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Mature Worker Response to a Flexibility Reform*

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Abstract

Many consider that reducing the eligibility age for pension benefits will discourage labor supply by mature workers. This paper analyzes a recent Norwegian pension reform which effectively lowered the eligibility age of retirement from 67 to 62 for a group of workers. For the individuals we study, the expected present value of benefits was held constant by introducing flexible claiming and actuarially adjusting the periodic pension payment. This neutralized the income effect of decreasing the access age, while the abolition of any earnings test ensured constant present value of the pension, independent of the age when it is claimed. This provides us with a unique opportunity to study the isolated impact of increased flexibility. We employ a particular difference-in-difference approach, which allows us to study the effect on the distribution of labor supply behavior (represented by earnings) instead of just the mean. Older workers are found to stay longer in the labor market but with reduced intensity, implying a higher incidence of gradual exit. On average the reform leads to small and statistically insignificant increases in aggregate earnings over ages 62 to 66. The fiscal effect was negligible, due to actuarial adjustments of pensions and small changes in aggregate earnings. We do however find a reduced inflow to disability, which may add to any positive fiscal effect. Our findings thus suggest that increased pension flexibility could promote gradual exit from the labor market, allowing improved individual choice and positive welfare effects. It could also be an important component of a broader pension reform.

JEL Classification: J14; J23; J26

Keywords: Retirement; Pension; Flexibility

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1 Introduction

The access age for retirement benefits is generally seen as a key driver of the retirement decision. As life expectancy increases, more than a dozen countries in the OECD group have increased access age to induce workers to postpone their withdrawal from the labor force (OECD, 2017). Such reforms necessarily reduce flexibility in labor force withdrawal, potentially discouraging workers from gradually phasing in retirement as they age.

By contrast, the 2011 Norwegian pension reform introduced additional flexibility in pension access age, including a significant reduction, from 67 to 62 years, for an important subgroup of workers (Stølen et al., 2020). While the main reform measures, including automatic longevity adjustment and abolition of all earnings tests in the private sector, are aimed at ensuring long-term fiscal balance of the public pension system, pension claiming flexibility is an integral part of the package. The flexibility seeks to unify the budget constraints confronting various subgroups in the retirement window, who before the reform had faced a disparate array of incentives and access ages. It will allow workers to adjust to new and increased work incentives from abolishing the earnings test and to compensate longevity adjustment by delaying exit from working life. The complex structure of the pension system and the reform implied that different groups of workers were affected in different ways, allowing analysis of the behavioral responses to the flexibility separate from responses to incentives.

Increased flexibility will likely impact aggregate work effort among older workers. In addition, flexibility can have important welfare effects by allowing individuals an expanded range of choice with regard to labor market exit, while simultaneously claiming part or full pension. Several surveys (Dalen, 2016; Brown, 2005; Tuominen, 2013) report a desire by workers to gradually reduce work and by employers to retain the competence of experienced employees. A recent paper by Ameriks et al. (2020), which uses data from strategic survey questions and finds that older Americans would work longer if jobs were flexible.

However, there are a number of possible reasons why more widespread gradual labor market exit is in general not observed. Some employers may not be willing to accommodate reduced hours. There may be fixed costs to having an employee such as office space; there may be certain tasks such as meetings that take the same amount of time for all and therefore a higher proportion for part-time employees; there may be a loss of skill through less practice in a part-time job; and there may be a loss of productivity for other employees because of interdependencies (see e.g. Hutchens & Grace-Martin, 2006; Hutchens, 2010; Blau & Shvydko, 2011; Even & MacPherson, 2004; Cahill et al., 2014). For the individual there may be a fixed disutility to having a job, such as restrictions on leisure activities, commuting time and strains from work (Fan, 2015; Angrisani et al., 2015; Böckerman & Ilmakunnas, 2019).[1]

The impacts of increased flexibility on labor supply responses and earnings among older workers are therefore empirical questions. Börsch-Supan et al. (2018) analyze data from nine OECD countries using a synthetic control method and find that flexibility reforms since the 1990s have had positive but small impacts on the labor force participation rates among older men aged 55-64 but decreased their weekly working hours, creating a negative (at best zero) effect on total labor supply. Similarly, Eurofound (2016) examines partial retirement and concludes that there was "no scheme [...] identified that unambiguously extended working lives for all participants" (p. 1).

This paper studies the effect of increased retirement flexibility by analyzing the choices of a particular subgroup of Norwegian workers before and after the pension reform. For this subgroup of workers, a fixed retirement pension access age of 67 was replaced by a non-earnings tested pension available from age 62, with payments actuarially adjusted to hold constant the present value of benefits. The dominant change for

[1] On the other hand, a job may entail a stimulating environment (Kantarci & van Soest, 2013b).

this group was therefore an earlier access age to an actuarially adjusted pension, ensuring that the treatment is only a lowering of the access age to pension benefits, holding the present value of the pension constant. This paper studies how this subgroup of workers has responded to this reform, through changes in the labor force participation and the earnings level and distribution.

We base our analysis on comprehensive administrative data on labor earnings and weekly working hours. Results are based on a difference-in-difference approach, where the earnings behavior of those impacted by the reform is compared with those whose retirement trajectories preceded the reform. We find that the flexibility component of the reform leads to two distinct effects: (i) a reduction in labor supply at the intensive margin, but also (ii) an increase in labor supply at the extensive margin. Older workers are found to stay longer in the labor market but with reduced intensity, implying a higher incidence of gradual exit.[2] The net effect of these two opposing forces is a small, but statistically insignificant increase in average work effort. On average, the total earnings over the age range 62-66 among male workers who were employed at age 59 increased by around 1.1 percent (EUR 2,180).

The distributional difference-in-difference approach we employ shows that this average effect masks that some high earners reduced their annual earnings after becoming eligible for the pension at age 62, which again increased the fraction of medium earners. Further evidence using weekly working hours indicates that the reduction in earnings is caused by the high earners reducing their hours of work. At the same time, there is an increase in labor force participation, suggesting substitution from disability benefit claiming to work and pension claiming instead. The net work effect tails off at age 66, suggesting that we capture most of the net effect. Therefore, while our findings confirm that reduced workload may increase the net amount of work by making it easier to continue to work for longer, the effect of the flexibility reform on the net amount of work is positive but relatively small. Neither do we find a reduction as suggested by Börsch-Supan et al. (2018). We also find that the increase in labor force participation is partly due to reduced inflow to disability, which may add to any positive fiscal effect.

The rest of the paper is organized as follows. Section 2 provides some institutional background to the Norwegian reform to place the policy reform that we focus on in a broader context. Section 3 describes our data and the sample used. Section 4 presents our empirical approach used in this analysis. Section 5 reports our difference-in-difference approaches and estimation results. In Section 6 we discuss the results and possible mechanisms, while Section 7 concludes.

2 Institutional Setting

2.1 Before the Reform

The backbone of retirement provision in Norway is a mandatory benefit plan, the old-age pension in the National Insurance Scheme (NIS).[3] It is dependent on the income history, but bounded from below and above. The accrual rate is capped at around average full-time earnings and the pension is based on average accrual over the best 20 years, indexed to wages. At constant real earnings at a level generating a pension equal to the guaranteed minimum pension level, the replacement rate is 60 percent. At constant real earnings at the maximum pension accrual level, the replacement rate is 33 percent. In 2017, the NIS old-age pension provided two thirds of total income received by individuals aged 75, an age at which earnings play a very small role in the total income. Occupational pensions provided another 20 percent and capital income most of the remainder.

[2] Since a majority of the eligible workers claim the pension, the increase in gradual retirement involves a combination of work and claiming of pension benefits.

[3] Further details on the NIS can be found in Norwegian Ministry of Labour and Social Affairs (2019).

Prior to the 2011 pension reform, there was little flexibility in pension claiming in Norway. The occupational pensions in the private and public sector and the NIS old-age pension had an eligibility age of 67, as had most of the private sector occupational pensions. Some occupations had lower retirement age. There were generally strict earnings tests after the eligibility age and no deferral of benefits, going a long way to define age 67 as the retirement age, when earnings stopped and pension was received.

There were only two exit routes of any importance before eligibility age. The first was permanent disability pension. At age 66, around 40 percent of the population were on permanent disability benefits. The other exit route before the reform was the early retirement pension (*avtalefestet pensjon* in Norwegian, henceforth AFP) which was introduced in 1989. The AFP covers the public sector and around half of the private sector, where firms have to choose to participate to give employees the option of early retirement. In addition, individuals have to meet a set of requirements with respect to earnings and employment history. Before 2011, the AFP scheme covered the age range from 62 and up to the general pension age of 67. Those eligible had three options of combining work and pension benefits, with the percentage of normal earnings and the percentage of a full pension adding up to 100 percent. However, any pension benefit that was not claimed was not preserved, implying a high total tax of continued work (Hernæs et al., 2016).

2.2 After the Reform

Flexibility was introduced in the 2011 pension reform (Brinch et al., 2017; Kudrna, 2017; Stølen et al., 2020). The NIS old-age pension, all occupational pensions and the private sector AFP could all be claimed between age 62 and age 75, with actuarial adjustment and without tests against continued earnings. There was also an option of claiming only a part of the benefits. However, claiming the NIS old-age pension required entitlements which gave an annual pension level at least equal to the guaranteed minimum pension from age 67.[4]

The AFP in the private sector was transformed from a strictly earnings-tested early retirement pension over the age range 62-66 into a non-tested, life-long pension which had to be claimed in combination with the NIS old-age pension. Since the earnings test was repealed, work incentives for those with AFP increased sharply, delaying labor market exit (Hernæs et al., 2016). The annual benefit level was reduced so as to preserve the present value of the AFP public subsidy.

For the workers who had sufficient entitlements to be eligible for the new NIS old-age pension from age 62, and who were not covered by the AFP scheme, the only change was the access to the new, flexible old-age public pension, and in most cases of any occupational pension, from age 62. The annual level of the NIS old-age pension benefits was actuarially adjusted to preserve a constant present value. Hence, the main change for this group was a change in the flexibility of pension, and this is the group we will analyze for impact on work behavior.

The actuarial adjustment of the annual old-age pensions described above is designed to be neutral, but the adjustment implies the same implicit discount rate for all. If the subjective discount rate deviates from the internal rate in the pension system, this could give rise to incentives for early or late claiming. For instance, there is a strong mortality gradient in income which could lead to deviations from the system's implicit discount rate (see e.g. Brinch et al., 2018 for an empirical study). However, it is important to emphasize that while this may alter the incentives for *claiming*, it does not alter the incentives for *work*.[5]

[4] The reform did not change the incentives for individuals to claim old-age pensions instead of disability benefits or vice versa.

[5] In Norway, combining pensions and employment income may increase tax levied on the wage income with the same work effort if the combined income ends up in a higher tax brackets. In this case, the work incentive will be lower than before, and our estimates can be considered as a lower bound of the effects of a pure flexibility reform.

3 Data and Descriptive Statistics

3.1 Data

The empirical basis for the analyses is an extensive set of administrative register data from Statistics Norway, and a data set with all private firms offering AFP, received from the early retirement administration unit. The two are linked by encrypted firm identification numbers. The register data sets cover the whole population of Norway and are linked by unique encrypted personal identification numbers. The most important information is annual earnings, weekly hours in the most important job each year, industry affiliation of the firm, worker occupation, wealth, age, gender and education.[6,7]

3.2 Sample

The large and abrupt changes in options for potential retirees following the 2011 pension reform provide a unique opportunity to investigate the impact of pure flexibility without any influence of changed economic incentives. For the analyses below, we use pre- and post-reform groups that are constructed in the same way so that they differ only with respect to the pension system they were exposed to: (i) individuals in the post-reform group had access to the new flexible NIS pension from age 62, while (ii) individuals in the pre-reform group only had access to the old NIS pension at age 67. None had access to the private sector AFP. The difference is therefore only the introduction of flexibility and there are no changes in the economic incentives. In a difference-in-difference setup, we use ages 60-61 as controls for general labor market changes and ages 62-66 as treated. At age 67 and onwards, all individuals have access to the NIS pension, and it is no longer possible to receive disability benefits. The choice alternatives are therefore changed at the 67th birthday.[8] Specifically, the sample is constructed as described below and illustrated in Table 1 for the 1949 birth cohort.

In the first step we select from the birth cohorts 1943-1958 those observed working in at least one of the years 2009-2018. In the second step we restrict attention to those who in the year they became 59 (i) were employed as wage earners, (ii) earned at least EUR 10,000 and (iii) did not receive disability benefits (either permanent or temporary). In the third step, we include from this group only those who were not eligible for AFP (due to their employer not participating in the AFP scheme). In the fourth step, we include only those who met the after-reform requirements for claiming the new public old-age pension, with actuarial adjustment, at age 62. Before the reform, they would have access age at 67, with no deferral.[9] We only use males, since there are fairly few females in this category. Many women are employed in the public sector, and among those who are in the private sector without AFP many do not meet the post-reform pension requirements.[10] The year-age groups each comprise about 5,000 males, about 20 percent of the population.

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[6] All monetary amounts used in this paper are derived from amounts measured in NOK. The amounts are first deflated by employing the consumer price index (CPI). We have then converted the CPI-adjusted amounts to 2018-EUR using the average exchange rate between EUR and NOK in that year (1 EUR = 9.85 NOK).

[7] Note that self-employed workers are not included in the sample.

[8] We have also performed the analysis where we include age 67, which shows that the reform effect at age 67 is negligible.

[9] By including only those whom we have found not to be in the public sector or in a private sector firm with AFP at age 59, we are sure that they do not qualify for the AFP by the pre-reform requirements. A small group of private sector workers have a lower eligibility age, but we cannot identity these individuals in the data.

[10] Estimation results when women are included in the sample are qualitatively similar, and are shown in Appendix A1.

Table 1: Sampling in the 1949 birth cohort

	All	Males	Females
Birth cohort 1949 at age 59	52,585	27,302	25,283
Working at age 59 and no disability benefits	39,428	22,058	17,370
Not covered by early retirement (AFP) scheme	9,212	5,971	3,241
Eligible for new old-age pension from age 62 after reform	6,671	5,522	1,149

Source: Authors' own calculations using data from Statistics Norway.
Note: Number of observations in 1949 birth cohort by sample restriction. Working is defined as having labor earnings above EUR 10,000, while disability benefits consist of both temporary and permanent disability benefits.

While the pension point accrual formula allows for individuals to improve their annual old-age pension payout by working past the age of 62, there are several reasons why we do not expect this to be a driving force behind the observed labor supply behavior of our treatment group. Firstly, having conditioned the sample of individuals to be eligible for the new old-age pension from age 62, most individuals have a sufficient number of years of residence (40) to obtain the full basic old-age public pension (first pillar). Secondly, most have their 20 best earnings-years before the age of 62, which means that there is no further accumulation of the earnings-related old-age public pension (second pillar) beyond the age of 62. Thirdly, as demonstrated by Brinch et al. (2017) in a different but related setting, there is a lack of salience in the accrual incentives such that individuals do not take the old-age pension accrual into account when determining their labor supply.

3.3 Measuring Work

Our main measure of work is annual labor earnings. Annual earnings year-by-year will capture aspects of work which working hours do not, among them changes to less demanding and lower paid jobs, without a corresponding reduction in working hours. Our data also contain information on the contracted weekly working hours of all jobs held. However, this information is much less reliable. We have therefore used total earnings in all jobs over the year as our main outcome, as it reflects work effort in a more precise manner.[11]

3.4 Descriptive Statistics

Table 2 gives the labor force participation rate and the average annual earnings in the sample analyzed, with columns representing age and rows representing year of observation, respectively. In this table, the main diagonal line represents the 1949 birth cohort. We see a clear time trend in both the labor force participation (LFP) and earnings over time: for the workers of same age, we observe higher LFP and earnings for the more recent years. There is also a clear aging trend as well. For the same year, older workers have lower LFP and earnings than younger workers. However, the time trend is far from enough to offset the aging effect: for the same cohort, we still observe a large reduction in labor supply over time. From Table 3 we notice an increase in the labor force participation rate of the control group after the reform, but an even stronger increase after the reform in the treated group. Furthermore, the average earnings increased more in the treatment group than in the control group.

[11] While the hourly wage rate is the most accurate measure of effort per unit of work, we do not have data on this for our sample.

Table 2: Labor force participation rate and annual earnings, by year and age

Age	60	61	62	63	64	65	66
2009	0.949	0.892	0.851	0.745	0.630	0.544	0.427
	55,603	51,775	47,829	40,973	33,325	28,636	21,864
2010	0.946	0.891	0.845	0.744	0.663	0.546	0.454
	57,224	51,857	48,040	41,886	36,299	28,120	23,648
2011	0.952	0.895	0.849	0.750	0.665	0.581	0.456
	60,050	55,741	49,563	42,947	37,757	31,378	23,423
2012	0.954	0.910	0.856	0.762	0.689	0.602	0.495
	61,310	58,933	53,255	45,367	40,048	33,934	27,111
2013	0.951	0.913	0.876	0.776	0.701	0.629	0.521
	63,338	58,910	55,483	48,285	41,962	35,392	28,788
2014	0.962	0.916	0.870	0.774	0.720	0.636	0.543
	65,029	60,624	55,088	48,999	43,830	36,601	30,007
2015	0.964	0.916	0.878	0.787	0.726	0.668	0.544
	63,889	60,660	56,342	48,918	45,077	39,176	30,305
2016	0.954	0.917	0.868	0.779	0.716	0.655	0.578
	63,635	59,067	54,199	48,046	42,698	38,236	31,888
2017	0.965	0.918	0.879	0.776	0.717	0.651	0.557
	66,111	61,195	55,146	47,792	43,798	37,537	32,039
2018	0.966	0.931	0.882	0.799	0.720	0.659	0.563
	65,448	62,471	57,566	49,298	43,734	38,332	31,773

Source: Authors' own calculations using data from Statistics Norway.
Note: Each cell shows the labor force participation rate in percent (first row) and the average earnings in EUR (second row). The sample consists of those working at age 59 (without receiving disability benefits) and not covered by AFP, but meeting the requirements for claiming the new public pension at age 62. We assign zero earnings for those not in the labor force.

4 Empirical Approach

4.1 The Identification Strategy

To study the impact of the 2011 pension reform, we adopt the difference-in-differences identification strategy, comparing the change in outcomes for the treatment group in the pre- and post-treatment periods with the corresponding change for the control group.

The control group consists of individuals who are 60-61 years old, while our treatment group consists of individuals who are 62-66 years old. The treatment period is 2011 and later, when workers aged 62 and older can withdraw from the labor force with no loss in pension benefits, while the 60- and 61-year-olds cannot. Thus, before 2011, both the treatment group and the control group are constrained by the eligibility age, while after 2011, only those in the control group are constrained. Table 2 illustrates the difference-in-difference structure. The control group is to the left of the solid vertical line and the treatment group to the

Table 3: Descriptive statistics

	Control		Treatment	
	Before	After	Before	After
Labor force participation (%)	92.0	93.7	64.1	70.4
Annual earnings (EUR)				
Average	54,101	61,800	34,829	42,025
75th percentile	67,412	74,904	54,503	62,489
Median	49,266	55,809	34,236	40,996
25th percentile	36,619	41,995	0	398
Covariates, average values				
Years of completed education	12.9	13.0	12.7	12.9
Annual earnings ages 30-59 (EUR)	52,673	59,141	49,536	54,420
Net liquid wealth at age 59 (EUR)	4,637	-26,563	3,482	3,816
Number of observations	21,022	89,330	56,076	212,463

Source: Authors' own calculations using data from Statistics Norway.
Note: Descriptive statistics for the treatment and control group, before and after the reform. Labor force participation is defined as labor earnings above EUR 10,000. Net liquid wealth is defined as the sum of all assets less property and debt.

right. Within the treated group, those who below the dashed "staircase" have had the new option from eligibility age 62 while those above of the staircase but below the solid horizontal line had the new option from ages 63-66, depending on the birth cohort.[12]

A challenge to our identification strategy could be that forward-looking workers plan their work career, and the potential effect of the reform on the labor supply in the control group that this type of behavior would imply. To illustrate this, consider a 60-year old worker in the pre-reform period. This person had to wait until age 67 to retire and claim old-age pension benefits. After the reform a worker aged 60 had to wait just two years before claiming the pension benefits, which puts the worker much closer to the end of working life. The former group could therefore have a greater incentive to invest in human capital, health etc. to ensure work capacity up until the retirement age compared to the latter group. If the control group had less incentive to prepare for a longer working life after the reform, they might have a lower labor supply later on - meaning that also the control group was affected by the reform. At the same time, we could imagine that workers who would, before the reform, apply for disability benefits at age 61 now instead "wait it out" until the earliest retirement age. This would mean the reform potentially increased their labor force participation rate also later on after age 62, if the continuation in the labor force implies sustained labor supply later on.

To investigate the extent of changes in forward-looking labor market responses, we consider (i) the labor force participation rates at age 60, and (ii) the average number of working hours for the relevant sample of birth cohorts at age 60 (namely the birth cohorts 1943-1958). The results in Table 4 indicate that there seems to be no differential labor force participation rates (which is steady at around 91-97 percent) or working hours unconditional on working (and set to zero for non-working) across the birth cohorts in our analysis. The table also shows the timing of the reform for each birth cohort, in terms of (i) the age when the reform was known to the general public, and (ii) the number of years until the birth cohort was affected by the reform.

[12] Note that some individuals are in the control group in one year and in the treatment group the following year. This does not invalidate any point estimates, but it needs to be taken into account when we compute standard errors. We report block-bootstrapped standard errors, with individuals as the unit for bootstrapping. We perform 200 bootstrap replications (see e.g. Efron and Tibshirani (1993) for rule of thumb regarding the necessary number of replications).

Table 4: Labor force participation, weekly working hours and reform timing, by birth cohort

Birth cohort	Labor force participation (percent)	Unconditional weekly working hours (mean)	Years until affected	Age reform was known
1943	0.907	32.7	0	67
1944	0.921	34.0	0	66
1945	0.923	34.2	0	65
1946	0.936	34.7	0	64
1947	0.940	34.8	0	63
1948	0.948	35.2	0	62
1949	0.949	35.5	0	61
1950	0.946	35.3	1	60
1951	0.952	35.6	2	59
1952	0.954	35.8	3	58
1953	0.951	35.9	4	57
1954	0.962	36.2	5	56
1955	0.964	35.3	6	55
1956	0.954	35.4	7	54
1957	0.965	35.8	8	53
1958	0.966	35.8	9	52

Source: Authors' own calculations using data from Statistics Norway.
Note: Percentage of individuals working at age 60, number of working hours (unconditional on working, set to zero for non-working individuals) at age 60, years until affected by the reform and age at time when reform was known, by birth cohort.

4.2 Studying the Heterogeneous Effects

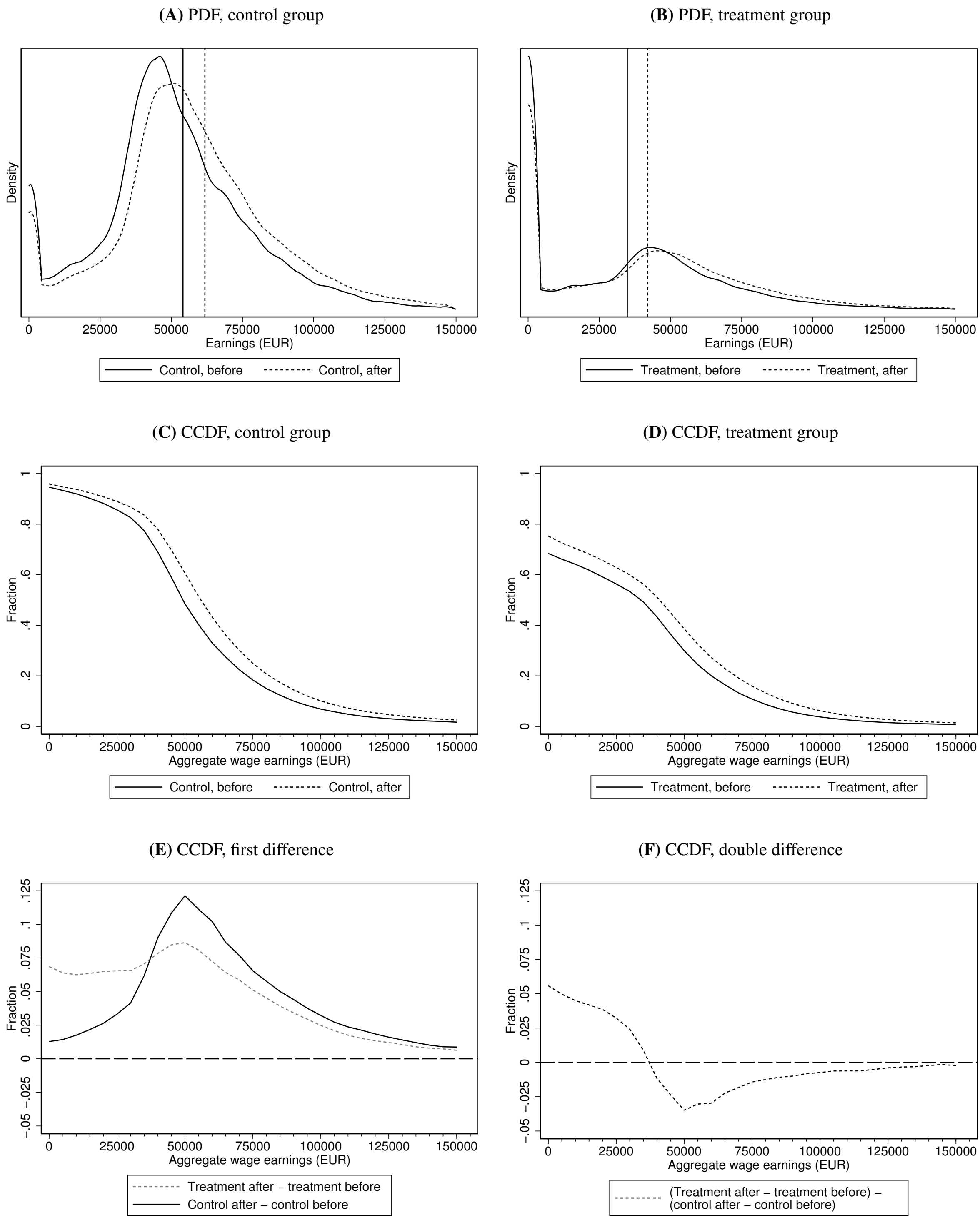
Because workers over the earnings distribution may response differently to the flexibility reform, we expect an uneven effect and would like to analyze the investigate the changes over the whole annual earnings distribution. To do this, we use an estimator based on the Complementary Conditional Distribution Function (CCDF), which is defined as 1 minus the cumulative distribution function (CDF), such that $CCDF(y) \equiv 1 - F(y)$. The construction of such distribution functions and the accompanying regression analyses of shifts and the impact of covariates are described in Hernæs and Jia (2013) and Brinch et al. (2017). When analyzing shifts and effects which can vary across the distribution, this approach is an alternative to quantile regressions (Lingxin & Naiman, 2007). Intuitively, while quantile analysis models the horizontal shifts in the cumulative function, the CCDF method models the vertical shifts. Both are suited for analyses of shifts which vary over the distribution, but the CCDF method is less cumbersome numerically.[13]

For an initial overview of our sample in terms of the earnings distribution, Panel A and Panel B in Figure 1 show the (unconditional) probability density functions (PDF) before and after the reform for the control and treatment group, respectively. Panel C and Panel D show the corresponding CCDF before and after the reform. From these diagrams, we see clearly that the earnings distribution has shifted after the reform for both the control and the treatment group.[14] However, these figures are not very informative if we are interested in studying the shifts in more detail.

To illustrate the distribution shift more clearly, we plot the (vertical) difference of the CCDFs before and

[13] A simulation exercise illustrating the qualitative equivalence of the two methods is available from the authors upon request.
[14] The low labor force participation rate of the treatment group before the reform was largely driven by individuals claiming disability benefits and exiting the labor force prior to the earliest retirement age.

Figure 1: Changes in earnings distribution, by group



Source: Authors' own calculations using data from Statistics Norway.
Note: Panel A and Panel B show the empirical plots of the (unconditional) probability density functions (PDF) of aggregate wage earnings (expressed in EUR) for the control and treatment group, respectively. The vertical lines show the mean of the aggregate wage earnings. Panel C and Panel D show the empirical plots of the Complementary Cumulative Distribution Functions (CCDF) of aggregate wage earnings (expressed in EUR) for the control and treatment group, respectively. Panel E and Panel F show the first and second vertical differences of the CCDFs in Panel C and Panel D, respectively. The sample is described in Table 3.

after the reform ($\Delta CCDF$) for both the treatment and control group in Panel E. This corresponds to the *observed* changes in the earnings distribution after the reform. For example, a difference of 6.9 percentage points at $y = 0$ for the treatment group implies that the raw labor force participation rate of that group increased by 6.9 percentage points after the reform. Other than the values of the differences, the slope of the curve also provides important information: for any given interval, the difference in $\Delta CCDF$ between the two endpoints represents the change in fractions of individuals with earnings in this interval before and after the reform. A positive (negative) average slope implies a drop (increase) in the fraction of individuals with earnings in this interval. Moreover, the steeper this slope is, the larger is the magnitude of the change. For example, for both the treatment and control group, Panel E implies a drop in the fraction of individuals within the earnings interval $(35000, 50000)$ due to the positive slopes for both groups over this interval. However, the drop is larger for the control than for the treatment group, since the former has a much steeper slope than the latter.

For both the treatment and control group, Panel E shows that $\Delta CCDF$ is positive for all earnings so that the before-reform and after-reform distribution do not cross. More formally, the after-reform earnings distribution stochastically dominates the before-reform earnings distribution, indicating higher levels of *observed* earnings after the reform. In order to isolate the treatment effect of the reform, Panel F in Figure 1 shows the difference-in-difference based on Panel E. In contrast to the first difference, the second difference is positive in the earnings interval $[0, 35000)$ and negative in the interval $(35000, 150000)$. The reform has a very uneven effect over the earnings distribution and no stochastic dominance can be established. The disagreements in effects at different parts of the distribution highlight the need for distributional analysis: while useful, no given summary measure can provide a complete picture of the reform effect.

From Panel F, we see that the reform has drawn more people into the labor force (positive reform effect at $y = 0$). However, the drop in the non-working fraction is offset by the increase over the interval $(0, 35000)$. The net result is that the fraction of individuals with earnings less than EUR 35,000 is the same before and after the reform. In the meantime, the reform shifts the rest of the earnings distribution to the left: there is an increase in the fraction of individuals with earnings between EUR 35,000 and EUR 50,000, and a reduction between EUR 50,000 and EUR 150,000. In sum, the reform seems to have increased the relative fraction of workers aged 62-66 in the lower part of the earnings distribution (below EUR 50,000) and decreased the relative fraction of workers aged 62-66 in the upper part of the earnings distribution (above EUR 50,000 and up to EUR 150,000). So the reform has a positive effect on the labor participation rate, while a negative effect on earnings by shifting the mass from the upper part of the earnings distribution to the lower part of it. These two effects point in opposite directions, which means that the overall effect cannot be recovered by simple visual inspection. In Section 5, we formalize the above idea and also include (pre-determined) covariates and dummies for time and age to partial out compositional differences, which is not done in the construction of the graphs in Figure 1.

5 Empirical Results

In this section, we present the difference-in-differences analysis of the 2011 Norwegian pension reform on labor earnings. We first present the effect on mean earnings and then the effects on the earnings distribution.

5.1 Effect on Mean Earnings

We estimate the following linear difference-in-difference equation to derive the effect on mean earnings:

$$y_{i,a,t} = \alpha + X_i\beta + \sum_{s=61}^{66} \gamma_s DA_s + \sum_{l=2010}^{2018} \lambda_l DT_l + \eta \Delta_{i,a,t} + \varepsilon_{i,a,t} \quad (1)$$

Here $y_{i,a,t}$ is the annual pre-tax labor earnings of individual i at age a in year t. The vector X_i includes controls for education length, education length squared, log average annual pre-tax earnings from age 30 to age

59, and net liquid wealth at age 59. $\Delta_{i,a,t}$ indicates the treatment variable, and equals one when individual i is in the treatment group after the reform and zero otherwise. DA_s are dummy variables for age (with age 60 as the reference age) and DT_l are dummy variables for year (with 2009 as the reference year). $\varepsilon_{i,a,t}$ is the error term. In order to explore potential age-dependent effects of introducing the flexible pension on mean earnings, we also estimate the following model with treatment effects interacted with age:

$$y_{i,a,t} = \alpha + X_i\beta + \sum_{s=61}^{66} \gamma_s DA_s + \sum_{l=2010}^{2018} \lambda_l DT_l + \sum_{m=62}^{66} \eta_m DA_m \Delta_{i,a,t} + \varepsilon_{i,a,t} \tag{2}$$

Note that the specifications in Equation (1) and Equation (2) resemble so-called "staggered DiD" setups (Goodman-Bacon, 2021; Sun & Abraham, 2021). This implies that the estimates from the two-way fixed effects models in Equation (1) and Equation (2) recover a weighted average of treatment effects for different cohorts over different time periods. Recent research has shown that these weights may lack economic interpretation and lead to potential bias. In these cases, estimate of the average treatment effects from Equation (1) and Equation (2) do not provide valid estimate of the causal effect of interest. To check whether this is potentially problematic for our study, we follow the suggestions by Sun and Abraham (2021) and estimate a fully saturated specification where we obtain cohort- and age-specific treatment effects. The results show no evidence that treatment effects differ across cohorts, which indicates that specifications in Equation (1) and Equation (2) do not suffer from the "staggered DiD" problem.

Figure 2 shows the OLS estimates for the average effect on the earnings and the age-specific effects on earnings. When only controlling for age and year dummies (black lines), there is a negative but insignificant effect on average over ages 62-66 (a reduction of EUR 595, or 1.2 percent of pre-reform earnings of the treatment group at age 59) while the age-dependent effects are significant for age 64. Adding the pre-determined covariates (gray lines) shifts up the age-dependent estimates of the reform effect, with the treatment effect at age 64 and 65 now being significant. The average effect (an increase of EUR 448, or 0.9 percent) is still statistically insignificant after adding the pre-determined covariates.

Furthermore, we can derive the year-by-year impact of introducing the flexible old-age pension on mean labor earnings by estimating the following linear difference-in-difference equation:

$$y_{i,a,t} = \alpha + X_i\beta + \sum_{s=61}^{66} \gamma_s DA_s + \sum_{l=2010}^{2018} \lambda_l DT_l + \sum_{m=2010}^{2018} \eta_m DT_m \Delta_{i,a,t} + \varepsilon_{i,a,t} \tag{3}$$

Figure 3 shows the OLS estimates for the average effect on the earnings and the year-specific effects on earnings. The reform effect at the time of reform (2011) is significantly negative with a decrease of EUR 1,729, but then generally increases over time. Furthermore, there are no significant reform effects in the pre-reform year (2010).

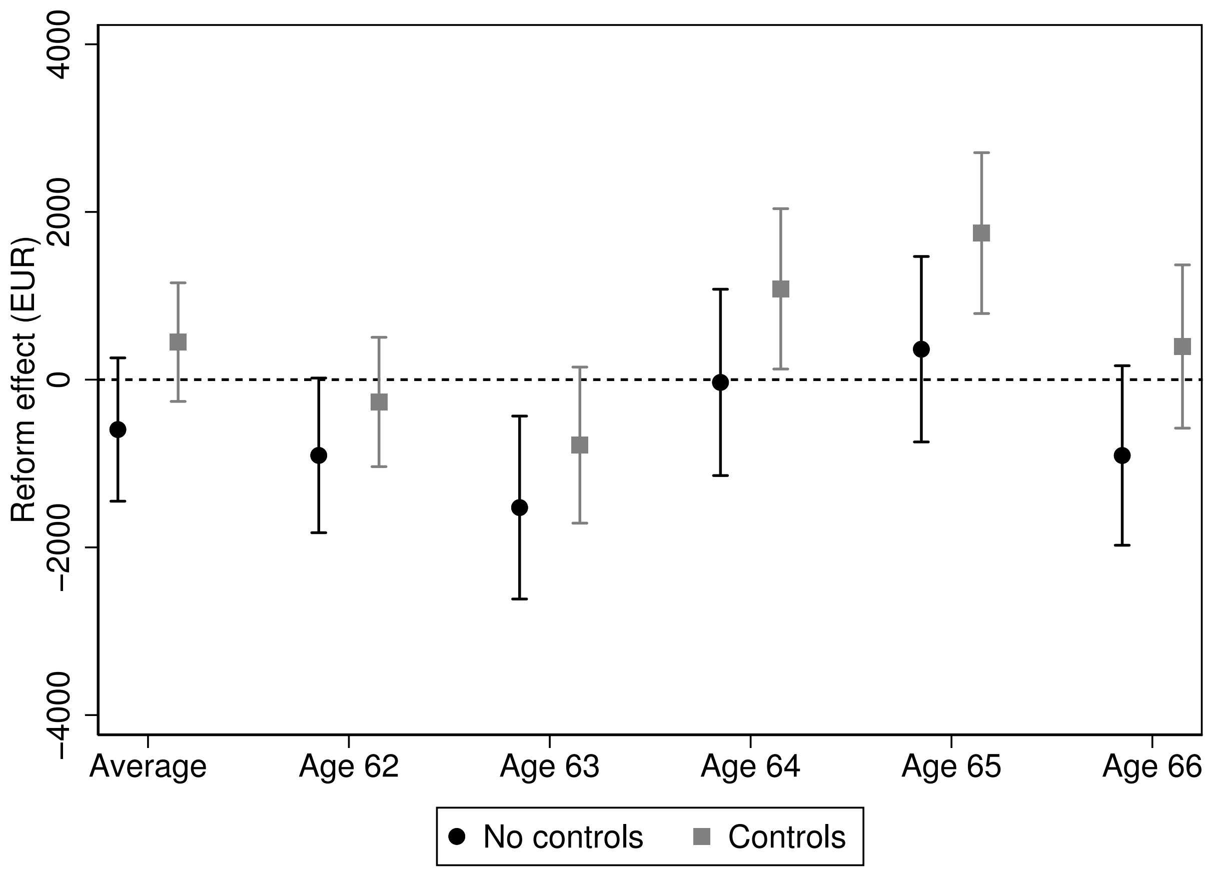
The differential changes to the shape of the earnings distributions illustrated in Panel A and Panel B in Figure 1 suggest that the results in Figure 2 and Figure 3 are not necessarily sufficient to capture the full effect of introducing the flexible old-age pension.[15] We now turn to this question.

5.2 The CCDF Method

While Figure 1 shows the simple difference-in-difference estimate of the reform effect, it does not take into account the observables used for estimating the effect on mean earnings using OLS. To take these into ac-

[15] To illustrate this with a conventional approach, we show the effect of introducing the flexible pension on earnings at different deciles of the (unconditional) earnings distribution using the recentered influence function difference-in-difference (RIF-DiD) approach (Firpo et al., 2009), and compare this to the mean (OLS) impact of the reform shown in Figure 2. The complete estimation results are available from the authors upon request.

Figure 2: Reform effect on mean earnings, by age



Source: Authors' own calculations using data from Statistics Norway.
Note: OLS estimation results of the average reform effect on earnings from Equation (1) and the age-specific reform effects on earnings from Equation (2). Black lines indicate estimation results with no control variables, gray lines indicate estimation results with control variables. Control variables are pre-determined and include linear controls for education length, education length squared, log average annual pre-tax earnings from age 30 to age 59, and net liquid wealth at age 59. The capped lines show the 95 percent confidence intervals, based on standard errors clustered on the individual level with 200 non-parametric bootstrap replications. Point estimates and the associated standard errors are deferred to Appendix A4.2.

count, we run a series of linear regressions on the probability of having earnings above a series of steps, each of length EUR 5,000, up to EUR 150,000. Intuitively, this explores vertical shifts in the CCDF distributions shown in Panel B in Figure 1. With a constant treatment effect for all years and ages we assume, for each earnings level $y_{i,a,t}$ for individual i at age $a = 60, \ldots, 66$, that the vertical shifts can be expressed as:

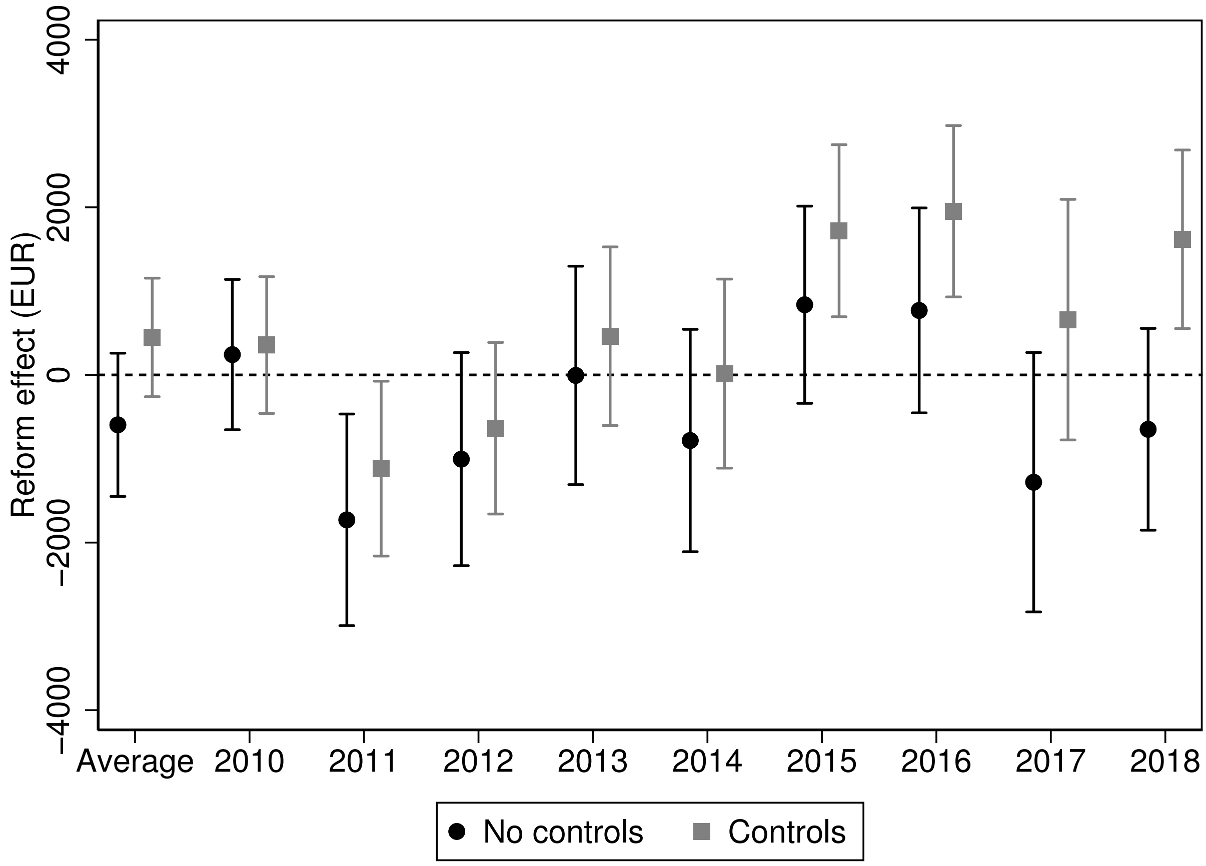
$$\mathbf{1}\left(y_{i,a,t} > y_k\right) = \alpha + X_i\beta + \sum_{s=61}^{66} \gamma_s DA_s + \sum_{l=2010}^{2018} \lambda_l DT_l + \eta\Delta_{i,a,t} + \varepsilon_{i,a,t} \tag{4}$$

The variables are defined as in Equation (1), where the outcome variable on the left-hand side equals one if $y_{i,a,t} > y_k$ and zero otherwise. We estimate the specification for 31 specific cases, letting y_k vary from EUR 0 to EUR 150,000 by increments of EUR 5,000 such that $y_k \in \{0, 5000, 10000, \ldots, 145000, 150000\}$. The coefficient η measures the treatment effect of interest.

With a constant treatment effect for all years, but allowing for different treatment effects over ages 62-66, we assume that for each earnings level $y_{i,a,t}$ for individual i at age $a = 60, \ldots, 66$ this can be expressed as:

$$\mathbf{1}\left(y_{i,a,t} > y_k\right) = \alpha + X_i\beta + \sum_{s=61}^{66} \gamma_s DA_s + \sum_{l=2010}^{2018} \lambda_l DT_l + \sum_{m=62}^{66} \eta_m DA_m \Delta_{i,a,t} + \varepsilon_{i,a,t} \tag{5}$$

Figure 3: Reform effect on mean earnings, by year



Source: Authors' own calculations using data from Statistics Norway.
Note: OLS estimation results of the average reform effect on earnings from Equation (1) and the year-specific reform effects on earnings from Equation (3). Black lines indicate estimation results with no control variables, gray lines indicate estimation results with control variables. Control variables are pre-determined and include linear controls for education length, education length squared, log average annual pre-tax earnings from age 30 to age 59, and net liquid wealth at age 59. The capped lines show the 95 percent confidence intervals, based on standard errors clustered on the individual level with 200 non-parametric bootstrap replications. Point estimates and the associated standard errors are deferred to Appendix A4.3.

Here, η_m for $m = 62, \ldots, 66$ measures the age-specific treatment effect. The age-specific treatment effects will capture any gradually increasing impact of the reform on the earnings distribution.

Lastly, with a constant treatment effect for all ages, but allowing for different treatment effects over years, we assume that for each earnings level $y_{i,a,t}$ for individual i in year $t = 2010, \ldots, 2018$ the vertical shifts can be expressed as:

$$\mathbf{1}\left(y_{i,a,t} > y_k\right) = \alpha + X_i\beta + \sum_{s=61}^{66} \gamma_s DA_s + \sum_{l=2010}^{2018} \lambda_l DT_l + \sum_{m=2011}^{2018} \eta_m DT_m \Delta_{i,a,t} + \varepsilon_{i,a,t} \tag{6}$$

The graph in Figure 4 is based on 31 separate estimations, one for each of the earnings levels described above. The estimated effects are used to simulate the CCDF of the earnings distributions of the type given in Panel B in Figure 1, which then shows the marginal effects equal to the difference in the post-reform and pre-reform probability of earnings higher than a given level y_k: $P\left(y_{i,a,t} > y_k | \Delta_{i,a,t} = 1, X_i, DA_s, DT_l\right) - P\left(y_{i,a,t} > y_k | \Delta_{i,a,t} = 0, X_i, DA_s, DT_l\right)$. The identifying assumption is the standard one within the difference-in-difference framework, namely no selection on the change in the non-treatment outcome level. However,

Table 5: Probability of being in selected earnings intervals

Earnings interval	Probability (before reform)	Reform effect	
		Estimate	Standard error
Non-participation (EUR 0)	0.316	-0.053	0.003
EUR 0 - EUR 30,000	0.151	0.029	0.005
EUR 30,000 - EUR 50,000	0.234	0.051	0.006
EUR 50,000 - EUR 80,000	0.213	-0.024	0.006
> EUR 80,000	0.087	-0.004	0.003

Source: Authors' own calculations using data from Statistics Norway.
Note: Probability of being in different earnings intervals and the reform effect on the probability of being in the different intervals. The reform effect is generated using the marginal effects from Figure 4, with pooled standard errors in the last column. The procedure is described in Appendix A3.1.

in our setting the identifying assumption must hold at *each* point on the support of the dependent variable:

$$\begin{gathered} E\left(\mathbf{1}\left\{y^0_{i,a,t\geq 2011} > y_k\right\} - \mathbf{1}\left\{y^0_{i,a,t<2011} > y_k\right\} | a_{t\geq 2011} \geq 62\right) \\ = \\ E\left(\mathbf{1}\left\{y^0_{i,a,t\geq 2011} > y_k\right\} - \mathbf{1}\left\{y^0_{i,a,t<2011} > y_k\right\} | a_{t\geq 2011} < 62\right), \;\; \forall k \end{gathered} \tag{7}$$

Here, $\mathbf{1}\{\bullet\}$ denotes the indicator function, equal to one if the argument holds true and zero otherwise, while the superscript 0 indicates the potential outcome if not treated. This means that the first line of Equation (7) expresses the expected value of the difference in likelihood of potential earnings under non-treatment ($y^0_{i,a,t}$) being greater than y_k after and before the reform in 2011, conditional on being aged 62 or more after the reform in 2011 (i.e. being in the treatment group). In full, the identifying assumption therefore states that in the absence of the reform, the change in the population shares at each of the earnings thresholds would have been the same in the treatment and control group.

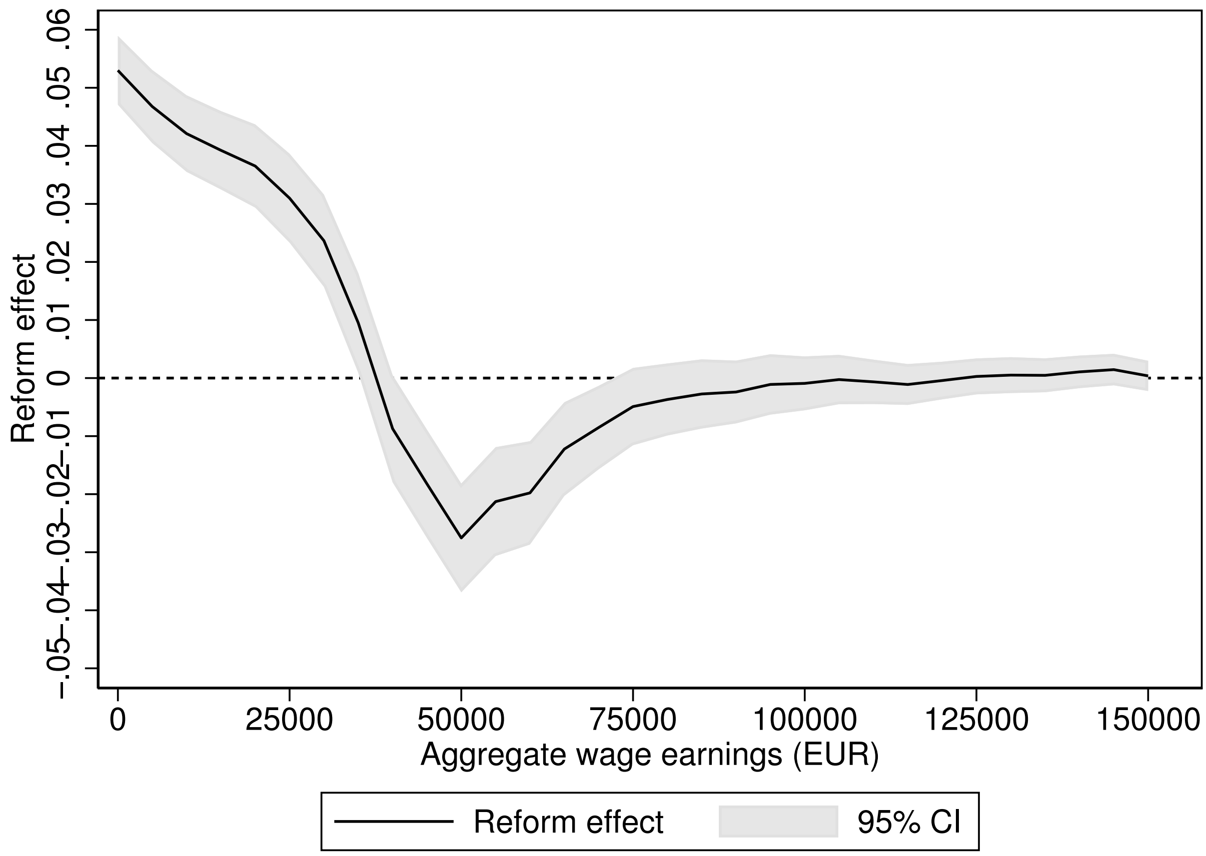
5.3 Reform Effect

Figure 4 shows, based on estimating Equation (4) with controls for individual (pre-determined) characteristics and dummies for age and calendar year, the average effect over all ages and years of the reform on the probability of having earnings above the earnings levels of the horizontal axis. The gray-shaded area around the curve with point estimates gives the 95 percent confidence interval. We see that when taking into account covariates, time- and age-fixed effects, the estimated effect is very similar to the raw difference-in-difference estimates in the data plots in Panel F in Figure 1.

The point estimates in Figure 4 start above zero, which means that the reform resulted in an increase in the labor force participation rate (of 5.3 percentage points). At EUR 50,000, the point estimate is significantly negative at -2.8 percentage points, with a 95 percent confidence interval from -3.7 to -1.8 percentage points. This means that the reform has increased the net fraction with earnings up to about EUR 50,000 by about 3 percentage points, which is mirrored by a reduction in the fraction above EUR 50,000.

The corresponding shifts in the probability of being in different intervals of the earnings distribution are shown in Table 5. The shifts in the earnings distribution are compatible with the process of gradual retirement, with both an increase in the mass in the middle part of the earnings distribution and an increase in the labor force participation rate.

Figure 4: Reform effect on earnings distribution



Source: Authors' own calculations using data from Statistics Norway.
Note: Simulation results from estimation of Equation (4), showing the difference in the CCDF for the treatment group and the control group. The gray-shaded area shows the 95 percent confidence intervals (based on 200 non-parametric bootstrap replications for each estimation, clustered on individual level). Aggregate earnings are expressed in EUR. Point estimates and the associated standard errors are deferred to Appendix A4.1.

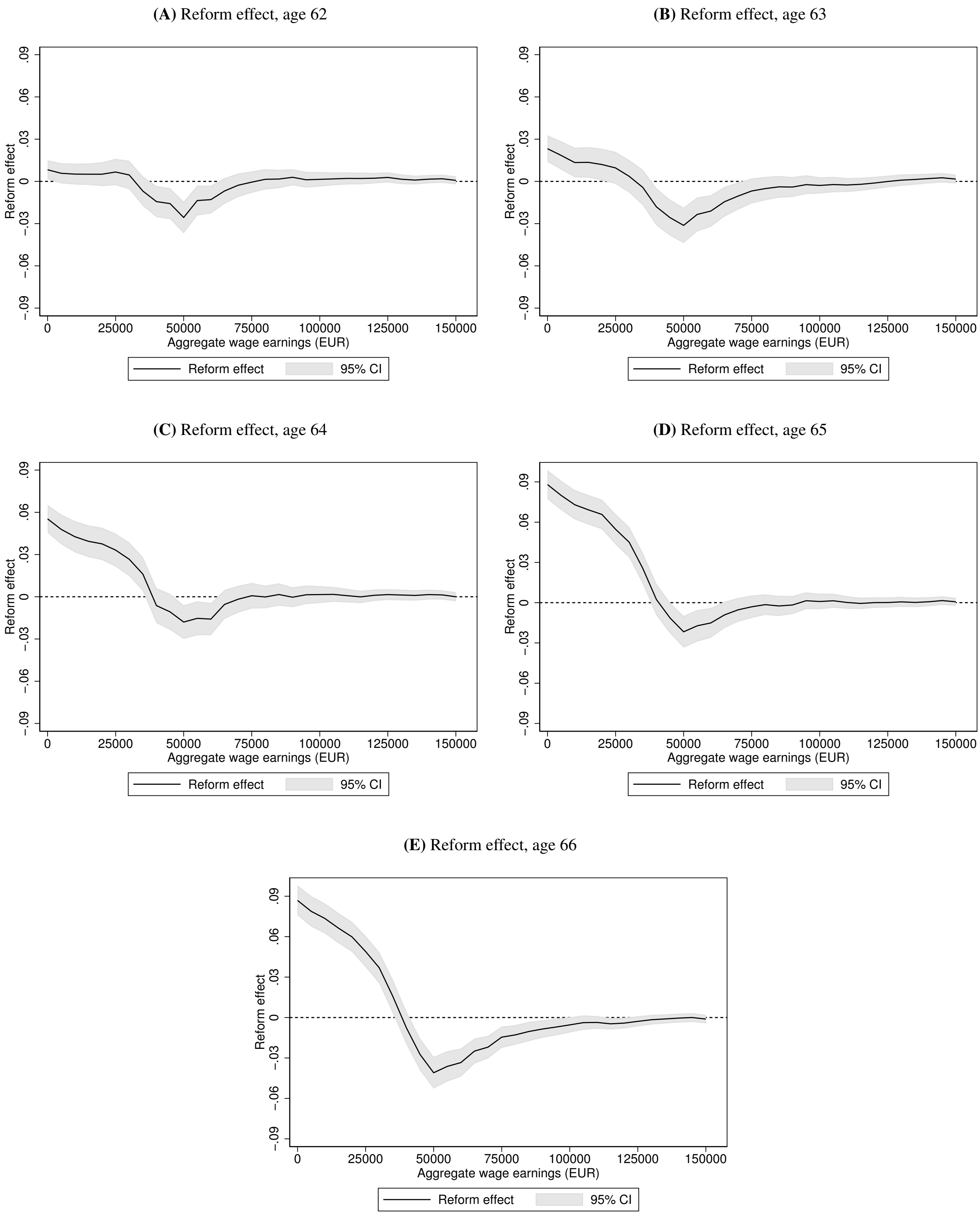
5.4 Age-Specific Reform Effects

The age-by-age results from estimating Equation (5) are illustrated in Figure 5. Looking at the starting points in Figure 5, the labor force participation rate is estimated to be between 0.8 and 8.8 percentage points higher for age 62 through age 66, with the changes being statistically significant. In all of the panels, the point estimates show larger effects on the lower part of the earnings distribution, up to about EUR 50,000. It seems that the flexible claiming option increases gradual labor market withdrawal (by means of reducing earnings), while at the same time increasing the labor force participation. From the age-by-age analysis, there also seems to be a state dependence in labor supply which translates into reduced earnings among those working over the ages 62-66, since more people are found in the below-average earnings range.

One way these age-specific results can be explained is as follows: a flexible retirement scheme allows older workers to reduce their work intensity when they want, which will lead to more job satisfaction (better matching of personal working capacity and working load) and eventually lead to a positive labor supply response: they will stay longer, but work less, so that the impact on total amount of work is ambiguous. If the reduced number of working hours per year leads to more years of work, the effect of this gradual retirement process on total labor supply may be positive.

This hypothesis implies some patterns in the observed effects: we should expect to find a negative effect on intensive margin and a positive effect on the extensive margin. However, the extensive margin will mostly not be observed before the intensive margin effect. So this will imply that the effects on labor force partic-

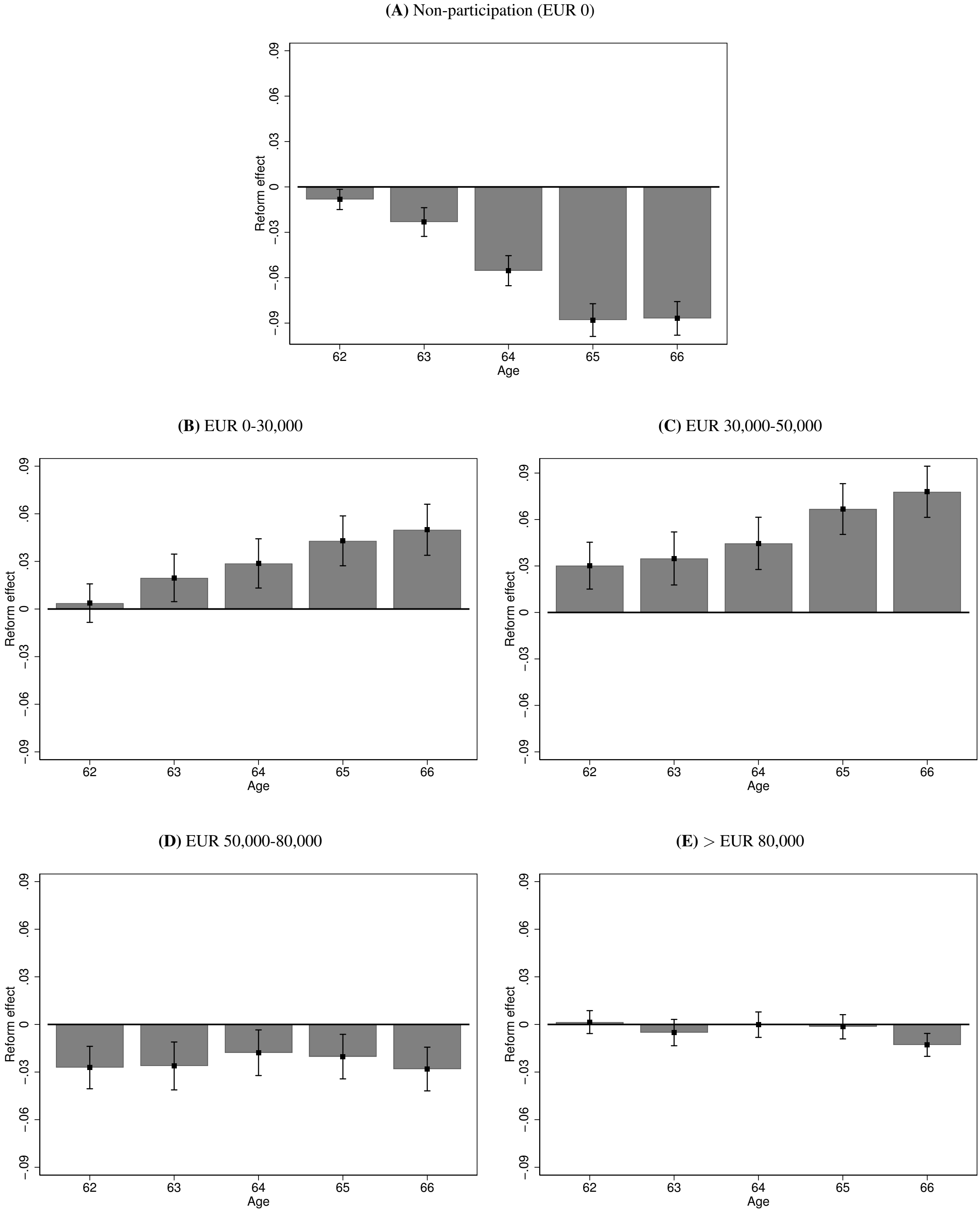
Figure 5: Reform effect on earnings distribution, by age



Source: Authors' own calculations using data from Statistics Norway.
Note: Simulation results from estimation of Equation (5), showing the difference in the CCDF for the treatment group and the control group. The gray-shaded area shows the 95 percent confidence intervals (based on 200 non-parametric bootstrap replications for each estimation, clustered on individual level). Aggregate earnings are expressed in EUR. Point estimates and the associated standard errors are deferred to Appendix A3.3.

ipation (LFP) differ across age and across time. We expect that there will be no or only a small effect on LFP at the new eligibility age, but that the effect becomes larger with age. Similarly, we expect no effect on LFP at the year of reform, and that the effects will only be observed after the reform is phased in.

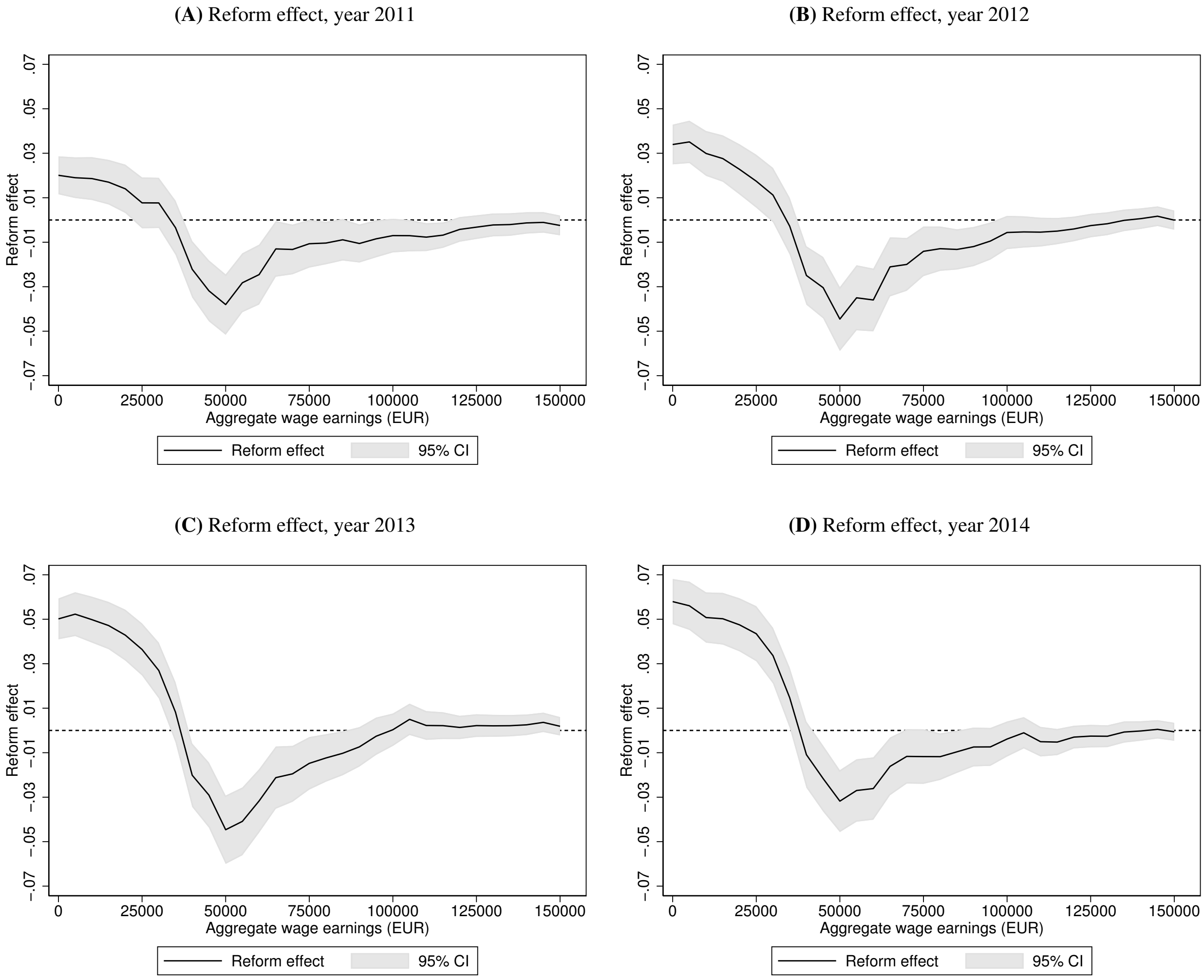
Figure 6: Change in probability of being in selected earnings intervals, by age



Source: Authors' own calculations using data from Statistics Norway.
Note: The reform effect on the probability of being in the different intervals, by age. The reform effects are generated using the marginal effects as visualized by Figure 5, with the capped lines showing the 95 percent confidence intervals. The procedure for deriving reform effects and the associated standard errors is described in detail in Appendix A3.1.

This suggests that the flexible claiming option to some degree facilitates gradual retirement, with a positive effect on the labor force participation rate, suggesting the notion that reduced work per period may make it easier to continue work for longer. The changes in the probabilities of being in different earnings intervals

Figure 7: Reform effect on earnings distribution, by year (2011-2014)



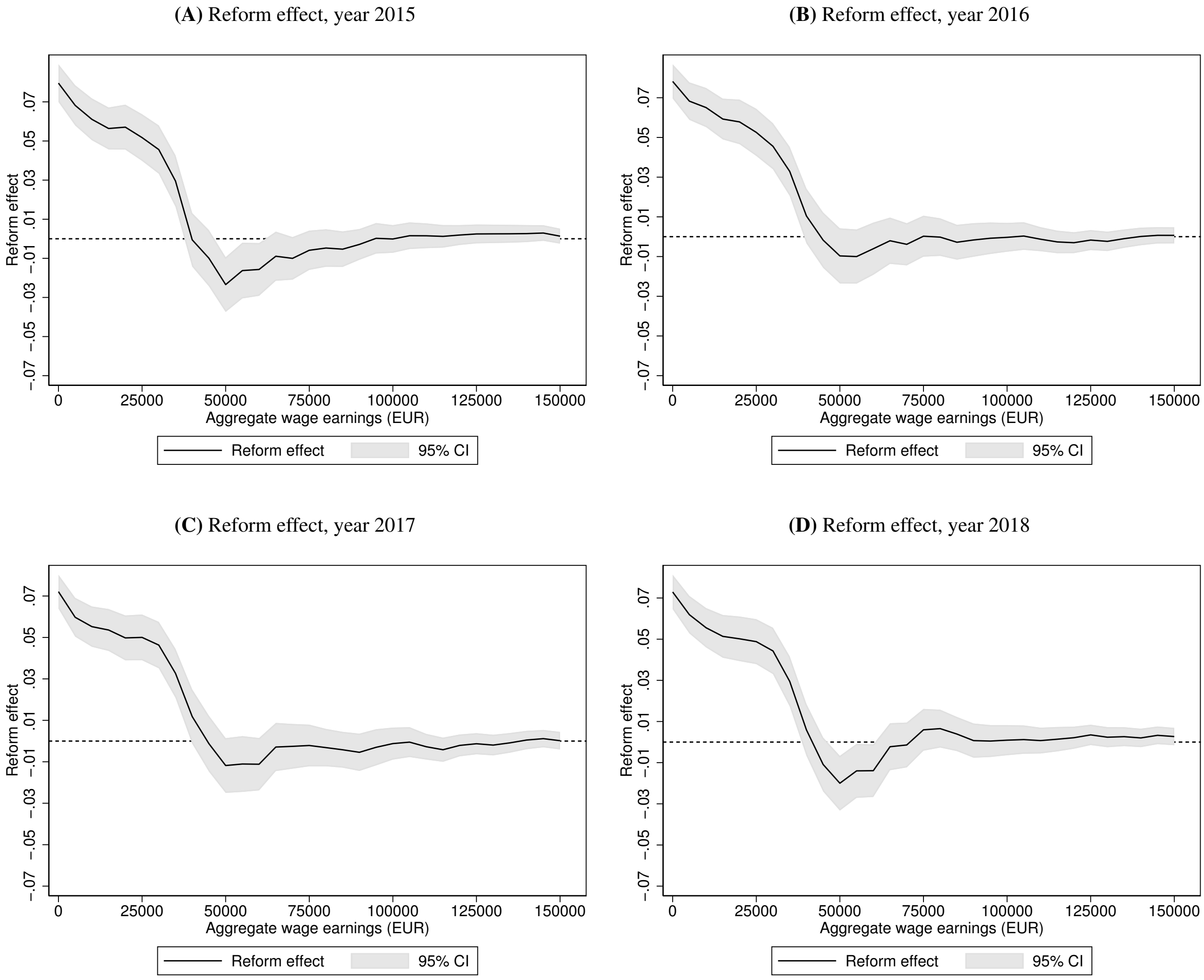
Source: Authors' own calculations using data from Statistics Norway.
Note: Simulation results from estimation of a year-by-year version of Equation (4), showing the difference in the CCDF for the treatment group and the control group. The gray-shaded area shows the 95 percent confidence intervals (based on 200 non-parametric bootstrap replications for each estimation, clustered on individual level). Aggregate earnings are expressed in EUR. Point estimates and the associated standard errors are deferred to Appendix A3.4.

by age are illustrated in Figure 6, and underline the dynamic effects of the reform. The reduction in work effort is further elaborated on in Section 6.1, while the decomposition of the extensive margin response is discussed in Section 6.2 and the extent of job changes and partial retirement is discussed in Section 6.4.

5.5 Year-Specific Reform Effects

The year-by-year results from estimating Equation (6) are illustrated in Figure 7, Figure 8 and Figure 9. This allows us to test the identifying assumption stated in Equation (7) by means of a placebo exercise. This exercise entails estimating the reform effect across the whole earnings distribution in the pre-reform year 2010. As the reform had not been implemented at this stage, we should expect there to be no effect on the changes in the earnings distribution, in line with the identifying assumption in Equation (7). The estimation results from this exercise are illustrated in Figure 9, and show only marginally significant effects at some parts of the earnings distribution. This suggests that the change in the population shares at each of the 31 earnings thresholds would have been the same in the treatment and control group in the absence of the old-age pension reform.

Figure 8: Reform effect on earnings distribution, by year (2015-2018)

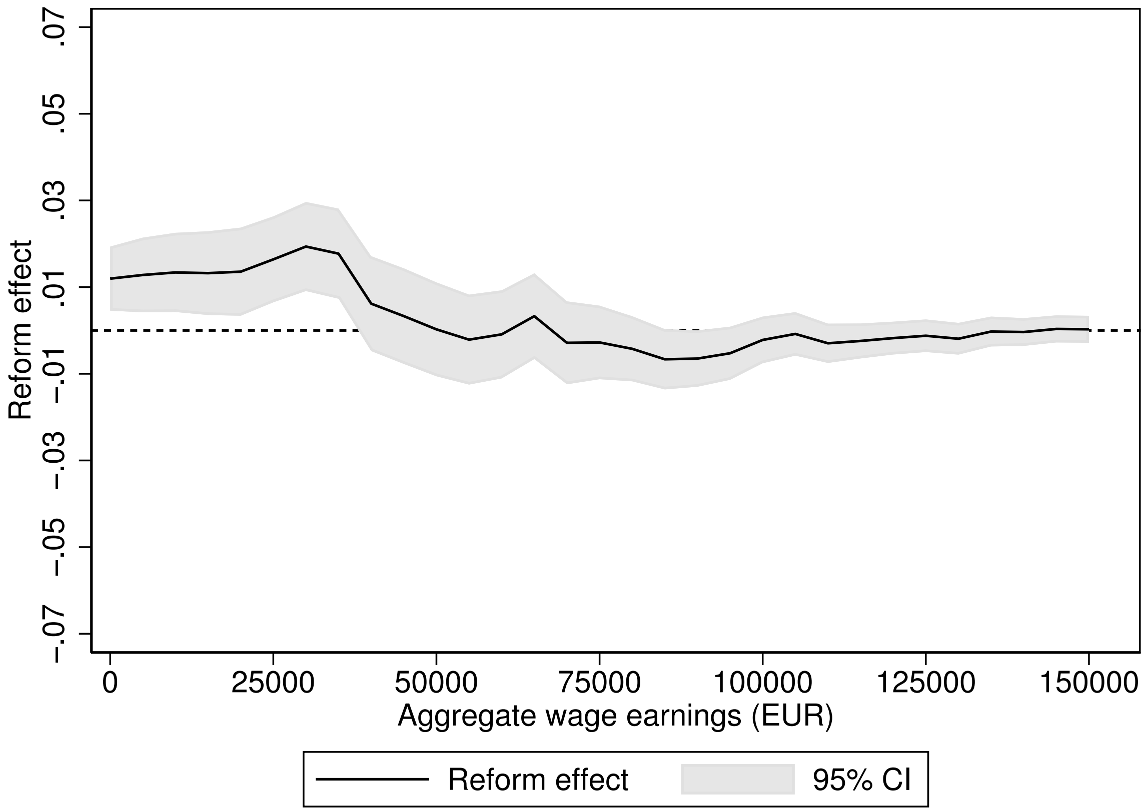


Source: Authors' own calculations using data from Statistics Norway.
Note: Simulation results from estimation of a year-by-year version of Equation (4), showing the difference in the CCDF for the treatment group and the control group. The gray-shaded area shows the 95 percent confidence intervals (based on 200 non-parametric bootstrap replications for each estimation, clustered on individual level). Aggregate earnings are expressed in EUR. Point estimates and the associated standard errors are deferred to Appendix A3.4.

5.6 Robustness

While the largely insignificant effects in the placebo exercise suggest that the difference-in-difference approach is valid, it is worthwhile examining the robustness of our results further. As a robustness check, we follow Brinch et al. (2017) and include group-specific linear time trends (estimated on pre-reform data covering the period 2006-2010) in Equation (4) to discern whether there are secular group-specific trends driving our results. The estimation results (reported in Appendix A3.5) are largely similar to the main estimation results for the average reform effect, suggesting that there are no significant differential trends in earnings that are driving our results. Including group-specific time trends for our sample period (2009-2014) directly into our main specification in Equation (4) instead yields qualitatively the same results, as reported in Appendix A3.5.

Figure 9: Reform effect on earnings distribution, by year (2010)



Source: Authors' own calculations using data from Statistics Norway.
Note: Simulation results from estimation of a year-by-year version of Equation (4) for the year 2010, showing the difference in the CCDF for the treatment group and the control group. The gray-shaded area shows the 95 percent confidence intervals (based on 200 non-parametric bootstrap replications for each estimation, clustered on individual level). Aggregate earnings are expressed in EUR. Point estimates and the associated standard errors are deferred to Appendix A3.4.

5.7 Comparison with OLS Results

It is of interest to compare the age-specific CCDF estimates in Figure 5 with the age-specific OLS estimates in Figure 2. To do this, we note that:

$$E(x_a) = \int_0^\infty CCDF_a(x)dx \approx \sum_{r=1}^{31} CCDF_{r,a} \times 5000 \tag{8}$$

which implies that we can calculate the age-specific differences in the CCDF (denote this $\Delta CCDF_{r,a}$, which is the difference between the counterfactual CCDF before and after the reform, i.e. the estimated reform effect) at each earnings increment multiplied by the step size of each of the 31 increments (EUR 5,000) as:

$$\begin{aligned} \Delta E_a &= \sum_{r=1}^{31} \Delta E_{r,a} \\ &= \sum_{r=1}^{31} \Delta CCDF_{r,a} \times 5000 \end{aligned} \tag{9}$$

The estimated reform effect and standard error for each age ΔE_a from the CCDF approach is reported in Table 6, where the age-specific OLS estimates and standard errors from Figure 2 are included for com-

Table 6: Age-specific reform effects, CCDF and OLS

	CCDF estimate (ΔE_a)			OLS estimate (η_a)		
Age (a)	Level	Standard error	Percentage	Level	Standard error	Percentage
62	-162	540	0.3	-266	394	0.5
63	-399	651	0.9	-781	475	1.7
64	1,202	650	3.0	1,083	488	2.7
65	2,112	628	6.1	1,748	489	5.1
66	962	627	3.4	395	497	1.4
62-66	3,716	3,096	1.8	2,180	1,798	1.1

Source: Authors' own calculations using data from Statistics Norway.
Note: Estimated CCDF reform effect and standard error for each age from Equation (9), and the estimated OLS reform effect and standard error for each age from Equation (2). Level indicates reform effect in EUR, standard error indicates standard error in EUR, while percentage indicates the reform effect in absolute terms as percentage of mean earnings for each age (for the age-specific estimates) and the reform effect in absolute terms as percentage of sum of mean earnings for ages 62-66 (for aggregate estimates).

parison.[16] From Table 6 we find that the magnitudes of the age-specific CCDF estimates are fairly well in accordance with age-specific OLS estimates. For instance, the CCDF approach implies a reform effect of EUR 1,202 for age 64 (or 3.0 percent of mean earnings at age 64), while the OLS estimates for age 64 implies an effect of EUR 1,018 (or 2.7 percent of mean earnings at age 64).

When we add up the impacts, we get the total impact over the age range 62-66. This can be interpreted as a simulation of the reform effect on a cohort. From Figure 2 we note that the OLS effects are (just) significantly positive at ages 64 and 65. Negative, but statistically insignificant effects at other ages makes the aggregate effect positive, but not significant. The CCDF estimates indicate a total effect of EUR 3,716 (or 1.8 percent of the sum of earnings over ages 62-66), while the OLS estimates indicate a total effect of EUR 2,180 (or 1.1 percent of the sum of earnings over ages 62-66).

6 Interpreting the Results

6.1 Weekly Working Hours

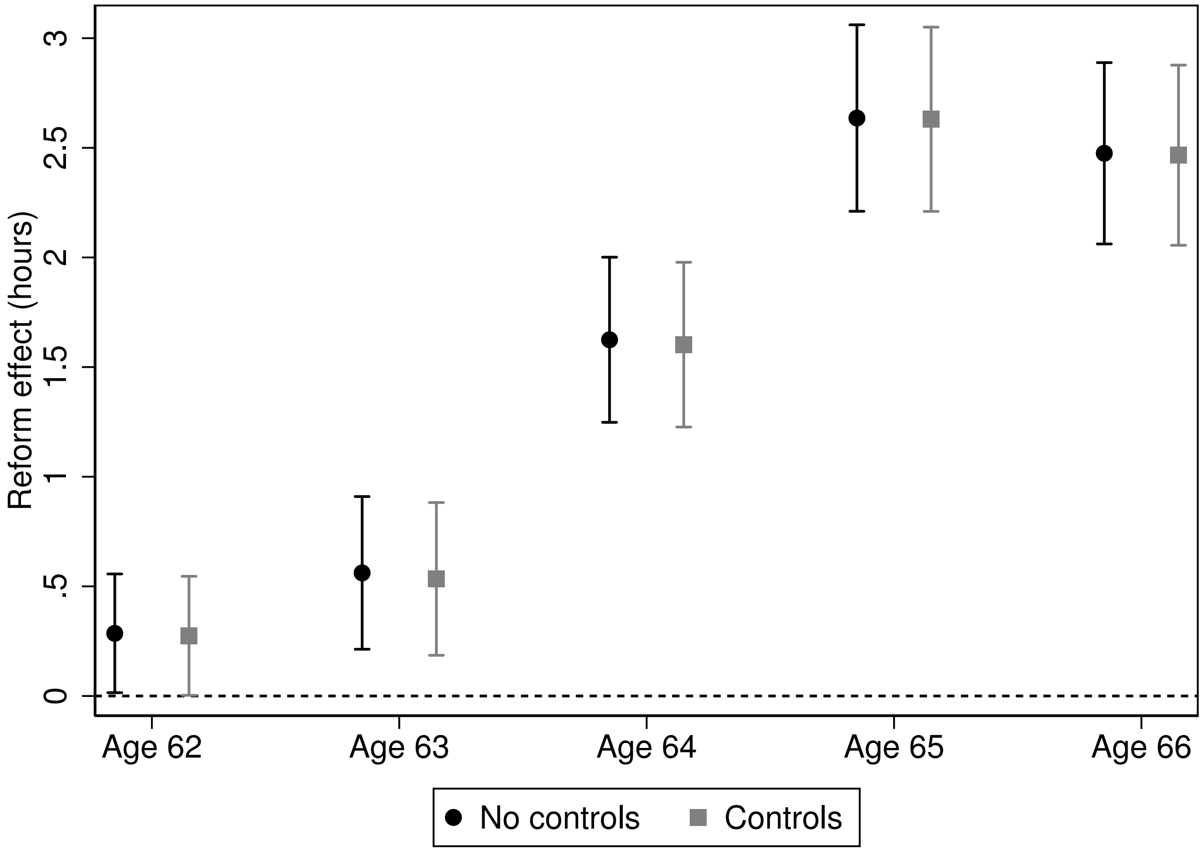
The results for earnings in Figure 6 point to gradual retirement being a potential explanation for the shift in the earnings distribution. To investigate if this could be a mechanism, we use an alternative measure of work effort – namely weekly working hours – as an outcome variable in the linear model from Equation (2) where we allow for age-specific reform effects. The estimation results are shown in Figure 10, and shows the dynamic effects of the reform on working hours when both the intensive and the extensive margin are included. The large positive effects on number of working hours at age 64 through age 66 are due to the positive effects on labor force participation, shown in Figure 5. Estimating a non-linear difference-in-difference model indicates that this is driven mostly by an increase in short part-time work and a reduction in non-work (the extensive margin).

6.2 Decomposing the Effect on Labor Force Participation

Given the strong positive effects on the extensive margin, it is worthwhile decomposing this effect into two distinct components: (i) a reduction in the claiming of disability benefits (as was widespread prior to the re-

[16] The standard errors for the age-specific effects and the total effect using the CCDF method are derived under fairly strict assumptions, see Appendix A5 for details.

Figure 10: Reform effect on number of weekly working hours, by age



Source: Authors' own calculations using data from Statistics Norway.
Note: OLS estimation results of the age-specific reform effect on the number of weekly working hours using the framework from Equation (2). Black lines indicate estimation results with no control variables, gray lines indicate estimation results with control variables. Control variables are pre-determined and include linear controls for education length, education length squared, log average annual pre-tax earnings from age 30 to age 59, and net liquid wealth at age 59. The capped lines show the 95 percent confidence intervals, based on standard errors clustered on the individual level with 200 non-parametric bootstrap replications. Point estimates and the associated standard errors are deferred to Appendix A7.1.

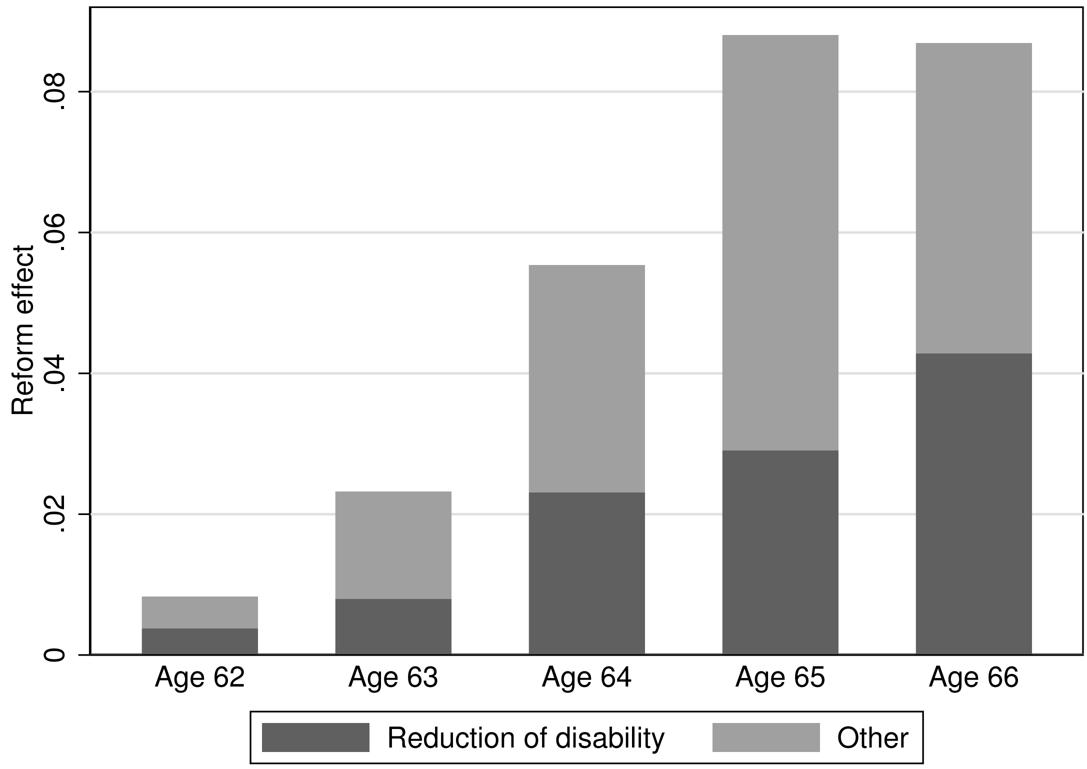
form), and (ii) a reduction in other types of labor force withdrawal. To do this, we use the same age-specific specification as in Equation (2), but define the outcome variable to be an indicator variable equal to 1 if the individual does not claim disability benefits/does not exit the labor force by other means.

Figure 11 shows the results from this exercise, where the percentage point effect on labor force participation is divided into (i) reduction of disability benefit claiming (dark gray bars), and (ii) other effects (gray bars). On average, 48 percent of the positive effect on labor force participation is due to a reduction of disability benefit claiming, indicating that disability insurance might have acted as a (health-contingent) early retirement scheme prior to the reform.

6.3 Income Composition

The results so far point to a decrease in full-time work and an increase in long part-time work corresponding to an increase in gradual retirement as measured by reduced earnings. One would expect that the individuals compensate for the income loss of reduced work effort by claiming old-age pension benefits to sustain the same consumption level as they would have in absence of the additional liquidity provided after the reform. Figure 12 shows that for the treatment group after the reform, the labor earnings constitute a lower fraction of total income compared to before the reform (decreasing from 73 to 49 percent of total earnings at age 66). This is compensated by an increase in claiming of old-age pension benefits (increasing from 0 to

Figure 11: Decomposing the effect on labor force participation, by age



Source: Authors' own calculations using data from Statistics Norway.
Note: OLS estimation results of the age-specific reform effect on the extensive margin using the framework from Equation (5). No disability is defined as no claiming of any disability benefits. Control variables are pre-determined and include linear controls for education length, education length squared, log average annual pre-tax earnings from age 30 to age 59, and net liquid wealth at age 59. Point estimates and the associated standard errors are deferred to Appendix A8.1.

38 percent of total earnings at age 66).

6.4 Job Changes

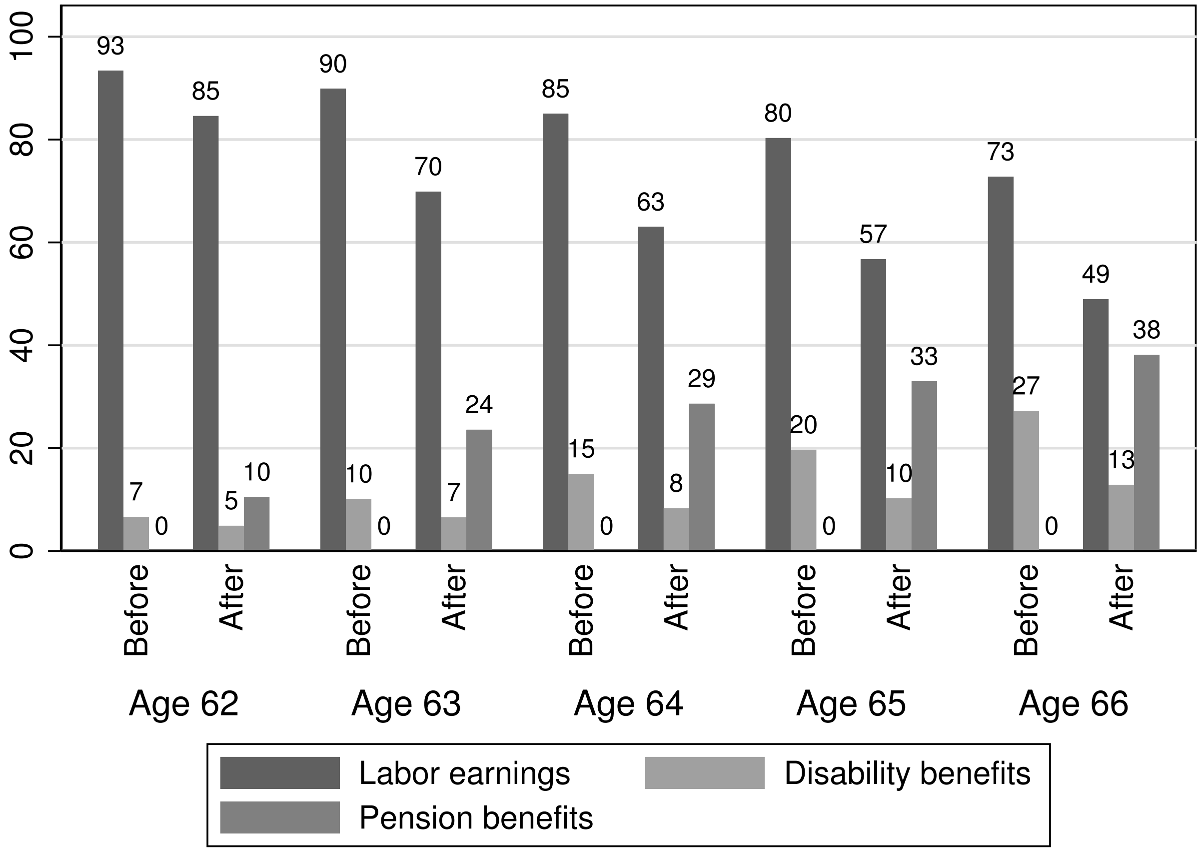
To look at what potential mechanisms might be behind the increased mass in the middle of the earnings distribution beyond that of reduced weekly working hours, we also examined job transitions. Workers may systematically change jobs at the end of the working career as a part of partial retirement, by switching from the career job to another less demanding and lower paid job and thereby reducing their earnings (Kantarci, 2013). We estimate the reform effect on (i) the likelihood of a job change and (ii) the likelihood of partial retirement using the same age-specific specification as in Equation (2).[17] The results indicate that there is a slight increase in job mobility due to the reform, which is largely driven by partial retirement.[18]

7 Conclusion

We study the impact of reforming a pension by reducing the access age, in combination with actuarially adjusting periodic pension levels, thus retaining the expected present value of the benefit stream constant, regardless of claiming age. This pension flexibility was one element of the comprehensive Norwegian pen-

[17] Job change is defined as a change of establishment, while partial retirement is defined as a job change with lower earnings than the previous job. Note that employer is defined on the establishment level, and we are not readily able to identify job changes within the establishment.
[18] Point estimates and the associated standard errors are deferred to Appendix A9.

Figure 12: Income composition, by age and reform status



Source: Authors' own calculations using data from Statistics Norway.
Note: Composition of income (measured in percent), by age and reform status. "Before" refers to pre-reform years (2009-2010), while "After" refers to post-reform years (2011-2018).

sion reform of 2011, in which a long-standing access age of 67 was reduced to age 62. In order to identify the impact of flexibility separate from the increased work incentives, we identify a group that were exposed only to the new pension option, without any changes in the present value of the pension. After taking into account the strong upwards trend in employment of the older worker population, we find that the earnings distribution shifted downwards. Analyses of transitions over age between working hours' groups show the downward shift to be caused mainly by high earners reducing their annual earnings through reduced annual working hours. We also find that labor force participation increases with age and with the phasing in of the reform. Together, this implies a higher incidence of gradual labor market exit. As older people reduce their average earnings, they stay longer in the labor market, and total earnings over the age range 62-66 is approximately constant, increasing by a not significant 1.1 percent (EUR 2,180).

While we have focused on the supply side of the labor market, there is good reason to believe there are restrictions on the demand side in terms of accommodating gradual retirement (Midtsundstad, 2018; Clark et al., 2019). This would in turn imply that our results constitute a lower bound on the effect of introducing a flexible pension on gradual retirement. Stated preference analysis indicates that workers prefer gradual retirement with decreasing labor supply over several years before entering full retirement over abrupt full retirement (Kantarci & van Soest, 2013a), a finding backed up by a host of surveys (OECD, 2017). While we cannot identify the reasons why some individuals undertake gradual retirement, surveys conducted in Finland (Takala & Väänänen, 2016) suggest that older workers opt for gradual retirement to (i) devote more time to hobbies and family and (ii) say that they had been working full-time for too long. Thus there seems to be a latent desire for phased retirement. Our results indicated that a reduced access age, holding the overall value of the pension constant, can facilitate such a transition to full retirement. The dynamic effect, with increasing labor force participation over age, reinforces such an argument. This presents a case for regulatory policies aimed at making jobs more suitable for older and part-time workers.

With an actuarially adjusted pension, the fiscal effects over the long run are small, mainly an earlier one-time payment. Since total earnings are fairly constant, that impact also appears to be low. After age 66 the effects tails off in our data set, indicating there will be only small effects at later ages. The fiscal effects via constant aggregate earnings over ages 62-66 and actuarially adjusted pension, in combination with a reduced inflow to disability, present a case for flexible pensions as part of broader reforms and welfare enhancement.

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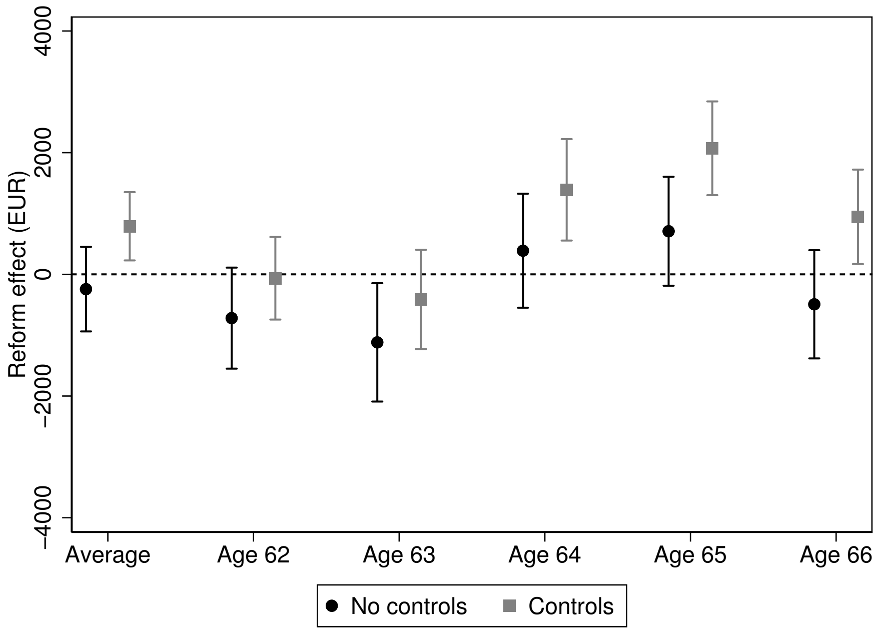
A1 OLS and CCDF Estimation with Females in Sample

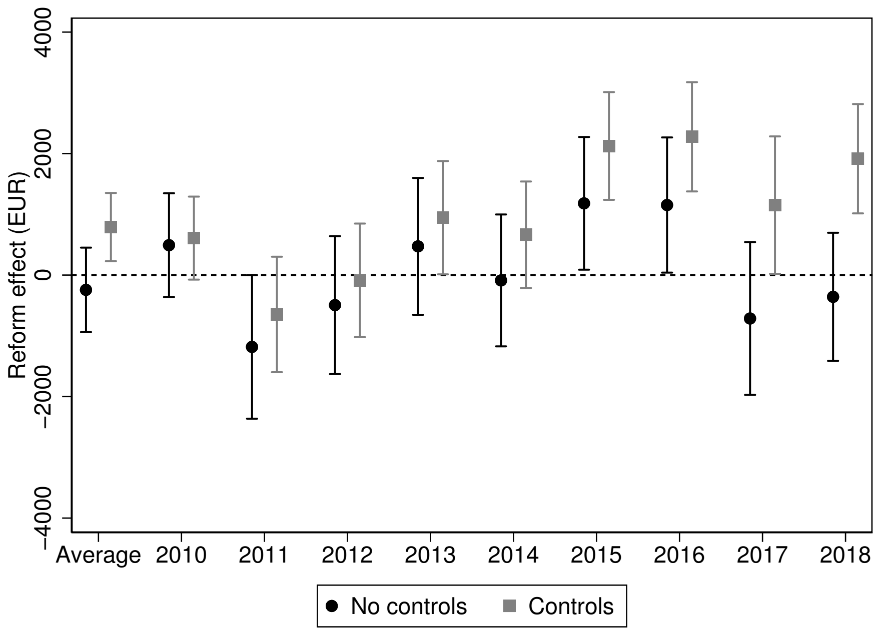
Figure A1 shows the OLS estimation results by age (Panel A) and year (Panel B) when women are included in the sample.

Figure A1: Reform effect on mean earnings, full sample, by age and year

(A) By age



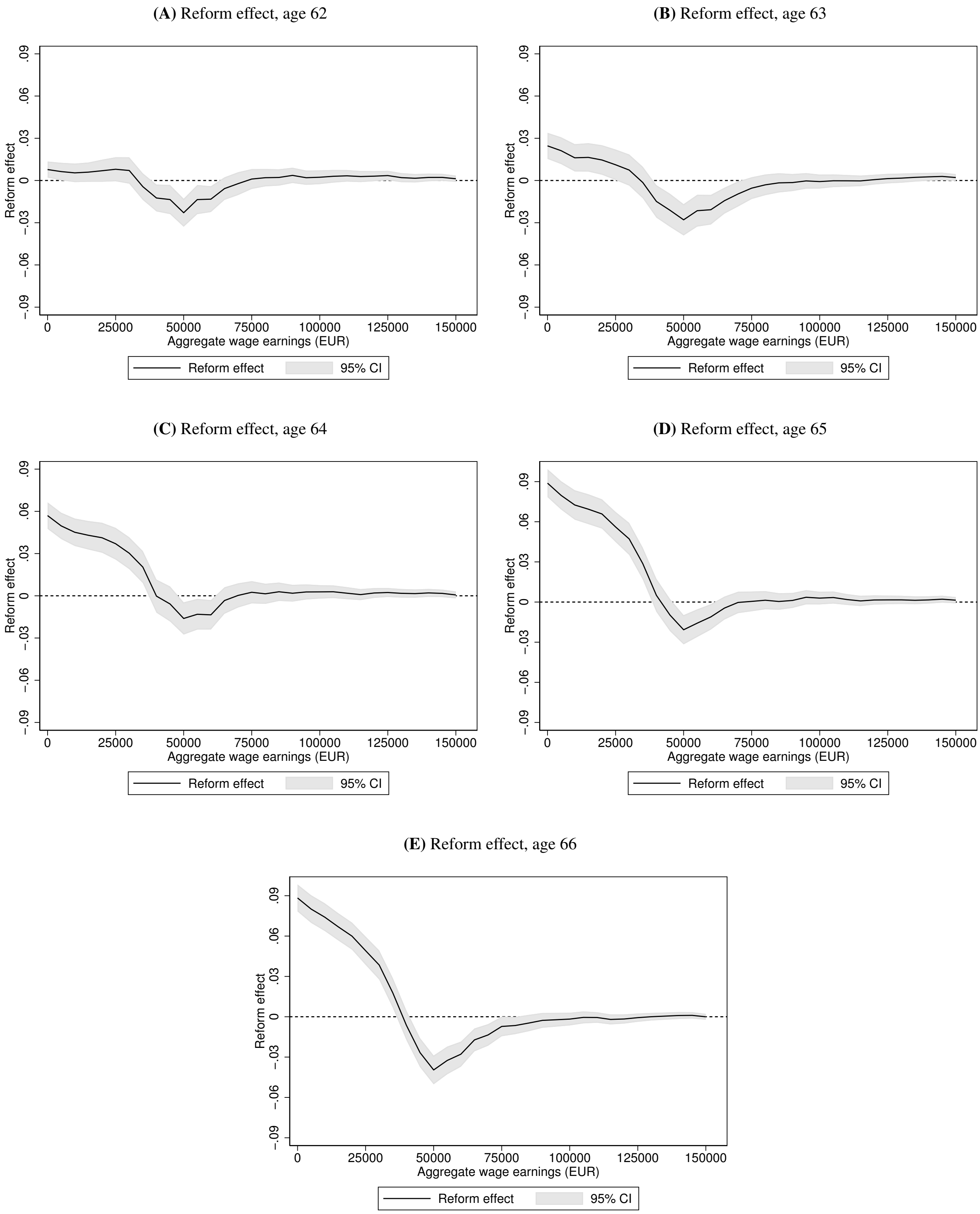
(B) By year



Source: Authors' own calculations using data from Statistics Norway.
Note: OLS estimation results of the average reform effect on earnings from Equation (1) and the year-specific reform effects (Panel A) on earnings from Equation (3) and the age-specific reform effects (Panel B) on earnings from Equation (2). Black lines indicate estimation results with no control variables, gray lines indicate estimation results with control variables. Control variables are pre-determined and include linear controls for education length, education length squared, log average annual pre-tax earnings from age 30 to age 59, and net liquid wealth at age 59. The capped lines show the 95 percent confidence intervals, based on standard errors clustered on the individual level with 200 non-parametric bootstrap replications. Sample consists of both men and women.

Figure A2 shows the CCDF estimation results by age when women are included in the sample.

Figure A2: Reform effect on earnings distribution, full sample, by age

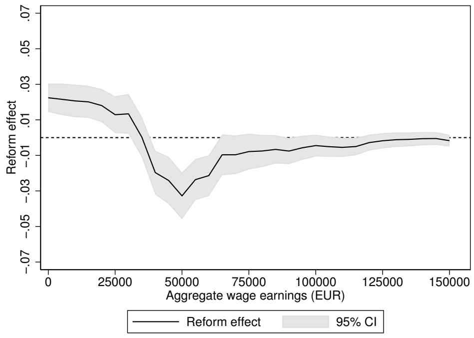


Source: Authors' own calculations using data from Statistics Norway.
Note: Simulation results from estimation of Equation (5), showing the difference in the CCDF for the treatment group and the control group. The gray-shaded area shows the 95 percent confidence intervals (based on 200 non-parametric bootstrap replications for each estimation, clustered on individual level). Aggregate earnings are expressed in EUR. Sample consists of both men and women.

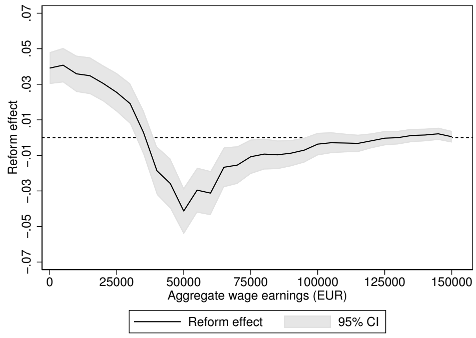
Figure A3 shows the CCDF estimation results by year when women are included in the sample.

Figure A3: Reform effect on earnings distribution, full sample, by year

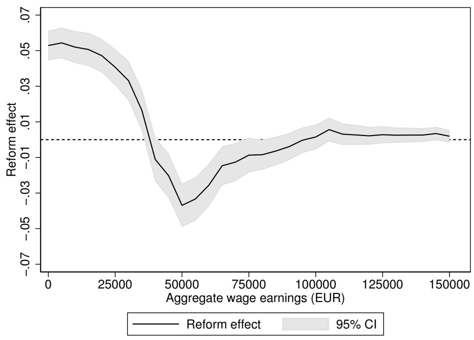
(A) Reform effect, year 2011



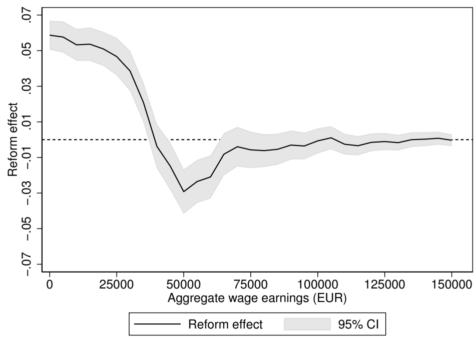
(B) Reform effect, year 2012



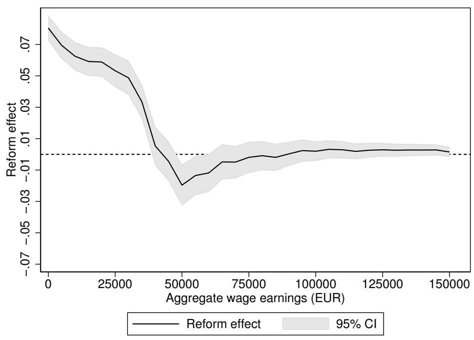
(C) Reform effect, year 2013



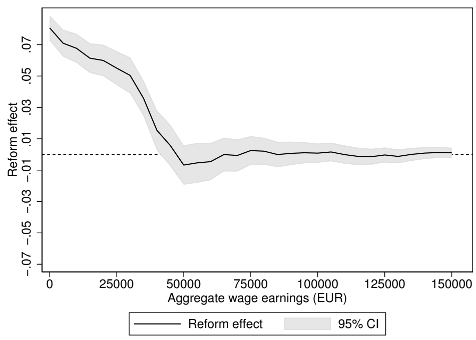
(D) Reform effect, year 2014



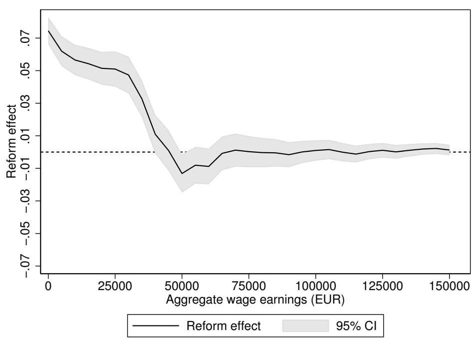
(E) Reform effect, year 2015



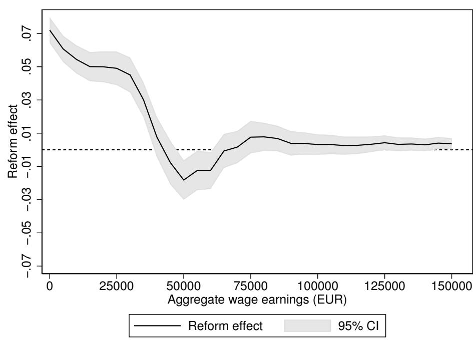
(F) Reform effect, year 2016



(G) Reform effect, year 2017



(H) Reform effect, year 2018

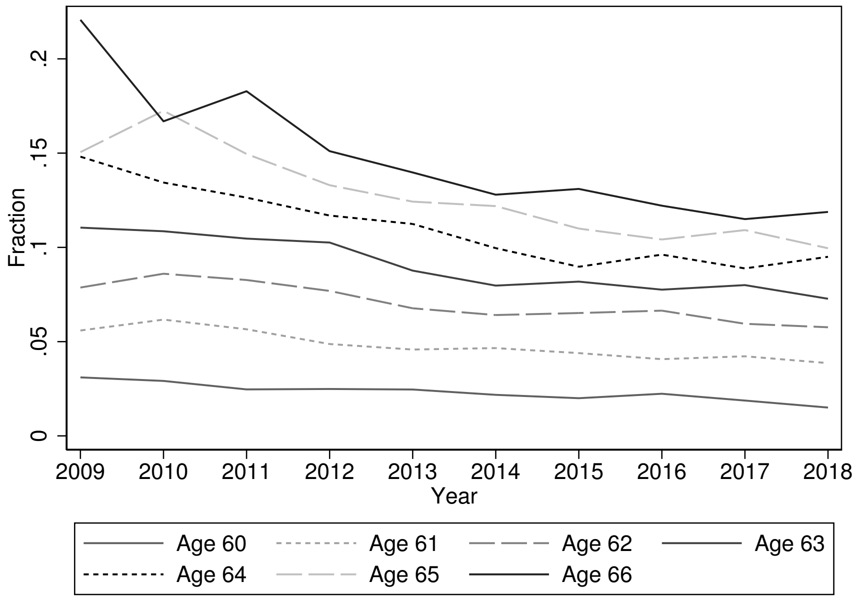


Source: Authors' own calculations using data from Statistics Norway.
Note: Simulation results from estimation of a year-by-year version of Equation (4), showing the difference in the CCDF for the treatment group and the control group. The gray-shaded area shows the 95 percent confidence intervals (based on 200 non-parametric bootstrap replications for each estimation, clustered on individual level). Aggregate earnings are expressed in EUR. Sample consists of both men and women.

A2 Disability Insurance Rates and Earnings

Figure A4 shows the fraction claiming disability insurance benefits (defined as any positive amount of disability insurance benefits claimed), by calendar year and age.

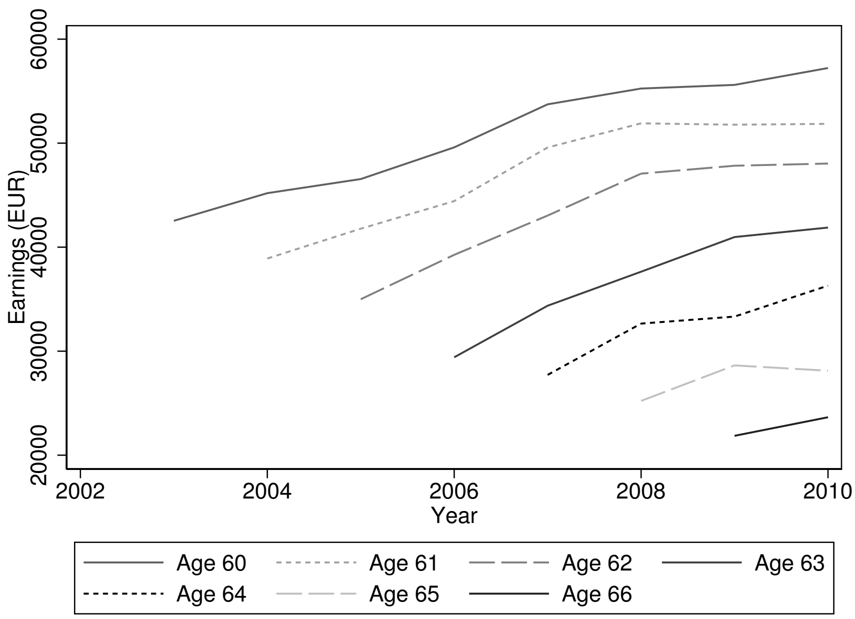
Figure A4: Fraction claiming disability insurance benefits, by calendar year and age



Source: Authors' own calculations using data from Statistics Norway.
Note: Claiming is defined as any positive amount of disability insurance benefits claimed.

Figure A5 shows the average earnings by age and calendar year prior to the reform in 2011, and indicates that the assumption of constant age effects across the birth cohorts in Equation (5) is not too restrictive.

Figure A5: Average earnings, by age and calendar year



Source: Authors' own calculations using data from Statistics Norway.
Note: Average aggegate wage earnings (expressed in EUR), by age and calendar year.

A3 Earnings, CCDF Estimation

A3.1 Probability of Being in Different Earnings Intervals

The change in the probabilities of being in different earnings intervals (reported in Table 5) is derived from the marginal effects reported in Panel A in Table A4 in Section A3.6 in this Appendix. Letting $T \in \{0,1\}$ denote treatment status, $F(\cdot)$ denote the CDF and $\Delta CCDF_k$ denote the marginal effect at the threshold $y = y_k$, the change in the probability of being in an earnings interval $[\underline{y}, \bar{y}]$ can be expressed as follows using the definition of the CDF and the CCDF:

$$\begin{aligned}
P\left(\underline{y} < y < \bar{y}|T=1\right) - P\left(\underline{y} < y < \bar{y}|T=0\right) &= \left[F\left(\bar{y}|T=1\right) - F\left(\underline{y}|T=1\right)\right] \\
&- \left[F\left(\bar{y}|T=0\right) - F\left(\underline{y}|T=0\right)\right] \\
&= \left[\left[1 - P\left(y > \bar{y}|T=1\right)\right] - \left[1 - P\left(y > \underline{y}|T=1\right)\right]\right] \\
&- \left[\left[1 - P\left(y > \bar{y}|T=0\right)\right] - \left[1 - P\left(y > \underline{y}|T=0\right)\right]\right] \\
&= P\left(y > \underline{y}|T=1\right) - P\left(y > \underline{y}|T=0\right) \\
&- \left[P\left(y > \bar{y}|T=1\right) - P\left(y > \bar{y}|T=0\right)\right] \\
&= \Delta CCDF_{\underline{y}} - \Delta CCDF_{\bar{y}}
\end{aligned} \tag{A1}$$

Based on the formula in Equation (A1), we find the following changes in probabilities:

$$\begin{aligned}
P\left(y = 0|T=1\right) - P\left(y = 0|T=0\right) &= -\Delta CCDF_0 = -0.053 \\
P\left(0 < y < 30,000|T=1\right) - P\left(0 < y < 30,000|T=0\right) &= \Delta CCDF_0 - \Delta CCDF_{30,000} \\
&= (0.053) - (0.024) \\
&= 0.029 \\
P\left(30,000 < y < 50,000|T=1\right) - P\left(30,000 < y < 50,000|T=0\right) &= \Delta CCDF_{30,000} - \Delta CCDF_{50,000} \\
&= (0.024) - (-0.028) \\
&= 0.051 \\
P\left(50,000 < y < 80,000|T=1\right) - P\left(50,000 < y < 80,000|T=0\right) &= \Delta CCDF_{50,000} - \Delta CCDF_{80,000} \\
&= (-0.028) - (-0.004) \\
&= -0.024 \\
P\left(y > 80,000|T=1\right) - P\left(y > 80,000|T=0\right) &= \Delta CCDF_{80,000} = -0.004
\end{aligned} \tag{A2}$$

The standard errors are derived using the conventional pooled variance of the estimated marginal effects, where we assume independence of the estimates:

$$SE\left(\Delta CCDF_s - \Delta CCDF_j\right) = \sqrt{\left[SE\left(\Delta CCDF_s\right)\right]^2 + \left[SE\left(\Delta CCDF_j\right)\right]^2} \tag{A3}$$

Using the general formula in Equation (A3), we derive the following standard errors:

$$\begin{aligned}
SE\left(\Delta CCDF\right) &= 0.003 \\
SE\left(\Delta CCDF_0 - \Delta CCDF_{30,000}\right) &= \sqrt{[0.003]^2 + [0.004]^2} = 0.005 \\
SE\left(\Delta CCDF_{30,000} - \Delta CCDF_{50,000}\right) &= \sqrt{[0.004]^2 + [0.005]^2} = 0.006 \\
SE\left(\Delta CCDF_{50,000} - \Delta CCDF_{80,000}\right) &= \sqrt{[0.005]^2 + [0.003]^2} = 0.006 \\
SE\left(\Delta CCDF_{80,000}\right) &= 0.003
\end{aligned} \tag{A4}$$

Given that we bootstrap each estimation with individuals as the unit of clustering, this should alleviate the issue of age-dependency of the estimates. This allows us to derive the standard errors here using the conventional pooled standard error formula. The same method is also used for deriving the probabilities and the associated standard errors appearing in Figure 6.

A3.2 Average Effect

Panel A in Table A4 in Section A3.6 in this Appendix shows the marginal effects and the associated standard errors for each of the estimations of Equation (A5) used to simulate the reform effect on the earnings distribution (shown in Figure 4):

$$\mathbf{1}\left(y_{i,a,t} > y_k\right) = \alpha + X_i\beta + \sum_{s=61}^{66} \gamma_s DA_s + \sum_{l=2010}^{2018} \lambda_l DT_l + \eta \Delta_{i,a,t} + \varepsilon_{i,a,t} \tag{A5}$$

A3.3 Age-by-Age Effect

Table A3 in Section A3.6 in this Appendix shows the marginal effects and the associated standard errors for each of the estimations of Equation (A6) used to simulate the age-by-age reform effects on the earnings distribution (shown in Figure 5), where we assume a constant treatment effect across years:

$$\mathbf{1}\left(y_{i,a,t} > y_k\right) = \alpha + X_i\beta + \sum_{s=61}^{66} \gamma_s DA_s + \sum_{l=2010}^{2018} \lambda_l DT_l + \sum_{m=62}^{66} \eta_m DA_m \Delta_{i,a,t} + \varepsilon_{i,a,t} \tag{A6}$$

A3.4 Year-by-Year Effect

Table A1 and Table A2 in Section A3.6 in this Appendix shows the marginal effects and the associated standard errors for each of the estimations of Equation (A7) used to simulate the year-by-year reform effects on the earnings distribution (shown in Figure 7 and Figure 8), where we assume a constant treatment effect across age:

$$\mathbf{1}\left(y_{i,a,t} > y_k\right) = \alpha + X_i\beta + \sum_{s=61}^{66} \gamma_s DA_s + \sum_{l=2010}^{2018} \lambda_l DT_l + \sum_{m=2011}^{2018} \eta_m DT_m \Delta_{i,a,t} + \varepsilon_{i,a,t} \tag{A7}$$

A3.5 Robustness of Results

To include a pre-reform trend in our main specification, we first estimate treatment-specific trends for each of the earnings intervals using data covering the pre-reform period (2006-2010) with the following model:

$$\mathbf{1}\left(y_{i,a,t} > y_k\right) = \alpha + \tau t + \gamma \mathbf{1}\left\{a_{i,t} \geq 62\right\} + \omega\left(t \times \mathbf{1}\left\{a_{i,t} \geq 62\right\}\right) + \varepsilon_{i,a,t} \tag{A8}$$

With the saturated model in Equation (A8), we obtain an estimated slope of the (linear) time trend for the treatment group (individuals aged 62-66) relative to the control group (individuals aged 60-61), denoted $\hat{\omega}$, which we then include into our main specification as follows:

$$\mathbf{1}\left(y_{i,a,t} > y_k\right) = \alpha + X_i\beta + \sum_{s=61}^{66} \gamma_s DA_s + \sum_{l=2010}^{2018} \lambda_l DT_l + \hat{\omega}\left(t \times \mathbf{1}\left\{a_{i,t} \geq 62\right\}\right) + \eta \Delta_{i,a,t} + \varepsilon_{i,a,t} \tag{A9}$$

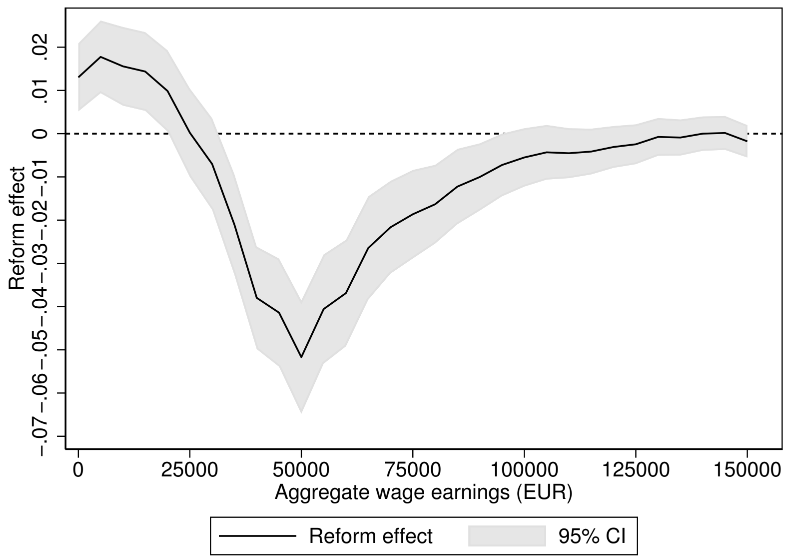
To instead include a linear time trend estimated using the sample years we use otherwise in the analysis (2009-2018), we estimate the following version of our main specification:

$$\mathbf{1}\left(y_{i,a,t} > y_k\right) = \alpha + X_i\beta + \sum_{s=61}^{66} \gamma_s DA_s + \sum_{l=2010}^{2018} \lambda_l DT_l + \varphi\left(t \times \mathbf{1}\left\{a_{i,t} \geq 62\right\}\right) + \eta\Delta_{i,a,t} + \varepsilon_{i,a,t} \quad \text{(A10)}$$

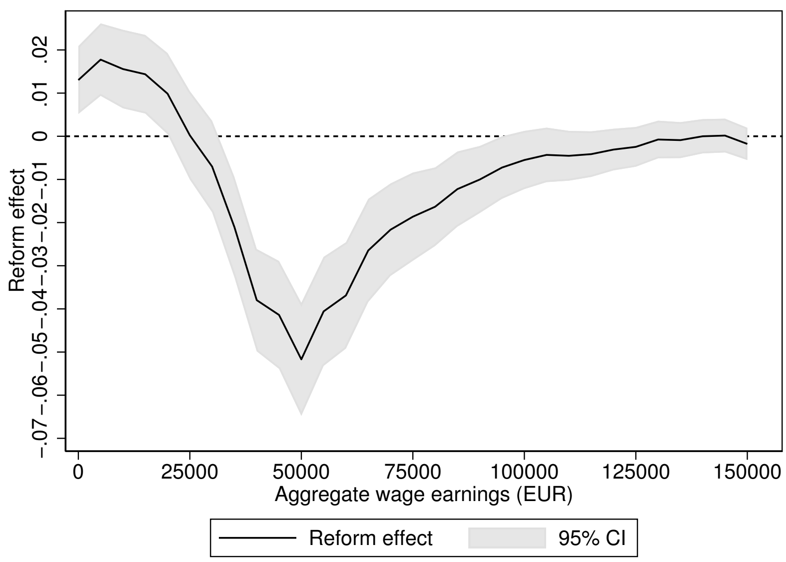
The marginal effects and standard errors from estimating Equation (A9) and Equation (A10) are shown in Panel A and B in Figure A6, and reported in Panel B and Panel C in Table A4 in Section A3.6 in this Appendix.

Figure A6: Reform effect on earnings distribution, time trend

(A) Pre-reform time trend



(B) Time trend



Source: Authors' own calculations using data from Statistics Norway.
Note: Simulation results from estimation of Equation (A9) (Panel A) and Equation (A10) (Panel B), showing the difference in the CCDF for the treatment group and the control group. The gray-shaded area shows the 95 percent confidence intervals (based on 200 non-parametric bootstrap replications for each estimation, clustered on individual level). Aggregate earnings are expressed in EUR.

A3.6 Tables

Table A1: Marginal effects, CCDF, reform effect by year (2010-2014)

Outcome	2010		2011		2012		2013		2014	
	ME	SE	ME	SE	ME	SE	ME	SE	ME	SE
$P(y_{i,a,t} > 0)$	0.012	0.004	0.020	0.004	0.034	0.005	0.050	0.005	0.058	0.005
$P(y_{i,a,t} > 5,000)$	0.013	0.004	0.019	0.005	0.035	0.005	0.052	0.005	0.056	0.006
$P(y_{i,a,t} > 1,0000)$	0.013	0.005	0.019	0.005	0.030	0.005	0.050	0.005	0.051	0.006
$P(y_{i,a,t} > 15,000)$	0.013	0.005	0.017	0.005	0.028	0.005	0.047	0.005	0.050	0.006
$P(y_{i,a,t} > 20,000)$	0.014	0.005	0.014	0.006	0.023	0.006	0.043	0.006	0.047	0.006
$P(y_{i,a,t} > 25,000)$	0.016	0.005	0.008	0.006	0.017	0.006	0.036	0.006	0.043	0.006
$P(y_{i,a,t} > 30,000)$	0.019	0.005	0.008	0.006	0.011	0.006	0.027	0.006	0.034	0.006
$P(y_{i,a,t} > 35,000)$	0.018	0.005	-0.003	0.006	-0.003	0.007	0.008	0.007	0.015	0.007
$P(y_{i,a,t} > 40,000)$	0.006	0.006	-0.022	0.006	-0.025	0.007	-0.020	0.007	-0.011	0.008
$P(y_{i,a,t} > 45,000)$	0.003	0.006	-0.032	0.007	-0.030	0.007	-0.029	0.007	-0.022	0.008
$P(y_{i,a,t} > 50,000)$	0.000	0.006	-0.038	0.007	-0.045	0.007	-0.045	0.008	-0.032	0.007
$P(y_{i,a,t} > 55,000)$	-0.002	0.005	-0.028	0.007	-0.035	0.007	-0.041	0.008	-0.027	0.007
$P(y_{i,a,t} > 60,000)$	-0.001	0.005	-0.025	0.007	-0.036	0.007	-0.032	0.007	-0.026	0.007
$P(y_{i,a,t} > 65,000)$	0.003	0.005	-0.013	0.006	-0.021	0.007	-0.021	0.007	-0.016	0.007
$P(y_{i,a,t} > 70,000)$	-0.003	0.005	-0.013	0.006	-0.020	0.006	-0.020	0.006	-0.012	0.006
$P(y_{i,a,t} > 75,000)$	-0.003	0.004	-0.011	0.005	-0.014	0.006	-0.015	0.006	-0.012	0.006
$P(y_{i,a,t} > 80,000)$	-0.004	0.004	-0.010	0.005	-0.013	0.005	-0.012	0.005	-0.012	0.005
$P(y_{i,a,t} > 85,000)$	-0.007	0.004	-0.009	0.005	-0.013	0.005	-0.010	0.005	-0.010	0.005
$P(y_{i,a,t} > 90,000)$	-0.006	0.003	-0.011	0.004	-0.012	0.004	-0.007	0.005	-0.007	0.004
$P(y_{i,a,t} > 95,000)$	-0.005	0.003	-0.008	0.004	-0.009	0.004	-0.003	0.004	-0.007	0.004
$P(y_{i,a,t} > 100,000)$	-0.002	0.003	-0.007	0.004	-0.006	0.004	0.000	0.004	-0.004	0.004
$P(y_{i,a,t} > 105,000)$	-0.001	0.003	-0.007	0.004	-0.005	0.004	0.005	0.004	-0.001	0.004
$P(y_{i,a,t} > 110,000)$	-0.003	0.002	-0.008	0.003	-0.005	0.003	0.002	0.003	-0.005	0.003
$P(y_{i,a,t} > 115,000)$	-0.002	0.002	-0.007	0.003	-0.005	0.003	0.002	0.003	-0.005	0.003
$P(y_{i,a,t} > 120,000)$	-0.002	0.002	-0.004	0.003	-0.004	0.003	0.001	0.003	-0.003	0.003
$P(y_{i,a,t} > 125,000)$	-0.001	0.002	-0.003	0.003	-0.003	0.003	0.002	0.003	-0.003	0.003
$P(y_{i,a,t} > 130,000)$	-0.002	0.002	-0.002	0.003	-0.002	0.003	0.002	0.003	-0.003	0.003
$P(y_{i,a,t} > 135,000)$	0.000	0.002	-0.002	0.003	0.000	0.002	0.002	0.002	-0.001	0.002
$P(y_{i,a,t} > 140,000)$	0.000	0.002	-0.001	0.002	0.001	0.002	0.003	0.002	0.000	0.002
$P(y_{i,a,t} > 145,000)$	0.000	0.002	-0.001	0.002	0.002	0.002	0.004	0.002	0.001	0.002
$P(y_{i,a,t} > 150,000)$	0.000	0.002	-0.002	0.002	0.000	0.002	0.002	0.002	-0.001	0.002

Source: Authors' own calculations using data from Statistics Norway.
Note: Marginal effects (ME) and associated standard errors (SE) for each of the estimations of Equation (A7). Standard errors are based on 200 non-parametric bootstrap replications for each estimation, clustered on individual level.

Table A2: Marginal effects, CCDF, reform effect by year (2015-2018)

Outcome	2015		2016		2017		2018	
	ME	SE	ME	SE	ME	SE	ME	SE
$P(y_{i,a,t} > 0)$	0.080	0.005	0.078	0.004	0.072	0.004	0.073	0.004
$P(y_{i,a,t} > 5,000)$	0.068	0.005	0.068	0.005	0.060	0.005	0.062	0.005
$P(y_{i,a,t} > 10,000)$	0.061	0.005	0.065	0.005	0.055	0.005	0.056	0.005
$P(y_{i,a,t} > 15,000)$	0.056	0.005	0.059	0.005	0.054	0.005	0.051	0.005
$P(y_{i,a,t} > 20,000)$	0.057	0.006	0.058	0.006	0.050	0.006	0.050	0.006
$P(y_{i,a,t} > 25,000)$	0.052	0.006	0.053	0.006	0.050	0.006	0.049	0.006
$P(y_{i,a,t} > 30,000)$	0.046	0.006	0.046	0.006	0.046	0.006	0.044	0.006
$P(y_{i,a,t} > 35,000)$	0.030	0.007	0.033	0.006	0.033	0.006	0.029	0.006
$P(y_{i,a,t} > 40,000)$	-0.001	0.007	0.010	0.007	0.012	0.007	0.006	0.006
$P(y_{i,a,t} > 45,000)$	-0.010	0.007	-0.002	0.007	-0.001	0.007	-0.011	0.007
$P(y_{i,a,t} > 50,000)$	-0.023	0.007	-0.010	0.007	-0.012	0.007	-0.020	0.007
$P(y_{i,a,t} > 55,000)$	-0.016	0.007	-0.010	0.007	-0.011	0.007	-0.014	0.007
$P(y_{i,a,t} > 60,000)$	-0.016	0.007	-0.006	0.007	-0.011	0.006	-0.014	0.007
$P(y_{i,a,t} > 65,000)$	-0.009	0.006	-0.002	0.006	-0.003	0.006	-0.002	0.006
$P(y_{i,a,t} > 70,000)$	-0.010	0.006	-0.004	0.005	-0.003	0.006	-0.001	0.006
$P(y_{i,a,t} > 75,000)$	-0.006	0.005	0.000	0.005	-0.002	0.005	0.006	0.005
$P(y_{i,a,t} > 80,000)$	-0.005	0.005	0.000	0.005	-0.003	0.005	0.007	0.005
$P(y_{i,a,t} > 85,000)$	-0.005	0.005	-0.003	0.004	-0.004	0.004	0.004	0.004
$P(y_{i,a,t} > 90,000)$	-0.003	0.004	-0.002	0.004	-0.005	0.005	0.001	0.004
$P(y_{i,a,t} > 95,000)$	0.000	0.004	-0.001	0.004	-0.003	0.004	0.000	0.004
$P(y_{i,a,t} > 100,000)$	0.000	0.004	0.000	0.004	-0.001	0.004	0.001	0.004
$P(y_{i,a,t} > 105,000)$	0.002	0.003	0.000	0.004	-0.001	0.004	0.001	0.004
$P(y_{i,a,t} > 110,000)$	0.002	0.003	-0.001	0.003	-0.003	0.003	0.001	0.003
$P(y_{i,a,t} > 115,000)$	0.001	0.003	-0.003	0.003	-0.004	0.003	0.001	0.003
$P(y_{i,a,t} > 120,000)$	0.002	0.003	-0.003	0.003	-0.002	0.003	0.002	0.003
$P(y_{i,a,t} > 125,000)$	0.002	0.002	-0.002	0.003	-0.001	0.003	0.003	0.003
$P(y_{i,a,t} > 130,000)$	0.003	0.002	-0.002	0.002	-0.002	0.003	0.002	0.002
$P(y_{i,a,t} > 135,000)$	0.003	0.002	-0.001	0.002	-0.001	0.002	0.003	0.002
$P(y_{i,a,t} > 140,000)$	0.003	0.002	0.000	0.002	0.001	0.002	0.002	0.002
$P(y_{i,a,t} > 145,000)$	0.003	0.002	0.001	0.002	0.001	0.002	0.003	0.002
$P(y_{i,a,t} > 150,000)$	0.001	0.002	0.001	0.002	0.000	0.002	0.003	0.002

Source: Authors' own calculations using data from Statistics Norway.
Note: Marginal effects (ME) and associated standard errors (SE) for each of the estimations of Equation (A7). Standard errors are based on 200 non-parametric bootstrap replications for each estimation, clustered on individual level.

Table A3: Marginal effects, CCDF, reform effect by age

Outcome	Age 62		Age 63		Age 64		Age 65		Age 66	
	ME	SE	ME	SE	ME	SE	ME	SE	ME	SE
$P(y_{i,a,t} > 0)$	0.008	0.003	0.023	0.005	0.055	0.005	0.088	0.006	0.087	0.006
$P(y_{i,a,t} > 5,000)$	0.006	0.004	0.018	0.005	0.048	0.005	0.080	0.006	0.079	0.006
$P(y_{i,a,t} > 10,000)$	0.005	0.004	0.013	0.005	0.043	0.006	0.073	0.006	0.074	0.006
$P(y_{i,a,t} > 15,000)$	0.005	0.004	0.014	0.006	0.039	0.006	0.069	0.006	0.066	0.006
$P(y_{i,a,t} > 20,000)$	0.005	0.004	0.012	0.006	0.038	0.006	0.066	0.006	0.060	0.006
$P(y_{i,a,t} > 25,000)$	0.007	0.005	0.010	0.006	0.033	0.006	0.055	0.006	0.049	0.006
$P(y_{i,a,t} > 30,000)$	0.005	0.005	0.004	0.006	0.027	0.006	0.045	0.006	0.037	0.006
$P(y_{i,a,t} > 35,000)$	-0.007	0.005	-0.004	0.006	0.016	0.006	0.026	0.006	0.016	0.006
$P(y_{i,a,t} > 40,000)$	-0.014	0.006	-0.018	0.007	-0.006	0.006	0.002	0.006	-0.008	0.006
$P(y_{i,a,t} > 45,000)$	-0.016	0.006	-0.026	0.007	-0.011	0.007	-0.011	0.006	-0.027	0.006
$P(y_{i,a,t} > 50,000)$	-0.026	0.006	-0.031	0.006	-0.018	0.006	-0.022	0.006	-0.041	0.006
$P(y_{i,a,t} > 55,000)$	-0.014	0.005	-0.023	0.006	-0.015	0.006	-0.017	0.006	-0.036	0.006
$P(y_{i,a,t} > 60,000)$	-0.013	0.005	-0.021	0.006	-0.016	0.006	-0.015	0.006	-0.033	0.005
$P(y_{i,a,t} > 65,000)$	-0.007	0.005	-0.014	0.005	-0.005	0.005	-0.009	0.005	-0.025	0.005
$P(y_{i,a,t} > 70,000)$	-0.003	0.004	-0.010	0.005	-0.002	0.005	-0.005	0.005	-0.022	0.004
$P(y_{i,a,t} > 75,000)$	-0.001	0.004	-0.007	0.005	0.001	0.005	-0.003	0.004	-0.015	0.004
$P(y_{i,a,t} > 80,000)$	0.001	0.004	-0.005	0.004	0.000	0.004	-0.001	0.004	-0.013	0.004
$P(y_{i,a,t} > 85,000)$	0.002	0.003	-0.004	0.004	0.002	0.004	-0.002	0.004	-0.010	0.004
$P(y_{i,a,t} > 90,000)$	0.003	0.003	-0.004	0.004	0.000	0.004	-0.002	0.003	-0.009	0.003
$P(y_{i,a,t} > 95,000)$	0.001	0.003	-0.002	0.003	0.001	0.003	0.001	0.003	-0.007	0.003
$P(y_{i,a,t} > 100,000)$	0.001	0.003	-0.003	0.003	0.002	0.003	0.001	0.003	-0.005	0.003
$P(y_{i,a,t} > 105,000)$	0.002	0.002	-0.002	0.003	0.002	0.003	0.001	0.003	-0.004	0.003
$P(y_{i,a,t} > 110,000)$	0.002	0.002	-0.003	0.003	0.001	0.002	0.000	0.002	-0.004	0.002
$P(y_{i,a,t} > 115,000)$	0.002	0.002	-0.002	0.002	0.000	0.002	-0.001	0.002	-0.005	0.002
$P(y_{i,a,t} > 120,000)$	0.002	0.002	-0.001	0.002	0.001	0.002	0.000	0.002	-0.004	0.002
$P(y_{i,a,t} > 125,000)$	0.003	0.002	0.000	0.002	0.002	0.002	0.000	0.002	-0.003	0.002
$P(y_{i,a,t} > 130,000)$	0.002	0.002	0.001	0.002	0.001	0.002	0.001	0.002	-0.002	0.002
$P(y_{i,a,t} > 135,000)$	0.001	0.002	0.001	0.002	0.001	0.002	0.000	0.002	-0.001	0.002
$P(y_{i,a,t} > 140,000)$	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.002	0.000	0.002
$P(y_{i,a,t} > 145,000)$	0.002	0.001	0.003	0.002	0.001	0.002	0.002	0.002	0.000	0.002
$P(y_{i,a,t} > 150,000)$	0.001	0.001	0.002	0.002	0.000	0.002	0.001	0.002	-0.001	0.002

Source: Authors' own calculations using data from Statistics Norway.
Note: Marginal effects (ME) and associated standard errors (SE) for each of the estimations of Equation (A6). Standard errors are based on 200 non-parametric bootstrap replications for each estimation, clustered on individual level.

Table A4: Marginal effects, CCDF, average reform effect

Outcome	A. Average reform effect		B. Linear time trend, pre-reform years		C. Linear time trend, sample years	
	ME	SE	ME	SE	ME	SE
$P(y_{i,a,t} > 0)$	0.053	0.003	0.013	0.004	0.013	0.004
$P(y_{i,a,t} > 5,000)$	0.047	0.003	0.018	0.004	0.018	0.004
$P(y_{i,a,t} > 10,000)$	0.042	0.003	0.016	0.005	0.016	0.005
$P(y_{i,a,t} > 15,000)$	0.039	0.003	0.014	0.005	0.014	0.005
$P(y_{i,a,t} > 20,000)$	0.037	0.004	0.010	0.005	0.010	0.005
$P(y_{i,a,t} > 25,000)$	0.031	0.004	0.000	0.005	0.000	0.005
$P(y_{i,a,t} > 30,000)$	0.024	0.004	-0.007	0.005	-0.007	0.005
$P(y_{i,a,t} > 35,000)$	0.009	0.004	-0.021	0.006	-0.021	0.006
$P(y_{i,a,t} > 40,000)$	-0.009	0.005	-0.038	0.006	-0.038	0.006
$P(y_{i,a,t} > 45,000)$	-0.018	0.005	-0.041	0.006	-0.041	0.006
$P(y_{i,a,t} > 50,000)$	-0.028	0.005	-0.052	0.007	-0.052	0.007
$P(y_{i,a,t} > 55,000)$	-0.021	0.005	-0.041	0.006	-0.041	0.006
$P(y_{i,a,t} > 60,000)$	-0.020	0.005	-0.037	0.006	-0.037	0.006
$P(y_{i,a,t} > 65,000)$	-0.012	0.004	-0.026	0.006	-0.026	0.006
$P(y_{i,a,t} > 70,000)$	-0.009	0.004	-0.022	0.005	-0.022	0.005
$P(y_{i,a,t} > 75,000)$	-0.005	0.003	-0.019	0.005	-0.019	0.005
$P(y_{i,a,t} > 80,000)$	-0.004	0.003	-0.016	0.005	-0.016	0.005
$P(y_{i,a,t} > 85,000)$	-0.003	0.003	-0.012	0.004	-0.012	0.004
$P(y_{i,a,t} > 90,000)$	-0.002	0.003	-0.010	0.004	-0.010	0.004
$P(y_{i,a,t} > 95,000)$	-0.001	0.003	-0.007	0.004	-0.007	0.004
$P(y_{i,a,t} > 100,000)$	-0.001	0.002	-0.006	0.003	-0.006	0.003
$P(y_{i,a,t} > 105,000)$	0.000	0.002	-0.004	0.003	-0.004	0.003
$P(y_{i,a,t} > 110,000)$	-0.001	0.002	-0.005	0.003	-0.005	0.003
$P(y_{i,a,t} > 115,000)$	-0.001	0.002	-0.004	0.003	-0.004	0.003
$P(y_{i,a,t} > 120,000)$	0.000	0.002	-0.003	0.002	-0.003	0.002
$P(y_{i,a,t} > 125,000)$	0.000	0.002	-0.002	0.002	-0.002	0.002
$P(y_{i,a,t} > 130,000)$	0.001	0.002	-0.001	0.002	-0.001	0.002
$P(y_{i,a,t} > 135,000)$	0.000	0.001	-0.001	0.002	-0.001	0.002
$P(y_{i,a,t} > 140,000)$	0.001	0.001	0.000	0.002	0.000	0.002
$P(y_{i,a,t} > 145,000)$	0.001	0.001	0.000	0.002	0.000	0.002
$P(y_{i,a,t} > 150,000)$	0.000	0.001	-0.002	0.002	-0.002	0.002

Source: Authors' own calculations using data from Statistics Norway.
Note: Marginal effects (ME) and associated standard errors (SE) for each of the estimations of Equation (A5) (Panel A), Equation (A9) (Panel B) and Equation (A10) (Panel C). Standard errors are based on 200 non-parametric bootstrap replications for each estimation, clustered on individual level.

A4 Earnings, OLS Estimation

A4.1 Average Effect

Panel A in Table A5 and Table A6 in Section A4.2 and Section A4.3 in this Appendix shows the estimation results from the following linear difference-in-difference model:

$$y_{i,a,t} = \alpha + X_i\beta + \sum_{s=61}^{66} \gamma_s DA_s + \sum_{l=2010}^{2018} \lambda_l DT_l + \eta\Delta_{i,a,t} + \varepsilon_{i,a,t} \tag{A11}$$

A4.2 Age-by-Age Effect

In order to explore potential age-dependent effects of introducing the flexible pension on mean earnings, we estimate the following linear difference-in-difference model:

$$y_{i,a,t} = \alpha + X_i\beta + \sum_{s=61}^{66} \gamma_s DA_s + \sum_{l=2010}^{2018} \lambda_l DT_l + \sum_{m=62}^{66} \eta_m DA_m\Delta_{i,a,t} + \varepsilon_{i,a,t} \tag{A12}$$

The estimation results are shown in Panel B in Table A5.

Table A5: Reform effect on mean earnings, by age

	A. Average effect		B. Age-specific effects	
	(1)	(2)	(3)	(4)
Treatment effect (η)	-595	448		
	(436)	(361)		
Treatment effect at:				
Age 62 (η_{62})			-903	-266
			(470)	(394)
Age 63 (η_{63})			-1,525	-780
			(556)	(475)
Age 64 (η_{64})			-33	1,083
			(567)	(488)
Age 65 (η_{65})			363	1,748
			(564)	(489)
Age 66 (η_{66})			-904	395
			(546)	(497)
Year and age dummies	Yes	Yes	Yes	Yes
Control variables	No	Yes	No	Yes
Adjusted R^2	0.078	0.298	0.078	0.298
No. of individuals (N)	89,177	89,177	89,177	89,177
Sample size ($N \times T$)	378,891	378,891	378,891	378,891

Source: Authors' own calculations using data from Statistics Norway.
Note: OLS estimation results of the average reform effect on earnings (Panel A) from Equation (A11) and the age-specific reform effects on earnings (Panel B) from Equation (A12). Control variables are pre-determined and include linear controls for education length, education length squared, log average annual pre-tax earnings from age 30 to age 59, and net liquid wealth at age 59. Standard errors (in parentheses) are clustered on the individual level, based on 200 non-parametric bootstrap replications.

A4.3 Year-by-Year Effect

We derive the year-by-year impact of introducing the flexible old-age pension on mean labor earnings by estimating the following linear difference-in-difference equation:

$$y_{i,a,t} = \alpha + X_i\beta + \sum_{s=61}^{66} \gamma_s DA_s + \sum_{l=2010}^{2018} \lambda_l DT_l + \sum_{m=2010}^{2018} \eta_m DT_m \Delta_{i,a,t} + \varepsilon_{i,a,t} \tag{A13}$$

The estimation results are shown in Panel B in Table A6.

Table A6: Reform effect on mean earnings, by year

	A. Average effect		B. Year-specific effects	
	(1)	(2)	(3)	(4)
Treatment effect (η)	-595	-448		
	(436)	(361)		
Treatment effect at:				
Year 2010 (η_{2010})			243	357
			(458)	(416)
Year 2011 (η_{2011})			-1,729	-1,117
			(644)	(532)
Year 2012 (η_{2012})			-1,005	-636
			(649)	(522)
Year 2013 (η_{2013})			-6	462
			(655)	(544)
Year 2014 (η_{2014})			-782	16
			(677)	(575)
Year 2015 (η_{2015})			838	1,721
			(600)	(524)
Year 2016 (η_{2016})			770	1,953
			(624)	(522)
Year 2017 (η_{2017})			-1,280	660
			(790)	(732)
Year 2018 (η_{2018})			-648	1,619
			(614)	(543)
Year and age dummies	Yes	Yes	Yes	Yes
Control variables	No	Yes	No	Yes
Adjusted R^2	0.078	0.298	0.079	0.298
No. of individuals (N)	89,177	89,177	89,177	89,177
Sample size ($N \times T$)	378,891	378,891	378,891	378,891

Source: Authors' own calculations using data from Statistics Norway.
Note: OLS estimation results of the average reform effect on earnings (Panel A) from Equation (A11) and the year-specific reform effects on earnings (Panel B) from Equation (A13). Control variables are pre-determined and include linear controls for education length, education length squared, log average annual pre-tax earnings from age 30 to age 59, and net liquid wealth at age 59. Standard errors (in parentheses) are clustered on the individual level, based on 200 non-parametric bootstrap replications.

A5 Derivation of Standard Errors for CCDF Total Effect

In order to derive the standard error of the CCDF age-specific effects (ΔE_a), we assume that for each age each point estimate across the earnings distribution is independent of each other. This yields the following simplification of the variance of the estimated age-specific effects:

$$\begin{aligned}
\text{var}(\Delta E_a) &= \text{var}\left(\sum_{r=1}^{31} \Delta E_{r,a}\right) \\
&= \sum_{r=1}^{31} \text{var}(\Delta E_{r,a}) \\
&= \sum_{r=1}^{31} \sqrt{\text{var}(\Delta CCDF_{r,a} \times 5000)} \\
&= \sum_{r=1}^{31} \sqrt{5000^2 \times [SE(\Delta CCDF_{r,a})]^2}
\end{aligned} \tag{A14}$$

Equivalently, we find the standard errors of the total CCDF effect (ΔE) assuming both independence of point estimates across the distribution for each age, as well as independence of the age-specific estimates. This yields the following simplification of the variance of the estimated total effect:

$$\begin{aligned}
\text{var}(\Delta E) &= \text{var}\left(\sum_{a=62}^{66} \Delta E_a\right) \\
&= \sum_{a=62}^{66} \text{var}(\Delta E_a) \\
&= \sum_{a=62}^{66} \sum_{r=1}^{31} \sqrt{5000^2 \times [SE(\Delta CCDF_{r,a})]^2}
\end{aligned} \tag{A15}$$

A6 Weekly Working Hours, OLS Estimation

A6.1 Age-by-Age Effect

We estimate the following linear difference-in-difference model to derive the reform effect on the number of working hours:

$$h_{i,a,t} = \alpha + X_i\beta + \sum_{s=61}^{66} \gamma_s DA_s + \sum_{l=2010}^{2018} \lambda_l DT_l + \sum_{m=62}^{66} \eta_m DA_m \Delta_{i,a,t} + \varepsilon_{i,a,t} \tag{A16}$$

Here, $h_{i,a,t}$ measures the number of weekly working hours (not conditional on working) of individual i at age a. Table A7 shows the estimation results from this exercise.

Table A7: Reform effect on weekly working hours, by age

	(1)	(2)
Treatment effect at:		
Age 62 (η_{62})	0.29	0.27
	(0.14)	(0.14)
Age 63 (η_{63})	0.56	0.53
	(0.18)	(0.18)
Age 64 (η_{64})	1.62	1.60
	(0.19)	(0.19)
Age 65 (η_{65})	2.64	2.63
	(0.22)	(0.21)
Age 66 (η_{66})	2.48	2.47
	(0.21)	(0.21)
Year and age dummies	Yes	Yes
Control variables	No	Yes
Adjusted R^2	0.078	0.298
No. of individuals (N)	89,177	89,177
Sample size ($N \times T$)	378,891	378,891

Source: Authors' own calculations using data from Statistics Norway.
Note: OLS estimation results of the age-specific reform effects on number of weekly working hours from Equation (A16). Control variables are pre-determined and include linear controls for education length, education length squared, log average annual pre-tax earnings from age 30 to age 59, and net liquid wealth at age 59. Standard errors (in parentheses) are clustered on the individual level, based on 200 non-parametric bootstrap replications.

A7 Weekly Working Hours, Non-Linear Estimation

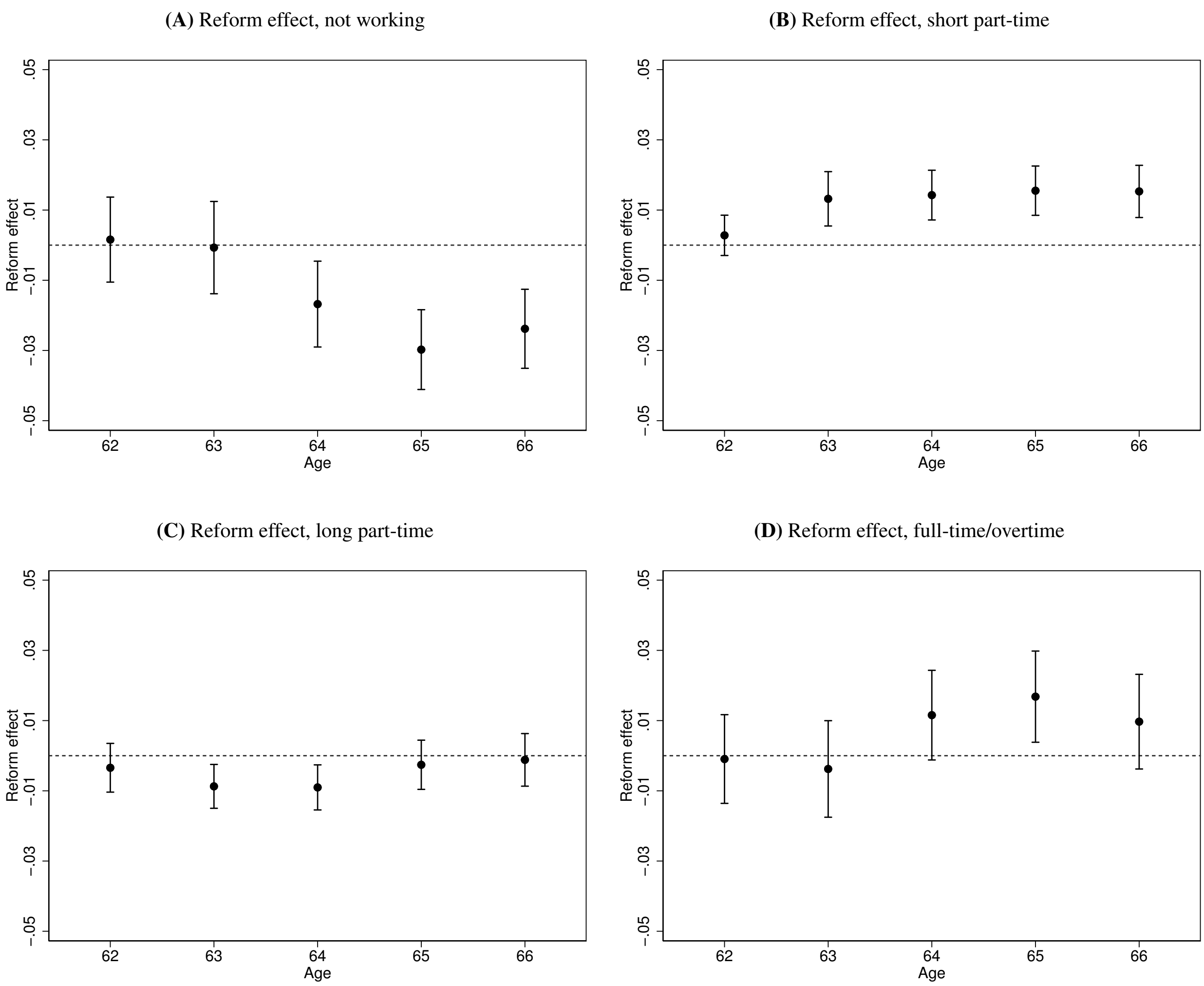
A7.1 Age-by-Age Effect

To derive the age-specific effects of the reform on the number of weekly working hours, where we decompose the effects on the intensive and extensive margin, we estimate the following non-linear difference-in-difference model for the alternatives $j \in \{$not working, short part-time, long part-time, full-time/overtime$\}$:

$$P\left(h_{i,a,t} = j\right) = \frac{\exp\left(\eta_{i,j,t}\right)}{\sum_{k=1}^{4} \exp\left(\eta_{i,k,t}\right)}, \quad \eta_{i,j,t} = \alpha + X_i\beta + \sum_{s=61}^{66} \gamma_s DA_s + \sum_{l=2010}^{2018} \lambda_l DT_l + \sum_{m=62}^{66} \delta_m DA_m \Delta_{i,a,t} \tag{A17}$$

Here the alternatives are $j \in \{\text{not working}, \text{short part-time}, \text{long part-time}, \text{full-time/overtime}\}$. The results from this exercise are illustrated in Figure A7. Table A8 in Section A7.3 in this Appendix shows the marginal effects (evaluated at the covariate values equal to the average of the treatment group in the post-reform period) and the associated standard errors used to simulate the age-by-age reform effects.

Figure A7: Reform effect on weekly hours, by age



Source: Authors' own calculations using data from Statistics Norway.
Note: Results from estimation of Equation (A17), showing the estimated marginal reform effects by age and the associated 95 percent confidence intervals (capped lines, based on 200 non-parametric bootstrap replications, clustered on individual level). The weekly-hours groups are defined as follows: (i) not working: 0 hours, (ii) short part-time: 0-20 hours, (iii) long part-time: 20-34 hours, and (iv) full-time/overtime: 34 hours or more.

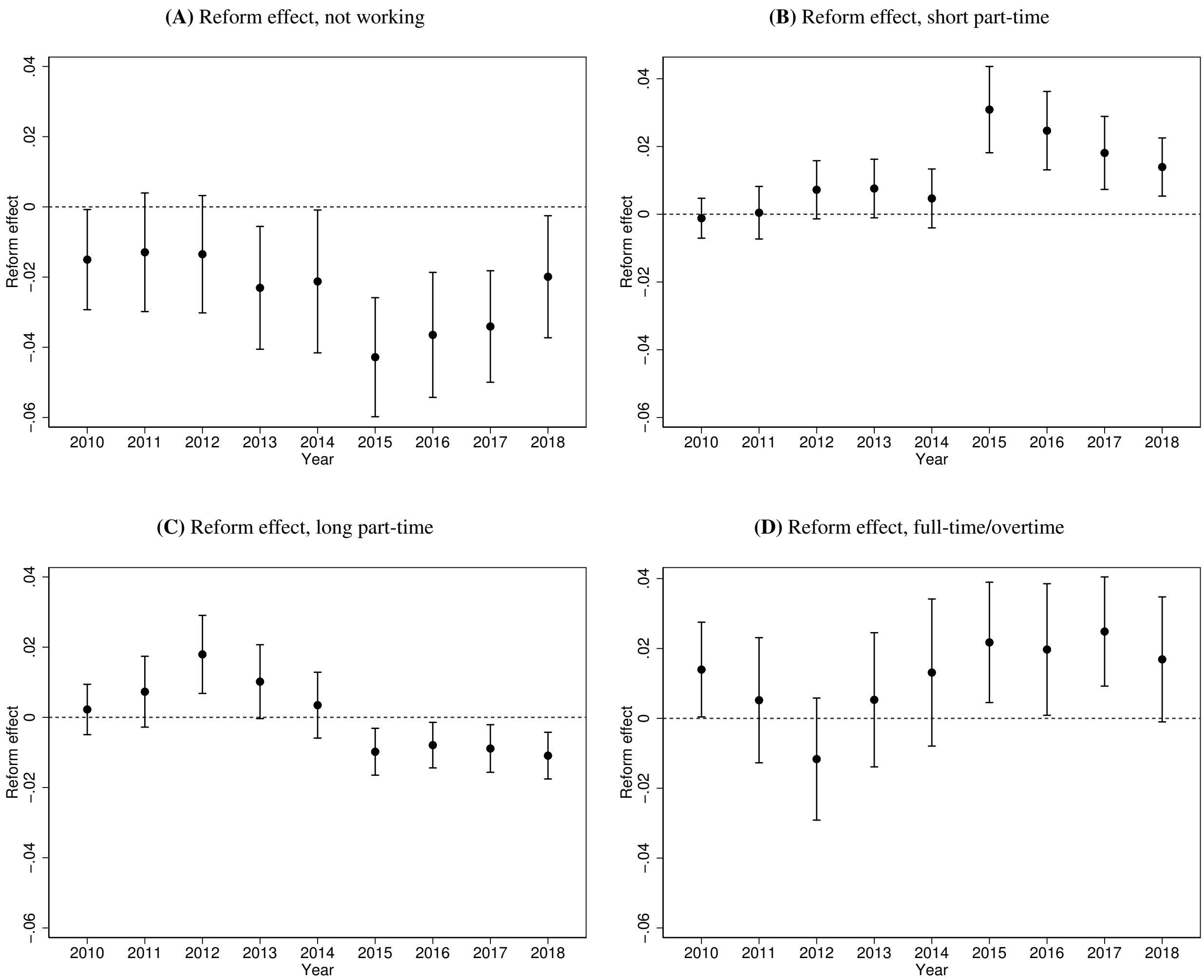
A7.2 Year-by-Year Effect

In order to consider the year-by-year reform effects, we estimate the following multinomial logit model for the four weekly-hours groups keeping the age-specific treatment effects constant:

$$P(y_{i,a,t} = j) = \frac{\exp(\eta_{i,j,t})}{\sum_{k=1}^{4} \exp(\eta_{i,k,t})}, \quad \eta_{i,j,t} = \alpha + X_i\beta + \sum_{s=61}^{66} \gamma_s DA_s + \sum_{l=2010}^{2018} \lambda_l DT_l + \sum_{m=2010}^{2018} \delta_m DT_m \Delta_{i,a,t} \qquad \text{(A18)}$$

Here the alternatives are $j \in \{\text{not working}, \text{short part-time}, \text{long part-time}, \text{full-time/overtime}\}$. The results from this exercise are illustrated in Figure A8. Table A9 in Section A7.3 in this Appendix shows the marginal effects (evaluated at the covariate values equal to the average of the treatment group in the post-reform period) and the associated standard errors used to simulate the year-by-year reform effects.

Figure A8: Reform effect on weekly hours, by year



Source: Authors' own calculations using data from Statistics Norway.
Note: Results from estimation of Equation (A18), showing the estimated marginal reform effects by year and the associated 95 percent confidence intervals (capped lines, based on 200 non-parametric bootstrap replications, clustered on individual level). The weekly-hours groups are defined as follows: (i) not working: 0 hours, (ii) short part-time: 0-20 hours, (iii) long part-time: 20-34 hours, and (iv) full-time/overtime: 34 hours or more.

A7.3 Tables

Table A8: Marginal effects, reform effect by age

Age	Not working		Short part-time		Long part-time		Full-time/overtime	
	ME	SE	ME	SE	ME	SE	ME	SE
62	0.002	0.006	0.003	0.003	-0.003	0.003	-0.001	0.006
63	-0.001	0.007	0.013	0.004	-0.009	0.003	-0.004	0.007
64	-0.017	0.006	0.014	0.004	-0.009	0.003	0.012	0.006
65	-0.030	0.006	0.016	0.004	-0.003	0.004	0.017	0.006
66	-0.024	0.006	0.015	0.004	-0.001	0.004	0.010	0.007

Source: Authors' own calculations using data from Statistics Norway.
Note: Marginal effects (ME) evaluated at the covariate values equal to the average of the treatment group in the post-reform period and associated standard errors (SE) for the estimation of Equation (A17). Standard errors are based on 200 non-parametric bootstrap replications, clustered on individual level.

Table A9: Marginal effects, reform effect by year

Year	Not working		Short part-time		Long part-time		Full-time/overtime	
	ME	SE	ME	SE	ME	SE	ME	SE
2010	-0.015	0.007	-0.001	0.003	0.002	0.004	0.014	0.007
2011	-0.013	0.008	0.000	0.004	0.007	0.005	0.005	0.009
2012	-0.013	0.008	0.007	0.004	0.018	0.006	-0.012	0.009
2013	-0.023	0.009	0.008	0.004	0.010	0.005	0.005	0.010
2014	-0.021	0.009	0.005	0.004	0.003	0.005	0.013	0.011
2015	-0.043	0.010	0.031	0.006	-0.010	0.003	0.022	0.009
2016	-0.036	0.008	0.025	0.006	-0.008	0.003	0.020	0.009
2017	-0.034	0.009	0.018	0.005	-0.009	0.003	0.025	0.008
2018	-0.020	0.009	0.014	0.004	-0.011	0.003	0.017	0.009

Source: Authors' own calculations using data from Statistics Norway.
Note: Marginal effects (ME) evaluated at the covariate values equal to the average of the treatment group in the post-reform period and associated standard errors (SE) for the estimation of Equation (A18). Standard errors are based on 200 non-parametric bootstrap replications, clustered on individual level.

A8 Labor Force Participation Decomposition, OLS Estimation

A8.1 Age-by-Age Effect

Firstly, we estimate the following linear difference-in-difference model to derive the reform effect on not claiming disability benefits:

$$nd_{i,a,t} = \alpha + X_i\beta + \sum_{s=61}^{66} \gamma_s DA_s + \sum_{l=2010}^{2018} \lambda_l DT_l + \sum_{m=62}^{66} \eta_m DA_m \Delta_{i,a,t} + \varepsilon_{i,a,t} \quad \text{(A19)}$$

Here, $nd_{i,a,t}$ is an indicator variable equal to one if individual i does not claim disability benefits at age a, and zero otherwise. Secondly, we estimate a similar model to derive the reform effect on the outcome of not being in a non-work state other than disability benefit claiming:

$$nn_{i,a,t} = \alpha + X_i\beta + \sum_{s=61}^{66} \gamma_s DA_s + \sum_{l=2010}^{2018} \lambda_l DT_l + \sum_{m=62}^{66} \eta_m DA_m \Delta_{i,a,t} + \varepsilon_{i,a,t} \quad \text{(A20)}$$

Here, $nn_{i,a,t}$ is an indicator variable equal to one if individual i is not in a non-work state other than disability benefit claiming at age a, and zero otherwise. Table A10 shows the estimation results from estimating Equation (A19) and Equation (A20), respectively.

Table A10: Reform effect on not claiming DI and not in other non-work state, by age

	A. Not claiming DI (1)	B. Not in other non-work state (2)
Treatment effect at:		
Age 62 (η_{62})	0.004 (0.002)	0.005 (0.003)
Age 63 (η_{63})	0.008 (0.003)	0.015 (0.004)
Age 64 (η_{64})	0.023 (0.003)	0.032 (0.005)
Age 65 (η_{65})	0.029 (0.003)	0.059 (0.005)
Age 66 (η_{66})	0.043 (0.004)	0.044 (0.006)
Year and age dummies	Yes	Yes
Control variables	Yes	Yes
Adjusted R^2	0.040	0.093
No. of individuals (N)	89,177	89,177
Sample size ($N \times T$)	378,891	378,891

Source: Authors' own calculations using data from Statistics Norway.
Note: OLS estimation results of the age-specific reform effects on not claiming disability benefits (Panel A) and not being in a non-work state other than disability benefit claiming (Panel B). Control variables are pre-determined and include linear controls for education length, education length squared, log average annual pre-tax earnings from age 30 to age 59, and net liquid wealth at age 59. Standard errors (in parentheses) are clustered on the individual level, based on 200 non-parametric bootstrap replications.

A9 Job Changes and Partial Retirement, OLS Estimation

In order to explore the age-dependent effects of introducing the flexible pension on job mobility, we estimate the following linear difference-in-difference model:

$$m_{i,a,t} = \alpha + X_i\beta + \sum_{s=61}^{66} \gamma_s DA_s + \sum_{l=2010}^{2018} \lambda_l DT_l + \sum_{m=62}^{66} \eta_m DA_m \Delta_{i,a,t} + \varepsilon_{i,a,t} \quad \text{(A21)}$$

Here, $m_{i,a,t}$ is an indicator variable equal to one if individual i performs job change at age a, and zero otherwise. Table A11 shows the estimated reform effect on changing jobs (Panel A) and changing jobs to a lower paid job (Panel B), where we denote the latter "partial retirement". The results from this exercise are illustrated in Figure A9.

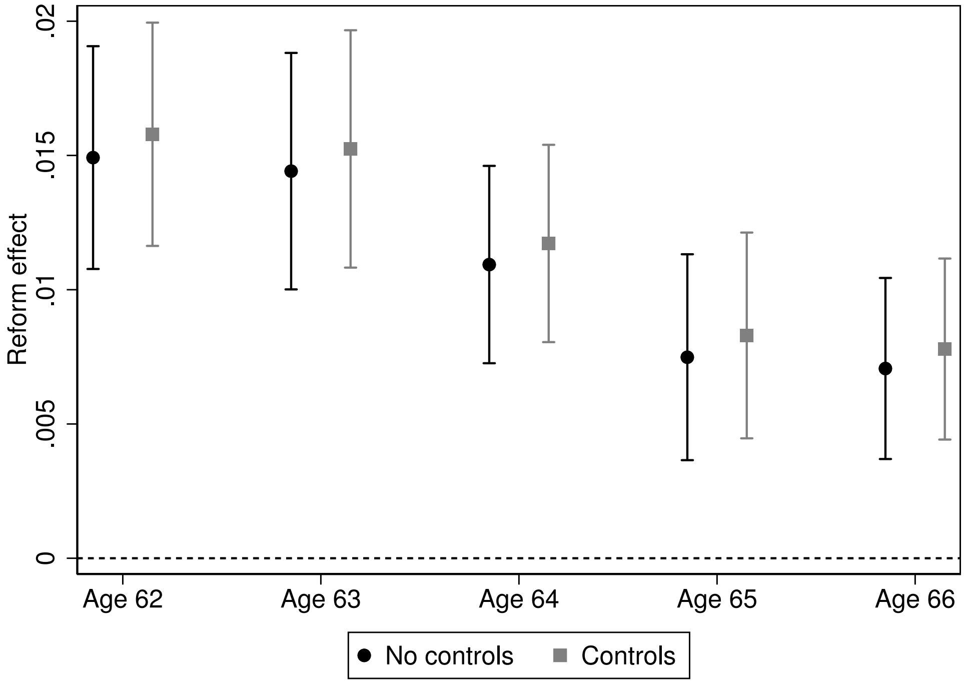
Table A11: OLS estimation results, job changes and partial retirement

	A. Job change		B. Partial retirement	
	(1)	(2)	(3)	(4)
Treatment effect at:				
Age 62 (η_{62})	0.015	0.016	0.010	0.010
	(0.002)	(0.002)	(0.002)	(0.002)
Age 63 (η_{63})	0.014	0.015	0.011	0.011
	(0.002)	(0.002)	(0.002)	(0.002)
Age 64 (η_{64})	0.011	0.012	0.009	0.009
	(0.002)	(0.002)	(0.002)	(0.002)
Age 65 (η_{65})	0.007	0.008	0.007	0.008
	(0.002)	(0.002)	(0.002)	(0.002)
Age 66 (η_{66})	0.007	0.008	0.006	0.007
	(0.002)	(0.002)	(0.001)	(0.001)
Year and age dummies	Yes	Yes	Yes	Yes
Control variables	No	Yes	No	Yes
Adjusted R^2	0.015	0.016	0.010	0.011
No. of individuals (N)	89,177	89,177	89,177	89,177
Sample size ($N \times T$)	378,891	378,891	378,891	378,891

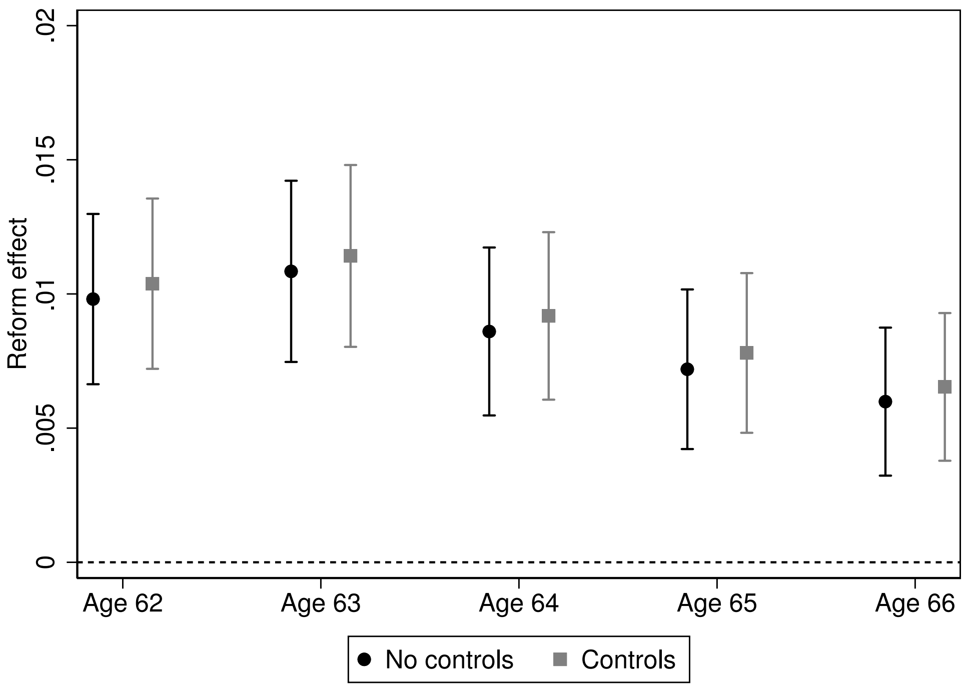
Source: Authors' own calculations using data from Statistics Norway.
Note: OLS estimation results of the average reform effect on probability of changing jobs (Panel A) and probability of changing jobs to a lower paid job (Panel B), using the model in Equation (A21). Control variables are pre-determined and include linear controls for education length, education length squared, log average annual pre-tax earnings from age 30 to age 59, and net liquid wealth at age 59. Standard errors (in parentheses) are clustered on the individual level, based on 200 non-parametric bootstrap replications.

Figure A9: Reform effect on job mobility

(A) Job change



(B) Partial retirement



Source: Authors' own calculations using data from Statistics Norway.
Note: OLS estimation results of the age-specific reform effect on job change (Panel A) and partial retirement (Panel B) from Equation (A21). Job change is defined as a change of establishment, while partial retirement is defined as a job change with lower earnings than the previous job. Black lines indicate estimation results with no control variables, gray lines indicate estimation results with control variables. Control variables are predetermined and include linear controls for education length, education length squared, log average annual pre-tax earnings from age 30 to age 59, and net liquid wealth at age 59. The capped lines show the 95 percent confidence intervals, based on standard errors clustered on the individual level with 200 non-parametric bootstrap replications.