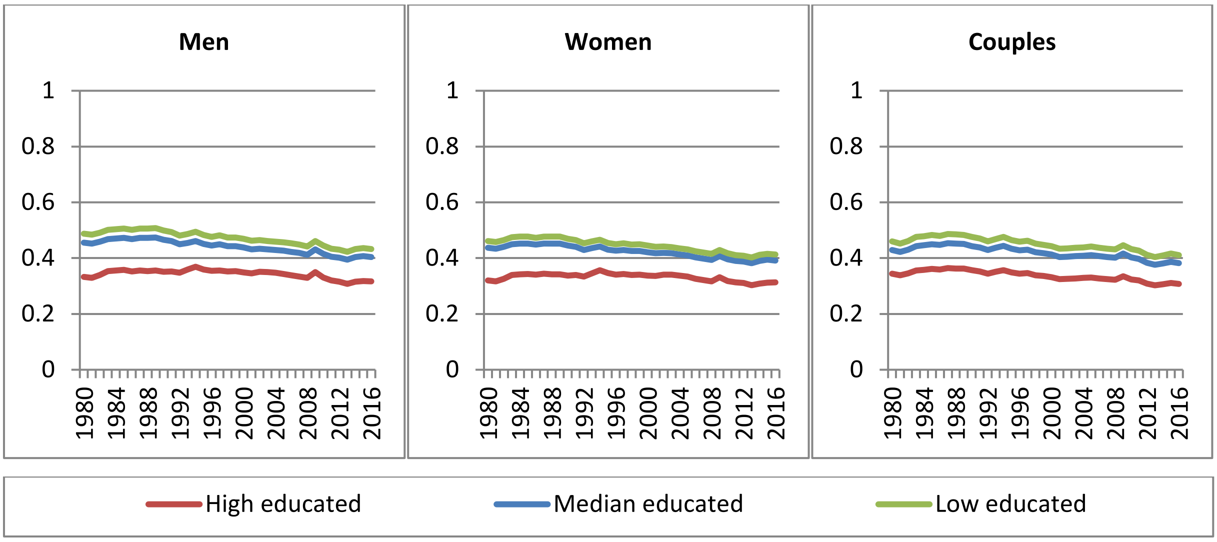
The respective net replacement rates are depicted in Figure 2.14. Due to the taxation of the pension benefits the replacement rates are much smaller than the replacement rates in Figure 2.10. Moreover, the development of the replacement rates under the common case assumptions is less volatile since the fluctuations caused by the changes in the time-specific German tax rates are smoothened. Moreover, the decrease in the replacement rates is less pronounced since the taxation of the pension benefits has led to a smaller influence of marginal changes in the pension level on the replacement rate.

Figure 2.14: Replacement rate for median educated men, women and couples by age (common case)



Source: Own calculations.

Figure 2.15: Average replacement rate of age group 60-64 by education group (common case)

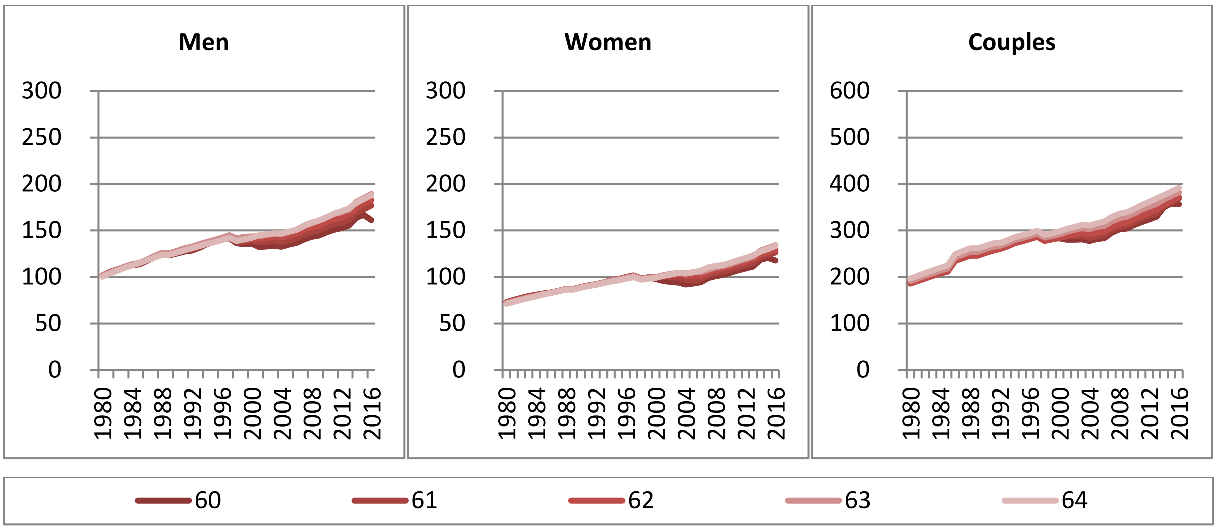


Source: Own calculations.

2.5.2.2 Social security wealth

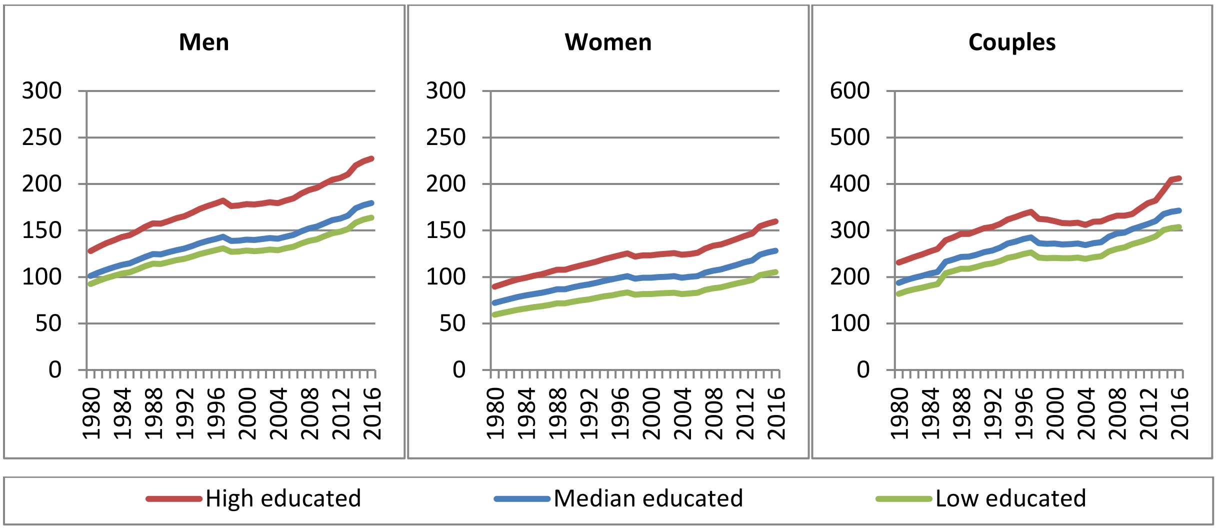
Figure 2.16 depicts the social security wealth of leaving the labor market immediately, now for the common case. Social security wealth is smaller in the common case since the OECD tax rates are considerable larger. Also the dynamics change: social security wealth increases after 2004 for both men and couples. This shows that the more or less constant social security wealth under German taxation is mainly a result of the introduction of the deferred taxation.

Figure 2.16: Median educated men's, women's and couple's social security wealth of leaving the labor market immediately in 1,000€ by age (common case)



Source: Own calculations.

Figure 2.17: Average social security wealth of age group 60-64 in 1,000€ by education (common case)



Source: Own calculations.

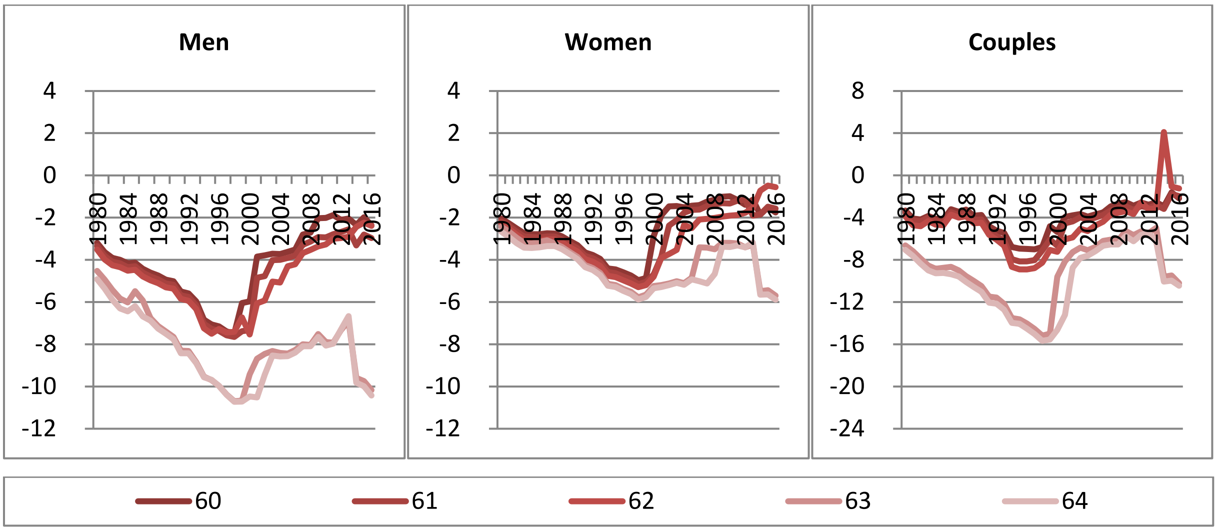
2.5.2.3 Accrual rates

We define the accrual of social security wealth as the change in social security wealth that workers expect when they postpone claiming benefits by one year. It is the numerator of the implicit tax on working longer as defined in Section 2.4.

Figure 2.18 shows the accrual for median educated single men, single women and couples while

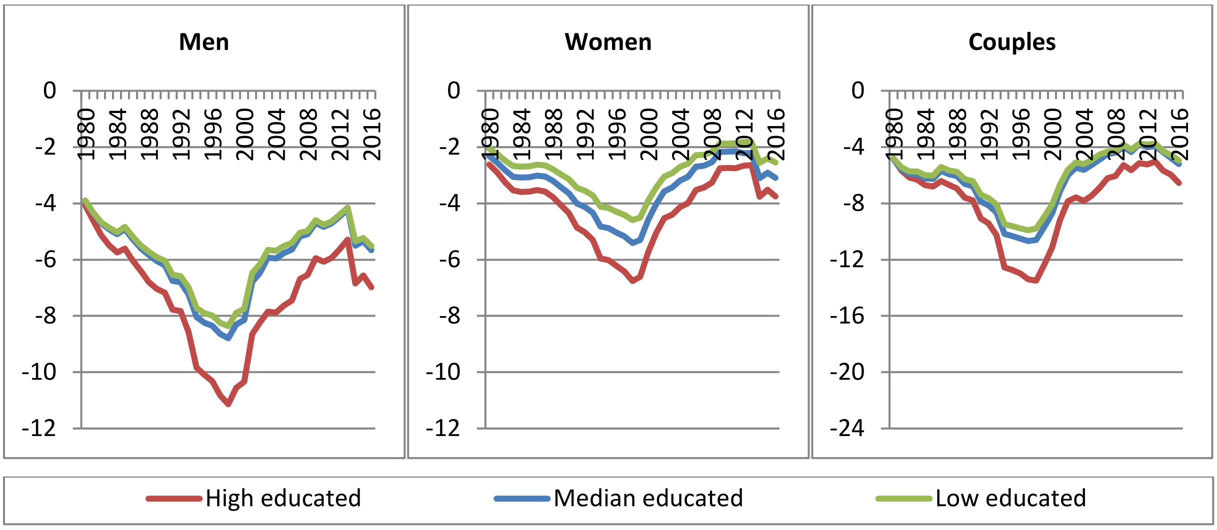
Figure 2.19 studies the variation by education/skill group. It is reported here for completeness and comparability to the other country studies in Börsch-Supan and Coile (2019). Since the accrual is qualitatively very similar to the implicit taxes, we relegate a detailed description to the following section.

Figure 2.18: Median educated men's, women's and couple's accrual of social security wealth of leaving the labor market immediately in 1,000€ by age (common case)



Source: Own calculations.

Figure 2.19: Average accrual of social security wealth of age group 60-64 in 1,000€ by education (common case)



Source: Own calculations.

2.5.3 Common macro environment: implicit taxes on working longer

Implicit taxes are defined as the accrual as shown in the preceding section divided by the most recent earnings. This section analyzes the median educated single men's case and proceeds with the median educated single women's and the median educated couple's cases. Section 5.4 discusses the differences between the three skill groups.

Figure 2.20 and Figure 2.21 display the median educated men's implicit taxes in the common macro environment. Figure 2.20 shows for all considered claiming ages the development of the implicit taxes over time. For readability reasons we divide Figure 2.20 into three subgraphs. The first one shows the implicit taxes for the early labor market exit ages between 55 and 59; the second graph contains the implicit taxes of the main early retirement window between 60 and 64; and the third graph depicts the implicit taxes at and after the statutory eligibility age. Figure 2.21 depicts the same data for a selection of four planning years (1985, 1995, 2005, and 2015) by age.[16]

We observe for almost each case positive implicit tax, hence incentives to leave the labor market immediately. A general exception is the age 65 and 66 with negative implicit taxes until 1992. The implicit taxes at age 55 to 57 lie over the whole observation time constantly around 19%. Hence, there exists already at those early ages an incentive to leave the labor market immediately. Until 1985 the implicit tax at the age of 58 had a similar level. However, this implicit tax rose by more than five percentage points when the extension of the duration period of unemployment benefits in 1985 (see Table 2.5).

Table 2.5 enabled individuals to build a bridge to retirement from this age on. Moreover, the implicit tax grew further in the early 1990s due to the general increase of unemployment. This process ended in 1996 when the first cohort who had to accept actuarial deductions for claiming an old-age pension due to unemployment at the age of 60 reached the age of 58.[17] In fact, the implicit tax even decreased as individuals can now avoid annual actuarial deductions of 3.6% by postponing claiming unemployment benefits and thereafter a pension to the following year. The overall deduction effect increased thereby over the introduction period of the actuarial deductions since the total deduction for claiming a pension at the age of 60 increased stepwise from 3.6% to 18% (five time 3.6%) (see Table 2.6). Since all actuarial deductions are introduced in an analogous pattern,

[16] Note that in both cases the same results are depicted. Only the considered dimension varies.

[17] Note that the 58 year old individuals draw unemployment benefits for the age 58 and 59 and claim afterwards their pension at the age of 60.

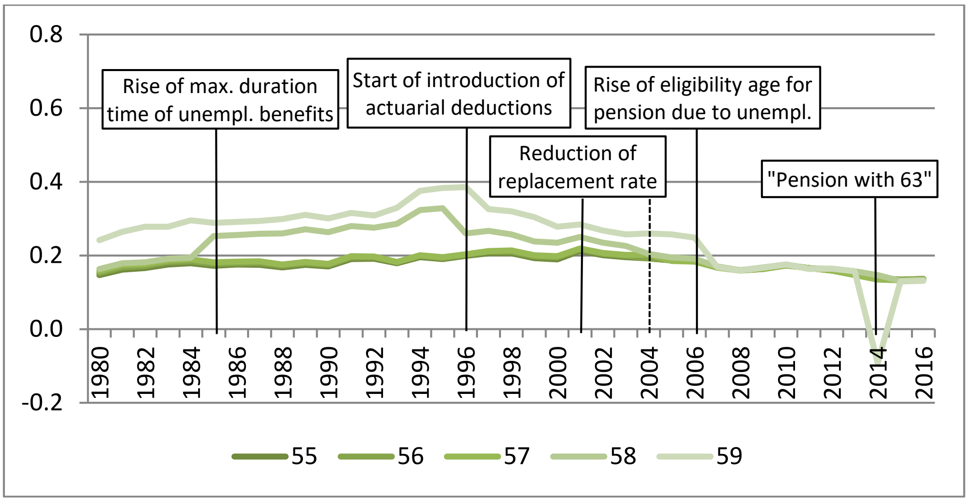
we observe a similar qualitative development for other ages. In the further process the implicit tax of age 58 went back to the level of the implicit taxes at ages 55 to 57. The main reason for this further decline is the abolishment of the old-age pension pathway due to unemployment (see Table 2.1). The pattern is similar for age 59. However, the implicit tax was from the beginning larger than for younger claiming ages since one year of unemployment benefits was sufficient to build a bridge to retirement. Moreover, the drop of the implicit taxes appeared two year later in 1998. This time lag results from the fact that the first cohort who had to accept actuarial deductions for claiming an old-age pension due to unemployment at the age 61 reached the age of 59 two years later. In general, we observe the same two-year time lag for all subsequent ages and cases (introduction of actuarial adjustment for other pension pathways like the old-age pension for women).

Between 1980 and 2000 the implicit taxes during the early retirement window (ages 60 to 65) were larger than the implicit taxes of the preceding claiming ages. Implicit taxes are around 35% for the claiming ages 60 to 62 and around 47% for the claiming ages 63 and 64. These rather large implicit taxes declined with the introduction of the actuarial deductions between 2000 and 2004. For the ages 60 to 62, the implicit taxes dropped by more than 25 pps to the level of the implicit taxes of the age group 55 to 59. This reduction occurs in two steps. The first drop results from the introduction of the actuarial deduction for the old-age pension for disabled the second one is due to the introduction of the actuarial deduction for the old-age pension due to unemployment. For the ages 63 and 64, the implicit taxes dropped by 11 pps to 40%. After the introduction of the actuarial adjustments we observe a further decrease of the implicit taxes which can be explained by the reduction of the replacement rates caused by the introduction of the sustainability factor. Contrary to this general trend, the implicit taxes of the claiming age 63 and 64 increased in 2014. The reason is the introduction of a new early retirement pathway called “pension with 63” which enabled individuals to claim a pension at age 63 and 64 without deductions (see Section 2.3). In fact, the increase of the implicit taxes match with the now abolished effect of the actuarial deductions.

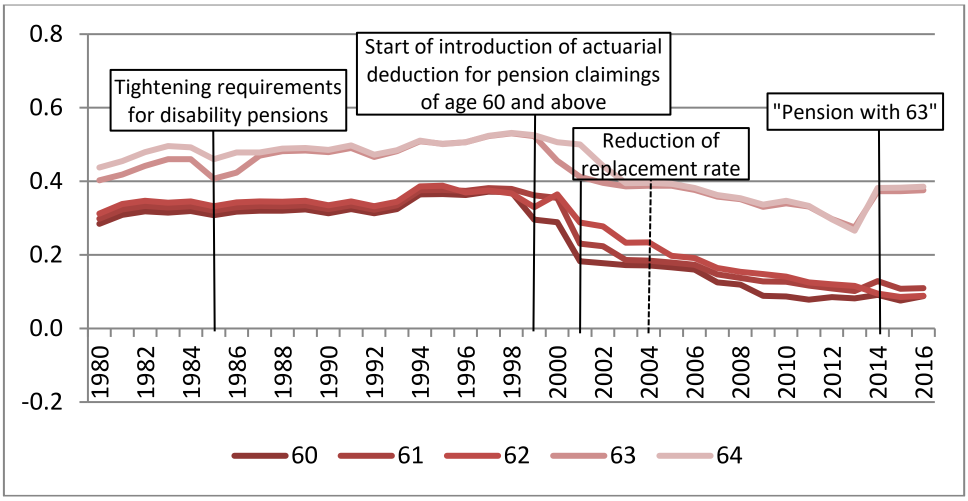
As already mentioned the implicit taxes of the ages 65 and 66 were negative until 1992. Hence, until 1992 there was an incentive to postpone the pension claiming beyond the age 65 and 66. On the other side, the implicit tax rates of ages 67 to 69 were extreme large with values above 60%. This apparent contradiction results from the actuarial supplements for postponing the pension claiming beyond the statutory eligibility age as they were organized until 1992. While actuarial supplements of 7.2% for postponing the pension claiming to the age of 66 and 14.4% for postponing the pension claiming to the age of 67 prevented positive implicit taxes (actuarial fair adjustments), there were no actuarial supplements for postponing the pension claiming beyond age 67. As the general actuarial supplements of six percent were introduced in 1992 the implicit taxes dropped consequently considerable for the claiming ages 67 to 69. All in all, we observe a reduction of more than 30 pps. The reduction was, thereby, larger for later claiming ages. However, the actuarial supplements for postponing the pension claiming at the age of 65 and 66 were reduced at the same time the implicit taxes of those claiming ages started to increase by approximately 20 pps which corresponds to the reduction of the former actuarial supplements. Similar to the claiming ages 60 to 64, the implicit taxes of the claiming ages 65 to 69 started to decrease in 2004 due to the introduction of the sustainability factor. For the most claiming ages, this decrease continued until today. An exception includes the claiming age 65 for which the implicit tax started to increase in 2012. The explanation for this opposite development lies in the increase of the statutory eligibility age from 65 to 67. The incentive to leave the labor market increases due to the fact that an individual does not anymore receive higher actuarial supplements for postponing the pension claiming beyond the statutory eligibility age but prevents only the smaller actuarial deduction for claiming a pension before his statutory eligibility age. Once the transition to the higher statutory eligibility age is completed, the implicit tax of the claiming age 65 should have risen to a similar level as of the implicit taxes of the claiming ages 63 and 64.

Figure 2.20: Median educated men's implicit taxes over time by age

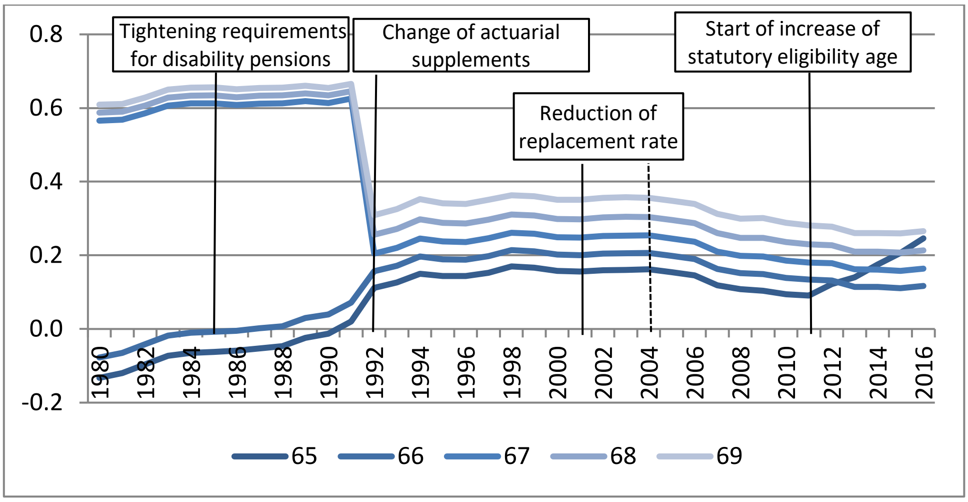
a) Implicit taxes for ages 55 to 59



b) Implicit taxes for ages 60 to 64

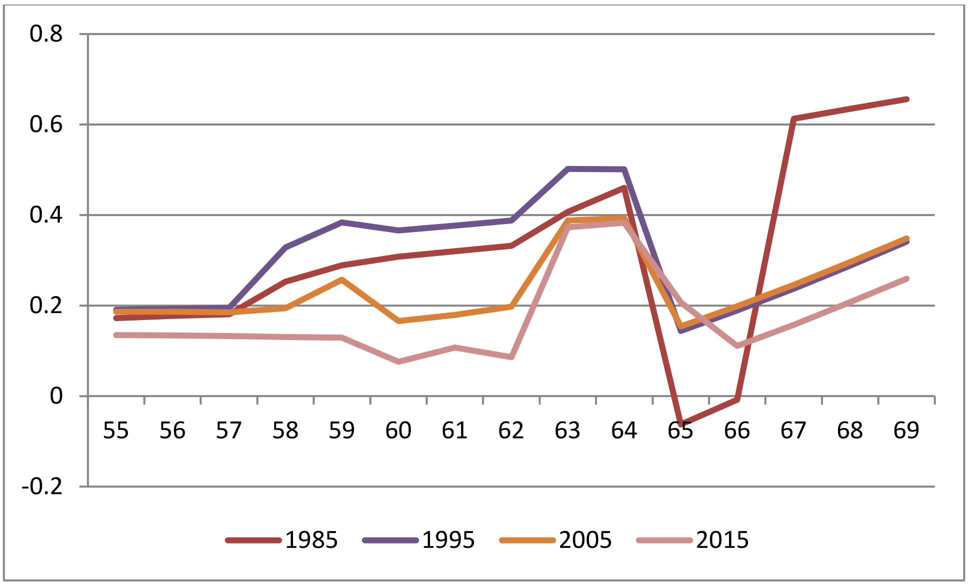


c) Implicit taxes for ages 65 to 69



Source: Own calculations.

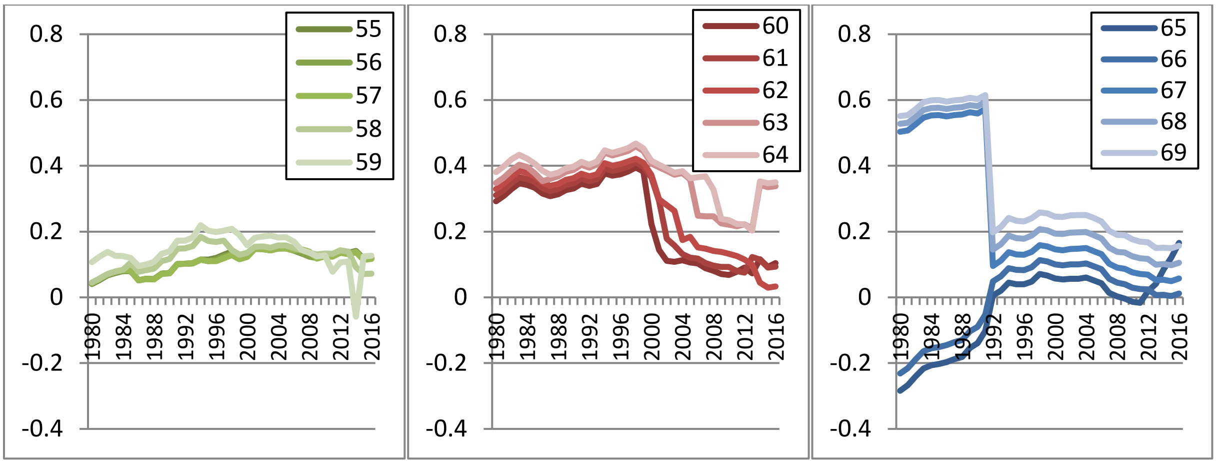
Figure 2.21: Median educated men's implicit taxes by age



Source: Own calculations.

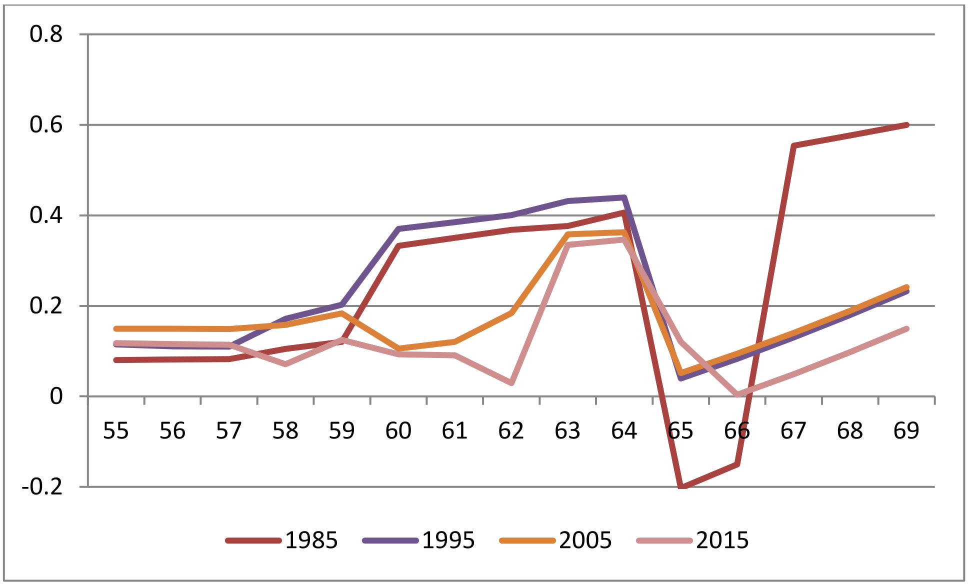
The women's implicit taxes developed in a similar manner as the men's implicit taxes (see Figure 2.22 and Figure 2.23). However, their implicit taxes are smaller due to their higher life expectancy, lower tax rates and smaller replacement rates. Moreover, there are some additional differences to the men's case. First, we observe a smaller differences between the implicit taxes of the claiming age 58 and 59 and the implicit taxes of the claiming ages 55 to 57. The main reason is that the distribution of the women's pension claims includes only a small fraction of old-age pensions due to unemployment. Hence the pathway via unemployment is less relevant in the women's case as compared to the men's case. Second, the implicit taxes at ages 60 to 62 are similarly large as the implicit taxes at ages 63 and 64. This can be explained with the old-age pension for women which enabled more or less all women to claim a pension at age 60 without eligibility requirements such as unemployment or disability. As shown in Figure 2.9 most women used this retirement pathway. As a consequence, the introduction of the actuarial deductions for the old-age pension for women had a very large effect on the implicit tax.

Figure 2.22: Median educated women's implicit taxes over time by age



Source: Own calculations.

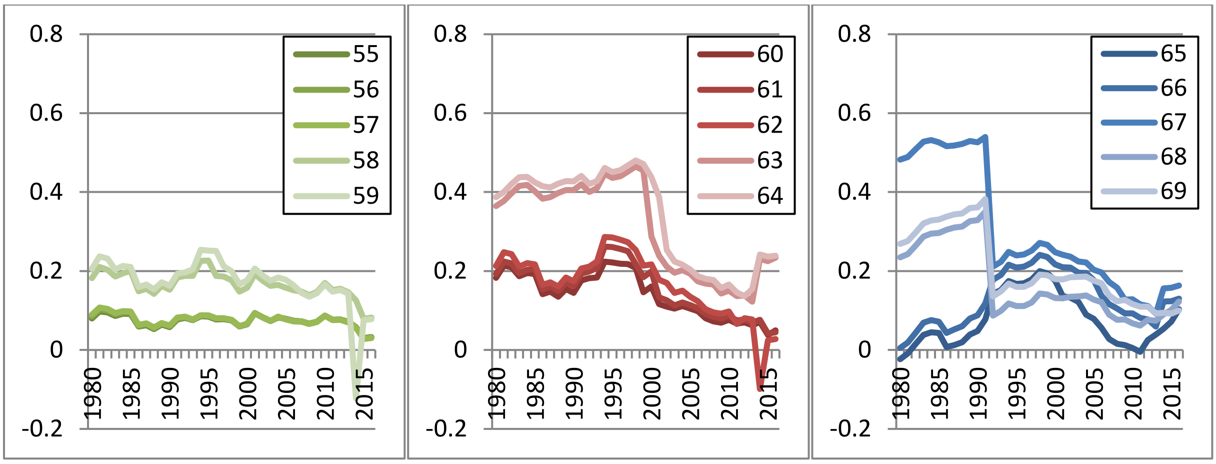
Figure 2.23: Median educated women's implicit taxes by age



Source: Own calculations.

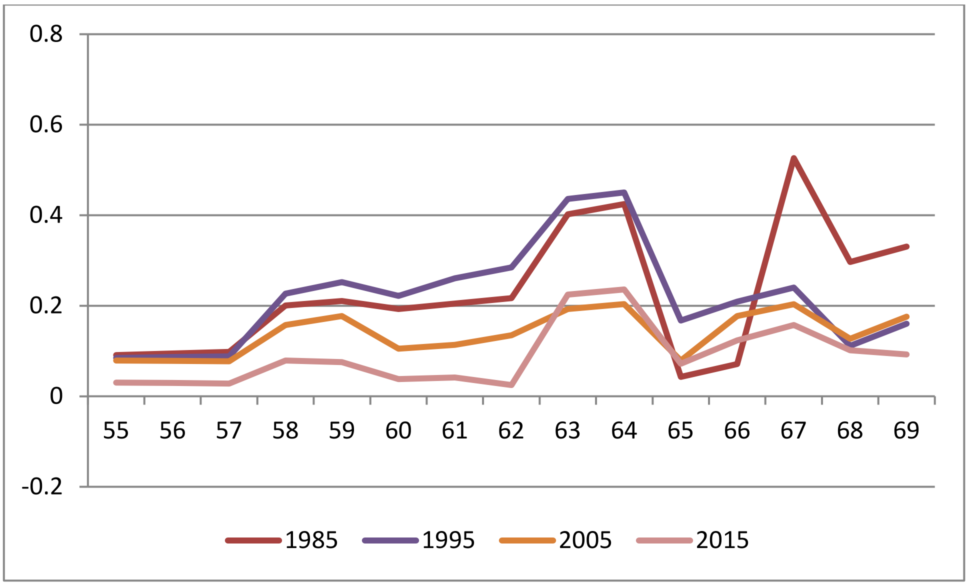
Finally, Figure 2.24 and Figure 2.25 depict implicit taxes for median educated couples. The claiming ages refer to the age of the husband; women are assumed to be three years younger. The general development is similar to the single household case. However, there are some differences due to the age differences of the spouses. For example, the implicit tax at the husband's claiming age 69 is smaller than in the single household case. The reason is that the wife is only 66 at this time. Hence, if the couple postpones claiming by one year, the women could gain the actuarial supplement for postponing the pension claiming beyond the statutory eligibility age. This had a large effect especially before 1992. Similar observations can be made for other claiming ages.

Figure 2.24: Median educated couple's implicit taxes over time



Source: Own calculations.

Figure 2.25: Median educated couple's implicit taxes by age



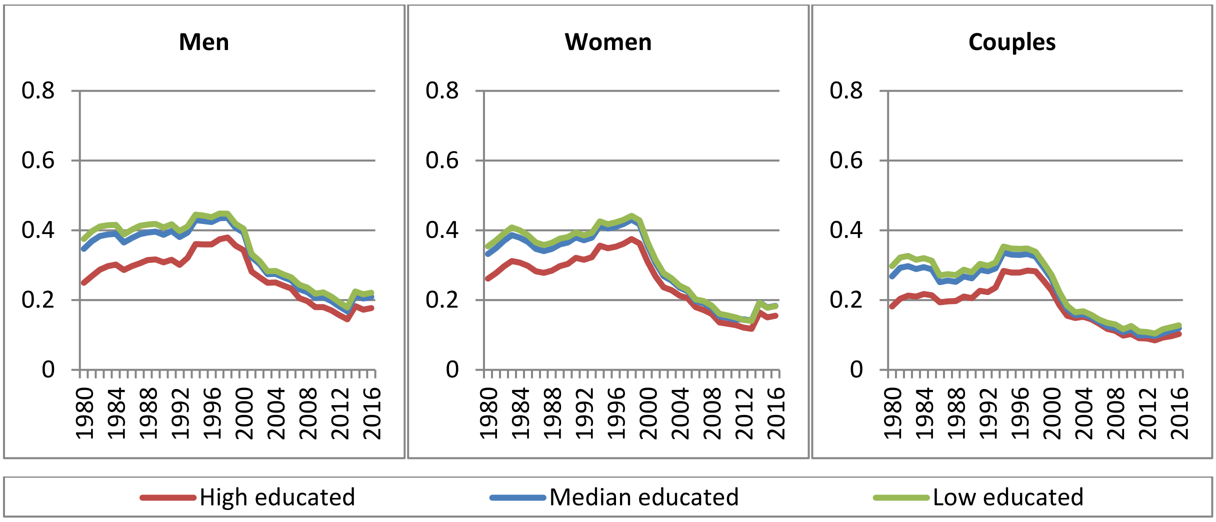
Source: Own calculations.

2.5.4 Implicit taxes on working longer by education/skill

So far, we have studied the implicit taxes for median educated individuals. This section looks at the differences across the three skill groups. We consider the average implicit taxes of the age groups from 60 to 64 only. Our findings are similar for other age groups. Figure 2.26 depicts the implicit taxes over time separately for single men, single women and couple by skill group. We can make two observations. First, the implicit taxes decrease with education. The gap is especially large between high and median educated individuals. Second, we observe that the gap between the implicit taxes decreases over time. This results from the introduction of the actuarial deductions since they have a greater effect on individuals with a lower life expectancy. Hence, the implicit taxes for low and median-educated individuals decrease stronger due to the introduction of the actuarial deductions than the implicit taxes for the high-educated.

More generally, the difference among the skill groups has three reasons: first, differences in the assumed life expectancy, second, different tax rates on the last labor income, and third, differences in the replacement rates. A higher life expectancy reduces the implicit tax since the additional pension claims for a postponement of claiming are received over a longer time horizon and offset a larger part of the pension benefits and contributions lost due to the additional working year. The relevance of the income tax rates and the replacement rates results from the division of the strictly gross income related additional benefits and contributions by the last net income.

Figure 2.26: Implicit taxes aggregated over age 60 to 64 by education group



Source: Own calculations.

2.5.5 German macro environment: the influence of changes in the taxation, cohort-specific income profiles and survival probabilities

We now switch from the common macro environment to the German macro environment. We discuss in which way taxation, cohort-specific income profiles and survival probabilities influence the implicit taxes. We start with taxation, then proceed with analyzing the income profiles and close with the survival probabilities.

Figure 2.27 depicts the average implicit taxes of single men, single women and couples at the claiming ages 60 to 64 for different taxations of the gross pension and labor income. All figures are aggregated over the three education groups. We consider three cases: first, the common taxation used in the common macro environment; second, the German taxation according to our tax calculator but without the introduction of the deferred taxation and finally German taxation with deferred taxation. The income profiles and survival probabilities remain as before and are taken from the common macro environment.[18]

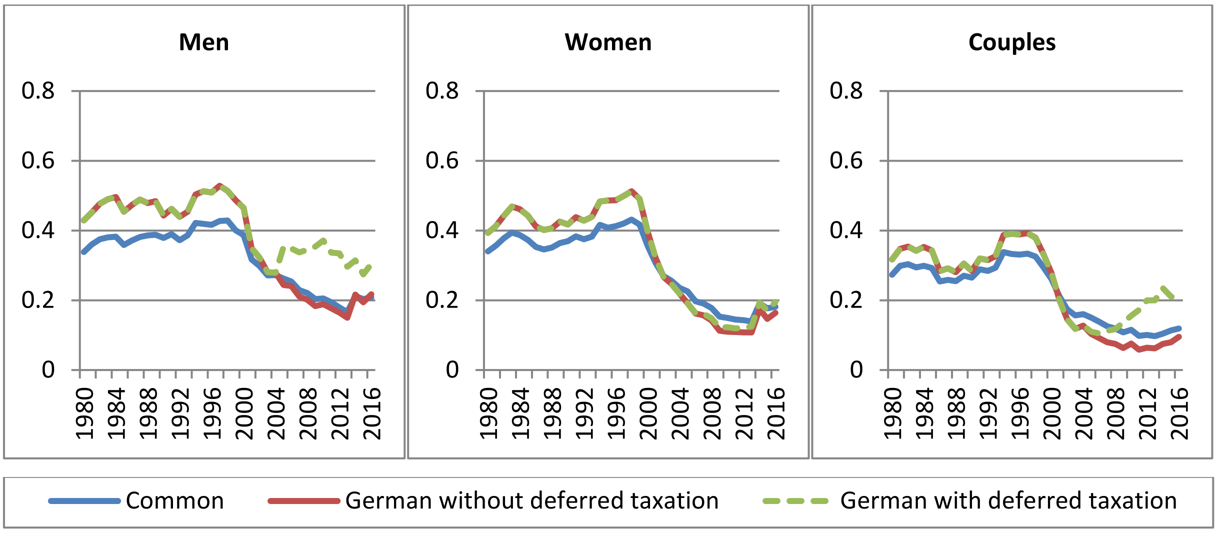
Until 2000, we observe for each case smaller implicit taxes under the common taxation than under the time-specific German taxation. The gap is larger for men than for women. It results from the fact that under the common taxation not only is the labor income taxed, but also public pension benefits. At the end of the 1990s, the gap becomes smaller and since 2000 the implicit taxes are larger under the common taxation than under the German time-specific taxation (at least if we do not consider the deferred taxation). This reversal is due to the introduction of the actuarial deductions which reduce the gain of claiming a pension immediately.

We have already shown that the deferred taxation has had a large influence on the determinants of the implicit taxes such as the replacement rate. Consequently, we also see a large reaction of the implicit taxes to the introduction of the deferred taxation, see Figure 2.27. The deferred taxation led to an increase of the implicit taxes for single men and couples. This effect is larger for higher claiming ages and conceals most of the effects that we have observed in the previous section, e.g. the effect of the “pension with 63” or the effect due to the increase of the statutory eligibility age. That we do not observe an effect on the women’s implicit taxes results from their rather small pension benefits and the large tax allowances which were granted at the beginning of the

[18] Note that the last case corresponds to the case for which we had presented the replacement rates and social security wealth shown in Section 2.5.1.

introduction of the deferred taxation. With the decrease of these tax allowances, women's implicit taxes will be similarly influenced by the deferred taxation.

Figure 2.27: Average implicit taxes (of ages 60 to 64) for common and German taxation

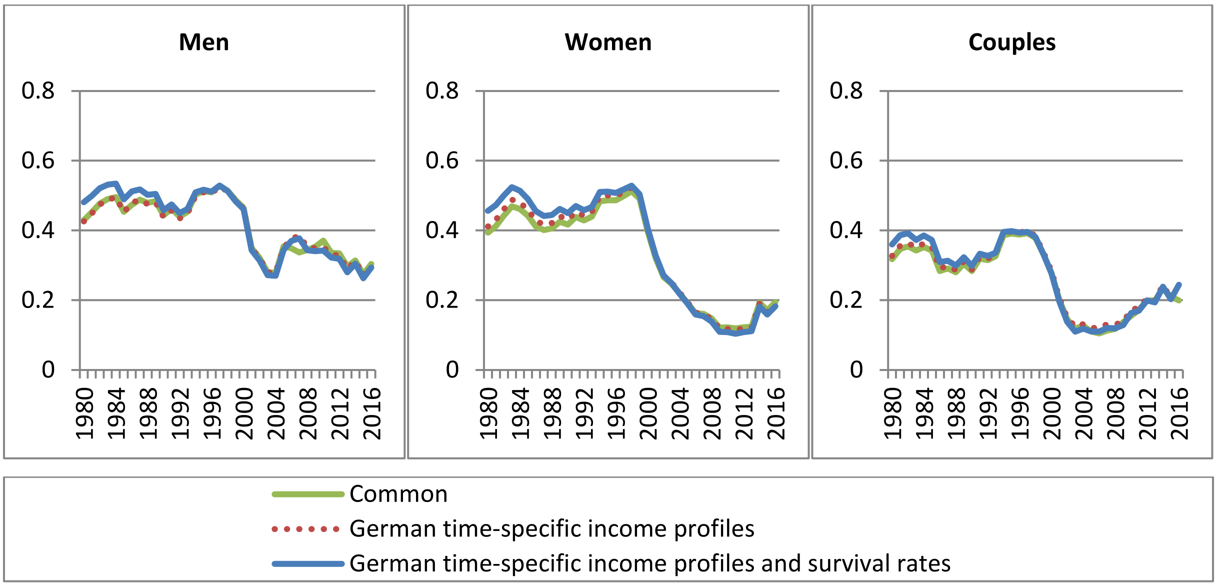


Source: Own calculations.

Figure 2.28 depicts implicit taxes for different income profiles and survival probabilities. The panel dubbed "common" depicts the implicit taxes for the common macro environment but with German taxation. The other two lines replace consecutively the common earnings profiles by German cohort-specific earnings profiles and the common survival probabilities by the German cohort-specific survival rates.

We do not observe relevant changes in the implicit taxes if we change the underlying earnings profiles. A somewhat larger effect can be observed when we change the underlying survival probabilities. Implicit taxes of earlier ages increase due to much lower life expectancies of older cohorts. However, this effect is rather small.

Figure 2.28: Average implicit taxes (of ages 60 to 64) for common and German cohort-specific income profiles and survival probabilities



Source: Own calculations.

2.5.6 Relation between implicit taxes and employment rates

This section graphically links the development of the implicit tax with the development of the employment rate.[19] We plot the average employment rates of older workers by age groups of 55-59, 60-64, 65-69 and 55-69 against the average implicit taxes of the same age groups. The result is shown in Figure 2.29. We first discuss the differences among age groups. For both men and women we see that younger age groups have large employment rates and smaller implicit taxes while the older age groups have smaller employment rates and higher implicit taxes. Hence, we observe a negative correlation between employment rates and implicit taxes.

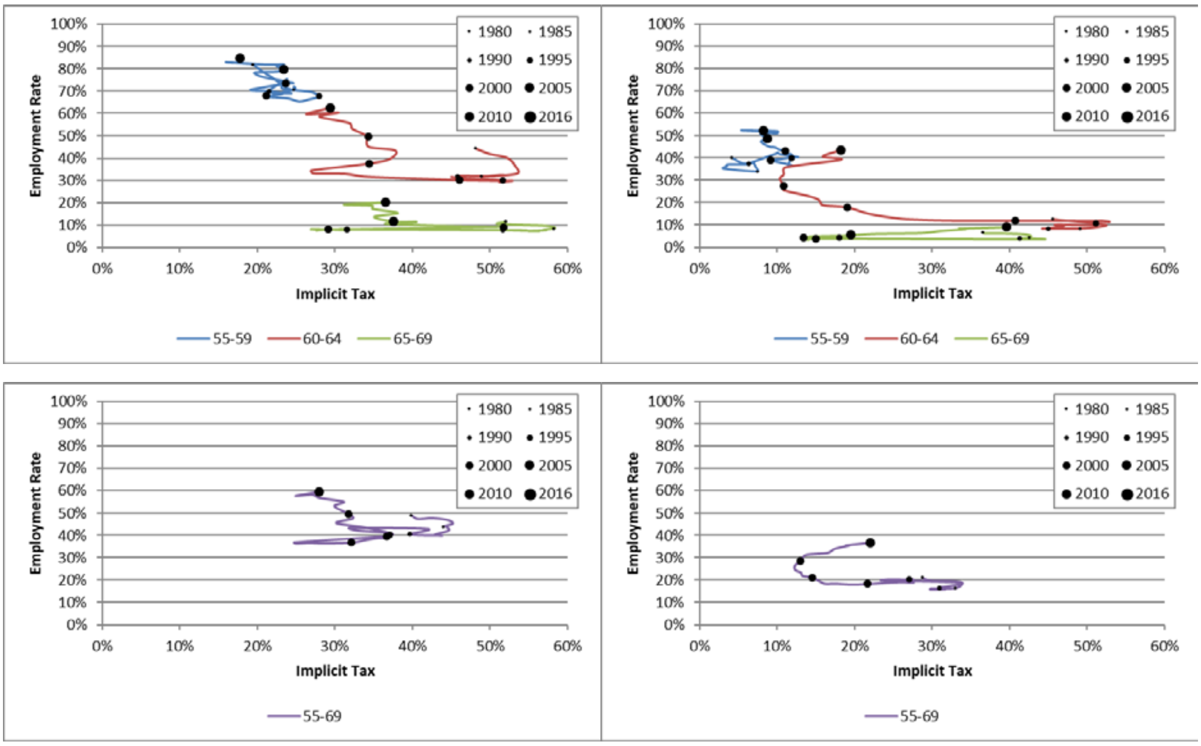
Within each age group, the picture is less clear. This is especially the case for the age group 55 to 59 since their implicit taxes did not change much for both single men and single women. For the age group 65 to 69, we observe for single men that the employment rate increases after the implicit taxes decreased. However, there seems to be a time lag between both events. In the women's case, the increase of the employment rate for the oldest age group is rather small. Moreover, the implicit taxes increased again after 2000 which yields a positive correlation. However, the increase of the implicit taxes results from the deferred taxation which may not yet be anticipated in the pension plans of older individuals. The picture is clearer for the age group 60 to 64. For instance, the men's

[19] In the women's case we will use the corrected employment rates.

picture resembles a U-shape. First, the employment rate decreased while the implicit tax remains at a high level of around 50%. The implicit tax then decreased very rapidly. At the same time, the employment rate starts to increase. This growth process accelerates and even continues after the implicit tax reached a new steady state around 25%.

Figure 2.29: Employment rate versus implicit tax

Single men **Single women**



Source: Own calculations.

The plot is quite similar in the women's case, although the initial decrease in the employment rate is missing. Another relevant difference is that the major part of the fast drop in the implicit tax happened in the women's case in one year while this process required three years in the men's case. On the other hand, the decrease of the implicit tax lasted longer in the women's case thus that the implicit tax decreased from 45% to a value below ten percent. However, the increase of the employment rate also starts in this case together with the decrease of the implicit tax. All observations taken together, we observe a negative correlation between employment rates and implicit taxes. The picture for the age group 55 to 69 is similar to the age group 60 to 64. However, the quantitative changes are smaller.

2.5.7 Relation between implicit taxes and pension claiming ages

Finally, we compare the development of the implicit tax with the distribution of pension claiming ages during the retirement window from 60 to 65. As mentioned before, we will consider hereby an alternative weighting procedure such that the implicit taxes may differ slightly from those just presented. However, the general development and the differences between the skill and age groups do not change.

For the pension claiming behavior at a certain age a two implicit taxes are relevant. First, there is the implicit tax of the previous age ($a-1$). If it becomes negative, it would indicate an incentive to postpone the pension claiming by one year. Hence, one year later the number of individuals claiming their pension at age a should increase. In fact, a decrease of the implicit tax at age ($a-1$) could lead to an increase of the pension claiming as the monetary incentive to claim their pension immediately declines. The other relevant implicit tax is the implicit tax of the current age. If the implicit tax becomes smaller or even negative, postponing the pension entry becomes less disadvantageous and can lead to a smaller share of pension claims at this age. Of course, there are other factors like the abolishment of early retirement pathways which may counteract to the implicit tax's effect on the pension claiming behavior.

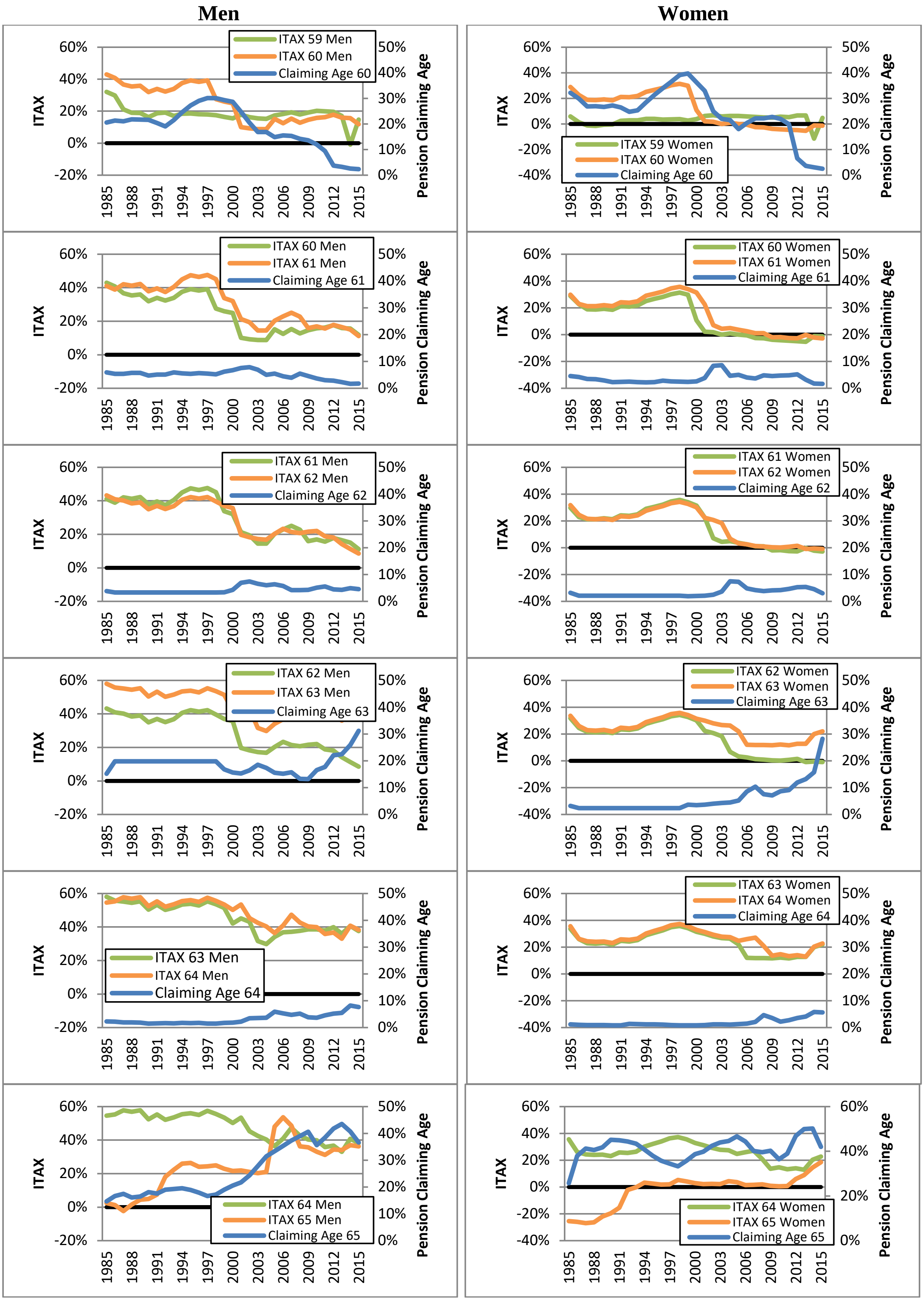
Figure 2.30 shows in separate graphs for each pension claiming age between 60 and 65 the development of its share on all pension claims of the respective year (left side: men, right side: women). Moreover, each graph includes the development of the implicit tax at the observed pension claiming age and the previous year. In general, our observations are in line with the previous discussions. We start with the pension claiming age 60. For both men and women, the implicit tax of the previous age (59) does not change in a relevant way. Hence, there are no changes in the incentive to leave the labor market at the age 59. On the other hand, there are quite large changes in the implicit tax at the age of 60 as we have seen in the previous section. In line with our previous argumentation these changes coincide with increases and decreases in the pension claims (i.e., higher (lower) implicit tax rates lead to more (fewer) pension claims). The decrease in pension claims after the introduction of the actuarial deduction and their impact on the implicit taxes is remarkable. Only the decrease in the pension claims after 2012 cannot be linked to a change in the implicit tax. In fact, the reason for the drop is the abolishment of the old-age pension for women and due to unemployment. Apparently, the abolishment of those pension pathways did not affect the implicit taxes of the age 60 since both the social security wealth with an immediate and with a postponed labor market exit are affected equally. For the pension claiming ages 61 and 62 the opposite happens. First, pension claims increase after the implicit tax of the previous age declined. Afterwards the pension claims decrease several years later together with the decline in the implicit tax of the considered age. Hence, the pension claiming rose only for a limited time together with the shift of the pension claiming from the age 60 to age 63 or 65.

For the pension claiming age 63 we have to differ between the men's and the women's case. In the men's case, the pension claims are rather constant until 2010. Smaller changes are again in line with the respective development in the implicit taxes. However, after 2009 the share of individuals who claim their pension at 63 increases rapidly. The main reason is that in 2009 the age 63 became for not disabled individuals the earliest eligibility age for an old-age pension. Moreover, the implicit tax still indicates a strong incentive to claim the pension immediately.

For women most of the observations are the same. However, due to the actuarial deductions and their higher life expectancy there remains no monetary incentives to leave the labor market before the age 63 since 2003. In fact, age 63 is the first age with positive implicit taxes. In line with our argument, pension claims at this age have increased since 2000, i.e., as soon as the actuarial deductions were introduced. The most recent and very strong increase in pension claims can be explained by the abolishment of the old-age pension for women. The pension claims at age 64 increase one year after the implicit tax of the previous age declined.

For the former statutory eligibility age of 65, we again need to differentiate between men and women. In the men's case we observe again the assumed development. Hence, the pension claims increase after the implicit tax at age 64 declines. At the same time, the implicit tax at age 65 are positive and even increased such that there is no incentive to further postpone pension claiming. For women, we observe an up and down in the frequency of pension claiming which corresponds to the observed development of the implicit tax at age 64. However, since the implicit tax at age 65 is approximately zero, there is no incentive to retire immediately which contradicts the observed high share of pension claims at age 65. The high share of initial pension claims at the historical statutory eligibility age 65, which is found in so many studies of retirement, may more be due to habit formation than to current monetary incentives.

Figure 2.30: Development of single person's implicit tax and pension claiming at different ages



Source: Own calculations.

2.6 Conclusions

Employment of older individuals in Germany has experienced a remarkable reversal around the late 1990s. After a long declining trend that began in the early 1970s, the employment rate for older men has strongly increased again. This increase has lasted until today. In contrast, employment of older women in Germany has experienced a less pronounced U-shaped pattern in particular because employment of younger women has steadily increased since the 1970s. This study has linked these trends to changes in public pension policies. The key instrument of our analysis is the concept of “implicit taxes on working longer” (ITAX) which represents the monetary incentives that individuals face in their labor supply and pension claiming decisions. In this article, we compute implicit taxes for a set of synthetic individuals differing by household demographics and education/skill, once based on a common macro environment across all 12 countries part of the International Social Security Project and once based on German age-earnings profiles, payroll taxes and survival probabilities.

We find that for both men and women the increase in the employment rate coincides with a reduction in the early retirement incentive expressed by the implicit taxes on working longer (Figure 2.29). The reduction of incentives mainly stems from the introduction of actuarial deductions for claiming a pension before the statutory eligibility age. In recent years, the employment rate additionally increased due to the abolishment of early retirement pathways for unemployed and women. We find similar correlations between the development of the implicit tax and actual pension claiming behavior (Figure 2.30).

The evidence in Figure 2.29 and Figure 2.30 is highly suggestive. However, these bivariate correlations of a relatively small set of synthetic individuals do not control for the many other potential explanatory factors and the heterogeneity in the population. This requires a much more elaborate multivariate analysis of actual individuals in panel data. The next step will therefore be devoted to a causal analysis of the role of public pension policies in shaping old-age employment. This is the objective of the following Chapter 3. We are doing this by constructing, for each individual, time series of the implicit tax. We will then use these incentive variables, the macro variables considered so far and other determinants on the individual level as explanatory variables in an econometric analysis of retirement and labor force participation.

3. Retirement Decisions in Germany: Micro-Modelling

This chapter was written in co-authorship with Axel Börsch-Supan, Irene Ferrari and Johannes Rausch.[20]

3.1 Introduction

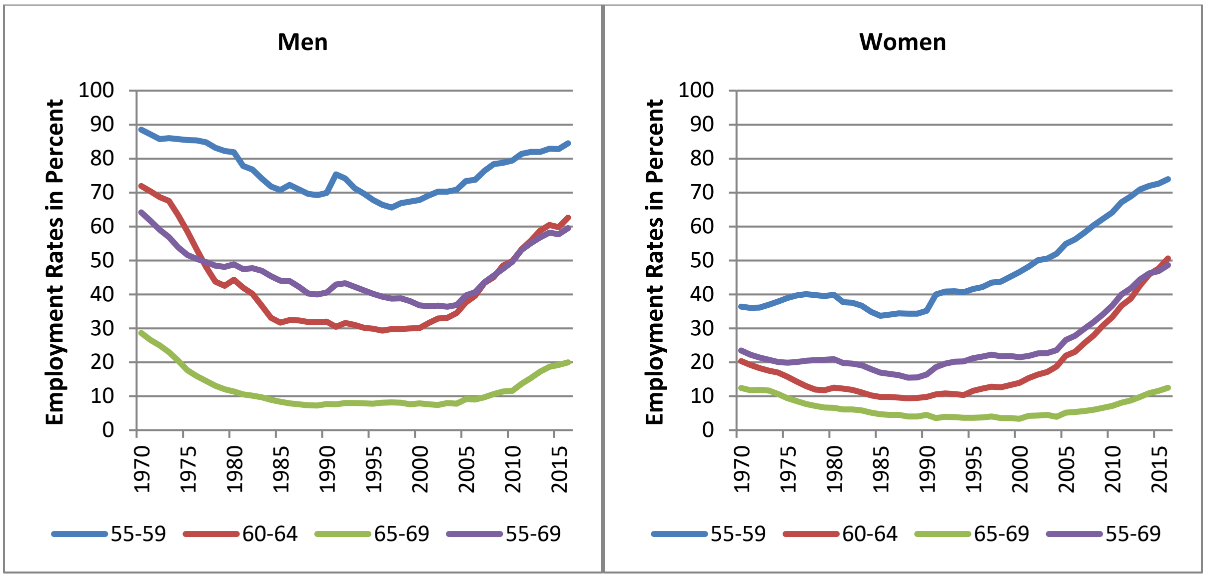
Employment in older ages has declined for a long time in Germany, even for women, reaching a level of only 36.8/21.5% (men/women) in 2000 for the 55-69 age group (see Figure 3.1). Since about 2000, however, working later in life has been making a stark comeback. West Germany has actually experienced the largest increase in the employment rate of the 55-69 age group in comparison to the other countries part of the International Social Security Project (ISSP). In 2016, the employment rate has reached a level of 59.5/48.6% (OECD 2018a). The trend reversal is particularly pronounced among men, while the picture is a bit more complex for women who experienced a rather constant increase for the 55-59 age group and a mild reversal for the other age groups.

Understanding the causes for this recent increase in employment is important if one wants to assess whether the current rising trend will continue, thus reducing the negative consequences of aging on fiscal sustainability. If the reversal is mainly caused by transitory or one-off events, old-age labor force participation may slow down again in the near future. However, if it is indeed caused by a structural change, we may expect a lasting impact on fiscal sustainability.

[20] This study uses data from German Socio-Economic Panel (GSOEP), data for years 1984-2016, version 33, SOEP, 2020, doi:10.5684/soep.v33, see Goebel et al. (2019).

Explaining the causes for this reversal with micro-econometric methods is the aim of the tenth phase of the ISSP. This chapter is the West German country study of this collaborative research project. It refers to West Germany in order to avoid confounding pension policy effects with the strong unification effects in East Germany after 1989.

Figure 3.1: West German employment rate by age group and gender



Source: Own calculations based on OECD and German Federal Statistical Office.

The evidence in the previous Chapter 2 suggested that much of the trend reversal of older men's labor force participation could be explained by changes in Germany's public pension rules, in particular by the phasing in of actuarial adjustments for early retirement. Regarding women's LFP, the picture was more complex. This suggests that the secular change of women's role in society was the main driver of the steadily increasing LFP among the younger West German women while there was a policy-related trend reversal among older women. However, these conclusions were based on aggregate data and stylized model households. The bivariate correlations do not control for the many other potential explanatory factors and the heterogeneity in the population. This requires a much more elaborate multivariate analysis. This is the aim of this chapter. We use micro data and structural policy changes since 1985 as instruments to draw causal inference on the effect of public pension rules on retirement and labor force participation choices at older ages.

In addition to public pension rules, other causes for the trend reversal in employment could be historical trends. Younger cohorts are healthier and have been better educated, permitting longer working lives. Moreover, the role of women in society has dramatically changed, affecting LFP of both genders. While a previous phase of the ISSP has shown that these secular developments have contributed astonishingly little to the trend reversal (Coile et al. 2019 for an overview; Börsch-Supan and Ferrari 2019 for Germany), we use a set of covariates to account for these changes.

Overall, this study contributes to the large empirical literature studying individual retirement responses to varying incentives in the old-age security system. The study is closely related to the work that was done by Gruber and Wise (1999, 2004), who investigated the effect of retirement incentives on the downturn of labor force participation of older individuals at the end of last century. They found that retirement incentives had a strong effect on retirement decisions. More recent empirical investigations have shown that specific reform devices have led to substantial reactions of older individuals' labor market behavior, albeit at varying magnitudes. Existing studies evaluated specific reforms such as the introduction of actuarial adjustments for early retirement (Hanel 2010, Engels et al. 2017, Giesecke 2018), the increase of the earliest eligibility age for early retirement (Geyer and Welteke 2017 and Geyer et al. 2020), the reform that increased the generosity of a specific early retirement pathway for individuals with at least 45 insurance years (Dolls and Krolage 2019), an earlier reform on supplemental pension benefits (Ye 2018), a reform on disability insurance (Hanel 2012), and whether the 2006 unemployment insurance reform affected older workers' labor market transitions (Riphahn and Schrader 2019). Beside financial incentives, Seibold (2019) found that reference point effects are a potential explanation of retirement patterns as well.

The key novelty of this study lies in investigating the reform effect of structural policy changes on retirement and employment choices at older ages over almost four decades. Within this observation period, Germany experienced a considerable reversal of employment rates and several reforms. However, limitations and questions for future research remain open. For instance, the analyses in this study primarily focus on how structural policy changes have influenced labor market behavior of the *average* older individual. However, the reforms may affect heterogeneous groups of individuals differently, depending on, e.g, the individuals' income situation, employment history or health (see, e.g., Giesecke 2018). Future research on the heterogeneous effects of structural policy changes can help to better understand the variety of reform effects.

The chapter is organized as follows. Section 3.2 provides a summary of the institutional changes and pension reforms in Germany that may be the causes for the observed trend reversal. Sections 3.3 and 3.4 are the main methodological parts of the chapter and describe our data (Section 3.3) and our main explanatory variable, the "implicit tax on working longer" (Section 3.4). Section 3.5 validates our pension calculator and Section 3.6 shows how we deal with expected pension benefits for all labor market exit ages of our retirement window. Section 3.7 presents our regression results. We then use these results to counterfactually predict what would have happened to labor force participation if the pension rules underlying the implicit tax on working longer had not changed since the 1980s (Section 3.8). Indeed, old-age labor force participation would have been substantially lower than it is today. Section 2.9 therefore concludes, that the negative correlation between the employment rate and the incentives to claim benefits early found in Chapter 2 has a causal interpretation: as the implicit tax on working longer decreased, employment at older ages increased.

3.2 German public pension system

In this section, we outline the German public pension system (*Gesetzliche Rentenversicherung,* GRV) and its general aspects. We primarily focus on the properties and the main mechanics we need for the analysis in this study. As this study is part of a multistage research project, a comprehensive analysis of the institutional details, the reforms process in the past decades and the resulting financial incentives for typical individuals has been carried out in the first step of this research project (see Chapter 2 of this dissertation).

The German public pension system was the first formal pension system in the world. It goes back to German Chancellor Otto von Bismarck, originally conceived as a funded disability insurance scheme in 1889. In the beginning, "old age" was classified as a subcategory of disability. "Disability benefits due to old age" were lower compared to real disability benefits and were granted starting from age 70. With further reforms in the following years (in particular in 1899, 1911, 1913, 1916), the scheme was broadened into a general old-age security system with disability pensions and mere old-age pensions. Benefits of disability pensions and old-age pensions were set on the same level and the coverage among workers and employees was increasingly enlarged. The eligibility age was lowered to 65 for employees in 1913 and for workers in 1916 (DRV 2020). After two world wars and a period of hyperinflation, about half of the capital stock was lost and the system was transformed into a pay-as-you-go (PAYG) system in 1957, where the pensions of current retirees are financed by the contributions of current workers.

The public pension system features a very broad coverage of workers. About 85% of the German workforce are part of the system. For most of the insurants, pension entitlements from the public pension system is the most important income source in old age. In fact, for the majority of the insurants, public pension benefits were even the only source of income in old age until the end of the 1990s. For this reason, the German public pension system was considered a monolithic pension system. Caused by the decline in birth rates since the 1970s and a parallel increase in life expectancy, demographic change has led to a paradigm shift at the end of the 1990s. With the 2001 pension reform the public old-age provision in Germany was transformed into a three-pillar system. In the three-pillar system, public pension benefits are still regarded as main source of income in old age (first pillar). However, in order to maintain their previous living standard, retirees are meant to top up public pension benefits with occupational pension benefits (second pillar) and benefits from private pensions (third pillar). Until today, first-pillar public pension benefits still shape the current retirees' income in old age. Second- and third-pillar benefits do play a minor role in providing old-age income. For that reason, we focus on the public pension system in our analysis.

Coverage and contributions. The scheme is mandatory for all private and public employees and covers about 85% of the German workforce. Civil servants, about 5%, are not part of the public pension scheme and have their own old-age provision scheme. With the exception of certain groups, the self-employed (roughly 10% of the workforce) also have their own pension systems.

Roughly 77% of the budget of the public pension scheme is financed by contributions of the insurants. The contributions are administrated like a payroll tax, levied equally on employees and employers. In 2018, the contribution rate was 18.6% on the first 78,000€ of yearly gross income. The latter is the upper-earnings threshold (*Beitragsbemessungsgrenze)* and represents about the double of the average yearly gross income of all insured individuals in the public pension system.[21] Technically, contributions are split evenly between employees and employers. The remaining approximately 23% of the public pension system budget is financed by governmental subsidies (*Bundeszuschüsse)*.

[21] The values refer to West Germany only (see DRV 2018).

Table 3.1: Pathways to retirement. Eligibility criteria

Pathway	Earliest eligibility age (EEA)		Years of service		Actuarial deductions*	Earnings tests	Other
(1) Regular OAP	Until 2012 65 (i.e. SEA)	After 2029 67 (i.e. SEA)	Until 1984 15	Since 1984 5	None	None	
(2) OAP for long-term insured	63		35		Yes	Yes	
(3) OAP for especially long-term insured	Increase from 63 to 65 until 2029		45		None	Yes	
(4) OAP for invalids	Until 2011 60	After 2025 62	35		Yes	(Yes)	At least 50% disabled
(5) OAP due to unemploym.	Until 1996 60	After 2002 63	15 (8 in last 10 years)		Yes	Yes	At least 52 weeks unemployed; Born before 1952
(6) OAP after part-time employ.	Until 1996 60	After 2002 63	15 (8 in last 10 years)		Yes	(Yes)	Two years part-time; Born before 1952
(7) OAP for Women	60		15 (10 after age 40)		Yes	Yes	Born before 1952
(8) Disability pension	–		Until 1984 5	Since 1984 5 (3 in last 5)	Yes	Yes	Medical exams

Note: * Actuarial deductions for early retirement were introduced between 1992 and 2004.

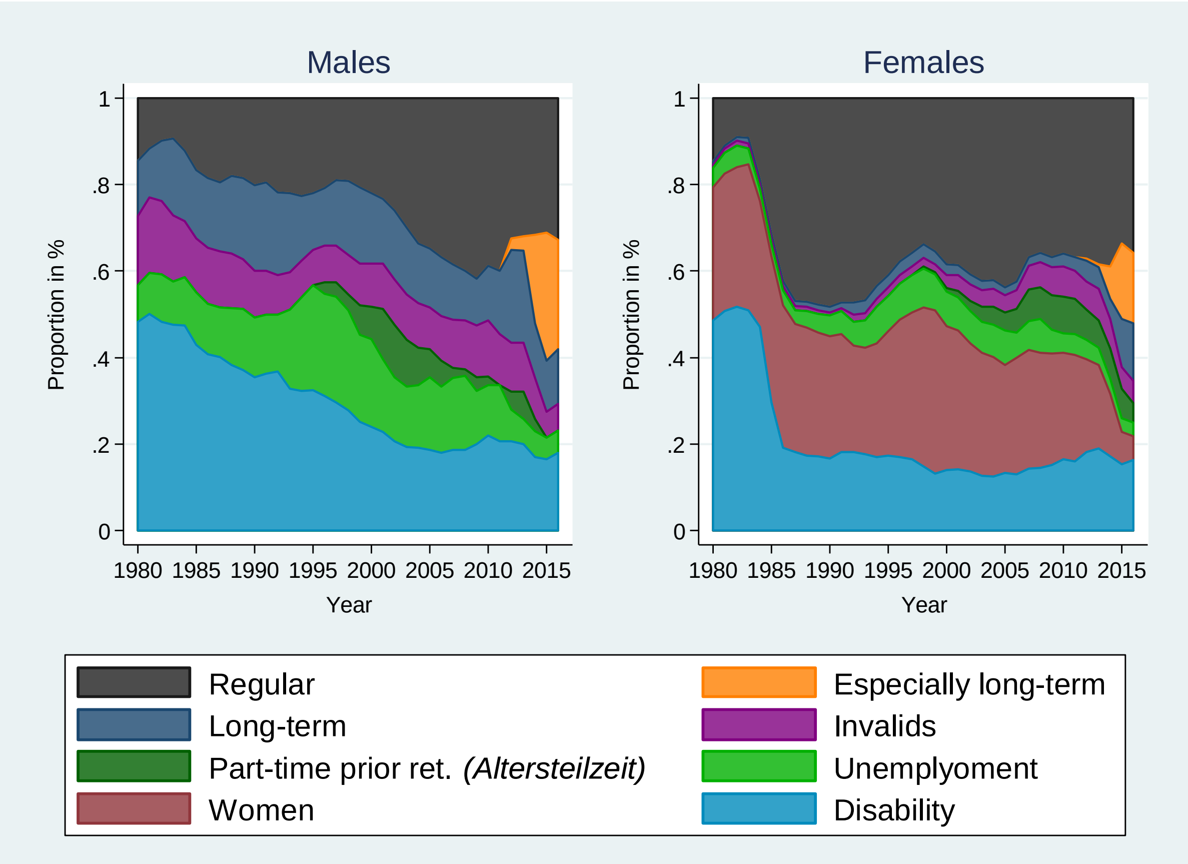
Source: Own table, see Chapter 2.

Eligibility and pathways to retirement. The German public pension scheme provides old-age pensions, disability pensions, and survivor pensions. In 2018, the German public pension system distinguished seven major types of old-age pensions (OAP) and disability pensions. Primarily, these are: (1) regular OAP, (2) OAP for long-term insured, (3) OAP for especially long-term insured, (4) OAP for invalids, (5) OAP due to unemployment, (6) OAP after part-time employment prior to retirement *(Altersteilzeit)*, (7) OAP for women, and (8) disability pensions.[22] Survivor pensions are

[22] The public pension system offers other very specific pension types like a separate old-age pension for miners. Measured against the total number of insurants, the number of individuals choosing one of the specific pension types is very low, so we do not consider these retirement pathways in our analysis.

not a separate pension pathway. Survivor pensions grant old-age pension or disability pension entitlements to a certain quota to eligible individuals after the death of an insurant. The pension types differ in eligibility criteria individuals have to fulfill to get access to their pension entitlements (Table 3.1). Regular old-age pension benefits can be drawn after individuals have reached the statutory eligibility age. The earliest eligibility age of the other pension types is lower than the statutory eligibility age and consequently offers early retirement. The old-age pension for invalids and the disability pension are slightly different from the other pension types since eligibility for those pension types additionally depend on the health status of an insurant.

Figure 3.2: Pathways to retirement, West Germany



Source: DRV (2019).

Figure 3.2 shows the uptake of the various pension types in West Germany over nearly the past 40 years. For each year the graph shows – separately for men and women – the proportion of each pension type on all newly claimed pensions in that particular year. For example, in 1980, about 15% of all new pension claims chose a regular old-age pension and, almost half of the new retirees claimed a disability pension. Figure 3.2 depicts how the different retirement pathways evolved over time, mostly in response to reforms, benefit adjustment, and institutional rule changes (e.g.

tightening of the disability screening process, for details see Chapter 2). The figure shows the multitude of possible retirement pathways. A major undertaking of this paper is to account for this diversity.

Benefits and taxation. Pension benefits of the PAYG public pension system are related to the individual earnings and contributions history. Pension benefits are computed according to the pension benefit formula as the product of two individual components (1, 2) and two universal components (3, 4): the individual components are (1) the sum of earnings points an individual has accumulated over her working career (*Entgeltpunkte)* and (2) an access factor which captures actuarial adjustments for early or late retirement *(Zugangsfaktor).* The universal components are (3) the current pension value *(aktueller Rentenwert)* and a (4) pension type factor (*Rentenartfaktor).*

(1) The sum of earnings points represents the individual earnings history. The earnings points ensure a relation between earnings and benefits (exceptions for care, unemployment, disability etc.). Earnings points are calculated by dividing the individual gross income by the average income of all insurants in the public pension system. If the individual's earnings are exactly the average gross earnings of all insurants, then this individual receives one earnings point. Half the average gross income entails 0.5 earnings points, etc. The official government computations, such as the official replacement rate (*Rentenniveau),* are based on a pensioner with forty-five contributions years and average earnings in each year. This standardized pensioner *(Eckrentner)* accumulates exactly forty-five earnings points. (2) The access factor *(Zugangsfaktor)* captures actuarial adjustments for early or late retirement. Actuarial deductions apply if individuals claim pension benefits before the statutory eligibility age. For each year of early retirement, pension benefits are reduced by 3.6%. In the 1992 pension reform, actuarial supplements for late retirement were adjusted. Late retirement is the practice of postponing benefit claiming beyond the SEA. For each year of late retirement, actuarial supplements of 6% are granted for postponing the pension claiming beyond the statutory eligibility age.[23] The factor equals one if individuals claim pension benefits at the statutory eligibility age or a pension-type-specific full rate age where no adjustments apply (e.g. age 63 for individuals born until 1952 with forty-five service years). (3) The current pension value indicates the relationship between average earnings and pension benefits. The current pension value is the amount of monthly pension benefits related to one earnings point.[24] Each year, the current pension

[23] Actuarial supplements were already introduced in 1972. Until the 1992 reform, however, only for two years of late retirement actuarial supplements in the amount of 7.2% applied (i.e. until age 66 and 67).
[24] Note that the pension benefit calculation is the base in the computation of social security wealth in Section 3.4.

value is replaced with a new value by law. (4) The pension type factor (*Rentenartfaktor)* reflects the type of pension and the percentage of pension entitlements. The pension type factor is for example one for old-age pensions and full disability pension benefits, and 0.55 (0.6 until 2001) for full survivor benefits (*große Witwen-/Witwerrente)*.

Until 2004, pension benefits were only taxed if benefits surpassed a quite large allowance. This affected only relatively few cases. With the 2004 pension reform coming into effect in 2005, deferred taxation of pension was introduced. Thus, contributions to the public pension system became tax exempted and the pension benefits taxable. To prevent a double taxation the reform included a generous transition period until 2040.

3.3 Data and variable specification

In the following sections, we will introduce our main data source, the German Socio-Economic Panel (GSOEP), and we will describe our strategy for constructing the income profiles using the panel data. We will then explain how we define retirement status – our outcome variable – and how we handle the choice of multiple retirement pathways. Finally, we will check our pension calculations against the actual pension received by individuals, as reported in GSOEP.

3.3.1 The German Socio-Economic Panel

The German Socio-Economic Panel (GSOEP) is a representative longitudinal study of private households (see Goebel et al. 2019). Interviews take place annually and the sample size has currently reached around 30,000 respondents in around 11,000 households. GSOEP was started in 1984 and we include waves up to 2015, therefore we can count on 32 consecutive years of data. This is particularly convenient for the current analysis, as this time span includes the reversal of older men's labor force participation since around the late 1990s. Furthermore, several pension reforms were implemented during these years which provide variation in pension incentives necessary for the identification of our retirement model.

GSOEP includes several subsamples, each with different sampling probabilities that were chosen to ensure that the number of cases are large enough for separate analyses of each sample.[25] We draw

[25] The subsamples consist, among others, of West German citizens, East German citizens, immigrants, high income individuals, as well as several refreshment samples.

our sample from the sample of West German citizens, as retirement patterns in East Germany are affected by the transition to a market economy and slightly different pension rules.

The data provide information on all household members and contain a stable set of core demographic and economic questions, including labor market status, gross and net income, hours worked, education and marital status. Since each member in the household is interviewed, we have the same information for both spouses.

A further advantage of the dataset is the possibility of constructing individuals' labor history since the age of 15. Individuals are asked once to provide information on their activity status over their entire life course up to the time of the interview. The information provided is in the form of spells of activities and distinguishes between time spent in education, doing apprenticeship or training, in the military force or community service, in full-time employment, in part-time employment, unemployed, out of the labor force or pensioner.

This retrospective occupation history can be integrated with information on the activity status during the sample period, as GSOEP also collects detailed information on occupation in the form of a calendar, with monthly information on labor market status.

On the other hand, while information on labor income is available for the sample period, no retrospective information is available. Furthermore, the dataset includes little or irregular information on health – especially objective measures of heath – and on household wealth.

Our sample selection is mostly based on two criteria. The first one is age: we keep individuals aged 55 or above until retirement, or until age 70 if they are not yet retired by this age. Second, we only keep employees of the private and public sector, therefore excluding civil servants and self-employed workers, as participation in the public pension system is not mandatory for these two latter categories of workers. This leaves us with around 5,000 individuals and 21,000 panel-year observations, with an average and median observation time equal to 4.2 and four years, respectively. In Table 3.2, we show some descriptive statistics of the main variables in our sample.

Table 3.2: Descriptive statistics of main variables

Variable	Valid observations	Mean	Standard Deviation
Age	21,195	58.54	2.76
Male	21,195	0.54	0.50
Married	21,020	0.77	0.42
Medium education	21,179	0.67	0.47
High education	21,179	0.14	0.34
Number of children	21,195	1.90	1.34
Home owner	20,596	0.59	0.49
Health satisfaction	20,980	6.31	2.16
Experience	21,195	33.56	8.87
Full-time	21,195	0.55	0.50

Source: Own calculations.

3.3.2 Income profiles

As explained above, GSOEP allows constructing the whole employment history of individuals. Information on labor income, however, is only available for the sample period. Since the pension benefit formula depends on earnings points (EP) – computed from the relative income position of the individuals with respect to the "average" earner – we need to predict each individual's history of earnings points, rather than incomes.

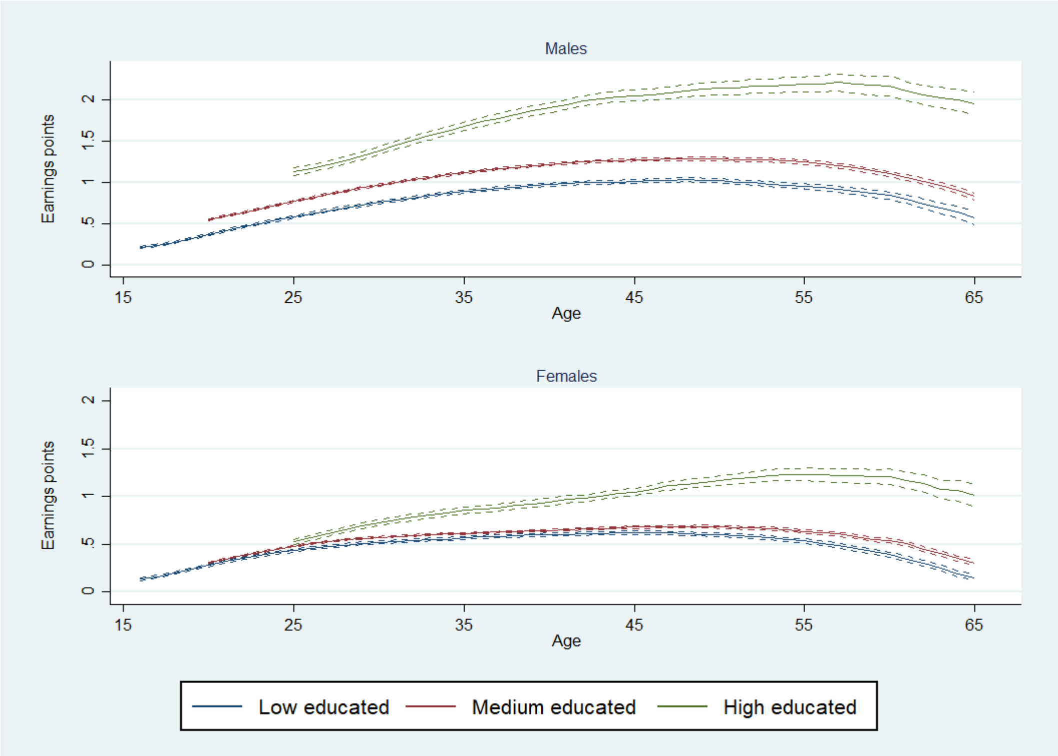
In order to do so, we calculate the earnings points position of all individuals in the sample who are working full- or part-time and earn a positive wage. Then, we estimate a fixed-effects earnings points model on the same sample of individuals:[26]

$$EP_{it} = \alpha + \beta_1 age_{it} + \beta_2 age_{it}^2 + \beta_3 exper_{it} + \beta_4 exper_{it}^2 + \beta_5 exper_{it} * educ_i + \beta_6 parttime_{it} + a_i + u_{it} \quad (3.1)$$

We include quadratics in age and experience, an interaction effect between experience and education, and a dummy indicating part-time status. The fixed effects absorb all individual constant characteristics. Finally, using the estimated model, we predict EP for the pre-survey years.

[26] The sample size used in this exercise amounts to 189,683 individual-year observations and 30,400 individuals.

Figure 3.3: Earnings points profiles by gender and education

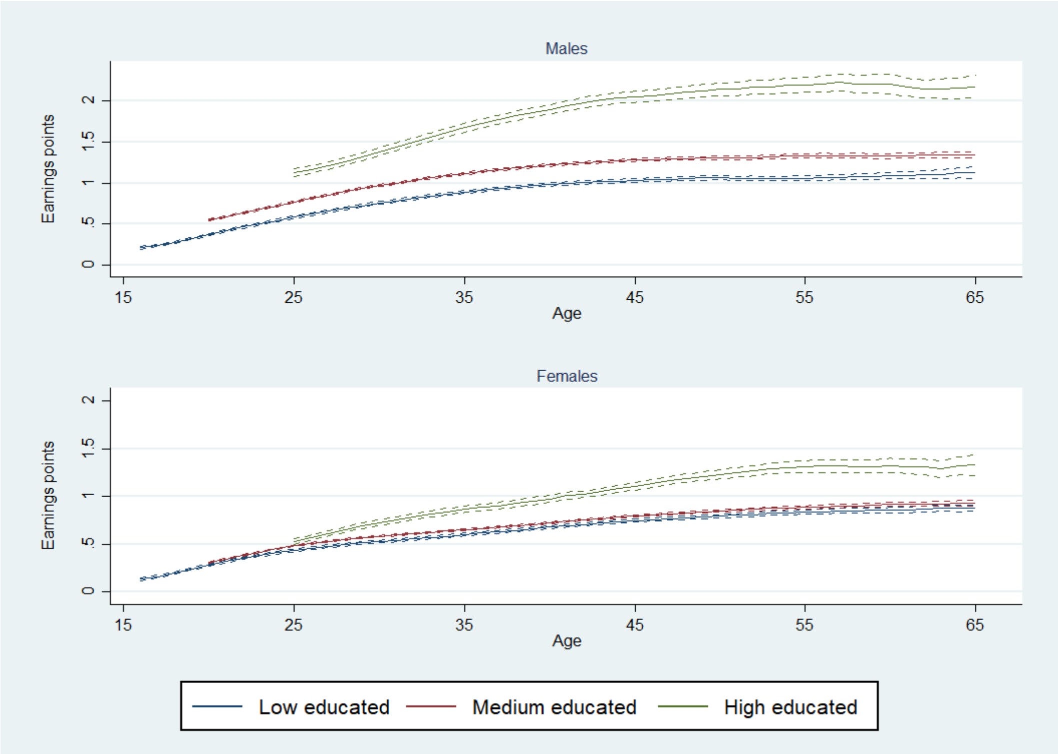


Source: Own calculations.

In Figure 3.3 we show our predicted profiles for three education levels, separately by gender. A decreasing EP profile in the last part of the working life clearly emerges from this graph. This is quite surprising, since it is shown in the literature that hourly wages do not decline at later ages (see Myck (2010) for evidence on Germany, Charni and Bazen (2017) for evidence on the UK). At the same time, hours of work do not dramatically decrease for men. In our sample the proportion of men working part-time increases from 2-3% to almost 7% at 63 with a peak of 9.6% at 64. For women, the proportion working part-time is around 50% at earlier ages, and it reaches 70% by age 65. Unlike men, for women this steep increase is mostly due to a selection effect, whereby women working full-time leave the labor market earlier. In any case, we observe the same EP pattern even when we restrict the analysis to only full- and only part-time workers.

A possible reason for the pattern of our predicted profiles is that we observe a too short period of a panel which does not allow fully controlling for cohort effects. Indeed, the average and median observation periods of the EP estimation sample are only six and four years, respectively. At the same time, there may be a reduction in hours that are not accounted for by a simple part-time dummy. Finally, there may be selection into retirement of higher income individuals.

Figure 3.4: Earnings points flat profiles by gender and education



Source: Own calculations.

As the evidence seems to point to rather flat income profiles at the end of the working life, we will assume flat profiles after each individual's income peak, and proceed with the analysis under this assumption. Figure 3.4 displays the EP profiles we obtained under this assumption for three different education levels and separately by males and females.[27] However, we will also run robustness checks where we use the unadjusted profiles.

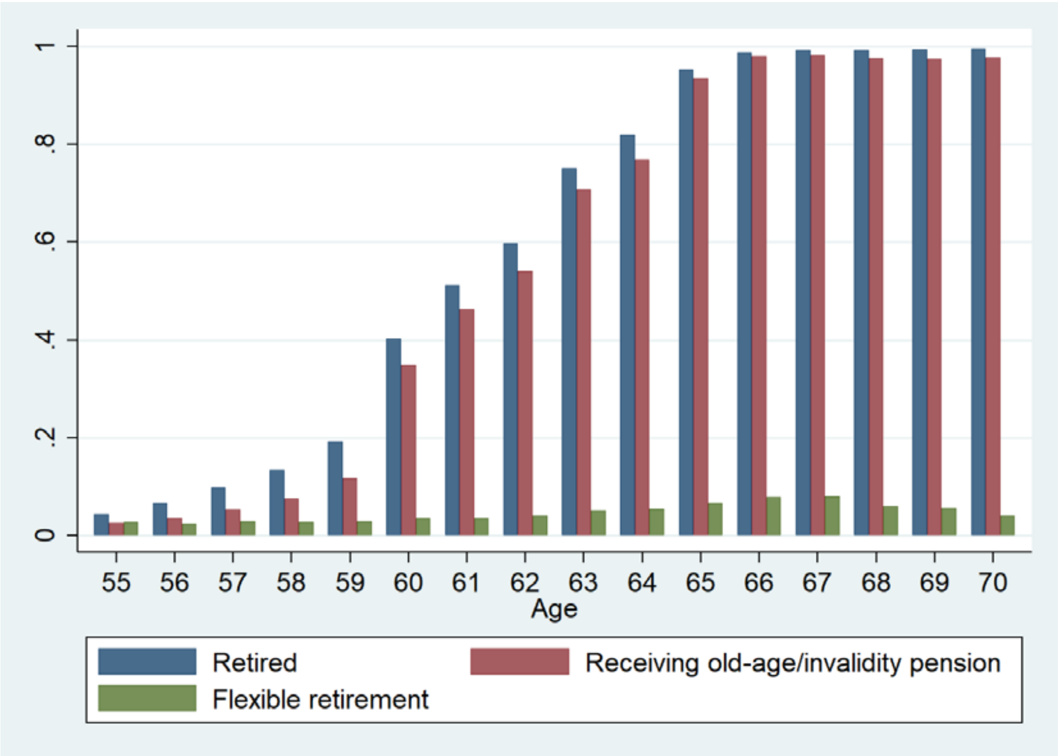
3.3.3 Definition of retirement status

The definition of our outcome variable – retirement status – is not trivial. There are at least two possible interpretations of it: one coincides with exit from the labor force, the second with the start of pension benefits claiming. Furthermore, the distinction between these two definitions is often not clear-cut. Indeed, individuals could receive pension benefits and simultaneously continue working or go back to work; alternatively, they could claim they are retired when receiving sources of income other than pension benefits, like severance payments or unemployment benefits.

[27] We assume different ages of entry into the labor market depending on the level of education: 16 for the low-educated, 20 for the medium-educated and 25 for the high-educated.

Understanding the relative importance of these potential definitions in Germany is crucial to model the retirement decision meaningfully.

Figure 3.5: Retiring, benefit claiming and flexible retirement

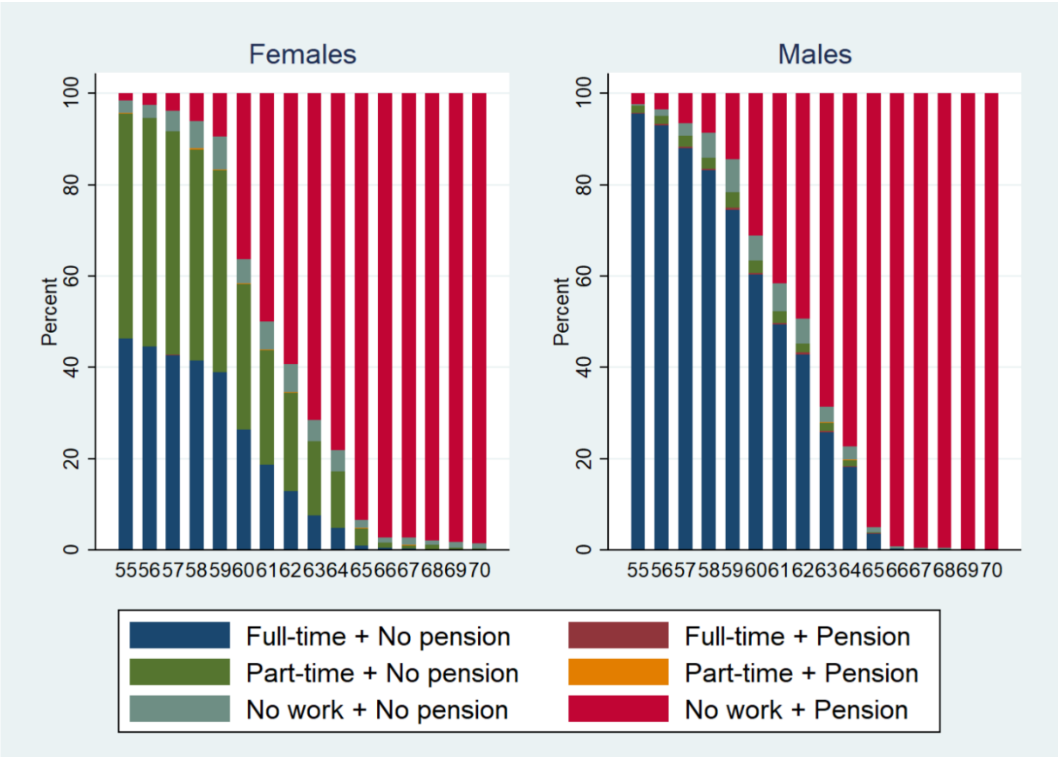


Source: Own calculations.

In Figure 3.5, we show the percentage of workers who retire at each age, conditional on having worked until that age. We distinguish between three possible definitions of retirement. The first definition, that we label "Retired", is simply based on the individuals' self-reported labor market status. The second definition, "Receiving old-age/invalidity benefits", is based on a question asking individuals what sources of income, if any, they received in the previous year. Finally, "Flexible retirement" is defined as claiming to be retired and simultaneously in full- or part-time work for at least two consecutive months, when asked about labor market status.

From this graph, we can first of all learn that the majority of individuals in Germany identify retirement with pension benefit claiming. However, the self-assessed notion of retirement is more general than this, as a significant portion of retired individuals at earlier ages do not receive pension benefits. Other individuals, on the other hand, claim they are simultaneously working and in retirement. Most likely, these individuals receive other types of income sources (e.g. severance pay), or are employed within the "block model" of the gradual retirement scheme for employees over 55.[28] Nevertheless, flexible retirement is a rather marginal occurrence, thus we do not deem it necessary to model it formally. From now on, our definition of retirement will be based on the self-reported labor market status of respondents.

Figure 3.6: Working status and benefit claiming by age and gender



Source: Own calculations.

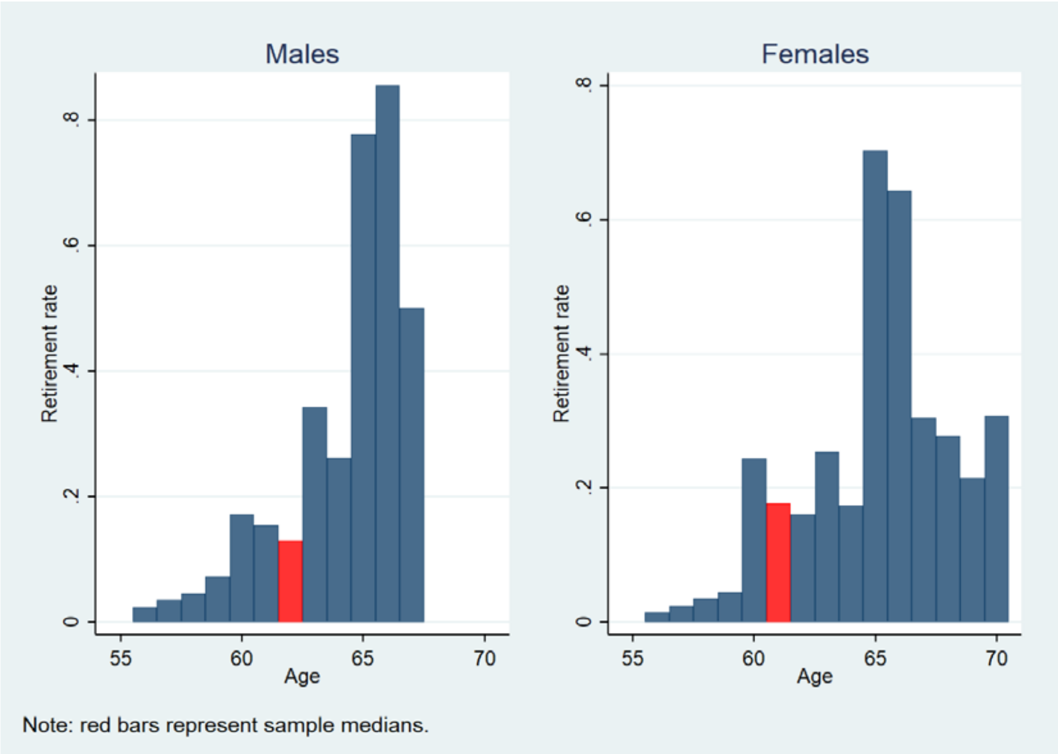
In Figure 3.6, the evolution by age of all the possible work and pension receipt combinations is shown, separately for males and females. Notice that "work + pension" is a different concept than flexible retirement, as with the latter we refer to individuals who consider themselves retired while working at the same time, irrespective of receiving or not receiving a pension. It emerges clearly

[28] The block model is one form the part-time scheme prior to retirement can be claimed as. The part-time scheme prior to retirement *(Altersteilzeit)* is the by far most widely used model of work reduction before retirement, which entered into force in 1996. With this scheme, the German legislator tried to implement flexible retirement. The minimum eligibility age is 55 and the scheme is based on a bilateral agreement between the employee and the employer. The scheme requires a reduction of working hours by half and lasts over a period of five years. Working time can be distributed in two distinct ways: Either the employee reduces his working hours for the whole period of five years by half or the "block model" option can be chosen. In this option the employee continues working without any reduction in working hours for the first two and a half years (first block), while for the second two and a half years (second block), the employee stops working completely. About 90% opt for the block model option (Wanger 2010, Ellguth and Koller 2000). Therefore, in most of the cases the scheme is not used for a real gradual transition, but rather for an early exit from the labor force.

from this graph that the occurrence of work (full- or part-time) together with pension benefits receipt is nearly non-existent.

Figure 3.7 shows the retirement hazard, defined as the flow into retirement on the stock of workers at each age between 55 and 70, separately by men and women. The graph clearly shows spikes in retirement at the early and statutory eligibility ages (60, 63 and 65). The red bars indicate the median age of retirement which amounts to 62 years for men and 61 for women.

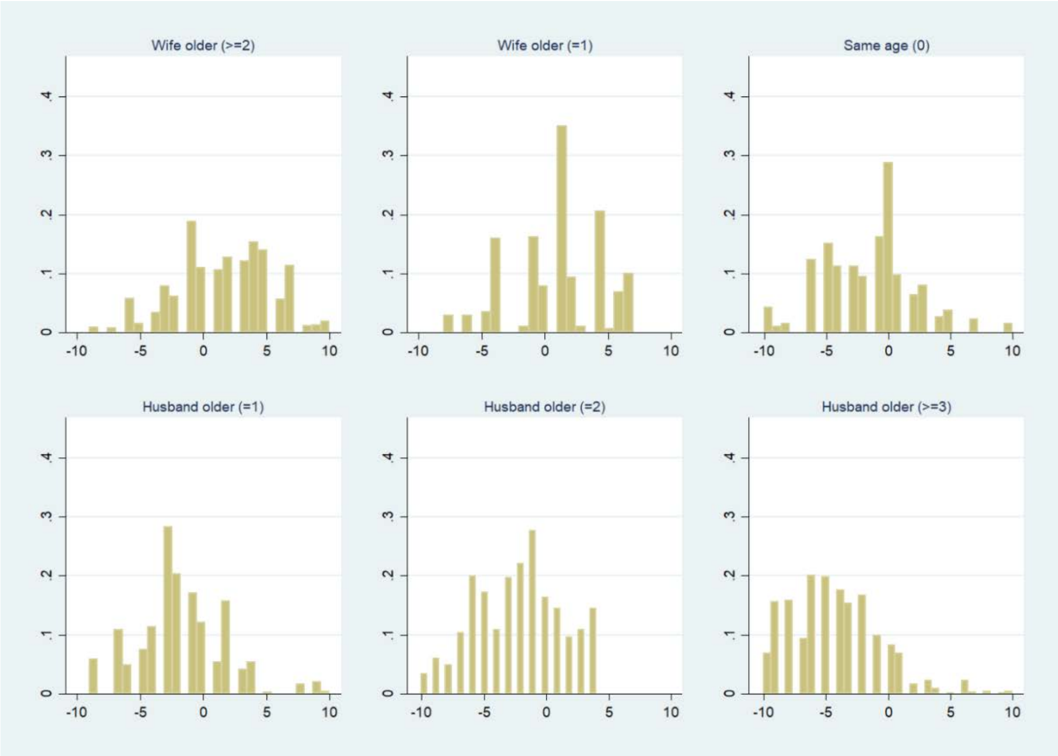
Figure 3.7: Retirement hazard by gender



Source: Own calculations.

A final point to be discussed is the potential presence of joint retirement. If there are leisure complementarities, the marginal utility of retirement increases when the partner is also retired. Furthermore, spouses may have correlated tastes for leisure. In order to assess whether this is an issue that needs to be addressed in our retirement model, we show in Figure 3.8 the distance in years between the retirement dates of the two spouses, conditional on their age difference. It emerges clearly from these graphs that spouses do not generally retire at the same time. Rather, they retire depending on their own age and irrespective of their partner's retirement status.

Figure 3.8: Distance between husband and wife's retirement dates by age difference



Source: Own calculations.

3.4 The implicit tax on working longer

The German retirement insurance system creates strong incentives to claim a pension and exit the labor force relatively early in life through a variety of mechanisms. These mechanisms can be summarized compactly in terms of a loss in social security wealth when pension benefit claiming and the labor force exit is postponed. Since Germany applies a relatively strict earnings test for ages below the statutory eligibility age, claiming pension benefits intrinsically implies leaving the labor force when individuals are eligible for an early pension.

Social security wealth is the expected net present value of social security benefits minus contributions to the public pension and unemployment insurance during the retirement window, here defined as the age range from 55 through 69. Contributions before age 55 are considered sunk. Future contributions and benefits depend on the legal situation l at the planning age S and the used pathway to retirement k (e.g. via unemployment or disability pension). Seen from the perspective of a worker who is S years old and plans to claim pension benefits at age R *social security wealth* is given by:

$$SSW_{S,k,l}(R,i) = \sum_{t=R}^{T} B_{t,k,l}(R,i) \cdot \sigma(i)_{S,t} \cdot \beta^{t-S} - \sum_{t=S}^{R-1} c_{t,l} \cdot Y_t(i) \cdot \sigma(\mathrm{i})_{S,t} \cdot \beta^{t-S} \tag{3.2}$$

with

SSW:	net present discounted value of retirement/unemployment benefits
S:	planning age
R:	benefit claiming age
i:	gender and skill type
k:	pathway to retirement
l:	legal situation at planning age S
$Y_t(i)$:	gross labor income at age t
$B_{t,k,l}(R,i)$:	net benefits from pathway k at age t for benefit claiming age R and legal situation l
$c_{t,l}$:	contribution rate to pension and unemployment system at age t for legal situation l
$\sigma(i)_{S,t}$:	probability to survive at least until age t given survival until age S
β:	discount factor $\delta = 1/(1+r)$. We choose the usual discount rate r of 3%.

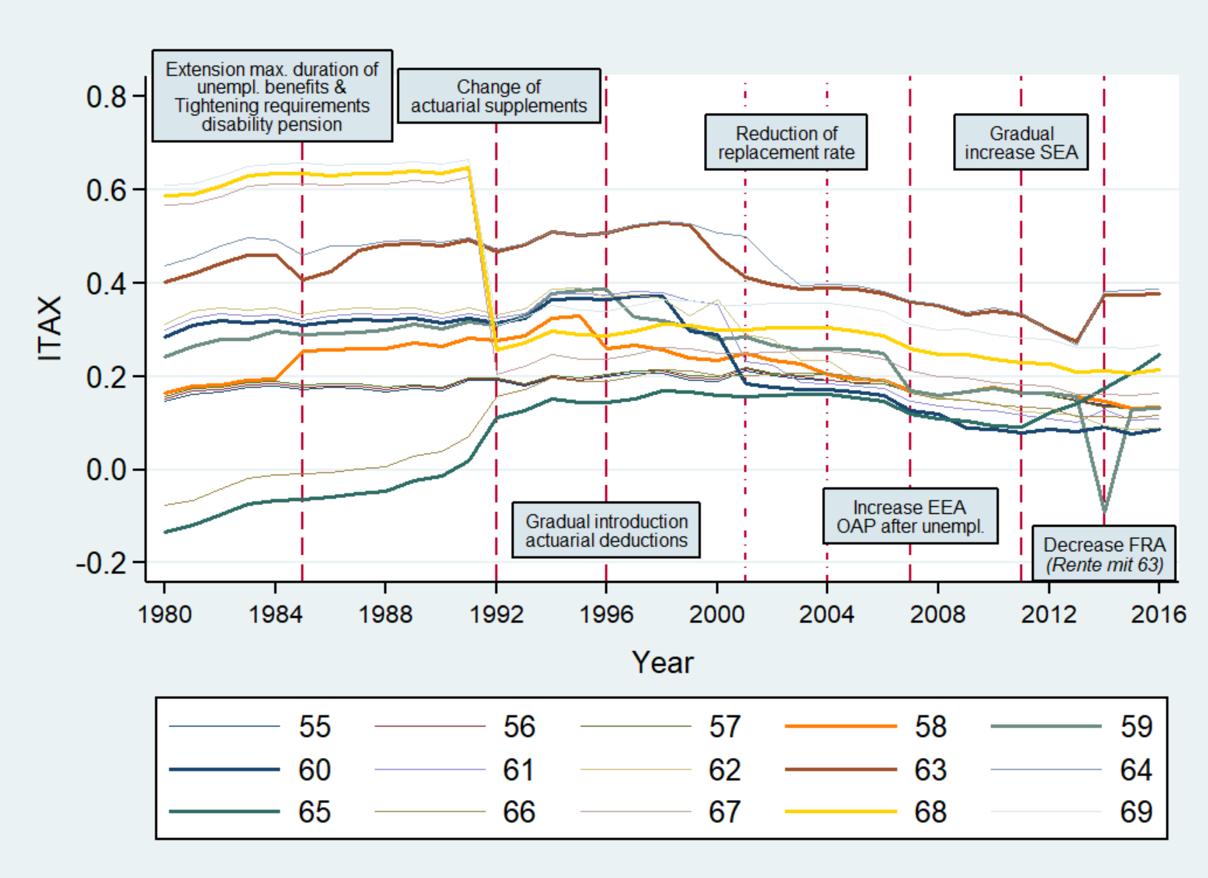
Postponing claiming social security benefits by one year has two effects on social security wealth. On the one hand, the individual receives one year less of benefits which decreases social security wealth. On the other hand, annual benefits increase with later claiming in most countries due to additional 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 an overall higher benefit amount. Moreover, in Germany as in almost all other countries, benefits are adjusted upwardly if benefits are taken later than the statutory eligibility age through the actuarial supplements. The balance between these mechanisms determines whether social security wealth increases or decreases with earlier or later retirement.

The incentives to leave the labor market and claim pension benefits can be expressed by the *implicit tax on working longer* which is based on the *accrual of social security wealth*. The *accrual* is defined as the numerical increase or decrease of social security wealth by postponing the labor market exit by one year. The implicit tax *($ITAX$)* is the negative accrual of social security wealth (ACC) divided by the after tax earnings (Y^{Net}) during the additional year of work:

$$ITAX = -\frac{ACC}{Y^{Net}} \tag{3.3}$$

As long as the implicit tax is negative, it is rational to postpone the withdrawal from the labor market unless labor/leisure preferences or similar considerations dominate the expected gain in social security wealth. Negative implicit taxes from a certain age on are sufficient (although not necessary) for leaving the labor market and claiming a pension at that age. A positive value of $ITAX$, on the other hand, means a tax on working longer and with that an incentive to claim pension benefits early.

Figure 3.9: ITAX in Germany over time by single years of age, men, median-educated

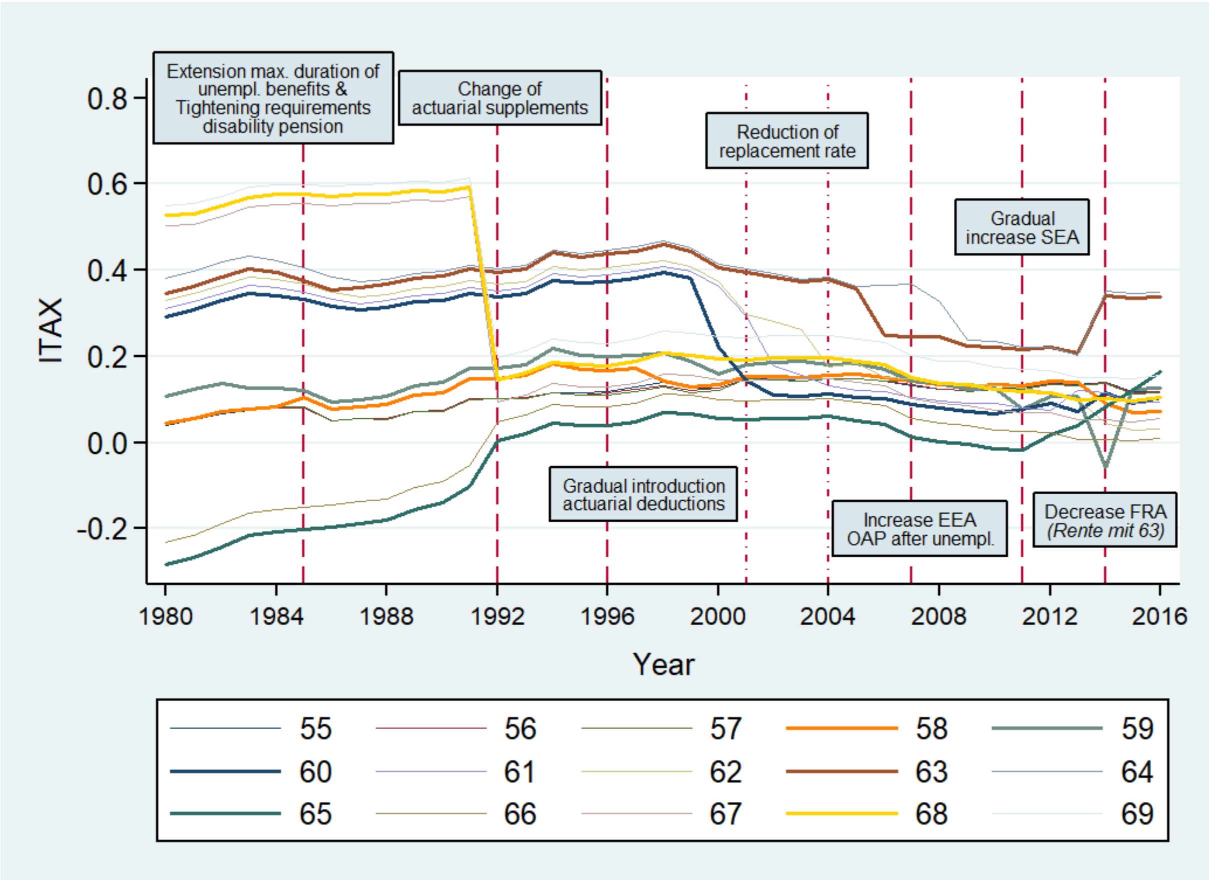


Source: Own calculations.

In Chapter 2, we have calculated ITAX-time series for a few typical benefits recipients in the first phase of this multistage research project. The typical individuals differ by basic socio-economic characteristics (sex, marital status, and education). Figure 3.9 and Figure 3.10 show the development of implicit tax rates for median-educated males and females from 1980 to 2016 in Germany. Chapter 2 has shown that there has been a positive ITAX for almost all ages in the retirement window throughout almost the whole observation period with only very few exceptions. Overall, this means that there has been an incentive to claim pension benefits early in nearly all periods. Additionally, the figure shows that ITAX captures reforms quite clearly. The introduction of actuarial adjustments for early or late retirement had a large influence on the incentives to work longer. This especially applies for the introduction of actuarial deductions for early retirement in

1997. We consider the reforms marked in the graph as main identifying reforms in the empirical analysis.[29]

Figure 3.10: ITAX in Germany over time by single years of age, women, median-educated



Source: Own calculations.

[29] For a comprehensive description of the time series taking reform details into account see Chapter 2.

3.5 Validation of pension calculator

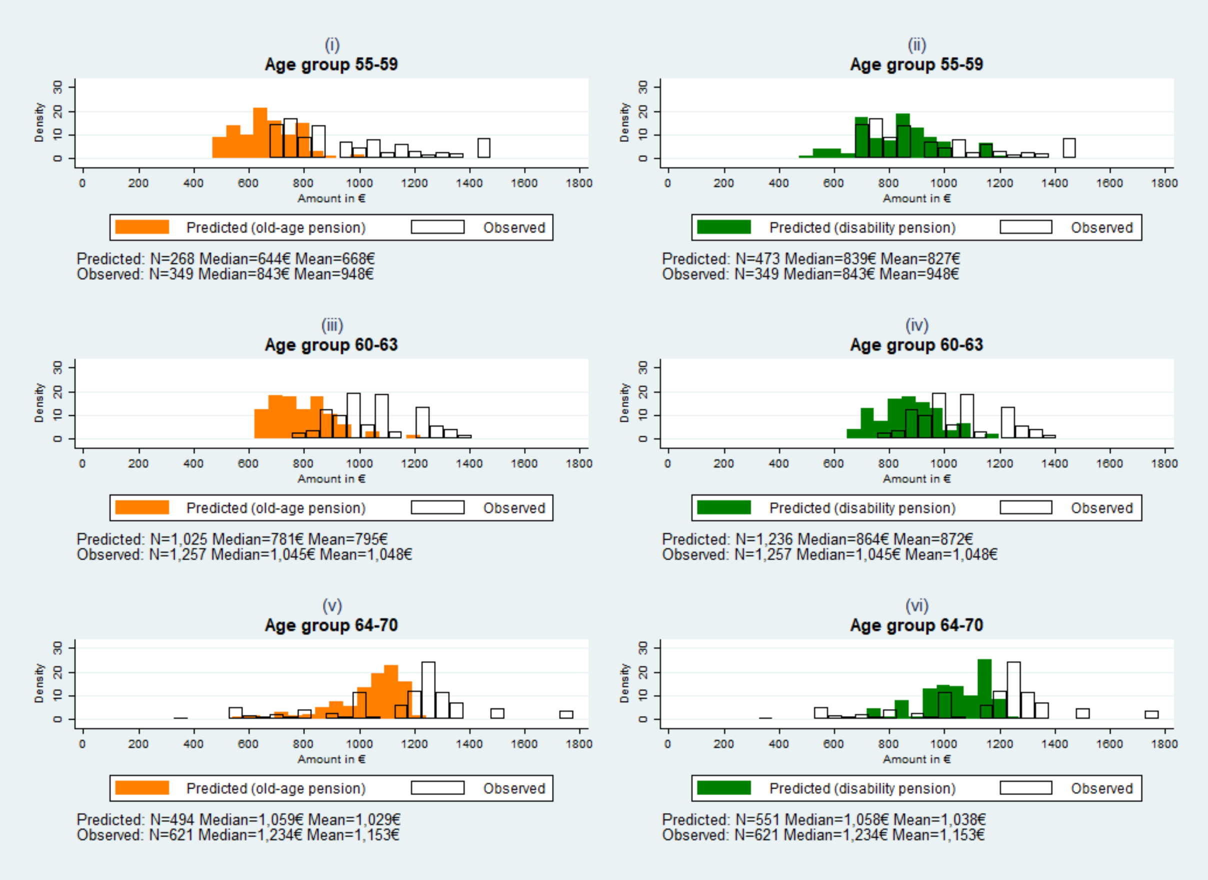
While we have computed pension benefits and implicit taxes for synthetic individuals in Chapter 2, this study aims at calculating individual pension benefits and implicit taxes for a representative sample of individuals from the GSOEP survey. Consequently, we have to determine their pension benefits under different assumptions, e.g. assumptions regarding the actual pension claiming age. In this section, we want to validate our pension calculator which we use for this purpose. To do so, we compare observed pension benefit information that individuals report in the GSOEP survey with our generated predicted pension benefits. For the validation of the pension calculator, we predict old-age pensions and disability pensions based on the *actual* first pension claiming year which we observe in the survey data. In order to construct the social security wealth and incentive variables for our main analysis, we will need expected pension benefits for *all* labor market exit ages in the window of retirement (age 55-69). In Section 3.6, we show the two-step procedure on how we handle expected pension benefits for all labor market exit ages.

Unfortunately, the survey data do not contain a stable benchmark to which we can validate our pension calculator over the long observation period (1984-2015) which simultaneously differentiates between old-age pensions and disability pensions. In GSOEP, the best information is a variable which summarizes old-age pensions and disability pensions in one single variable. Until 2001, it is not possible to distinguish occupational pension benefits. However, this is not an issue for the predictions of our main analysis, since our pension benefit calculator depends on earnings points computed from relative-income positions (see Section 3.2 and Section 3.3.2.). Hence, our predictions rely on earnings information rather than on reported pension benefits.

Since we do not have a single benchmark to which we can validate our predictions, we compare the reported pension benefits, first, with generated old-age pensions (orange bars) and second, with generated disability pensions (green bars) (see Figure 3.11). Moreover, we show the validation for different age groups, as claiming disability pension and/or old-age pension is not possible at any age. Indeed, in some cases it is possible to infer the type of received pension benefit from the pension claiming age.[30]

[30] Note that within each age group the observe pension benefits (white bars) are the same for both sides.

Figure 3.11: Validation of pension benefit calculator – Distribution of predicted vs. observed pension benefits by age groups and pension type

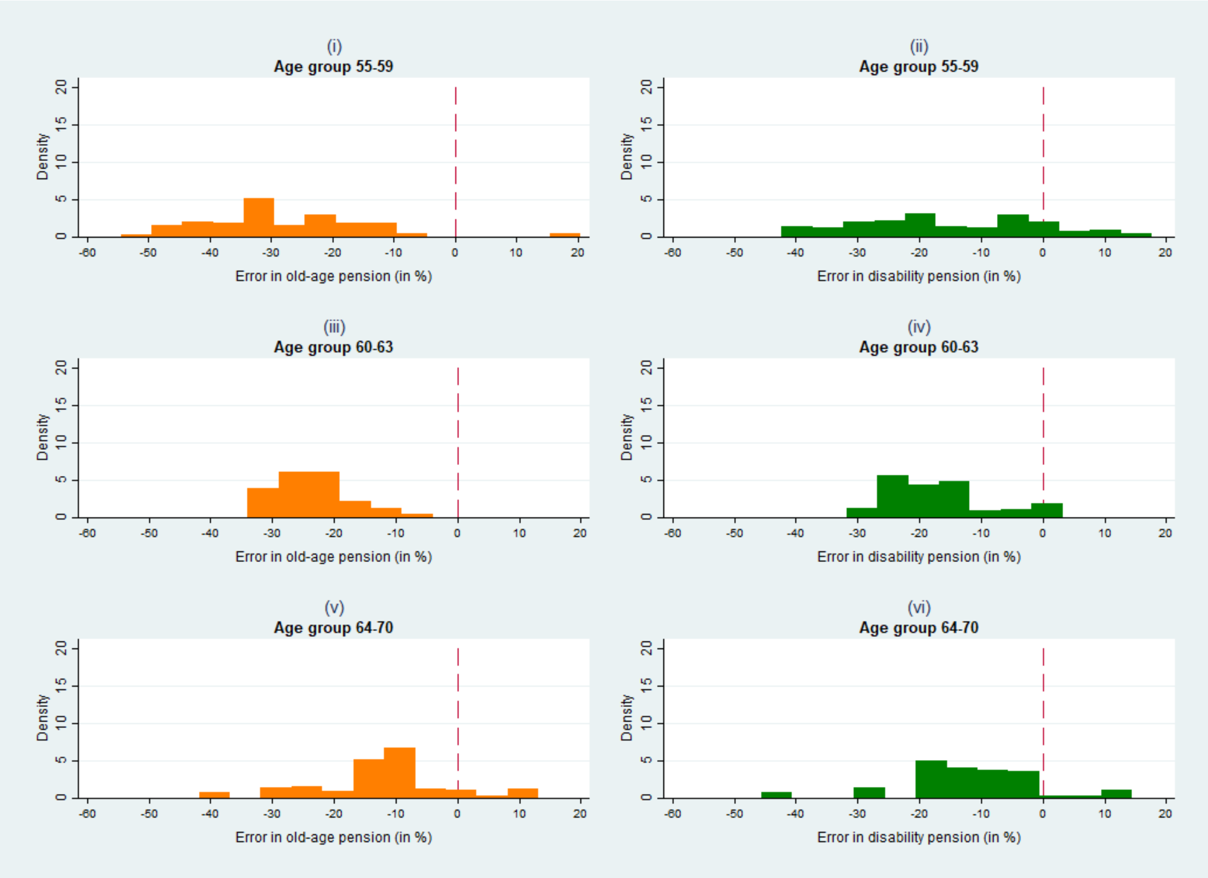


Source: Own calculations.

In the group of individuals aged 55-59, respondents are more likely to report disability pension benefits only. As we have shown in Table 3.1 (Section 3.2) old-age pension pathways are not available before age 60. For this age group it makes the most sense to validate the quality of our pension calculator with subframe (ii) which displays our predicted disability pensions. With only few exceptions, the figure shows that our predicted disability pension benefits match the observed pension benefits well.

The subframes (iii) and (iv) suggest that our pension calculator systematically underestimates the observed values. In the age group 60-63, however, individuals might receive and report various income sources. First, individuals can report both old-age pensions and disability pensions. Moreover, individuals may receive severance payments or other benefits from their employer. Especially in the 1990s, severance payments were a widespread practice to discharge employees into early retirement and to rejuvenate the age structure of the workforce. Individuals might incorrectly report those payments as public pension benefits which can explain part of the difference between the observed numbers and the predicted values. The difference may additionally arise from the fact that we cannot distinguish between public pension benefits (old-age pensions and disability pensions) and occupational pension benefits in the micro data for seventeen years (1984-2001) of the observation period. We do not capture these additional income sources individuals might incorrectly report as public pension benefits.

Figure 3.12: Validation of pension benefit calculator – Difference between predicted and observed pensions by age group and pension type



Source: Own calculations.

In Figure 3.12, we show the percentage difference between predicted and observed benefits. A value of minus ten means that predicted pension benefits are ten percent lower than observed pension benefits. The figure graphically reflects the left-shifted distributions of predicted pension benefits displayed in Figure 3.11 and the lower mean values given in the notes to Figure 3.11. For the age group 55-59, receiving disability pension benefits is the only possibility. For part of the observations, our pension calculator matches the observed values. Subframe (ii) shows, however, that the distribution is broad. In the older age groups, the receiving of an old-age pension may coincide with receiving occupational pension benefits and other payments which we do not include in our pension calculator (subframes iii and v).

Overall, our predicted pension benefits seem to underestimate the observed pensions. However, the differences can most likely be explained with the receipt of occupational pension benefits and other payments our pension calculator does not consider. However, since we focus on the evaluation of incentives from the public pension system, our pension calculator seems to work reasonably well.

3.6 Expected pension benefits on multiple pathways to retirement

So far, we validated our pension calculator for individuals at their actual first pension claiming year. For the construction of social security wealth and the incentive variables (see Section 3.4), we need expected pension benefits for all labor market exit ages of our retirement window. At least theoretically, there are several retirement pathways for a worker to exit the labor market and start drawing from their public pension. The most important ones are:

- Regular old-age pension (at the statutory eligibility age),
- Early pension claiming via old-age pension for (especially) long-term insured or for women,
- Leaving the labor market via unemployment,
- Part-time employment prior to retirement,
- Early pension claiming via old-age pension for the disabled, and
- Disability pension

It is important to notice that all of these pathways pay the same benefit once a person is eligible. The main differences lie in the income between the labor market exit and first pension drawing. However, in practice there is no free choice, as all of these pathways are subject to eligibility criteria (see Table 3.1). Among those criteria, “strict” and “soft” eligibility rules can be distinguished. The first are tied to objective variables, such as age, gender, and previous contribution history while the second are subject to discretionary decisions, notably the determination of a workers’ disability status.

We compute the expected pension benefits, which depend on the choice of the specific pathway, in two steps. First, we compute the pension benefits for each pathway taking into account the “strict” eligibility criteria only. Once an individual fulfills the criteria of a pathway this individual is assumed to claim the pension as soon as possible. For example, a 60-year-old male worker with 35 service years can claim an old-age pension for long-term insured beginning from age 63. On the other hand, if this individual does not fulfill any additional criteria, he cannot draw a public pension earlier. A 60-year-old female worker with 35 service years most likely also fulfills the eligibility criteria for an old-age pension for women and can consequently draw her pension immediately.

If individuals do not fulfill the criteria of the considered pathway, they may claim their pension at the statutory eligibility age.[31] In the worst case, when not even the five-year vesting period for a regular old age pension is met, we consider at least the basic old-age support.

As stated, the income between an individual's actual age and first pension claiming depends on the considered pathway. For instance, there is no income in the case of normal early retirement while the pathway via unemployment considers unemployment benefit payments.

In the second step, we weight the benefits, or rather the SSW, of the different pathways by their observed frequency on all pension claims of the considered year (i.e. according to the number shown in Figure 3.2). For individuals with a disability status (handicap) of at least 50%, we only weight the pathway for the old-age pension for the disabled with the disability pension pathway. For individuals with no handicap or a handicap status below 50% we weight the disability pension with all other retirement options. We make this distinction since the old-age pension for the disabled is more generous than the other retirement pathways.

Moreover, for couples we consider the possibility of survivor pensions. The survivor pensions are computed for each pathway and each possible death date of the spouse and are weighted with the probability that the spouse dies at the respective date.

[31] Consequently, the regular old-age pension is covered through all other pathways and must not be calculated separately.

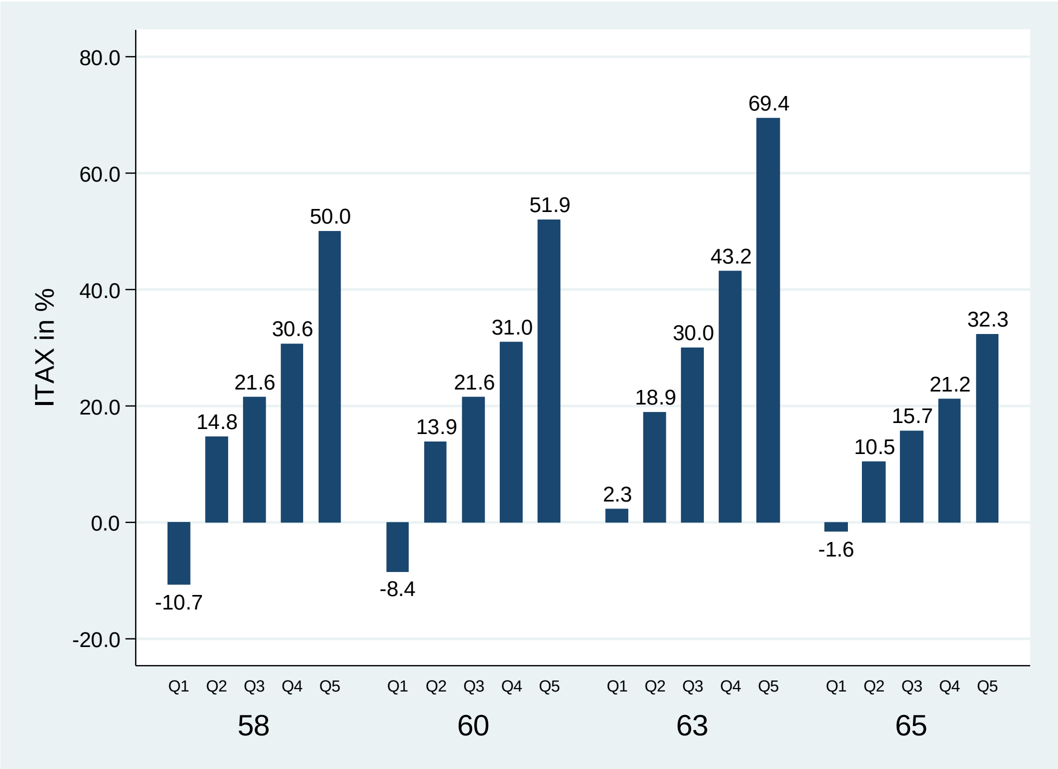
3.7 Results

In this section, we present our results. In a first step, we present the implicit tax rates that we have calculated based on survey data from GSOEP. Subsequently, we present the results from our empirical estimation applying these ITAX rates.

3.7.1 ITAX based on micro data

Figure 3.13 gives an idea about how the distribution of ITAX computed from micro data looks like. The figure shows ITAX by age. For single years of age, we group ITAX in quintiles and depict the quintile-mean values of ITAX. We present the numbers for the most salient age steps (i.e. eligibility ages) in the German public pension scheme. The graph reflects the findings from the synthetic ITAX values from the first phase of this multistage research project (see Section 3.4 and Chapter 2 of this dissertation). We observe a positive ITAX for almost each case which provides a disincentive to postpone pension benefit claiming at each age.

Figure 3.13: Distribution of ITAX by age



Source: Own calculations.

3.7.2 Empirical estimation

3.7.2.1 The retirement model

Our outcome variable is labor force status in old age. It takes the value zero when the individual is in the labor force, and value one when they are retired. As explained above, we will simply model the transition from being in the labor force (full- or part-time) to being fully retired, as flexible retirement is relatively rare in Germany. We assume that retirement is an absorbing state; therefore, individuals are kept in the regression sample only until the first observation in retirement, and are dropped from the sample afterwards. Thus, we can interpret our dependent variable as the probability to retire in a given year, provided that the individual has been working in the previous year.

Our main explanatory variable will be one of the two incentive variables described in Section 3.4: accrual rate (the accrual divided by the level of social security wealth) and implicit tax rate. This reduced form model of retirement has been extensively used in the literature along with different incentive measures, for example the option value and the peak value (see, among others, Coile and Gruber 2001 and Gruber and Wise 2004). The main difference with respect to measures like accrual or ITAX is that the latter are one-year forward measures, whereas option value and peak value are forward-looking measures, where the individual looks forward to the optimal retirement year, rather than just to next year. However, as workers may be not completely forward-thinking or may be unwilling to postpone retirement for too many years, the incentive measures we are using may be considered appropriate.

A crucial issue in the analysis of retirement "is identification - that is, determination of the separate effect of each variable on retirement, as distinct from each of the other variables" (Gruber and Wise 2004). Indeed, in order to determine the effect of social security or pension incentives on retirement, one needs to be able to separate the pure effect of economic incentives from the other determinants of SSW, for example age and income. Controlling for these other determinants is important if they are also independently correlated with retirement choices. However, there may be a trade-off to take into account when introducing other control variables, as their estimated effect may capture part of the effect pertaining to financial incentives, rather than individual heterogeneity, thus leading to an underestimation of the incentives themselves. For this reason, exogenous variation of financial incentives is important for identification. In this respect, Germany represents a particularly well suited setting, given the various reforms and minor changes of the pension system that were presented in Section 3.2. Furthermore, as first observed by Hurd (1990) and then reiterated by Coile and Gruber (2001) "if there are significant nonlinearities and interactions otherwise (likely) uncorrelated with retirement that primarily identify the impact of these incentive measures, one might feel more confident about retirement estimates".

In the following regressions, households are divided into single households, meaning either non-married individuals or single-earner households, and couple households, meaning households with two earners or one earner and one retired spouse.[32] Furthermore, we will show results separately for men and women. Besides the main incentive variables, we will run regressions with and without including a measure of individuals' position in the lifetime earnings distribution (calculated as the cumulative sum of earnings points, EP, divided by the length of the working life), as well as a number of control variables: number of children, dummies for low and medium education, ISCO code (one-digit classification of occupation), health satisfaction (from 0-low to 10-high), a dummy for home ownership, and a dummy for working full-time. As displayed clearly in Figure 3.7, the retirement probability by age is characterized by peaks in correspondence of the pension eligibility ages. This may be due to liquidity constraints or social norms, the effects of which are not taken into account by our constructed incentives measure. In order to address this concern, we will include age dummies in all regressions.

Our main analysis is based on a random effects probit model. We will, however, also show the robustness of our results by the use of alternative models, in particular: linear probability model (LPM), random effects linear probability model (RE-LPM), fixed effects linear probability model (FE-LPM), and probit model. In all models, standard errors are clustered at the individual level.

[32] We include couples with one retired spouse in the group of couple households because the pension of the retired spouse enters the calculation of the working spouse's ITAX through total household income.

3.7.2.2 Estimation results

Our main results are shown in Table 3.3 to Table 3.6, where we report marginal effects for the explanatory variables of interest. As the accrual rate captures the substitution effect on retirement decision from foregone future labor income, we expect the sign of this incentive to be negative: the greater the foregone opportunities, the less likely workers are to retire. On the contrary, we expect the sign of ITAX to be positive, as ITAX is defined as the negative accrual of social security wealth divided by the after tax earnings during the additional year of work.

In almost all groups and specifications, we obtain the expected incentives signs. In all specifications where the sign goes in the wrong direction, the corresponding coefficient is not significant (accrual in the single-males specification (3), ITAX in the single males and females specification (1) and (2)). In general, results for couples are more satisfactory than results for singles, as coefficients are more often found to be statistically significant and are more robust to the inclusion of average EP and other control variables. This might depend, among other things, on the larger sample sizes.

Overall, our results point to a generally statistically insignificant effect of accrual rate for single households, and a positive and statistically significant effect of ITAX for single females. If we concentrate on the full specification, a ten percentage point increase in ITAX determines an increase in the probability of retirement of 1.22 percentage points (pps) for females (see Table 3.5). In regards to couples, a ten pps increase in the accrual rate determines a 3.9 pps increase in the probability of retirement for males, while the effect of this incentive is not statistically significant for females when control variables are included. A ten pps increase in ITAX is instead found to increase males' probability of retirement by 1.1 pps, and females' probability by 0.6 pps.

In Table 3.7 to Table 3.10, we check the robustness of these results using different models. For the sake of space, in these tables we concentrate on the full specification that includes all control variables. In general, results are rather robust. LPM and RE-LPM deliver almost exactly the same results, and both seem to underestimate the effect of the incentives that we find using the RE probit model. Similarly, probit and RE probit also deliver almost exactly the same results.

Table 3.3: Regression estimates for single households (accrual rate)

	SINGLE MALES			SINGLE FEMALES		
	(1)	(2)	(3)	(4)	(5)	(6)
Accrual rate	-0.033	-0.033	0.125	-0.058	-0.058	-0.012
p-value	*0.370*	*0.377*	*0.313*	*0.151*	*0.155*	*0.900*
Average EP		-0.010	-0.005		-0.005	0.025
p-value		*0.161*	*0.432*		*0.762*	*0.228*
Age dummies	X	X	X	X	X	X
Control variables			X			X
Observations	4,819	4,819	3,714	2,614	2,614	1,982

Source: Own calculations.

Table 3.4: Regression estimates for couple households (accrual rate)

	COUPLE MALES			COUPLE FEMALES		
	(1)	(2)	(3)	(4)	(5)	(6)
Accrual rate	-0.441	-0.449	-0.391	-0.144	-0.144	-0.089
p-value	*0.000*	*0.000*	*0.000*	*0.001*	*0.001*	*0.566*
Average EP		-0.033	-0.019		0.001	-0.036
p-value		*0.000*	*0.019*		*0.883*	*0.196*
Age dummies	X	X	X	X	X	X
Control variables			X			X
Observations	6,544	6,544	5,080	7,202	7,202	5,042

Source: Own calculations.

Table 3.5: Regression estimates for single households (ITAX)

	SINGLE MALES			SINGLE FEMALES		
	(1)	(2)	(3)	(4)	(5)	(6)
ITAX	-0.014	-0.013	0.031	-0.003	-0.004	0.122
p-value	*0.433*	*0.461*	*0.166*	*0.898*	*0.894*	*0.027*
Average EP		-0.016	-0.006		0.001	0.016
p-value		*0.037*	*0.376*		*0.947*	*0.388*
Age dummies	X	X	X	X	X	X
Control variables			X			X
Observations	5,173	5,173	3,959	2,903	2,903	2,205

Source: Own calculations.

Table 3.6: Regression estimates for couple households (ITAX)

	COUPLE MALES			COUPLE FEMALES		
	(1)	(2)	(3)	(4)	(5)	(6)
ITAX	0.048	0.060	0.110	0.061	0.062	0.061
p-value	*0.026*	*0.007*	*0.000*	*0.000*	*0.001*	*0.067*
Average EP		-0.034	-0.020		-0.002	-0.033
p-value		*0.000*	*0.014*		*0.857*	*0.044*
Age dummies	X	X	X	X	X	X
Control variables			X			X
Observations	6,864	6,864	5,328	7,559	7,559	5,278

Source: Own calculations.

Table 3.7: Regression estimates for single households using alternative models (accrual rate)

	SINGLE MALES					SINGLE FEMALES				
	LPM	LPM with RE	LPM with FE	Probit	Probit with RE	LPM	LPM with RE	LPM with FE	Probit	Probit with RE
Accrual rate	0.062	0.064	-0.124	0.125	0.125	-0.004	-0.002	-0.092	-0.011	-0.012
p-value	*0.005*	*0.003*	*0.489*	*0.289*	*0.313*	*0.958*	*0.976*	*0.342*	*0.884*	*0.900*
Average EP	-0.005	-0.006	-1.998	-0.005	-0.005	0.024	0.024	1.801	0.024	0.025
p-value	*0.244*	*0.186*	*0.001*	*0.405*	*0.432*	*0.147*	*0.145*	*0.010*	*0.195*	*0.228*
Age dummies	X	X	X	X	X	X	X	X	X	X
Control variables	X	X	X	X	X	X	X	X	X	X
Observations	4,264	4,264	4,264	3,714	3,714	2,307	2,307	2,307	1,982	1,982

Source: Own calculations.

Table 3.8: Regression estimates for couple households using alternative models (accrual rate)

	COUPLE MALES					COUPLE FEMALES				
	LPM	LPM with RE	LPM with FE	Probit	Probit with RE	LPM	LPM with RE	LPM with FE	Probit	Probit with RE
Accrual rate	-0.420	-0.420	-0.392	-0.391	-0.391	-0.052	-0.052	-0.244	-0.089	-0.089
p-value	*0.000*	*0.000*	*0.122*	*0.000*	*0.000*	*0.371*	*0.371*	*0.033*	*0.168*	*0.566*
Average EP	-0.015	-0.015	-1.719	-0.019	-0.019	-0.029	-0.029	2.486	-0.035	-0.036
p-value	*0.019*	*0.019*	*0.001*	*0.014*	*0.019*	*0.009*	*0.009*	*0.000*	*0.006*	*0.196*
Age dummies	X	X	X	X	X	X	X	X	X	X
Control variables	X	X	X	X	X	X	X	X	X	X
Observations	5,943	5,943	5,943	5,079	5,080	5,827	5,827	5,827	5,042	5,042

Source: Own calculations.

Table 3.9: Regression estimates for single households using alternative models (ITAX)

	SINGLE MALES					SINGLE FEMALES				
	LPM	LPM with RE	LPM with FE	Probit	Probit with RE	LPM	LPM with RE	LPM with FE	Probit	Probit with RE
Accrual rate	0.031	0.034	0.074	0.031	0.031	0.123	0.123	0.117	0.121	0.122
p-value	*0.108*	*0.109*	*0.141*	*0.158*	*0.166*	*0.000*	*0.000*	*0.020*	*0.000*	*0.027*
Average EP	-0.005	-0.007	-2.250	-0.006	-0.006	0.018	0.018	1.155	0.016	0.016
p-value	*0.237*	*0.170*	*0.000*	*0.354*	*0.376*	*0.264*	*0.264*	*0.062*	*0.388*	*0.388*
Age dummies	X	X	X	X	X	X	X	X	X	X
Control variables	X	X	X	X	X	X	X	X	X	X
Observations	4,545	4,545	4,545	3,959	3,959	2,550	2,550	2,550	2,205	2,207

Source: Own calculations.

Table 3.10: Regression estimates for couple households using alternative models (ITAX)

	COUPLE MALES					COUPLE FEMALES				
	LPM	LPM with RE	LPM with FE	Probit	Probit with RE	LPM	LPM with RE	LPM with FE	Probit	Probit with RE
Accrual rate	0.092	0.092	0.097	0.110	0.110	0.039	0.039	0.096	0.061	0.061
p-value	*0.000*	*0.000*	*0.019*	*0.000*	*0.000*	*0.004*	*0.004*	*0.004*	*0.003*	*0.067*
Average EP	-0.014	-0.014	-1.766	-0.021	-0.020	-0.028	-0.028	2.326	-0.033	-0.033
p-value	*0.023*	*0.023*	*0.001*	*0.011*	*0.014*	*0.008*	*0.008*	*0.000*	*0.007*	*0.044*
Age dummies	X	X	X	X	X	X	X	X	X	X
Control variables	X	X	X	X	X	X	X	X	X	X
Observations	6,226	6,226	6,229	5,328	5,328	6,100	6,100	6,100	5,278	5,278

Source: Own calculations.

3.8 Counterfactual simulations

In this section, we exploit the estimated coefficients to perform counterfactual simulations. The key idea is to show the impact of the incentive variable in the metric of the outcome variable, e.g., the probability to be retired. Our aim is to show what the probability of retirement would have been, had there been no policy changes, or in other words, had the incentives to retire remained constant throughout our observation period. Our expectation is that, without interventions on the pension rules aimed at reducing the generosity of the pension system, the probability to retire would have been higher than what we actually observe.

In the following graphs, we show two lines. The first line ("pred") depicts the average individual retirement probabilities as predicted by our estimated model for the years 1985 to 2015. The model includes the explanatory variables as they have actually developed during those years. In contrast, the second line ("cfac") is based on the counterfactual retirement probabilities. These probabilities are obtained by the same model, but we substitute the observed time- and individual-varying incentive variable (ITAX) by the values that would have been obtained if the rules at time 0 (in our case: 1985) had been valid in all years between 1985 and 2015. All other covariates, including age, are kept at their actual and changing value, including the effect of age and other covariates in the incentive variables. This way, we remove the changes due to policy reforms but acknowledge all other changes. All calculations are based on our preferred specification which includes both age dummies and a set of control variables.

In mathematical terms, assume a labor force probability model:

$$LFP_{it} = f(ITAX_{it}(age_{it}, covariates_{it}), age_{it}, covariates_{it}) + \mu_{it} \quad (3.4)$$

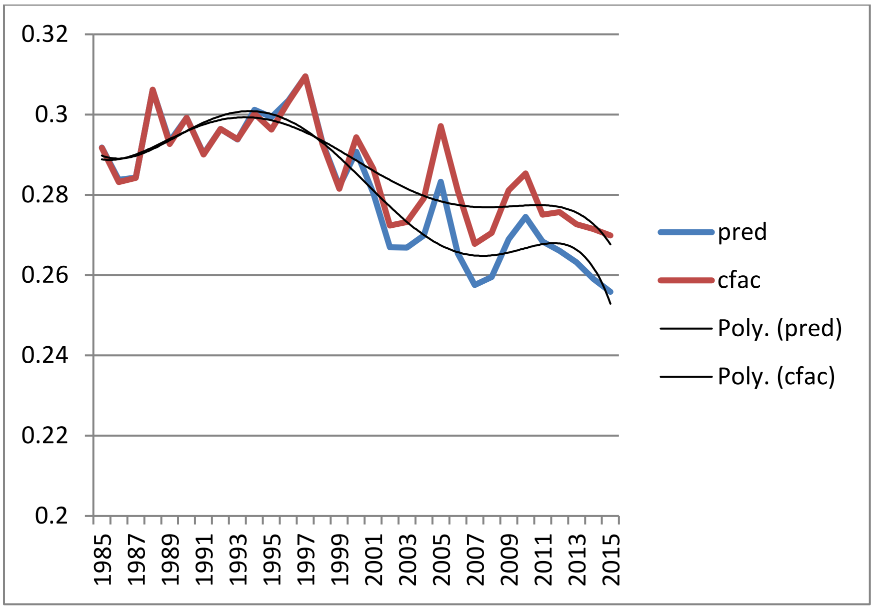
Here, i and t index individuals and years, respectively, LFP_{it} stands for labor force participation and μ_{it} is the error term. Then the counterfactual predicted labor force probability for each individual is defined as:

$$LFP_{it}^{pred} = f(ITAX_{i0}(age_{it}, covariates_{it}), age_{it}, covariates_{it}) \quad (3.5)$$

Figure 3.14 to Figure 3.16 show the development of the average retirement probability, first across the entire age range from 55 to 65, then separately for the younger and the older age range. They refer to the evolution of the predicted and counterfactual statistics for the subsample of males in dual-earner households. The baseline model used is RE probit with ITAX as incentive variable.

Figure 3.14 shows that the 1992 reform, which gradually introduced actuarial adjustments and closed certain early-retirement pathways, kicked in after 2000. In 2007, the gradual shift of the normal retirement age was legislated; it took effect in 2011. The combined effect reduced the average probability of retiring in 2015 by about 1.4 pps, with respect to a counterfactual situation with no reforms. In other words, reforms explain around 39% of the observed reduction in retirement probability between 1985 and 2015.

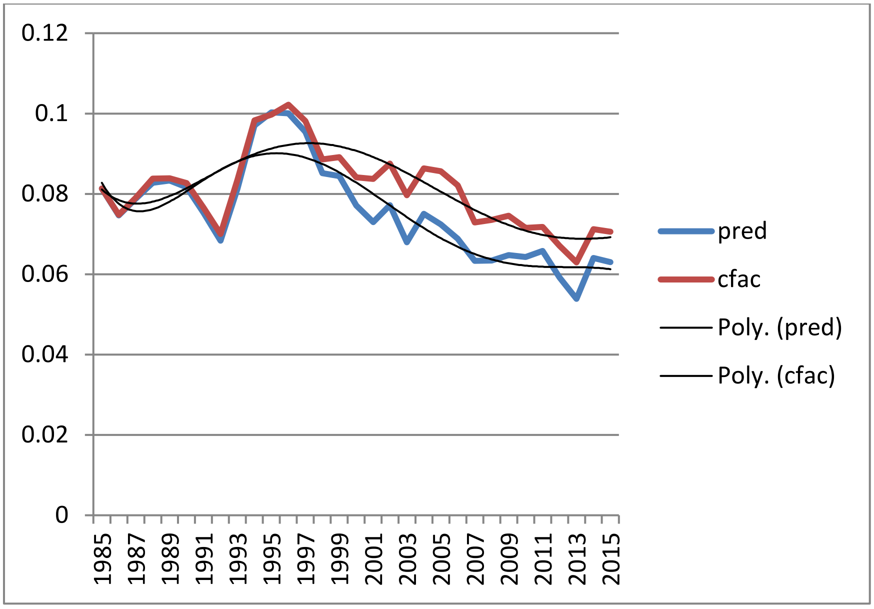
Figure 3.14: Counterfactual simulation: average retirement probability for age 55-65



Source: Own calculations.

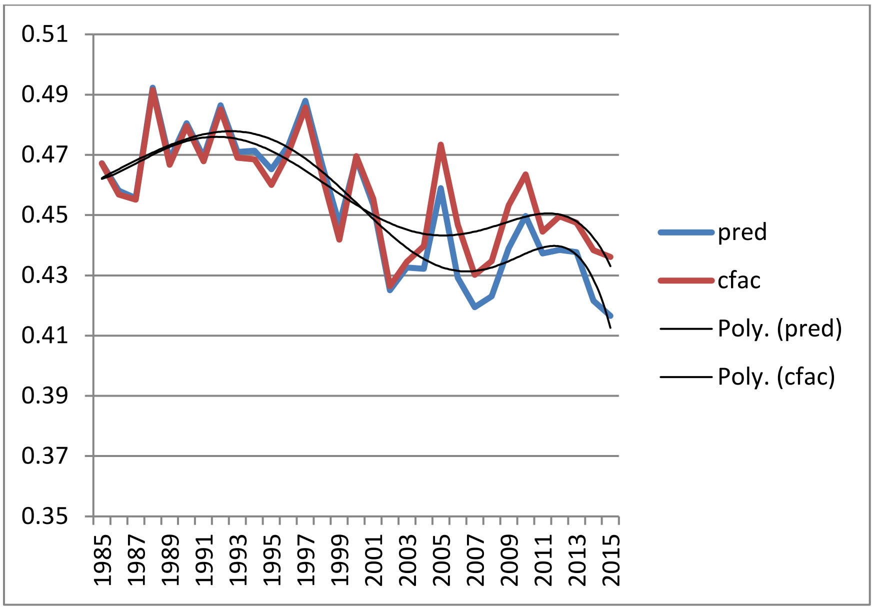
In Figure 3.15 and Figure 3.16, we look at specific age subgroups, restricting the analysis to individuals of age 55 to 59 and 60 to 65 respectively. We conclude that the reforms explain around 41% of the observed reduction in retirement probability, and that the probability of retirement in 2015 would have been around 0.8 pps higher without the reforms for workers of age 55 to 59. For workers older than 59 years, the policy effect amounts to around 39%, and the probability of retirement in 2015 would have been around two pps higher without the reforms that changed ITAX. Therefore, in relative terms, we observe a similar size of the effect of reforms for the two age groups considered.

Figure 3.15: Counterfactual simulation: average retirement probability for age 55-59



Source: Own calculations.

Figure 3.16: Counterfactual simulation: average retirement probability for age 60-65

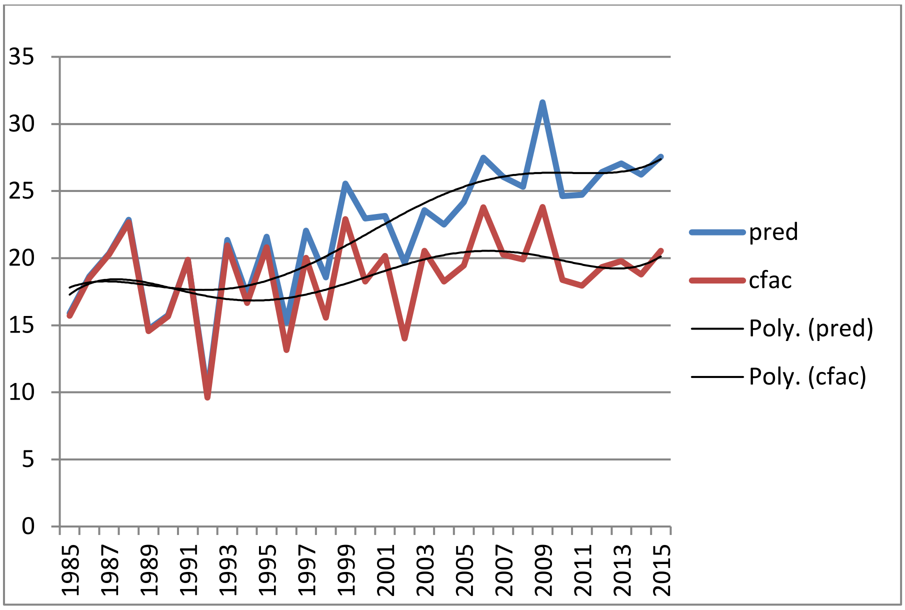


Source: Own calculations.

The retirement probabilities in Figure 3.14, Figure 3.15 and Figure 3.16 can be used to construct a "worklife table" from which the equivalents of survival rates and conditional life expectancies for a cohort of workers can be derived. Survival corresponds to remaining in the labor force, and conditional life expectancy corresponds to the expected retirement age seen from the viewpoint of a worker at a given age.[33]

Figure 3.17 depicts the percentage of individuals still working at age 65, given that they were working at age 55. In the counterfactual scenario without reforms, this percentage would have been substantially lower than what was actually observed (21 rather than 28%). Reforms explain in this case about 58% of the overall increase. This corresponds closely to the actual development of labor force participation among men aged 55-69, displayed in Figure 3.18, which is roughly constant until about 2000, and then strictly increasing.[34]

Figure 3.17: Counterfactual simulation: percentage of individuals still working at age 65

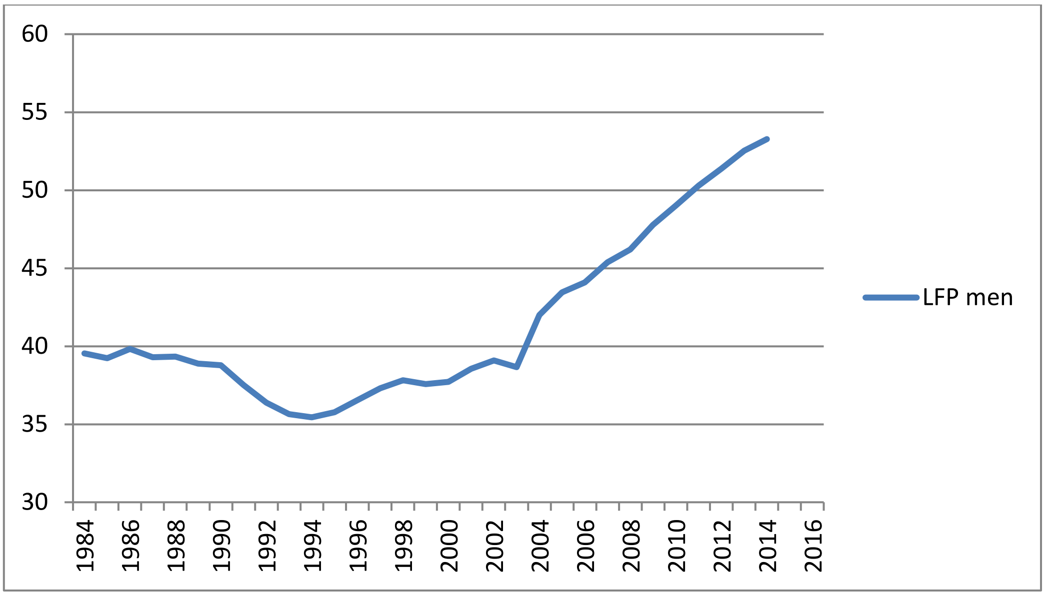


Source: Own calculations.

[33] To be precise: cohort life expectancies, not period life expectancies.

[34] Note that Figure 3.18 corresponds to the later part of the developments shown in Figure 3.1.

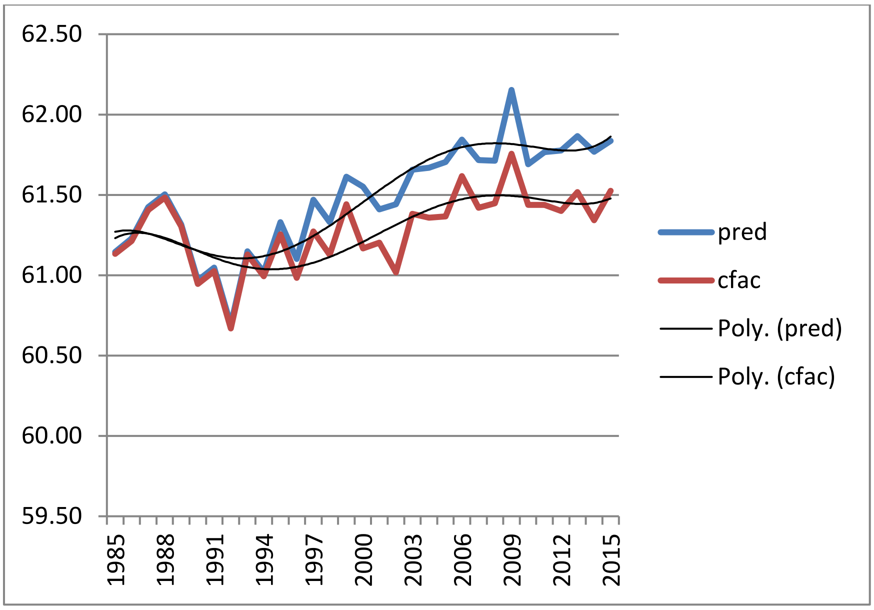
Figure 3.18: Observed labor force participation of men, age group 55-69, 1984-2015



Source: Own calculations.

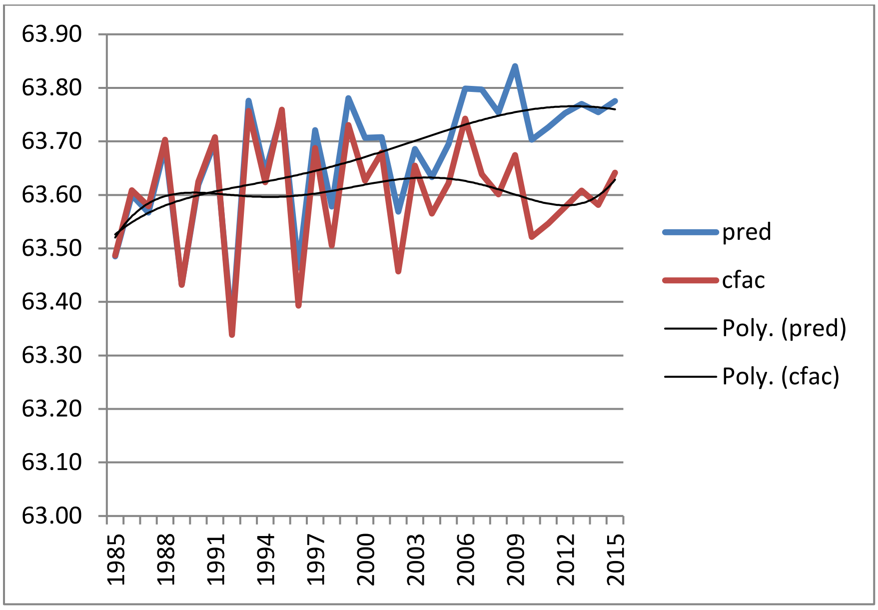
Finally, we calculate expected retirement ages seen from the perspective of workers at age 55 and 62, respectively. The shapes are very similar but the magnitudes differ. Expected retirement seen from the younger perspective (and thus closer corresponding to the actually observed retirement age) would have been 3.6 months lower in the counterfactual case of no reforms (61.5 rather than 61.8). Seen from the perspective of a 62-year-old worker, expected retirement age would have been 63.6 rather than 63.8. The reforms explain 43% and 47%, respectively, of the overall increase in expected retirement age observed between 1985 and 2015.

Figure 3.19: Counterfactual simulation: expected retirement age at age 55



Source: Own calculations.

Figure 3.20: Counterfactual simulation: expected retirement age at age 62



Source: Own calculations.

3.9 Conclusions

Employment of older individuals in Germany has experienced a remarkable reversal around the late 1990s. After a long declining trend that began in the early 1970s, the employment rate for older men has strongly increased again. This increase has lasted until today. This chapter uses micro data from the German Socio-Economic Panel in order to link these labor market trends to changes in public pension policies, especially the change in the incentive variables ITAX, the implicit tax on working longer, using various regression models.

Our model produced predicted retirement probabilities for each sample person and how this has changed from 1985 to 2015. We also used this model to compute counterfactual retirement probabilities, i.e., estimates of how retirement probabilities would have changed if public pension policies in Germany had remained unchanged after 1985. The difference between the counterfactual retirement probabilities and the predicted baseline probabilities can be interpreted as the causal effect of the sequence of pension reforms that took place between 1985 and 2015 in Germany.

We find that for men in couple households the predicted and counterfactual retirement probabilities start to deviate from each other after about the year 2000. This coincides with the introduction of the actuarial deductions as legislated in the 1992 reform. We also find that our model relates an increase of about 0.3 years in the average retirement age to the reform-driven change of the implicit tax on working longer. This is substantially less than the actual increase which was around 1.5 years.[35] One reason may be that ITAX only captures part of the changed policy environment. Other parts of this environment include the general awareness of population aging and related or unrelated changes in the preference for work vs. leisure in the age range under consideration. Moreover, the closure of entire pathways such as the pathway for women and the pathway for unemployment may only partially be reflected in the construction of our main incentive variable ITAX.

This paper only observes labor supply reactions until 2015, the last year of our data. We therefore do not observe reactions to further changes that have already been legislated, especially the gradual increase of the retirement age which will last until 2030. Future research has to show whether this gradual change will increase the actual retirement age in Germany even further.

[35] Actual retirement age for men was 62.5 in 1980 and 64 in 2015.

4. Dangerous Flexibility – Retirement Reforms Reconsidered

This chapter was written in co-authorship with Axel Börsch-Supan, Tabea Bucher-Koenen and Vesile Kutlu Koc.

4.1 Introduction

In the face of aging societies, there is an on-going debate in many countries around the world on how to make pension systems more sustainable. The combination of rising life expectancy and low fertility rates, as well as the retirement of the baby boomers, are putting pressure on pension systems. In order to ease the burden of demographic change, a common objective in many developed economies is to better tap into the pool of older workers.

Increasing the statutory retirement age is an obvious and effective policy to achieve this objective. Later retirement has two effects which help to stabilize the financial situation of pension systems: it reduces the volume of pension benefits to be paid and it increases the total labor volume that constitutes the tax and contribution base to finance the pension system.

Increasing the retirement age, however, is not a very popular policy. Politicians often consider reforms which are designed to make pension systems more sustainable and resilient against population aging as the "third rail in politics", referring to the high-voltage rail in the subway which gives a fatal jolt to those who touch it (Safire 2007, Lynch and Myrskyl 2009). Increasing the retirement age appears to carry a particularly high voltage.

Politicians therefore have invented a new kid in the town of retirement policies called "flexibility reforms". They are designed to allow workers to retire more "flexibly", "gradually" or "partially" as a seemingly elegant way to increase older workers' labor supply by relaxing constraints such as mandatory retirement, earnings tests which effectively impose maximum hours constraints and minimum hours constraints, and by introducing partial retirement, a combination of part-time work and pension benefit receipt.

While flexible retirement policies may have intuitive appeal to policy makers and the populace in general, this study argues that they are dangerous instruments because they are likely to exert counteracting incentives when they are applied to the currently existing public pension systems. Economic theory shows that – while some workers who retire early without the availability of the part-time option might extend their working lives on a part-time schedule – others might opt for part-time work instead of full-time work and thus reduce their total hours worked. It is therefore an empirical question whether flexible retirement can be a successful policy alternative to a later statutory retirement age. Our empirical results shed serious doubts on this. At best, recent flexibility reforms show no significant effects on total labor volume; in many cases, however, they decreased it. If neutral, flexibility reforms are dangerous because they postpone or replace more effective policies such as increasing the statutory retirement age. Even larger are the dangers if they actually reduce total labor volume supplied by older workers – as they have in many countries – and thereby weaken the financial base of pension systems rather than strengthening it.

There is not much research on this issue. Previous work focuses on the effect of a particular reform in a specific country (see, e.g., Graf et al. 2011 for evidence on Austria, Huber et al. 2013 for evidence on Germany, Ilmakunnas and Ilmakunnas 2006 for evidence on Finland, and Brinch et al. 2015 for evidence on Norway). Gustman and Steinmeier (1983) study the presence and rationale for minimum hours constraints and cite empirical evidence that this is particularly salient for the US. They show that a minimum hours constraint changes retirement behavior since older workers may prefer part-time but are forced to decide between full-time work and full-time retirement. The dynamic programming model by Gustman and Steinmeier (1984, 1986, 2004) predicts that the typical minimum hours constraint in the US generates earlier retirement than in the case of unrestricted hours. There are also restrictions on the maximum amount of labor that households may supply. The most prominent examples are earnings tests which distort labor supply at older ages in many countries (Börsch-Supan et al. 2017). Further studies show that older workers would prefer to reduce their working hours towards their retirement as an alternative to fully retiring (Gielen 2009, Büsch et al. 2010, Cihlar et al. 2014 for evidence on Germany).

We employ an internationally comparative view to study the effect of flexibility reforms. We collect evidence of different reform measures taken in various countries at different times. We use the pooled cross-national and intertemporal variance in pension rules to identify the effects of the flexibility reforms on the total labor supply of older workers. We use aggregate time series data from the OECD's employment database for a subsample of nine OECD countries which introduced flexible retirement reforms in the past, namely Australia, Austria, Belgium, Denmark, Finland, France, Germany, The Netherlands, and Sweden. Using this sample, we first estimate the effect of flexible retirement on labor force participation (extensive margin) and then on working hours of older workers (intensive margin). Our distinction between the intensive and the extensive margin is an important feature of this study. So far most of the studies evaluating the effects of flexibility reforms on labor supply have focused on the extensive margin. We will show that more flexibility can increase the overall labor force participation (extensive margin). At the same time, however, more flexibility can decrease the average hours worked (intensive margin), potentially decreasing total labor volume.

The chapter proceeds as follows: Section 4.2 presents stylized facts about labor force participation of older workers in the countries under investigation. Section 4.3 summarizes the flexible retirement schemes that have been introduced in the countries which we study. Section 4.4 provides the theoretical reasoning and shows that the overall effect of a reform allowing for more flexible transitions to retirement on total labor supply is *ex ante* unclear. The empirical analysis in Section 4.5 documents that the potentially unpleasant effects predicted by the theoretical analysis have indeed happened in many countries. We therefore conclude in Section 4.6 that the flexibility reforms enacted so far have failed to be an effective policy to increase the labor supply of older workers. While they might increase utility for current retirees, they are dangerous if they replace more effective policies or decrease total labor volume and thus increase the financial burden for the younger generation.

4.2 Labor supply and retirement patterns

The statutory retirement age – more precisely named the statutory eligibility age (SEA) as it defines the age at which workers are eligible for full pension benefits independent of any other qualification – sends a strong signal to older workers to leave the labor force. This is shown in Figure 4.1.[36] Most workers have left the labor force when they have reached the statutory eligibility

[36] The study concentrates on the labor supply of men age 55 and over. In most countries considered, female labor force participation of the equivalent cohorts has been low with a large share of part-time work at younger ages, making these women ineligible for most of the reforms considered later in this analysis.

age, and the average exit age (AEA) from the labor force is considerably lower than the statutory eligibility age. This pattern is similar among the European countries. Only for males in Sweden, the average exit age is later than the statutory eligibility age. In all countries, the labor force profiles exhibit a rather steep slope during the period shortly before the statutory retirement age.

From an economist's perspective, the existence of a fixed and universal retirement age needs explanation since preferences for leisure differ between individuals and over age, health at older ages varies widely and family circumstances such as the need to take care of parents or a partner differ across households especially at older ages. Moreover, there is no economic reason why claiming a pension must imply leaving the labor force. When to claim a contributory pension should depend on actuarial rules while when to exit the labor force should depend on the preference for leisure. Hence, the exit from the labor force could occur earlier, at the same time or later than claiming a pension. However, in many cases, this flexibility is restricted by a combination of constraints and incentives imposed by employers, unions and governments. Flexibility reforms try to reduce these constraints.

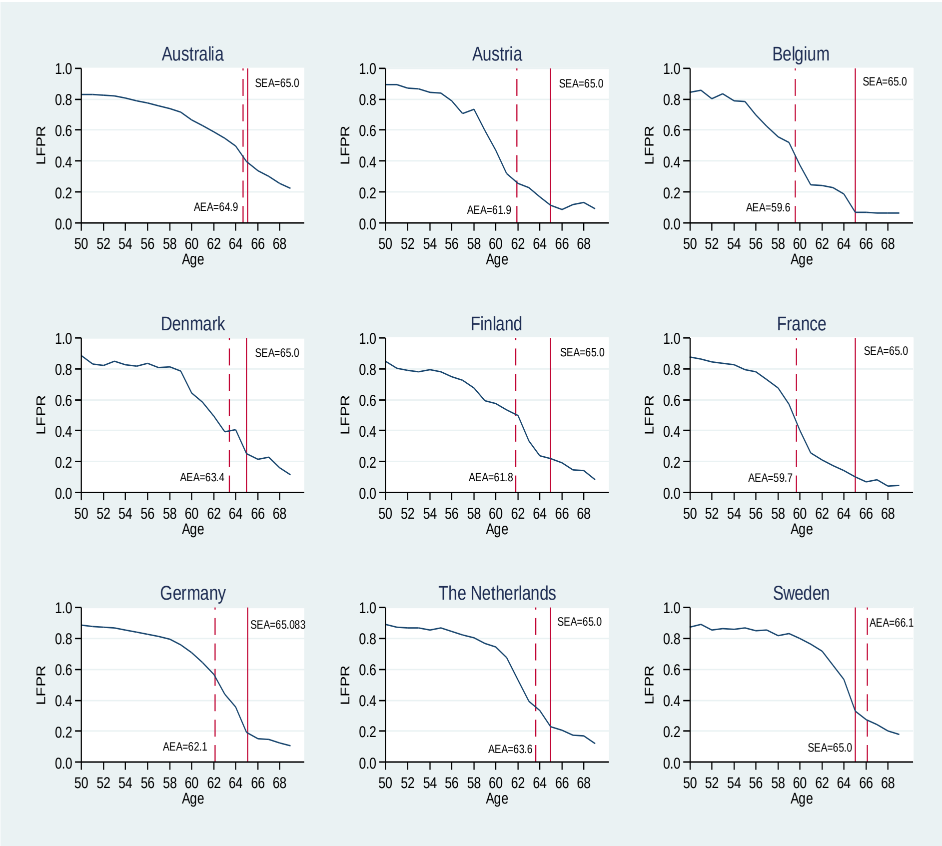
First, in many sectors of European countries the statutory eligibility age is effectively a mandatory retirement age. This is usually not a legal constraint but determined in labor agreements between the social parties. Unions have traditionally pursued a policy of pushing for an early retirement age and justified this by protecting workers with declining health and (misleadingly so) by freeing up jobs for younger workers. Employers, as pointed out already very early by Gustman and Steinmeier (1983), like to impose a lower limit on the hours worked since part-time jobs and flexible hours incur additional fixed costs of work.[37] As a consequence, and in contrast to standard labor market theory, many workers are not free to choose their working hours, in this case to reduce their working hours when they become older but must choose between working full-time or retiring fully.

Second, many pension systems impose earnings tests which limit the amount of earnings that can be received by an individual who receives pension benefits. They usually concern the time period before reaching the statutory eligibility age. Again, this is an impediment for flexible retirement since earnings tests impose a maximum hours constraint for a given wage. As Table A.1.1 (Appendix to Chapter 4) shows, the maximum permissible earnings are relatively low and in many cases (e.g. in Austria, Belgium and Germany) are substantially below a half-time job. In

[37] Fixed costs of employment and team production are some of the reasons why minimum hours constraints exist. See Gustman and Steinmeier (1983) and Hurd (1996) for other possible reasons.

combination with a minimum hours constraint imposed by the employers this may restrict labor supply choices to a very narrow range of hours or, in the extreme, to full work or no work at all. After the statutory eligibility age, many countries do not limit the combination of work income and pension benefits. Nevertheless, this is rather unpopular. The main reason is most likely the inflexible regulation prior to the standard eligibility age since decisions to exit the labor market are normally not revised – only few employees pick up work after having reached the standard eligibility age.

Figure 4.1: Labor force participation rate (LFPR) by single years of age, statutory eligibility age (SEA) and average exit age (AEA) by country, 2012, males



Note: The statutory eligibility age (SEA) is defined as the age at which workers are eligible for full pension benefits independent of any other qualification. The most salient other qualifications for a full pension is the number of working years with the effect that the normal retirement age is effectively the earliest eligibility age, e.g., age 62 in Belgium and France. The labor force participation data for Australia are those of 2011 (2011 Census data).

Source: Australian Bureau of Statistics (2016), OECD (2013a), OECD (2015a).

Third, most European countries have allowed and sometimes even encouraged alternative forms of exiting the labor force before reaching eligibility for an old-age pension. Typical forms are incentives set by specific pre-retirement schemes, unemployment and/or disability benefits or early retirement pensions. In many countries these pathways into early retirement are very attractive since pension benefits are not calculated in an actuarially neutral way. This means that there exists an implicit tax on working longer once individuals have reached the earliest eligibility age, thus encouraging them to claim their pensions as early as possible (Gruber and Wise 1999, 2002).

The combination of these constraints and incentives tends to induce workers to both claim the pension and exit the labor force at the earliest possible time. The two events then occur simultaneously. This is reflected in the rapid and early decline in labor force participation in Figure 4.1. The differences in the slopes reflect different preferences for leisure as well as differences in early retirement incentives provided by the pension systems in each country and the other impediments to flexibility that disrupt the bridge between exiting the labor force and eligibility for a pension.

Institutional arrangements also influence the demand for labor at older ages: it might be optimal for employers to discharge older workers when their productivity does not increase anymore but labor contracts still impose rising wages. Moreover, in many countries it is much cheaper to dismiss older rather than younger workers when a company is forced to restructure because severance payments to older workers are effectively subsidized by early retirement and disability benefits (Börsch-Supan et al. 2009). These mechanisms have also shaped the slopes visible in Figure 4.1. We will, however, focus on the supply side in the sequel of the study.

4.3 Flexibility reforms

In the last two decades, most OECD countries have attempted a shift away from the different early retirement policies mentioned in the previous section and moved towards a strategy of more active aging and longer working lives. Many countries have undertaken substantial pension reforms which have included flexible retirement schemes. The primary goals of these flexible retirement schemes are, on the one hand, to enable employees to gradually reduce their working hours with increasing age in order to facilitate the transition from full-time employment to full retirement. On the other hand, older workers are encouraged to remain in the labor market as long as possible, preferably beyond the statutory eligibility age. Since very often the minimum hours constraints by the employers restrict the labor supply of older workers, in some countries the flexibility reforms targeted firms and set incentives for them to offer part-time schemes to older workers by subsidizing the wages of those workers under certain conditions. Table A.1.1 gives an overview of the flexibility reforms that will be analyzed in Section 4.5 and summarizes their key parameters.[38]

A particularly interesting case is **Sweden**. With the 2000 pension reform that introduced the now famous notional defined contribution system (Palmer 2000), Sweden also introduced a much more flexible scheme regarding retirement entry. Since then, there is no formal retirement age any more. In the new system, pensions can be drawn from age 61 onwards, without an upper age limit. Pension entitlements accrue on individual notional accounts if the person earns pensionable income, regardless of his or her age and irrespective whether the individual already gets a pension. Pension payments are calculated by dividing the notional account balance by a cohort-specific annuity divisor which is linked to the retirement age and the life expectancy of each cohort. The pension payment increases with the age of retirement due to the resulting shorter period over which a pension is paid. It is possible to combine an old-age pension with work income without any financial restrictions or earnings test (Lindecke et al. 2007). Over time, an increasing number of Swedes has begun to claim a pension at the age 61. While 3.9% of the 1939 cohort received a pension with 61, the proportion increased to 5.9% in the 1949 cohort and 7.8% in the 1953 cohort. The persistent trend to claim pension benefits as early as possible led to a debate in Sweden with the plan to raise the minimum eligibility age from 61 to 63 (Statens Offentliga Utredningar 2013).

Already in 1992, **Germany** introduced a partial pension system. In compliance with certain supplementary income limits, individuals could reduce their working hours by working part-time and compensate the resulting income loss by drawing a partial pension. The pension contributions payed on the reduced labor income led to higher pension entitlements later on. Eligibility for the partial pension depended on being entitled to an old-age pension. The partial pension could only be drawn for certain proportions of the split between work and retirement: either one third, one half, or two thirds. In between, no further gradations were possible. The earning limits were calculated individually based on the labor income of the last three years before drawing the partial pension. This system of partial pensions, was not successful and only taken up by few individuals. In 1993, the number of new partial pensioners was around 1,100; approaching 3,000 at the end of the 1990s and declining thereafter. Since the introduction in 1992, the proportion of new pensioners claiming a partial pension was below 0.5% in each year (Börsch-Supan et al. 2015). The rigid earnings limits

[38] Norway, the UK and the US have also recently introduced flexibility reforms. Since those reforms were very recent, we do not have a sufficient number of post-reform observations for the empirical analysis and therefore do not describe those reforms here.

were slightly increased in 2008 and finally substituted by a more flexible limit in 2016 which came into force in July 2017.

In the early 1990s, but especially with the 1993 reform, the **French** government attempted to reverse the previously widespread early retirement trend by promoting gradual retirement through governmental subsidies. The partial retirement scheme was designed for employees from age 55 to 65. Employees could earn income based on their part-time work and in the time before full retirement, receive a governmental income supplement equal to about 30% of the daily reference wage (up to a ceiling). The firm had to hire a new employee for the vacant part-time position. At the end of the 1990s, about 45,000 private-sector workers were benefitting from the governmental subsidies within this partial retirement scheme. The scheme was abolished in 2004 (Reday-Mulvey 2000, OECD 2005a).

With the 1995 reform in **Denmark**, the government tried to encourage gradual retirement by replacing the full early retirement system with a part-time work scheme. The system required that the employee was aged between 60 and 66 years, was entitled to unemployment benefits and was a member of an unemployment insurance fund for at least 20 out of the last 25 years. Within the scheme, working time had to be reduced by at least 25% (or by 18.5 hours per week for self-employed), but the remaining working time should be at least twelve hours a week. The income loss was compensated by a fixed payment of the unemployment insurance fund which was in 1995 7.67€ per hour of working time reduction (2016: 12.32€). The unemployment insurance fund administered the scheme (European Commission 1995, Delsen 1996, Eurofound 2016). Hansen (2001) states that the scheme never attracted many participants; in the late 1990s there were around 1,000 partial pensioners per year. The scheme is being phased out (OECD 2011a).

In **Austria**, a subsidized old-age part-time scheme was introduced in 2000. The scheme is based on a bilateral agreement between the employer and the employee and requires a reduction of working hours between 40% and 60%. Working time can be distributed in two distinctly different ways: Either the employee reduces his working hours for the whole period of 6.5 years by half or the "block model" option can be chosen. In this option the employee continues working without any reduction in working hours for the first part of the period (first block), while for the second period (second block), the employee stops working completely. Employees must have worked at least 80% of a regular full-time employment, before they are entitled to the subsidized scheme. 50% of the income loss is compensated by governmental subsidies, up to 75% of the former gross wage. Pension contributions have to be paid at the same amount as before the working time reduction. In

2000, the lower age limit of the flexible retirement window was 50 for women and 55 for men. In 2005, this was increased to 52 for women and 57 for men, and further to 55 and 60 in 2013. In 2001, 5,274 individuals were part of the scheme. The number grew to almost 40,000 in 2004. Subsequently the number of participants slightly declined (Graf et al. 2008, Graf et al. 2011).

In 2002, the **Belgian** government introduced a system of partial interruption of the working career. In the new time credit system, the employees can take time credit for reducing their working hours fully or by half for up to one year or they can reduce their working hours by one fifth for a maximum of five years; this scheme requires that the employee worked full-time before. The idea of the scheme was to give individuals time for themselves or their family at some point of their working career, so that they will stay longer in the labor force. Especially for employees aged 50 or older the time credit scheme provided extra possibilities. The scheme was named as end-of-career-scheme. If older workers have worked at least 20 years and were employed at the same employer for at least three years, they were eligible to reduce their working hours by half or one fifth until their retirement. The employees are partially compensated for their income loss by governmental flat-rate benefits, depending on the reduction of working time (Devisscher and Sanders 2008). While being part of the scheme, the employees acquire the same amount of pension entitlements as before the working time reduction. The number of participants grew steadily from 8,700 in 2002, to 88,000 in 2011. In 2012, the lower age limit of the flexible retirement window was raised to 55 years and will gradually increase to 60 between 2015 and 2019 (Albanese at al. 2015). Moreover, the government announced to lift the earnings test restrictions after the statutory eligibility age (OECD 2015b).

The **Australian** pension system with its fully funded “superannuation” scheme introduced flexible retirement in 2005 with the aim to encourage older workers to remain in the workforce. This program is called “transition-to-retirement-pension”. Since then, those who have reached the superannuation preservation age are allowed to access their superannuation as an additional income stream. The current preservation age is 55 for those born before 1960, gradually being increased to 60 by 2025. Those who want to remain in the workforce but reduce their working hours in the period between the preservation age and the statutory eligibility age are allowed to supplement their work income with benefits of their superannuation. The amount that can be taken from the superannuation as income compensation is limited to 10% of the person’s superannuation balance in the respective year. Access to the full superannuation benefits is permitted with reaching age 65 (Australian Government 2004, Warren 2008).

A major reform in the **Finnish** pension system came into effect in 2005. The reform was a substantial step towards improving the earnings-related part of the Finnish pension system. Finland introduced a window of flexible retirement between age 63 and 68 (plus an early retirement option at age 62). Within the new system, employees who have turned 63 can decide their individual date of retirement themselves: an employee may retire on an old-age pension within the window of flexible retirement. For giving incentives to the employees to postpone their withdrawal from the labor force, there is a sharp increase in the pension accrual rate at the age of 63 (from 1.9% to 4.5%). Besides, there is no cap of the replacement rate under the new regulation (in the old system the pension could not exceed 60% of the highest wage). Employment beyond age 63 is also encouraged by making it more attractive to combine an old-age pension with income from work. An employee drawing old-age pension benefits may work and have earnings without any financial restrictions. Furthermore, new pension entitlements accrue up to the age 68, the accrual rate being 1.5% (instead of 4.5%). The additional pension rights are added up to the former old-age pension entitlements at the age of 68 (Börsch-Supan 2005, Ilmakunnas and Ilmakunnas 2006). The earliest eligibility age will be raised from 63 to 65 by 2027 (Finnish Centre for Pensions 2014).

Until the revision in 2006, important facilities for gradual retirement in **The Netherlands** were tax-supported saving plans. But in order to increase the labor force participation, all tax facilities for gradual (or early) retirement schemes were abolished. As a consequence of that policy change, the Dutch (occupational) pension funds were obliged to offer part-time pensions. Part-time retirement requires that the insurant reduces his or her working hours, while simultaneously drawing pension benefits out of the pension fund. The lower age limit of the flexible retirement window for retiring part-time varies across the pension funds, starting from age 55 or 60. Besides the different eligibility ages, there is much variety regarding the generosity of pension benefits, and whether pension benefits are based on the average or the final income (Bloemen et al. 2014).

4.4 Economic theory: More flexibility does not necessarily increase labor supply

We build a simple model to show that a flexibility reform is likely to increase labor force participation among older workers but may decrease their working hours such that the reform has an ambiguous effect on total labor supply. We characterize the conditions under which a flexibility reform is likely to be counterproductive by decreasing labor supply. Section 4.4.1 provides a model of a stylized flexibility reform, Section 4.4.2 adds various extensions.

4.4.1 A simple model of a stylized flexibility reform

Our model has two scenarios. The "constrained scenario" is the inflexible status quo described in Section 4.2. It deviates from standard labor market theory in so far as workers cannot flexibly choose their working hours as they wish, especially when they get older and would like to reduce working hours. Rather, the labor market imposes a combination of a minimum hours constraint with a fixed mandatory retirement age. The second scenario ("unconstrained scenario") abolishes both constraints.[39]

In a nutshell, the model works as follows. In the absence of the constraints, workers will gradually reduce their working hours as they age and their preference for leisure increases. They will remain in the labor market until it is too costly for them to drive to work. If employers impose a minimum hours constraint, however, which may be half-time or even higher, workers can reduce their working hours only slightly until they reach that employer-imposed constraint. They then work for a while more hours than they would have preferred without the constraint but only until the loss in preferred leisure is so large that they retire fully. Our model assumes, following the logic in Section 4.2, that the social partners have acknowledged this mechanism and have chosen this age as the statutory retirement age which is thus effectively a mandatory retirement age.[40]

Hence, while abolishing the constraints will induce workers to work more *past* the former retirement age, workers who have worked full-time with the constraints imposed will now reduce their working hours *before* the former retirement age. The overall effect of a flexibility reform on total labor volume is therefore *ex ante* unclear and depends on the distribution of age-related leisure preferences in the population.

We provide a rigorous formal treatment in Section 4.2 and only show the results in graphical form. We assume that individuals value consumption (c) and leisure $(1-l)$ according to a very simple additively separable utility function given by

$$u = \ln(c) + \alpha \ln(1-l)$$

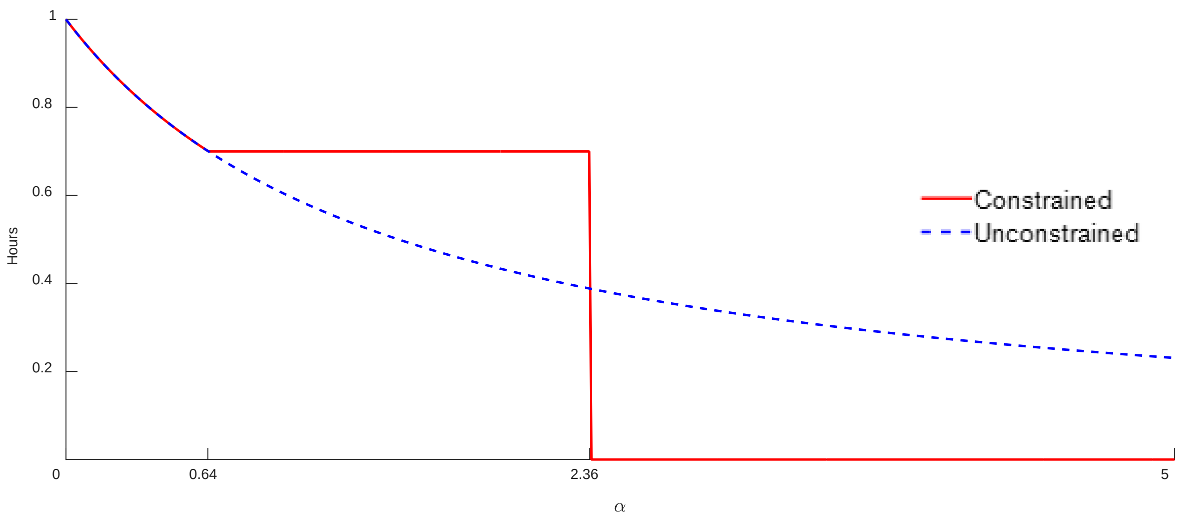
---

[39] We are only modelling the complete abolishment of a minimum hours constraint, although many of the reforms listed in Section 4.3 still require some minimum hours of work. However, the principle mechanism of our model works in the same way if the minimum hours constraint is relaxed partially or completely.

[40] Using the definitions explained later in the formal model, the mandatory retirement age is the age in which α reaches α''.

where l denotes working hours and α represents the importance of leisure relative to consumption during the second period. In this very simple version of the model, we assume that α increases monotonically with age and is the same for all workers of a given age, so α also represents the birth cohort of an individual. α is the key behavioral parameter in our model since it directly relates to whether the minimum hours constraint is binding or not. It may not only reflect preferences but also other circumstances, e.g., the need to take care of a relative or the influence of health on the utility of consumption and the disutility of work.

Figure 4.2: Number of hours worked when middle-aged



Source: Own calculations.

Figure 4.2 shows the optimal labor supply with and without the constraints. The red solid line corresponds to the optimal decisions in the constrained scenario while the dashed blue line corresponds to the unconstrained textbook scenario. We are particularly interested how labor supply in the two scenarios relates to the age-dependent preferences for leisure, described by the parameter α in the utility function. α is therefore shown on the x-axis in Figure 4.2. The importance of leisure relative to consumption increases as we move to the right as does the age of the individuals.

We first discuss the constrained case in which labor supply faces a minimum hours constraint. It is defined by $\bar{l}$ which we set to 0.7. Individuals must choose between working $l \geq \bar{l}$ hours or retiring completely from the labor market, in which case $l = 0$. Younger individuals with a very low preference for leisure like to work more than the minimum number of hours; they are thus unconstrained. As they get older and α increases, however, there is an α' where the constraint becomes binding ($\alpha' = 0.64$ in our parametrization and $l = \bar{l}$). To the right of α', individuals continue to work although they work more hours than they would have preferred without the constraint. Increasing age and thus α even further, we reach an α'' where labor supply changes qualitatively ($\alpha'' = 2.36$ in our parametrization). This corresponds to the retirement age. Beyond this age, individuals have a sufficiently high preference for leisure, $\alpha > \alpha''$, to retire fully and thus work fewer hours than they would have preferred without the constraint.

After a flexibility reform which removes the constraints, individuals will follow the path of labor supply represented by the dashed blue line in Figure 4.2. Nothing changes for the youngest individuals with a very low $\alpha < \alpha'$. Moderate-α individuals with $\alpha' < \alpha < \alpha''$, however, reduce their labor supply to a more desirable level in the unconstrained scenario. This produces a negative effect on hours worked while leaving labor force participation unchanged. The oldest individuals with a high preference for leisure ($\alpha > \alpha''$) increase their working hours to the desired level rather than retire early. This creates a positive effect on hours worked and labor force participation.

Our model therefore predicts an unambiguously positive effect of a flexibility reform on labor force participation but generates opposing effects on total labor supply. Whether the negative effect on total labor supply of those younger than the former mandatory retirement age dominates the positive effect on total labor supply of those older than the former mandatory retirement age depends on the distribution of α representing the age-dependent preferences for leisure and thus the size of the underlying birth cohorts.[41] A flexibility reform put into place when the baby boomers are still relatively young is therefore most likely to reduce total labor supply.

4.4.2 Model extensions and pension policy

The point of the preceding section was to show that even in a very simple model of labor supply more flexibility does not necessarily mean more labor volume, using the combination of a mandatory retirement age and a minimum hours constraint as an example for inflexibility.

In a richer model, there will be additional effects. Moreover, pension policies may shift the cut-off point α'' in Figure 4.2. This section provides examples which show that the basic insights of the simple model are robust.

First, we may want to loosen the strict link between age and the preference for leisure and introduce heterogeneity of preference within a given birth cohort. The simple model of Section 4.4.1

[41] Age, as pointed out, also represents birth cohorts, and we interpret the model as if it were based on a stationary population.

can then be re-interpreted by replacing the single representative individual for each birth cohort by the median individual. The mandatory retirement age becomes binding for all individuals who reach this age and (still) have a lower preference for leisure than the median individual. Success and failure of a flexibility reform does not only depend on the relative size of birth cohorts but also on the distribution of leisure preferences within each cohort. Increasing flexibility means more labor supply for individuals with a high preference for consumption while it means less labor supply for individuals with a high preference for leisure.

Second, there may be repercussions of the constraints on labor supply at younger ages. We therefore expand our simple model to a three period model (young, retirement window and old). Individuals work during the first two periods. The retirement decision is taken in the second period. All individuals are retired in the third period. They supply l_1 and l_2 hours of labor and receive an hourly wage of w in return. The remaining hours are dedicated to leisure. For convenience, the total number of hours in a period is normalized to 1 ($l_t < 1$ for $t = 1,2,3$).

The individuals' period utility increases in consumption (c_t) and leisure $(1 - l_t)$ and is given by the same additively separable utility function as in our simple model:

$$u_t = \ln(c_t) + \alpha \ln(1 - l_t)$$

Individuals choose a sequence $\{c_t, l_t, t = 1 \dots 3\}$ to maximize their lifetime utility, U, where:

$$U = \sum_{t=1}^{3} u_t$$

subject to the lifetime budget constraint:

$$\sum_{t=1}^{3} w\, l_t = \sum_{t=1}^{3} c_t$$

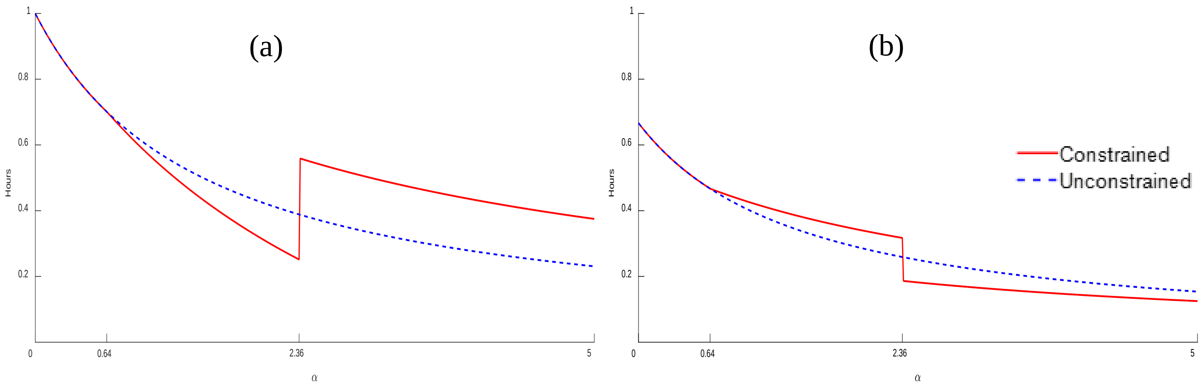
where we set the price of the consumption good to one and the time preference and interest rates to zero.[42] In the third period all workers are retired, $l_3 = 0$. Consumption in retirement is financed by saving or an equivalent actuarial pension implicit in the budget constraint of our model.

[42] We make these simplifying assumptions to ease exposition. Introducing impatience or positive interest rates would not qualitatively change our results. Note that saving or an equivalent actuarial pension cancel from the lifetime budget constraint.

The focus of the simple model in Section 4.1 was on the second period. The equations for α' at which the minimum hours constraint starts to be binding and α'' at which individuals are forced to retire fully are given in the Appendix to this chapter (Appendix A.2). This appendix also shows the number of working hours gained by a flexibility reform for all individuals with $\alpha > \alpha''$ and the number of working hours lost by a flexibility reform for all individuals with $\alpha < \alpha''$.

Due to the symmetry of the model, $l_1 = l_2$ if there is no minimum hours constraint. If the constraint is binding, however, labor supply decisions in the second period have repercussions on the labor supply in the first period.[43] This is shown in Figure 4.3a. As in Figure 4.2, α indexes the leisure preferences in the second period. Since moderate- α individuals work shorter hours in the second period when labor supply is unconstrained, they earn less and therefore want to work more in the first period to maintain their old consumption levels. The opposite is the case for the high- α individuals.

Figure 4.3: Number of hours worked when young (a) and total number of life-time hours worked (b)



Source: Own calculations.

Note that the moderating effect in Figure 4.3a is substantially smaller than the original effect in Figure 4.2. The extended model therefore delivers the same qualitative result as the simpler specification in Section 4.1 did. This is shown in Figure 4.3b which displays life-time labor supply. For individuals with moderate α the overall effect of the reform on total life-time labor supply is negative, while high- α individuals increase their labor supply after the reform.

[43] We did not model another minimum hours constraint for the first period for clarity and simplicity of exposition. The effect of having a minimum hours constraint in both periods is qualitatively similar: abolishing the constraint in both or one of the two periods will increase labor supply for some workers and decrease it for others, with the total effect depending on the distribution of α.

A third extension of our model involves pension policies. The separability of leisure and consumption in the simple utility function implies that income changes affect consumption but not the choice between work and leisure. In a technical sense, it makes life very easy because we can ignore how pension income is provided. In a richer model, however, pension policies may shift the cut-off point α'' in Figure 4.2 and Figure 4.3. This mechanism explains how differences in leisure preferences and pension policies across countries generate the different retirement patterns which have been shown in Figure 4.1. We provide two examples:

Generosity of the pension system: As discussed in Section 4.2, the generosity of the pension system especially in the years before the statutory retirement age crucially determines the retirement decisions of workers. The more generous (early) pensions are, the higher the incentives to retire early. This relationship has been extensively discussed in the literature and is supported by the empirical evidence (see e.g. Gruber and Wise 2004).

To be precise, "generous" refers to an (early) retirement benefit that is larger than actuarially fair. This is the case in most of the countries in our sample (Queisser and Whitehouse 2006, OECD 2015b). With a non-separable utility function, a higher income will increase consumption as well as leisure, hence the cut-off point α'' in Figure 4.2 and Figure 4.3 will shift to the left, increasing the number of individuals who will retire fully when a minimum hours constraint is in place. Lifting this constraint has therefore more likely a positive effect on total labor supply in an actuarially unfair system which is generous to the early retirees relative to our baseline model. The total effect, however, remains ambiguous.

Maximum hours constraints generated by earnings tests: In Section 4.2 we also discussed that in many countries earnings tests limit the amount of labor income individuals can earn while receiving a pension. In this sense, the earnings test is equivalent to a maximum hours constraint in the second period. We discuss two cases. First, if the earnings limit is very low (see Table A.1.1), the combination of minimum and maximum hours effectively prohibits work and forces individuals to retire early even if their preferred hours were exceeding the minimum hours constraint. Making the earnings test less incisive then unambiguously increases labor supply. Second, plugging a maximum hours constraint into our model in $t = 2$ reveals that, in this case, individuals would try to compensate the earnings lost due to the constraint by increasing their labor supply in $t = 1$. Relaxing a maximum hours constraint in our framework would thus reduce the hours worked in $t = 1$ and increase the hours worked in $t = 2$. In our simple model, total labor supply thus remains unchanged; in a more complex model with age-dependent preferences for leisure, the total effect is likely to be negative since the preference for leisure is supposedly larger in older age.

Börsch-Supan et al. (2017) show that the combination of early retirement incentives and earnings tests can create distinct patterns of labor force exit and pension claiming age. If earnings tests are lifted (i.e. maximum hours constraints are abolished) in the presence of non-actuarial adjustment factors, this can lead to very early pensions claiming. This means that an increase in labor force participation happens at the cost of the pension system since individuals have an incentive to claim their pension as early as possible and continue to work according to their leisure preferences.

It is possible to merge all these extensions into a single structural model of saving and retirement. This has been done by Gustman and Steinmeier (1986, 2004) for the US institutional environment and results in a very complex dynamic programming model that has to be solved numerically. The authors show that if a minimum hours constraint is present, individuals will immediately move from full-time work to full retirement. This is the same qualitative result as derived from our simple model.

4.5 Empirical analysis

4.5.1 Methodology

The objective of our empirical analysis is to estimate the effect of the flexibility reforms described in Section 4.3 on total labor supply. We first estimate the effects on labor force participation (extensive margin), then the effect on total hours worked for those who participate in the labor market (intensive margin) and finally the effect on total labor supply.

We employ two different estimation methods. The first method is a pooled Ordinary Least Squares (OLS) regression which captures the reform effect by a dummy variable indicating that the reform is in effect (Section 4.5.3). This method combines cross-sectional data on N countries and T time periods to produce a dataset of NxT observations. In our analysis we combine time series data for nine countries which adopted a flexibility reform in the past as described in Section 4.3. The advantage of the pooled OLS method is that combining time series with cross sections yields larger samples than using only cross sections or time series. We obtain an average effect of the flexibility reforms over all countries and time periods. The disadvantage of pooled OLS is that the estimated effects may have no causal interpretation if the reforms were driven by unobserved time varying factors that are more complex than those captured by country-specific linear time trends and which may also affect labor force participation and/or working hours.

We therefore use as a second method, known as the synthetic control method (SCM), which was proposed by Abadie and Gardeazabal (2003) and extended in Abadie et al. (2010, 2015) for each country individually (Section 4.5.4). This means that for each treated country we construct a synthetic control from a weighted average of untreated countries. The synthetic control country should approximate the treated country without the reform as closely as possible. We use a set of (at that point in time) non-treated OECD countries for this purpose. The weights for the control countries are set in such a way that the pre-reform trends in labor force participation and working hours, respectively, match the treated countries. The treatment effect is then estimated by taking the difference between the outcome variable (labor force participation or working hours) in the treated country and in its synthetic counterpart after the reform – similar to a difference-in-difference estimator, permitting us to evaluate the effects of the flexibility reforms at the country level. Additionally, endogeneity stemming from omitted variable bias is treated by allowing the existence of unobserved time-varying variables in the estimation. The synthetic control method also permits evaluating the heterogeneity of the reforms by country given the differences in the country circumstances and the reform specifics as described in Section 4.3. The synthetic control method, however, requires long time series of the outcome and the control variables not only for the treated but also for untreated countries. Hence data limitations tend to weaken the theoretical advantages of the synthetic control method.

Since the advantages and disadvantages of the two different empirical approaches complement each other, it is important to employ both methods – pooled OLS and SCM – in order to increase the validity and robustness of our empirical findings. As we will see, both methods produce rather similar results, giving us confidence in the obtained results.

4.5.2 Data

The empirical analyses require a large amount of data; especially the synthetic control method requires time series data for at least ten years before a flexibility reform came into effect in order to construct the synthetic control country. In particular time series data on working hours for older workers are hard to obtain; they are only available for more recent years restricting our analysis depending on the year of the reform.

Dependent variables. Our main dependent variables are **labor force participation** and **working hours** for the age groups 55-64 and 65+.[44] Annual time series data on labor force participation and working hours are obtained from different sources: the OECD's Employment database, Eurostat, Eurofound, the International Labour Organization (ILO) and from several national statistical agencies (Australian Bureau of Statistics, Statistics Canada, Statistics Finland, Statistics Japan, Central Bureau of Statistics of Norway, Statistics Portugal, Statistics Sweden, UK Data Service, US Bureau of Labor Statistics). In order to obtain the **total labor supply,** we multiply labor force participation rates and working hours at the country and year level.

Control variables.[45] The **labor force participation** rates and **working hours of younger workers** at ages 25-54 are included in the estimations to capture country-specific labor market trends over time. These data are obtained from the same sources as the dependent variables. We additionally control for the **statutory eligibility age** at which a person becomes eligible for full (state) pension benefits, and the **earliest eligibility age**, when early retirement (mostly with reduced benefits) is possible. Those data are obtained from the Social Security Administration's *Social Security Programs Throughout the World* (1985-2014), OECD's *Pensions at a Glance* (OECD 2011a, 2013b) and Duval (2003). **Average years of total schooling** are taken from Barro and Lee (2013). **GDP per capita** and **life expectancy at birth** are obtained from the OECD (OECD 2016a, OECD 2016b). Summary statistics for all variables are presented in Table A.3.1.

Treated countries. Our basic estimation sample includes nine countries: Australia, Austria, Belgium, Denmark, Finland, France, Germany[46], The Netherlands and Sweden. The periods covered in the OLS estimation are: 1983-2013 for Australia, Belgium, Denmark, France and Germany, 1989-2013 for Finland, 1990-2013 for Sweden and 1995-2013 for Austria and The Netherlands, resulting in an unbalanced panel of 242 observations. Due to the unavailability of the data on working hours for the age group 65+, Sweden is not part of this analysis. As a result, the

[44] For the labor force participation and the working hours we follow the OECD definition. The labor force participation rate is defined as the ratio of the labor force to the working-age population, broken down by age group. Working hours are defined as average weekly working hours of people who are employed and work full-time or part-time.

[45] For the construction of some of the synthetic control countries we also used the years of early retirement, i.e. the difference between the statutory and the earliest eligibility age. The data on schooling are available in five-year increments and therefore, converted to annual frequency by means of linear interpolation.

[46] Annual data on the labor force at the OECD are averages of monthly estimates supplied by the German authorities. From 1991 onwards, data for unified Germany are available.

number of observations drops to 218 for the older age group. The treatment dummy is constructed according to the reform year as indicated in Table A.1.1.

Control countries. In the synthetic control method potential comparison countries for each treated country are the OECD member countries which have not adopted a flexibility reform during the observation period. The set of comparison countries and the observation periods may differ for each treated country since the reform years are different in each country. Additionally, the availability of the time series determines the observation periods. More precisely, a comparison country is included in the estimation if a sufficiently long time series of the outcome and the control variables before the reform (usually around ten years) is available and it has stayed untreated for a sufficiently long time period after the reform took place in the treated country (here around seven years).[47] We selected the control countries in such a way that the residuals of the pre-treatment trends between the synthetic control country and the treated country are minimized while at the same time the length of the pre-treatment time series is maximized. The set of a specific treated country and the comparison countries constitutes a balanced panel.[48] In Table A.5.1 we report the time periods included before and after the reform by country. Table A.6.1 and Table A.6.2 show the set of comparison countries included in the estimation for each treated country including the weight of each comparison country in the synthetic control and the time periods covered in the estimation.[49]

[47] Some treated countries which had flexibility reforms rather late have also been included among the untreated countries for the construction of the synthetic control group of countries that were treated early (e.g., Belgium, Finland, The Netherlands, and Sweden).

[48] More specifically, we started the selection of control countries by including all those potential control countries for which at least ten years of data on labor force participation or hours worked were available, respectively, before the flexibility reform in a specific treated country was introduced. If the pre-treatment trend for the resulting synthetic control did not closely match the corresponding trend for the treated country before the reform, we successively included more countries with shorter time series. The match in trend development was checked graphically and by minimizing the root mean square error (RMSE). The inclusion of additional countries automatically reduces the length of the pre-treatment time period because a balanced panel of treatment and control countries is needed for the estimation. Thus, the time period used in the estimation was determined by adding or removing countries (see Appendix A.5 for details).

[49] As a robustness check we estimated all our results excluding Luxemburg from the control group, since Luxemburg is a very small country with very close labor market ties to Germany, France and Belgium. Our results are robust to this change. Results are available upon request.

4.5.3 Pooled OLS

In the following, we first run pooled Ordinary Least Squares (OLS) regressions of labor force participation and working hours. We estimate the following Equation 4.1 separately for men aged 55-64 and 65+ where these two age ranges roughly correspond to the age bands to the right and left of α'' in our theoretical model:

$$Y_{it} = \beta_0\, POSTREFORM_{it} + \beta_1 X_{it} + \delta_i + f(t) + u_{it} \quad (4.1)$$

where Y_{it} is the dependent variable. It is alternatively labor force participation (LFP), working hours (WH), or the multiplication of the two, i.e., total labor supply (TLS). *i* and *t* are country and time suffices. $POSTREFORM_{it}$ is a dummy variable which is equal to one in the year of the reform and in the subsequent years of the reform and is equal to zero otherwise.[50] δ_i is a set of country fixed effects. u_{it} is the error term. X_{it} is a set of control variables including the labor force participation, the hours worked or total labor supply of the young (25 to 54 year olds) depending on the specification and the statutory and early pension eligibility ages in order to capture the generosity of the pension systems. $f(t)$ specifies country-specific time trends or time fixed effects.

Table 4.1 shows the main explanatory variable of interest, the post-reform dummy for three different specifications. The baseline specification has neither country-specific time trends nor time fixed effects. The second specification includes a country-specific linear time trend while the third specification includes time fixed effects. For all specifications we calculate standard errors which are clustered at the country level (in round parentheses) and standard errors which are calculated using the method developed by Driscoll and Kraay (1998) in order to account for serial and spatial correlation (in square brackets). Significance levels are reported for both types of standard errors. Note that accounting for serial and spatial correlation produces much sharper results.

[50] Since France abolished flexible retirement in 2004, the reform dummy is set to zero thereafter.

Table 4.1: Effects of flexibility reforms on labor force participation (LFP), working hours and total labor supply (TLS)

	(1) LFP 55-64	(2) LFP 65+	(3) WH 55-64	(4) WH 65+	(5) TLS 55-64	(6) TLS 65+
Baseline	0.023	0.007	-0.653	-4.403	0.191	-0.085
	(0.024)	(0.011)	(0.364)	(2.110)*	(1.092)	(0.283)
	[0.012]*	[0.007]	[0.186]***	[0.777]***	[0.494]	[0.139]
Country-specific linear time trend included	-0.028	-0.010	-0.418	-0.635	-1.166	-0.295
	(0.024)	(0.010)	(0.295)	(0.909)	(1.123)	(0.395)
	[0.008]***	[0.004]**	[0.310]	[0.397]	[0.375]***	n/a
Time fixed effects included	-0.016	0.003	-0.239	-1.219	-0.778	0.057
	(0.009)*	(0.011)	(0.417)	(0.955)	(0.323)**	(0.272)
	[0.005]***	[0.005]	[0.288]	[0.517]**	[0.216]***	[0.148]
N	242	242	242	218	242	218

Note: Each cell refers to a separate regression specification. We only report the coefficient of the reform dummy. All specifications include controls for the country- and time-specific early and standard eligibility age. Depending on the dependent variable we control for LFP, WH and TLS of workers aged 25-54, respectively. Clustered standard errors in parentheses; Driscoll-Kraay standard errors in brackets. We estimate the Driscoll-Kraay standard errors following Hoechle (2007). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The periods covered are: 1983-2013 for Australia, Belgium, Denmark, France and Germany, 1989-2013 for Finland, 1990-2013 for Sweden and 1995-2013 for Austria and The Netherlands. Due to the unavailability of the data on working hours for the age group 65+, Sweden is not part of the analysis.

Source: Own calculations.

Columns 1 and 2 show the effects on labor force participation of men, separately by age between 55 and 64 and above 65. Average labor force participation of men aged 55-64 was 53% in the years before the reforms. According to the baseline specification, LFP of men in that age group increased on average by 2.3% after the introduction of the flexible retirement reforms (Column 1). This increase is insignificant using clustered standard errors and marginally significant using Driscoll-Kraay adjusted standard errors.

When accounting for country-specific linear time trends or time fixed effects, the effect becomes negative; i.e., LFP of workers aged 55-64 has decreased by 2.8% or 1.6%, respectively. Both effects are significant if we use Driscoll-Kraay standard errors to account for serial and spatial correlations (in square brackets). The effect for the age group 65+ is small and mostly insignificant (Column 2). Labor force participation remained at around 7% before and after the flexibility reforms for this age group. This is in line with the hypothesis derived from the theoretical model that the effects of flexibility reforms on labor force participation can be positive or zero depending on the distribution of leisure preferences in the population and the cohorts affected. The fact that not many individuals increased participation in the labor market in the older age group despite the increased flexibility reflects their lower preferences for leisure. Our empirical results based on the OLS regressions give a first indication that not even the effect of flexibility reforms on LFP is positive.

The effect of the reform on working hours of older workers is shown in Columns 3 and 4. Our evidence here indicates that the average effect is negative both for workers before and after the statutory eligibility age. The effects are significant in the baseline specification and for Driscoll-Kraay adjusted standard errors. Most other specifications show insignificant effects.

We are ultimately interested in the overall effect of the flexibility reforms on total labor supply. We therefore multiply the LFP and WH variables in order to obtain an unconditional measure of the total labor supply and run the regressions with the same explanatory variables as before. Results are presented in Columns 5 and 6. The effect on total labor force participation is not significant in the baseline specification for both age groups. When we include country-specific linear time trends or time fixed effects and use Driscoll-Kraay standard errors, then the overall effect on total labor supply becomes significantly negative for workers aged 55-64 and remains insignificant for the older age group.

In addition to the change in *levels* we checked how the flexibility reforms affected the *trends* in labor force participation, hours worked and total labor supply (see Table A.4.1). Again we find that flexibility reforms had largely negative effects on the labor markets in the countries under consideration. On average labor force participation of male workers above age 55 increased, but the increase was dampened by the flexibility reforms. The reforms also amplified the decrease in weekly working hours. Overall, the yearly increase in total labor supply was dampened by 0.3% due to the flexibility reforms.

In summary, the reforms did not produce the desired positive effect on total labor supply among older male workers. On the contrary, both labor force participation and hours worked were affected negatively by the flexibility reforms such that the overall effects were zero or negative in the nine flexibility reforms included in our analysis.[51]

[51] As results in Austria (see discussion in Section 4.5.4) might be confounded by the pension reform in 2004, we ran a robustness check dropping Austria and our general results remain.

4.5.4 Synthetic control method

4.5.4.1 The model

While we included country-specific linear time trends and common time fixed effects in the pooled OLS estimations, the effects of the flexibility reforms may have been confounded by time trends that have been more complex, e.g. non-linear with shapes that differed across countries. In this case, the OLS results cannot be interpreted causally. Another disadvantage of the OLS method is that we pooled reforms across countries and time and thus obtain an average measure of the effects of the reforms described in Section 4.3. These reforms were, however, quite heterogeneous. We therefore also pursue a second estimation strategy and apply the synthetic control method to those countries that introduced a flexibility reform in the past. The model that we adopt is the following:

Let D_{jt} be an indicator for treatment, for country j at time t. In our case this would be the adoption of a flexibility reform. Then the observed outcome variable Y_{jt} can be defined as the sum of a time-varying treatment effect $\alpha_{jt}D_{jt}$ and the outcome that would have been observed for country j at time t if the reform had not taken place, expressed as Y_{jt}^N (i.e. the counterfactual):

$$Y_{jt} = \alpha_{jt}D_{jt} + Y_{jt}^N = \alpha_{jt}D_{jt} + (\delta_t + \boldsymbol{\theta_t Z_j} + \boldsymbol{\lambda_t \mu_j} + \varepsilon_{jt}) \tag{4.2}$$

Y_{jt}^N is determined by δ_t, an unknown time factor; $\boldsymbol{Z_j}$, a vector of observed covariates (not affected by the treatment) which can be either time-invariant or time-varying; $\boldsymbol{\theta_t}$, a vector of unknown parameters; $\boldsymbol{\lambda_t}$, a vector of unobserved common factors; $\boldsymbol{\mu_j}$, a vector of unknown factor loadings and the error terms ε_{jt} which are unobserved transitory shocks at the country level with zero mean. Assuming that only the first country is exposed to the treatment, the treatment effect D_{jt} is estimated by approximating the counterfactual Y_{1t}^N with a weighted average of untreated countries:

$$\widehat{\alpha_{1t}} = Y_{1t} - \sum_{j\geq 2}^{J+1} w_j Y_{jt} \tag{4.3}$$

for $t \in \{T_0 + 1, \ldots, T\}$ with $0 \leq w_j \leq 1$ for $j = 2, \ldots, J + 1$ and $w_2 + \cdots + w_{J+1} = 1$, $T_0 + 1$ is the year of the treatment, T is the total number of years and $J + 1$ is the total number of countries in the sample. The weights are chosen such that pre-treatment characteristics of the treated country closely reflect those of the synthetic control country. These characteristics include all those salient covariates that explain the outcome variable and the pre-treatment values of the outcome variable.

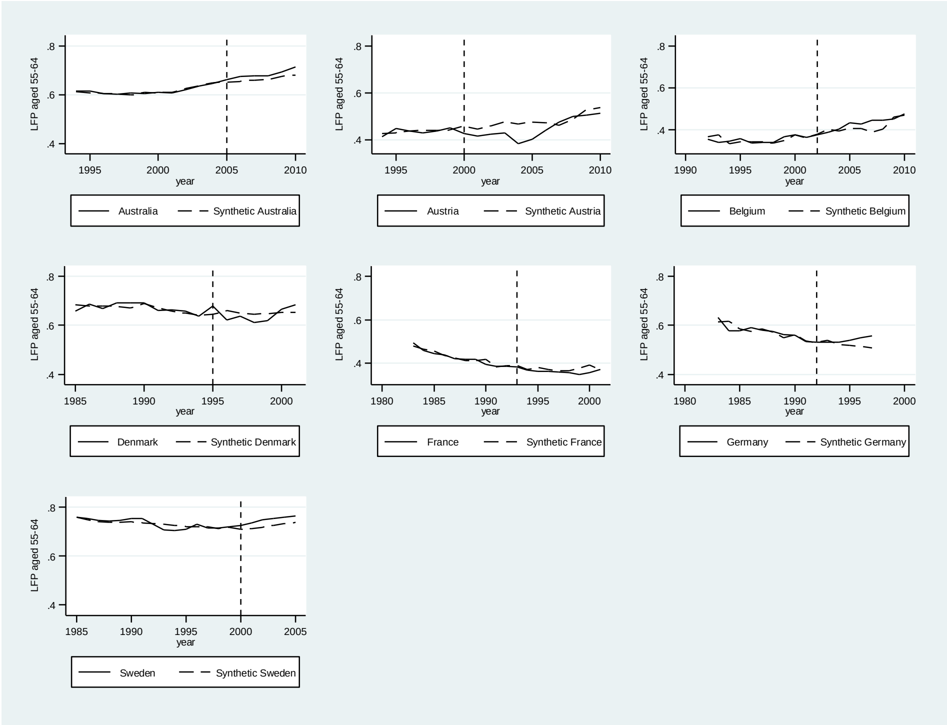
Note that Equation 4.2 is equivalent to estimating a traditional fixed effect model if $\lambda_t u_j = \phi_j$. That is, the traditional fixed effect model assumes that unobserved heterogeneity is time-invariant. The advantage of the synthetic control method over the fixed effect estimation is that it deals with endogeneity stemming from omitted variable bias by allowing the existence of unobserved time-varying variables in the estimation. Moreover, this method also allows for the presence of a common time trend across countries.

4.5.4.2 Treatment effects

The quality of the estimation depends crucially on finding a good synthetic control. The synthetic control must provide a good approximation how the outcome variable of the treated country would have developed in the absence of the flexibility reform. This is the case if the counterfactual pre-treatment values of the outcome variable provided by the synthetic control are close to the corresponding values of the treated country. For constructing the synthetic control we use the averages of the pre-treatment values of the outcome variables and a set of covariates which explain the outcome variable. These covariates are labor force participation at younger ages 25-54, the statutory eligibility age or the eligibility age for early retirement, GDP per capita, years of schooling, and life expectancy (see Appendix to Chapter 4, Table A.8.1 and Table A.8.2, for the quality of pre-treatment characteristics).[52] Since alternative specifications are possible we report robustness checks in Appendix A.7. We were unable to establish the robustness of the treatment effects on labor force participation for Finland and The Netherlands, and on working hours for Sweden and The Netherlands (see Figure A.7.1 and Figure A.7.2 in Appendix A.7). Therefore, we exclude those countries when reporting the treatment effects in the rest of the chapter.

[52] We do not include all lagged outcome values as predictors in order to increase the quality of the pre-treatment match since Kaul et al. (2015) show that the inclusion of the entire pre-treatment path of the outcome variable saturates the regression model and causes all other covariates to be irrelevant in the estimation. Note also, that the control variables in the SCM are not identical to the controls of the pooled OLS. In OLS we pool countries and years. We therefore run into multicollinearity problems if we include too many variables that only vary by country or only over time. In SCM, however, we are interested in getting a very good prediction of the pre-treatment trend in the outcome variable, so we include all variables that contribute to an improvement in fit even if they are highly correlated. In general, the criterion for selecting the inclusion of control countries and control variables was to minimize the RMSE.

Figure 4.4: Trends in labor force participation: treated vs. synthetic control



Source: Own calculations.

Figure 4.4 displays labor force participation rates of men aged 55 to 64 for the treated countries and their synthetic counterparts before and after the flexibility reforms. In general, the labor force participation trend for the synthetic control closely matches the corresponding trend for the treated country before the reform. In some countries such as Australia, the synthetic control almost exactly reproduces the actual labor force participation rates during the entire pre-treatment period. The treatment effect is given by the difference between labor force participation rates in the treated country and in its synthetic counterpart after the implementation of the reform. The discrepancy between these two lines is positive for Australia, Belgium, Germany, and Sweden, indicating an increase in LFP. It is negative in France, indicating a decrease in LFP after the flexibility reforms. The picture for Austria and Denmark is mixed. In order to evaluate statistical significance in the following we present yearly treatment effects.

Table 4.2: Post-treatment results regarding LFP of males aged 55-64, effects and pseudo p-values

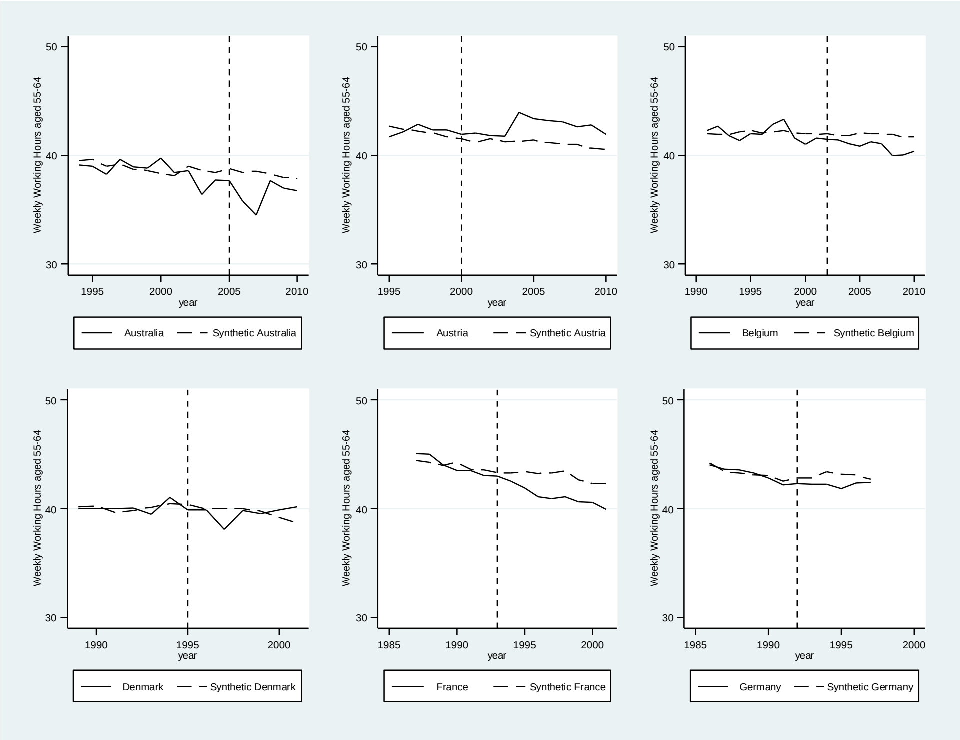
Australia			Austria			Belgium		
year	estimates	pseudo p-values	year	estimates	pseudo p-values	year	estimates	pseudo p-values
2005	**0.010****	**0.048**	2000	-0.030	0.263	2002	-0.005	0.824
2006	**0.018*****	**0**	2001	-0.029	0.316	2003	-0.013	0.529
2007	**0.017****	**0.048**	2002	-0.036	0.263	2004	0.008	0.824
2008	**0.014***	**0.095**	2003	-0.048	0.158	2005	0.027	0.412
2009	**0.019*****	**0**	**2004**	**-0.083***	**0.053**	2006	0.021	0.529
2010	**0.032*****	**0**	2005	-0.073	0.158	**2007**	**0.055*****	**0**
			2006	-0.033	0.526	2008	0.041	0.118
			2007	0.015	0.737	2009	-0.008	0.941
			2008	0.011	0.737	2010	0.006	0.941
			2009	-0.023	0.474			
			2010	-0.023	0.368			
Denmark			**France**			**Germany**		
year	estimates	pseudo p-values	year	estimates	pseudo p-values	year	estimates	pseudo p-values
1995	**0.034*****	**0**	1993	-0.006	0.667	1992	0.001	0.923
1996	-0.04	0.176	1994	-0.003	0.867	1993	-0.008	0.846
1997	-0.013	0.412	1995	-0.018	0.333	1994	0.008	0.923
1998	-0.035	0.235	1996	-0.007	0.733	1995	0.02	0.538
1999	-0.028	0.294	1997	-0.008	0.667	1996	0.035	0.385
2000	0.014	0.471	1998	-0.007	0.6	1997	0.048	0.231
2001	0.03	0.353	1999	-0.029	0.333			
			2000	-0.035	0.333			
			2001	-0.004	0.867			
Sweden								
year	estimates	pseudo p-values						
2000	0.016	0.533						
2001	0.024	0.2						
2002	0.029	0.133						
2003	0.028	0.2						
2004	0.028	0.333						
2005	0.026	0.333						

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Source: Own calculations.

Yearly treatment effects on labor force participation are summarized in Table 4.2 together with their statistical significance. To evaluate the significance of the treatment effects, we conduct placebo tests and calculate pseudo p-values. In other words, we check if the treatment effects are driven by chance by estimating the same model on each country in our control group, assuming it was treated at the same time in order to obtain a distribution of placebo effects. If many of the placebo effects are as large as the actual effect, then it is likely that the actual effect is observed by chance.[53]

Figure 4.5: Trends in working hours: treated vs. synthetic control



Source: Own calculations.

[53] To evaluate the significance of the treatment effects, we conduct placebo tests and then calculate pseudo p-values. Those placebo effects can be quite large if the quality of matches in the pre-treatment period is poor. This would make p-values too conservative. Following Galiani and Quistorff (2016), we calculate the pseudo p-values by dividing the estimated treatment effects by the corresponding pre-treatment match qualities. Then the inferences are made based on these ratios instead of on the treatment effects solely. As defined by Galiani and Quistorff (2016), the pseudo p-value in one period is the proportion of placebo pseudo effects (each control unit's treatment effect divided by its pre-treatment root mean square error) that are at least as large as the actual treated unit's pseudo effect.

The results in Table 4.2 suggest that the estimated effect of the reform on labor force participation is close to zero in most of the post-reform years in most of the countries. It is positive and statistically significant only for Australia in all years after the reform. For Belgium there is a significant increase in labor force participation only in 2007, five years after the introduction of the reform. For Denmark the labor force participation significantly increased in the year of the reform only. For France, Germany, and Sweden the reform did not change the labor force participation significantly. Only for Austria we observe a weakly significant negative effect on labor force participation in 2004, four years after the reform was enacted. Thus, with the exception of Australia, there does not seem to be a consistent pattern of increased labor force participation due to the flexibility reforms.

In Figure 4.5 we show the trends in weekly working hours for men aged 55 to 64 for the treated countries and their synthetic counterparts. In general, pre-treatment observation periods for working hours are shorter compared to pre-treatment observation periods for labor force participation due to data restrictions. Nevertheless, the synthetic control matches for actual pre-treatment working hours were stable for six of our initial countries. Robustness checks are shown in the Appendix to this Chapter 4 (Figure A.7.2).

According to Figure 4.5, the estimated effects of the flexibility reforms on working hours are negative in Australia, Belgium, France and Germany. The hours worked increased in Austria and the picture is mixed for the post-treatment years in Denmark.

Table 4.3: Post-treatment results regarding working hours of males aged 55-64, effects and pseudo p-values

Australia			Austria			Belgium		
year	estimates	pseudo p-values	year	estimates	pseudo p-values	year	estimates	pseudo p-values
2005	-1.120	0.333	2000	0.421	0.833	2002	-0.484	0.571
2006	**-2.646*** **	0	2001	0.838	0.333	2003	-0.396	0.786
2007	**-4.057*** **	0	2002	0.255	0.667	2004	-0.755	0.214
2008	-0.643	0.8	2003	0.522	0.667	**2005**	**-1.254* **	**0.071**
2009	-0.994	0.667	**2004**	**2.645*** **	**0**	2006	-0.733	0.429
2010	-1.108	0.733	**2005**	**1.964* **	**0.056**	2007	-0.861	0.357
			2006	**2.052* **	**0.056**	**2008**	**-1.984* **	**0.071**
			2007	2.073	0.167	2009	-1.619	0.143
			2008	1.657	0.278	2010	-1.317	0.286
			2009	2.158	0.111			
			2010	1.378	0.444			
Denmark			**France**			**Germany**		
year	estimates	pseudo p-values	year	estimates	pseudo p-values	year	estimates	pseudo p-values
1995	-0.478	0.333	1993	-0.303	1	1992	-0.493	0.231
1996	-0.073	1	1994	-0.75	0.615	1993	-0.636	0.231
1997	**-1.875* **	**0.067**	**1995**	**-1.485* **	**0.077**	1994	-1.16	0.154
1998	-0.178	0.933	**1996**	**-2.131* **	**0.077**	**1995**	**-1.352*** **	**0**
1999	-0.232	0.933	1997	-2.397	0.154	1996	-0.723	0.154
2000	0.712	0.533	1998	-2.394	0.154	1997	-0.297	0.692
2001	1.501	0.267	**1999**	**-2.021**	**0.077**			
			2000	-1.723	0.154			
			2001	**-2.36* **	**0.077**			

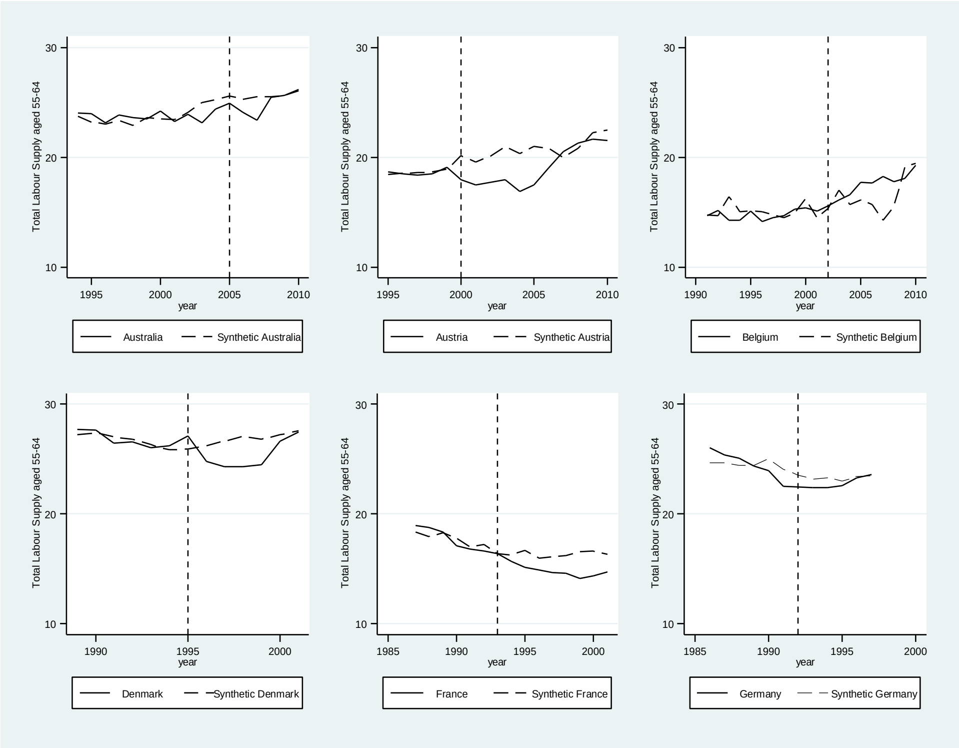
Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Source: Own calculations.

The size of the treatment effects on working hours and pseudo p-values in each year are shown in Table 4.3. According to these results, the reforms' effect on working hours tends to be negative or close to zero for all post-treatment years and all countries except Austria. Effects are not always significant, but there are some significant negative effects determined in all countries. For Austria, on the other hand, there is a significant increase in working hours after the reform in 2004, 2005, and 2006 which may be due to other pension reforms which took place in Austria during the same time.

As a final step, we estimate the effect of flexibility reforms on total labor supply of men aged 55-64. Total labor supply is measured as the product of labor force participation and working hours for those who participated. Time periods covered in this estimation are determined by the availability of the time series of working hours which are usually shorter than the time series of labor force participation.

Figure 4.6: Trends in males' total labor supply: treated vs. synthetic control



Source: Own calculations.

Treatment effects on total labor supply of men aged 55-64 are shown graphically in Figure 4.6 and the yearly effect sizes and pseudo p-values are reported in Table 4.4. As Figure 4.6 shows, in all countries the change in total labor supply after the reform is negative except for Belgium. Table 4.4 reveals that total hours worked per week significantly decreased by 2.2 units (or 9%) in 2007 in Australia and by two to three units (or 11% to 16%) in the first seven years of the reform in Austria. In Denmark, we find a two unit (or 4%) increase in total hours worked per week in the year of the reform, yet the direction of the effect changes starting from 1997, resulting in a reduction by two to three units (or 7% to 11%) between 1997 and 1999. In Belgium, on the other hand, total hours worked per week increased by four units (or 24%) in 2007, five years after the introduction of the reform. In France and Germany the total labor supply did not change significantly after the respective reforms.

Table 4.4: Post-treatment results for total labor supply of males aged 55-64, effects and pseudo p-values

Australia			Austria			Belgium		
year	estimates	pseudo p-values	year	estimates	pseudo p-values	year	estimates	pseudo p-values
2005	-0.628	0.733	**2000**	**-2.193*** **	**0**	2002	0.190	0.929
2006	-1.189	0.4	**2001**	**-2.095 *** **	**0**	2003	-0.873	0.714
2007	**-2.194*** **	**0.067**	**2002**	**-2.407*** **	**0**	2004	0.869	0.643
2008	-0.052	1	**2003**	**-3.056*** **	**0**	2005	1.605	0.5
2009	0.016	1	**2004**	**-3.455*** **	**0**	2006	1.932	0.5
2010	0.154	0.933	**2005**	**-3.459*** **	**0**	**2007**	**4.011*** **	**0**
			2006	**-1.786***	**0.056**	2008	2.231	0.143
			2007	0.535	0.444	2009	-1.008	0.643
			2008	0.485	0.5	2010	-0.226	0.929
			2009	-0.603	0.333			
			2010	-0.92	0.167			

Denmark			France			Germany		
year	estimates	pseudo p-values	Year	estimates	pseudo p-values	year	estimates	pseudo p-values
1995	**1.193*** **	**0**	1993	0.024	0.923	1992	-1.107	0.692
1996	-1.457	0.133	1994	-0.592	0.538	1993	-0.802	0.615
1997	**-2.302***	**0.067**	1995	-1.559	0.308	1994	-0.892	0.769
1998	**-2.744***	**0.067**	1996	-1.104	0.385	1995	-0.447	0.846
1999	**-2.339***	**0.067**	1997	-1.446	0.462	1996	-0.155	0.923
2000	-0.58	0.667	1998	-1.591	0.615	1997	0.127	1
2001	-0.124	1	1999	-2.438	0.308			
			2000	-2.225	0.308			
			2001	-1.557	0.462			

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Source: Own calculations.

Finally, we would like to link the differences in the effects found in the various countries to the specific reform features or the context of the reform.

Germany and **France** show very similar labor market patterns: the effect on LFP is zero, hours worked decline slightly in the years after the reform and overall we find no effect on total labor supply. Both countries introduced the flexibility schemes in the early 1990s, Germany in 1992 and France in 1993. In Germany at the time several early retirement routes existed for workers. Those pathways to retirement were very generous since they were granted to qualifying workers mostly without deductions. Deductions for early retirement were phased in gradually by cohort at the end of the 1990s. Compared to those schemes the partial retirement scheme was never very attractive. In 1993, only 1,100 workers chose partial retirement. The total fraction of new pensioners claiming a partial pension was below 0.5% in each year (Börsch-Supan et al. 2015). The reasons for the unattractiveness of the scheme were supposedly related to the very strict earnings tests and the complicated regulations (Börsch-Supan et al. 2012 and Gasche and Krolage 2012). In France the individuals selecting the so-called RPR scheme was larger – around 45,000 individuals at the end of the 1990s. However, compared to the alternative early retirement schemes the number was small. The scheme was abolished in 2004.

Denmark enacted the flexibility reform in 1995. We find a positive LFP effect in the first year after the reform, and a negative effect on WH after three years. Overall, total labor supply increased only in the first year of the reform and after that decreased slightly. Hansen (2001) reports that the Danish part-time scheme never attracted many participants (only around 1,000 per year). He proposes that this could be due to the unavailability of suitable part-time jobs. Additionally, an attractive early retirement scheme existed in Denmark which attracted around 150,000 individuals at the end of the 1990s (Hansen 2001). Thus, similar to France and Germany the partial retirement scheme in Denmark seemed to lack popularity most likely due to the simultaneous existence of attractive routes for full early retirement.

Austria adopted the part-time scheme in 2000. We find no effect on LFP except in 2004, where we find a negative effect, which is contrary to our predictions, but only weakly significant at the 10% level. We find a positive effect on weekly working hours in the years 2004 to 2006 which is again in contrast to all other countries in our study. It is strongly significant for the year 2004 in which the flexibility scheme was reformed again. What we see is most likely not the effect of the flexibility reform in 2000 but rather the effect of the pension reform in 2004. This reform made early retirement more costly by increasing eligibility ages to various early retirement pathways and introducing actuarial adjustments to benefits received before the statutory retirement age. Overall, however, we find a significantly negative effect of the flexibility reforms on total labor supply. These results are in line with the micro-econometric estimation results obtained by Graf et al. (2008, 2011) who find a significant reduction of the part-time scheme on total labor supply for both men and women.

The **Belgian** part-time scheme was introduced in 2002, after the baby-boomers had already started to retire. We find zero effects on LFP in all years except in 2007, where we find a significantly positive effect on LFP. Effects on working hours are mostly negative, however they are only significant in 2005 and 2008. The effect of the flexibility scheme on total labor supply is zero in all years except in 2007. Here the positive effect on LFP creates an overall positive effect on labor supply. Overall, the time credit scheme is evaluated as successful scheme in terms of take-up. It was criticized because it did not show the desired effects of keeping individuals in the labor force longer, but it was used in some sectors as an early exit scheme (Albanese et al. 2015).

Australia enacted the reform in 2005, when the baby-boomers had already started to retire (the oldest baby-boomer cohort reached the retirement window in 2001). It is the only country where we find a consistently positive effect of the reform on LFP. However, we find a slightly negative effect on working hours after two and three years, so that the overall effect of the reform on labor supply becomes zero (negative in year three after the reform). Overall, only few relatively wealthy workers opted for the scheme. This could be related to the tax incentives or lack of information about the available options (Australian Government 2015).

In summary, we find that labor force participation slightly increased or stayed the same in most countries after the introduction of the flexibility reforms. At the same time hours worked largely decreased after the reforms. The overall effects on total labor supply are either zero or negative, except for Belgium, where we find a slight increase in total labor supply five years after the flexibility reform.

Results from the pooled OLS and SCM approaches thus consistently point into the same directions. This makes us confident that the evidence is robust in spite of the various caveats of the methods and the dearth of data available especially for working hours in the early periods of our investigation.

4.6 Conclusions

Making retirement more flexible sounds like a good thing for sure. If the aim is to increase labor supply at older ages, however, this is not necessarily true. From a theoretical point of view, flexibility reforms have ambiguous effects on labor supply and might endanger the intended goal of increasing total labor volume. Our empirical analyses show that they have actually done so in most of the countries in our study.

Total labor supply is the product of labor force participation (the extensive margin) and average hours worked (the intensive margin). One has to consider the effects of increased flexibility on both margins. Our theoretical model shows that the effect of a reform on labor force participation is positive if workers value leisure highly. If they have a moderate or low preference for leisure, there will be no effect on labor force participation. Moreover, the effect on total hours worked can be positive or negative depending on the distribution of age-related leisure preferences in the population.

We exploit the evidence drawn from several flexibility reforms that were introduced in nine OECD countries between 1992 and 2006. Using two different econometric approaches, we reach the same conclusion: labor force participation has very little if at all increased in some countries and years due to the flexibility reforms introduced since the 1990s. At the same time we find that older men aged 55-64 have decreased their weekly working hours. In sum, the reforms have produced zero to negative effects on total labor supply. Hence, if the objective of these flexibility reforms was to increase labor supply of older workers, they have failed to reach this aim.

Notwithstanding this failure, flexibility reforms are a good thing for the targeted workers when they remove constraints such that individuals are put into a situation which permits them to better trade-off leisure and consumption in their specific life circumstances. For instance, if individuals would like to spend time caring for a relative, retire jointly with a spouse, or are not healthy enough to work full time but would like to work part-time and smooth consumption, more flexible retirement conditions are likely to increase the utility of the targeted individuals. This is where the intuition of "more flexibility is better" holds.

Whether welfare for society as a whole increases is another issue. If more flexibility comes along with lower total labor supply and higher pension expenditures, then the tax and contribution base will be reduced and taxes and pension contributions will have to be increased. This will lessen the utility of tax payers and younger workers. The tax and contribution increases will be particularly strong in pension systems in which benefits are not linked in an actuarially neutral way to the retirement age. Whether overall societal welfare increases or decreases then depends on the underlying demographic structure and the respective weights given to each cohort.

Welfare is also affected by general equilibrium effects. First, higher taxes and contributions will have feedback effects on labor supply. Second, aggregate productivity might be affected depending on the age structure of the workforce and the number of full-time and part-time workers. Moreover, fixed costs of part-time work and frictions related to this have to be taken into account. The analysis of welfare effects therefore requires a macro-economic model with multiple generations and strong assumptions how to aggregate the utility functions of each cohort, see e.g. Börsch-Supan et al. (2016). Due to the different mechanisms and trade-offs, it is *ex ante* unclear whether the net effect of more flexibility on welfare for society as a whole is positive or negative.

The message of this study is therefore that increasing flexibility has two sides: a potentially positive side for the targeted older workers and a dangerous one for an aging society as a whole. Flexibility may taste sweet but policy makers cannot escape the fact that if one wants to increase labor volume for an aging population, one must increase the average exit age from the labor force. The danger of flexibility reforms is the suggestion that such an escape is possible.

How can one sweeten this sour fruit? Increasing the retirement age has often been perceived as exchanging years in sweet retirement for years in sour work. This view is wrong since during the period in which the retirement age will be gradually increased, life expectancy will also increase – short of an unlikely reversal of the trend during the last decades. This permits increasing the length of the working life in parallel to increasing the length of life in retirement. Stabilizing the financial base of a pension system with respect to ever longer lives only requires stabilizing the ratio of time spent in retirement to time spent in work. Thus, to make it concrete, the sour fruit of 2 years more work can be sweetened by 1 year more retirement made possible by an increase of life expectancy by 3 years. These numbers correspond to the ratio of roughly 40 years of work and 20 years of retirement in most OECD countries, plus the fact that these countries gain about 3 years of life expectancy in about 15 calendar years if the trend of the last decades will continue. Even better would be to make this proportionality rule an automatic stabilizer as proposed by Börsch-Supan (2007) and OECD (2011b) which could then also accommodate different speeds or even a reversal in the increase of life expectancy.

Other possible accompanying measures are the abolishment of all earnings tests – if, and this is a strong if, pension systems are made actuarially fair. Earnings tests are only necessary if the pension system provides non-actuarial transfers. In a DC system in which benefits match contributions, earnings tests are superfluous (Disney and Smith 2002).

Mandatory retirement ages are obviously counterproductive to flexibility and longer working lives. The often voiced argument that older workers need to make place for the young is wrong, at least in such generality, see the country studies in Gruber and Wise (2010). As we have shown, minimum hours constraints imposed by employers have effects similar to a mandatory retirement age. In a modern service economy, fixed costs of work are probably much lower than they were in economies dominated by manufacturing, hence such constraints could be abolished.

In a package with all these elements, flexibility reforms are a complement, not a substitute. While the evidence is still outstanding, such a package is more likely to increase total labor volume and thereby strengthen the financial base of our pension systems.

5. Dangerous Flexible Retirement Reforms – A Supplementary Placebo Analysis across Time

This chapter is single-authored.

5.1 Introduction

Declining birth rates paired with an increase in life expectancy lead to population aging in many countries around the world. These developments together with the looming retirement of the baby boomers put enormous pressure on pension systems within the next years. To ease the burden of these developments, a common aim of governments in many developed countries has been to strengthen the pool of older workers. However, increasing eligibility ages for drawing pension benefits as one option of keeping older workers in the labor market is not a very popular policy. Therefore, many governments have enacted flexible retirement options that allow workers to gradually reduce work effort with increasing age. The aim of those reforms is to provide a seemingly elegant way to increase older workers' labor supply.

From a theoretical point of view, however, the model of a stylized flexibility reform in Chapter 4 of this dissertation shows that flexibility reforms can have ambiguous effects on total labor supply. While flexibilization is likely to increase labor force participation among older workers, it may decrease their working hours. Consequently, the effect on total labor supply is *ex ante* unclear and remains an empirical question. The analysis in Chapter 4, therefore, evaluates flexibility reforms from different OECD countries enacted between 1992 and 2006 and finds that they produced zero to negative effects on total labor supply. The conclusion is that flexibility reforms can be regarded as dangerous instruments for two reasons: First, if the aim was to increase older worker's labor supply these reforms have failed to reach their objective. Second, the reforms may have additionally postponed or even replaced the introduction of more effective policies.

In Chapter 4, the synthetic control method – proposed by Abadie and Gardeazabal (2003) and extended in Abadie et al. (2010, 2015) – is applied to study the effects of different flexibility reforms. Aim of Chapter 4 is to investigate the effect of flexibility reforms on the labor force participation rate (extensive margin), the average number of weekly working hours (intensive margin), and on the total labor volume of men aged 55-64. The latter is the product of intensive and extensive margin. According to Athey and Imbens (2017), the synthetic control method "*is arguably the most important innovation in the policy evaluation literature in the last 15 years*". It builds on the idea of difference-in-differences estimations which have been an important tool for empirical research since the early 1990s (see, for instance, the classic difference-in-differences study by Card 1990). The advantage of the synthetic control method lies in the acknowledgement of the premise that, when the unit(s) of interest are only a few aggregate entities, such as countries, states, regions, or cities, a combination of comparison units (called "synthetic control group") usually better reproduces the characteristics of the unit(s) of interest than any single comparison unit alone. Hence, the idea of the synthetic control method consists in constructing the synthetic control group as a weighted average of all potential comparison units that best resembles the pre-treatment characteristics of the case of interest (Abadie et al. 2015). The post-treatment outcomes of the treated unit are then compared to the post-treatment outcomes of the untreated synthetic control group. With that, it becomes possible to estimate what would have happened to the treated unit of interest in the absence of a specific treatment or intervention (such as, e.g., event, shock, law, reform).

Abadie et al. (2010) state that the potential applicability of the synthetic control method to comparative case studies is very large since many policy interventions or other events of interest take place at an aggregate level (e.g., countries, states, regions, cities) and affect only a small number of aggregate units. This holds especially in situations where traditional regression methods are not appropriate. In line with this prediction, the synthetic control method has been applied across various fields over the last years.

As Abadie et al. (2010) further note, large sample inference techniques are, however, problematic for comparative case studies when the number of comparison units is small. Already in Abadie and Gardeazabal (2003), the authors therefore proposed placebo studies to perform inference when applying the synthetic control method. The basic idea of placebo studies is to reassign the treatment to members of the control group that were not actually exposed to it. Abadie et al. (2015) refer to this procedure as “in-space placebos”. If many of the placebo effects are as large as the actual effect, it is likely that the actual effect is observed by mere chance. An alternative dimension that can be used for placebo studies is the timing of the treatment: Instead of reassigning the treatment to actually untreated countries, it can also be assigned to points in time when the intervention did not occur. Abadie et al. (2010) refer to this exercise as “in-time placebos”.

To perform inference, Chapter 4 applies in-space placebos by reassigning the intervention (i.e. the coming into force of a flexible retirement reform) to other members of the control group which did not experience a reform in the same year. The research aim of this chapter is to investigate the same reforms and to scrutinize the former results by making use of the time dimension in the placebo studies. This is achieved by reassigning the flexibility reforms to dates when they did not actually happen (i.e. in-time placebos). The rationale behind this exercise is the following: If I found estimated effects in the analysis of reforms assigned to dates where they did not actually happen that are of similar or larger magnitude than the effects estimated for the actual reform years in Chapter 4, the confidence in these results would diminish. In this case, the estimated effects for the actual flexibility reforms would hardly be attributable to these reforms. Put in the opposite way: It increases the confidence of the results found in Chapter 4, if the application of the in-time placebo studies does not yield significant effects.

The remainder of the chapter is as follows: Section 5.2 discusses the synthetic control method, highlights requirements and limitations of the method and reviews the application of placebo studies in the field of the synthetic control method in more detail. A description of the data used in this chapter is given in Section 5.3. Section 5.4 presents the results from the in-time placebo study and recalls the results of Chapter 4 to ease a direct comparison of all results. Section 5.5 summarizes the findings and concludes that the results found in Chapter 4 are stable to the robustness check in the form of the in-time placebo studies.

5.2 The synthetic control method

The synthetic control method is a data-driven approach to estimate treatment effects of policy interventions in comparative case studies (Abadie and Gardeazabal 2003, Abadie et al. 2010, 2015). Similar to a difference-in-differences design, the synthetic control method exploits the difference in treated and untreated units across an event of interest. In the environment of Chapter 4 and this chapter, the events of interest are the flexibility reforms in the respective OECD countries. However, in contrast to a difference-in-differences approach, the synthetic control method does not give the same weight to all untreated units. Instead, the procedure induces a weighted average of the untreated units that closely matches the pretreatment-trend of the treated unit. Outcomes for this synthetic control are then projected into the post-treatment period using the weights emerging from the pre-treatment trend matching. This projection serves as a counterfactual for the treated unit approximating the outcome that would have been observed in the treated country without the intervention. In the following, the synthetic control model is described in more formal detail following Abadie et al. (2010, 2015).

5.2.1 The model

The model supposes that there is a sample of $J + 1$ units indexed by j which will be countries in the context of this chapter. Only the first country $j = 1$ is exposed to the treatment or intervention of interest. Here, the event of interest is the adaption of the flexibility reform. The remaining countries $j > 1$ constitute the synthetic control group, a reservoir of comparison countries (in the usage of Abadie and co-authors called "donor pool").

Let D_{jt} further be an indicator that takes the value 1 if the treatment occurred for country j at time t. Then the observed outcome variable Y_{jt} can be defined as the sum of a time-varying treatment effect $\alpha_{jt}D_{jt}$ and the outcome that would have been observed for country j at time t if the reform had not taken place. The latter is the counterfactual expressed as Y_{jt}^N :

$$Y_{jt} = \alpha_{jt}D_{jt} + Y_{jt}^N \tag{5.1}$$

Suppose that the counterfactual Y_{jt}^N is given by

$$Y_{jt}^N = \delta_t + \boldsymbol{\theta_t Z_j} + \boldsymbol{\lambda_t \mu_j} + \varepsilon_{jt} \tag{5.2}$$

where δ_t is an unknown time factor, $\boldsymbol{Z_j}$ a vector of observed covariates (not affected by the treatment) which can be either time-invariant or time-varying, $\boldsymbol{\theta_t}$ a vector of unknown parameters, $\boldsymbol{\lambda_t}$ a vector of unobserved common factors, $\boldsymbol{\mu_j}$ a vector of unknown factor loadings and the error terms ε_{jt} which are unobserved transitory shocks at the country level with zero mean.

The treatment effect a_{jt} is estimated by approximating the counterfactual Y_{1t}^N with a weighted combination of untreated countries:

$$\hat{a}_{1t} = Y_{1t} - \sum_{j\geq 2}^{J+1} w_j Y_{jt} \tag{5.3}$$

for $t \in \{T_0 + 1, \dots, T\}$, with a (J × 1) vector of weights $W = (w_2, \dots, w_{J+1})$' with $0 \leq w_j \leq 1$ for $j = 2, \dots, J + 1$ and $w_2 + \cdots + w_{J+1} = 1$. $T_0 + 1$ is the year of the treatment, and T is the total number of years. Note that choosing a specific value of W is equivalent to choosing a particular synthetic control.

The weights are chosen such that pre-treatment characteristics of the treated country are best resembled by the characteristics of the synthetic control. More formally, suppose that X_1 is a (k × 1) vector with the values of the pre-treatment characteristics of the treated units which should be matched as closely as possible, and let X_0 be the (k × 1) vector collecting the same variables for the units in a synthetic control group. Note that pre-treatments characteristics in X_1 and X_0 may include pre-treatment values of the outcome variable. Consequently, the vector $(X_1 - X_0W)$ gives the difference between the pre-treatment characteristics of the treated unit and a synthetic control. The weights, $W*$, are selected in a way which minimizes the distance

$$\|X_1 - X_0W\|\text{v} = \sqrt{(X_1 - X_0W)'V(X_1 - X_0W)} \tag{5.4}$$

with V is some (k × k) positive semidefinite matrix indicating the importance of each predictor.[54]

[54] There are different techniques of obtaining V (see Abadie et al. 2010). Following Abadie et al. 2010 and Abadie and Gardeazabal 2003, in the empirical section in this chapter the weights are chosen such that the root mean squared error (RMSE) of the outcome variable is minimized for the pre-treatment periods (see also Abadie and Gardeazabal 2003, Appendix B, for more details). This is the same approach as in Chapter 4.

Notice that Equation 5.1 and Equation 5.2 put together generalize a traditional fixed effect model that is often applied in empirical studies. The traditional fixed effects model can be obtained when imposing that $\lambda_t u_j = \phi_j$ in Equation 5.2 by assuming that unobserved heterogeneity is time-invariant. The advantage of the synthetic control method over the fixed effect estimation is that it deals with endogeneity stemming from omitted variable bias as it allows unobserved variables in the estimation that vary with time. Moreover, the synthetic control method allows for the presence of a common time trend across countries as well.

After estimating the treatment effect, statistical significance can be determined by running placebo tests and calculating pseudo p-values. Estimating the same model on each untreated unit of the synthetic control yields a distribution of placebo effects. If many of the placebo effects are as large as the actual effect, it is likely that the actual effect is observed by mere chance. Following Galiani and Quistorff (2016), the pseudo p-value can be written as

$$p - value = \frac{\sum_{j\geq 2}^{J+1} I(|\hat{a}_{jt}| \geq |\hat{a}_{1t}|)}{J} \tag{5.5}$$

with t as given above and $I(|\hat{a}_{jt}| \geq |\hat{a}_{1t}|)$ being an indicator that takes the value one if the inequality in parentheses is fulfilled.[55]

5.2.2 Requirements and limitations of the synthetic control method

Constructing a synthetic control group requires a careful selection of comparison units: First, the units in the control group should have similar characteristics as the treated unit to avoid interpolation biases. To address this issue, both Chapter 4 and this chapter use OECD member countries as potential comparison countries only. Moreover, units affected by the same or similar treatments, or units that may have suffered large idiosyncratic shocks to the outcome variable should not be included in the synthetic control group. In the sense of this chapter, this means that only those OECD member countries, which have not adopted flexible retirement reforms during the observation period, are potential comparison countries.

Key challenge of the synthetic control method is that it requires a substantial amount of data. This in particular holds true for the number of pre-intervention periods. The reason is that the pre-

[55] Following Galiani and Quistorff (2016), the pseudo p-values in the empirical section are adjusted with the pre-treatment match qualities. Otherwise, p-values could get too conservative. See Footnote 53 in Section 4.5.4 for more details.

treatment match of the synthetic control unit with the treated unit determines the credibility of the synthetic control. Time series data in particular on working hours for older workers are, however, hard to obtain. This especially holds true for data from before the turn of the millennium. Only in recent years, data availability on working hours in the older age groups has increased. Abadie et al. (2015) do not recommend applying the synthetic control method when the number of pre-treatment periods is small unless the pre-treatment fit is good.[56]

5.2.3 Inference with the synthetic control method: in-space placebos and in-time placebos

Abadie et al. (2015) recall that the use of statistical inference in comparative case studies is problematic due to, for instance, the small-sample nature of the data or the absence of randomization. These difficulties complicate traditional approaches to statistical inference. The synthetic control method, however, allows conducting different falsification exercises akin to permutation tests – termed placebo studies. The idea of these placebo studies is to artificially reassign the intervention either to units that were not exposed to the treatment or to dates prior to the actual intervention. The advantage of these inferential methods is that it can be used for both individual (micro) and aggregate (macro) data, and can even be applied if the number of comparison units in the synthetic control group is small (Abadie et al. 2010).

In their seminal paper on the economic effects of the terrorist conflict in the Basque Country, Abadie and Gardeazabal (2003) already performed a placebo study to assess whether the terrorist conflict truly had an effect on the economic performance or whether it was rather an artifact of a poorly measured synthetic control. They find that after the outbreak of terrorism in the late 1960s GDP per capita declined about ten percentage points compared to a synthetic control region without terrorism. To assess whether the gap in GDP is actually driven by terrorism, they also applied the method to a similar region (Catalonia in this case) which was not exposed to terrorism during the observation period and compared the resulting estimates to the actual ones.

Abadie et al. (2010) extend the idea of placebo studies by applying the placebo treatments to every comparison country in their control group. The authors study the effect of Proposition 99, a large-scale tobacco control program which was implemented in California in 1988. They demonstrate that tobacco consumption fell remarkably in California relative to a comparable synthetic control

[56] Abadie et al. (2010) state that time series data for at least ten years before the treatment would be ideal.

region following Proposition 99. Their estimates suggest a decline of per-capita cigarette sales of about 26 packs that can be attributed to Proposition 99. The control group in their study contains 38 US states that did not introduce formal statewide tobacco control programs or substantially raised the states' cigarette taxes during the observation period. To assess the significance of their estimates, the authors conduct a series of placebo studies by iteratively applying the synthetic control method to every other comparison state in the control group. They show that the estimated effect for California during the study period 1989-2000 is unusually large relative to the distribution of the effects for the states in the synthetic control.

In their most recent work, Abadie et al. (2015) apply the synthetic control method to the 1990 German reunification and investigate the economic impact on West Germany. Austria, the United States, Japan, Switzerland, and The Netherlands constitute the control group. They find that reunification had a negative effect on West German income, with a reduction of per-capita gross domestic product (GDP) of about $1,600 per year on average over the 1990-2003 period. This amounts to approximately 8% of the 1990 baseline level. To evaluate the credibility of their estimates, they for one thing conduct in-space placebos by artificially reassigning the intervention to each member of the control group. In addition, they apply in-time placebos by reassigning the reform to dates when the actual intervention did not occur. As placebo reform year, they use 1975 instead of the actual reunification year 1990.[57] The interpretation of this approach is similar to the in-space placebo approach: If similarly large effects could be obtained when applying the treatment to dates at which it did not occur, the confidence about the existence of an effect would dissipate. They show that their results are robust across both placebo dimensions and a further sensitivity check.[58]

The results of Chapter 4 are based on in-space placebos. In other words, it is under investigation if the treatment effects of the flexibility reforms are driven by chance by estimating the same model on each country in the synthetic control group, assuming it was treated at the same time. In doing

[57] The authors show that their results are similar when reassigning the placebo reform year to 1970 and 1980, respectively.

[58] Though sometimes described as "in-place" or "cross-sectional placebo tests" by other authors, the main methodology of in-space placebos remains the same. I follow the nomenclature of Abadie et al. (2015) regarding "in-space placebos" and "in-time placebos", respectively, in the rest of the dissertation.
Another sensitivity check proposed by Abadie et al. (2015) is reducing the number of units in the synthetic control to analyze whether the results are sensitive to single units in the synthetic control. The exclusion of Luxembourg later in this study represents such a further sensitivity check (see Section 5.4 and Appendix B.5).

so, we obtain a distribution of placebo effects against which we can evaluate the effect estimated for the reform-treated country.

In contrast to the application of in-space placebos in Chapter 4, this chapter applies in-time placebos by reassigning the flexibility reforms to placebo reform dates other than the actual reform year. The placebo reform years are set three years earlier than the actual reform years. The choice of three years is the same for all countries and is the result of a compromise: As historical time series data, in particular on working hours for older age groups are hard to obtain, the choice of three years still allows a pre-treatment period with some years. Simultaneously, the determination of three years still ensures a post-placebo-treatment period consisting of three treatment effects until the actual reform effect would influence the effects. Abadie et al. (2015) emphasize that the number of post-treatment years should not be too small in case the treatment effect only emerges gradually after the intervention.

Since Abadie and Gardeazabal (2003), numerous authors have utilized the synthetic control method across many fields over the last years.[59] Among the literature, it appears that in-space placebos are the most widely used base to performing inference (Bilgel and Galle 2015, Bohn et al. 2014, Cavallo et al. 2013, Kleven et al. 2013, Liu 2015, Stearns 2015). A few papers utilize in-time placebos to prove the validity of their estimates (Freire 2018, Saia 2017). However, in-time placebos are clearly in the minority. While other authors have analyzed the effectiveness of the synthetic control method using Monte Carlo simulations (see, e.g., Ferman et al. 2020, Hahn and Shi 2017, Kaul et al. 2015, O'Neill et al 2016, Gobillon and Magnac 2016), it appears that the majority of synthetic control literature focusses on choosing one placebo test, either in-space or in-time. This chapter adds to the very few to date who compare both (see beside, Abadie et al. 2015).

[59] For instance in Acemoglu et al. (2016) on political connections, Abadie et al. (2010) (tobacco control program), Abadie et al. (2015) (Germany's reunification), Bilgel and Galle (2015) (organ donations), Bohn et al. (2014) (2007 Legal Arizona Workers Act), Cavallo et al. (2013) (natural disasters), Gobillon and Magnac (2016) (enterprise zones), Hinrichs (2012) (affirmative action bans on college enrolment), Kleven et al. (2013) (taxation of athletes), Kreif et al. (2016) and O'Neill (2016) (health improvement), Liu (2015) (spillover from universities), Nannicini and Billmeier (2011) and Billmeier and Nannicini (2013) (economic growth).

5.3 Data and variables

The empirical analysis with the synthetic control method requires a large amount of data. In particular, the fact that time series data are not only necessary for the treated countries but also for all control countries increases the required amount of data.[60]

Dependent variables. The main dependent variables are **labor force participation** (extensive margin) and **working hours** (intensive margin) of males for the age groups 55-64. The outcome variable **total labor supply** is obtained by multiplying labor force participation rates and working hours at the country and year level. Annual time series data on labor force participation and working hours are obtained from different sources: the OECD's Employment database, Eurostat, Eurofound, the International Labour Organization (ILO) and from several national statistical agencies (Australian Bureau of Statistics, Statistics Canada, Statistics Finland, Statistics Japan, Central Bureau of Statistics of Norway, Statistics Portugal, Statistics Sweden, UK Data Service, US Bureau of Labor Statistics).

Control variables. From the same sources as the dependent variables, I use the labor force participation rate and the average number of weekly working hours of the young (age group 25-54) as control variables. These variables capture country-specific labor market trends over time. Variables describing the pension system serve as control variables as well: these are the statutory eligibility age at which workers become eligible for full pension benefits regardless of any other qualification and the earliest eligibility age. The latter is defined as the age at which early retirement is possible, mostly with reduced benefits.[61] The data describing the pension system are obtained from the Social Security Administration's *Social Security Programs throughout the World* (1985-2014), OECD's *Pensions at a Glance* (OECD 2011a, 2013b) and Duval (2003). Data on years of total schooling are from Barro and Lee (2013). GDP per capita and life expectancy at birth are taken from the OECD's database (OECD 2016a, OECD 2016b).

Treated countries and placebo reform years. The countries under investigation in this chapter are the ones part of the empirical analysis with the synthetic control method in Chapter 4 to enable a meaningful comparison, namely: Australia, Austria, Belgium, Denmark, France, Germany, and

[60] The data used in this chapter are the same as in Chapter 4.
[61] See the glossary of Börsch-Supan and Coile (2019).

Sweden.[62] For the application of in-time placebo studies, the placebo reform years (PRY) are chosen to be three years earlier compared to the years where the flexibility reforms actually were adapted. This means: Australia: PRY=2002, Austria: PRY=1997, Belgium: PRY=1999, Denmark: PRY=1992, France: PRY=1990, Germany: PRY=1989, and Sweden: PRY=1997.[63]

Control countries. The pool of potential comparison countries comprises the OECD member countries that have not adopted a flexibility reform during the observation period of each country.[64] The actual selection of comparison countries for the synthetic controls for the treated countries is the same as in Chapter 4 and differs for each treated country since the (placebo) reform years are different in each country. In addition, data availability determines observation periods. The data set for each treated country and its comparison countries in this chapter constitute a balanced panel, meaning a longitudinal data set where all units are observed at the same time periods. Table B.1.1 reports the time series included before and after the placebo reform year by country and by outcome variable. Table B.2.1 and Table B.2.2 show the comparison countries, which constitute the synthetic controls for each treated country, and present the weight of each comparison country in the control group. The two tables in addition show the time periods included in the estimation.

[62] The analysis in Chapter 4 started by additionally looking at flexibility reforms in Finland, The Netherlands, and Sweden. However, with the data at hand we were not able to find robust synthetic controls for Finland and The Netherlands for all outcome variables. Regarding Sweden, we only found a proper synthetic control for the outcome variable labor force participation, but not for the outcome variable weekly working hours. Therefore, the analysis on Sweden is restricted to labor force participation.

[63] Table A.1.1 (Appendix A.1) comprises comprehensive details of the flexibility reforms. The table comprises country-specific information on gender-specific statutory eligibility ages for public pension, the age at which the flexible retirement window starts if flexible retirement schemes are available through systems other than the public pension scheme, information on the extent to which the working time must be reduced within the flexible retirement option, information on the income loss compensating financial sources, whether earnings tests apply, and mandatory retirement regulations.

[64] Belgium and Sweden, which had flexibility reforms rather late, have also been included among the untreated countries for the construction of the synthetic control group of countries that were treated early.

5.4 Results

Finding a good synthetic control country is crucial for the estimation quality. The synthetic country should as closely as possible approximate how the outcome variable of the treated country would have developed without the flexibility reform. This is the case if the synthetic control country provides a counterfactual pre-treatment value of the outcome variable that comes close to the corresponding value of the treated country.

The approach for constructing the synthetic control in this chapter is the same as in Chapter 4 to allow a clear comparison: For the outcome variables, labor force participation of males aged 55-64 and working hours of males aged 55-64, I use the average of the pre-treatment values of the outcome variables for constructing the synthetic control.[65] In addition, I control for a set of covariates which explain the outcome variables. These covariates are the labor force participation rate of the younger age group (age 25-54) when the outcome variable is labor force participation, the number of working hours of the younger age group (age 25-54) when the outcome variable is working hours, the multiplication of extensive and intensive margin of the younger age group (age 25-54) when the outcome variable is total labor volume, the statutory eligibility age or the earliest eligibility age. Moreover, gross domestic product (GDP, per capita), years of schooling, and life expectancy are control variables.[66] Table B.4.1 and Table B.4.2 show the quality of pre-treatment characteristics by comparing the pre-treatment characteristics of the treated country with that of the synthetic control country. Total labor supply is measured as the product of labor force participation and working hours for those who participated.

The application of the in-time placebo studies in this chapter reduces the number of pre-treatment years because the placebo reforms years are reassigned to three years earlier that the actual reform came into effect. However, even with the shorter pre-treatment periods, the estimation yields

[65] Alternative specifications are, e.g., controlling for the last pre-treatment value of the outcome variable only or including all lagged outcome values as predictors. I report robustness checks in Appendix 3 comparing the different possible specifications (i.e. average pre-treatment value vs. last pre-treatment value vs. all pre-treatment values of labor force participation rate). Kaul et al. (2018), however, demonstrate both theoretically and empirically that controlling for all outcome lags causes all other covariates to be irrelevant. Therefore, I do not include all lagged outcome values as predictors. In general, the criterion for selecting the inclusion of control countries and control variables is to minimize the root mean squared error (RMSE).

[66] For the construction of some of the synthetic control countries, I use the years of early retirement as control variable. This variable is measured as the difference between the statutory eligibility age and the earliest eligibility age. The data on schooling are available in five-year increments and, therefore, converted to annual frequency by means of linear interpolation.

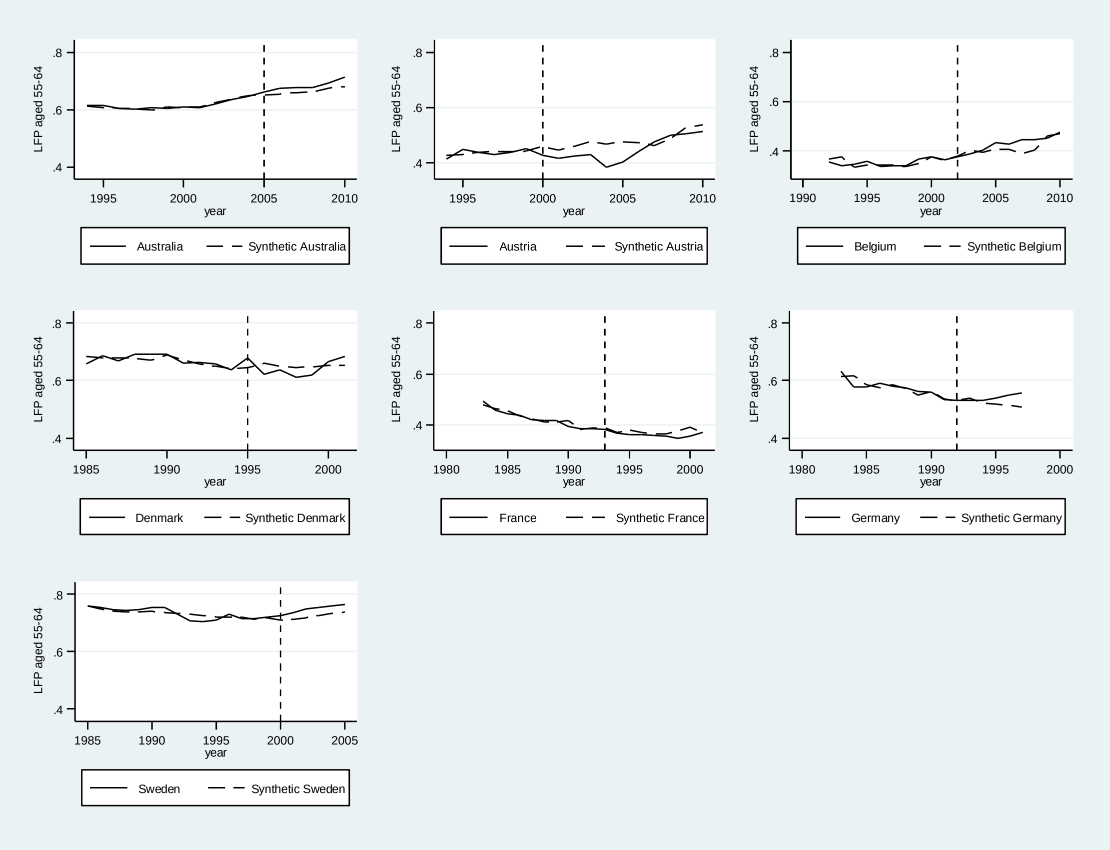
synthetic controls that come close to the corresponding values of the treated country. In particular, this holds true for the outcome variable labor force participation. The match is slightly less close for working hours and total labor supply. Despite the slightly more vague matches for the latter two outcome variables, the application of the in-time placebo studies overall seems to be a reasonable approach to validate the results of Chapter 4. The following sections show the results of the in-time placebo studies, separately for the outcome variables labor force participation, working hours, and total labor supply. Each section initializes with recalling the graphical trends in outcome variables with the actual reform year from Chapter 4 to ease the comparison of the in-space placebo studies with the in-time placebo studies.

5.4.1 Labor force participation

I first examine labor force participation, the extensive margin: Figure 5.1 shows labor force participation rates of men aged 55-64 for the treated countries and their synthetic counterparts before and after the flexibility reforms. Figure 5.1 displays the results from Chapter 4 with the actual reform year and shows that the labor force participation trend for the synthetic control closely matches the corresponding trend for the treated country before the reform. In Australia, for instance, the synthetic control almost exactly reproduces the actual labor force participation rates during the entire pre-treatment period.

The treatment effect is given by the difference between the outcome variable of the treated country and in its synthetic counterpart after the implementation of the reform. In Figure 5.1, this is the difference between solid and dashed line right of the reform year. The reform year is indicated by the vertical line. The discrepancy between solid and dashed line is positive for Australia, Belgium, Germany, and Sweden, indicating an increase in labor force participation after the reform. It is negative in France, indicating a decrease in labor force participation in the years after the reform. The picture for Austria and Denmark is mixed.

Figure 5.1: Trends in labor force participation: treated vs. synthetic control. Actual reform years

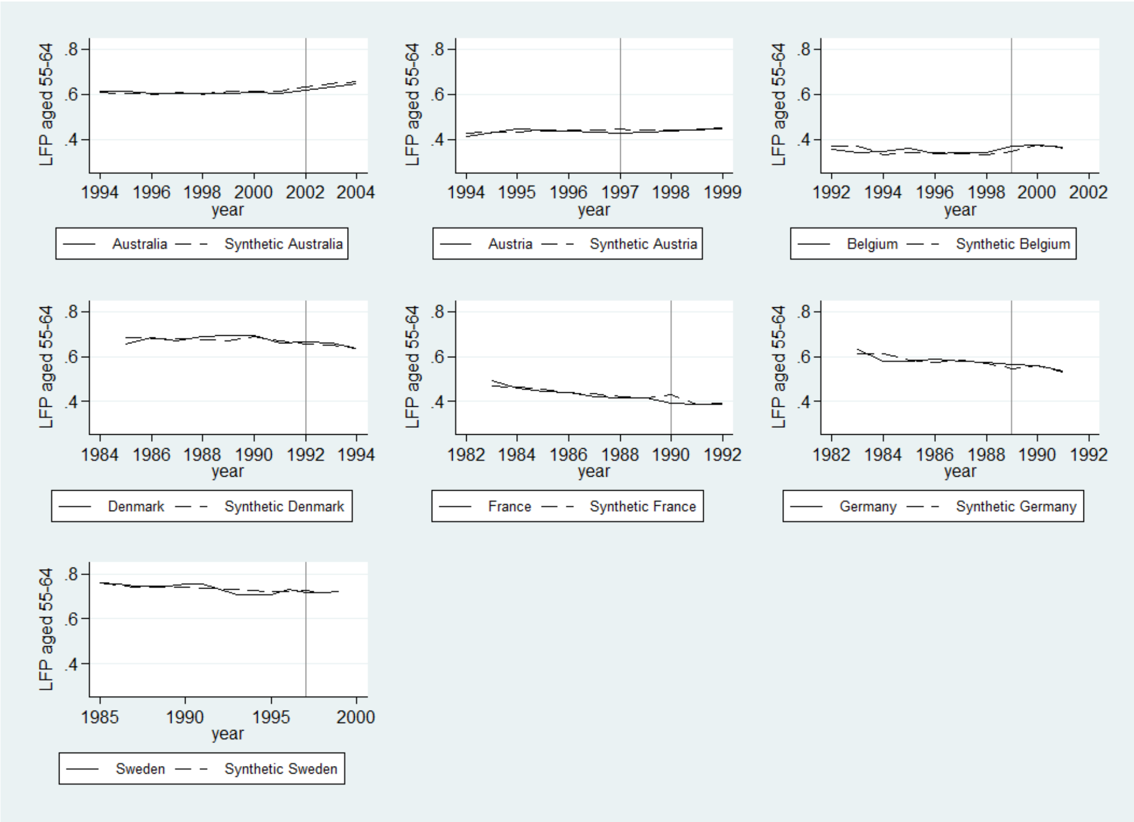


Source: Own calculations.

In Figure 5.2, the reform year is now reassigned to a placebo reform year, which is three years earlier compared to the actual reform years for all countries and indicated by the vertical line. Figure 5.2, therefore, shows the results of the “in-time placebo” study with the placebo reform year. Despite the comparably fewer pre-treatment years, the synthetic control comes close to the corresponding value of the treated country.

The most important result, however, is that the trajectories of the actual values of labor force participation and its synthetic counterparts do not diverge considerably in the post-treatment years in the in-time placebo study. This holds true for all countries. This means that the in-time placebo studies have no perceivable effects at all. This suggests that the gaps estimated in Figure 5.1 (with the actual reform year) actually reflect the impact of the flexibility reforms on labor force participation and not a potential lack of predictive power of the synthetic control.

Figure 5.2: Trends in labor force participation: treated vs. synthetic control. Placebo reform years



Source: Own calculations.

To evaluate the significance of the treatment effects, we calculated pseudo p-values according to Equation 5.5 (Section 5.2.1.).[67] Table 5.1 presents yearly treatment effects on labor force participation together with their statistical significance. The first three columns (1) to (3) recall the results of Chapter 4 with the actual reform year. Columns (4) to (6) show the yearly treatment effects from the in-time placebo study with the placebo reform years. Pseudo p-values from the in-time placebo study also stem from estimating the model on all countries in the synthetic control group using the placebo reform years, yielding a distribution of placebo effects.

[67] Chapter 4 and the analysis in this chapter follow the approach of Galiani and Quistorff (2016) in the calculation of pseudo p-values. As placebo effects could be quite large if the quality of matches in the pre-treatment period is poor, Galiani and Quistorff (2016) propose to divide the estimated treatment effects by the corresponding pre-treatment match qualities. Otherwise, p-values could get too conservative. Subsequently, inference is made based on these ratios instead of on the treatment effects only. Following the definition of Galiani and Quistorff (2016), the pseudo p-value in one period is the proportion of placebo pseudo effects (each control unit's treatment effect divided by its pre-treatment root mean square error) that are at least as large as the actual treated unit's pseudo effect.

Table 5.1 shows a first validation: While the results of Chapter 4 reveal significant results for some countries, shifting the reform year suspends significance of effects. This is the case for almost all countries in almost all years (except France in 1990). This means that in contrast to the actual flexibility reforms, the placebo flexibility reforms have no perceivable effect.

Table 5.1: Post-treatment results regarding LFP of males aged 55-64, effects and pseudo p-values

"In-space placebos" (actual reform year, Chapter 4)			**"In-time placebos"** (placebo reform year)		
(1)	(2)	(3)	(4)	(5)	(6)
year	estimates	pseudo p-values	year	estimates	pseudo p-values
Australia					
			2002	-0.012	0.238
			2003	-0.013	0.190
			2004	-0.009	0.476
2005	**0.010****	**0.048**	2005		
2006	**0.018*****	**0**	2006		
2007	**0.017****	**0.048**	2007		
2008	**0.014***	**0.095**	2008		
2009	**0.019*****	**0**	2009		
2010	**0.032*****	**0**	2010		
Austria					
			1997	-0.016	0.421
			1998	-0.004	1
			1999	0.006	0.947
2000	-0.03	0.263			
2001	-0.029	0.316			
2002	-0.036	0.263			
2003	-0.048	0.158			
2004	**-0.083***	**0.053**			
2005	-0.073	0.158			
2006	-0.033	0.526			
2007	0.015	0.737			
2008	0.011	0.737			
2009	-0.023	0.474			
2010	-0.023	0.368			
Belgium					
			1999	0.021	0.235
			2000	0.001	0.941
			2001	0.002	0.882
2002	-0.005	0.824			
2003	-0.013	0.529			
2004	0.008	0.824			
2005	0.027	0.412			
2006	0.021	0.529			
2007	**0.055*****	**0**			
2008	0.041	0.118			
2009	-0.008	0.941			
2010	0.006	0.941			

		Denmark			
			1992	0.006	0.824
			1993	0.010	0.647
			1994	0.001	1
1995	0.034***	**0**			
1996	-0.04	0.176			
1997	-0.013	0.412			
1998	-0.035	0.235			
1999	-0.028	0.294			
2000	0.014	0.471			
2001	0.03	0.353			
		France			
			1990	-0.038*	**0.067**
			1991	-0.002	0.933
			1992	-0.008	0.733
1993	-0.006	0.667			
1994	-0.003	0.867			
1995	-0.018	0.333			
1996	-0.007	0.733			
1997	-0.008	0.667			
1998	-0.007	0.6			
1999	-0.029	0.333			
2000	-0.035	0.333			
2001	-0.004	0.867			
		Germany			
			1989	0.016	0.769
			1990	0.000	1.000
			1991	0.002	0.923
1992	0.001	0.923			
1993	-0.008	0.846			
1994	0.008	0.923			
1995	0.02	0.538			
1996	0.035	0.385			
1997	0.048	0.231			
		Sweden			
			1997	-0.010	0.667
			1998	-0.003	0.933
			1999	-0.002	0.867
2000	0.016	0.533			
2001	0.024	0.2			
2002	0.029	0.133			
2003	0.028	0.2			
2004	0.028	0.333			
2005	0.026	0.333			

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Source: Own calculations.

The significant effect for France might rather stem from the fact that in 1990 the synthetic control matches the actual value least (see Figure 5.2). The synthetic country exhibits a peak that leads to the largest difference between solid and dashed line in the observation period. Luxembourg and Italy have substantial weight in the construction of the synthetic control country for France. Both countries experienced a peak of labor force participation in 1990 which might drive the value of the synthetic control. For Italy, a weighting factor of 0.257 was assigned and for Luxembourg a weighting factor of 0.413 (see Table B.2.1 on synthetic control weights for the outcome variable labor force participation). In Italy, labor force participation (of the age group 55-64) in 1990 was

53.0% compared to a value of 51.8% in 1989 and 51.4% in 1991. In Luxembourg, labor force participation rate amounted to 43.2% in 1990, while the values in 1989 (38.2%) and 1991 (34.1%) were clearly lower. The significant effect in France in 1990, therefore, might more likely stem from a poor synthetic control in this specific year.

Generally, including Luxembourg in the control group might cause further objection: As Luxembourg is a small country with close labor market ties to, e.g., France, labor market developments may not be completely independent of the developments in the surrounding countries. Therefore, I repeat the analysis as a further robustness check without incorporating Luxembourg in the synthetic control (see Appendix B.5).[68] For the analysis for France, excluding Luxembourg from the control group means two things: First, the peak in the synthetic control in 1990 disappears (Appendix B, see Figure B.5.1). Second, the former significant effect turns insignificant (Appendix B, see Table B.5.1). The effect, therefore, actually seems to have been driven by Luxembourg's outlier in labor force participation.

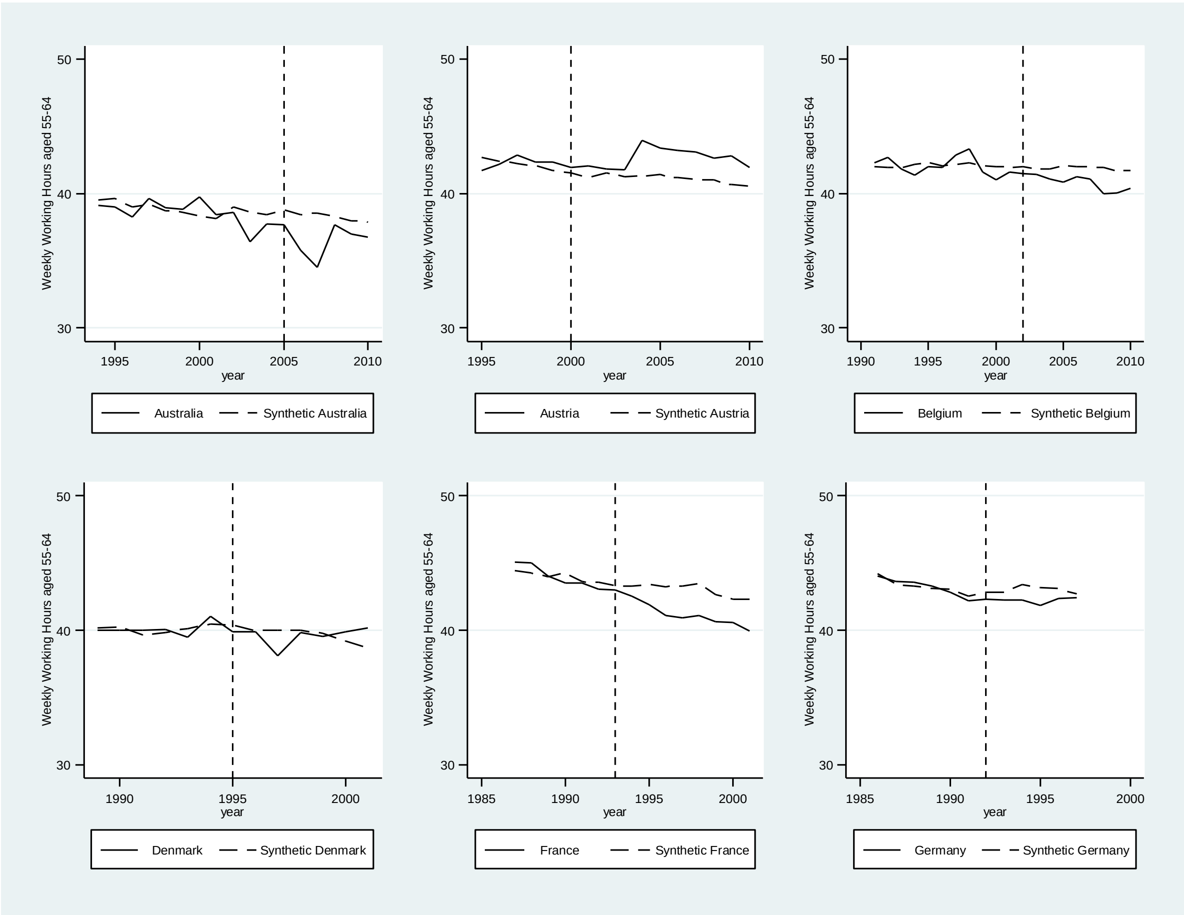
Keeping the results from the robustness check without Luxembourg in the synthetic control group in mind, the in-time placebo study for the outcome variable labor force participation reveals the overall result: reassigning the reform year to earlier dates compared to the actual reform year suggests that the results found in Chapter 4 actually reflect the impact of the flexibility reforms. Therefore, the confidence in these results is strengthened.

[68] Reducing the number of units in the synthetic control is a sensitivity check that was proposed and conducted by Abadie et al. (2015).

5.4.2 Working hours

The second outcome variable is the number of weekly working hours (intensive margin). Figure 5.3 shows the trends in weekly working hours for men aged 55 to 64 for the treated countries and their synthetic counterparts for the actual reform years (see Chapter 4).

Figure 5.3: Trends in working hours: treated vs. synthetic control. Actual reform years



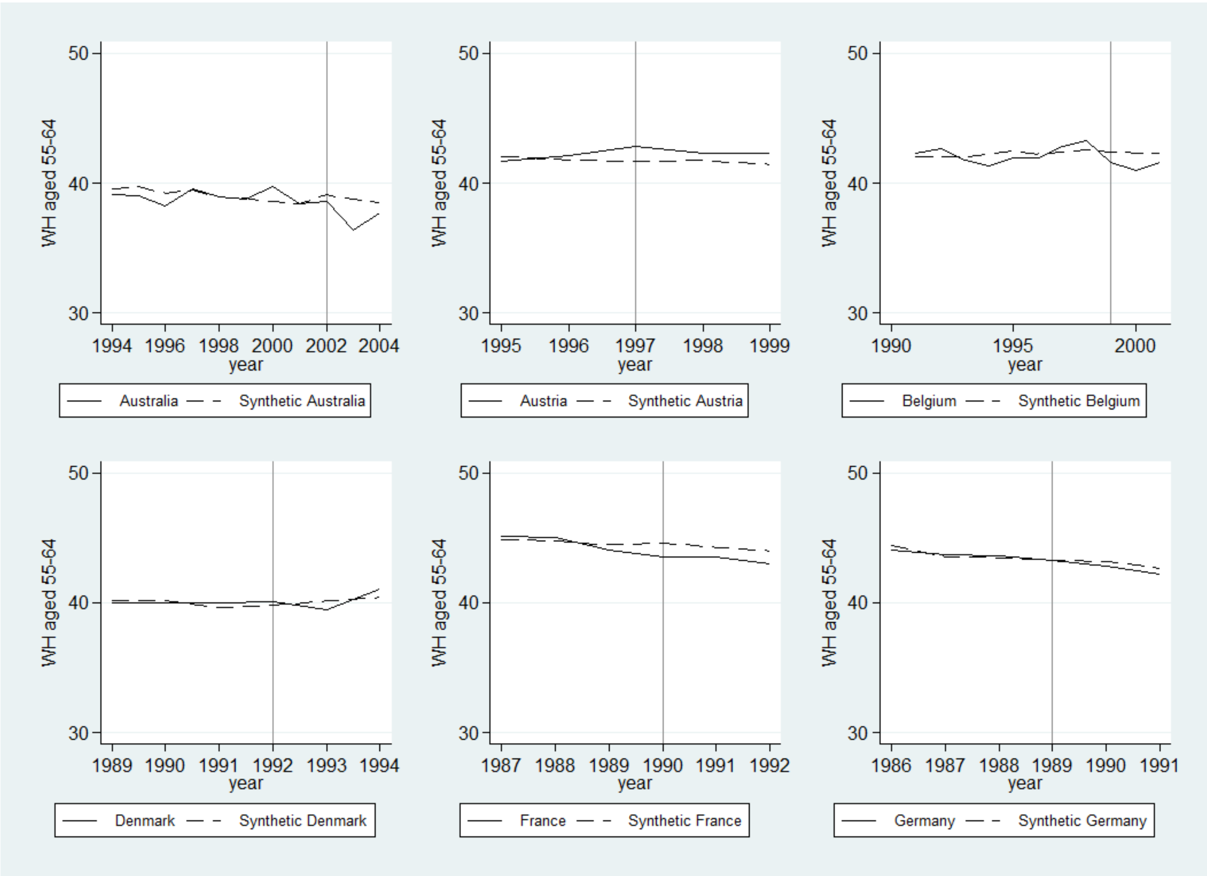
Source: Own calculations.

The figure displays that, due to data restrictions in particular for working hours, the pre-treatment observation periods for working hours are slightly shorter compared to pre-treatment observation periods for labor force participation.[69] Figure 5.3 hints at negative reform effects on working hours in Australia, Belgium, France and Germany. In Austria, working hours have increased after the reform, while the picture in mixed in Denmark.

[69] Since we could not find a stable synthetic control for working hours in Sweden, we dropped Sweden from the further analysis (see Figure A.7.2 in Appendix A.7).

In contrast to the depiction with the actual reform years in Figure 5.3, Figure 5.4 shows the results with the placebo reform years. Likewise, the analysis of labor force participation, the placebo reform years were reassigned three years earlier compared to the actual reform year for all countries. This leads to even less pre-treatment years due to data restrictions. Overall, the synthetic controls do not as closely match the corresponding trend for the treated country as for labor force participation. However, in some countries such as Denmark and Germany, the synthetic controls fairly precisely match the actual pre-treatment trend of working hours.

Figure 5.4: Trends in working hours: treated vs. synthetic control. Placebo reform years



Source: Own calculations.

The size of the treatment effects on working hours and its significance are shown in Table 5.2. Columns (1) to (3) recall the results from Chapter 4 with the actual reform years. The results show that the effects of the reforms on working hours tends to be negative or close to zero for all post-treatment years and all countries except Austria. The positive effects in Austria in 2004, 2005, and 2006 might also stem from other pension reforms which were enacted during the same time.

Columns (4) to (6) display the yearly treatment effects and pseudo p-values from the in-time placebo study. As in the analysis of labor force participation, almost all effects disappear when artificially reassigning the treatment years to placebo reform years three years earlier. The disappearance of effects on working hours again means that the effects found in Chapter 4 actually reflect the effects of the flexibility reforms. This interpretation is based, as explained above, on the initial idea of the in-time placebo studies: The confidence about the validity of results dissipates if the estimation procedure of the synthetic control method had also produced large effects when applied to dates where the reforms did not occur. Only in Australia (2003) and France (1990), the estimation procedure yields occasional significant effects.[70] For France, this most likely stems from a poor synthetic control. Due to data availability, the pre-treatment period is only three years and therefore does not constitute a solid basis to develop a stable synthetic control. I observe for 1989 that the actual trend of working hours of the treated country and the trend of the synthetic control drift apart. Regarding Australia, the actual data show a downward spike in 2003 which may explain the significant effect. However, this effect may be due to a set of reforms of the superannuation system that happened in 2002 and 2003 (Warren 2008). The placebo reform year therefore most likely coincides with these other reforms which took place during the same time.

[70] Excluding Luxembourg from the synthetic control group in this case does qualitatively not change anything as Luxembourg's weight in the synthetic control for the outcome variable working hours for Australia is zero and for France only 0.195 (Appendix B, see Table B.2.2 and Table B.5.2).

Table 5.2: Post-treatment results regarding working hours of males aged 55-64, effects and pseudo p-values

"In-space placebos" (actual reform year, Chapter 4)			**"In-time placebos"** (placebo reform year)		
(1)	(2)	(3)	(4)	(5)	(6)
year	estimates	pseudo p-values	year	estimates	pseudo p-values
Australia					
			2002	-0.575	0.400
			2003	**-2.352***	**0.067**
			2004	-0.803	0.467
2005	-1.12	0.333			
2006	**-2.646*****	**0**			
2007	**-4.057*****	**0**			
2008	-0.643	0.8			
2009	-0.994	0.667			
2010	-1.108	0.733			
Austria					
			1997	-0.016	0.421
			1998	-0.004	1
			1999	0.006	0.947
2000	0.421	0.833			
2001	0.838	0.333			
2002	0.255	0.667			
2003	0.522	0.667			
2004	**2.645*****	**0**			
2005	**1.964***	**0.056**			
2006	**2.052***	**0.056**			
2007	2.073	0.167			
2008	1.657	0.278			
2009	2.158	0.111			
2010	1.378	0.444			
Belgium					
			1999	-0.777	0.500
			2000	-1.348	0.286
			2001	-0.759	0.643
2002	-0.484	0.571			
2003	-0.396	0.786			
2004	-0.755	0.214			
2005	**-1.254***	**0.071**			
2006	-0.733	0.429			
2007	-0.861	0.357			
2008	**-1.984***	**0.071**			
2009	-1.619	0.143			
2010	-1.317	0.286			
Denmark					
			1992	0.269	0.467
			1993	-0.663	0.333
			1994	0.655	0.667
1995	-0.478	0.333			
1996	-0.073	1			
1997	**-1.875***	**0.067**			
1998	-0.178	0.933			
1999	-0.232	0.933			
2000	0.712	0.533			
2001	1.501	0.267			

		France			
			1990	**-1.103***	**0.077**
			1991	-0.747	0.308
			1992	-0.969	0.308
1993	-0.303	1			
1994	-0.75	0.615			
1995	**-1.485***	**0.077**			
1996	**-2.131***	**0.077**			
1997	-2.397	0.154			
1998	-2.394	0.154			
1999	-2.021	0.077			
2000	-1.723	0.154			
2001	**-2.36***	**0.077**			
		Germany			
			1989	0.022	1
			1990	-0.348	0.538
			1991	-0.482	0.462
1992	-0.493	0.231			
1993	-0.636	0.231			
1994	-1.16	0.154			
1995	**-1.352*****	**0**			
1996	-0.723	0.154			
1997	-0.297	0.692			

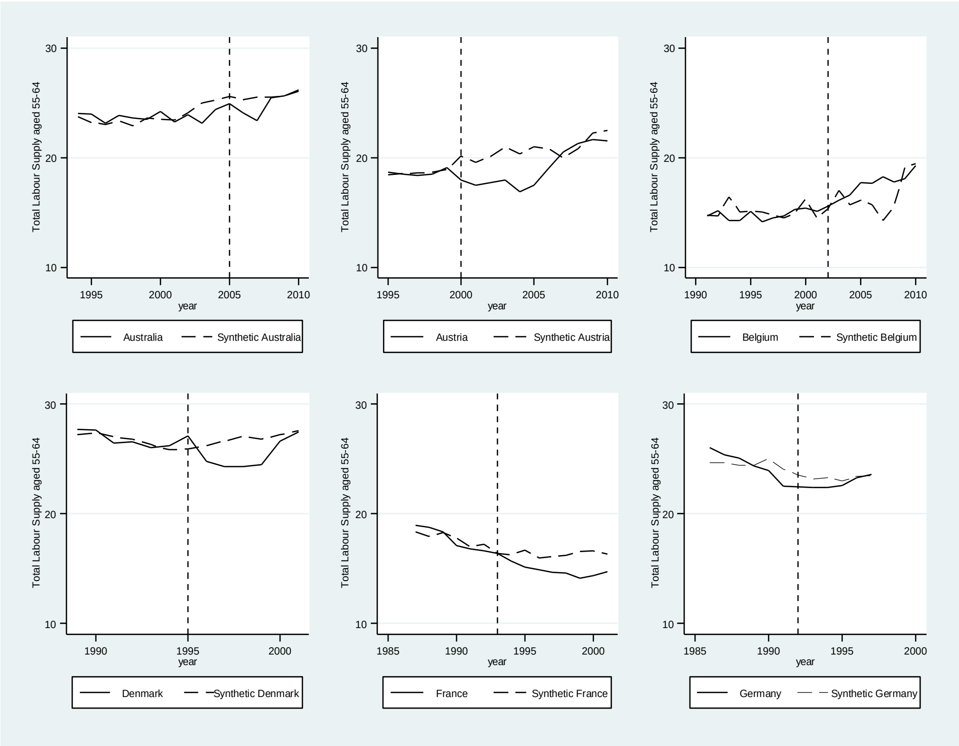
Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Source: Own calculations.

5.4.3 Total labor supply

As a final step, I show the effects of flexibility reforms on total labor supply for males in the age group 55-64. As total labor supply is measured as the product of labor force participation and working hours for those who participated, the time periods covered are determined by the availability of data on these two variables. Time series data on labor force participation are available for slightly more years compared to working hours. That is why the time periods covered on total labor supply is mainly determined by the availability of the time series of working hours.

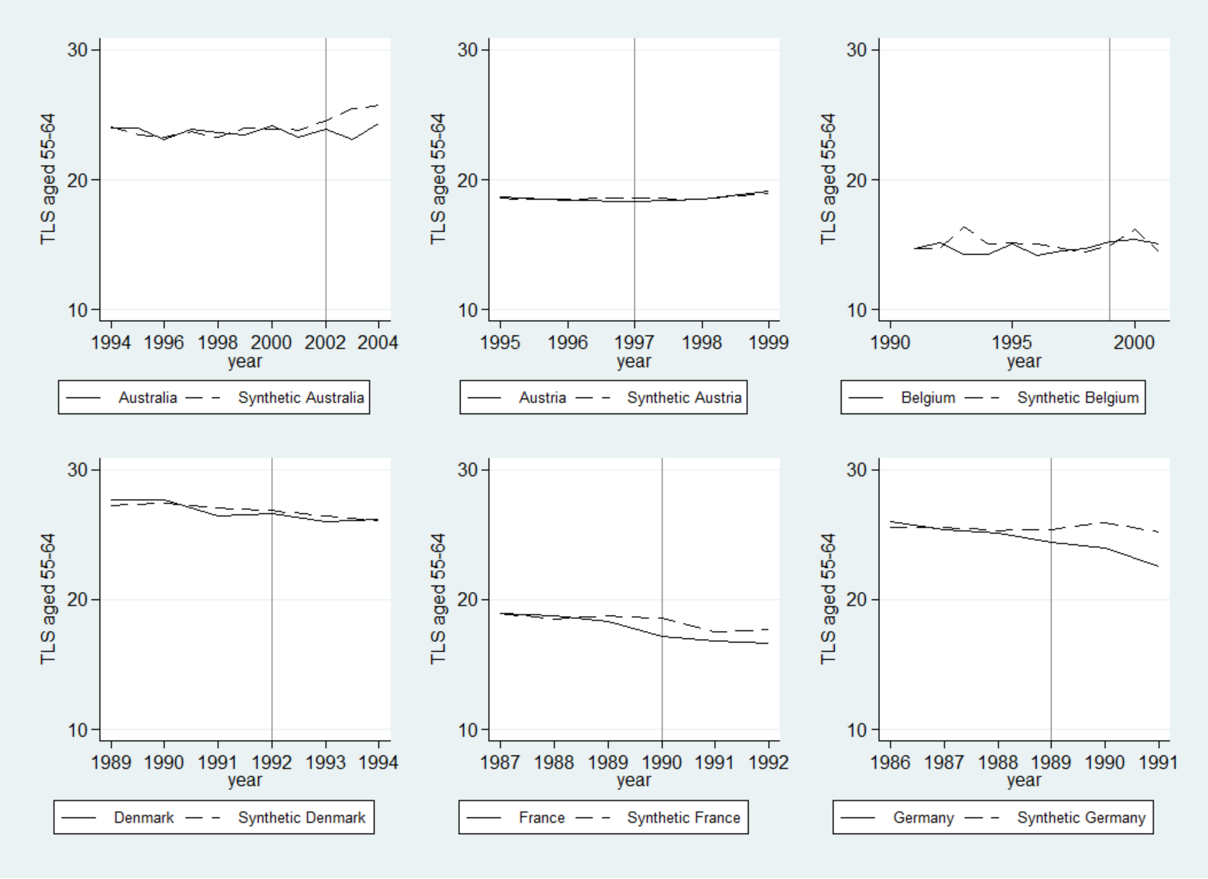
Figure 5.5: Trends in total labor supply: treated vs. synthetic control. Actual reform year



Source: Own calculations.

Treatment effects on total labor supply of men aged 55-64 are shown graphically in Figure 5.5 and the yearly effect sizes and pseudo p-values are reported in Table 5.3. Figure 5.5 again recalls the results of Chapter 4 and graphically shows that in all countries the overall change in total hours worked per week after the reform is negative. The only exception is Belgium where the synthetic control reflects higher values in the majority of post-treatment years compared to the treated country values. Pseudo p-values given in Table 5.3 mostly prove what Figure 5.5 graphically displays. Total labor supply significantly decreased in Australia (2007) and Austria (2000-2006). After a significant increase in Denmark in the reform year (1995), the total number of working hours significantly decreases in later years (1997-1999). In Belgium, total labor supply significantly increases in 2007, and the total labor supply did not change significantly after the flexibility reforms in France and Germany.

Figure 5.6: Trends in total labor supply: treated vs. synthetic control. Placebo reform year



Source: Own calculations.

Eventually, Figure 5.6 graphically shows the treatment effects when reassigning the reform years to placebo reform years. As for labor force participation and working hours, placebo reform years are reassigned three years earlier compared to the actual reform years. Data availability is again the crucial factor to construct synthetic controls that reproduce the actual trend in males' total labor supply more precisely. However, in particular for Australia, Austria, and in the first years of the observation period for France and Germany, the synthetic controls come close to the actual trends.

Table 5.3 finally compares yearly treatment effect sizes and its significance from Chapter 4 with the results from the robustness checks with the placebo reforms years. A similar transition can be ascertained as for labor force participation and working hours: When estimating treatment effects with placebo reforms years, the synthetic control method does not produce significant results anymore. This holds true for Austria, Belgium, Denmark, and Germany and all years. Only Australia (2003) and France (1990) are exemptions. As total labor supply is the product of extensive margin (labor force participation) and intensive margin (working hours), the effects found for Australia and France most likely are translated from what was found for working hours (see Section 5.4.2): For France, the pre-treatment period is only three years which does not allow the establishment of a stable synthetic control, and for Australia the placebo reform year may most likely capture other reforms of the superannuation system that happened at that time (Warren 2008).

Table 5.3: Post-treatment results for total labor supply of males aged 55-64, effects and pseudo p-values

"In-space placebos" (actual reform year, Chapter 4)			**"In-time placebos"** (placebo reform year)		
(1)	(2)	(3)	(4)	(5)	(6)
year	estimates	pseudo p-values	year	estimates	pseudo p-values
Australia					
			2002	-0.633	0.133
			2003	**-2.372*****	**0**
			2004	-1.359	0.133
2005	-0.628	0.733			
2006	-1.189	0.4			
2007	**-2.194*****	**0.067**			
2008	-0.052	1			
2009	0.016	1			
2010	0.154	0.933			
Austria					
			1997	-0.227	0.389
			1998	-0.040	1
			1999	0.113	0.944
2000	**-2.193*****	**0**			
2001	**-2.095 *****	**0**			
2002	**-2.407*****	**0**			
2003	**-3.056*****	**0**			
2004	**-3.455*****	**0**			
2005	**-3.459*****	**0**			
2006	**-1.786***	**0.056**			
2007	0.535	0.444			
2008	0.485	0.5			
2009	-0.603	0.333			
2010	-0.92	0.167			

		Belgium			
			1999	0.349	0.929
			2000	-0.826	0.786
			2001	0.641	0.786
2002	0.19	0.929			
2003	-0.873	0.714			
2004	0.869	0.643			
2005	1.605	0.5			
2006	1.932	0.5			
2007	**4.011*** **	**0**			
2008	2.231	0.143			
2009	-1.008	0.643			
2010	-0.226	0.929			
		Denmark			
			1992	-0.271	0.733
			1993	-0.374	0.467
			1994	0.131	0.867
1995	**1.193*** **	**0**			
1996	-1.457	0.133			
1997	**-2.302***	**0.067**			
1998	**-2.744***	**0.067**			
1999	**-2.339***	**0.067**			
2000	-0.58	0.667			
2001	-0.124	1			
		France			
			1990	**-1.409*** **	**0**
			1991	-0.715	0.462
			1992	-1.077	0.231
1993	0.024	0.923			
1994	-0.592	0.538			
1995	-1.559	0.308			
1996	-1.104	0.385			
1997	-1.446	0.462			
1998	-1.591	0.615			
1999	-2.438	0.308			
2000	-2.225	0.308			
2001	-1.557	0.462			
		Germany			
			1989	-0.984	0.231
			1990	-1.962	0.154
			1991	-2.713	0.231
1992	-1.107	0.692			
1993	-0.802	0.615			
1994	-0.892	0.769			
1995	-0.447	0.846			
1996	-0.155	0.923			
1997	0.127	1			

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Source: Own calculations.

5.5 Summary and conclusion

Over the past decades, several OECD countries have enacted flexible retirement reforms. According to politicians, flexibilization is supposed to provide an elegant way to increase older workers' labor supply. The model in Chapter 4, however, has shown from a theoretical point of view that flexibility reforms may have ambiguous effects on labor supply. Therefore, the question whether flexibility reforms have actually helped to increase older workers' labor supply remains an empirical one.

In the empirical analysis of Chapter 4, the synthetic control method is used to investigate the effect of flexibility reforms enacted in different OECD countries between 1992 and 2006. As large sample inference techniques are problematic in comparative case studies, placebo studies can provide a remedy to facilitate inference. Following the nomenclature of Abadie et al. (2015), there are two possibilities of placebo studies: in-space placebos and in-time placebos. To investigate the significance of the estimates, in-space placebo studies were applied in Chapter 4. This meant an artificially reassigning of the treatments (i.e. flexibility reform) to members of the synthetic control group which were not directly exposed to a reform at the same time. The results show that labor force participation of males aged 55-64 has very little if at all increased in some countries and years due to the flexibility reforms introduced since the 1990s. At the same time, we find that older men of the same age group have decreased their weekly working hours. In sum, the reforms have produced zero to negative effects on total labor supply.

The aim of this chapter is to scrutinize these results by applying in-time placebo studies. The strategy of in-time placebo studies is to reassign the treatment to dates when then actual reform did not take place (i.e. a reassignment with respect to time). The idea is to find out whether the synthetic control method produces significant effects when applied to dates other than the actual reform date. If this were the case, the confidence about the validity of the results presented in Chapter 4 would dissipate.

The application of in-time placebo studies, however, reveals that the results of Chapter 4 are stable to this robustness check. In contrast to the results from the in-space placebo study, reassigning the reform years to placebo reform years display no perceivable effects. Significant effects diminish in almost all cases when reassigning the reform dates three years earlier. Remaining effects more likely stem from poor synthetic controls resulting from data restrictions or from the concurrence of other reforms.

Finding a good synthetic control country is crucial for the estimation quality. Yet, a key challenge of the synthetic control method is that it requires a substantial amount of data. Particularly time series on working hours for older workers are hard to obtain. The application of placebo reform years to earlier years reduces the length of pre-treatment periods even more. A higher number of pre-treatment periods would very likely substantially improve the pre-treatment fit. However, more data is not available. If one nevertheless does not want to forgo the potential in-time placebo robustness check, data restrictions remain Achilles' heel.

6. Working Pensioners in Europe

This chapter is single-authored.[71]

6.1 Introduction

Declining birth rates and increasing life expectancy have caused population aging in many countries around the world. In many European countries, those dynamics will continue well into the twenty-first century and will thereby change the age structure within the affected countries substantially (OECD 2015b). This development puts enormous pressure on old-age provision and has caused a long-lasting debate on how to make the old-age provision systems more sustainable (Börsch-Supan and Schnabel 1998, Gruber and Wise 1999, 2004, Börsch-Supan and Coile 2019).

In order to ease the burden of aging societies, a common objective has been to better tap into the pool of older workers. However, one option of harnessing older workers, namely through increasing eligibility ages for drawing pension benefits, is not a very popular policy. Therefore, many governments have enacted flexible retirement options that allow workers to gradually reduce work

[71] This chapter uses data from SHARE Wave 6 (DOI:10.6103/SHARE.w6.700), see Börsch-Supan et al. (2013) for methodological details. The SHARE data collection has been funded by the European Commission through FP5 (QLK6-CT-2001-00360), FP6 (SHARE-I3: RII-CT-2006-062193, COMPARE: CIT5-CT-2005-028857, SHARELIFE: CIT4-CT-2006-028812), FP7 (SHARE-PREP: GA N°211909, SHARE-LEAP: GA N°227822, SHARE M4: GA N°261982) and Horizon 2020 (SHARE-DEV3: GA N°676536, SERISS: GA N°654221) and by DG Employment, Social Affairs & Inclusion. Additional funding from the German Ministry of Education and Research, the Max Planck Society for the Advancement of Science, the US National Institute on Aging (U01_AG09740-13S2, P01_AG005842, P01_AG08291, P30_AG12815, R21_AG025169, Y1-AG-4553-01, IAG_BSR06-11, OGHA_04-064, HHSN271201300071C) and from various national funding sources is gratefully acknowledged (see www.share-project.org). In addition, this chapter uses data from the generated Job Episodes Panel (OI: 10.6103/SHARE.jep.700), see Brugiavini et al. (2019b) for methodological details. The Job Episodes Panel release 7.0.0 is based on SHARE Waves 3 and 7 (DOIs: 10.6103/SHARE.w3.700, 10.6103/SHARE.w7.700).

effort with increasing age. The idea of flexible retirement is to insert a transition period with reduced work effort between the phases of full-time employment and full retirement and to thereby increase older workers' labor supply. The income loss resulting from the work reduction is supposed to be compensated by drawing (partial) pension benefits or by other compensatory sources (e.g. governmental subsidies, unemployment insurance funds, occupational pension funds etc. See Appendix to Chapter 4 for country-specific sources to compensate the income loss).

Assuming that the relative preference for leisure increases when individuals get older, standard labor market theory predicts that in the absence of constraints workers will gradually reduce work effort with increasing age. In other words, individuals will remain in the labor market until it becomes too costly for them to work (see Börsch-Supan et al. 2018 and Chapter 4 of this dissertation, respectively). Previous literature confirms that workers actually want greater flexibility and would prefer to reduce their working hours towards their retirement (Gielen 2009, Büsch et al. 2010, Dorbritz and Micheel 2010, Cihlar et al. 2014).

On the other hand, recent empirical research (OECD 2017) shows that take-up rates of flexible retirement schemes are still relatively low even though many countries in the European Union have made it easier for pensioners to combine pension benefits with earnings from employment over the past decade (OECD 2017, Eurofound 2012). Such simplifications included the introduction of partial retirement schemes, which allow a combination of part-time work and pension benefits, as well as relaxing constraints like mandatory retirement regulations, earnings tests, which limit the additional earnings for recipients of public pension benefits, and minimum hours constraints. While earnings tests effectively mean a maximum hours constraint, minimum hours constraints are imposed by the employers. In reality, employers often seem to have an aversion towards part-time employment (Gustman and Steinmeier 1986, Hutchens and Grace-Martin 2006, Hutchens 2010).

The aim of this study is to investigate this mismatch between what workers wish and standard labor market theory predicts on the one side, and low take-up rates of flexible retirement schemes on the other side. For this purpose, I will proceed in two main steps: First, I will focus on individual factors that are likely part of the explanation why individuals actually decide to become working pensioners, i.e., to combine pension benefits with work income. Second, I will investigate which of those factors may be responsible for variation across countries.

Overall, there is not much research on this issue. Previous research is fragmented across different single-country studies (e.g. Graf et al. 2011 for evidence on Austria, Huber et al. 2013 for evidence on Germany, Ilmakunnas and Ilmakunnas 2006 for evidence on Finland, and Brinch et al. 2015 for evidence on Norway). The few existing cross-country studies mainly focus on different motivational aspects in the working pensioners' decision to continue working as well as on the sociodemographic composition of the group of working pensioners: OECD (2017) finds that workers' and employers' enthusiasm varies across countries. With respect to the individual, the attractiveness of combining work and receiving a pension varies across socio-economic groups and is subject to changing expectations and preferences, financial incentives and individual health. Eurofound's (2012) main findings are that the typical working pensioner is still relatively young, male, highly educated, and living in an urban area or has a mortgage. Although employment rates of female and medium-educated pensioners are beginning to increase, there is still a considerable proportion of pensioners who are willing to work but cannot find the right job.

Dingemans et al. (2017) explore potential determinants of working beyond retirement age which is referred to as "bridge employment". Individual determinants, such as age, education, pension income and health, as well as family factors, e.g., marital status and whether the respondents undertake informal care tasks, appear to have importance why individuals choose bridge employment. In addition, broader normative and economic societal factors at the country level, such as the presence of a favorable environment and expenditure on pensions appear to also be relevant. Dingemans and Henkens (2019) examine differences in life satisfaction between full retirees and working retirees in Europe. Their results indicate a positive relationship between working after retirement and life satisfaction for retirees with low pension income without a partner. Furthermore, working after retirement seems to be most important for life satisfaction in relatively poor countries. Dingemans and Möhring (2019) examine the role of individual work histories as predictor for working while receiving a pension. Their results indicate that the larger the share of part-time work or self-employment over the working career, the higher the likelihood to work while receiving pension benefits. Those with high occupational status and flexible careers, measured by the number of job changes experienced, are particularly likely to be in paid work while receiving pension benefits. In terms of gender, the authors find that divorced women are especially likely to work while receiving a pension, but only if they did not marry again. The authors conclude that inequalities that develop over the life course continue to play a role for the decision to be in paid work while receiving a pension. The last three studies mentioned use data from the Survey of Health, Ageing and Retirement in Europe (SHARE), as does this study.

To the best of my knowledge, this study is among the first which explicitly focus on the role that different pension systems might play by shaping the incentive structures in the decision of whether to become a working pensioner or not. I add to the existing literature by employing an internationally comparative view on variables that may play a crucial role why individuals receive employment income while pension benefit receipt. In addition, I study the variation across countries by explicitly integrating the pension system into the analysis. The pension system is described by a set of variables consisting of eligibility ages for (1) normal and (2) early retirement, (3) actuarial deduction rates for early retirement, (4) a specific "start of the retirement window" if flexible retirement schemes allow an earlier take-up, whether pension schemes comprise of (5) earnings tests, and (6) the replacement rate which shows the level of pension benefits relative to earnings from employment.

The remainder of the chapter is as follows: Section 6.2 provides theoretical background and connects the theory to institutional details across countries. After a description of the data in Section 6.3, the empirical analysis in Section 6.4 proceeds in two parts. First, I study the within-country variation by analyzing variable sets which influence whether individuals have earnings from employment while pension receipt and therefore qualify as working pensioners (Part I). By applying counterfactual simulations, I subsequently investigate the cross-country variation (Part II). Section 6.5 concludes that working pensioners are not a very broad phenomenon in Europe. There are, however, substantial differences across countries. The study indicates that economic differences and pension systems likely are driving factors for the cross-country variation.

6.2 Economic theory and institutional details

The theoretical literature has emphasized constraints that may hinder individuals from combining pension benefits with income from work at the end of their working career. Those constraints hamper both combining pension benefits and work income without institutional arrangement and take-up rates of institutionalized flexible retirement schemes (e.g. partial retirement schemes etc.). I primarily draw on the theoretical background developed in Börsch-Supan et al. 2018 (also see Chapter 4 of this dissertation). There, constraints have been discussed which may be part of the explanation of the mismatch between individuals' preferences for a reduction of work effort with increasing age and the low take-up rates of flexible retirement schemes. These theoretical thoughts serve to inspire the choice of institutional variables included in the later empirical analysis in this study.

One constraint are minimum hours constraints. According to the very early work of Gustman and Steinmeier (1983), employers like to impose a minimum number of working hours since part-time jobs and flexible hours involve additional fixed costs of work.[72] Hutchens and Grace-Martin (2006) study how and why firms differ in their willingness to permit flexible ("phased") retirement. They model a profit-maximizing firm and conclude that, first, a minimum hours constraint can be profit-maximizing. Second, they state that differences in technology may be the reason why some firms impose a minimum hours constraint while others do not.

What minimum hours constraints imply for a flexible transition phase from full time employment to full retirement, is shown in the model of Börsch-Supan et al. (2018): In the absence of constraints, their model predicts that workers gradually reduce their working hours with increasing age when their preferences for leisure increase. This corresponds to the standard labor market theory case. However, employers often do not offer the free choice of working hours. In reality, employers often impose a minimum hours constraint which might be half-time or even higher. This means that employees can reduce their working hours only slightly until they reach the employer-imposed constraint. After that, the minimum hours constraint requires that employees work more hours than they would have preferred without constraints for some time up to the age at which their loss in preferred leisure is so large that they retire fully. The existence of minimum hours constraints therefore restricts the flexibility employees have in their labor supply decisions.

Besides minimum hours constraints imposed by the employers, the pension systems in many countries comprise of earnings tests. Table 6.1 shows details on earnings tests in the countries under consideration. Earnings tests limit the amount of income individuals can generate while receiving pension benefits. Thus, earnings tests effectively mean a constraint on the maximum number of working hours an individual can work. In many countries, earnings test regulations differ before and after the statutory eligibility age: Earnings tests often apply before the statutory eligibility age and usually are lifted after the statutory eligibility age (e.g. Austria, Belgium, Czech Republic, Estonia, Germany, Italy, Poland, and Slovenia). Table 6.1 also shows that the maximum permissible earnings are relatively low and, in some cases (e.g. Austria, Belgium, and Germany), substantially below the equivalent of a half-time job.

[72] According to Hurd (1996), team production is another reason why minimum hours constraints exist. Functioning team production requires that most workers are present in the workplace at the same time. See Hurd (1996) and Gustman and Steinmeier (1983) for other possible reasons.

Hutchens and Grace-Martin (2006) mention that the existence of earnings tests may influence a firm's flexible retirement policy. Börsch-Supan et al. (2016) show that the combination of earnings tests and early retirement incentives can create distinct patterns of labor force exit and pension claiming age. It can lead to very early pension claiming if maximum hours constraints are abolished in the environment of non-actuarial adjustment factors for early retirement.

Early retirement is the practice of claiming (early) pension benefits before an individual reaches the statutory eligibility age and can be claimed after attaining the earliest eligibility age.[73] Adjustment factors (i.e. deductions) typically lead to reduced early retirement benefits relative to the benefits available at the statutory eligibility age. Non-actuarial adjustment factors mean that actual adjustment factors for early retirement – as they are written in the law – are lower than actuarially fair. Adjustment factors, which are lower than actuarially fair, make pension benefits more generous and is the case in most of the countries considered in this study (see Queisser and Whitehouse 2006, OECD 2015b). Both country-specific earliest eligibility ages and actual deduction rates, as they are legislated, are also shown in Table 6.1. The generosity of pension systems, especially in the years before the statutory eligibility age, has a crucial effect on the retirement decision of individuals: The more generous (early) pension benefits are, the higher the incentives to retire early (see e.g. Gruber and Wise 2004).

These constraints (i.e. earnings tests, minimum hours constraints, eligibility ages, non-actuarial adjustment factors) taken together could, at least partially, explain why reported preferences for a reduction of working hours with increasing age do not match the take-up rates of flexible retirement schemes. Thus, they will be part in the empirical analysis that follows. Even though the literature has shown that the role of employers surely plays a role in demanding labor supply of (older) individuals, the focus of the following empirical analysis is on the supply side and on the role of pension systems.

[73] This chapter follows the nomenclature given in the glossary of Börsch-Supan and Coile (2019).

Table 6.1: Overview of institutional details concerning flexible retirement options and earnings tests

	Statutory Eligibility Age[74] (SEA) for public pensions	Earliest Eligibility Age[75] (EEA) for public pensions	Flexible retirement option outside the public pension scheme[76]	Start of the flexible retirement window[77]	Earnings Tests[78] (i.e. limit of additional earnings for recipients of public pension benefits)	Actuarial deductions per year[79], in %	Gross replacement rate[80], in %	Mandatory retirement[81]
Austria	65 (men), 60 (women)	62 (men), 57 (women)	employer-employee agreement on a working time reduction of between 40% and 60%, subsidized by governmental subsidies	55 (men), 50 (women)	*Before SEA*: when earnings are above a ceiling of 405.98€ per month, the pension is fully withdrawn; *After SEA*: no limit	4.2	76.6	Mandatory retirement age for certain groups (e.g. 70 for notaries)
Belgium	65 (men), 65 (women)	60.5 (men), 60.5 (women)	employer-employee agreement on a reduction of working hours by 20% or 50% for employees aged 50 and older (time credit system), subsidized by governmental subsidies	50 (men), 50 (women)	*Before SEA*: when annual earnings are above 7,793€ (single) or 11,689€ (dependent child), the pension is reduced by the amount that exceeds the limit. If annual earnings are 25% above the limit, the pension is fully withdrawn for as long as the additional income is higher than the ceiling; *After SEA*: no limit	0	41.0	Mandatory retirement age is 65 for most civil servants
Czech Republic	62.8 (men), 61.4 (women)	60 (men), 60 (women)	-	60 (men), 60 (women)	*Before SEA*: only earnings lower than CZK 2,500 per month are allowed; *After SEA*: no limit	5.6	51.3	None
Denmark	65 (men), 65 (women)	60 (men), 60 (women)	-	60 (men), 60 (women)	*Before SEA*: partial early retirement pension for workers aged between 60 and 65 who continue to work between 12 and 30 hours a week; weekly hours must be reduced by at least seven hours a week or at least one quarter of total hours worked in an average week. *After SEA*: the full basic pension (795€ per month or 9,540€ per year which is equivalent to around 17% of average earnings) is reduced at a rate of 30% against earned income, if work income exceeds 40,518€ per year (approx. ¾ of average earnings)	0	78.5	Mandatory retirement age is 70 for public servants; for certain groups via collective agreement

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[74] The statutory eligibility age (SEA) is defined as the age at which workers are eligible for full pension benefits independent of any other qualification. 2013 regulation.
[75] The earliest eligibility age is defined as the age at which early retirement is possible, mostly with reduced benefits. 2013 regulation.
[76] I consider only non-public-pension institutions that individuals may perceive as occupational institutions and are available before having reached the earliest eligibility age for public pension benefits. The reason for this choice is that the working pensioner definition is based on whether an individual receives either public pension benefits or occupational pension benefits/occupational early retirement benefits.
[77] Through the flexible retirement option outside the public pension scheme, the flexible retirement window may start earlier than the earliest eligibility age. If there are flexible retirement schemes outside the public pension system (if column "Flexible retirement option outside the pension system" is available), the start of the flexible retirement window is that of the flexible retirement option outside the public pension system. Otherwise, it is determined by the earliest eligibility age for public pension receipt. 2013 regulation.
[78] Earnings tests limit additional earnings for recipients of public pension benefits.
[79] Actuarial deductions are a factor used to adjust the pension payments if the worker opts for early retirement.
[80] The gross replacement rate stem from the OECD's database and is defined as gross pension entitlements from mandatory public and private pension schemes divided by gross pre-retirement earnings (see OECD 2014b).
[81] The information about the mandatory retirement regulations are widely those of 2016.

Estonia	63 (men), 62.5 (women)	60 (men), 59.5 (women)	-	60 (men), 59.5 (women)	*Before SEA:* workers already receiving early retirement pension who decide to start working again will not receive the early retirement pension starting from the first date following the month of re-employment. Pension receipt will start after retiring fully or attaining the old-age pension age; *After SEA:* no limit. Exceptions apply to old-age pension under favourable conditions and superannuated pension: accumulation impossible if pensioner continues working in occupation that entitled him to one of these pension types. Otherwise accumulation is possible.	4.8	52.2	None
France	65 (men), 65 (women)	61.2 (men), 61.2 (women)	reduction of working hours by an average of 50% over a five year gradual retirement period based on employer-employee agreement, subsidized by governmental subsidies	55 (men), 55 (women)	*Before SEA:* workers can additionally receive earnings when drawing full public pension benefits. Workers can claim full public pension benefits if they fulfill either both a minimum contributory record (in 2014: 41.25 years for people born in 1953) and the minimum legal pension age (61 years and two months) or the age of 66 years and two months *After SEA:* no limit	2.5	58.8	Mandatory retirement age is 70 for private-sector workers. For public-sector workers, there is a full pension age limit (67 in 2017), with exceptions
Germany	65.2 (men), 65.2 (women)	63 (men), 60 (women)	-	63 (men), 60 (women)	*Before SEA*: for workers with annual earnings up to 6,300€, the full pension is paid; for those with annual earnings above 6,300€, the full pension is reduced by 40% of the additional earnings. *After SEA*: no limit	3.6	42.0	Mandatory retirement age for certain groups (e.g. 75 for professors; 70 for attorneys, notaries; 67 judges, 65 for pilots, mayors)
Greece	67 (men), 67 (women)	62 (men), 62 (women)	-	62 (men), 62 (women)	*Before/after SEA:* Accumulation of pension benefits with earnings from work is possible for pensioners aged 55 or above but there is an earnings test before and after the statutory eligibility age: For pensioners who undertake a job (as employed or self-employed which is subject to compulsory insurance of EFKA), main and supplementary gross pensions are reduced by 60% during the employment period. Income test: Limit on overall net annual income (salaries and pensions) of 6,824€; total annual personal taxable income, 7,961€; and total annual family taxable income, 12,389€.	6.0	53.9	Mandatory retirement age for public sector employees.[82]
Italy	66.3 (men), 63.3 (women)	63.3 (men), 63.3 (women)	-	63.3 (men), 63.3 (women)	*Before SEA*: early retirement pensions can be combined with self-employment or project work only and not with income from dependent employment. Limits to combining pensions with other sources of income established by previous rules remain for disability allowances, pensions for survivors, pensions for workers under certain workfare measures, minimum income measures, and the pensions of employees who transit from full-time into part-time work; *After SEA*: no limit	2.9	71.2	Deferment possible up to the age of 70 years and 3 months (adjusted according to life expectancy).

[82] Greece is a special case: there is no fixed age at above which employees can be dismissed because of their age, which would be considered a breach of the fundamental right of work written down in the Constitution. Retirement is therefore rather a voluntary decision resulting in negotiated agreements between employers and employees. Mandatory retirement only applies for public sector employees who can retire between age 60 and 65, depending on insurance years and when exactly this is completed (Kremalis 2018).

Slovenia	65 (men), 63 (women)	58 (men), 57.8 (women)	-	58 (men), 57.8 (women)	*Before SEA*: except in case of partial pension, if an insured person enters into an employment relationship or engages in self-employed activities or fulfils any other condition to participate in insurance, the pension is not paid. *After SEA*: no limit	3.6	42.2 (men), 44.4 (women)	None
Spain	67 (men), 67 (women)	61 (men), 61 (women)	-	61 (men), 61 (women)	*Before SEA:* Partial retirement is possible from age of 61 years, with a new employee. It requires an agreement between the employee and the employer to reduce the total number of working hours and the salary between 25 and 75 per cent. Simultaneously, the employer is required to hire another person to replace the retiring employee partially via the replacement contract. *After SEA:* Since March 2013, it is possible for individuals above the statutory eligibility age to combine retirement benefit receipt and work. However, in these cases the amount of the pension benefit is reduced by 50%.	8	73.9	Deferment possible up to age 70 if the insured has at least 15 years of contributions including at least two years of contributions in the last 15 years.
Sweden	65 (men), 65 (women)	61 (men), 61 (women)	-	61 (men), 61 (women)	No limit	4.7	55.6	None
Switzer-land	65 (men), 64 (women)	63 (men), 62 (women)	-	63 (men), 62 (women)	*Before SEA*: allowed, without reduction of the pension and irrespective of the wage amount; *After SEA*: no limit. No contributions are paid after age 65 under the public pension scheme.	4.5	55.2 (men), 54.3 (women)	Public pension can be deferred for up to 5 years, occupational pension benefits until age 70.

Sources: Bloemen et al. (2014), Börsch-Supan and Coile (2019), Chapter 4 and Appendix to Chapter 4 (or Börsch-Supan et al. 2018 respectively), Devisscher and Sanders (2008), Graf et al. (2011), Lindecke et al. (2007), MISSOC (2013), OECD (2013c), OECD (2014b), OECD (2015b), OECD (2017), Queisser and Whitehouse (2006), Reday-Mulvey (2000), Social Security Administration (2012-2013), SPLASH-database (2012), SPLASH-database (2019).

6.3 Data and variables

6.3.1 SHARE data and other data

The individual level data required for the empirical analysis come from SHARE (see Börsch-Supan et al. 2013). SHARE is a multidisciplinary and cross-national panel database of micro data on health, socio-economic status and social and family networks of individuals aged 50 or older. SHARE is a representative survey and was conducted for the first time for eleven European countries in 2004. Since then, the scope of the survey has expanded in biennial survey waves; it now covers more than 140,000 individuals in 28 countries. This study uses data from Wave 6 collected in 2015 and integrates 13 countries in the analysis (see Footnote 87 below for the rationale behind the country selection).

Additionally, I use information to describe the pension system and macro data to control for the economic situation. Information on gross domestic product (GDP, per capita), labor force participation rates (LFPR, age 55–64) and the replacement rate (RR, gross) stem from the OECD's database (see OECD 2013d, OECD 2013e, and OECD 2014b).[83] To describe the pension system, I use information from various sources given in the list of sources to Table 6.1.

6.3.2 Variables and sample selection

Dependent variable. The dependent variable in the current study is an indicator variable which equals one if an individual is characterized as working pensioner and zero otherwise. A working pensioner is identified by focusing on the income sources of older individuals reported in SHARE Wave 6. Hence, the group of pensioners comprises those who report receiving income from (1) a public old-age pension, (2) income from a public early retirement or pre-retirement pension, or (3) report receiving occupational pension benefits/occupational early retirement benefits in the last year. Accordingly, the group of workers are those individuals who report (1) having received wages, salaries or other earnings from dependent employment or (2) any income from self-employment or work for a family business in the last year. Pensioners who at the same time meet the definition of a worker are classified as working pensioner. Due to data restrictions, I was not able to establish specific thresholds on earnings or weekly hours of working pensioners, respectively. The same

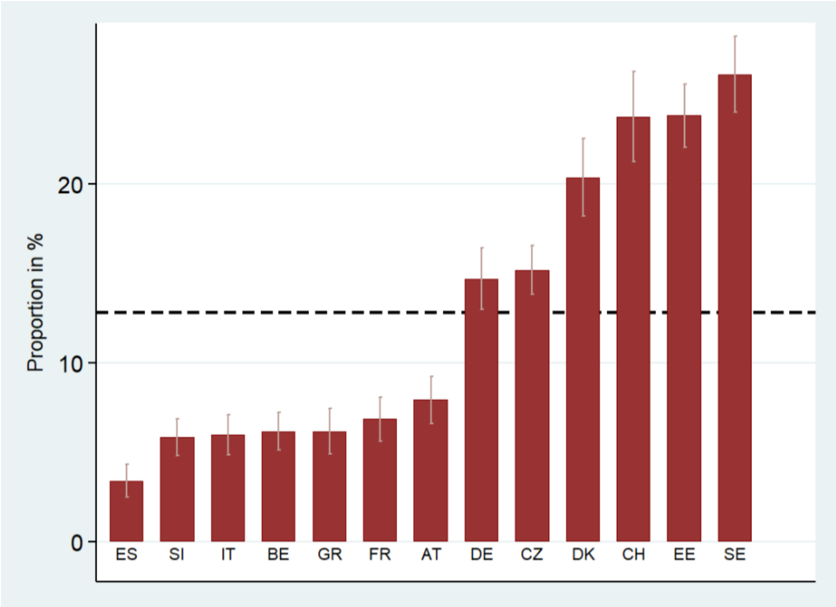
[83] Table C.1 shows numbers for GDP and LFPR (age 55–64) by countries.

holds true for the length working pensioners simultaneously receive both earnings from employment and pension benefits. In many cases, this period may only be a rather short transition phase while in other cases it may last longer. The investigation of how long working pensioners actually stay in the transition period remains open for future research. In addition, I focus on public pension benefits and occupational pension benefits only. In the single countries other labor market institutions may play a role in the context of working pensioners as well. The examination of other labor market institutions should be the objective of future research to obtain a better understanding.

At first glance, the simple definition of working pensioners seems straightforward and has been applied in previous literature. However, the yearly character of the SHARE employment data might lead to mismeasurement. Since all questions relevant to the definition of working pensioners refer to the year preceding the interview, the following problem could arise: If somebody has been in full employment in the first part of the year, e.g. from January until June, and has started to claim pension benefits at some point later that year, e.g. in July, she indicates both income from work and pension income for the last year in the interview. However, the two sorts of income may well have been received in consecutive periods rather than simultaneously. The latter is required to meet the definition of a working pensioner. My definition adjusts for this potential mismeasurement problem by classifying all individuals who retired in 2014 and 2015 and do not report having worked continuously since the last interview not as working pensioners but as pensioners.[84] This approach leads to conservative estimates for the number of working pensioners which tend to underestimate the number of working pensioners and simultaneously overstate the number of pensioners.

[84] Figure C.1 graphically shows the potential mismeasurement to provide a more intuitive depiction of the problem.

Figure 6.1: Working pensioner proportion across countries



Source: Own calculations.

Applying the definition of working pensioners to the data yields varying proportions of working pensioners on all pensioners across countries for the age group 50-75. The average proportion across countries is 12.8% and is displayed with the dotted line in Figure 6.1. However, it is also apparent that there is substantial variation across countries. There are countries with relatively high proportions such as Estonia, Sweden, Denmark or Switzerland, and countries with relatively lower proportions such as Spain, Slovenia, and Italy.[85] The aim of the empirical analysis is to find out which variables may play a role for, first, the within-country variation and second, the between-country variation.

I use the following **explanatory variables** on individual-level and country-level, summarized to four sets of variables: demographics, health variables, economic and financial variables as well as variables describing the pension system.

[85] Dingemans and Henkens (2019) use SHARE data as well and define working pensioners as individuals participating in paid work while simultaneously receiving public or occupational pension benefits. Their sample is restricted to the age group 60-75. Even if the authors do not account for the potential mismeasurement and include a different set of countries in their analysis, they find enormous variation across countries with the highest proportions in Estonia, Sweden, Switzerland and Denmark, and the lowest proportions in Slovenia, Spain, Poland and Italy. With the exemption of Poland, countries with the highest and lowest proportions are the same here as in their study. Poland is not part of the analysis in this study, see Footnote 87 in this section.

Demographics. I use age (centered), gender, education and marital status to describe the individual's demographic characteristics. Education is based on the ISCED-1997-classification. *Low education* corresponds to ISCED 0-2, *medium education* to ISCED 3-4 and *high education* to ISCED 5-6. The current marital status is split into the categories married, divorced, widowed or single. I additionally include a variable to reflect whether the respondent's partner is in the labor force or not.

Health. Health plays an important role in the decision to exit the labor market and to start claiming pension benefits. To describe the individuals' health status, I use several dimensions: First, I employ the interviewee's self-reported health status which is a categorical variable on a five-point scale from poor (1) to excellent (5). The self-reported health status is one of the most commonly used measures in public health surveys; it captures various physical, emotional, and social aspects of health and has been found to predict mortality (e.g. Idler and Benyamini 1997, Jylhä 2009). Self-reported health may, however, suffer from justification bias (Bound 1991, Sen 2002), meaning retired pensioners report a worsening of the individual health status to justify retirement. Therefore, I include additional objective health measures. Grip strength (in kg) is the most objective measurement of health. The test is performed during the interview. It reflects the overall muscle status of the respondent and has been linked to mortality in previous research (e.g. Gale et al. 2007). Functional health is measured by whether the respondent reports having limitations to performing (instrumental) activities of daily living (ADL and IADL). Finally, I also include the number of chronic diseases. Individuals report zero to up to twelve chronic diseases.

Economic and financial situation. I include variables on both the individual level (equivalized household net income and household net worth) and the country level (per-capita GDP and the labor force participation rate of the age group 55–64) to capture the economic and financial situation. The information on household net income comes from the SHARE module on household income. Respondents are asked about the overall income (after taxes and contributions) that the entire household has in an average month. In order to reflect differences in a household's size and composition, I divide this number by the weighted sum of household members.[86] Household net worth stems from the imputed dataset and is the sum of net financial assets (i.e. the sum of bank accounts, bonds, stocks, mutual funds, savings for long-term invests, minus financial liabilities) and household real assets. The latter is the total value of the household's main residence (adjusted for

[86] The weighting factor is equal one for the first adult and 0.5 for each subsequent person.

the percentage of house owned), value of the own business (adjusted for the share of own business), value of cars, value of other real estate minus mortgage on main residence. The variable thus broadly captures the households' net worth. Both household net income and household net worth are adjusted for purchasing power parity to allow cross-country comparisons.

Pension system. I use different variables to describe the pension system. I include the statutory eligibility age at which an individual becomes eligible for full public pension benefits. Moreover, I control for an earlier "start of the retirement window" (SRW): On the one hand, this variable comprises the earliest eligibility age, when public pension benefit receipt is possible (mostly with reduced benefits). On the other hand, the SWR contains the eligibility age for non-public-pension institutions if flexible retirement options outside the public pension system are available (see Table 6.1). However, I consider only non-public-pension institutions that individuals may perceive as occupational institutions. The reason for this choice is that the working pensioner definition in this study is based on the receipt of public pension benefits and occupational pension/occupational early retirement benefits. If there is no broad non-public-pension institution available, the SRW is the earliest eligibility age for the receipt of public pension benefits. Gender differences in eligibility ages are taken into account. A dummy variable indicating whether earnings tests apply before the statutory eligibility age is included as well. Earnings test limit the income individuals are allowed to earn while receiving pension benefits and these tests apply in most of the countries before the statutory eligibility age. I additionally integrate the level of actuarial deduction rates, which apply if individuals claim pension benefits before reaching the statutory eligibility age (usually for each year of early retirement), and the gross replacement rate which captures the level of pension benefits relative to earnings from employment. Values for the gross replacement rate stem from the OECD's database. The gross replacement rate is defined as gross pension entitlements from mandatory public and private pension schemes divided by gross pre-retirement earnings (see OECD 2014b). I finally include two dummy variables indicating whether individuals have reached the earliest eligibility age and the statutory eligibility age for public pension benefit receipt. Since earliest and statutory eligibility age are usually cohort- and gender-specific due to their incremental increase in many countries, the construction of the two dummies uses detailed information on cohort- and gender-specific eligibility ages from Bucher-Koenen et al. (2019).

Sample selection. The final sample comprises 13 countries, namely Austria, Germany, Sweden, Spain, Italy, France, Denmark, Greece, Switzerland, Belgium, Czech Republic, Slovenia, and

Estonia.[87] The sample is restricted to the age group 50-75. In addition, the sample solely includes working pensioners and pensioners only receiving public or occupational pension benefits without simultaneously qualifying as working pensioner. The analytical sample consists of 21,929 observations out of which 2,815 are working pensioners.[88]

Table 6.2 presents summary statistics of the individual-specific controls for the group of working pensioners (WP=1) and the group of non-working pensioners (WP=0) as currently delimited.

[87] From the sum of countries part of SHARE's wave 6, I exclude five countries from the analysis for the following reasons: In Portugal the early retirement pathway was closed between 2012 and 2014 due to the financial crisis; Poland also doesn't offer an early retirement pathway in the general pension system (OECD 2013c). Therefore, important information such as EEA, SRW and actuarial adjustments are not available. For Croatia, there is no comparable gross replacement rate available at the OECD database. Israel's pension system follows an entirely different logic (National Insurance Institute of Israel 2019). With only N=32, Luxembourg's number of working pensioners is too small to include in the comparison.

[88] Table C.2 shows the number of cases, the gender composition and the average age for the working pensioner group and the group of pensioners by single countries.

Table 6.2: Summary statistics

	Categories	Share of total sample	WP = 1	WP = 0
Age	50–59	3.53%	17.21%	82.79%
	60–64	18.58%	13.60%	86.40%
	65–69	38.15%	14.40%	85.60%
	70–75	39.74%	10.59%	89.41%
Gender	Male	48.40%	14.22%	85.78%
	Female	51.60%	11.54%	88.46%
Education	Low	32.17%	7.95%	92.05%
	Medium	41.47%	13.68%	86.32%
	High	23.67%	18.90%	81.10%
Marital status	Married/Partner	74.64%	12.53%	87.47%
	Single	5.06%	11.99%	88.01%
	Widowed/Divorced	20.22%	14.19%	85.81%
Partner in labor force	No	90.88%	11.87%	88.13%
	Yes	9.12%	22.46%	77.54%
Self-reported health	Poor	8.01%	5.47%	94.53%
	Fair	28.15%	11.01%	88.99%
	Good	39.43%	12.54%	87.46%
	Very good	17.89%	16.65%	83.35%
	Excellent	6.52%	21.13%	78.87%
Number of limitations (IADL)	0	87.28%	13.81%	86.19%
	1	7.39%	8.15%	91.85%
	2	2.02%	5.86%	94.14%
	>3	2.38%	2.29%	97.71%
Number of limitations (ADL)	0	91.57%	13.40%	86.60%
	1	4.71%	8.91%	91.09%
	2	1.73%	5.26%	94.74%
	>3	1.99%	2.75%	97.25%
Grip strength	0–20	7.17%	7.18%	92.82%
	20–50	58.42%	11.47%	88.53%
	40–60	27.43%	17.66%	82.34%
	>60	0.88%	13.92%	86.08%
Number of chronic diseases	0	20.41%	16.89%	83.11%
	1	29.30%	14.44%	85.56%
	2	23.19%	11.70%	88.30%
	3	14.33%	9.96%	90.04%
	>4	12.77%	7.96%	92.04%
			Average (in €)	
Equivalized household net income			2,259	1,802
Household net worth			362,348	243,561

Source: Own calculations.

6.4 Empirical analysis

To investigate the variables that may drive the decision to become a working pensioner, I follow the empirical approach of Börsch-Supan et al. (2020b). The authors analyze the interrelated role of health and welfare state policies in the decision to take up disability insurance benefits due to work disability. Since their study aims at investigating the potential causes for reporting a work disability and/or receiving disability benefits within and between countries, their approach is particularly suitable to the research interests of this analysis.

The chapter continues as follows: In Section 6.4.1., I study the within-country variation to find out which variables could play a role in the decision why individuals are working pensioners (Part I). Section 6.4.2. proceeds with counterfactual analyses to investigate which variables (or better: variable sets) may be responsible for the between-country variation (Part II).

6.4.1 Part I: within-country variation

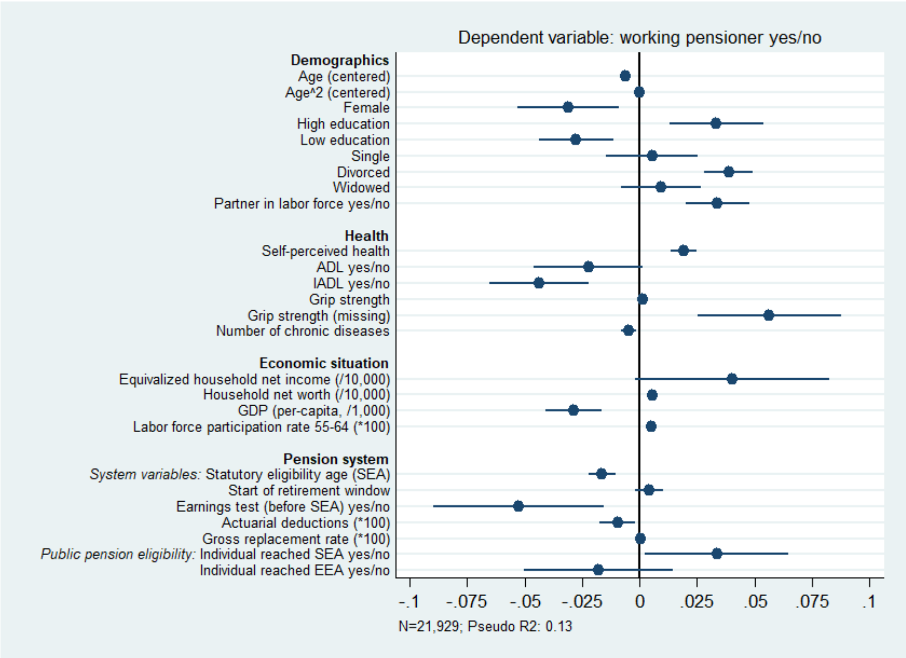
6.4.1.1 Regression analysis

What can determine being a working pensioner? To address this question, I estimate a regression model based on the pooled sample of all countries. Since the dependent variable of interest – working pensioner – is binary, I estimate the following model by probit estimation:

$$WP_{i,c} = \alpha + \boldsymbol{Dem}_{i,c}{}'\boldsymbol{\beta} + \boldsymbol{Health}_{i,c}{}'\boldsymbol{\gamma} + \boldsymbol{Econ}_{i,c}{}'\boldsymbol{\delta} + \boldsymbol{Pen}_{i,c}{}'\boldsymbol{\theta} + \varepsilon_{i,c} \qquad (6.1)$$

where i indexes individuals and c countries. $WP_{i,c}$ denotes an indicator that takes the value one if an individual meets the definition of a working pensioner and zero otherwise. The vector $\boldsymbol{Dem}_{i,c}$ contains the set of individual level demographic characteristics age, gender, education, marital status as well as the partner's labor force status as described above. In the vector $\boldsymbol{Health}_{i,c}$ the selected variables from SHARE describing an individual's health are included (self-perceived health, ADL, IADL, grip strength as well as the number of chronic diseases). Variables concerning the economic situation of the respondent or the country that she or he lives in are collected in the vector $\boldsymbol{Econ}_{i,c}$. The variables describing the individual's economic situation are her or his equivalized household net income and the household net worth. Per-capita GDP as well as the labor force participation rate of the age group 55-64 are included to describe the economic situation of the respondent's country. Finally, the vector $\boldsymbol{Pen}_{i,c}$ comprises all individual or country-specific variables describing the pension system and the individual's status within that system. On the country level those variables are the statutory eligibility age, the start of the retirement window, the presence of earnings tests before the statutory eligibility age as well as actuarial deductions and the gross replacement rate. The variables describing the individual's status in the pension system comprise a dummy indicating whether the respondent has reached the statutory eligibility age and one indicating whether the respondent has reached the earliest eligibility age. Regression results (i.e. marginal effects) are displayed in Figure 6.2. The model explains 13% of the total variation.[89] To examine which role probit estimation plays for the estimation results, I also show the results based on a linear regression model in the Appendix to Chapter 6 (graphically in Figure C.2 and in tabular form in Table C.5). The results remain stable when applying a linear regression model.

Figure 6.2: Potential determining factors of being a working pensioner



Note: Marginal effects of probit estimation. Clustered standard errors by country. Household income and worth adjusted for purchasing power parity. Based on SHARE including the following countries: AT, DE, SE, ES, IT, FR, DN, GR, CH, BE, CZ, SI, EE.

Source: Own calculations.

The probability of being a working pensioner significantly decreases with age. However, the effect is very small. Women are less likely to work while receiving a pension. This can be explained by a lower labor market participation of women in general. Moreover, there is a clear education gradient:

[89] Regression results listed in tabular form are shown in Table C.3. As a robustness check, I run regressions with country-fixed effects instead of the country-specific variables. The results for the other sets of variables remain stable in size and sign Table C.4.

The summary statistics in Table 6.2 have shown that in the group of low-educated individuals only approximately 8% are working pensioners, while among the high-educated individuals almost 19% work while receiving a pension. This correlation translates to the regression results: High-educated individuals are more likely to retire flexibly and pensioners with low education are less likely to simultaneously receive employment income. This may be explained by different occupational types. Jobs in the low-education sector are more often physically demanding. Individuals suffering from a physically demanding job might be forced to retire fully. Marital status as well plays a role for the decision to combine pension income and work income. While being single and widowed compared to married individuals does not have an effect, divorced individuals are more likely to be a working pensioner. This could result from financial needs. Divorced individuals might have experienced a negative income shock due to the divorce which they try to compensate with additional earnings through receiving a pension. These findings are in line with the results established by Dingemans and Möhring (2019). They found that divorced women are especially likely to be a working pensioner if they did not marry again. In contrast, singles are accustomed to their income position and widowed individuals may be eligible for survivor benefits. If the partner still is in the labor force, working while receiving a pension gets significantly more likely.

As expected, health is an important variable set. The self-reported health status has a positive impact on the likelihood of being a working pensioner, i.e., the higher the self-rated heath status, the higher the probability to become a working pensioner. This finding matches the summary statistics in Table 6.2. The better the health categories, the higher the proportions of working pensioners. Reporting at least one limitation with (instrumental) activities of daily living decreases the probability. However, the vast majority in the sample do not report any limitations with (instrumental) activities of daily living (see Table 6.2). The probability of working while receiving a pension decreases also with the number of self-reported chronic diseases. This corresponds to the descriptive results in Table 6.2, where the proportion of working pensioners in the single categories of chronic diseases decreases with increasing number of chronic diseases. The most objective health measure is the individual’s grip strength measured in kilogram. I impute missing values for grip strength by setting them to zero. I add an additional flag variable to control for these imputed values. Grip strength only has a very low but still significant effect. The health variables, however, may suffer from reverse causality: healthier individuals may more likely be working pensioners since their health allows a continuation of employment. At the same time, however, staying active at the labor market can influence individual’s health.

In addition to demographic variables and health variables, I include a set of variables capturing the economic and financial situation. T-tests reveal that equivalized household net income (p-value 0.000) and household net worth (p-value 0.000) are significantly higher in the group of working pensioners compared to the group of pensioners. In the regression, both variables have a positive and significant effect on the probability of being a working pensioner. This could hint at two reverse effects and may suffer from endogeneity as well: On the one hand, it might indicate that working pensioners are not mainly motivated by financial motives to keep on working while receiving pension benefits because they live in comparably wealthier households. On the other hand, this effect could as well work into the opposite direction: Households with working pensioners are wealthier because they supplement their pension benefits with income from work. The integration of the labor force participation rate of the age group 55–64 is supposed to capture the overall employment possibilities of older workers in the labor market. The labor force participation rate also has a positive and significant effect, indicating that countries with a more active 55–64 age group better facilitate flexible transitions into full retirement. Looking at the set of economic variables, only the amount of per-capita GDP has a negative effect.

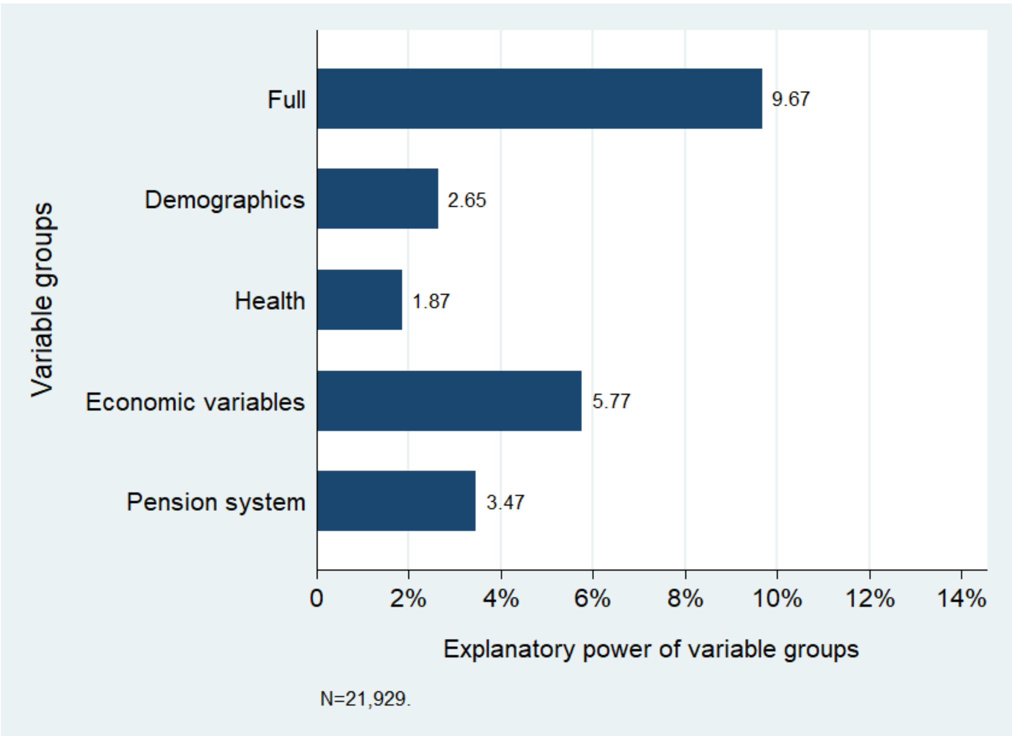
The pension system is captured by seven variables described above with effects going in different directions. However, the seven variables cannot be interpreted in isolation and can be understood only in conjunction with each other. The start of the flexible retirement window and the existence of earnings tests before the statutory eligibility age interact with each other. In addition, these variables interact with the actuarial deductions for early retirement and whether these adjustment factors are actuarial fair. Taken as a whole, the results suggest that the interactions before the statutory eligibility age may rather hamper the combination of pension benefits and earnings from employment. Against this, the comparably higher degree of flexibility past the statutory eligibility age in many countries may rather ease the combination of employment income and pension benefits receipt. It may be surprising that the gross replacement rate does not have significant influence. The reason for this results most likely stems from the fact that the gross replacement rate only varies by country (in some cases additionally by gender). Thus, this number may suffer from high collinearity and should not be interpreted in too much detail. It remains open for future research actually which features of the pension systems are the driving forces in supporting or hampering the combination of employment income receipt and pension benefit receipt. Likely a combination of features plays a crucial role.

Overall, the regression analysis indicates that demographic variables as well as health variables, economic variables and the pension system may be important factors why pensioners simultaneously receive pension benefits and earnings from employment. Whether these sets of variables do as well play a role in the investigation of the variation across countries will be examined in Part II.

6.4.1.2 Variance decomposition

In order to understand the contribution of different sets of variables on the working pensioner proportions, I perform a variance decomposition analysis of the individual variation in working pensioner proportions. The decomposition is based on a linear regression model and the results are shown in Figure 6.3. The linear specification gives very similar results as the probit model presented before (for the results from the linear specification see Figure C.5 and Table C.2, respectively). The explanatory power of the full model is 9.67%. The full model contains the full set of control variables as in Section 6.4.1.1., the other models respectively contain the demographic variables, health variables, economics variables or pension system variables only.

Figure 6.3: Variance decomposition for the probability of being a working pensioner



Note: Based on linear regression model.

Source: Own calculations.

Figure 6.3 shows that demographic variables account for 2.65% and health variables for 1.87% of the total variation. The set of variables describing the pension system accounts for 3.47% of the total variation, while the economic variables contribute to a comparably higher extent to the total variation (5.77%).

When combining the results from the regression analysis with the variance decomposition analysis, the choice of variables and the conflation to the four sets of variables seems to be a proper choice for the following between-country analysis. The aim of the next section is to investigate whether differences in the variable sets may be responsible for cross-country variation.

6.4.2 Part II: between-country variation

Why is there large variation in proportions of working pensioners across countries? In order to answer that question, I perform counterfactual simulations. The idea of counterfactual simulations is to set explanatory variables to the average across countries to take account of cross-country differences. Compared to the European average, Italy, for example, has an older population while Denmark has a younger population. In the counterfactual simulations, these demographic differences are taken out by substituting the country-specific demographic variables with the average across countries and predicting country proportions if Italy and Denmark had the same demographics.

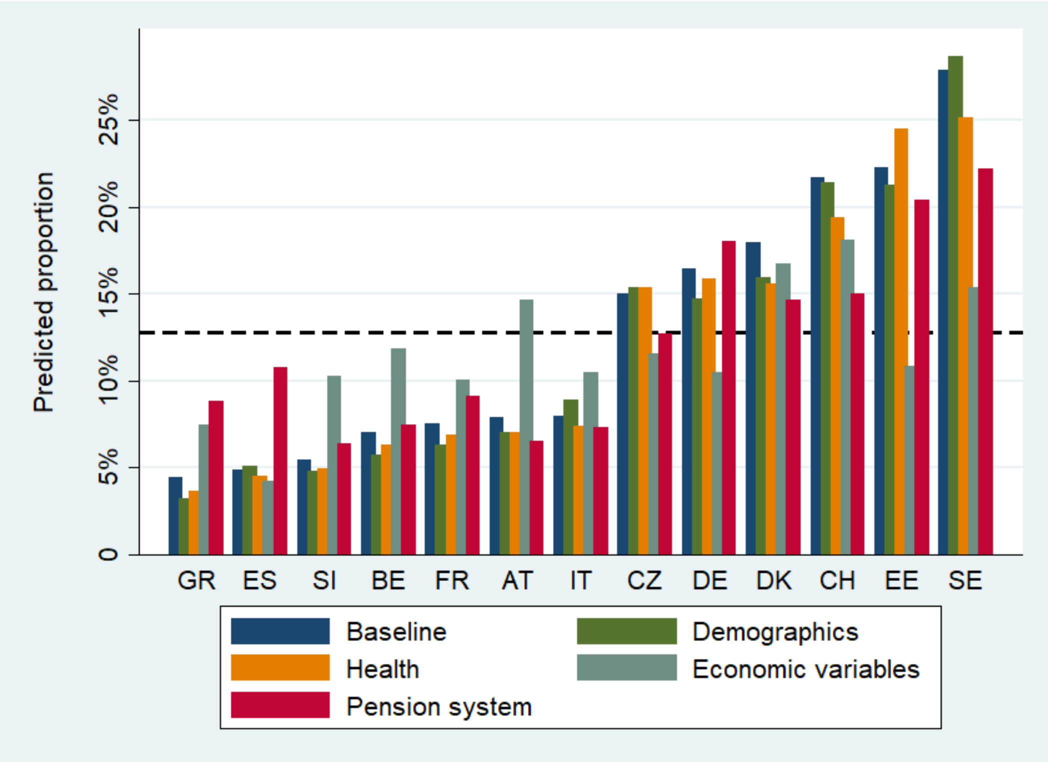
The procedure is as follows: I estimate the same model as given in Equation 6.1 by probit estimation to predict the working pensioner proportions for each country. For the baseline prediction, I use all variables as they are. The counterfactual simulations are executed with specific sets of variables (i.e. demographics, health, economic variables, pension system) set to the average across all countries. This way, I predict the working pensioner share as if everybody had the same characteristics in a specific set of variables as the average of all countries.[90]

Figure 6.4 presents the main result of this section by comparing the predicted working pensioner proportions with counterfactual simulation results if the demographic variables, health variables, economic variables and variables describing the pension system are set to the average across all countries. The predicted average working pensioner proportion across all countries, represented by the dotted line, is 12.8%. The countries are sorted by the baseline proportions.

I first take out demographic differences by equalizing age, gender, education, marital status and the partner information. I then predict the working pensioner share as if all countries had the same demographic structure. The results are shown in Figure 6.4 by comparing the counterfactual simulation with the baseline results. Equalizing the demographic structure does not change much, as indicated by the first and the second bar for each country. Therefore, demographic differences do not appear to be the main cause of the between-country variation.

[90] To verify which role probit estimation plays for the estimation results, I show the counterfactual simulations based on linear regression in Figure C.3 (see the Appendix to Chapter 6). The results remain stable when applying a linear regression model.

Figure 6.4: Counterfactual simulation for working pensioner proportions



Note: Based on probit estimation. Root mean square error: Baseline=56.5%, Demographics=59.1%, Health=54.0%, Economic variables=13.0%, Pension system=26.8%.

Source: Own calculations.

In a second step, I take account of health differences between the countries. Again, I first calculate the average over the different health variables to account for health differences across countries. I then predict the share of working pensioners as if all countries had the same health status. Equalizing health across countries does not make a substantive difference as indicated by the first and third bar for each country. Hence, health differences do not seem to be a main driver of the between-country variation as well. This result is in line with the findings by Börsch-Supan et al. (2009). The authors investigate the role of pension and social security institutions in shaping the European patterns of work and retirement. They found that health is an important determinant of earlier retirement within each country, yet it does not explain the large cross-national variation.

The third step is to account for economic and financial differences by establishing the influence of the economic and financial variables. Equalizing all economic and financial variables generates more changes in the variation of working pensioner shares than equalizing demographics and health as indicated by the first and fourth bar in the graph. The working pensioner shares would be different in many countries if all countries had the same economic and financial variables. In countries with, for example, a lower than average labor force participation rate for the age group 55–64 (average 56.6%) such as in France (50.7%), Italy (48.9%), Austria (46.9%), Belgium (45.1%) and Slovenia (38.4%), working pensioner shares would be much higher if they had the average economic environment. The opposite holds true for countries with comparably high labor force participation rates such as in Sweden (78.4%) and Germany (69.1%). In these countries, the shares would be lower if they had the same economic environment. At the same time, in Sweden (41,060€) and Germany (33,930€) per-capita GDP is above the average per-capita GDP across all countries (average 29,980€). This may be another contributing factor to the counterfactually lower shares. In Slovenia (17,620€) and Greece (17,040€) in contrast, per-capita GDP is below average. This counterfactually leads to a higher share if Slovenia and Greece had the average economic environment. Overall, economic differences can be recorded as potential source for between-country variation.

The last counterfactual simulation is on equalizing the pension system variables across countries and thus accounts for differences in the pension systems. Once again, working pensioner shares are predicted as if all countries had the same pension system variables. The rightmost bar shows the predicted rates if the system characteristics were identical to the average in all countries. The pattern of working pensioner proportions changes strikingly when equalizing pension systems. The shares counterfactually decrease, e.g., in Sweden and Switzerland. In both countries, no earnings tests apply before the statutory eligibility age, thus allowing an unlimited combination of pension benefits and work income. This makes the pension systems more flexible. The share counterfactually decreases in Estonia as well when using the average pension variables across countries. An earnings test applies before the statutory eligibility age in Estonia. However, the statutory eligibility age is comparably low (63 for men, 62.5 for women, see Table 6.1). Therefore, individuals are allowed to combine pension income and work income relatively early without any limitations. Reducing flexibility through equalizing system variables in these countries counterfactually has a negative effect on working pensioner shares. In Greece and Spain, for instance, comparably high statutory eligibility ages apply (67 for both men/women). According to the regression analysis in Part I, the higher the statutory eligibility age, the lower the probability of being a working pensioner. Conversely, equalizing the statutory eligibility age with the average across countries (65.3 for males, 64.3 for females) counterfactually yields a higher share. Overall, in most countries counterfactual simulation leads to working pensioner shares that approach the overall average proportion. This becomes most apparent when comparing Greece (smallest proportion at baseline: 4.8%) and Sweden (highest proportion: 27.7%). The proportions in both countries are much closer to each other and to the overall average value across all countries when counterfactually assuming that both countries have the same pension system variables. More formally, the average deviation from the average across countries (i.e. from the dotted line), measured as the root mean square error (RMSE), clearly decreases from the baseline value (56.5%) to the simulation which counterfactually eliminates cross-country differences in variables describing pension systems (26.8%). This means that differences in the pension systems may also be responsible for cross-country variation.

Summarizing the results from the counterfactual simulations reveals that economic differences and differences in pension systems likely are driving factors for the variation in working pensioner proportions between countries. Demographic differences and health differences do not appear to be the main causes for cross-country variation. This is supported by the results by Börsch-Supan et al (2009). They found that institutional differences across countries explain much of the cross-country differences in work and retirement, while differences in health and demographics only play a minor role.

6.5 Summary and conclusions

Over the past decade, many countries have made it easier for pensioners to combine pension benefits with income from work. However, working pensioners are not a broad phenomenon in Europe, even if survey evidence revealed that substantial shares of individuals prefer a flexible transition into full retirement.

This study aims at a better understanding of this mismatch. The analysis follows a two-step procedure: In a first step, I explore variables that influence why individuals combine pension income and work income at the end of the working career. The regression analysis suggests that demographic variables, health variables, economic variables as well as the pension system may be important factors. The second step of the analysis is to find out which variables may account for the variation in working pensioner proportions across countries. This is realized by performing counterfactuals simulations. The purpose of counterfactual analysis is to set explanatory variables to the average across countries to capture cross-country differences. Based on the counterfactual simulations, I predict working pensioner shares that would prevail in each country, if each individual had the same characteristics as the average of all countries. Applying counterfactual simulations indicates that economic differences as well as differences in pension systems may be responsible for cross-country variation. The theoretical literature has emphasized constraints that might hinder individuals from combining pension benefits with income from work at the end of their working career. Some of the constraints are inherent the pension systems. Equalizing theses constraints across countries suggests that differences in the pension systems could be an important source for between-country variation. Future research has to show which features of the pension systems actually are the driving forces.

There has not been much literature with a cross-country focus to date. This article adds to the few cross-country studies and explicitly integrates variables describing the pension systems. Moreover, the definition used in this study measures working pensioners more precisely than it has been done in previous literature.

However, there are still open issues which go beyond the scope of this chapter and remain open for future research. One question is why working pensioners actually combine pension benefits with employment income. Next to health limitations and social factors, further motivation might indeed stem from financial reasons. Overall, it may be the case that individuals in different income classes have different motives to have income from employment while receiving a pension. A more comprehensive analysis of the financial motives in the context of varying pension systems, therefore, could bring new and more insights. Moreover, the cross-sectional character of the data in this article does not allow a complete explanation of the transition process from full employment to either full retirement on a direct way or to a flexible transition phase first. An extension of the investigation to a panel perspective could help to better understand the actual transition choices. In addition, this study does not consider how long working pensioners actually stay in the transition period and how much they earn. This remains open for future research. Moreover, besides public pension benefits and occupational pension benefits other labor market institutions may play a role as well. The examination of other labor market institutions in the context of working pensioners should be the objective of future research to obtain a broader picture.

A. Appendix to Chapter 4

A.1 Flexible retirement options and institutional details

Table A.1.1: Overview of flexible retirement options, earnings tests and mandatory retirement regulations across countries

	Year of Introduction[a]	Statutory Eligibility Age (SEA) for public pensions[b]	Start of the flexible retirement window[c]	Working Hours (i.e. extent to which the working time must be reduced within the flexible retirement option)	Compensation of Income Loss	Earnings Tests[d] (i.e. limit of additional earnings for recipients of public pension benefits)	Mandatory Retirement[e]
Australia	2005	65 men, 63 women	55	full flexibility	via superannuation	before Statutory Eligibility Age (SEA): no Age Pension claiming possible; after SEA: the Age Pension benefits are reduced if the annual income exceed the "income free area" of 168€ per month	mandatory retirement age for certain groups (e.g. 70 for federal judges, 60 and 65 for Australian Defence Force personnel and reservists respectively)
Austria	2000	65 men, 60 women	55 men, 50 women	bilateral agreement between employer and employee on a working time reduction of between 40% and 60%	via governmental subsidies	before SEA: when earnings are above a ceiling of 290€ per month, the pension is fully withdrawn; after SEA: no limit	mandatory retirement age for certain groups (e.g. 70 for notaries)
Belgium	2002	65 men, 62 women	50	reduction of working hours by 20% or 50%	via governmental subsidies	before SEA: when annual earnings are above 7,793€ (single) or 11,689€ (dependent child) per year, the pension is reduced by the amount that exceeds the limit. If annual earnings are 25% above the limit, the pension is fully withdrawn for as long as the additional income is higher than the ceiling; after SEA: when earnings are above 22,509€ (single) or 27,379€ (dependent child) per year, the pension is reduced by the amount that exceeds the limit. If annual earnings are 25% above the limit, the pension is fully withdrawn for as long as the additional income is higher than the ceiling. For a retiree older than 65 with at least 42 years of contribution, the ceiling is lifted entirely	mandatory retirement age is 65 for most civil servants
Denmark	1995	67 men, 67 women	60	working hours reduction by at least 25%, but the remaining working time has to be at least twelve hours per week (18.5 hours per week for self-employed)	via fixed payment of unemployment insurance fund	before SEA: no public pension receipt possible, therefore no conflict between public pension benefits and additional income; after SEA: full basic pension (795€ per month or 9,540€ per year which is equivalent to around 17% of average earnings) is reduced at a rate of 30% against earned income, if work income exceeds 40,518€ per year (approx. ¾ of average earnings)	mandatory retirement age is 70 for public servants; for certain groups via collective agreement

Finland	2005	65 men, 65 women	63	full flexibility	via public pension benefits	no limit	mandatory retirement age is 67 for some public servants (e.g. university professors, judges); employment relationship ends automatically at the end of month when the employee turns 68, unless employer and employee agree otherwise
France	1993	65 men, 65 women	55	reduction of working hours by an average of 50% over the five year gradual retirement period	via governmental subsidies	no limit for full pension recipients; workers are eligible for full public pension benefits if they fulfil either both a minimum contributory record (in 2014: 41.25 years for people born in 1953) and the minimum legal pension age (61 years and two months) or the age of 66 years and two months.	mandatory retirement age is 70 for private-sector workers. For public-sector workers, there is a full pension age limit (67 in 2017), with exceptions
Germany	1992	65 men, 65 women	63 men, 60 women	reduction of working hours determines the level of the partial pension. Partial pension benefits can be drawn either to one third, one half, or two thirds of the full pension entitlements, depending on the additional work income	via public partial pensions	before SEA: for drawing full pension payments the limit is one-seventh of the reference base (i.e. 3,060€ per year or 255€ per month respectively); for drawing a partial pension the ceiling is dependent of the partial pension level i.e. 1,483€ per month (1/3 partial pension), 1,112€ per month (1/2 partial pension), 741€ per month (2/3 partial pension), multiplied with the individual earnings points in the year before pension claiming after SEA: no limit	mandatory retirement age for certain groups (e.g. 75 for professors; 70 for attorneys, notaries; 67 judges, 65 for pilots, mayors)
Netherlands	2006	65 men, 65 women	55 to 60, varies across pension funds	reduction of working hours is dependent on employer agreement and required to draw pension fund payments	via occupational pension funds	before SEA: no public pension receipt possible, therefore no conflict between public pension benefits and additional income; after SEA: no ceiling on additional earnings for public pension recipients	mandatory retirement age of 65 in the public sector was abolished in 2008
Sweden	2000	65 men, 65 women	61	full flexibility	via public pension benefits	no limit	none

Notes: [a] The information refer to the regulations in the respective years of the introduction of the flexible retirement option, except the information about earnings tests and mandatory retirement.
[b] The statutory eligibility age (SEA) is defined as the age at which workers are eligible for full pension benefits independent of any other qualification. See note to Figure 4.1.
[c] The flexible retirement window may start earlier than the earliest eligibility age if the income loss is compensated by sources other than the state pension.
[d] The information about earnings tests refers to the following years: Belgium (2015 regulation), Denmark (2015 regulation), France (2016 regulation) and The Netherlands (2016 regulation).
[e] The information about the mandatory retirement regulations are those of 2016.

Sources: Bloemen et al. (2014), Börsch-Supan (2005), Börsch-Supan et al. (2015), Devisscher and Sanders (2008), Eurofound (2012), European Commission (2011), Graf et al. (2011), Ilmakunnas and Ilmakunnas (2006), Lindecke et al. (2007), OECD (2005b), OECD (2014a), OECD (2015b, 2015c), Reday-Mulvey (2000), Warren (2008).

A.2 Mathematical appendix to model of stylized flexibility reform

A.2.1 Model without constraints on hours worked (situation after flexibility reform)

$$\mathrm{Max}U(c_1,c_2,c_3,l_1,l_2,l_3)$$

s.t. $wl_1 + wl_2 = c_1 + c_2 + c_3$, $l_3 = 0$

where

$$U(c_1,c_2,c_3,l_1,l_2,l_3) = \sum_{t=1}^{3} u\left(c_t\right) + \alpha \sum_{t=1}^{3} v\left(1-l_t\right)$$

Optimal consumption is:

$$c_1 = c_2 = c_3 = c*$$

$$c* = \frac{wl_1 + wl_2}{3}$$

Let's assume that $u\left(c_t\right) = \ln c_t$ and $v\left(1-l_t\right) = \ln\left(1-l_t\right)$

Then optimal hours worked in the first two periods are obtained as follows:

$$l_1^* = l_2^* = \frac{3}{2\alpha+3}$$

If N is the total number of people in the population, share of retirees= $\frac{N}{3}$

Total labor supply= $\frac{N}{3}.\frac{3}{2\alpha+3} + \frac{N}{3}.\frac{3}{2\alpha+3} = \frac{2N}{2\alpha+3}$.

A.2.2 Model with minimum hours constraints imposed (situation before flexibility reform)

In the second period the individual chooses whether he works or retires. If someone wishes to work in the second period, he must work for a minimum of $\bar{l}$ hours in that period. In this case $l_2^{**} \geq \bar{l}$ and the utility from working will be denoted by $U\left(c^{**}, l_1^{**}, l_2^{**}\right)$. If someone wishes to retire, the number of hours worked is equal to zero and the utility from being retired will be denoted by $U\left(c^{***}, l_1^{***}, 0\right)$.

If $U\left(c^{***}, l_1^{***}, l_2^{***}\right) > U\left(c^{**}, l_1^{**}, l_2^{**}\right)$, individual chooses to retire, he works otherwise.

The maximization of the utility function subject to the budget constraint and hours constraint $l_2 \geq \bar{l}$ yields $l_2^{**} = \bar{l}$ and $l_1^{**} = \dfrac{3 - \alpha\bar{l}}{\alpha + 3}$

If $l_2 = 0$, the solution of the maximization problem yields $l_1^{***} = \dfrac{3}{3+\alpha}$

Comparison of $U\left(c^{***}, l_1^{***}, l_2^{***}\right)$ with $U\left(c^{**}, l_1^{**}, l_2^{**}\right)$ reveals that the individual retires if

$$\alpha'' = \frac{-3\ln\left(1+\bar{l}\right)}{\ln\left(1+\bar{l}\right) + \ln\left(1-\bar{l}\right)} < \alpha \cdot$$

There are three cases depending on α and $\bar{l}$:

(a) If $\bar{l} < \dfrac{3}{2\alpha+3} = \alpha'$, we have the same problem as if there were no constraints on hours worked. So:

$$l_1^* = l_2^* = \frac{3}{2\alpha+3}$$

If N is the total number of people in the population, share of retirees= $\dfrac{N}{3}$

Total labor supply= $\dfrac{N}{3} \cdot \dfrac{3}{2\alpha+3} + \dfrac{N}{3} \cdot \dfrac{3}{2\alpha+3} = \dfrac{2N}{2\alpha+3}$.

(b) If $\bar{l} \geq \frac{3}{2\alpha+3} = \alpha'$, and if $\alpha'' = \frac{-3\ln\left(1+\bar{l}\right)}{\ln\left(1+\bar{l}\right)+\ln\left(1-\bar{l}\right)} < \alpha$,

individual retires in the second period, $l_1^{***} = \frac{3}{3+\alpha}$, $l_2^{***} = 0$,

Share of retirees= $\frac{2N}{3}$

Total labor supply= $\frac{N}{3}.\frac{3}{3+\alpha} = \frac{N}{3+\alpha} < \frac{2N}{2\alpha+3}$

implying that total labor supply is smaller compared to the unconstrained case.

(c) If $\bar{l} \geq \frac{3}{2\alpha+3} = \alpha'$, and if $\alpha'' = \frac{-3\ln\left(1+\bar{l}\right)}{\ln\left(1+\bar{l}\right)+\ln\left(1-\bar{l}\right)} \geq \alpha$,

individual works in the second period, $l_1^{**} = \frac{3-\alpha\bar{l}}{3+\alpha}$, $l_2^{**} = \bar{l}$,

Share of retirees= $\frac{N}{3}$

Total labor supply= $\frac{N}{3}.\frac{3\left(\bar{l}+1\right)}{3+\alpha} = \frac{N\left(\bar{l}+1\right)}{3+\alpha} > \frac{2N}{2\alpha+3}$.

Together with $\bar{l} \geq \frac{3}{2\alpha+3}$, this implies that total labor supply is larger compared to the unconstrained case.

A.3 Descriptive statistics

Table A.3.1: Descriptive statistics

Australia			Austria			Belgium		
	Pre Reform	Post Reform		Pre Reform	Post Reform		Pre Reform	Post Reform
Years included	1983-04	2005-13	Years included	1995-00	2000-13	Years included	1983-01	2002-13
LFP aged 55-64	0.6167	0.6943	LFP aged 55-64	0.4382	0.4667	LFP aged 55-64	0.3780	0.4422
LFP aged 25-54	0.9194	0.9046	LFP aged 25-54	0.9385	0.9258	LFP aged 25-54	0.9251	0.9158
WH aged 55-64	38.05	36.57	WH aged 55-64	42.21	42.47	WH aged 55-64	42.83	40.79
WH aged 25-54	40.85	39.35	WH aged 25-54	41.48	43.13	WH aged 25-54	41.06	40.97
SEA	65	65	SEA	65	65	SEA	65	65
EEA	55	55	EEA	60	62.57	EEA	60	60.04
GDP per capita	31,558.27	42,299.18	GDP per capita	34,967.33	40,991.12	GDP per capita	29,866.34	38,558.17
Years of schooling	11.29	11.46	Years of schooling	9.81	10.32	Years of schooling	9.86	10.78
Life expectancy	74.86	79.32	Life expectancy	74.30	77.16	Life expectancy	72.91	76.82

Denmark	Pre Reform	Post Reform
Years included	1983-94	1996-13
LFP aged 55-64	0.6708	0.6721
LFP aged 25-54	0.9376	0.9189
WH aged 55-64	41.16	39.00
WH aged 25-54	41.65	39.70
SEA	67	65.95
EEA	60	60
GDP per capita	31,731.23	40,854.93
Years of schooling	9.63	11.11
Life expectancy	72.07	75.53

Finland	Pre Reform	Post Reform
Years included	1989-04	2005-13
LFP aged 55-64	0.4742	0.5982
LFP aged 25-54	0.9084	0.9053
WH aged 55-64	39.81	38.92
WH aged 25-54	41.14	40.65
SEA	65	65
EEA	60.25	62
GDP per capita	29,798.10	38,794.72
Years of schooling	8.84	9.75
Life expectancy	73.18	76.72

France	Pre Reform	Post Reform
Years included	1983-92	1993-13
LFP aged 55-64	0.4253	0.4125
LFP aged 25-54	0.9577	0.9434
WH aged 55-64	43.49	41.47
WH aged 25-54	41.83	41.10
SEA	65	60.47
EEA	60	60
GDP per capita	26,884.15	33,972.01
Years of schooling	7.52	10.13
Life expectancy	72.04	76.19

Germany	Pre Reform	Post Reform
Years included	1983-91	1992-13
LFP aged 55-64	0.5769	0.5987
LFP aged 25-54	0.9273	0.9331
WH aged 55-64	43.46	41.31
WH aged 25-54	42.38	41.13
SEA	65	65.01
EEA	63	63
GDP per capita	28,163.86	37,002.58
Years of schooling	8.51	11.37
Life expectancy	71.54	75.81

Netherlands	Pre Reform	Post Reform
Years included	1995-05	2006-13
LFP aged 55-64	0.5022	0.6713
LFP aged 25-54	0.9301	0.9332
WH aged 55-64	37.31	36.15
WH aged 25-54	39.59	39.02
SEA	65	65.01
EEA	61.45	65
GDP per capita	39,435.15	44,982.15
Years of schooling	11.09	11.53
Life expectancy	75.70	78.75

Sweden	Pre Reform	Post Reform
Years included	1990-99	2000-13
LFP aged 55-64	0.7245	0.7702
LFP aged 25-54	0.9208	0.9202
WH aged 55-64	38.26	38.83
WH aged 25-54	40.78	39.99
SEA	66	65
EEA	60.1	61
GDP per capita	30,530.61	40,059.94
Years of schooling	10.80	11.33
Life expectancy	76.04	78.82

Source: Own calculations.

A.4 Checking for changes in trend

Table A.4.1: OLS Regression – effects of flexibility reforms on labor force participation (LFP), working hours and total labor supply (TLS) – trend specification

	(1) LFP 55-64	(2) LFP 65+	(3) WH 55-64	(4) WH 65+	(5) TLS 55-64	(6) TLS 65+
Interaction	-0.014	-0.002	-0.124	-0.626	-0.534	-0.075
(=Post	(0.009)	(0.005)	(0.164)	(0.487)	(0.419)	(0.148)
reform*Year/1000)	[0.004] ***	[0.002]	[0.125]	[0.212]***	[0.176]***	[0.057]
Year	0.006	0.001	-0.047	-0.360	0.184	0.010
	(0.001)***	(0.000)**	(0.030)	(0.085)***	(0.036)***	(0.008)
	[0.001]***	[0.000]***	[0.013]***	[0.031]***	[0.051]***	[0.007]
N	242	242	242	218	242	218

Note: Clustered standard errors in parentheses; Driscoll-Kraay standard errors in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The periods covered are: 1983-2013 for Australia, Belgium, Denmark, France and Germany, 1989-2013 for Finland, 1990-2013 for Sweden and 1995-2013 for Austria and The Netherlands. Due to the unavailability of the data on working hours for the age group 65+, Sweden is not part of the analysis.

Source: Own calculations.

A.5 Pre- and post-treatment periods by country

Table A.5.1: Treated countries and time periods for labor force participation (LFP) and working hours (WH)

Treated country	Reform year	Pre-treatment time period	Post-treatment time period	Comment
Australia	2005	LFP: 1994-2004 WH: 1994-2004	LFP: 2005-2010 WH: 1994-2010	The time series data ends in 2010.
Austria	2000	LFP: 1994-1999 WH: 1995-1999	LFP: 2000-2010 WH: 2000-2010	The time series data ends in 2010.
Belgium	2002	LFP: 1992-2001 WH: 1991-2001	LFP: 2002-2010 WH: 2002-2010	The time series data ends in 2010.
Denmark	1995	LFP: 1985-1994 WH: 1989-1994	LFP: 1995-2001 WH: 1995-2001	Post-treatment period ends in 2001 b/c Belgium incl. among control countries which experienced reform in 2002.
France	1993	LFP: 1983-1992 WH: 1987-1992	LFP: 1993-2001 WH: 1993-2001	Post-treatment period ends in 2001 b/c Belgium incl. among control countries which experienced reform in 2002.
Germany	1992	LFP: 1983-1991 WH: 1986-1991	LFP: 1992-1997 WH: 1992-1997	Additional pension reform in Germany that affected retirement behavior was phased in from 1998.
Sweden	2000	LFP: 1985-1999 WH: 1990-1999	LFP: 2000-2005 LFP: 2000-2005	Post-treatment period ends in 2005 b/c The Netherlands incl. among control countries which experienced reform in 2006.

Source: Own calculations.

A.6 Synthetic control weights

Table A.6.1: Synthetic control weights, outcome variable: labor force participation

Untreated Countries	Treated Countries								
	Australia	Austria	Belgium	Denmark	Finland	France	Germany	The Netherlands	Sweden
Belgium	-	-	-	0	-	0.468	-	-	-
Canada	0.476	0	0	0	0	0	0	0.479	0.328
Czech republic	0	0.042	-	-	-	-	-	-	-
Estonia	0	-	-	-	-	-	-	-	-
Finland	-	-	-	0	-	0	-	-	-
Greece	0	0	0	0	0	0	0	0	0
Hungary	0	0	0.285	-	0	-	-	0.059	-
Iceland	0	0	0	-	0	-	-	0	-
Ireland	0	0	0	0	0	0	0.472	0	0
Israel	0.341	0	-	0	0	-	-	0	0.205
Italy	0	0	0.094	0	0.487	0.217	0.181	0.024	0
Japan	0.054	0.005	0	0	0	0	0	0	0.375
Korea	0	0	0	0.136	0	0	0	0	0.092
Luxembourg	0.105	0.548	0.621	0.195	0.054	0.314	0.306	0.438	0
The Netherlands	-	-	-	-	-	-	-	-	0
New Zealand	0	0	0	0	0	0	0	0	0
Norway	0	0	0	0	0.097	0	0	0	0
Poland	0	0.128	0	-	0.331	-	-	0	-
Portugal	0	0	0	0.052	0.031	0	0.041	0	0
Slovak Republic	0	-	-	-	-	-	-	-	-
Spain	0	0.277	0	0	0	0	0	0	0
Sweden	-	-	-	0.616	-	-	-	-	-
Switzerland	0	0	0	-	0	-	-	0	-
UK	0	0	0	0	0	0	0	0	0
US	0.024	0	0	0	0	0	0	0	0
Time periods covered	1994-2010	1994-2010	1992-2010	1985-2001	1992-2010	1983-2001	1983-1997	1992-2010	1985-2005

Note: “-” means that the corresponding country is not included in the estimation.

Source: Own calculations.

Table A.6.2: Synthetic control weights, outcome variable: weekly working hours

Untreated Countries	**Treated Countries**								
	Australia	Austria	Belgium	Denmark	Finland	France	Germany	The Netherlands	Sweden
Australia	-	-	-	-	-	-	0	-	-
Belgium	-	-	-	0.057	-	0.388	0	-	-
Canada	0	0	0	0	0	0	0	0	0
Czech republic	-	-	-	-	-	-	-	-	-
Estonia	-	-	-	-	-	-	-	-	-
Finland	-	-	-	0.378	-	-	-	-	-
Greece	0	0	0	0	0	0	0.015	0	0
Hungary	-	0.066	-	-	-	-	-	-	-
Iceland	-	0	-	-	-	-	-	-	-
Ireland	0	0.154	0	0	0	0.092	0	0	0
Israel	-	0	-	-	-	-	-	-	-
Italy	0	0.207	0.09	0	0	0	0	0	0
Japan	0	0	0	0	0	0	0	0	0
Korea	0	0	0	-	0	-	-	0	-
Luxembourg	0	0	0	0.14	0	0.127	0.164	0	0
The Netherlands	-	-	-	0.378	-	-	0.307	-	0.86
New Zealand	0	0	0	0	0	0	0	0	0
Norway	0.553	0.297	0.141	0	0.078	-	-	1	0.14
Poland	-	-	-	-	-	-	-	-	-
Portugal	0	0.042	0.038	0	0	0.011	0.399	0	0
Slovak Republic	0.038	0	-	-	-	-	-	-	-
Spain	0	0.233	0.375	0	0	0.382	-	0	0
Sweden	-	-	-	-	-	-	-	-	-
Switzerland	0.41	0	0	-	0.642	-	-	0	-
UK	0	0	0	0	0	0	0.007	0	0
US	0	0	0.357	0.047	0.28	0	0.108	0	0
Time periods covered	1994-2010	1995-2010	1991-2010	1989-2001	1991-2010	1987-2001	1986-1997	1991-2010	1990-2005

Note: “-” means that the corresponding country is not included in the estimation.

Source: Own calculations.

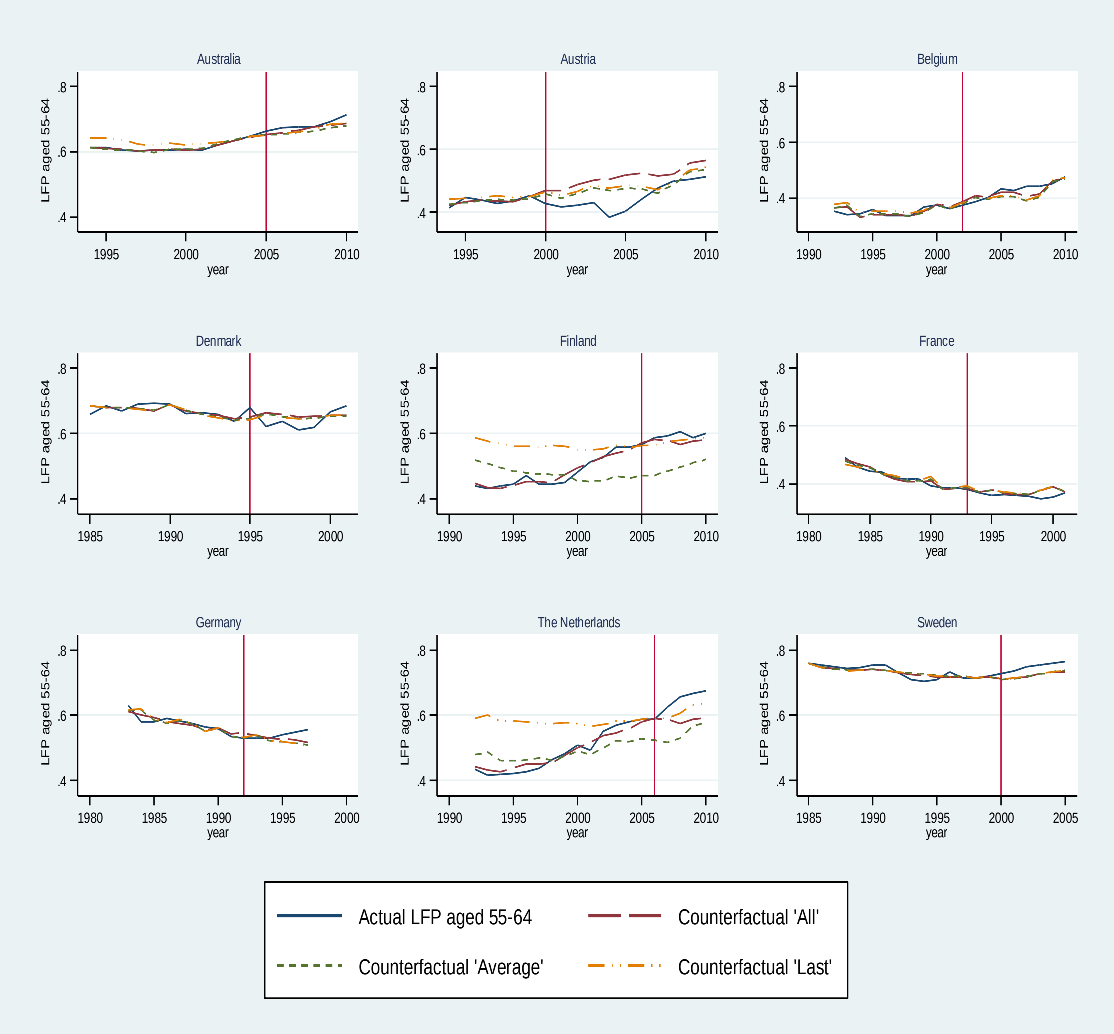
A.7 Robustness of the treatment effects

We check the robustness of the treatment effects using a method developed by Kaul et al. (2015). They point out that it is important to keep the number of pre-treatment outcome values as small as possible in the estimation. They also recommend applying the synthetic control method at least twice. One estimation should include only the average of the pre-treatment outcome variable in addition to the covariates, while the other estimation should use only the last pre-treatment value of outcome variable in addition to the set of covariates. If the two estimations yield similar results in the sense that if the weights of the corresponding synthetic units and, therefore, the pattern of the predicted counterfactuals are close to each other, the treatment effects are unbiased since the inclusion of the lagged outcome variable does not substantially change the size of the treatment effects.

Following Kaul et al. (2015), we report the treatment effects obtained using both estimators as discussed above. Figure A.7.1 and Figure A.7.2 show the treatment effects on labor force participation and working hours for those aged 55-64, respectively, under different specifications and for all treated countries. The red vertical line stands for the year of the reform in each treated country. The blue line depicts the actual outcome trajectory for a treated country while the red line shows the synthetic control for the corresponding treated country constructed using all pre-treatment values of the outcome variable before the reform in addition to the set of covariates. The green and orange lines stand for the synthetic controls obtained using the average and the last pre-treatment values of the outcome variables, respectively, plus covariates. A comparison of the green and orange lines for labor force participation reveals a robust effect of the treatment for all countries except Finland and The Netherlands. In these two countries, the use of the pre-treatment average leads to a substantially different synthetic control than the use of the last pre-treatment value as additional predictor in the estimation. Although for these two countries the use of all pre-treatment values seems to provide a good match between the labor force participation series of the treated and the synthetic control before the treatment, the predicted treatment effects differ across the three alternatives. In other words, the data at hand and the covariates used in the estimation are not enough to find a robust effect of the reform on labor force participation using the synthetic control method for these countries. Therefore, we exclude Finland and The Netherlands from our analysis in the rest of the study.

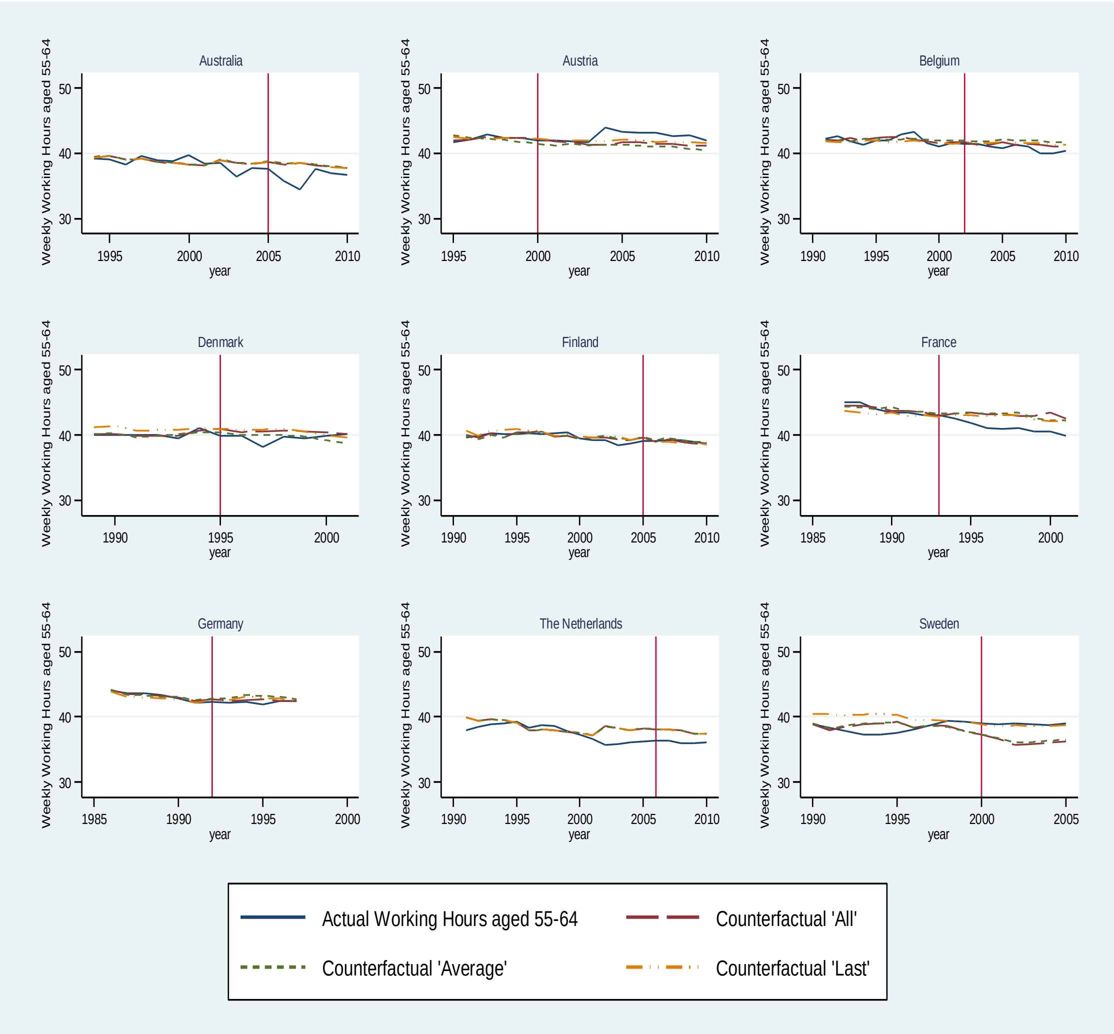
As Figure A.7.2 demonstrates, the use of the pre-treatment average leads to similar treatment effects on working hours compared to the use of the last pre-treatment value in the estimation for most of the countries except Sweden. For The Netherlands, on the other hand, the match quality before the treatment is not good enough no matter which specification is used probably because Norway is the only country which receives a positive weight in its synthetic control (see Table A.3.1 above). Since the use of the average and the last pre-treatment values give similar results for most of the countries, we will use the average pre-treatment outcome variable in addition to the set of covariates in the rest of our analysis.

Figure A.7.1: Trends in males' LFP aged 55-64, robustness of the treatment effects



Source: Own calculations.

Figure A.7.2: Trends in males' working hours aged 55-64, robustness of the treatment effects



Source: Own calculations.

A.8 The quality of pre-treatment characteristics

Table A.8.1 and Table A.8.2 compare the pre-treatment characteristics of the synthetic control to those of the treated country where the outcome variables are labor force participation and working hours, respectively. Overall, the results suggest that for all countries which adopted a flexibility reform in the past, the synthetic country provides a good approximation for the corresponding actual country before the reform. Only in few cases, there is a discrepancy between the treated country and its synthetic control in terms of GDP per capita. This stems from the fact that among all predictor variables GDP per capita has the lowest power especially for predicting labor force participation before the reform. For some countries we used the standard retirement age instead of the possible years of early retirement as the quality of the pre-treatment matches increased remarkably in those cases.

Table A.8.1: Labor force participation predictor means before the partial retirement reform

	Australia	Synthetic Australia	Austria	Synthetic Austria
LFP aged 55-64	0.615	0.615	0.436	0.435
LFP aged 25-54	0.907	0.906	0.937	0.932
SEA	65	65.013	65	64.804
GDP per capita	35,416.88	34,771.73	34,008.58	44,122.33
Years of schooling	11.257	11.130	9.705	9.620
Life expectancy	76.345	76.098	73.967	73.144
	Belgium	Synthetic Belgium	Denmark	Synthetic Denmark
LFP aged 55-64	0.352	0.353	0.671	0.670
LFP aged 25-54	0.919	0.915	0.938	0.941
Years of early retirement	5	5.001	7	6.140
GDP per capita	32,488.35	47,387.80	32,369.45	30,167.10
Years of schooling	10.284	10.035	9.791	10.083
Life expectancy	73.930	71.636	72.170	72.788
	France	Synthetic France	Germany	Synthetic Germany
LFP aged 55-64	0.425	0.426	0.577	0.577
LFP aged 25-54	0.956	0.938	0.922	0.935
Years of early retirement	5	4.995	2	2.907
GDP per capita	26,884.15	33,139.19	28,163.86	27,605.39
Years of schooling	7.528	9.040	8.510	9.137
Life expectancy	72.040	71.780	71.771	71.611
	Sweden	Synthetic Sweden		
LFP aged 55-64	0.733	0.732		
LFP aged 25-54	0.928	0.935		
Years of early retirement	6.091	3.975		
GDP per capita	29,942.47	26,400.50		
Years of schooling	10.639	10.714		
Life expectancy	75.420	74.667		

Note: Years of early retirement is defined as the difference between the statutory and the early eligibility age.

Source: Own calculations.

Table A.8.2: Working hours predictor means before the partial retirement reform

	Australia	Synthetic Australia
WH aged 55-64	38.602	38.836
WH aged 25-54	41.153	41.068
SEA	65	65.982
GDP per capita	35,416.88	48,069.73
Years of schooling	11.257	10.981
Life expectancy	76.345	76.109
	Austria	Synthetic Austria
WH aged 55-64	42.275	42.226
WH aged 25-54	41.472	41.784
SEA	65	64.877
GDP per capita	34,428.92	34,719.11
Years of schooling	9.788	9.722
Life expectancy	74.120	74.205
	Belgium	Synthetic Belgium
WH aged 55-64	42.036	42.085
WH aged 25-54	40.774	42.201
SEA	65	65.093
GDP per capita	32,238.20	34,919.59
Years of schooling	10.243	10.261
Life expectancy	73.836	74.264
	Denmark	Synthetic Denmark
WH aged 55-64	40.093	40.094
WH aged 25-54	40.883	40.636
Years of early retirement	7	4.906
GDP per capita	33,021.48	33,184.84
Years of schooling	9.995	9.713
Life expectancy	72.417	72.730
	France	Synthetic France
WH aged 55-64	44.029	44.026
WH aged 25-54	42.096	42.230
Years of early retirement	5	4.577
GDP per capita	28,116.68	28,237.57
Years of schooling	7.948	8.730
Life expectancy	72.617	72.711

	Germany	Synthetic Germany
WH aged 55-64	43.265	43.266
WH aged 25-54	42.088	42.596
Years of early retirement	2	2.581
GDP per capita	29,266.27	28,739.65
Years of schooling	8.810	8.791
Life expectancy	71.883	71.757

Note: Years of early retirement is defined as the difference between the statutory and the early eligibility age.

Source: Own calculations.

B. Appendix to Chapter 5

B.1 Pre- and post-treatment periods by country

Table B.1.1: Treated countries, placebo reform years and time periods for labor force participation (LFP) and working hours (WH)

Treated country	Actual reform year	Placebo reform year	Pre-treatment time period (in-time placebo study)	Post-treatment time period (in-time placebo study)
Australia	2005	2002	LFP: 1994-2001 WH: 1994-2001	LFP: 2002-2004 WH: 1994-2004
Austria	2000	1997	LFP: 1994-1996 WH: 1995-1996	LFP: 1997-1999 WH: 1997-1999
Belgium	2002	1999	LFP: 1992-1998 WH: 1991-1998	LFP: 1999-2001 WH: 1999-2001
Denmark	1995	1992	LFP: 1985-1991 WH: 1989-1991	LFP: 1992-1994 WH: 1992-1994
France	1993	1990	LFP: 1983-1989 WH: 1987-1989	LFP: 1990-1992 WH: 1990-1992
Germany	1992	1989	LFP: 1983-1988 WH: 1986-1988	LFP: 1989-1991 WH: 1989-1991
Sweden	2000	1997	LFP: 1985-1996 WH: 1990-1996	LFP: 1997-1999 WH: 1997-1999

Note: Post-treatment time periods are restricted to the year before actual reform year. Otherwise, the actual reform effect would affect the results.

Source: Own calculations.

B.2 Synthetic control weights

Table B.2.1: Synthetic control weights, outcome variable: Labor force participation

Untreated countries	**Treated countries**						
	Australia	Austria	Belgium	Denmark	France	Germany	Sweden
Belgium	-	-	-	0	0.331	-	-
Canada	0.649	0	0	0	0	0	0.398
Czech republic	0	0.021	-	-	-	-	-
Estonia	0	-	-	-	-	-	-
Finland	-	-	-	0	0	-	-
Greece	0	0	0	0	0	0	0
Hungary	0	0	0.357	-	-	-	-
Iceland	0	0	0	-	-	-	-
Ireland	0	0	0	0	0	0.487	0
Israel	0.188	0	-	0	-	-	0.101
Italy	0	0	0.102	0	0.257	0.161	0
Japan	0.027	0.005	0	0	0	0	0.418
Korea	0	0	0	0.145	0	0	0.083
Luxembourg	0.053	0.591	0.541	0.198	0.413	0.327	0
The Netherlands	-	-	-	-	-	-	0
New Zealand	0	0	0	0	0	0	0
Norway	0	0	0	0	0	0	0
Poland	0	0.051	0	-	-	-	-
Portugal	0	0	0	0	0	0.025	0
Slovak Republic	0	-	-	-	-	-	-
Spain	0	0.235	0	0.05	0	0	0
Sweden	-	-	-	0.607	-	-	-
Switzerland	0	0	0	-	-	-	-
UK	0	0	0	0	0	0	0
US	0.083	0	0	0	0	0	0
Time periods covered	1994-2004	1994-1999	1992-2001	1985-1994	1983-1992	1983-1991	1985-1999

Note: "-" means that the corresponding country is not included in the estimation. The upper bound of the time periods covered is the pre-reform year of the actual flexibility reform.

Source: Own calculations.

Table B.2.2: Synthetic control weights, outcome variable: weekly working hours

Untreated countries	Treated countries						
	Australia	Austria	Belgium	Denmark	France	Germany	Sweden
Australia	-	-	-	-	-	0	-
Belgium	-	-	-	0.038	0.206	0	-
Canada	0	0	0	0	0	0	0
Czech republic	-	-	-	-	-	-	-
Estonia	-	-	-	-	-	-	-
Finland	-	-	-	0.441	-	-	-
Greece	0	0	0	0	0	0	0
Hungary	-	0.108	-	-	-	-	-
Iceland	-	0	-	-	-	-	-
Ireland	0	0.095	0	0	0.168	0	0
Israel	-	0	-	-	-	-	-
Italy	0	0.228	0.056	0	0	0	0
Japan	0	0	0	0.005	0	0	0
Korea	0	0	0	-	-	-	-
Luxembourg	0	0	0	0.136	0.195	0.18	0
The Netherlands	-	-	-	0.38	-	0.331	0.86
New Zealand	0	0	0	0	0	0	0
Norway	0.449	0.320	0.074	0	-	-	0.14
Poland	-	-	-	-	-	-	-
Portugal	0	0	0	0	0	0.402	0
Slovak Republic	0.073	0	-	-	-	-	-
Spain	0	0.249	0.507	0	0.431	-	0
Sweden	-	-	-	-	-	-	-
Switzerland	0.478	0	0	-	-	-	-
UK	0	0	0	0	0	0.007	0
US	0	0	0.363	0	0	0.108	0
Time periods covered	1994-2004	1995-1999	1991-2001	1989-1994	1987-1992	1986-1991	1990-1999

Note: “-” means that the corresponding country is not included in the estimation. The upper bound of the time periods covered is the pre-reform year of the actual flexibility reform.

Source: Own calculations.

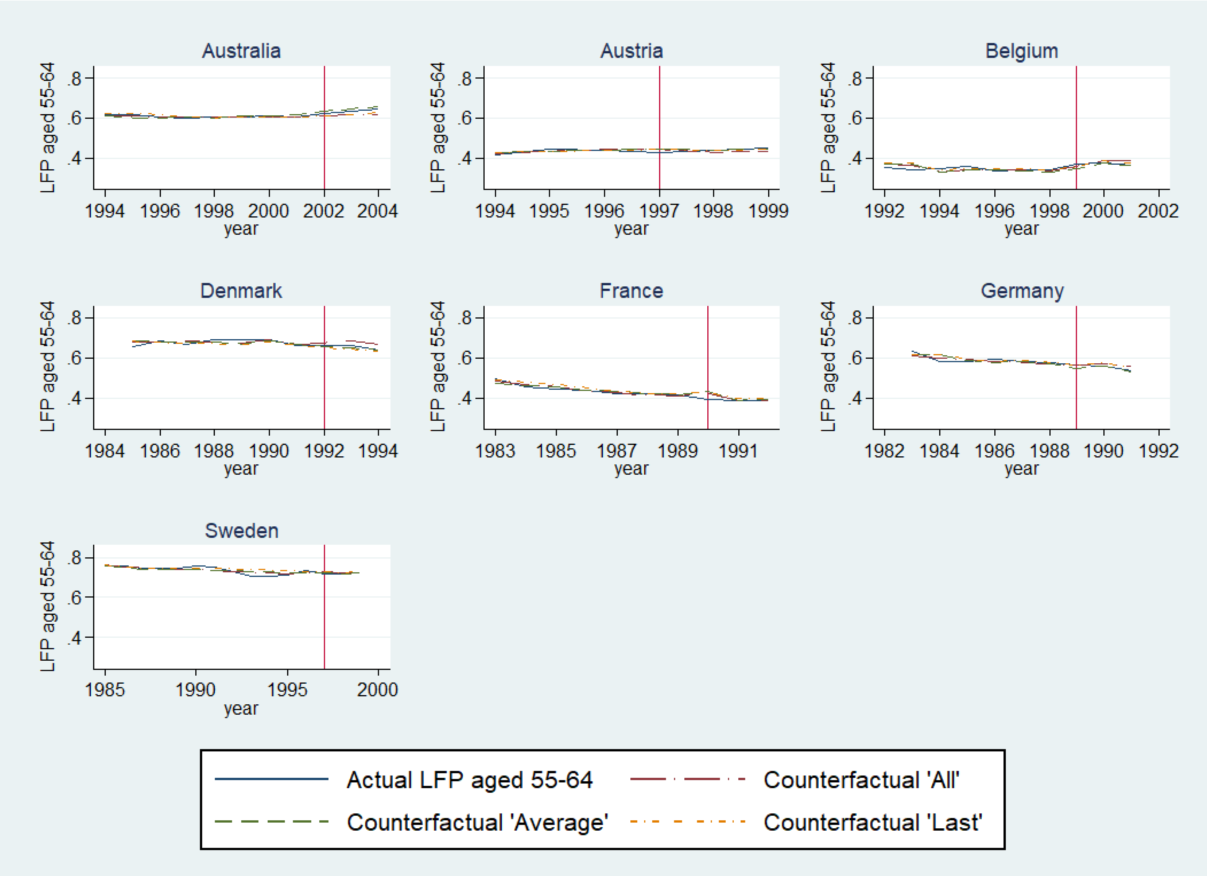
B.3 Robustness of the treatment effects

As in Chapter 4, I check the robustness of the treatment effects for the case of the placebo reform years by using a method developed by Kaul et al. (2015, updated in Kaul et al. 2018). Kaul et al. (2015) recommend applying the synthetic control method at least twice: one estimation should incorporate only the average of the outcome variable’s pre-treatment values in addition to the set of covariates. Another version should only include the last pre-treatment value of the outcome variable (i.e. in the last period before the treatment) in addition to the other covariates. If the two estimation versions yield similar results in terms of similar weights of the corresponding synthetic units and, therefore, in terms of similar patterns of the predicted counterfactuals that come close to each other, the treatment effects are unbiased.

Another specification could include all pre-treatment values in addition to the covariates. Kaul et al. (2018) state that it actually becomes increasingly popular in applications of synthetic control methods to include the entire pre-treatment path of the outcome variable as economic predictors and following Cavallo et al. (2013) including the entire pre-treatment path seems the obvious choice. Including all pre-treatment values of the outcome variables is exactly was has been done, e.g., in Bilgel and Galle (2015), Billmeier and Nannicini (2013), Bohn et al. (2014), Hinrichs (2012), Kreif et al. (2016), Liu (2015), Nannicini and Billmeier (2011), O’Neill et al. (2016), and Stearns (2015). Kaul et al. (2018) demonstrate, however, both theoretically and empirically that incorporating all outcome lags causes all other covariates to be irrelevant in the estimation. This finding holds irrespective of how important these covariates are for accurately predicting post-treatment values of the outcome and therefore threatens the estimator’s unbiasedness.

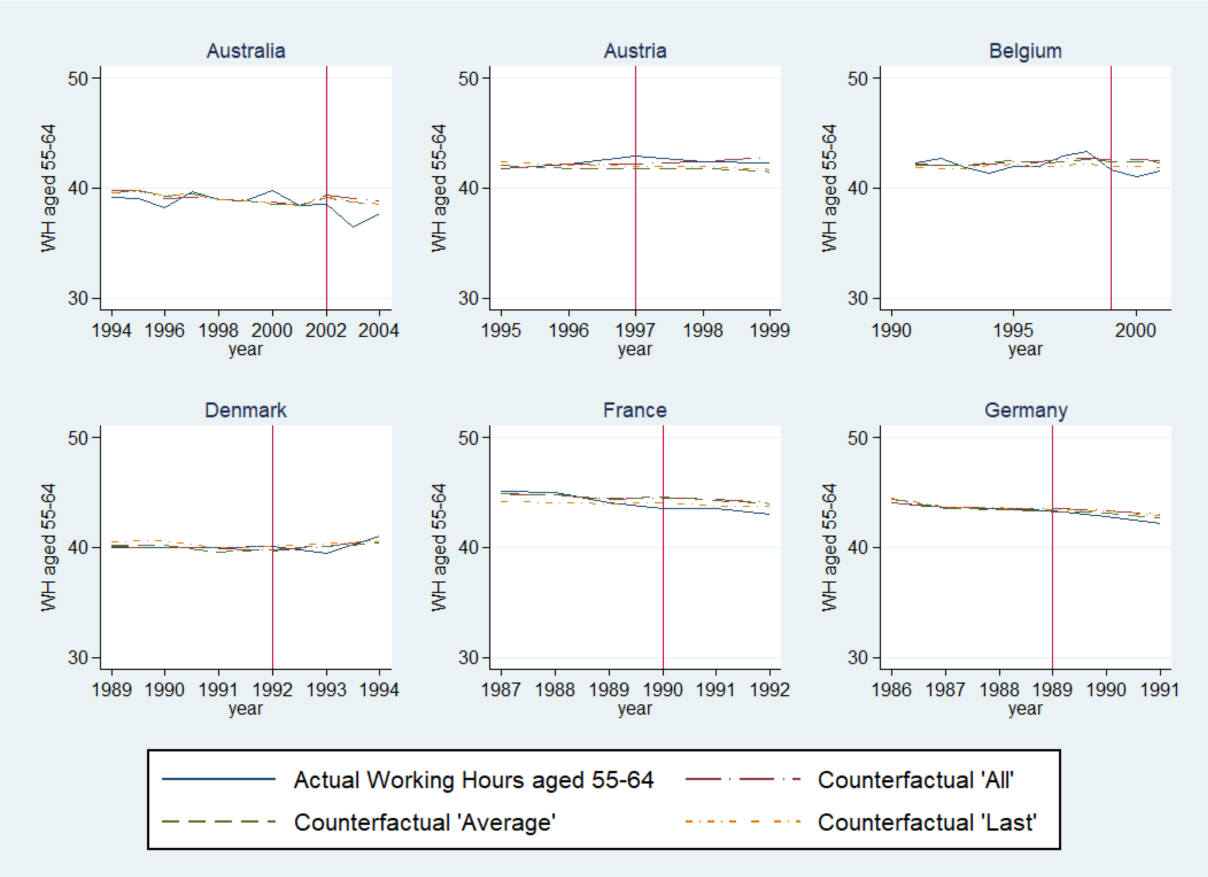
Following the recommendation of Kaul et al. (2015) to apply the synthetic control method at least twice, I report treatment effects on labor force participation (Figure B.3.1) and working hours (Figure B.3.2) for males aged 55-64, under different specifications and for all treated countries. In Figure B.3.1 and Figure B.3.2, the red vertical line indicates the placebo reform year. The blue solid line depicts the actual outcome trajectory of the treated country and the red long dashed-dotted line shows the synthetic control country when controlling for the entire pre-treatment path of the outcome variable (“All”) in addition to the set of other covariates. While the green dashed line represents the synthetic control when including the average pre-treatment value of the outcome variable plus covariates, the orange short dashed-dotted line depicts the specification when controlling for the last pre-treatment outcome value only plus covariates. The comparison of the green dashed line and the orange short dashed-dotted line reveals that controlling for the pre-treatment average or the last pre-treatment value yields similar results. This holds true for both outcome variables labor force participation (Figure B.3.1) and working hours (Figure B.3.2). Since the use of the average and the last pre-treatment values give similar results, I use the average value of the pre-treatment outcome values in addition to the set of covariates in the analysis.

Figure B.3.1: Trends in males' LFP aged 55-64, robustness of the treatment effects. Placebo reform year



Source: Own calculations.

Figure B.3.2: Trends in males' working hours aged 55-64, robustness of the treatment effects. Placebo reform year



Source: Own calculations.

B.4 Quality of pre-treatment characteristics

Table B.4.1 and Table B.4.2 compare the pre-treatment characteristics of the countries experienced the reform and its synthetic control country. Table B.4.1 shows the characteristics for the outcome variable labor force participation, and Table B.4.2 depicts the values for the outcome variable working hours. Overall, the tables allow the same conclusion as in Chapter 4: The synthetic control countries provide a good approximation for the treated country in the years before the flexibility reform. Only when it comes to GDP per capita, in few countries there is a discrepancy between the actual country values and the values of the synthetic country. This stems from the same fact as in Chapter 4 namely that per-capita GDP has the lowest predictive power especially for labor force participation among all predictor variables. I also use the statutory eligibility age instead of possible years of early retirement for some countries as the quality of the pre-treatment matches increased in these cases.

Table B.4.1: Labor force participation predictor means before the flexibility reform

	Australia	Synthetic Australia	Austria	Synthetic Austria
LFP aged 55-64	0.607	0.607	0.433	0.434
LFP aged 25-54	0.909	0.908	0.934	0.935
SEA	65	65	65	64.96
GDP per capita	34,125	34,134	32,687	45,223
Years of schooling	11.2	11.1	9.6	9.6
Life expectancy	75.8	75.5	73.4	73. 4
	Belgium	Synthetic Belgium	Denmark	Synthetic Denmark
LFP aged 55-64	0.344	0.345	0.678	0.678
LFP aged 25-54	0.920	0.912	0.942	0.950
Years of early retirement	5	4.2	7	6.2
GDP per capita	31,302	41,084	31,796	29,461
Years of schooling	10.2	9.9	9.6	10.04
Life expectancy	73.6	73.6	72.0	72.5
	France	Synthetic France	Germany	Synthetic Germany
LFP aged 55-64	0.441	0.442	0.589	0.589
LFP aged 25-54	0.958	0.946	0.926	0.939
Years of early retirement	5	5.005	2	2.927
GDP per capita	25,946	32,755	26,886	25,752
Years of schooling	7.2	8.8	8.19	9.14
Life expectancy	71.6	71.4	71.53	71.24
	Sweden	Synthetic Sweden		
LFP aged 55-64	0.737	0.737		
LFP aged 25-54	0.934	0.942		
Years of early retirement	6.5	4.50		
GDP per capita	29,218	26,814		
Years of schooling	10.54	10.55		
Life expectancy	75.04	74.43		

Note: Years of early retirement is defined as the difference between the statutory eligibility age and the earliest eligibility age.

Source: Own calculations.

Table B.4.2: Working hours predictor means before the flexibility reform

	Australia	Synthetic Australia
WH aged 55-64	38.99	38.10
WH aged 25-54	41.41	41.61
SEA	65	65.533
GDP per capita	34,125	45,052
Years of schooling	11.2	10.8
Life expectancy	75.8	75.4
	Austria	Synthetic Austria
WH aged 55-64	41.9	41.9
WH aged 25-54	41.4	41.6
SEA	65	64.4
GDP per capita	33,077	33,134
Years of schooling	9.7	9.7
Life expectancy	73.5	73.8
	Belgium	Synthetic Belgium
WH aged 55-64	42.28	42.28
WH aged 25-54	40.69	42.26
SEA	65	64.94
GDP per capita	31,107	31,933
Years of schooling	10.1	9.9
Life expectancy	73.5	73.9
	Denmark	Synthetic Denmark
WH aged 55-64	39.98	39.99
WH aged 25-54	40.77	40.51
Years of early retirement	7	5
GDP per capita	32,336	32,380
Years of schooling	9.8	9.4
Life expectancy	72.17	72.34
	France	Synthetic France
WH aged 55-64	44.7	44.7
WH aged 25-54	42.28	42.87
Years of early retirement	5	4.3
GDP per capita	27,161	27,079
Years of schooling	7.87	8.55
Life expectancy	72.27	72.40

	Germany	Synthetic Germany
WH aged 55-64	43.76	43.80
WH aged 25-54	42.49	42.90
Years of early retirement	2	2.42
GDP per capita	27,814	26,685
Years of schooling	8.47	8.53
Life expectancy	71.67	71.57

Note: Years of early retirement is defined as the difference between the statutory eligibility age and the earliest eligibility age.

Source: Own calculations.

B.5 Sensitivity check: dropping Luxembourg from the synthetic control groups

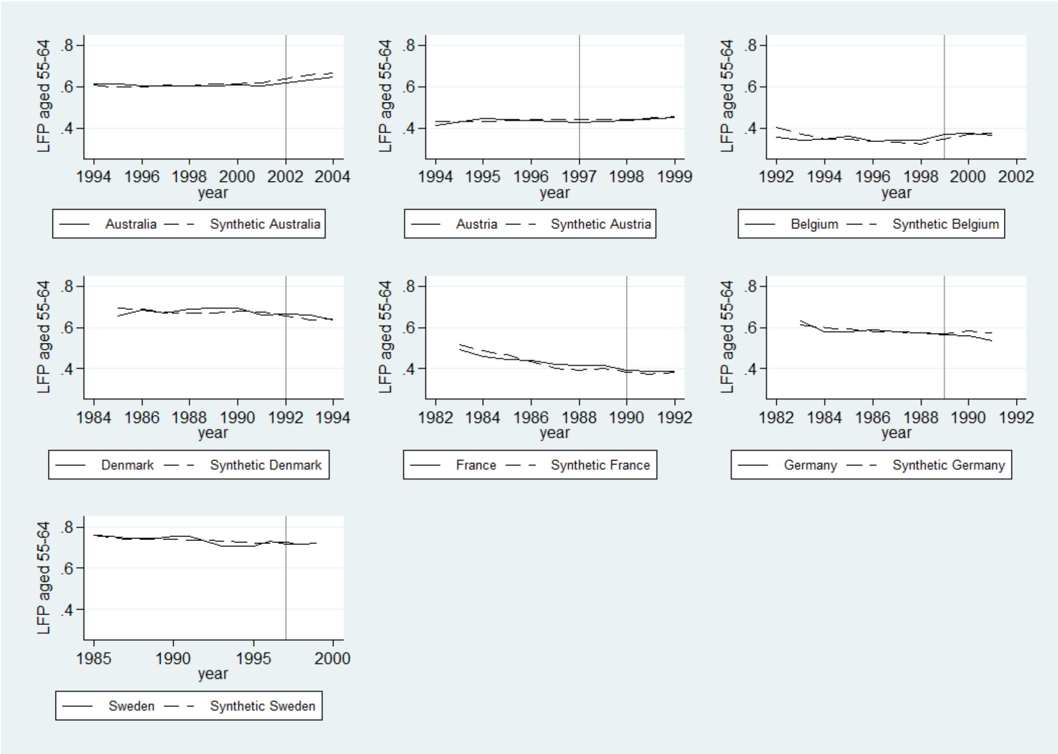
Abadie et al. (2015) state that the selection of comparison units is crucial to avoid erroneous conclusions. Differences in outcome variables between treated units and control units may merely reflect disparities in the units' characteristics, if comparison units are not sufficiently similar to the units of interest. A potential problem in this chapter might be that the synthetic counterfactual in many cases heavily relies on Luxembourg. In other words, for constructing the synthetic controls, in particular for the case of labor force participation, Luxembourg has a rather high weight for almost all countries (see Table B.2.1). Luxembourg, however, is a relatively small country, with very close labor market ties to France, Germany and Belgium. Thus, labor market developments in Luxembourg might not be completely independent of the developments in the surrounding countries. I therefore drop Luxembourg from the synthetic control group as a robustness check.

Figure B.5.1, Figure B.5.2, and Figure B.5.3 show the trends in outcome variables for the treated country and the synthetic controls when excluding Luxembourg from the synthetic control group for all treated countries. Figure B.5.4 and Figure B.5.5 display the robustness of the treatment effects for different specifications.

The post-treatment results regarding labor force participation (Table B.5.1) do not at all show significant effects anymore when excluding Luxembourg. Therefore, the significant effect found for France in 1990 actually seems to have been driven by Luxembourg's outlier in labor force participation (see Section 5.4.1.). For the outcome variable working hours, the exclusion of Luxembourg from the synthetic controls maintains the significant negative effects found for

Australia (2003) and France (1990) (see Section 5.4.2.). For France, this most likely stems from a poor synthetic control. Due to data availability, the pre-treatment period is only three years and does constitute a solid basis to develop a stable synthetic control. However, the effect for Australia may be due to a set of reforms of the superannuation system that happened in 2002 and 2003 (see Section 5.4.2. and Section 5.4.3.). Both effects persist when excluding Luxembourg from the synthetic controls. Excluding Luxembourg from the synthetic controls yields significant negative effects on working hours for Germany (1989, 1990, 1991). The effects for Germany, however, very likely stem from a reform which first came into effect in 1989 and initialized part-time employment before retirement (*Altersteilzeit*). This scheme comprised a reduction of working hours in a specific period before full retirement (Lindecke et al. 2017). In practice, the scheme achieved its breakthrough only after a revision in the later 1990s, but may explain the negative effects found on working hours. While the negative effect for Australia (2003) translates also to total labor supply (Table B.5.3), no other effects remain significant. Overall, the robustness check excluding Luxembourg suggest that the results are not driven by the inclusion of Luxembourg in the synthetic controls.

Figure B.5.1: Trends in males' LFP aged 55-64: treated vs. synthetic control. Placebo reform years. Without Luxembourg in the synthetic control groups



Source: Own calculations.

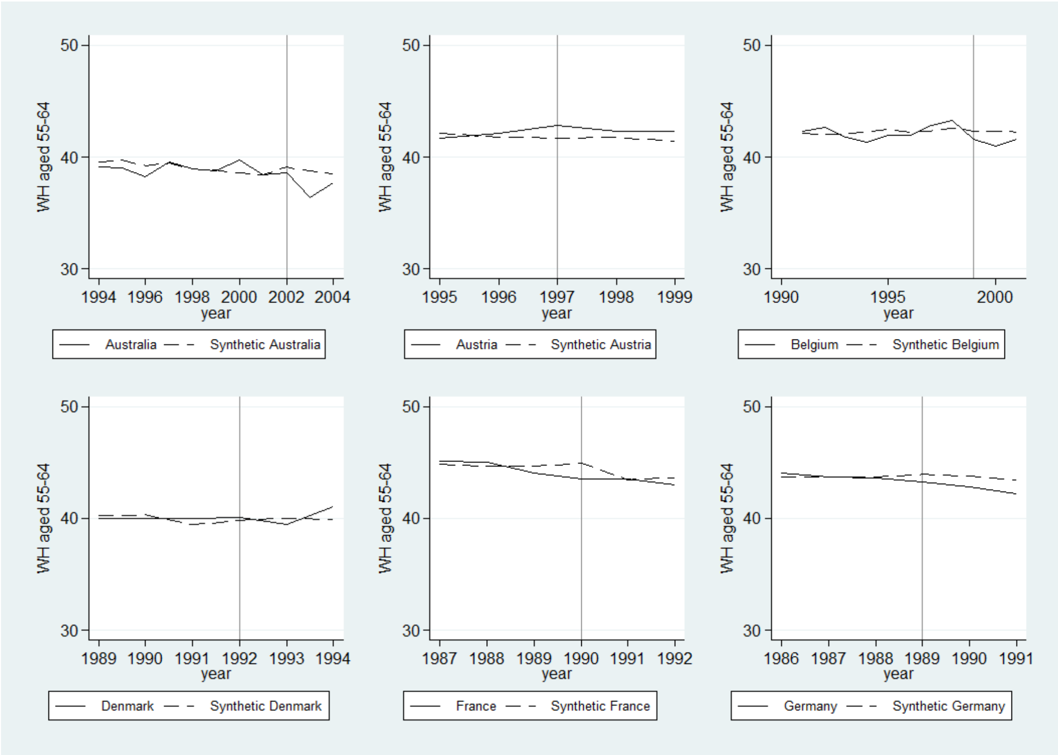
Table B.5.1: Post-treatment results regarding LFP of males aged 55-64, effects and pseudo p-values. Without Luxembourg in the synthetic control group

Australia			Austria		
year	estimates	pseudo p-values	year	estimates	pseudo p-values
2002	-0.019	0.150	1997	-0.014	0.667
2003	-0.023	0.100	1998	-0.003	1
2004	-0.017	0.350	1999	-0.004	1
Belgium			**Denmark**		
year	estimates	pseudo p-values	year	estimates	pseudo p-values
1999	0.021	0.750	1992	0.007	0.938
2000	0.007	0.875	1993	0.021	0.250
2001	-0.013	0.688	1994	-0.001	1
France			**Germany**		
year	estimates	pseudo p-values	year	estimates	pseudo p-values
1990	0.010	0.929	1989	-0.006	0.833
1991	0.011	1	1990	-0.023	0.833
1992	0.005	1	1991	-0.040	0.500
Sweden					
year	estimates	pseudo p-values			
1997	-0.011	0.571			
1998	-0.003	0.929			
1999	-0.002	1			

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Source: Own calculations.

Figure B.5.2: Trends in males' working hours aged 55-64: treated vs. synthetic control. Placebo reform years. Without Luxembourg in the synthetic control group



Source: Own calculations.

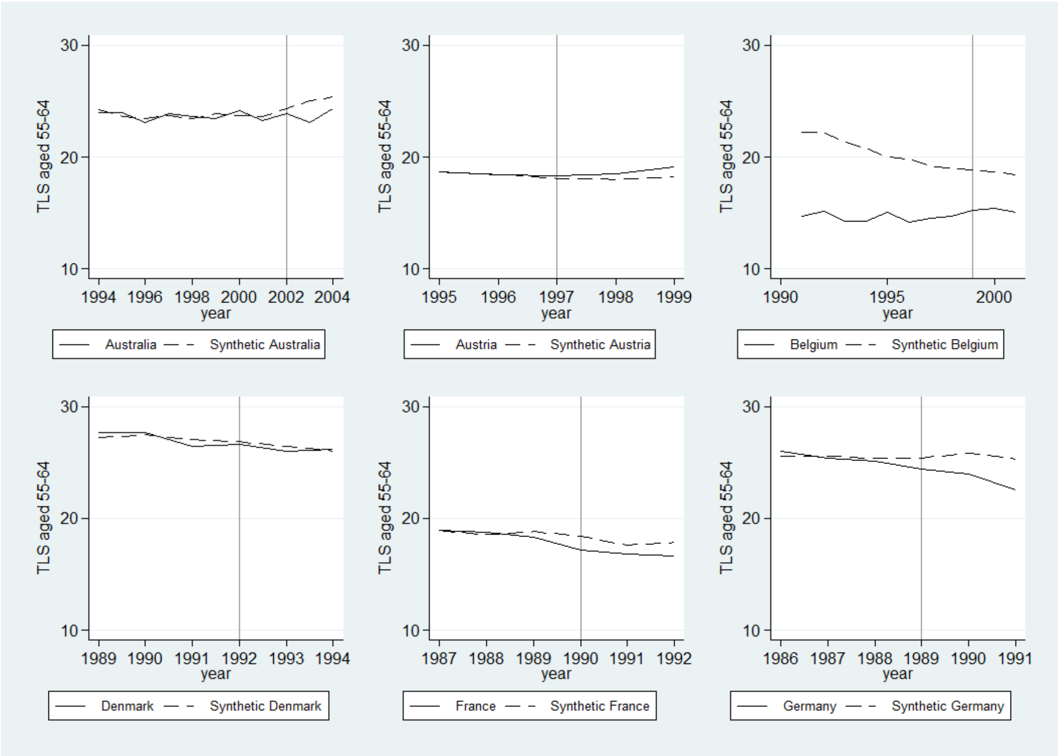
Table B.5.2: Post-treatment results regarding working hours of males aged 55-64, effects and pseudo p-values. Without Luxembourg in the synthetic control group

	Australia			**Austria**	
year	estimates	pseudo p-values	year	estimates	pseudo p-values
2002	-0.577	0.400	1997	-0.014	0.667
2003	**-2.354***	**0.071**	1998	-0.003	1
2004	-0.805	0.500	1999	-0.004	1
	Belgium			**Denmark**	
year	estimates	pseudo p-values	year	estimates	pseudo p-values
1999	-0.733	0.692	1992	0.266	0.500
2000	-1.304	0.231	1993	-0.554	0.643
2001	-0.704	0.846	1994	1.135	0.357
	France			**Germany**	
year	estimates	pseudo p-values	year	estimates	pseudo p-values
1990	**-1.435***	**0.091**	**1989**	**-0.636*****	**0**
1991	0.040	1	**1990**	**-0.966*****	**0**
1992	-0.609	0.545	**1991**	**-1.242***	**0.083**

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Source: Own calculations.

Figure B.5.3: Trends in males' total labor supply aged 55-64: treated vs. synthetic control. Placebo reform years. Without Luxembourg in the synthetic control group



Source: Own calculations.

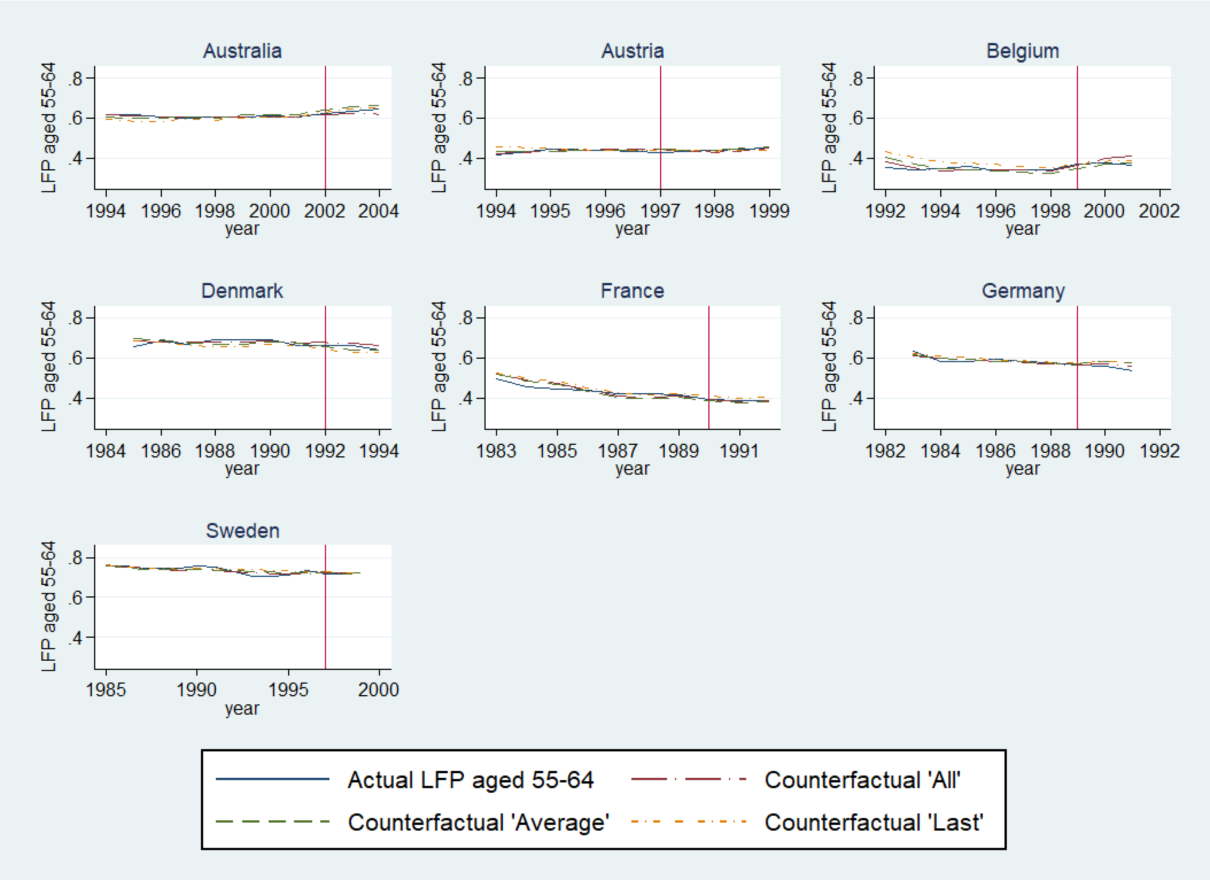
Table B.5.3: Post-treatment results regarding total labor supply of males aged 55-64, effects and pseudo p-values. Without Luxembourg in the synthetic control group

Australia			**Austria**		
year	estimates	pseudo p-values	year	estimates	pseudo p-values
2002	-0.409	0.133	1997	0.248	0.176
2003	**-1.970*** **	**0**	1998	0.456	0.176
2004	-0.996	0.143	1999	0.862	0.118
Belgium			**Denmark**		
year	estimates	pseudo p-values	year	estimates	pseudo p-values
1999	-3.582	0.923	1992	-0.273	0.786
2000	-3.315	0.769	1993	-0.369	0.571
2001	-3.307	0.846	1994	0.158	0.857
France			**Germany**		
year	estimates	pseudo p-values	year	estimates	pseudo p-values
1990	-1.295	0.182	1989	-1.028	0.250
1991	-0.796	0.545	1990	-1.885	0.167
1992	-1.225	0.273	1991	-2.790	0.250

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

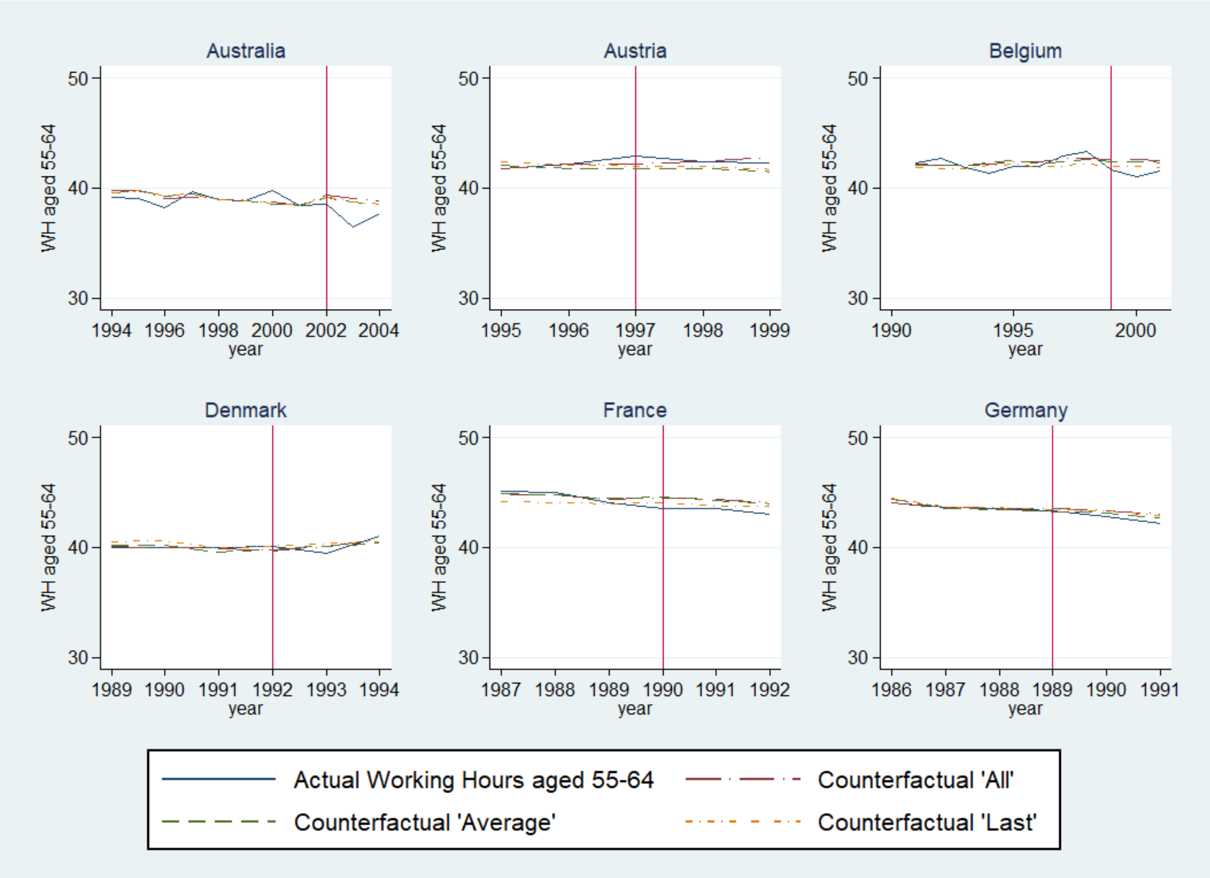
Source: Own calculations.

Figure B.5.4: Trends in males' LFP aged 55-64, robustness of the treatment effects. Placebo reform year. Without Luxembourg in the synthetic control group



Source: Own calculations.

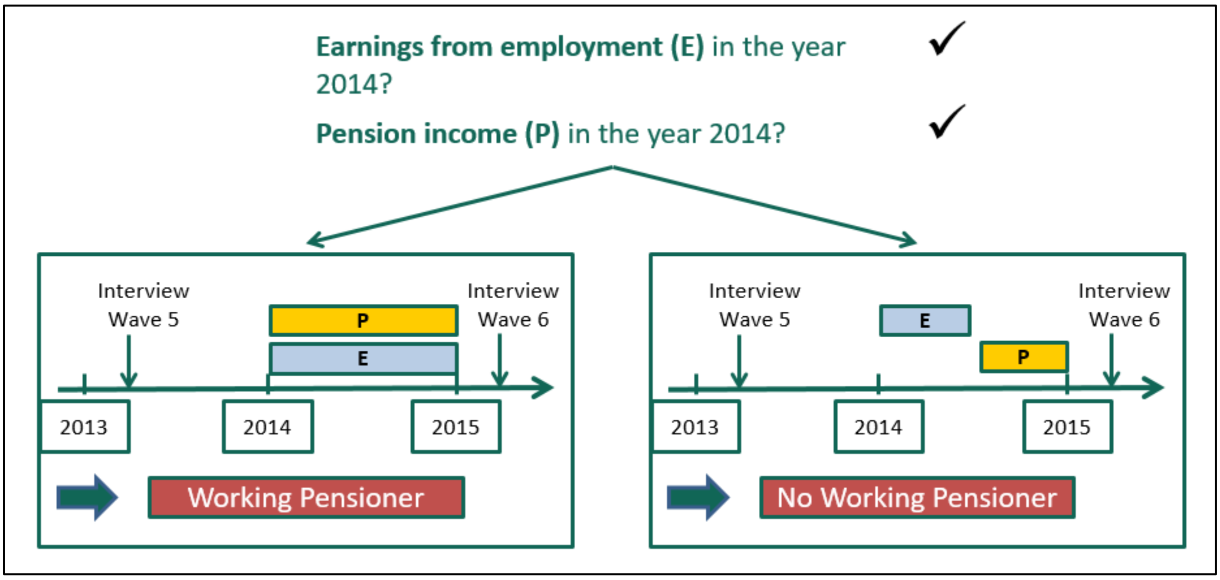
Figure B.5.5: Trends in males' working hours aged 55-64, robustness of the treatment effects. Placebo reform year. Without Luxembourg in the synthetic control group



Source: Own calculations.

C. Appendix to Chapter 6

Figure C.1: Depiction of potential mismeasurement



Source: Own depiction.

Table C.1: Gross domestic product and labor force participation rate of age group 55–64 by countries

	Country												
	ES	**IT**	**SI**	**GR**	**BE**	**FR**	**AT**	**DE**	**CZ**	**DK**	**CH**	**SE**	**EE**
GDP in 1,000€ (per capita)	22,2	25,4	17,6	17,0	33,9	31,3	36,1	33,9	15,3	44,8	57,7	41,0	13,0
Average	29,9												
LFPR in % (age 55–64)	55.4	48.9	38.4	41.1	45.1	50.7	46.9	69.1	56.8	66.4	71.6	78.4	67.6
Average	56.6												

Source: OECD. Detailed sources given in Section 6.3.1.

Table C.2: Sample size, gender composition and average age by group and country

	Working Pensioner			Pensioner		
	N	**Females**	**Age**	**N**	**Females**	**Age**
Austria	128	53%	67.4	1,468	56%	67.8
Germany	236	41%	68.1	1,368	49%	68.7
Sweden	428	45%	69.0	1,198	58%	69.9
Spain	52	35%	68.1	1,443	36%	68.7
Italy	101	35%	67.6	1,594	45%	68.6
France	110	45%	65.0	1,485	54%	67.4
Denmark	265	37%	67.7	1,018	58%	68.5
Greece	80	33%	63.7	1,197	40%	66.7
Switzerland	261	42%	68.2	826	54%	69.3
Belgium	122	30%	65.9	1,833	48%	67.4
Czech Rep.	394	55%	67.2	2,156	63%	68.1
Slovenia	115	48%	65.7	1,859	55%	66.4
Estonia	523	58%	66.7	1,669	59%	68.9

Source: Own calculations.

Table C.3: Potential determining factors of working pensioners. Dependent variable: working pensioner yes/no

VARIABLES	
Demographics:	
Age (centered)	-0.006***
	(0.001)
Age^2 (centered)	0.000
	(0.000)
Female	-0.031***
	(0.011)
High education	0.033***
	(0.010)
Low education	-0.028***
	(0.008)
Single	0.005
	(0.010)
Divorced	0.039***
	(0.005)
Widowed	0.009
	(0.009)
Partner in labor force yes/no	0.034***
	(0.007)
Health:	
Self-perceived health	0.019***
	(0.003)
ADL yes/no	-0.022*
	(0.012)
IADL yes/no	-0.044***
	(0.011)
Grip strength	0.001***
	(0.000)
Grip strength (missing)	0.056***
	(0.016)
Number of chronic diseases	-0.005***
	(0.002)
Economic and financial situation:	
Equivalized household net income (/10,000)	0.040*
	(0.021)
Household net worth (/10,000)	0.005***
	(0.001)
GDP (per-capita, /1,000)	-0.029***
	(0.006)
Labor force participation rate 55–64 (*100)	0.005***
	(0.001)

Pension system:	
Statutory eligibility age (SEA)	-0.016***
	(0.003)
Start of retirement window	0.004
	(0.003)
Earnings test (before SEA) yes/no	-0.053***
	(0.019)
Actuarial deductions (*100)	-0.010**
	(0.004)
Gross replacement rate (*100)	0.000
	(0.000)
Individual reached SEA yes/no	0.034**
	(0.016)
Individual reached EEA yes/no	-0.018
	(0.017)
Observations	21,929
Pseudo R2	0.13

Marginal effects from probit estimation. Standard errors in parentheses, clustered standard errors by country. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Based on SHARE including the following countries: AT, DE, SE, ES, FR, DN, GR, CH, BE, CZ, SI, EE.

Source: Own calculations.

Table C.4: Potential determining factors of working pensioners. Dependent variable: working pensioner yes/no

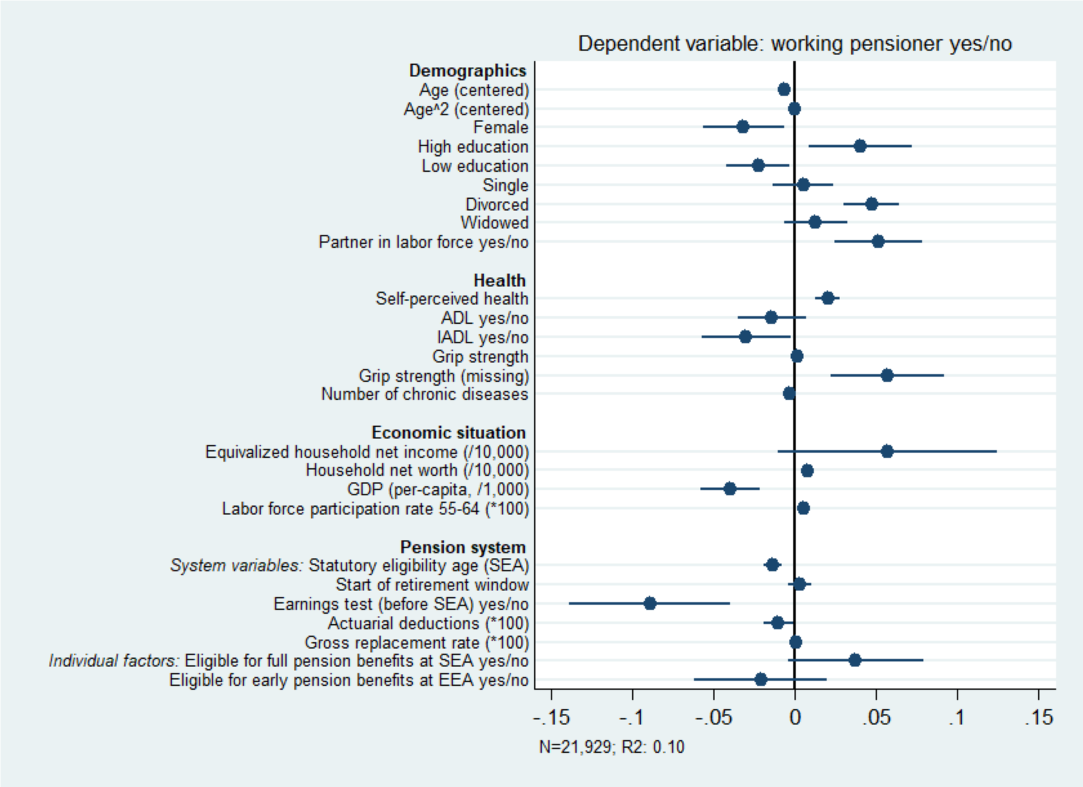
VARIABLES	
Demographics:	
Age (centered)	-0.006***
	(0.001)
Age^2 (centered)	0.000
	(0.000)
Female	-0.022***
	(0.008)
High education	0.034***
	(0.010)
Low education	-0.021**
	(0.009)
Single	0.006
	(0.009)
Divorced	0.038***
	(0.005)
Widowed	0.008
	(0.009)
Partner in labor force yes/no	0.033***
	(0.007)
Health:	
Self-perceived health	0.019***
	(0.003)
ADL yes/no	-0.021*
	(0.012)
IADL yes/no	-0.046***
	(0.010)
Grip strength	0.001**
	(0.000)
Grip strength (missing)	0.052***
	(0.016)
Number of chronic diseases	-0.005***
	(0.002)
Economic and financial situation:	
Equivalized household net income (/10,000)	0.041*
	(0.022)
Household net worth (/10,000)	0.006***
	(0.001)
Individual public pension eligibility:	
Individual reached SEA yes/no	0.038**
	(0.016)
Individual reached EEA yes/no	-0.022
	(0.016)

Country-fixed effects:	
Germany	0.076***
	(0.003)
Sweden	0.148***
	(0.003)
Spain	-0.046***
	(0.008)
Italy	-0.001
	(0.008)
France	-0.023***
	(0.002)
Denmark	0.100***
	(0.003)
Greece	-0.019***
	(0.007)
Switzerland	0.107***
	(0.006)
Belgium	-0.040***
	(0.005)
Czech Republic	0.104***
	(0.004)
Slovenia	-0.012**
	(0.006)
Estonia	0.168***
	(0.005)
Observations	21,929
Pseudo R2	0.13

Marginal effects from probit estimation. Standard errors in parentheses, clustered standard errors by country. *** p<0.01, ** p<0.05, * p<0.1. Based on SHARE including the following countries: AT (reference category), DE, SE, ES, IT, FR, DN, GR, CH, BE, CZ, SI, EE.

Source: Own calculations.

Figure C.2: Potential determining factors of being a working pensioner. Based on linear regression model.



Note: Clustered standard errors by country. Household income and worth adjusted for purchasing power parity. Based on SHARE including the following countries: AT, DE, SE, ES, IT, FR, DN, GR, CH, BE, CZ, SI, EE.

Source: Own calculations.

Table C.5: Potential determining factors of working pensioners. Dependent variable: working pensioner yes/no. Based on linear regression model.

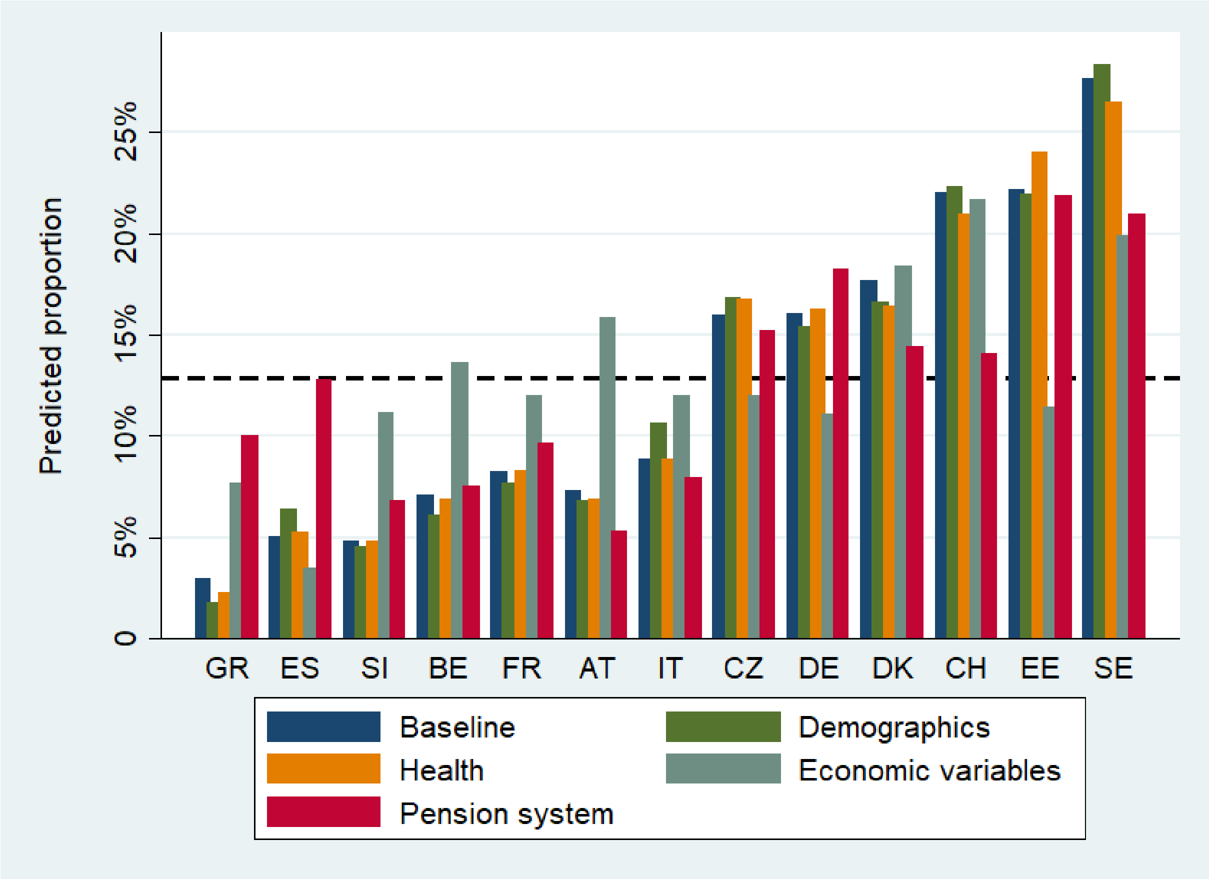
VARIABLES	
Demographics:	
Age (centered)	-0.006***
	(0.001)
Age^2 (centered)	0.000
	(0.000)
Female	-0.032**
	(0.011)
High education	0.040**
	(0.014)
Low education	-0.023**
	(0.009)
Single	0.005
	(0.009)
Divorced	0.047***
	(0.008)
Widowed	0.013
	(0.009)
Partner in labor force yes/no	0.051***
	(0.012)
Health:	
Self-perceived health	0.020***
	(0.003)
ADL yes/no	-0.014
	(0.010)
IADL yes/no	-0.030**
	(0.013)
Grip strength	0.001**
	(0.000)
Grip strength (missing)	0.057***
	(0.016)
Number of chronic diseases	-0.004**
	(0.002)
Economic and financial situation:	
Equivalized household net income (/10,000)	0.057*
	(0.031)
Household net worth (/10,000)	0.008***
	(0.001)
GDP (per-capita, /1,000)	-0.040***
	(0.008)
Labor force participation rate 55–64 (*100)	0.005***
	(0.001)

Pension system:	
Statutory eligibility age (SEA)	-0.014***
	(0.003)
Start of retirement window	0.003
	(0.003)
Earnings test (before SEA) yes/no	-0.089***
	(0.023)
Actuarial deductions (*100)	-0.010**
	(0.004)
Gross replacement rate (*100)	0.001
	(0.001)
Individual reached SEA yes/no	0.038*
	(0.019)
Individual reached EEA yes/no	-0.021
	(0.019)
Constant	0.622***
	(0.190)
Observations	21,929
R-squared	0.096

Standard errors in parentheses, clustered standard errors by country. *** p<0.01, ** p<0.05, * p<0.1. Based on SHARE including the following countries: AT, DE, SE, ES, FR, DN, GR, CH, BE, CZ, SI, EE.

Source: Own calculations.

Figure C.3: Counterfactual simulation for working pensioner proportions. Based on linear regression model.



Note: Root mean square error: Baseline=58.0%, Demographics=61.2%, Health=58.2%, Economic variables=22.4%, Pension system=26.7%.

Source: Own calculations.

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