The Role of Social Security Reforms in Explaining Changing Retirement Behavior in Denmark 1980-2016

Paul Bingley, VIVE – The Danish Center for Social Science Research
Nabanita Datta Gupta, Aarhus University and IZA, Bonn
Malene Kallestrup-Lamb, Aarhus University
Peder J. Pedersen, Deceased

1. Introduction

Denmark, like the other OECD countries, has witnessed a remarkable turnaround in the labor force participation of the elderly over the last half of a century. Labor force participation of men in the 60-64 age range was as high as 90 percent in the 1960s. It declined by about 10 percentage points in the 1970s due to production shifting from agriculture to industry. However, in the 1980s and 1990s labor force participation declined considerably further after the introduction of an early retirement program known as Post-Employment Wage (*efterløn*) and its extension, the Transitional Benefits Program (*overgangsydelse*), reaching a low of 40 percent at the end of the 1990s.

Starting from mid-1990s, however, a series of pension reforms were enacted tightening eligibility requirements, closing off certain early retirement pathways and shortening the duration of the Post-Employment Wage. These reforms increased the incentives for later labor force exit. In 1996, the entry in to the Transitional Benefits Program was ended and in 1999, the statutory pension claiming age was reduced from 67 to 65, thereby shortening the duration of the Post-Employment Wage from a seven to a five-year program. Both these reforms reduced the incentives to early retirement considerably and in the years following 1999, the labor force participation of men aged 60-64 began to rise again. Women aged 60-64 saw an even sharper rise in labor force participation, because in addition to pension reforms, successive cohorts gained more labor market experience. Over the period 1999-2012 several more reforms were enacted, the most recent of which (the Welfare Agreement of 2006 and the Retirement Reform of 2011) raised both the early and statutory pension claiming ages in half years steps to, eventually, 64 and 67, thereby gradually shortening early retirement benefits from a maximum five to a three-year duration. Furthermore, future statutory pension ages are set to increase by (at most) one year every five years from 2025 to give 14.5 years average life expectancy in retirement. While our data period will primarily reflect the policy changes in the period mid-1990s to mid-2000s, in the last years we will be able to capture the effects of the most recent reforms from the late 2000s.

In Bingley et al. (2018) we described the factors associated with the trend reversal in labor force exit in Denmark, finding evidence of the importance of the pension programs enacted at the beginning of the period 1999-2012, together with effects from rising education, improved health, sectoral changes and changes in the specific nature of jobs. In Bingley et al. (2020) simulating pension benefits, we found that a reduction in the tax force to retire early due to the 1999, 2006 and 2011 reforms was consistent with the observed increase in labor force participation of the 60-64 year age group. Thus, incentives may have played a role in explaining the trend reversal in the Danish labor market.

The purpose of this chapter is to establish whether changing incentives in the pension system caused the rising labor force participation of the elderly in Denmark since the turn of the century. We do so by applying a benefits calculator we have developed in previous work to micro data on a representative sample. We compute an after-tax retirement income stream for each possible pathway out of the labor market for each retirement age, and construct incentive measures inherent in the pension system, such as social security wealth and its annual accrual relative to earnings. We then regress labor force exit on these incentive measures, separately by gender and marital status and generate predicted and counterfactual retirement probabilities that we compare to the observed probabilities to infer the causal effect of incentives for explaining changing retirement ages.

The chapter proceeds as follows: section 2 describes the institutional setting and major pension reforms over the period 1980-2016; section 3 describes the evolution of older workers' attachment to the labor market; section 4 presents the data and modeling concepts; section 5 presents estimates and simulations; section 6 concludes.

2. Institutional setting, 1980-2016

The Danish pension system is one of the most generous and fiscally sound in the world because of the high replacement rate[1] and because of the gradual historical shift from a largely pay-as-you-go system towards a funded system. Furthermore, the statutory pension age has recently increased and will in future increase to keep average expected lifetime in retirement at 14.5 years to ensure fiscal sustainability. However, generous public pension benefits are means-tested against private pension income, implying high implicit tax rates and reducing the incentives to accumulate private pension savings or to remain on the labor market (Pensionskommissionen, 2015). Some individuals may not have access to occupational pensions due to not having had stable or long-lasting labor market careers and this group relies exclusively on public pensions in retirement.

The average retirement age in Denmark (now around 64) is relatively high compared to other OECD countries, and life expectancy after pensionable age one of the lowest. However, to maintain a generous pension system when faced with increasing life expectancy (though not by as much as other OECD countries), declining fertility, near full labor market participation of women and restricted immigration policies means that there is increasing pressure to retain older workers on the labor market in order to avoid raising taxes even further[2].

With this background in mind, in this Section, we describe the four building blocks of the Danish pension system – Old Age Pension (OAP, *folkepension*), Post-Employment Wage (PEW, *efterløn*), Transitional Benefits Program (TBP, *overgangsydelse*), Social and Disability Pension (TBP, *førtidspension*) – and reforms implemented over the past few decades that we analyze. The first program we will consider belongs in the first pillar of the social security system and is the defined-benefit OAP scheme, financed entirely pay-as-you-go out of general taxation. It is available to all citizens residing in the country starting from ages 65-67, depending on year of birth (see below). The OAP consists of a basic and a supplementary amount, with means testing against other pension and labor income. Over time, the basic amount has fallen and the supplementary amount has risen. However, as occupational pensions and private pensions mature, fewer individuals will qualify for anything other than the basic amount in OAP. This claw-back reduces incentives for low-income workers to save for their own retirement.

In the period 1980-2016, there have been five reforms of OAP. First, stricter means testing and cancellation of a modest actuarial element in 1984. Second, a lowering of the OAP age from 67 to 65 for those born on or after June 1939, enacted in 1999, and implemented between the years 2004-2006.

[1]The replacement rate (measured as disposable income upon retiring divided by disposable income in the last years of working life) can be nearly 100% for the low-income group while it is around 65% for the high-income group. (See Report of the Pension Commission, 2015).

[2] In 2018, the tax/GDP ratio in Denmark was 45% compared to the OECD average of 34%. (See Revenue Statistics 2019, OECD.)

Third, the re-introduction of an actuarial adjustment for OAP if delayed past age 65 and up to a max of 75.[3] It may seem surprising that Denmark lowered its statutory retirement age while other countries were raising theirs. However, the main rationale for doing so was to substitute old age retirement for early retirement among 65 and 66 year olds and thereby save on public finances since the early retirement benefit entitlement exceeded the OAP benefit.

A fourth reform to OAP occurred in 2006. Faced with growing concerns for future sustainability of public finances caused by demographic change and a declining average retirement age, the Welfare Agreement was enacted, whereby the OAP age was to be increased again with half-year steps starting from 2024 until it reached 67 again in 2027. Furthermore, starting from 2025, OAP (and early retirement) age were to be raised each 5th year depending on life-expectancy increases.[4] A fifth reform to OAP occurred with the 2011 Retirement Reform that expedited part of the 2006 reform, by beginning to increase OAP starting age from 2019 so that by 2022, it would again be 67. The life-expectancy indexation, however, would start in 2025 as earlier planned. As our sample period ends in 2016, we will only capture the decrease of the OAP age from 67 to 65 in 2004-6 but not the planned increase starting from 2019.

The second public pension program we will consider is PEW, which actually belongs in the third pillar as it is an individual voluntary scheme. Introduced in 1979, this program aimed to give workers in physically demanding jobs an opportunity for early exit from the labor market. Another rationale stated at the time was to free up jobs for young job seekers at a time of high youth unemployment. However, youth unemployment had been rather stable in the years leading up to its introduction and remained unaffected in the years immediately following it as well (see Bingley et al., 2010). Arguably the most dramatic change in the history of Danish pensions, the labor force participation rate of men in the 60-64 age group fell 20 percentage points (from 80% to 60%) immediately in the year after its introduction and then gradually declined another 20 percentage points over the next 20 years. The main eligibility requirements were age (between 60 and 66) and sufficient years of membership in an unemployment insurance fund. Even though the PEW was contribution based, it was underfunded and since the take-up was far greater than expected, the program came to be a huge drain on public finances in the years to come.

There have been numerous reforms of the PEW and over time the eligibility rules in terms of number of years of membership in an unemployment insurance fund have been continuously raised (with grandfathering) in an attempt to stem the flow into the program. Stringency of the program has also increased in several ways: incentives to defer retirement to 63 (1992)[5]; offering a tax-free premium to continue working until 65 (1999); allowing some paid employment while receiving PEW (1999); reducing the OAP age to 65 so that PEW lasts five rather than seven years.

Similar to OAP, both the Welfare Agreement and its sequel, the Retirement Reform completely overhauled the PEW program. The PEW age would also be raised in six month steps from 2014 to 2017 (original proposed period was from 2019 to 2022) so that PEW first age of eligibility would be 62 in

---

[3] However, the deferred OAP scheme was very little used (Amilon, et. al., 2008).

[4] The indexation would be done each 5th year with 15 years notice, conditional on the life-expectancy of 60 year olds increasing by at least 0.6 years over the notice period (Ministry of Finance report, 15th March, 2019).

[5] Before 1992, the benefit was 100% max UI for the first 2 years then 82% of max UI through age 66. In 1992, the "63 years rule" was implemented, whereby if individuals waited to go on PEW until 63, the benefit would be 100% of maximum Unemployment Insurance Benefits through age 66.

2017. Furthermore, during 2018-2023, PEW shorten to three years, beginning at age 64. In our sample period, we will not observe the latest changes in PEW. However, we will observe the effects of the 1999 reform in which the duration fell from seven to five years.

The third public pension program we will consider is TBP. Introduced in 1992-1996, a window of even earlier retirement was opened allowing individuals between the ages of 55-59 who had been unemployed for at least 12 out of the last 15 months to stop actively searching for work and receive a benefit (80% of the PEW level) until age 60. In 1994, the eligibility criteria were further broadened to include individuals aged 50-54 as well. As with PEW, this program turned out to be quite popular and around nine percent in the relevant age group took it up. In contrast to PEW, TBP receipt was greatest among women who were more likely to have fulfilled the eligibility requirements.

The fourth and final public pension program we will consider in the analysis is SDP. From the 1980's, three levels of disability benefits were awarded on health grounds, with social criteria also taken into consideration for the lowest benefit level. A 1999 reform introduced the requirement of rehabilitation before awarding the lowest level of SDP. A 2003 reform consolidated the SDP so that only two levels would be available, both on health grounds depending on work capacity reduction (i.e. a high level or a moderate level). Awards of SDP require several stages of evaluation, assessment of remaining work capacity and work rehabilitation via job tryouts.

The second pillar of the Danish pension system consists of a number of mandatory contribution-based occupational pensions, first covering white-collar workers in the 1960s and expanding to include blue collars in the 1990s. These have been maturing over time, and eventually more workers will make use of these schemes and presumably also their early retirement provisions. At the current time, more than 85% of workers are at least partially covered. However, we will not model these schemes in the analysis or third pillar private and voluntary schemes.

To sum up, there have been several pathways out of the labor market in the years in our observation period. During the 1980s and up to mid-1990s, early retirement programs expanded. Since the mid-1990s, the general trend has been a tightening up of eligibility rules for early retirement, shortening of program durations and stricter means testing against labor and pension income. Labor force participation of the elderly in Denmark in turn has risen and fallen in sync with early retirement program generosity, therefore we expect retirement behavior to respond to the incentives inherent in these programs. The most recent reforms enacted under the Welfare Reform of 2006 and expedited under the Retirement Reform of 2011 constitute sweeping changes to the pension system. Indeed, the Economic Council of Denmark projects an increase in the size of the structural labor force of the country with about 100,000 individuals by 2025 because of these reforms (Economic Council Report, Spring, 2018). However, we will not be able to capture the full effects of these reforms in the window of data available to us.

3. Older workers' relationship to the labor market

We start out by describing how older workers' relationship to the labor market has changed over time. Figure 1 shows LFP rates by age group to illustrate the narrowing of gender differences. LFP rates for women in their 50s have been increasing throughout the study period, with the exception of a dip in the mid-1990s coincidental with TBP, which punctuates an earlier period of relatively steep increases, and a later period of more modest increases. In contrast, men in their 50s maintained a 90 percent LFP rate throughout. By 2016, the last year of the sample, men and women in their early 50s had the same LFP rate.

[Figure 1 about here]

For women in their early 60s, LFP declines only very slightly until 2000, increasing rapidly thereafter. In contrast, men in their 60s exhibit a u-shape in LFP, which bottoms-out in 2000. The most striking feature of Figure 1 is the increase in LFP for women aged 50-64, which moves much closer to LFP for men. This closing of the participation differential corresponds with the aging of cohorts of women with greater labor market experience. An important feature both genders share is the increase in LFP from 2000 for those in their early 60s. This common increase, or trend reversal, corresponds with reduced pension benefit entitlements, and appears unaffected by the great recession of 2008.

Several pension benefits can support consumption after leaving the labor market. Eligibility to benefits differs between individuals and between different ages. While eligibility to the main pension benefits are exclusive, and there is no simultaneous claiming of different benefits, individuals may receive different benefits sequentially. Rather than illustrate the various benefit sequences, Figure 2 presents aggregations of different pathways to retirement as characterized by proportions of retirees in receipt of each benefit by year.

[Figure 2 about here]

There are two distinctive features of women's pathways to retirement. First, the declining proportion of "other" represents a legacy program of survivor benefits becoming less important over time. Second, the growth and then decline of PEW. The declining importance of survivor benefits explains only part of the increased PEW. For the most part, PEW increases with female eligibility, which is a function of (unemployment insured) labor market experience. The main change shared by men and women is the increase in OAP at the expense of PEW from 2004, following the reduction in OAP first age of eligibility from 67 to 65, and corresponding shortening of PEW eligibility from latest age 66 to 64. Another shared feature is TBP, a program introduced, expanded, and then closed to new entrants but grandfathered, around the middle of our study period. The TBP was a more common route to retirement for women than for men.

[Figure 3 about here]

A useful way to put pathways to retirement into perspective is to expand the groupings to include other non-participants in the labor market as well as labor market participants. In Figure 3 we can see the steady increase in female LFP, and the flat or very slight u-shape of male LFP. Participation in the last year 2016 for males is back to where it was in 1980, after reaching its lowest point in the mid-1990s. Two aspects of benefit receipt are more evident in Figure 3 than in Figure 2. First, there is a declining share of women receiving SDP whereas for men the share on SDP is unchanged and seems rather unaffected by trends over the period (see also, Bingley et al., 2016). Second, for both genders, the 2004 change in PEW/OAP eligibility ages was a program switch without a LFP change.

These figures show increasing statutory pension claiming and decreasing early pension claiming over time in the 50-69 age group. There is an evident trend reversal starting from about 2000, driven by women and men in the age group 60-64, and influenced by three factors. Firstly, the opening and closing of the extension to the PEW program (TBP). Secondly, reducing the retirement age from 67 to 65 via the

1999 reform implemented in 2004. Thirdly, raising of the PEW and OAP ages for individuals born after June 1959 via the 2006 Welfare reform and the 2011 Retirement reform.

4. Data and modeling concepts

We use population-based administrative data for individuals for the period 1980-2016. We have information on various individual demographic and financial characteristics, health, and labor market status, enabling us to identify individual transitions between different labor market states on an annual basis.

For the descriptive figures of labor market attachment, we use the full population data. For estimation, we use a random sample of those aged 49 or older in the period 1990-2016, sampling around 100,000 individuals each year amounting to 3,206,305 person-years. Excluding individuals who are outside the labor market the first time we observe them, we include only the employed and all unemployed workers who are actively looking for a job. We follow them until retirement, age 70, death, or end of study period (2016), whichever is first. Following individuals from 49 and conditioning on labor market participation at this age implies that our results are not representative for the full population, including those who tend to enter non-participation and retirement states even before 49. This restriction reflects our focus on retirement among workers not subject to loose attachment.

Married is an indicator variable taking the value one for those married or cohabiting. We group education into three categories: less than high school, high school diploma, and college degree. Income includes labor income, unemployment benefits, social assistance and pension income, deflated to 2016 levels. This income measure is used in the calculation of ITAX as defined in equation 2 below.

We observe discharge diagnoses from the National Patient Registry according to the 8th and 10th revision of the World Health Organization (WHO) hierarchical classification system. We generate indicator variables for diagnosis at the top level of the diagnosis hierarchy in each year, yielding 11 diagnosis categories.

1. Malignant Cancer including leukemia, melanoma, and other malignant cancers.

2. Benign Cancer including various types of tumors.

3. Endocrine, nutritional, and metabolic diseases including diabetes, obesity.

4. Diseases of the nervous system and sensory organs including Alzheimer's, Parkinson's, epilepsy, sclerosis, migraine.

5. Diseases of the circulatory system: Ischaemic and other heart diseases, acute rheumatic fever, high blood pressure, hypertension, stroke and other cerebrovascular diseases.

6. Diseases of the respiratory system including influenza, pneumonia, acute and chronic bronchitis, asthma.

7. Diseases of the digestive system including gastric ulcer, hernia, diseases of the liver and gallbladder.

8. Diseases of the genitourinary system including kidney stone, renal failure, diseases of the urinary system.

9. Diseases of the musculoskeletal system and connective tissue including arthritis, osteoarthritis, Lyme disease, herniated disc, lumbago, osteoporosis, sclerosis, rheumatism.

10. Injury, poisoning and certain other consequences of external causes including bone fractures, dislocations.

11. Other diseases.

From the table describing our estimation sample, we see that it consists of slightly more men (58%) than women and that the majority of individuals are married or cohabiting (75%).

Estimation sample by gender and marital status

	Single	married	total
Female	387,892	968,536	*1,356,428*
	28%	71%	*100%*
Male	392,545	1,457,332	*1,849,877*
	21%	78%	*100%*
Total	*780,437*	*2,425,868*	*3,206,305*
	24%	*75%*	*100%*

Having described the proportions of individuals in our sample, in the labor force, and in receipt of different pension benefits over time in Section 3, we consider explicitly the age dimension and now turn to descriptions of flows of individuals between labor market states. In Figure 4, we graph the proportion of individuals who are in the labor force at each age, conditional on being a labor force participant in the previous year. Two features are common for both genders. First, we can see a gradual decline in labor force survival from the early 50s until a rapid fall from age 59. Second, the 1946 cohort survives in the labor force for longer at all ages compared to the three earlier selected cohorts. That the 1946 cohort distinguishes itself as young as age 54, suggests differences are not only driven by benefit reforms affecting that cohort first from ages 60 and then from 65. A distinctive feature of the female 1941 cohort was less labor force survival from their mid-50s, corresponding to age of eligibility to the TBP program. While men were also eligible for TBP, there was less take-up.

[Figure 4 about here]

An alternative way to display labor market flows is in terms of transitions. Figure 5 presents the probability of leaving the labor market, conditional on having been a labor force participant the year before. Figure 5 graphs (the negative of) the slope of the lines in Figure 4. Retirement hazards are quite flat until age 59, with the exception of some TBP transitions in the mid-50s. At age 60 there is a large spike in the retirement hazard, and the level remains high at around 0.2-0.3 at older ages. Spikes for different cohorts at different ages reflect changing ages of benefit eligibility, for example the age 67 spike for 1931 and 1936 cohorts and the age 65 spike for the 1946 cohort.

[Figure 5 about here]

For modeling retirement behavior, it is important to distinguish between pension benefit receipt and labor market exit. Benefit eligibility rules out employment for some benefits and earnings from work trigger claw-backs for other benefits. Furthermore, because of the conventions of registration, we observe age at the beginning of the year, labor force status close to the end of the year, and earnings throughout the year. Because of this registration timing, we will expect to observe positive earnings during the calendar year that retirement occurs.

[Figure 6 about here]

In Figure 6 we show the various combinations of earning and receiving pension benefits by age. We can see that either only claiming benefits or only earning covers about 90 percent of the population up to age 59, and from 60 there is as much as 10 percent who are earning while claiming. Much of this 10 percent will be spurious registration of transitions during a year, although some will be working less than a 200 hours ceiling while claiming PEW before 1999, or earning while claiming PEW subject to claw-backs thereafter.

We characterize incentives by calculating a measure of social security wealth (SSW): the discounted present value of the expected stream of future pension benefits following retirement next year. For an individual of gender *g* at each calendar year *t* and labor force exit age *R*, SSW is the sum from age *R* to end-of-life *T* of a weighted future benefits streams discounted back to current age *a*, where the weights denote probabilities of being observed on certain pathways (see e.g. Gruber and Wise, 2004).

$$SSW_{gt}(R) = \sum_{a=R}^{T} \sum_{k} \pi_{gk} \,.\, B_{at}(R).\, \sigma_{gat}.\, \beta^{a-R}\,, \qquad 50 \leq a \leq 69. \qquad (1)$$

The parameter π denotes the probability of a given pathway, σ is the survival probability and β is the discount factor.

A complementary way to characterize incentives is the implicit tax on working another year (ITAX): the (negative) difference in SSW for delaying retirement by one year divided by annual labor earnings. We define ITAX as follows:

$$ITAX_{gt}(R) = -(SSW_{gt+1}(R) - SSW_{gt}(R))/E_{gt}, \qquad (2)$$

Where, *E* represents earnings from work. Thus, *ITAX* >0 (<0) implies that there is an implicit tax (subsidy) for working an additional year.

We discount benefits at two percent annually, and obtain survival probabilities from Statistics Denmark yearbooks by age and gender. Where future eligibility to retirement benefits is unknown, for example with SDP, we weight potential benefit streams by gender-specific award rates.

[Figure 7 about here]

Figure 7 presents median SSW over time, with each line representing a selected age. The SSW lines generally increase over calendar time in parallel, with some notable exceptions. For most calendar years SSW-profiles shift upward between ages 50 and 60, and then shift downward to age 66. Four aspects of pension benefit reforms are evident from blips in the age profiles: First, the TBP introduction, expansion and closure for ages 50 and 55 in the mid-1990s. Second, the 1999 PEW reform incentivizing delaying retirement from age 60 to 62 is visible as the year from which age 62 SSW exceeds age 60 SSW. Third, the 2004 PEW/OAP transition age shift from 67 to 65 is visible as the year from which age 65 SSW is no longer above age 66 SSW. Fourth, the 2014 increase in PEW eligibility age appears as the large drop in age 60 SSW.

[Figure 8 about here]

Figure 8 presents median ITAX over time, with each line representing a selected age. ITAX for ages 50 and 55 is always negative, incentivizing staying in the labor market. For other ages, ITAX is positive but decreasing over time, with age 60 ITAX becoming negative following the 1999 PEW reform, and ages 65 and 66 ITAX becoming negative following the 2004 PEW/OAP transition age shift; from 2006 the only consistently positive ITAX is for age 62. In summary, the trend has been reducing disincentives to work at older ages – a downward trend with two jumps down due to the 1999 and 2004 pension benefit reforms. ITAX at ages 60-66 for women were higher than for men of similar ages, until the rates equalize following the 1999 and 2004 reforms.

[Table 1 about here]

For modeling retirement behavior, we calculate incentive measures and use information on annual labor earnings from tax registers, educational qualifications from the ministry of education, and diagnoses from the national hospital discharge register. For estimation, we require valid observations for all covariates, conditional on labor force participation in the year of covariate observation, and require residency in Denmark the following year. Hence, individuals attrite from the sample the year after they leave the labor force. Table 1 presents descriptive statistics for the four estimation samples – split by gender and marital status.

We are more likely to observe a woman retiring than a man, and slightly more likely to observe a single than a married individual retiring. ITAX is top and bottom coded at +/- unity, a negative number implying a financial incentive to stay in the labor market. Singles have greater incentives to stay in the labor market than the married, and these incentives are stronger for men. Women have higher SSW than men because women are more likely eligible to SDP throughout the period; men had more PEW eligibility than women until the late 1990s, and thereafter women became relatively more eligible. Overall weighting of early benefit entitlement dominates for women because SDP is available from age 50 but PEW first from age 60. Male earnings are about 10-25 percent higher than female. About 40 percent of the sample has less than a high school degree. Among hospital discharge diagnoses, the most important single groups are musculoskeletal and digestive disorders.

5. Results

In Table 2 we present OLS estimates of linear probability models for retiring based on the samples described in Table 1. ITAX coefficients are positive and significant, indicating that a higher implicit tax rate on working another year increases the probability of retiring this year. Similarly, SSW coefficients are positive and significant, indicating that a higher social security wealth increases the probability of retiring this year. Higher earnings last year reduce the probability of retiring this year. Compared to individuals with a high school diploma, those without are more likely to retire at any age. Men with a college degree are less likely to retire at any age compared to men with a high school diploma. Compared to having no hospital discharge diagnosis, most diagnoses significantly increase the probability of retirement.

[Table 2 about here]

As an alternative to the linear probability model, we estimate a probit retirement model and present marginal effects in Table 3. While the magnitude of the OLS estimates and probit marginal effects on individual covariates are not comparable, sign and significance are almost identical for the models. The only important difference is the ITAX coefficient for married women, which is significantly negative for the probit model, implying that higher implicit taxes for working another year reduce the probability of retiring this year. This surprising result suggests potential issues with incentive calculations for married women. While we calculate individual pension benefits, and we ignore a small element of joint income taxation of capital income, we do not include spouse characteristics as covariates. It may be the case that spousal incentives or retirement decisions are important omitted variables for married women.

[Table 3 about here]

For married individuals we estimate retirement probits in Table 4, now also including spouse incentives. For women the coefficient on own ITAX remains negative but becomes insignificant. While husband SSW and ITAX coefficients are insignificant, that their inclusion causes female ITAX to become insignificant suggests there may be omitted variable bias in the Table 3 married women specification. For married men, inclusion of spouses' incentives reduces the magnitude of own ITAX and SSW coefficients slightly, but they remain significant. Indeed, higher wife SSW significantly increases married men's retirement probability.

[Table 4 about here]

OLS estimates appear to be more consistent and robust across samples when compared to estimates from probit models. In the remainder of this results section, we will examine robustness of OLS estimates of incentive measures to the exclusion of different sets of covariates. In Table 5, we present OLS retirement estimates without controls for hospital discharge diagnosis and without controlling for education. Coefficients on all incentive measures are unchanged from those presented in Table 2, which included diagnosis controls. R^2 goodness-of-fit measures are also very similar in both specifications, indicating that health controls add little explanatory power.

[Table 5 about here]

In Table 6 we present OLS retirement estimates on incentives without any additional covariates; further to Table 5, in Table 6 we no longer include controls for age. Coefficients on incentive measures approximately double in size and explanatory power falls by 3-5 percentage points when age is not included as a control. Obviously, age has a strong relationship with retirement probability, incentives from pension benefits correlate with age, and incentive coefficients in Table 6 suffer from omitted variable bias. Our preferred set of estimates are OLS with the full specification where incentive measures are interpreted conditional on age, schooling and diagnosis.

[Table 6 about here]

A neat way to summarize the goodness-of-fit of our estimations is to compare predictions from our models with the behavior described in Figure 4 for survival in the labor market and in Figure 5 for retirement hazards. Table 2 presents our preferred estimates are from OLS regressions using our full specification. Using these estimates, we predict retirement probabilities for each age and calculate a weighted average across gender and marital status to compare with observed retirement patterns.

[Figure 9 about here]

In Figure 9 we present observed and predicted survival in the labor force. Predictions track the observed data remarkably well in 1981, following the downward linear trend with age until the kink and subsequent steeper fall from age 59. While the 2010 predictions also track observed survival in the labor force quite well, we overestimate survival in the early 60s. Estimates include quadratic controls for age, and the distinct kink at age 59 must be due to incentive changes specific to that age rather than the smooth function of age *per se*.

[Figure 10 about here]

Turning to a more direct way of comparing labor market transitions, we contrast observed and predicted retirement hazards in Figure 10. Both hazards are low and flat before age 59, with a well-fitted four percent exit rate in 1981 and a likewise well-fitted one percent exit rate in 2010. We track increasing retirement hazards from age 59 throughout the sample period. However, the 1981 predicted hazards better fit the spikes in the early and late 60s, whereas 2010 predictions fail to pick up spikes and instead track the generally increasing hazard rate from age 59.

[Figure 11 about here]

Our objective is to understand the role of pension benefits in explaining patterns of senior LFP since 1980. Figure 1 presents observed LFP trends by age group and we now use our preferred model to predict LFP as an alternative summary measure of goodness-of-fit in Figure 11. Estimates fit the upward trend in LFP for ages 54 and 59 quite well, but underestimate the increase from 2000 for those age 64. We pick up the 1994-96 reduction in LFP at ages 54 and 59, corresponding to TBP, to a certain extent. In terms of levels, LFP fits well at age 54, but under-predicts age 59 LFP by 10 percentage points throughout.

Counterfactual Simulations

We perform a number of counterfactual simulations in order to distinguish the roles of changes in demographic characteristics and changes in incentives in explaining the evolution of senior labor force participation throughout the study period. Using our preferred OLS estimates as presented in Table 2 we predict retirement behavior by combining observed characteristics with actual or counterfactual incentives. Predictions based on actual incentives correspond to those used for goodness-of-fit illustrations. Predictions with counterfactual incentives combine observed characteristics from all years with benefit rules from a specific “counterfactual” base year. The extent to which predictions differ between actual and counterfactual rules illustrates the aggregate effect of pension benefit changes between the base and target years.

[Figure 12 about here]

Figure 12 presents retirement probabilities by age group using 1980 pension benefit rules compared to actual rules in each year. During the 1980s, incentive changes had little effect on retirement probabilities and we predict retirement probabilities to be quite stable. From 1990 to 2016 predicted retirement probabilities for ages 55-66 fell by three percentage points using actual incentives, but would have fallen by an additional two percentage points using 1980 incentives. Staying with the 1980 benefit rules would have meant a 60 percent greater reduction in retirement probabilities. In the lower panes of Figure 12, breaking down retirement probabilities by averaging over the late 50s and early 60s we can see that behavior in the early 60s drives effects. For those in their late 50s retirement probabilities using incentives in the 2010s resemble those using incentives from 1980, with an intervening period during which incentives caused one percentage point more retirement.

[Figure 13 about here]

An alternative way to present counterfactuals from different benefit regimes is in terms of relative survival in the labor force. Figure 13 presents labor force survival from 49-65 by calendar year of benefit rule comparison. From 1980 to 2005, the percentage of individuals predicted to work until age 65 with actual incentives increased gradually from 30 to 50, and stayed at that level until 2015. Counterfactual predictions using 1980 incentives would have caused a gradual increase to 60 percent in 2005, and staying at that level. Staying with 1980 incentives would have increased those working until they age 65 by 50 percent.

[Figure 14 about here]

Predicting expected retirement age under counterfactual benefit regimes is another way of conveying effects of changing incentives. In Figure 14, we present expected retirement ages by year of benefit rule comparison. Conditional on working to age 55 (top pane), expected retirement age increases by 1.3 years from 1980-2005 and declines slightly thereafter using actual incentives. Expected retirement age would have increased by 2 years under the 1980 benefit rules; staying with the 1980 incentives would have meant a 50 percent greater retirement delay. Conditioning on working until age 62 (bottom pane) shows a modest 0.2 years increase in expected retirement age using actual incentives compared to a 0.8 years increase using 1980 incentives. Contrasting the two panes reveals that most of the increase in expected retirement age from 55 occurs before age 62, whereas only about half of the increase in expected retirement age from 55 that would have occurred under 1980 rules occurs before 62.

[Figure 15 about here]

In a final simulation, we perform a decomposition exercise for survival in the labor force. In Figure 15 we present predicted survival by age using 1980 characteristics and rules, predicted survival using 2015 characteristics and rules, and compare to counterfactual predicted survival using 2015 characteristics and 1980 rules. All curves show a steady linear decline in survival, until a certain age from which survival declines more rapidly. Kinks in survival curves follow earliest years of PEW eligibility. Using 1980 characteristics and rules survival falls to 75 percent at age 59 before declining more rapidly. Using 2015 characteristics and rules the decline is to 80 percent at age 61 before declining more rapidly. The counterfactual with 1980 rules declines to only 98 percent by age 59, before declining more rapidly. Maintaining 1980 rules would have caused greater survival in the labor market at all ages for the 2015 population than under the prevailing benefit regime. However, under the 1980 rules, the change in demographic characteristics from 1980 to 2015 alone would have caused a greater increase in labor force survival. Changes in incentives between 1980 and 2015 offset about half of the increase in expected retirement age that would have occurred due to changes in demographics.

What can explain the general finding in these counterfactual simulations that staying with the 1980 rules and incentives would have caused a greater increase in labor force survival than under the current benefit regime holding constant any demographic change? One explanation is that the OAP age in 1980 was 67, whereas in 2015 this was 65 (reduced in the years 2004-5). Outside our observation period, 2019-2023 sees OAP increasing back to 67, and thereafter linking to increases in life expectancy. Incorporating later years, we should expect to see the current benefit scheme providing stronger incentives to stay on in the labor market compared to the 1980 benefit scheme. A second explanation is that because the PEW program has been shortened, with more means testing and stringent eligibility criteria in 2015 compared to 1980, the incentive to stay on in the labor market until PEW age was likely greater in 1980 than in 2015. In other words, in 1980, many more individuals had access to a longer and more generous early retirement program than in 2015 and therefore, this gave them an incentive to remain at work until PEW age (first age 60, incentivized age 62). Finally, in the period between 1980 and 2015 the pension environment has seen a maturing of a number of Pillars two and three occupational and private pensions, which may also carry their own early retirement options. Such programs reduce elderly workers' dependence on public pension programs and weaken their incentives to stay on in the labor market until the statutory retirement ages.

7. Conclusions

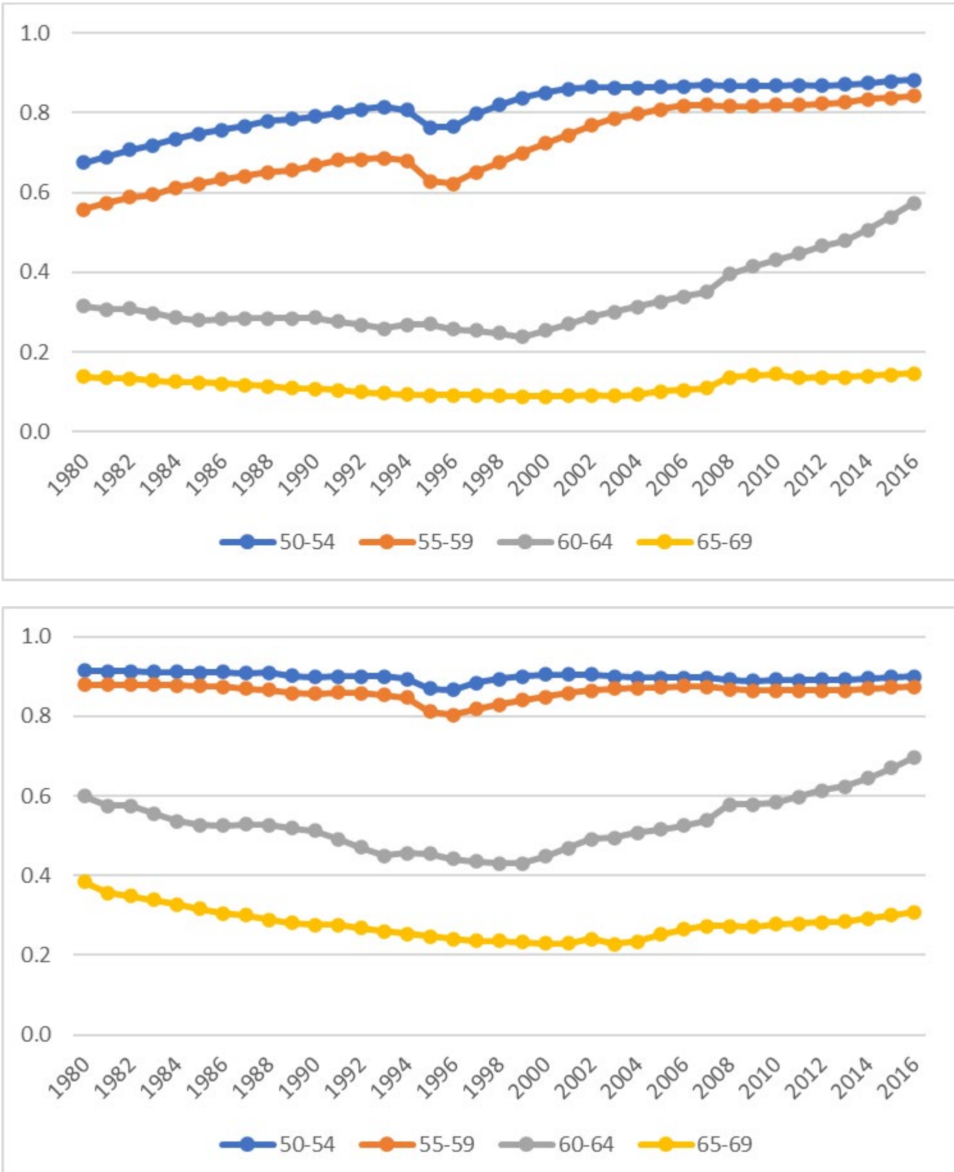
As in the other OCED countries, the labor force participation rate for the elderly in Denmark has undergone a remarkable reversal. The rate was about 80% during the 1970s and, following the introduction of an early retirement program in 1979, declined rapidly to half that level in the late 1990s. From the turn of the century, participation started to rise again, up to 70% currently. Among females, there has been a similar turnaround, with a less pronounced initial decline, because at first fewer females were eligible for early retirement benefits. Furthermore, females have experienced an underlying trend of increasing participation throughout the period, as successive cohorts have gained more labor market experience. Over the same period, a series of reforms of the pension system have tightened eligibility criteria, closed off some pathways, and shortened benefit duration, while extending means testing against other income. Paradoxically, reducing OAP age from 67 to 65 over the years 2004-6, was yet another means to reduce the costs of public pension benefits.

This chapter uses population-based administrative data to quantify how much changing incentives due to reforms of the pension system has meant for the changing labor force participation of the elderly in Denmark over the period 1980-2016. We apply a benefits calculator to a representative sample and compute after-tax retirement income streams for each major pathway out of the labor market for each potential retirement age. We then construct summary incentive measures such as social security wealth and ITAX, the annual accrual of SSW relative to earnings, and relate them to retirement behavior among the 50-69 age group.

Our results show that the incentive measures are important and significant, indicating that a higher implicit tax rate on working or higher social security wealth in a year increase the probability of retiring this year, whereas higher earnings last year reduces the probability of retiring this year. The less educated are more likely to retire at any age, as are those in poorer health (more diagnoses). OLS estimates are more robust than Probit estimates, and our preferred specification shows that the models fit the data reasonably well, particularly for the younger part of the sample. Counterfactual simulations holding the demographic composition fixed and comparing the effect of changing incentives of the pension system show that staying with the 1980 rules would have caused later retirement than the 2015 rules. This somewhat surprising finding is because the OAP retirement age is 65 in 2015 compared to 67 in 1980, and that the incentive to stay on in the labor market until PEW age has weakened in 2015. Still, adding more years of data will most likely reverse this result, as sweeping reforms of the pension system have been undertaken via the Welfare Agreement of 2006 and the Retirement Reform of 2011, which start to take effect from 2014 (early retirement age) and 2019 (OAP age).

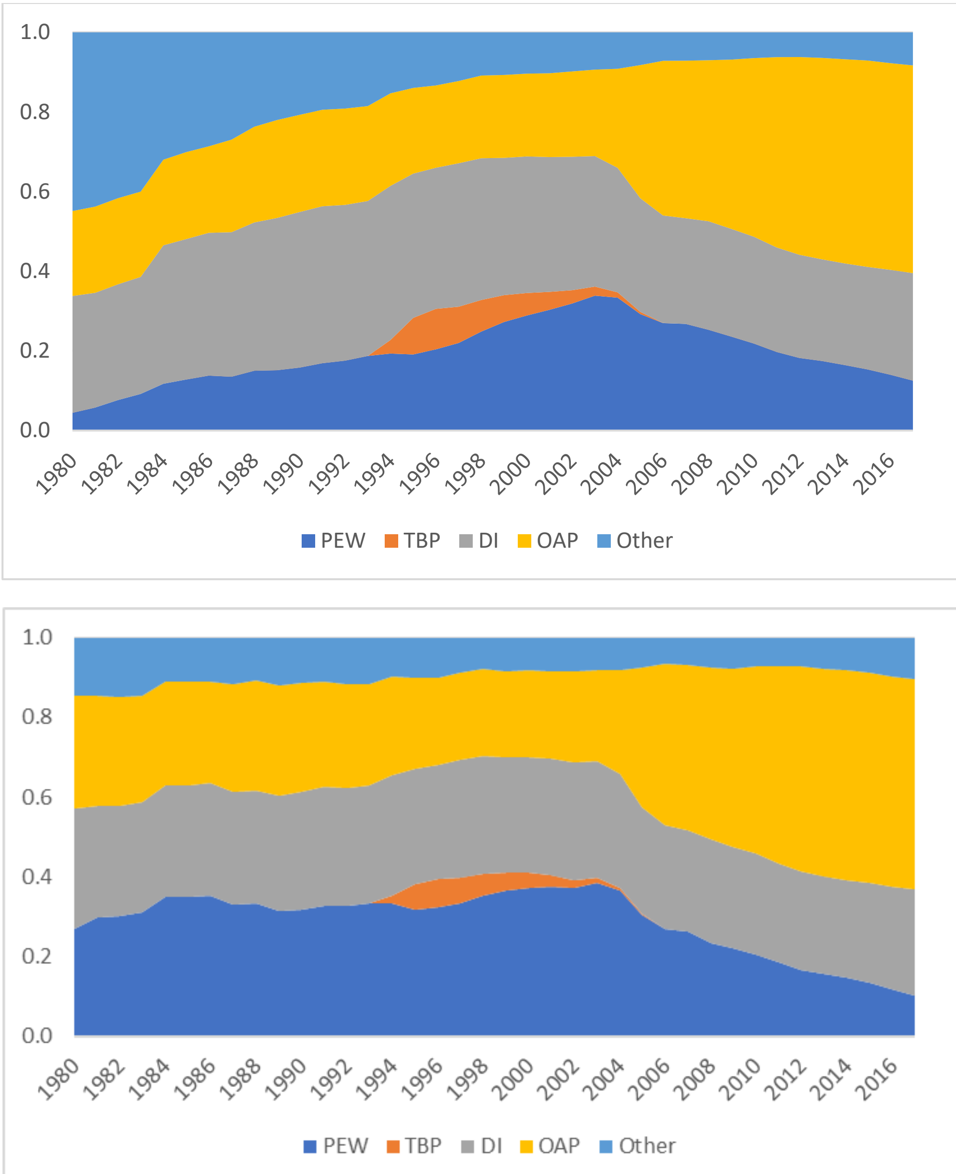
Tables and Figures

Figure 1. Labor force Participation Rates for Women (top) and Men



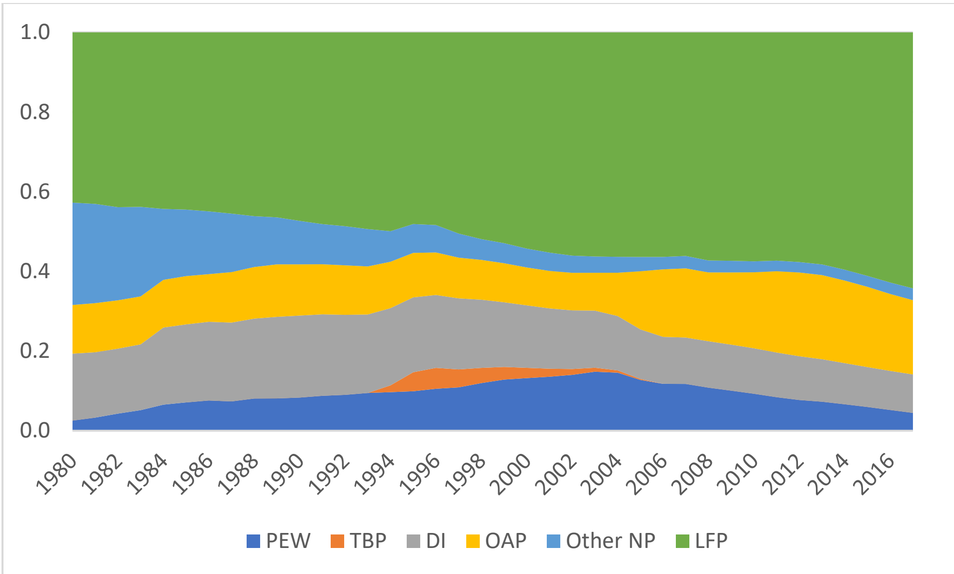
Note: Own calculations based on population of residents in Denmark in week 48 each year. Proportion of individuals with main source of income from labor force participation by calendar year. Different lines represent age groups (age assigned in week one of the year).

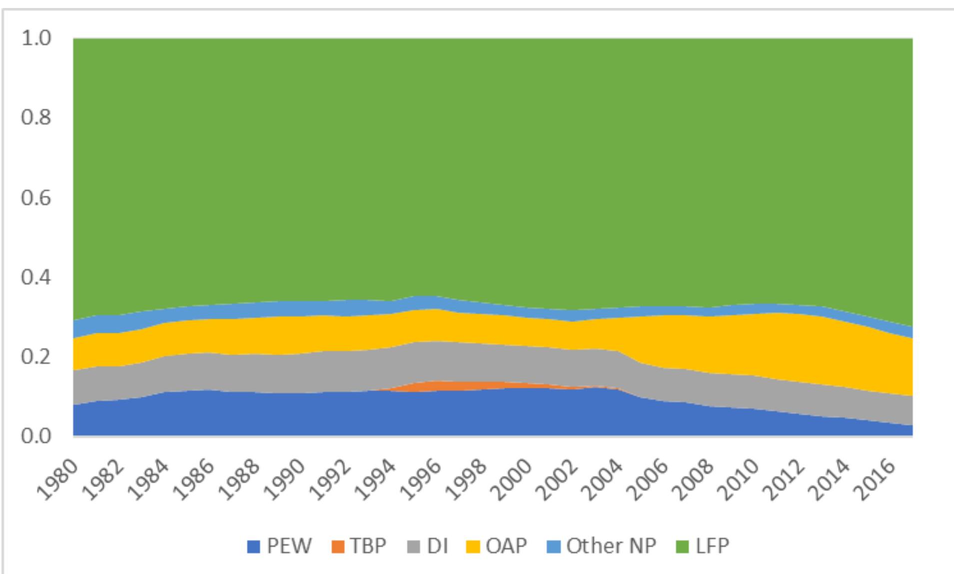
Figure 2. Pathways to Retirement for Women (top) and Men



Note: Own calculations based on population of residents in Denmark in week 48 each year in the age range 50-69 by calendar year. Of those with pension as their primary source of income during the year, the proportion of individuals with most income from each program. Category "Other" includes survivor benefits (enkepension) and civil servant's pension (tjenestemandspension).

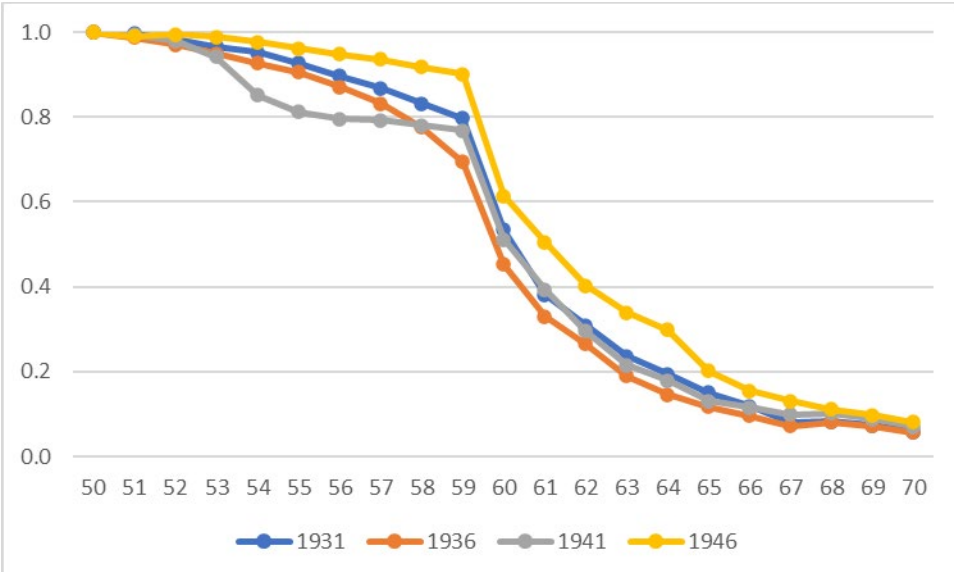
Figure 3. LFP and Pension Benefits for Women (top) and Men

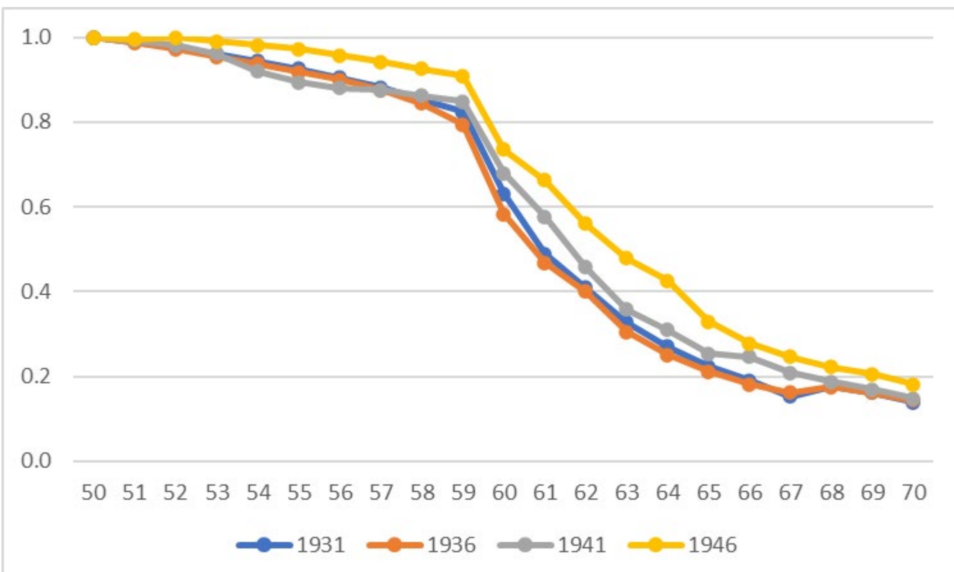




Note: Own calculations based on population of residents in Denmark in week 48 each year in the age range 50-69 by calendar year. Proportion of individuals by main income source. LFP includes all labor force participants. Category "Other NP" bundles all other transfer programs for labor market non-participants.

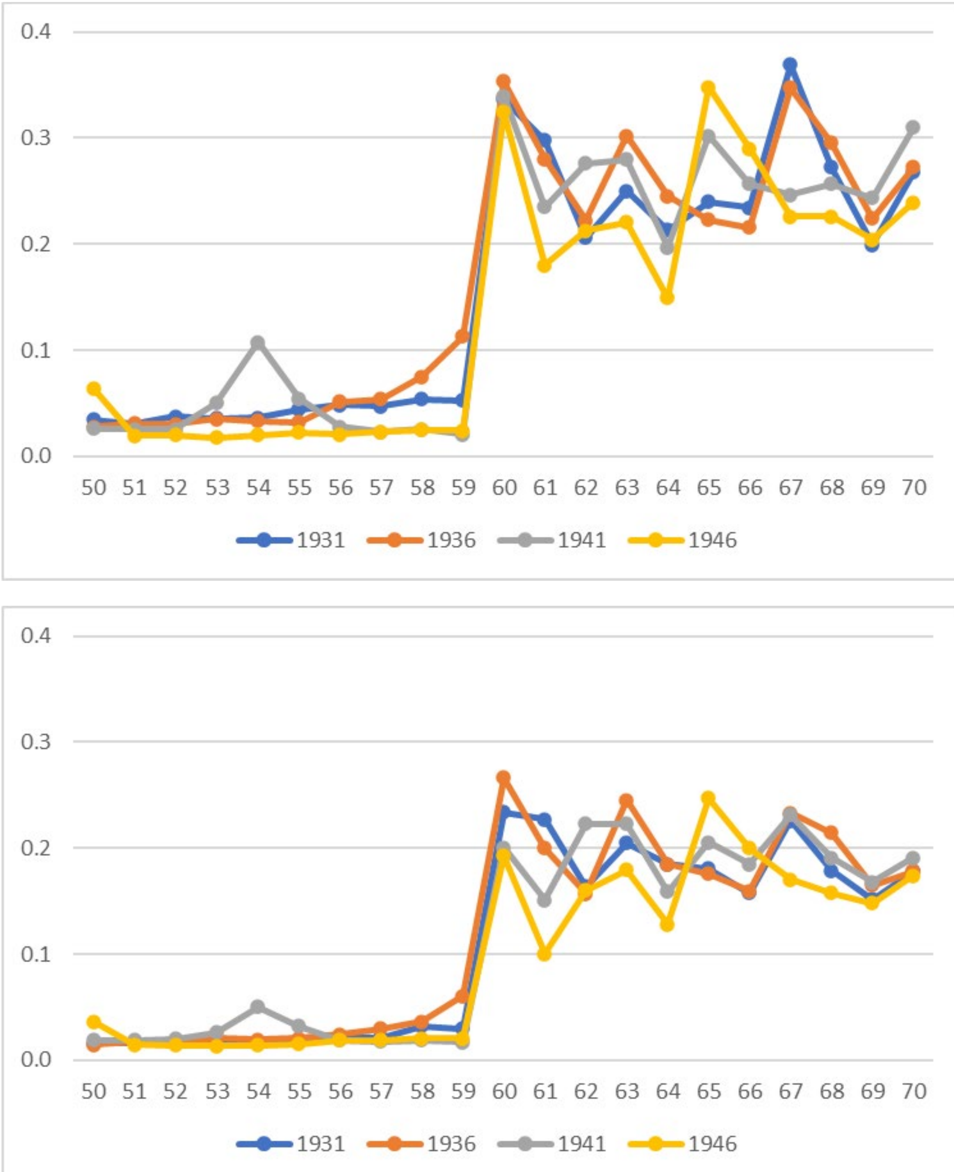
Figure 4. Labor Force Survival for Women (top) and Men





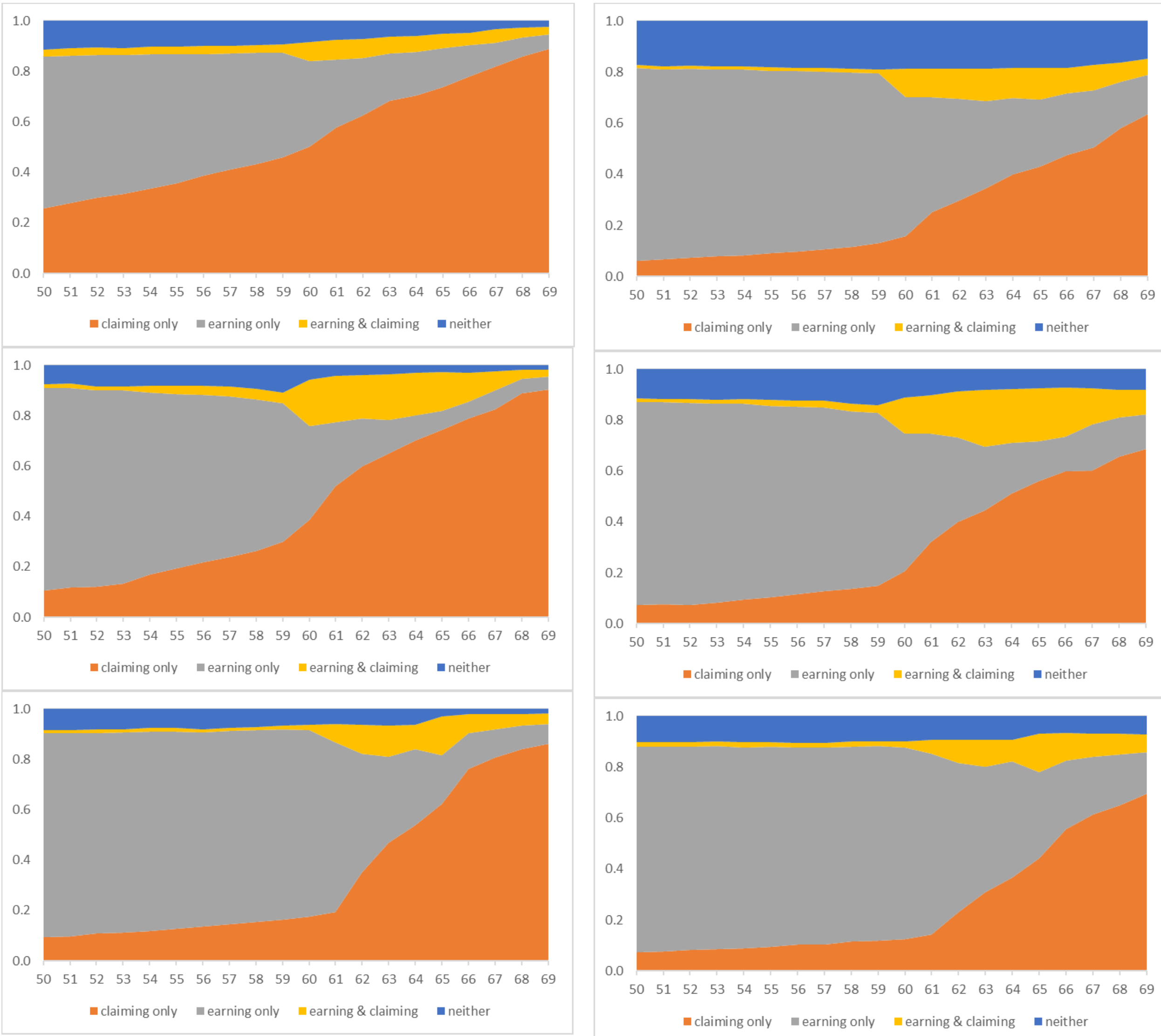
Note: Own calculations based on population of residents in Denmark in week 48 of each year. Proportion of individuals with main source of income from labor force participation by age, conditional on same status during at least one preceding year back to 1980 or age 49. Different lines for selected birth cohorts.

Figure 5. Retirement Hazard Rates for Women (top) and Men



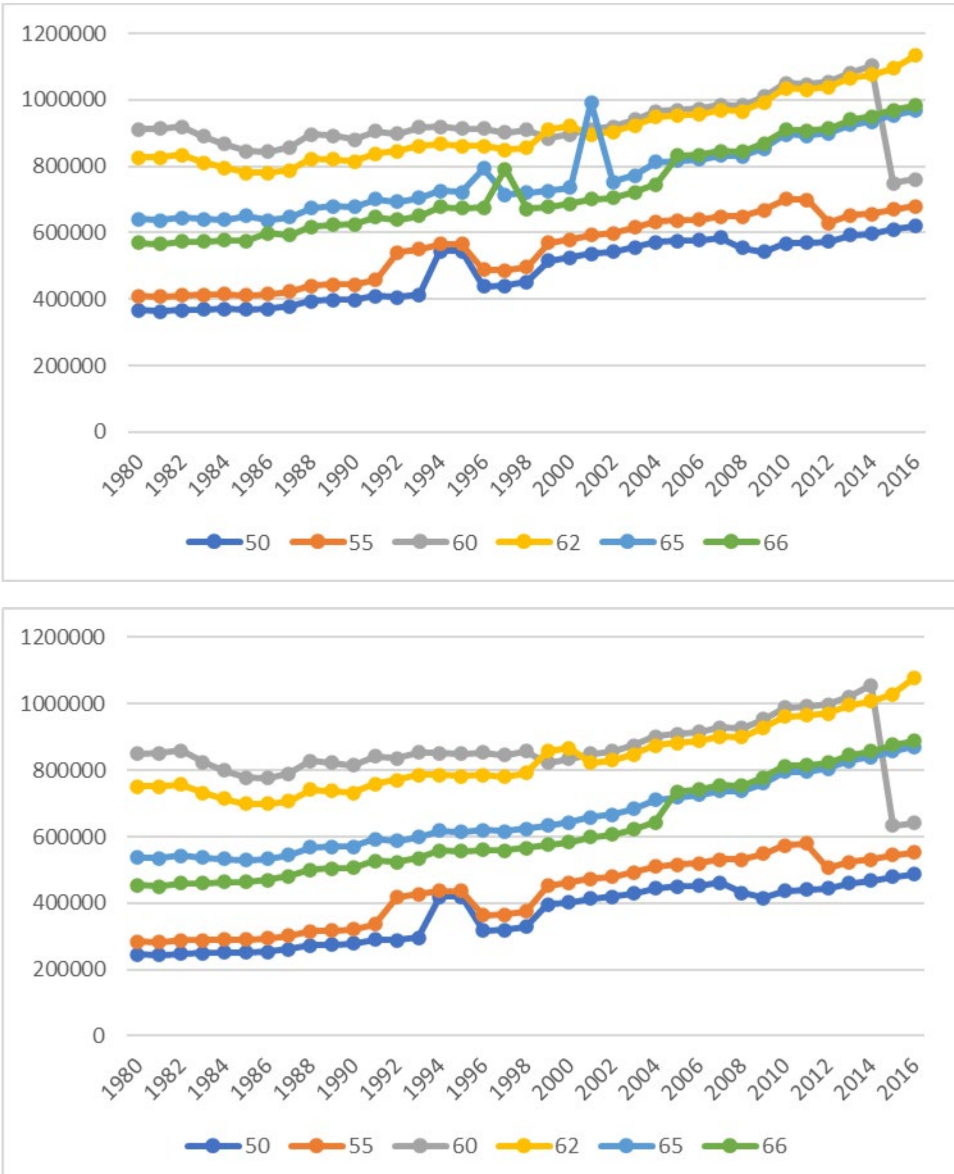
Note: Own calculations based on population of residents in Denmark in week 48 of each year. Proportion of individuals with main source of income from pension benefits by age, conditional on main source of income from labor force participation the year before. Different lines for selected birth cohorts.

Figure 6. Earning & Claiming Pension Benefits for Women (left) and Men, for 1980 (top), 2000 and 2016



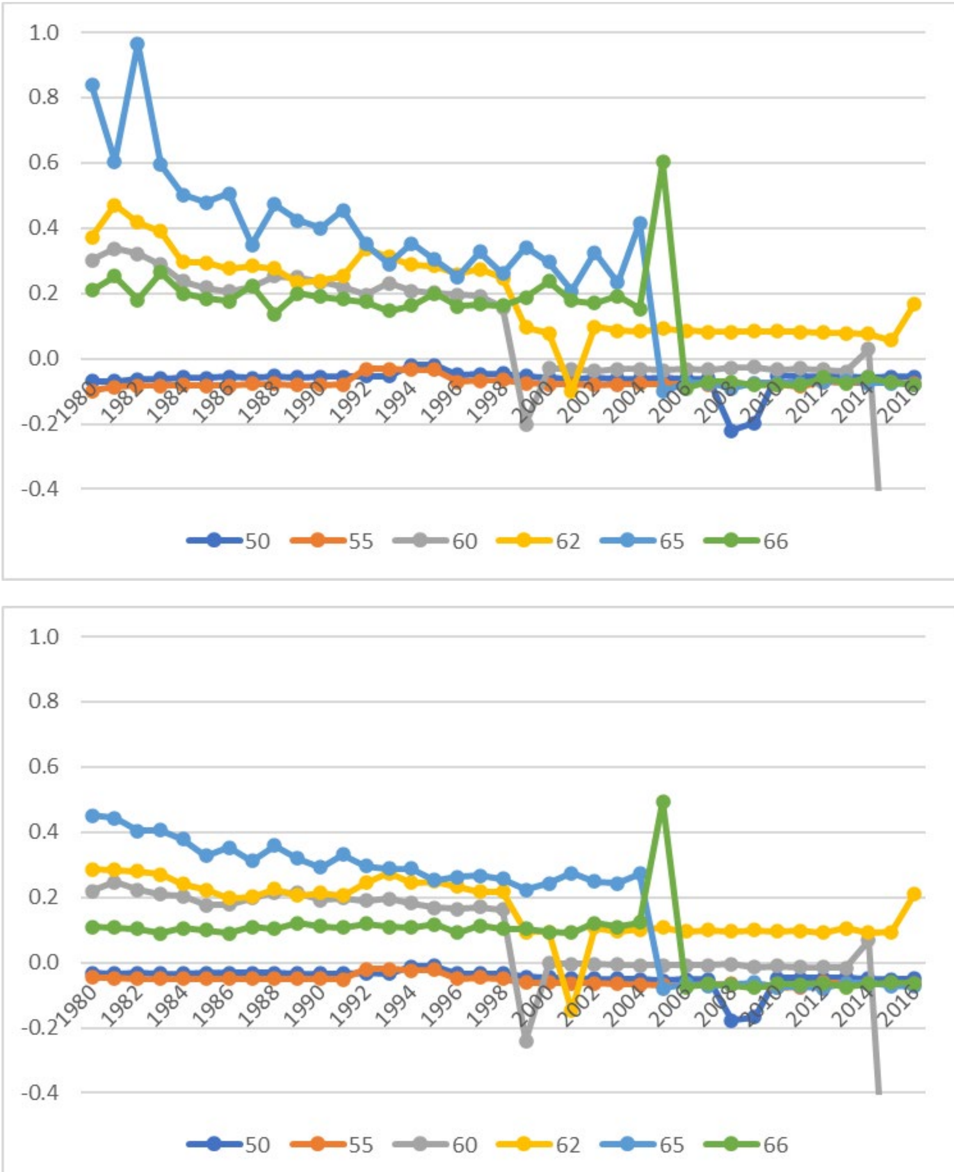
Note: Own calculations based on population of residents in Denmark in week 48 each year. Proportions of various combinations of positive/zero earnings and positive/zero benefits during the year, by age in selected calendar years.

Figure 7. Social Security Wealth for Women (top) and Men



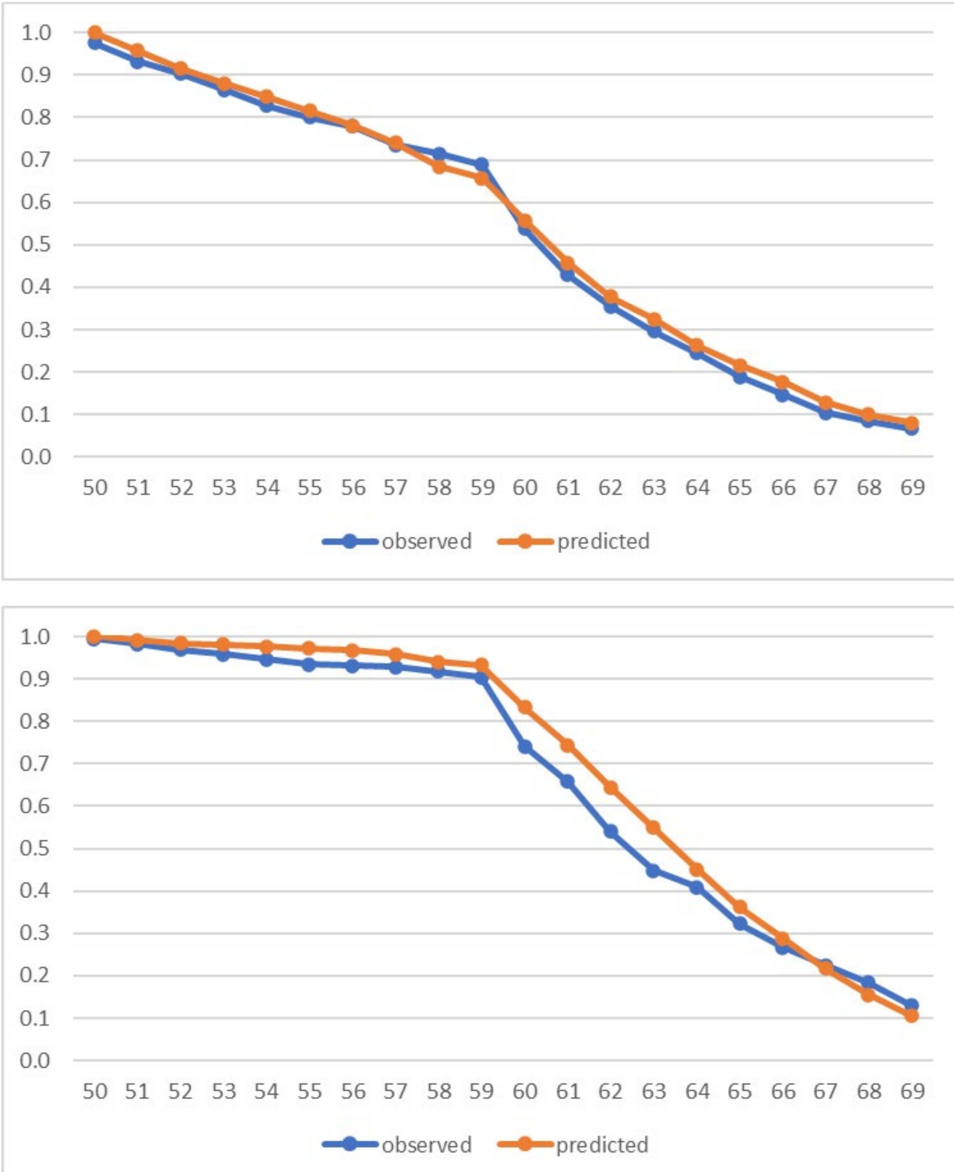
Note: Own calculations based on population of residents in Denmark in week 48 each year with valid demographic records described in Table 1, conditional on residency and labor force participation the year before. Median individual Social Security Wealth discounted by 2 percent and deflated to 2016 Euro, by calendar year. Different lines represent selected ages.

Figure 8. Implicit Tax on working one more year (ITAX) for Women (top) and Men



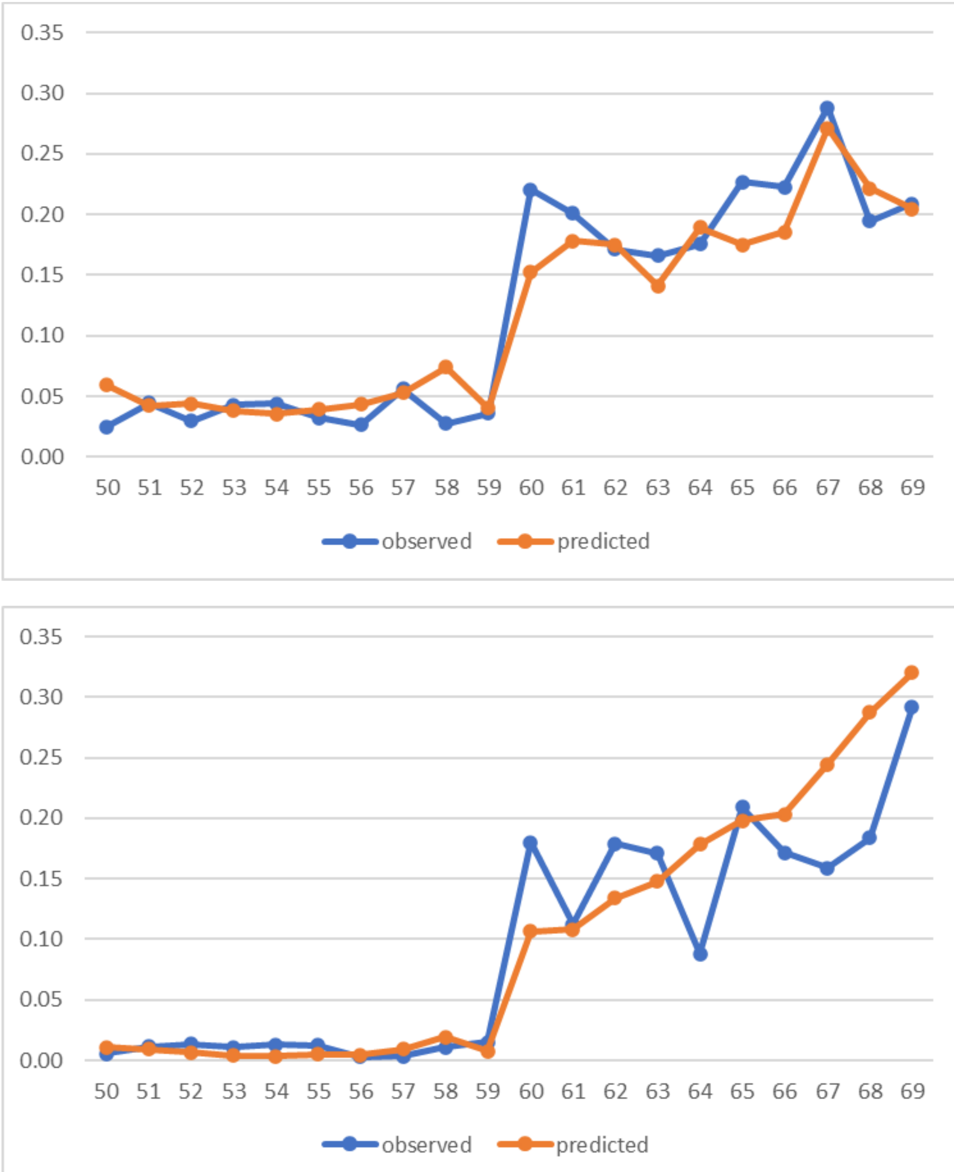
Note: Own calculations based on population of residents in Denmark in week 48 each year with valid demographic records described in Table 1, conditional on residency and labor force participation the year before. Median individual Implicit Tax Rate for working an additional year, by calendar year. Different lines represent selected ages.

Figure 9. Goodness-of-Fit for Survival in the Labor Force in 1981 (top) and 2010



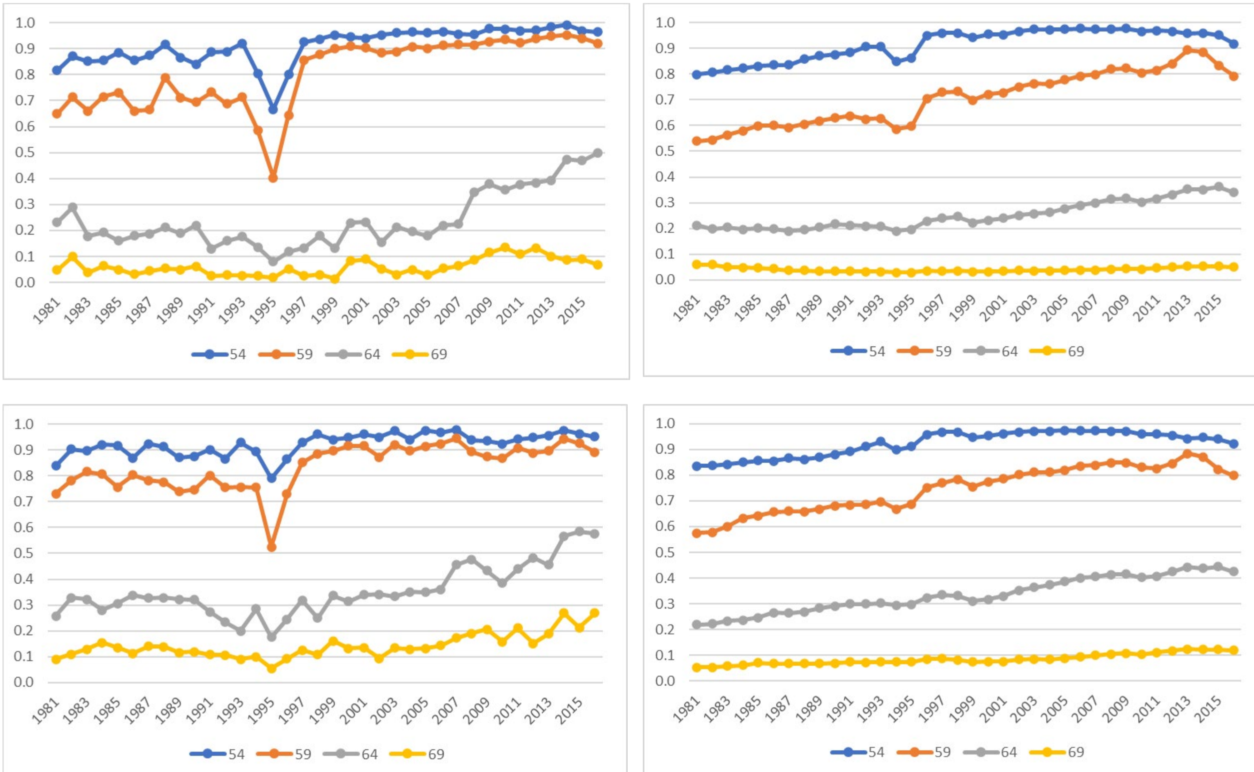
Note: Own calculations based on population of residents in Denmark in week 48 each year with valid demographic records described in Table 1, conditional on same status during at least one preceding year back to 1980 or age 49. Proportion of individuals with main source of income from labor force participation by age. Different lines represent observed and predicted proportions based on OLS estimates from the full specification presented in Table 2.

Figure 10. Goodness-of-Fit for Retirement Hazards in 1981 (top) and 2010



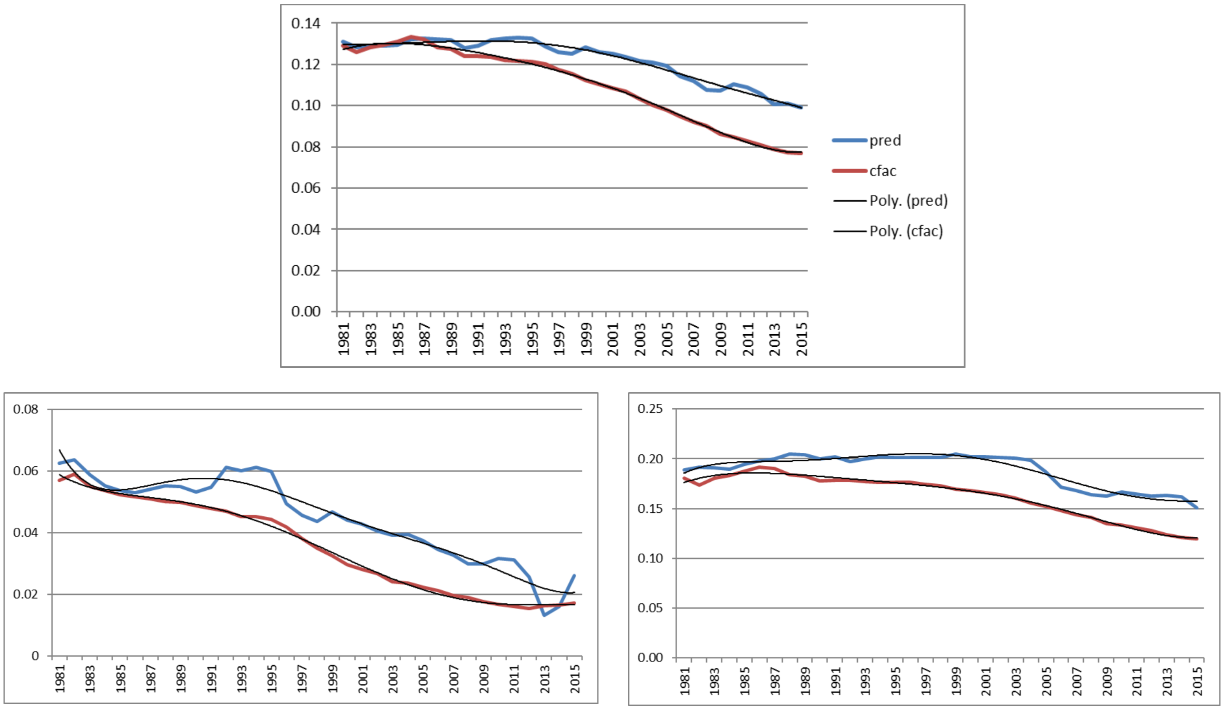
Note: Own calculations based on population of residents in Denmark in week 48 each year with valid demographic records described in Table 1, conditional on residency and labor force participation the year before. Proportion of individuals with main source of income from labor force participation by age. Different lines represent observed and predicted proportions based on OLS estimates from the full specification presented in Table 2.

Figure 11. Labor Force Participation Rates Observed (left) and Predicted for Women (top) and men



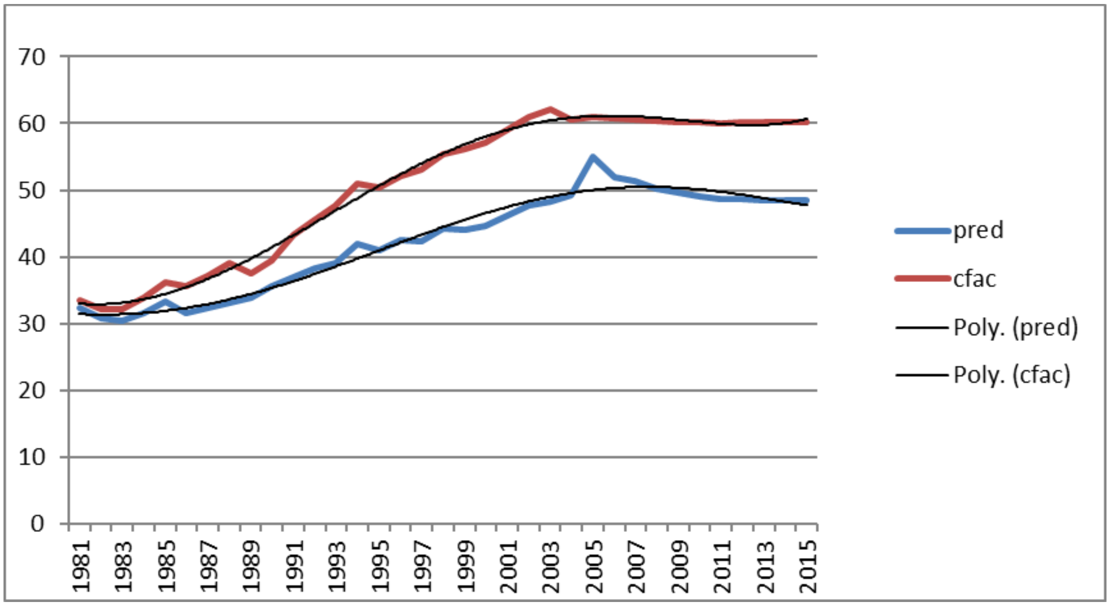
Note: Own calculations based on population of residents in Denmark in week 48 each year with valid demographic records described in Table 1, conditional on being in the labor force during at least one preceding year back to 1980 or age 49. Proportion of individuals with main source of income from labor force participation by calendar year. Different lines represent observed and predicted proportions for selected ages based on OLS estimates from the full specification presented in Table 2.

Figure 12. Retirement Probabilities for ages 55-66 (top), 55-59 (lower left) and 60-66 (lower right)



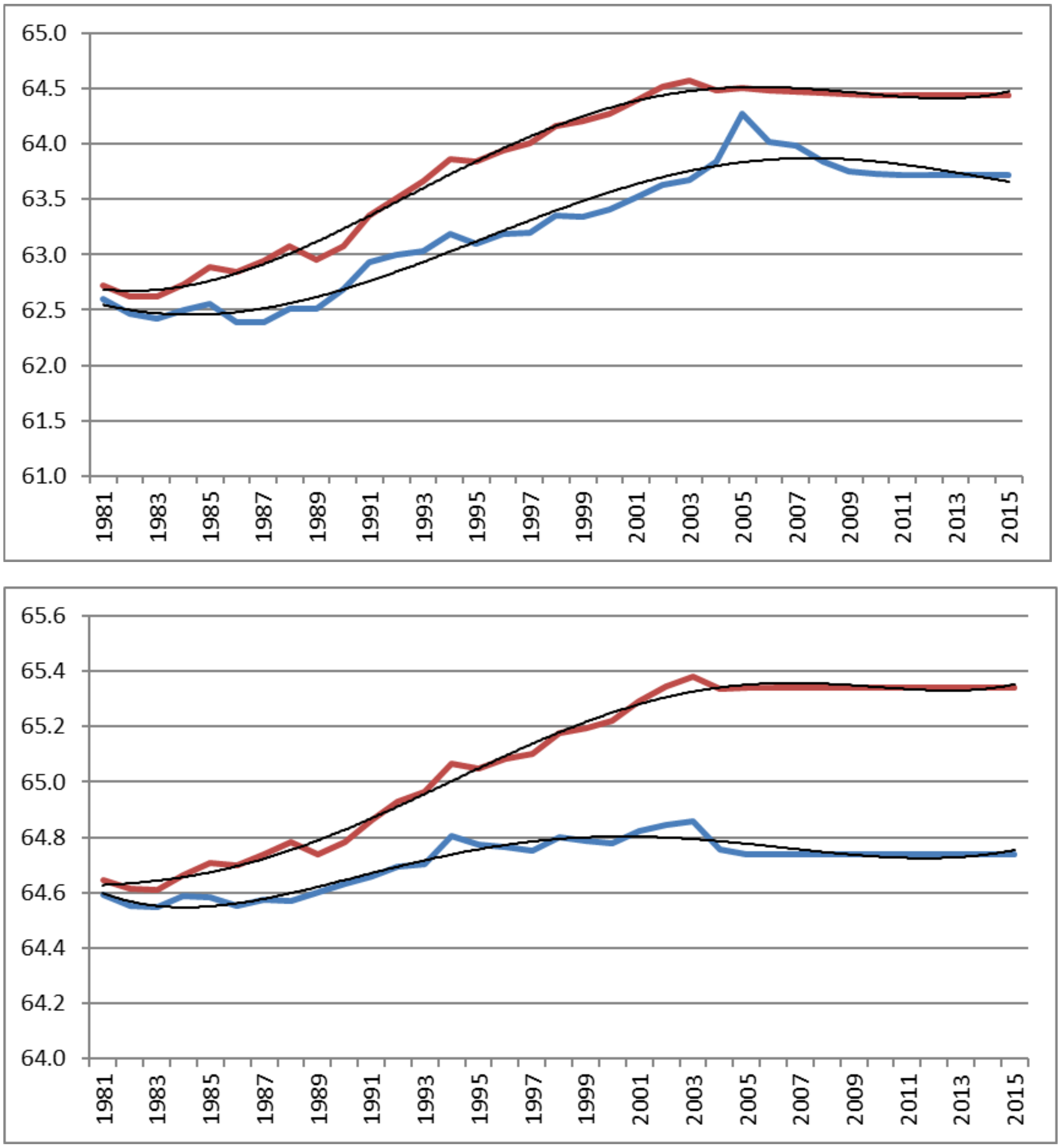
Note: Predictions (blue lines) and counterfactual simulations (red lines) based on OLS estimates presented in Table 2. Predictions use observed individual characteristics in each year and pension benefits as in place (or announced) in each year. Counterfactuals use observed characteristics in each year and pension benefits as in place in the base year 1980; incentives are recalculated using base year rules for all cohorts and these new incentives are combined with regression coefficients to calculate counterfactual probabilities of retirement. Panes in the Figure represent average retirement probabilities over different age ranges. Be aware of the different scales which are used to illustrate relative changes in predictions and counterfactuals within age group.

Figure 13. Of 100 individuals working at age 49, how many will work until they are age 65?



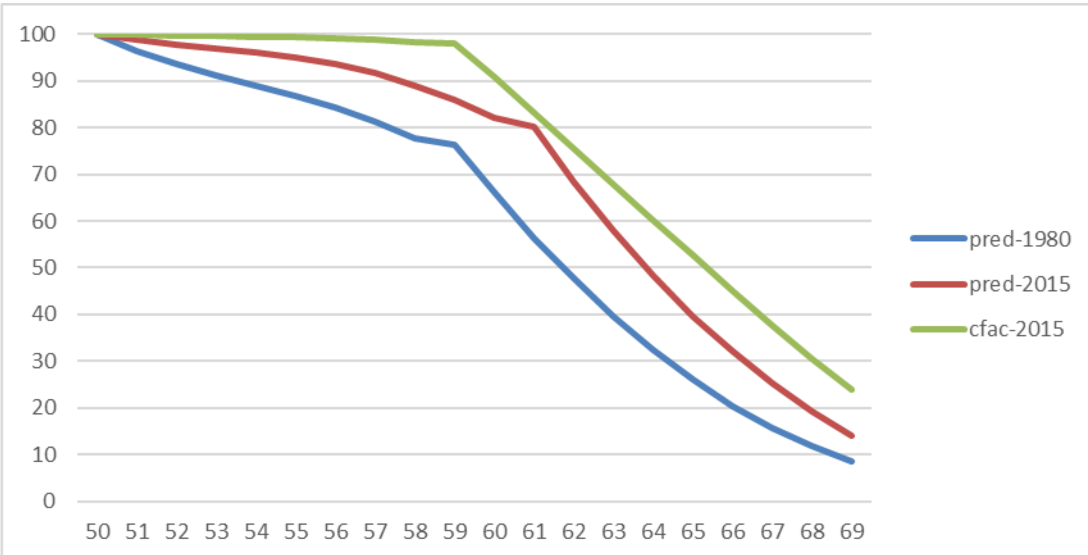
Note: Predictions (blue lines) and counterfactual simulations using 1980 incentives (red lines) based on OLS estimates presented in Table 2. Percent survival until age 65 is calculated by the product of surviving for one more year across the age range 50-65 for observed characteristics in the year denoted on the horizontal axis.

Figure 14. Expected retirement age given working at age 55 (top) and at age 62



Note: Predictions (blue lines) and counterfactual simulations using 1980 incentives (red lines) based on OLS estimates presented in Table 2. Expected retirement age is calculated by the age-weighted sum of probabilities of retiring at each age in the range 56-69 (top pane) and 62-69 (bottom pane) for observed characteristics in the year denoted on the horizontal axis. Be aware the different scales which are used to illustrate relative changes in predictions and counterfactuals for different initial working ages.

Figure 15. Predicted and Counterfactual Employment Survival Curves



Note: Predictions using 1980 characteristics and rules (blue line), predictions using 2015 characteristics and rules (red line) and counterfactual simulation using 2015 characteristics and 1980 incentives (green line) based on OLS estimates presented in Table 2. Percentage surviving in the labor force is calculated as the product of survival probabilities averaged over individuals observed in the year that characteristics are simulated.

Table 1. Descriptive Statistics - means *(standard deviations)*

	female	single	female	married	male	single	male	married
Retired=1	0.0717	*0.2581*	0.0647	*0.2459*	0.0576	*0.2330*	0.0542	*0.2263*
ITAX	-0.0692	*0.2989*	-0.0587	*0.3325*	-0.0626	*0.3115*	-0.0288	*0.3083*
SSW	0.8034	*0.2672*	0.6413	*0.1964*	0.6751	*0.2730*	0.5553	*0.2243*
Log(earnings)	12.1923	*0.8144*	12.0787	*0.8693*	12.3107	*0.9342*	12.3593	*0.9808*
No high school=1	0.3976	*0.4894*	0.4132	*0.4924*	0.4173	*0.4931*	0.3579	*0.4794*
College=1	0.2888	*0.4532*	0.2446	*0.4299*	0.1959	*0.3969*	0.2311	*0.4215*
cancer-malignant	0.0159	*0.1250*	0.0142	*0.1183*	0.0097	*0.0979*	0.0109	*0.1037*
cancer-benign	0.0142	*0.1182*	0.0148	*0.1208*	0.0082	*0.0902*	0.0085	*0.0920*
endocrine	0.0161	*0.1260*	0.0143	*0.1189*	0.0174	*0.1309*	0.0139	*0.1173*
nervous system	0.0236	*0.1519*	0.0219	*0.1464*	0.0260	*0.1590*	0.0250	*0.1563*
circulatory	0.0269	*0.1618*	0.0260	*0.1593*	0.0412	*0.1988*	0.0399	*0.1956*
respiratory	0.0114	*0.1063*	0.0092	*0.0955*	0.0128	*0.1122*	0.0109	*0.1038*
digestion	0.0211	*0.1438*	0.0208	*0.1426*	0.0285	*0.1665*	0.0268	*0.1615*
genitourinary	0.0256	*0.1580*	0.0278	*0.1643*	0.0135	*0.1155*	0.0146	*0.1199*
musculoskeletal	0.0452	*0.2077*	0.0442	*0.2056*	0.0367	*0.1880*	0.0352	*0.1843*
other	0.2228	*0.4161*	0.2189	*0.4135*	0.1212	*0.3264*	0.1089	*0.3115*
injury	0.0766	*0.2660*	0.0664	*0.2490*	0.0784	*0.2688*	0.0648	*0.2462*
age	56.6298	*4.7536*	55.8642	*4.3200*	56.3642	*4.8165*	57.0074	*4.8789*
#obs.	348791		836441		319979		1184856	

Note: Own calculations based on population of residents in Denmark in week 48 each year 1981-2016, age 50-69, with valid demographic records and conditional on residency and labor force participation the year before. SSW is Social Security Wealth reflated to 2016 million Euros. ITAX is a coefficient on the implicit tax rate for staying in the labor market another year. Log(earnings) is the log of lagged gross annual labor earnings deflated to 2016 Euro. Diagnoses are binary indicators for receiving a primary diagnosis in the National Hospital Discharge Registry in a given year; an individual can have several primary diagnoses in a year.

Table 2. OLS Retirement Estimates, full specification

	female	single	female	married	male	single	male	married
ITAX	0.0494	*0.0017*	0.0213	*0.0010*	0.0342	*0.0016*	0.0595	*0.0008*
SSW	0.0881	*0.0039*	0.2340	*0.0028*	0.1000	*0.0035*	0.0716	*0.0019*
Log(earnings)	-0.0364	*0.0006*	-0.0281	*0.0004*	-0.0234	*0.0005*	-0.0090	*0.0002*
No high school=1	0.0113	*0.0010*	0.0090	*0.0006*	0.0043	*0.0009*	0.0039	*0.0005*
College=1	-0.0005	*0.0010*	-0.0003	*0.0006*	-0.0100	*0.0010*	-0.0157	*0.0005*
cancer-malignant	0.0235	*0.0032*	0.0285	*0.0021*	0.0264	*0.0040*	0.0247	*0.0020*
cancer-benign	-0.0034	*0.0034*	0.0001	*0.0020*	0.0059	*0.0043*	0.0067	*0.0022*
endocrine	0.0071	*0.0033*	0.0089	*0.0021*	0.0121	*0.0031*	0.0150	*0.0018*
nervous system	0.0119	*0.0026*	0.0085	*0.0016*	0.0183	*0.0024*	0.0162	*0.0013*
circulatory	0.0239	*0.0026*	0.0147	*0.0016*	0.0254	*0.0021*	0.0234	*0.0011*
respiratory	0.0313	*0.0038*	0.0263	*0.0025*	0.0287	*0.0035*	0.0238	*0.0020*
digestion	0.0129	*0.0028*	0.0113	*0.0017*	0.0109	*0.0023*	0.0087	*0.0013*
genitourinary	0.0020	*0.0026*	0.0034	*0.0015*	0.0109	*0.0034*	0.0045	*0.0017*
musculoskeletal	0.0149	*0.0020*	0.0156	*0.0012*	0.0118	*0.0021*	0.0123	*0.0011*
other	-0.0009	*0.0011*	-0.0009	*0.0007*	-0.0035	*0.0013*	-0.0021	*0.0007*
injury	-0.0015	*0.0015*	0.0006	*0.0010*	0.0041	*0.0015*	0.0004	*0.0008*
Age	-0.1145	*0.0024*	-0.1399	*0.0015*	-0.0926	*0.0022*	-0.0768	*0.0012*
Age^2	0.0011	*0.0000*	0.0013	*0.0000*	0.0009	*0.0000*	0.0007	*0.0000*
Constant	3.3440	*0.0707*	3.9010	*0.0483*	2.7089	*0.0666*	2.0043	*0.0347*
#obs/R^2	348791	0.1159	836441	0.1230	319979	0.0937	1184856	0.0937

Note: OLS estimates based on the sample and variables described in Table 1. Dependent variable takes the value 1 if the individual retires during the year, and zero otherwise. Standard errors are clustered by individuals.

Table 3. Retirement Probit Marginal Effects

	female	single	female	Married	male	single	male	married
ITAX	0.0232	*0.0017*	-0.0078	*0.0009*	0.0089	*0.0015*	0.0447	*0.0009*
SSW	0.1030	*0.0037*	0.2000	*0.0026*	0.1060	*0.0032*	0.0768	*0.0018*
Log(earnings)	-0.0242	*0.0005*	-0.0196	*0.0003*	-0.0160	*0.0003*	-0.0069	*0.0002*
No high school=1	0.0122	*0.0010*	0.0099	*0.0006*	0.0050	*0.0009*	0.0034	*0.0005*
College=1	-0.0043	*0.0011*	-0.0038	*0.0007*	-0.0134	*0.0011*	-0.0170	*0.0005*
cancer-malignant	0.0188	*0.0027*	0.0220	*0.0017*	0.0150	*0.0031*	0.0157	*0.0015*
cancer-benign	-0.0018	*0.0035*	0.0004	*0.0020*	0.0051	*0.0037*	0.0048	*0.0018*
endocrine	0.0069	*0.0030*	0.0080	*0.0019*	0.0110	*0.0026*	0.0113	*0.0015*
nervous system	0.0126	*0.0024*	0.0093	*0.0015*	0.0156	*0.0021*	0.0142	*0.0011*
circulatory	0.0176	*0.0022*	0.0113	*0.0014*	0.0186	*0.0017*	0.0175	*0.0009*
respiratory	0.0262	*0.0032*	0.0213	*0.0021*	0.0188	*0.0028*	0.0171	*0.0016*
digestion	0.0120	*0.0026*	0.0104	*0.0015*	0.0103	*0.0021*	0.0077	*0.0011*
genitourinary	0.0017	*0.0027*	0.0042	*0.0015*	0.0073	*0.0028*	0.0031	*0.0014*
musculoskeletal	0.0174	*0.0019*	0.0167	*0.0011*	0.0123	*0.0019*	0.0132	*0.0010*
other	0.0029	*0.0012*	0.0026	*0.0007*	-0.0015	*0.0013*	-0.0002	*0.0007*
injury	-0.0022	*0.0016*	0.0004	*0.0010*	0.0039	*0.0014*	-0.0002	*0.0008*
Age	-0.0274	*0.0027*	-0.0484	*0.0016*	-0.0378	*0.0023*	0.0042	*0.0015*
Age^2	0.0003	*0.0000*	0.0005	*0.0000*	0.0004	*0.0000*	0.0000	*0.0000*
#obs/ps-R^2	348791	0.2100	836442	0.2321	319979	0.1871	1184856	0.2123

Note: Probit marginal effects based on the sample and variables described in Table 1. Dependent variable takes the value 1 if the individual retires during the year, and zero otherwise. Standard errors are clustered by individuals.

Table 4. Retirement Probit Marginal Effects with Spouse Incentives

	male	married	female	married
ITAX	0.0350	*0.0069*	-0.0017	*0.0071*
SSW	0.0739	*0.0140*	0.2050	*0.0200*
Log(earnings)	-0.0073	*0.0014*	-0.0164	*0.0021*
Spouse ITAX*1000	3.9300	*2.0500*	-4.7000	*13.8000*
Spouse SSW	*0.0392*	*0.0093*	0.0061	*0.0111*
No high school=1	0.0043	*0.0035*	0.0138	*0.0044*
College=1	-0.0171	*0.0041*	-0.0061	*0.0050*
cancer-malignant	0.0000	*0.0118*	0.0244	*0.0124*
cancer-benign	-0.0028	*0.0167*	0.0136	*0.0141*
Endocrine	0.0152	*0.0106*	-0.0145	*0.0172*
nervous system	0.0065	*0.0079*	0.0075	*0.0111*
Circulatory	0.0329	*0.0062*	-0.0005	*0.0106*
Respiratory	0.0117	*0.0118*	0.0033	*0.0166*
Digestion	0.0050	*0.0085*	0.0055	*0.0129*
Genitourinary	0.0071	*0.0111*	0.0132	*0.0116*
Musculoskeletal	-0.0077	*0.0078*	0.0160	*0.0083*
Other	0.0000	*0.0049*	0.0122	*0.0052*
Injury	-0.0046	*0.0061*	-0.0034	*0.0076*
Age	0.0010	*0.0115*	-0.0568	*0.0125*
Age^2	0.0001	*0.0001*	0.0005	*0.0001*
#obs/ps-R^2	20108	0.2348	14507	0.2402

Note: Probit marginal effects based on the sample and variables described in Table 1. Dependent variable takes the value 1 if the individual retires during the year, and zero otherwise. Standard errors are clustered by individuals.

Table 5. OLS Retirement Estimates, without health controls

	female	single	female	married	male	single	male	married
ITAX	0.0490	*0.0017*	0.0211	*0.0010*	0.0334	*0.0016*	0.0592	*0.0008*
SSW	0.0889	*0.0039*	0.2340	*0.0028*	0.1010	*0.0035*	0.0726	*0.0019*
Log(earn)	-0.0379	*0.0006*	-0.0293	*0.0004*	-0.0250	*0.0005*	-0.0110	*0.0002*
Age	-0.1140	*0.0024*	-0.1392	*0.0015*	-0.0924	*0.0022*	-0.0753	*0.0012*
Age^2	0.0011	*0.0000*	0.0013	*0.0000*	0.0009	*0.0000*	0.0007	*0.0000*
Constant	3.3563	*0.0706*	3.9001	*0.0482*	2.7182	*0.0665*	1.9863	*0.0347*
#obs/R^2	348791	0.1145	836441	0.1218	319979	0.0913	1184856	0.0949

Note: OLS estimates based on the sample and variables described in Table 1. Dependent variable takes the value 1 if the individual retires during the year, and zero otherwise. Standard errors are clustered by individuals.

Table 6. OLS Retirement Estimates, only with incentives

	Female	single	female	Married	male	single	male	married
ITAX	0.0968	*0.0015*	0.0433	*0.0009*	0.0763	*0.0014*	0.0748	*0.0008*
SSW	0.1670	*0.0017*	0.3240	*0.0014*	0.1310	*0.0015*	0.1830	*0.0010*
Log(earn)	-0.0612	*0.0005*	-0.0478	*0.0003*	-0.0397	*0.0004*	-0.0235	*0.0002*
Constant	0.6860	*0.0063*	0.4301	*0.0034*	0.4610	*0.0052*	0.2464	*0.0026*
#obs/R^2	348791	0.0716	836441	0.0934	319979	0.0566	1184856	0.0602

Note: OLS estimates based on the sample and variables described in Table 1. Dependent variable takes the value 1 if the individual retires during the year, and zero otherwise. Standard errors are clustered by individuals.

References

Autor, David H., Lawrence F. Katz, & Melissa S. Kearney. (2006). The Polarization of the US Labor Market. *American Economic Review*, 96(2): 189–94.

Bingley, Paul, Nabanita Datta Gupta & Peder J. Pedersen. (2010). Social Security, Retirement, and Employment of the Young in Denmark. In Social Security and Retirement Around the World: The Relationship to Youth Employment, J. Gruber and D.Wise (eds.), Chicago, University of Chicago Press D. Wise (ed.), Chicago, University of Chicago Press, .

Bingley, Paul, Nabanita Datta Gupta, Michael Jørgensen & Peder J. Pedersen. (2016). Health, Disability Insurance and Retirement in Denmark. In Social Security and Retirement Around the World: Disability Insurance Programs and Retirement, D.Wise (ed.), Chicago, University of Chicago Press, 331-68.

Bingley, Paul, Nabanita Datta Gupta & Peder J. Pedersen. (2018). From Early Retirement to Staying in the Job: Trend Reversal in the Danish Labor Market. In Social Security Programs and Retirement around the World: Working Longer, C. C. Coile, K. Milligan and D. Wise (eds.), National Bureau of Economic Research Inc., 67-86.

Bingley, Paul, Nabanita Datta Gupta, Malene Kallestrup-Lamb & Peder J. Pedersen. (2018), Labor Force Exit in Denmark, 1980-2016 – Impacts from Changes in Incentives. Forthcoming, National Bureau of Economic Research, 2020

Burr, Hermann, Jakob B. Bjorner, Tage S. Kristensen, Finn Tüchsen & Elsa Bach. (2003). Trends in the Danish work environment 1990-2000 and their association with labor-force changes. *Scand J Work Environ Health*, 29(4): 270-79.

De Økonomiske Råd (2018). Danske økonomi, Forår 2018 – finanspolitisk holdbarhed (The Danish Economy, Spring 2018 – Fiscal sustainability). Rapport fra Formandsskabet af De Økonomiske Råd, forår 2018. (Report of the chairmanship of the Economic Council, Spring 2018).

Finansministeriet (2019). Teknisk gennemgang vedr. provenuberegninger af tilbagetrækningsreformer (Technical analysis of revenue calculations of retirement reforms), Oplæg for finansudvalget, den 15. marts, 2019 (presentation to the finance working group, 15th March, 2019).

Gruber, Jonathan & David Wise (eds). (2004). Social Security Programs and Retirement Around the World: Microestimation. Chicago, University of Chicago Press.

Amilon, Anna, Paul Bingley & Torben H. Nielsen (2008) Opsat Pension : - øger den arbejdsudbuddet? (Actuarially increased old-age pension – will it increase labor supply?) SFI report 29: 08.

OECD Revenue Statistics- Denmark (2019). Center for Tax Policy and Administration.

Pensionskommissionen (2015). Det danske pensionssystem – international anderkendt men ikke problemfrit (The Danish pension system – internationally recognized but not problem-free). Pensionkommissionens rapport, januar 2015 (The Pension Commission's report, January 2015)