Shattered Dreams: The Effects of Changing the Pension System Late in the Game

Andries De Grip, Maarten Lindeboom, Raymond Montizaan

Andries De Grip and Raymond Montizaan are affiliated to ROA, Maastricht University and IZA
*Maarten Lindeboom is affiliated to VU University Amsterdam, Tinbergen Institute, HEB, IZA and Netspar**

January, 2010

Abstract

This paper assesses the impact of a dramatic reform of the Dutch pension system on mental health, savings behaviour and retirement expectations of workers nearing retirement age. The reform means that public sector workers born on January 1, 1950 or later face a substantial reduction in their pension rights while workers born before this threshold date may still retire under the old, more generous rules. We employ a unique matched survey and administrative data set comprising male public sector workers born in 1949 and 1950 and find strong ex ante effects on mental health for workers who are affected by the reform. The effects differ in accordance with worker characteristics and increase as birth dates of the treated approach the threshold date. Furthermore, we find that those affected by the reform also respond by working an additional four months and that they are more likely to participate in a savings program that partially compensates for the loss in pension wealth. This later expected retirement and feelings of unfair treatment are main drivers of the strong effects from the reform on mental health.

Keywords: mental health, retirement, natural experiment, regression discontinuity.

*We gratefully acknowledge ABP for making the administrative data available. We acknowledge the comments and suggestions of Lex Borghans, Norma Coe, Owen O'Donnel, Arnaud Dupuy, Hans Kippersluis, Ben Kriechel, Jan Sauermann, Thomas Dohmen and seminar participants at Pompeu Fabra Barcelona, the University of Sheffield and the Netspar Theme conference on Health and Retirement.

1 Introduction

This paper assesses the mental health effects of a change in the Dutch pension system. Prior to 2006, public sector workers in the Netherlands could retire at age 62 years and 3 months with a replacement rate of 70% of their average yearly earnings since 2002.[1] As of 2006, those born before January 1, 1950 could continue to retire under the old rules, but for those born on or after January 1, 1950 the replacement rate is lowered to 64%. These younger workers need to work an additional 1 year and 1 month to obtain the 70% replacement rate enjoyed by counterparts who may be just a few days, weeks or months older. Two years after the policy change, we compared the mental health of workers born in 1949 (turning 59 years old in 2008) and 1950 (turning 58 years old in 2008). We find strong effects from the exogenous change in the retirement system: depression rates among the 1950 cohort were about 40% higher than among the 1949 cohort. To our knowledge, this is the first study to document large and persistent ex ante mental health effects from a change in a retirement system.

Our findings are relevant for a number of reasons. First, depression is a relatively common disorder, with prevalence rates of about 10% in the US, the UK and The Netherlands. Depression is among the leading causes of disability worldwide (WHO, 2006) and it is associated with heart disease, diabetes, some forms of cancer, and other diseases. Indeed, health care expenditures of depressed individuals are about four times higher than those of non-depressed individuals. In addition to these direct effects on health care costs, indirect costs from depression are substantial. Depression leads to lower productivity, workplace errors, faulty products, accidents, and increased absenteeism and disability insurance expenditures. In fact, in the last decade an increasing share of disability insurance expenditure in the western world is due to mental illnesses (OECD, 2008).

Second, our findings are relevant for public policy in the context of ageing. Most developed countries are currently encouraging prolonged working lives for older workers in order to mitigate the adverse effects of an aging population. Increasing labour force participation rates among older workers improves the fiscal stability of pension systems. However,

[1] Until January 1, 2002, pension benefits were calculated using wage earnings in the year prior to retirement. Since 2002, pension benefits have been calculated using average annual earnings since 2002.

a natural question which has been largely overlooked by policy makers concerns the effect of later retirement on individual well-being and, in particular, on health. Adverse (or positive) effects from later retirement on post-retirement health not only influence individual well-being, but also directly affect health care costs at ages after retirement. Our finding of persistent ex ante health effects from changes in the retirement system suggests that post-retirement health worsens when individuals are induced to extend their working lives.

Third, following up on the second point, there is a recent and growing body of literature on the health effects of retirement. Cross-sectional analyses usually find that those who retire early have worse post-retirement health. Tsai et al. (2005) compare mortality rates at later ages and find that post-65 mortality rates are higher for those who retire early. Dave, et al. (2008) find that earlier retirement is associated with poor physical and mental health after retirement. It has been hypothesised that retirement in itself is a stressful event, or that retired people lose the physical and mental activity that is associated with work and/or that social networks associated with work decline. The policy implication of such findings indicates that increasing retirement age would lead to better individual health and well-being and may reduce the burden on (public) health care systems as well as on pension systems. Alternatively, it may be true that aspects of work (stress or job characteristics) worsen health, leading to positive effects from retirement and negative effects from continued work. These alternative mechanisms illustrate that it is difficult to infer causation from a direct comparison of the health status of early retirees with later retirees. Indeed, health may affect work and vice versa. Moreover, unobserved factors may confound the relationship between health and work.

Recent papers in this area have tried to circumvent this endogeneity problem by using an Instrumental Variable approach. Charles (2004) and Neuman (2007) use age-specific retirement incentives provided by the US social security system to capture changes in labour force participation that are unrelated to health. Similarly, Bound and Waidmann (2008) employ age-specific retirement incentives of the UK social security system to gauge the effect of retirement on health. Coe and Lindeboom (2008) use the availability of retirement windows as an instrument. All these studies confirm that the cross-sectional

association between health and retirement is positive; i.e., those who retire later tend to be in better health. However, when the endogeneity of retirement is accounted for, the results change dramatically. Coe and Lindeboom (2008) find no negative effect from early retirement on male health; if anything, these authors report a temporary increase in self-reported health improvement in highly educated workers. Bound and Waidmann (2008) find no evidence of negative health effects from retirement and some evidence that there may be a positive effect for males. Neuman (2007) finds, for subjective health measures, that retirement maintains health, but finds no effect on objective health variables. Charles (2004) focuses on mental health and finds that the direct effect of retirement on mental well being is positive. Our findings of strong ex ante mental health effects are consistent with the Charles (2004) findings.

Finally, the finding of ex ante effects of retirement on mental health has implications for the literature on the determinants of retirement decision making. The larger part of this vast literature focuses on the role of financial incentives on retirement behaviour, with health included as an exogenous regressor (see e.g., the survey by Lumsdaine and Mitchell, 1999). For the identification of the causal effect of financial incentives on retirement it is generally believed that it is preferable to rely on exogenous changes in the retirement system. In the presence of ex ante health effects, changes in the retirement system will not only have an impact on the budget constraint, but will also influence health prior to retirement. This will confound both the health effects and the effect of financial incentives in retirement models.[2]

Our contribution is most closely related to the recent paper by Falba et al. (2008), which examines the impact on depression of deviation of actual retirement dates from their preceding expectations. The paper finds significant effects on depression at age 62 from those working more than expected and from those working less than expected. Our study differs from this paper in three important ways. First, we are able to exploit a natural experiment that generates a drastic change in the retirement system that is in-

[2]Part of the effect of the financial incentives will be absorbed by the health effect if health changes prior to actual retirement. This suggests, moreover, that there are feedback effects of work on health, which in turn implies that health should be treated as an endogenous regressor in retirement models. See Bound and Waidmann (2008) for similar reasoning in the context of the effects of retirement on post-retirement health.

dependent of health and that affects only a subgroup of workers. We link survey and administrative information of the pension fund. The survey was conducted in 2008 and consists of approximately 5,200 observations of fulltime working males born in 1949 and 1950. The limited age difference between the treatment and control groups in our sample and the simple and transparent age criterion determining entitlement to the old or new pension rights guarantees the internal validity of the experiment. Furthermore, there have been no other institutional changes that differentially affected the 1950 (1949) cohort as opposed to the 1949 (1950) cohort. Our findings are therefore less likely to be confounded. Second, our study shows that there are ex ante effects, that these are substantial and that they persist over time. Third, our data allow, to some extent, for further analysis of savings decisions and retirement expectations. This gives more insight into the mechanisms underlying our findings.

This paper proceeds as follows: Section 2 presents a brief description of the institutional setting in The Netherlands and the policy change that was implemented in January 2006. Section 3 describes the data and examines the validity of our natural experiment, i.e., whether individuals are aware of the reform and whether the treated group and the control group are comparable with respect to other characteristics. Section 4 presents the results of the empirical analyses. We analyse, in Section 5, whether the reform changes retirement savings and retirement expectations of the affected group. In Section 6, we further explore mechanisms that may explain our finding of higher depression rates among workers affected by the reform. We close with a discussion of our conclusions.

2 The Dutch pension system

The Dutch pension system consists of three pillars: 1) at age 65, all residents are entitled to a state old age pension financed by contributions that are levied along with the income tax; 2) most employees are entitled to an (early) supplementary sectoral or firm pension of the defined-benefit type; and 3) individuals can voluntarily build up savings typically taken as annuities through an insurance company. However, due to the supplementary pensions in the second pillar, the third pillar is less well developed in The Netherlands.

For nearly all employees, early retirement before the age of 65 is possible only through the sectoral pension systems in the second pillar. In general for individual employees, participation in sectoral pension schemes is mandatory. These pension schemes are negotiated between unions and employer organisations at the sector or firm level and are officially set forth in collective agreements. The administration of these schemes is delegated to pension funds to which both employers and employees contribute. The 'Algemeen Burgelijk Pensioenfonds' (ABP) is the pension fund for public sector workers in The Netherlands. Until 2006, sectoral pension schemes were facilitated by the government through preferential tax treatment which granted large tax advantages due to the progressive tax system (Euwals et al., 2006).[3]

2.1 Changes in the pension system for workers in the public sector

The 2006 reform of the Dutch pension system provides the basis for our natural experiment. In line with its policy of stimulating the labour force participation of older workers, the government abolished the favourable tax treatment of early retirement schemes in the second pillar for all workers born after 1949.[4] As in other sectors, anticipation of the change in tax rules formed an input to collective bargaining on the introduction of a new pension scheme for the public sector in the summer of 2005 ('ABP flexible pension scheme'). In light of demographic changes, it had by then been acknowledged that reform of the pension system would be a necessity. In that sense, a change in pension rights was not entirely unexpected. However, the timing of the reform as well as the particular implementation of a discontinuous assignment rule and the strong differential treatment of workers born around January 1, 1950 came as a surprise to public sector employees when it was announced on July 5, 2005.

The new pension scheme for public sector workers was launched on January 1, 2006. Workers born before 1950 remain entitled to the old, generous pre-pension rights if they

[3]Employees and employers were allowed to deduct their contribution to the sectoral early retirement schemes from their current pre-tax income.

[4]The abolition of favourable tax treatment was not limited to the public sector but also applied to workers in the private sector.

have worked continuously in the public sector since April 1, 1997. This means that such workers can retire between age 55 and 65. Retirement at age 62 years and 3 months yields a pension benefit at a replacement rate of 70% of average yearly earnings since 2002. However, employees born after 1949 and workers born before 1950 who did not work continuously in the public sector in the 10 years prior to retirement are subject to the new and less generous system. The new flexible pension system is characterised by: (i) a drop in pension benefits, (ii) an increase in pension contribution payments to partly account for the drop in pension wealth resulting from (i), and (iii) stronger incentives to continue working, generated by penalties on pension income when retiring before commencement of the state pension at age 65 and by supplements for later retirement. Moreover, the eligibility age for pension benefits is increased to 60 years and workers may decide to continue working until their 70th birthday. For younger workers, the increase in pension contributions partly compensates for the decrease in pension benefits over time. However, public sector workers born just after 1949 do not have enough time to compensate for this drop in pension benefits. Therefore, as a consequence of both the abolition of the tax rules and the steeper early retirement scheme, workers born after 31 December 1949 are confronted with a substantial decrease in pension benefits if they wish to retire at age 62 and 3 months. More specifically, the replacement rate drops to 64% and they must work an additional 13 months to qualify for a pension at a replacement rate of 70%.[5]

In 2006, the Dutch government also introduced the "Life course savings" program (Levensloopregeling). This program allows tax free saving of up to 12% of annual earnings in a fund that can be used to finance periods of non-employment, such as a sabbatical or early retirement. Workers are allowed to save up to a cumulative amount of 210% of their annual earnings in this "life course savings" fund, which can be used to finance about two years of early retirement. Note, however, that at a savings rate of 12%, a worker needs to save for 17.5 years to reach the cumulative maximum of 210%. Special arrangements were made for older workers who were most affected by the pension reform. Those who

[5]Nevertheless, there is a small minority of older employees born after 1950 who can still retire early without experiencing a substantial drop in income. This pertains to employees with burdensome jobs (firemen, ambulance and police personnel) who are eligible for special arrangements that allow early retirement against a replacement rate of at least 70% between ages 55 and 61. However, these workers are not included in our data.

were born in the years 1950 through 1954 are allowed to save more than 12% of their annual earnings, so long as the cumulative maximum does not exceed 210% of annual earnings. It must be noted that workers of the 1950 cohort have to save for seven years approximately 14% of their annual earnings to finance early retirement at age 62. It is likely that only a very small fraction of such workers are willing or capable of saving such a high proportion of their earnings each year before retirement.

The strong differential treatment of workers born around January 1, 1950 came as a surprise to public sector employees. Besides the pension reform, there are no institutional rules that differentially affects the 1949 to the 1950 cohort. In essence we therefore have a sharp regression discontinuity design. However, for our empirical analyses it is important that workers born in 1950 are aware of the consequences of the new pension system for their individual situations. To make the introduction of the new pension system known to participants, ABP launched a campaign in the second half of 2005 to explain the implications of the new system. A special newspaper was devoted to the new pension system; in it, unions, employer organisations and ABP jointly explained the new flexible pension scheme. All 1.2 million ABP participants received a letter on the core characteristics of the new scheme and a complete electronic service pack for public service employers was developed. Therefore, we may assume that at 1 January 2006 most public sector employees born after 1949 and their employers were familiar with the exogenous shock in their pension rights. Of course this must be verified empirically. Since our data contain information on expectations about the replacement rate at age 62, we can check whether those born after 1949 indeed predict their replacement rate to be lower than 70%. We return to this issue at the end of the next section.

3 Data

3.1 Matched survey and administrative data

We use matched survey data and administrative data for male full time employees in the public sector who were born in 1949 or 1950.[6] The administrative data come from the pension fund for public sector employees in The Netherlands (ABP). The data contain detailed information on annual wage income, the number of years of contribution and establishment size.

The panel survey data are available for three years. The data in the initial wave were gathered in two stages, one year after the introduction of the new pension system. In the first stage, all 27,871 male public sector workers in the Netherlands who were born in 1949 or 1950 were sent a request to participate in the survey and to provide their e-mail address.[7] In the second stage, those who gave permission (11,458 workers sent their e-mail address) received an e-mail with a link to the survey. Potential respondents were not informed about the experimental character of the study and no references were made to the shock in the pension system. In total, 8,526 individuals answered the questionnaire, of which 7,739 completed it successfully. Analyses based on the administrative data show that the 7,739 respondents form a representative sample of the 27,871 male public sector workers in the Netherlands born in 1949 or 1950. Importantly, the response rate to the survey for the two birth cohorts were virtually identical and a simple Probit confirmed that selection into the survey was not related to the treatment (year of birth).[8]

In this study, we rely on data from the second wave of the survey, which was held in March 2008 and includes 6,078 employees of the public sector. In this wave, detailed questions were asked on mental and physical health, job characteristics, retirement ex-

[6]We focus on male employees because for this cohort the male worker aged 57 or 58 is generally the main family wage earner. Moreover, in The Netherlands only a small fraction of women of this birth cohort is still working.

[7]This most likely does not affect the representativeness of the survey. At least 91% of the public workers aged 55 years or older have an internet connection at home (TNS-NIPO, 2006). Moreover, virtually all public sector workers have internet access at work.

[8]More specifically, the Probit for participation in the survey resulted in a small and insignificant coefficient for being born in 1950 (0.0244 with a t-statistic of 1.3). The Probit included variables that were available in the administrative data, such as sector of work, hours of work and log wage.

pectations and indicators for personal wealth.[9] We only use the second wave because the first wave does not have information on mental and physical health and the third wave does not include important control variables such as personal wealth, savings behaviour, and several job characteristics. We use the savings behaviour variables to further examine behavioural responses to the pension reform in section 5. The analysis is restricted to full time employees who have worked continuously in the public sector since 1997.[10] For these workers, the pension reform is clear and simple, as age is the only criterion that determines whether a worker is eligible for the restricted or the more generous retirement scheme. The final sample consists of 5,195 men, of which 2,724 were born in 1950 (the treatment group) and 2,471 were born in 1949 (the control group).

Our primary interest lies in investigating how the change in the pension system affects the mental health of public sector workers. For measuring mental health, we use the CES-D8 indicator of depression, derived from the Center for Epidemiologic Studies Depression Scale (CES-D, Radloff 1977). The CES-D8 is a well validated instrument for measuring emotional function and depressive symptoms (see Blazer et al., 1991; Hays et al., 1993; Adams et al., 2003; Falba et al. 2008) and is used in many large sample-population based studies such as the US Health and Retirement Survey (HRS). The CES-D8 consists of eight items, of which six are negatively phrased statements that reflect the presence of depressive symptoms (depression; that everything was an effort; restless sleep; inability to get going; felt lonely; and felt sad). Two positively phrased statements reflect the absence of depressive symptoms (enjoying life and happiness). To create the variable used in our analyses, we first dichotomise (yes/no) responses and reverse the coding of the positively phrased items to achieve a count variable from 0 to 8, where higher values suggest worsening depressive symptoms. In the next step, we construct a dummy variable that indicates whether workers are considered to be depressed. We used the suggested

[9]For the second wave, all individuals who started the questionnaire in 2007 received an e-mail with the link to the survey in March 2008. Again, the invitation to the survey did not reveal the experimental character of the survey. The questionnaire did not contain questions about the shock in the pension system. To further diminish the possibility of priming effects, the block of questions concerning mental and physical health was carefully placed after a block of questions unrelated to retirement.

[10]This resulted in exclusion of 260 observations on employees born in 1949 who were not eligible for the old pension rights. This group is not large enough to serve as an additional control group.

score of 4 and above, consistent with probable clinical depression (see Andresen et al., 1994; and Blazer et al., 1991).

In addition to mental health, we collected information about physical health, using both objective and subjective measures. First, we asked public sector workers the following question: 'In general, how would you describe your current health?' Response categories ranged form 1 (very good) to 5 (bad). Second, we asked individuals to describe their health in comparison with other persons of the same age and in comparison with their health situation three years ago. Again, response categories ranged form 1 (very good) to 5 (bad). Thirdly, we asked how often individuals visited their doctor in 2007 and whether they were sick for more than 14 days. Lastly, we asked workers whether their health limits them in the kind and amount of work they are able to perform.

3.2 Descriptives

Table 1 presents descriptive statistics for the entire sample, the treatment group and the control group. The last column gives the results of a simple t-test for equality of the means of a variable for both groups. The table shows that on average 4.3% of all public sector workers are depressed as measured by our depression indicator. Workers with retrenched pension rights are relatively more depressed (5.0%) than those who are not affected by the policy change (3.5%). A simple t-test indicates that the difference between the two groups is significant at the 5% level (t-stat = 2.63). A similar result is found for the raw CES-D8 score (t-stat = 2.03). This preliminary analysis indicates that there is a negative ex ante effect from the shock in the pension system on the mental health of workers nearing retirement. Figure 1 presents a scatter plot of the mean depression rate (mean for two birth months) and confirms that the deviations in the depression rate between the treatment and control group emerge precisely around January 1, 1950, threshold.

Table 1 also shows that there are no significant differences in the averages of the physical health measures between the two groups. In 2007, on average, workers visited their doctor twice, 17% of workers were sick more than 14 days and 18% indicated that their health limits them in their job. The t-statistics for the differences between the con-

trols and the treated for number of doctor visits, self-reported health and the limitations question are 0.05, 0.83 and 0.28, respectively.

In our empirical analyses we will exploit the sharp discontinuity in pension treatment induced by the natural experiment. It is therefore important that the individuals in the treatment and control groups be sufficiently similar (apart from differential treatment in the pension system). Table 1 shows that most differences between the group of workers who are affected by the new pension system and the group that falls under the old system are indeed extremely small. Job characteristics, personal characteristics and wealth components are similar across both groups, and with a few exceptions, are not significantly different from each other. Concerning job characteristics, we observe that most public sector workers have mentally demanding work (67%) and that they spend approximately 29% of their working time on non-routine tasks.[11] Approximately 62% of public sector workers have a high education level and more than 91% are married.[12] The fraction of married individuals in our sample is slightly higher among the group that is not affected by the reform and this difference is significant at the 10% level. This higher fraction can be explained by the continuously declining fraction of married men with year of birth. Municipal register data that cover the whole population confirm that the fraction of married men is indeed slightly higher for the 1949 cohort in the Netherlands (Statistics Netherlands, 2008). Anyway, this indicates that it is relevant to control for marital status in our multivariate analyses. We also see some very small yet significant differences between the two groups in the government and education sector. The most recurrent wealth components are private savings (more than 15,000 Euros), net housing wealth and annuity insurance. Among the set of wealth variables, three variables are significantly different between the control and the treatment groups: the number of years individuals built up pension rights in the public sector pension fund; the response to a question on whether

[11]The questions on physically/mentally demanding work are based on two survey questions which asked how well they identified themselves with the following statements: I have physically (mentally) demanding work. Answer categories ranged form 1 (very good) to 5 (bad). For this table, the answer categories are dichotomised (1 corresponds to a score of 1 or 2, and 0 corresponds to a score of 3 or higher).

[12]The public sector has an overrepresentation of highly educated workers. The fraction in our sample is consistent with the OSA labor supply panel, which is a representative panel survey of the working population in The Netherlands.

respondents undertook extra savings arrangements for their retirement in the past year; and the response to a question on whether individuals participated in the "Life course savings" program (see Section 2). The difference in the pension rights variable (t-stat = 8.2) is due to the small age difference between the control and the treatment groups. The extra pension savings (t-stat = 3.7) and participation in the "Life course savings" program (t-stat = 9.3) are likely to be responses to the policy reform. In light of this, it is noted that the government introduced favourable tax treatment for participation in the "Life course savings" program and in particular for those affected by the reform (see Section 2). Of the 1949 cohort, only 6% participate in this "Life course savings" program. Of the 1950 cohort, this fraction is more than two times higher (about 15%). In Section 5, we further explore individual savings behaviour in response to the reform.

Respondents were asked three questions concerning their retirement expectations: 1) 'At what age did you expect to retire 5 years ago?' 2)'At what age do you expect to retire now?' 3) 'Suppose, you would retire at the age of 62'. How large would your pension benefit be as a percentage of your net wage income? The average response to the first question does not differ significantly between the treated and the control groups. However, we do find a significant difference between the two groups for the second question (t-stat = 3.1), although this difference is relatively small. Those born in 1949 on average expect to retire at age 61 years and 8 months, while those born in 1950 expect to retire at age 62 years and 1 month. This small difference in expected retirement age could imply that many workers in the treatment group accept lower pension benefits because they do not want to change their retirement plans. Another possible explanation is that workers are not well enough informed about their pension rights or that they increased their private savings. In light of the latter variable, it is important to have a closer look at the response to the third question.

Do people understand the consequences of the changes in the pension system? The averages in Table 1 show that respondents born in 1949 expect, on average, a pension income at the replacement rate of 72% at retirement age 62, while employees born in 1950 anticipate a replacement rate of only 67% at this age (t-stat = 16.0). These expectations are remarkably close to the actual replacement rates of 70% and 64%, respectively, that

they are forecast to receive based on past and projected pension contributions. Figure 2 shows expected replacement rates for workers born in 1949 and 1950. The dots represent expected average replacement rates for individuals born in a specific two month period. The figure shows that there is a clear break in expectations around the threshold date (December 31, 1949). It seems reasonable to conclude from the figure that employees are indeed familiar with the consequences of the new pension system with respect to their individual situations.

4 Results

We operate simple linear probability models for whether an individual is depressed. This is equivalent to a regression discontinuity approach (see e.g. van der Klaauw, 2003), given that we have a sharp discontinuity induced by the change in the pension system and the small age difference between the treated and the controls. Section 3 showed us in addition that the treated and controls were very similar in observed characteristics. The results are presented in Table 2. An individual is defined to be depressed if the CES-D8 score equals 4 or higher (see section 3). The table includes a base specification, where, apart from the indicator for the reform, no other variables are included. The remaining columns refer to specifications where, subsequently, additional controls are included. In specification II, we add a set of individual controls, including age, marital status, education, wage income, how many years the worker has contributed to the pension fund and job characteristics (sector of work). This specification excludes an indicator for whether individuals characterise their work as mentally or physically demanding, and the proportion of routine tasks. It is conceivable that depression status may have a direct effect on these variables. In specification III, we add a set of controls for personal wealth. Although our data set contains indicators for wealth aside from those included here, such as whether individuals have an annuity or a life insurance policy, whether they have more than 15,000 Euros in their bank account, and whether they participate in a life course savings program (see Table 1), we decide not to include these variables in the regressions because some of these

variables may themselves be influenced by the reform and may therefore absorb some of the effect of the reform on depression.

For wealth variables that we do include, it is less likely that they are affected by the pension reform. However, there were some missing observations: the sample size is reduced to 3,314 observations if we omit those observations where at least one of the wealth variables is missing. We therefore include indicators for whether there was item non-response on each of the included wealth variables.[13] In the last specification (IV) we include the three potentially endogenous job characteristics variables (whether the work was mentally or physically demanding and the fraction of routine tasks) along with other health indicators and a health care utilisation variable. One could argue that these health variables are potentially endogenous in the sense that they may relate to unobservable factors that also influence depression, or that causality may run from depression status to the health variable. Note however, that we find no differences between both groups for these health and job characteristics variables (see Table 1 and the discussion in the data section). Inclusion of these variables controls for individual heterogeneity and it is therefore expected that such inclusion will have little impact on the estimate of the reform indicator. A comparison of the reform dummy in specifications III and IV will be informative on this issue.

The results displayed in the table are very clear: in all specifications the reform has significant effects on mental health and the magnitude of these effects increases when we add controls for individual heterogeneity. These effects are sizeable. For instance, the coefficient in the last specification (specification IV) is 0.028, which implies that depression rates increase with 2.8 percentage points as a result of the shock in the pension system. The other variables in Table 2 show the expected signs. For example those who are married have a lower probability of being depressed; the same holds for those whose partner has a pension or an income. The health variables are all strongly significant, although these effects may be biased as discussed above. We see however, no large changes in the reform indicator across the different specifications in columns II, III and IV. Next, we perform analyses on the total CES-D8 score. This variable ranges from 0 to 7 and

[13] We also run a regression where we include only these 3,314 observations. The coefficient of the reform was even higher (0.032 with standard error of 0.013) and was significant at the 1 percent level.

shows substantive heaping at the 0 score. Following Falba et al. (2008), we estimate a Poisson model;[14] the results are reported in Table A1 of the appendix and they indicate that the reform has a significant impact on CES-D8 score.

Of relevance is whether this effect of elevated depression rates persists over time. It is important to note that the depression indicator used in the analyses above is measured in Spring 2008, already more than two years after the implementation of the new pension system. In order to further check for the persistence of the pension reform effect, we also use available data from the 2009 wave. This wave does not include important savings, and wealth variables. We therefore run regressions on a limited set of controls, comparable to specifications I, II and III of Table 2. The results are reported in Table A2 of the Appendix. The results of these additional analyses indicate that the effect of the reform is slightly smaller in magnitude, but still significant at the 5 percent level. This suggests that the effects of the reform persist over time.

We also perform regressions on subsamples of the 2008 wave for different age windows around the treatment threshold. We include these regressions for two reasons. First, it is conceivable that effects from the reform may be particularly strong for individuals who barely missed the old generous pension system by a few days, weeks or months. After all, the deadline of December 31, 1949 is arbitrary and given that there is an effect from the pension reform on the depression rate, one may expect that this effect will be stronger on those who, by fate, just missed the threshold. A second reason is that we include age in the specifications of Table 2 as the number of days after January 1, 1949. Clearly age should be controlled for as this may be a relevant factor for depression. At the same time, there is little variation in the age variable and it clearly correlates with the reform dummy; this may affect our results. By omitting the age variable in the regressions, but nevertheless estimating the regressions for different age windows, we address the issue of the sensitivity of our findings to the inclusion of the linear age variable.

The results are presented in Table 3. The table reports only the coefficients of the reform indicator, but all regressions include the full set of controls (only age is excluded), as in specification IV of Table 2. Table 3 shows that the effect of the reform is stronger for

[14] A regression of log(CES-D8 +1) gave similar results.

those born near the threshold date and that the effect gradually decreases with a wider window around the threshold date. This is consistent with what we observe in figure 1. We think that the age range for the smallest window is too small for age effects to be relevant. Therefore, the coefficient of 0.024 for the treatment effect can be expected to be a reliable estimate of the causal impact of the reform. This coefficient is only slightly smaller than the 0.028 that we obtained from specification IV in Table 2, where age is included as a linear trend. This adds confidence to the estimates presented in Table 2. The pattern in the coefficients of Table 3 suggests that those who were born just after the threshold date (January - March 1950) are more depressed than those who were born later in the year (April - December 1950). The average depression rate for those born in the January - March 1950 period is 0.053, compared to 0.048 for their younger counterparts born in the April - December 1950 period. However, a simple t-test shows that this difference is not significant (t-stat = 1.0). Alternatively, there could be a "relief effect", meaning that particularly those who just qualified (i.e., those born October - December 1949) have lower depression rates. We therefore check the depression rates for several groups. The average depression rate for those born October - December 1949 is 0.027, whereas the depression rate for their older counterparts (January - September 1949) who also qualified for the old generous pension system is 0.036. This suggests a relief effect. A t-test, however, revealed that the differences between these two groups (approximately 550 observations for each group on either side of the threshold date) is not significant (t-stat = 0.5). Hence, we can conclude that the previous results are not driven by a relief effect.[15]

Further, we analyse whether the pension reform differentially affects different types of workers. Table 4 presents the results of separate analyses on subsamples. The regressions include the same set of explanatory variables as in specification IV of Table 2, but again we here report only the coefficient for the reform indicator. The table shows that there can be substantial differences in the impacts of the reform for different subgroups. The effects are in the expected direction. For instance, those who are not married experience a substantially greater effect from the reform, although the effect is significant only at

[15]See figure 1 for a graphical representation of this finding.

the 10% level, which may be due to the low number of unmarried males in our sample. The reform has the greatest financial consequences for those with a higher income and those with nearly full pension rights (measured by number of years contributing to the pension fund). Indeed, the effect of the reform on mental health is also highest for these workers. Similarly, workers whose partners have a pension or an income are likely to be less affected by the income shock due to the pension reform. We also note that for this group the reform has no significant impact on the depression rate.[16]

The estimation results presented in Tables 2, 3 and 4 are all consistent with strong ex ante effects from the pension reform on mental health. Is it likely that our findings are due to some artifact? We are not aware of studies demonstrating differences in the mental health of the two cohorts prior to the pension reform. Unfortunately we can not check this with our data as we only have post 2006 data. However, if such effects would exist, one would also expect to see some differences in other health variables. Table 1 showed that this was not the case. This table also showed that there were no other factors that systematically differ between the two groups that may have caused the differences. Furthermore, there have not been changes in the system that may have differentially affected the 1950 (1949) cohort as opposed to the 1949 (1950) cohort.

Could it be that the reform caused some workers who are less prone to depression to leave the public sector and that this effect is stronger for the 1950 cohort? This effect is not likely. Public sector pensions are relatively generous and, along with the pension reform in the public sector, all other sectors changed their pension plans because the preferential tax treatment of pension premiums was abolished for both public and private sector workers. Further, job mobility rates out of the public sector into the private sector are extremely low for older workers. When moving to another sector, it is likely that these workers will not only incur costs associated with a change in pension fund, but that they will entirely loose their rights to retire before age 65. The majority of pensions in The Netherlands impose not only an age criterion but also a minimum number of tenure years within a sector or sometimes even a firm (Euwals et al., 2006)

[16]It would have been interesting to see whether the partner is also affected by the reform and examine whether the treatment effect differs with respect to this. However, we only know the age of the partner and whether the partner has an income. The latter variable is already included in the analyses. We therefore did not pursue this issue further.

Those born in 1949 still have the option to retire between age 55 and 65. We therefore also examined whether some workers stopped working between the introduction of the reform in 2006 and the second wave of the survey (2008). This may influence our results if this effect is sizeable. We find that only 64 workers of the 1949 cohort who participated in the first wave (7,739 workers) retired during 2006 and 2008. This number is too small to substantially change the results.

We drop individuals who did not work continuously in the public sector since 1997. It is conceivable that those with mental health problems are more likely to have gaps in their employment history and therefore do not pass this selection criterion. However, this could affect our results only if this affects the treated cohort (that of 1950) differently than the 1949 cohort. There is no reason to expect this. Moreover, when this is the case, one would expect to see this reflected in other factors that are correlated with depression (such as marital status) or with gaps in employment (income for instance). As discussed in Section 3, we see no differences in the observed variables between the two groups (see Table 1). We run additional regressions in which we add this group to the sample (216 full-time workers) and include a dummy variable for this group in addition to whether workers of this group were born in 1950. Both coefficients are insignificant, indicating that the mental health status of this group does not differ from workers born in 1949 and those who worked continuously since 1997 (the controls).

5 Behavioural responses

One important question is whether the reform has affected the savings behaviour and/or the retirement behaviour of those affected, as workers with retrenched pension rights may save more in order to maintain their previously planned retirement date. In a recent paper, Delavande and Rohwedder (2008) explore this issue with respect to the US. They used an internet survey in which they asked the respondents of the Health and Retirement Survey (HRS) what they would do if their Social Security benefits were cut by 30 percent. The authors found that on average individuals would then postpone retirement by 1.13 years. About two-thirds indicated that they would reduce their spending to compensate for the

drop in pension wealth. Our survey includes two savings questions and one question on expected retirement age that enable us to analyse such behavioural responses.

5.1 Savings behaviour

The first savings question asks whether the respondent undertook additional savings arrangements for their pension in the past year. The second question addresses whether the respondent participates in the "Life course savings" program (see Section 2). In Table 5, we report the results from analyses of the savings question. Columns 1 and 2 report results from the first question, columns 3 and 4 report results from the second question. The first two columns of Table 5 show a strong effect from the reform on additional pension savings if no controls are included. The coefficient is positive, indicating that those who are affected by the reform engaged in additional savings in the past year to compensate for the loss in pension wealth. However, the effect becomes insignificant when we include the full set of regressors. Columns 3 and 4 show strong effects from the pension reform on participation in the "Life course savings" program. The results of column 3 reflect what we see in Table 1: the reference group (1949) has a participation rate of around 6 percent, whereas the participation rate of the affected cohort is about nine percentage points higher. Adding controls reduces the magnitude of the reform effect, but the effect is nevertheless substantial and strongly significant. Unfortunately, we cannot observe how much participants save yearly in the "Life course savings" program. Workers in the 1950 cohort would have to save for seven years about 14% of their annual yearly earnings to finance early retirement at the age of 62. It is likely that only a small fraction of participants is able and willing to save such a high share of their earnings each year prior to retirement.

5.2 Expected retirement age

Figures 3a and 3b give a histogram of expected retirement ages (At what age do you expect to retire now?), and figures 4a and 4b of expectations 5 years ago (At what age did you expect to retire 5 years ago?). From Figures 4a and 4b, one may conclude that the distribution of expected retirement ages five years ago was virtually identical for the

1949 and 1950 cohorts. However, this is very different for Figures 3a (affected by the reform) and 3b (not affected by the reform). Compared to the 1949 cohort, a much larger share of those treated expects to retire at age 65. On the other hand, quite surprisingly, rather equal fractions of both the treated and the control groups expect to retire at age 57 or 58. The treated workers may harbour no such expectation, because in the new system they cannot receive pension benefits prior to age 60 (see Section 2). It could be that these workers do not fully understand all details of the new system. However, Figure 2 shows clearly that the cohort that is affected by the reform understands the implications for their replacement rate if they wish to retire at age 62. Alternatively, it could be that these are workers who decide to stop working in the public sector or that they are more likely to leave the labour force via alternative exit routes like disability insurance. The data allow us to check the latter proposition to some extent. We examine prevalence rates for other health variables (self-assessed health, the response to the limitations question, the number of visits to the doctor and whether respondents were sick more than 14 days in the past year) for this group and the other respondents born in 1950 and find no difference with respect to these health variables. Also, the depression rates for this group are similar to the rates of others born in 1950.

In Table 6, we report the results of further analysis on the expected retirement age. The table shows that the reform has a significant effect on the expected age of retirement, but this effect is significant only at the 10% level when the full set of controls is added to the specification. The coefficient of 0.274 amounts to about 4 months' postponement of retirement. This is lower than the effect found by Delavande and Rohwedder (2008), but in their hypothetical situation they asked respondents to indicate what they would do when the Social Security benefit is reduced by 30%. Furthermore, those affected by the reform are more likely to participate in the "Life course savings" program (see Table 5), which may partially compensate for the loss in pension wealth. We also perform a regression on the probability of late retirement (later than age 63). This regression indicates that the probability of late retirement is increased by 16 percentage points and that this effect is significant at the 1% level.

6 Why is the affected cohort so depressed?

An important question is why the reform has such a strong impact on mental health? One possibility is that (the prospect of) longer working in itself causes decreased mental health. We explore this by examining the effect of expectations about the retirement age on depression. For this, we use an Instrumental Variable (IV) approach in which we instrument expected retirement age with the reform dummy.[17] This measures a Local Average Treatment Effect (LATE). Table 7 shows that the coefficient of the expected retirement age is equal to 0.116 and is not significant at the standard levels (s.e. = 0.088). However, the F-test of the first-stage regression suggests a weak instruments problem (the F-statistic equals 2.53, which is well below the value of 10 suggested by Staiger and Stock, 1997). We also examine the effect of expected late retirement (later than age 63) on mental health. The IV regression reveals a positive and strongly significant coefficient (0.179, s.e. 0.0078). The F-test of this first stage regression equals 35.90. This finding thus suggests a strong causal effect of expected late retirement on depression.[18]

We also performed a regression in which we regressed the depression indicator simultaneously on the treatment dummy, savings, expected late retirement and a full set of controls. The idea is that if (forced) savings and late expected retirement are the main factors responsible for the relatively high depression rate among those affected by the reform, one would expect that the effect of the reform indicator (treatment dummy) diminishes when we include these variables. However, the results (tables available on request) show that the reform indicator remains large (coefficient is 0.031) and strongly significant (s.e. 0.013) after inclusion of savings and late expected retirement. One can conclude from this that apparently also factors other than (forced) savings and late expected retirement are responsible for the relatively high depression rate among those affected by the reform.

[17] It is likely that retirement age expectations are endogenously related to the depression rate. Either because there are feedback effects from depression on retirement expectations, or because there are unobservables that correlate both to depression and individual expectations. When using the reform dummy as an instrument we assume that any effect of the reform on mental health must run via retirement expectations

[18] We also performed IV-regressions in which we instrumented extra pension savings and investments in the life course savings program. In both cases the F-test of the first-stage regression suggests a weak instruments problem.

Another potential factor is the way in which the pension system reform was set up. The 2006 reform of the pension system represented a major change that added to previous reforms in the retirement system. In particular, the 1949 cohort was the last cohort that was allowed to retire at relatively young ages against relatively generous replacement rates. The 1950 cohort is the first cohort that must work longer against substantially lower replacement rates. Further, this group of workers is adversely affected by their employer who reneges on pre-existing arrangements (violates an implicit contract) in ways that it is difficult to adjust to once one has taken those rules into account in one's plans. Workers born in 1950 face this new situation with relatively short notice-too short to completely offset the change in the system with additional savings. The change in the pension system was not entirely unexpected, but the particular type of discontinuous assignment rule and the strong differential treatment of workers born around January 1, 1950 came as a surprise when announced in July 2005. Anecdotal evidence suggests that it was perceived to be unfair. For more on this issue, see Montizaan et al. (2009), who use the same data as this paper to examine the relation between job motivation and reciprocity.[19] Their main finding is that job motivation declines among negatively reciprocal individuals who face an unexpected drop in pension rights, while no effect is found among non-reciprocal employees. We therefore also estimate separate models for negatively reciprocal individuals and non-negatively reciprocal individuals. The measure of negative reciprocity is derived from the responses to three questions.[20] A worker is defined to be negatively reciprocal if his score falls above the median score. We find that negatively reciprocal individuals have a much stronger response to the reform than non-negatively reciprocal workers. The coefficients are 0.044 (s.e. of 0.017) and 0.013 (s.e. of 0.014) for negatively reciprocal and non-negatively reciprocal individuals, respectively. This suggests that indeed feelings of unfair treatment may drive much of the strong effects from the reform on mental health. It is likely that these sentiments are less relevant for younger cohorts and therefore their

[19]Negative reciprocity is an in-kind response to hostile acts which indicates retaliatory tendencies.

[20]Respondents had to respond to how much (ranging form 1 = not at all to 5 = fits me completely) they identified themselves with each of the following statements: 1) If I suffer a serious wrong, I will take up revenge no matter what the costs; 2) If somebody puts me in a difficult position, I will do the same to him or her; 3) If somebody insults me, I will give an insult back.

mental health is likely to be less affected. Unfortunately, we can not check this with our data.

Our findings also relate to the literature on individual well being and happiness. This literature finds that individual well being may be affected by income, but also by the difference between one's own income and the income of a reference group (see for an overview, Clark et al., 2008). Ferrer-i-Carbonell (2005) finds that the income of the reference group is about as important as own income for individual happiness. Calvo, Haverstick and Sass (2007) examine the factors that affect individual happiness in the transition to retirement. Their results suggest that what really matters is whether people perceive the transition from work to retirement as chosen or forced. These authors suggest that it is the sense of control over their own retirements that influences the happiness of older workers. It appears clear that control over one's own retirement is a problem for Dutch workers born in 1950. For cohorts born in later years, this is presumably less of a problem as the longer period before retirement allows them to better compensate for their loss of pension wealth.

7 Conclusion

The pension reform that was implemented in 2006 induced a sharp discontinuous treatment of pensions rights of cohorts born around january 1, 1950. We exploit this discontinuity to measure the effect of changes in pension rights on mental health, savings behaviour and retirement expectations of workers approaching retirement. We find that the reform had a strong impact on the mental health of workers who are affected by the reform. Our analysis reveals that those who by chance are exposed to a pension reform that confronts them with substantially lower pension wealth have higher depression rates. This effect persists over time and grows stronger the closer one is born to the threshold date. Furthermore, we find differing effects for different types of workers. For instance, the effects are stronger for unmarried workers and negligible for workers whose partner has a pension or an income. Finally, we find that those affected by the reform also respond by working an additional four months and that they are more likely to participate in a

savings program that is likely to only partially compensate for the loss in pension wealth. We find that later expected retirement is important for mental health, but other factors are also at work. The discontinuous assignment rule and the strong differential treatment of workers born around January 1, 1950 is perceived to be unfair, especially because it was announced only a few years before the retirement date of the affected workers. Too little time remained to allow these workers to fully offset the loss in pension wealth. Workers were suddenly forced into a new situation with little control over their retirement decision; this may have affected their mental health.

Our findings have great relevance for public policy. Currently, most countries in the developed world are revising their pension systems to cope with population aging. The reforms are geared toward extending working life and to a smaller role for defined benefit pensions. Furthermore, a substantial part of the pension wealth of workers has recently evaporated due to the current financial crises. Changes in worker pension claims, due either to financial crises or to government pension policy changes, will have severe consequences for most workers nearing retirement. Workers either have to accept a substantial drop in pension wealth, increase pension contributions or work substantially longer than they expected before the current crisis. The results of this study show that a sudden irreversible deterioration of future prospects can have serious consequences for the mental health of workers nearing retirement, especially when their own employer reneges on pre-existing arrangements (violates an implicit contract) in ways that it is difficult to adjust to once one has taken those rules into account in one's plans. The period before the planned retirement is too short to compensate for losses in pension wealth. In the longer run these mental health effects may translate into somatic diseases. This will not only affect individual well being, but it will also engender costs associated with depression and worse physical health. As mentioned, health care expenditures of depressed persons are about four times higher than those of non-depressed individuals. Moreover, there are high indirect costs due to loss of productivity, flawed decision making, and workplace accidents. Governments should take these effects and costs into account when redesigning pension policies.

References

Adams, O., Hurd, P., McFadden, D., Merrill, A., Ribeiro, T., 2003. Healthy, wealthy, and wise? tests for direct causal paths between health and socioeconomic status. Journal of Econometrics 112, 3–56.

Andresen, E., Malmgren, J., Carter, W., Patrick, D., 1994. Screening for depression in well older adults: evaluation of a short form of the CES-D (Center for Epidemiologic Studies Depression Scale). American Journal of Preventive Medicine 10, 77–84.

Blazer, D., Burchett, B., Service, C., George, L., 1991. The association of age and depression among the elderly: an epidemiologic exploration. Journal of Gerontology 46 (6), M210–215.

Bound, J., Waidmann, T., 2008. Estimating the health effects of retirement. Working paper University of Michigan.

Calvo, E., Haverstick, K., Sass, S., 2007. What makes retirees happier: A gradual or 'cold turkey' retirement? Center for Retirement Research Working paper.

Charles, K., 2004. Is retirement depressing?: Labor force inactivity and psychological well-being in later life. Research in Labor Economics 23, eds. S.W. Polacheck.

Clark, A., Frijters, P., Shields, M., 2008. Relative income, happiness and utility: An explanation for the easterlin paradox and other puzzles. Journal of Economic Literature 46, 95–144.

Coe, N., Lindeboom, M., 2008. Does retirement kill you? Evidence from early retirement windows. IZA working paper no. 3817.

Dave, D., Rashad, I., Spasojevic, J., 2008. The effects of retirement on physical and mental health outcomes. Southern Economic Journal 75, 497–523.

Delavanda, A., Rohwedder, S., 2008. Individual responses to social security reform. Michigan Retirement Research Center working paper WP2008-12.

Euwals, R. W., van Vuuren, D. J., Wolthoff, R. P., 2006. Early retirement behaviour in the Netherlands: Evidence from a policy reform. Tinbergen Institute Discussion Paper $2006 - 021/3$.

Falba, T., Gallo, W., Sindelar, J., 2008. Work expectations, realizations and depression in older workers. NBER working paper 14435.

Ferrer-i-Carbonell, A., 2005. Income and well-being: an empirical analysis of the comparison income effect. Journal of Public Economics 89, 997–1019.

Hays, J., Blazer, D., Gold, D., 1993. CES-D: cutpoint or change score? Journal of the American Geriatrics Society 41, 344–345.

Lumsdaine, R. L., Mitchell, O., 1999. New developments in the economic analysis of retirement. In: Ashenfelter, O., Card, D. (Eds.), Handbook of Labor Economics 3. Elsevier.

Montizaan, R., Andries de Grip, Cörvers, F., Dohmen, T., 2009. Demotivating workers: retrenchment of pension rights and negative reciprocity. ROA Working paper.

Neuman, K., 2007. Quit your job and get healthier? The effect of retirement on health. Journal of Labor Research 29, 177–201.

OECD, 2008. Employment outlook, Paris.

Radloff, L., 1977. The CES-D scale: A self-report depression scale for research in the general population. Applied Psychological Measurement 1, 385–401.

Staiger, D., Stock, J., 1997. Instrumental variables regression with weak instruments. Econometrica 65, 557–586.

Statistics Netherlands, 2008. Statline. Gemeentelijk Basis Administratie.

TNS Nipo, 2006. ABP marktmonitor 12-meting e5351, Amsterdam.

Tsai, S., Wendt, J., Donnelly, R., De Jong, G., Ahmed, F., 2005. Age at retirement and long term survival of an industrial population: Prospective cohort study. British Medical Journal doi:10.1136/bmj.38586.448704.EO.

Van der Klaauw, W., 2002. Estimating the effect of financial aid offers on college enrollment: A regression-discontinuity approach. International Economic Review 43, 1249–1287.

WHO, 2006. The world health report 2006: Working together for health, Geneva.

Table 1 Means of variables for all respondents and for respondents affected and not affected by the policy change

	All		Affected by policy change	Not affected by policy change	T-stat
	Mean	St. Dev	Mean	Mean	
Health					
Depressed	0,043	0,202	0,050	0,035	2.63
CESD8 score	0,589	1,174	0,621	0,554	2.03
Number of doctor visits in past year	2,128	2,533	2,126	2,130	0.05
Sick for > 14 days in past year	0,167	0,373	0,163	0,171	0.83
Health limits work (yes=1)	0,182	0,386	0,185	0,178	0.28
Retirement expectations					
Expectations about replacement rate	69,378	11,765	66,972	72,049	16.00
Expected retirement age	62,000	2,580	62,105	61,884	3.12
Expected retirement age 5 years ago	61,455	2,240	61,417	61,497	1.24
Job Characteristics					
Fraction of non-routine tasks (opposite to routine tasks)	0,294	0,210	0,297	0,291	0.99
Physically demanding work	0,131	0,337	0,131	0,131	0.05
Mentally demanding work	0,666	0,472	0,676	0,655	1.63
Log yearly wage income	10,832	0,283	10,828	10,836	0.99
Other personal characteristics					
Lower secondary education	0,110	0,313	0,117	0,103	1.62
Higher secondary education	0,038	0,192	0,039	0,038	0.17
Vocational education	0,135	0,341	0,132	0,138	0.64
Higher education	0,617	0,486	0,612	0,622	0.75
Married	0,916	0,278	0,909	0,923	1.85
Sectors					
Government	0,400	0,490	0,416	0,382	2.61
Education sector	0,374	0,484	0,359	0,391	2.43
Energy, public transportation	0,136	0,342	0,137	0,134	0.33
Other (Judicial sector, utilities)	0,030	0,170	0,030	0,028	0.64
Wealth and Income sources after retirement					
Number of years contributed to pension fund	31,143	6,340	30,468	31,894	8.24
Pension rights at other pension funds	0,131	0,337	0,132	0,130	0.16
Partner has pension or income	0,473	0,499	0,471	0,475	0.28
Net housing wealth	0,562	0,496	0,567	0,557	0.73
Inheritance	0,138	0,344	0,139	0,136	0.61
Annuity Insurance	0,517	0,500	0,518	0,516	0.12
Life insurance	0,264	0,441	0,263	0,266	0.23
Savings account > 15,000 Euros	0,610	0,488	0,615	0,604	0.71
Investment	0,350	0,477	0,352	0,348	0.28
Life course savings program	0,115	0,319	0,159	0,060	9.31
Other assets or pension savings	0,098	0,298	0,104	0,092	1.28
Extra savings for pensions in previous years	0,249	0,433	0,270	0,226	3.70

Table 2 The effect of the policy change on mental health (Depression indicator; CESD 8 $\geq$ 4)

VARIABLES	I	II	III	IV
Treated (affected by the policy)	0.015***	0.026**	0.026**	0.028**
	(0.006)	(0.012)	(0.012)	(0.011)
Age (in days divided by 100)		0.003	0.003	0.003
		(0.003)	(0.003)	(0.003)
Married		-0.044***	-0.037***	-0.035***
		(0.011)	(0.011)	(0.011)
Lower secondary education		0.003	0.005	0.001
		(0.011)	(0.011)	(0.011)
Higher secondary education		-0.009	-0.003	-0.008
		(0.016)	(0.016)	(0.016)
Higher education		0.005	0.011	0.008
		(0.009)	(0.010)	(0.009)
Government		-0.002	-0.002	-0.012
		(0.017)	(0.017)	(0.016)
Education sector		0.002	0.003	-0.017
		(0.017)	(0.017)	(0.017)
Energy, public transportation		-0.006	-0.009	-0.025
		(0.018)	(0.018)	(0.018)
Physically demanding work				-0.002
				(0.009)
Mentally demanding work				0.024***
				(0.006)
Fraction of non-routine tasks				-0.026*
				(0.014)
Log yearly wage income (/100)		-3.743***	-3.712***	-1.484
		(1.264)	(1.270)	(1.264)
Number of years contributed to the pension fund (/100)		0.073	0.094*	0.094**
		(0.046)	(0.049)	(0.047)
Pension rights at other pension funds			0.016*	0.011
			(0.010)	(0.009)
Partner has pension or income			-0.022***	-0.018***
			(0.007)	(0.007)
Net housing wealth			0.003	0.009
			(0.007)	(0.007)
Inheritance			-0.016*	-0.012
			(0.009)	(0.008)
Missing info on other pension			0.010	0.002
			(0.014)	(0.013)
Partner info missing			-0.024	-0.015
			(0.015)	(0.014)
Net housing wealth missing			0.017	0.020
			(0.014)	(0.014)
Info on inheritance missing			-0.002	-0.002
			(0.012)	(0.011)
Self-reported general health				0.034***
				(0.005)
Self-reported work limitations				0.066***
				(0.009)
Number of doctor visits in past year				0.007***
				(0.001)
Sick for > 14 days in past year				0.028***
				(0.009)
Observations	5,195	4,854	4,854	4,765
R-squared	0.001	0.009	0.012	0.101

*** p < 0.01, ** p < 0.05, * p < 0.10. Standard errors in parentheses

Table 3 The effect of the policy change on depression: results for respondents born more or less near to 1-1-1950

VARIABLES	Born within 3 months of 1-1-1950	Born within 6 months of 1-1-1950	Born within 9 months of 1-1-1950	Born within 12 months of 1-1-1950
Treated (affected by the policy)	0.024**	0.022***	0.020***	0.016***
	(0.011)	(0.008)	(0.006)	(0.006)
Observations	1,168	2,407	3,557	4,765
R-squared	0.126	0.116	0.100	0.101

Standard errors in parentheses *** p < 0.01, ** p < 0.05, * p < 0.10 The regressions include the same set of regressors (without the age variable) as in specification IV of Table 2 (a set of health variables, individual and job characteristics and selected wealth variables)

Table 4 The effect of the policy change on depression: heterogeneous effects

	Married		Below Average income		Partner has pension or income		Number of years contributed (≥ 32)	
VARIABLES	Yes	No	Yes	No	Yes	No	Yes	No
Treated (affected by policy change)	0.023**	0.099*	0.021	0.029**	0.008	0.037**	0.032**	0.022
	(0.011)	(0.055)	(0.019)	(0.013)	(0.014)	(0.017)	(0.016)	(0.015)
Observations	4,376	389	1,972	3,009	2,265	2,150	2,544	2,221
R-squared	0.091	0.214	0.131	0.080	0.092	0.111	0.105	0.106

*** p < 0.01, ** p < 0.05, * $p < 0.10$. Standard errors in parentheses. The regressions include the same set of regressors as in specification IV of Table 2(a set of health variables, individual and job characteristics and selected wealth variables)

Table 5 Do people supplement their retirement income with extra pension savings?

	Extra pension savings		Life course savings	
VARIABLES	I	II	III	IV
Treated (affected by the policy)	0.044***	0.011	0.094***	0.052***
	(0.012)	(0.024)	(0.010)	(0.019)
Age (in days divided by 100)		-0.006		-0.005
		(0.006)		(0.005)
Married		0.027		-0.008
		(0.023)		(0.018)
Lower secondary education		-0.031		-0.012
		(0.024)		(0.020)
Higher secondary education		0.025		-0.020
		(0.034)		(0.027)
Higher education		0.035*		0.008
		(0.021)		(0.017)
Government		-0.015		-0.019
		(0.036)		(0.029)
Education sector		0.014		-0.011
		(0.037)		(0.029)
Energy, public transportation		-0.013		0.028
		(0.039)		(0.033)
Physically demanding work		0.034*		0.016
		(0.021)		(0.017)
Mentally demanding work		0.026*		0.006
		(0.014)		(0.011)
Fraction of non-routine tasks		0.020		0.014
		(0.030)		(0.024)
Log yearly wage income (/100)		6.410**		6.687***
		(2.795)		(2.274)
Number of years contributed to the pension fund (/100)		-0.563***		-0.098
		(0.103)		(0.085)
Pension rights at other pension funds		0.035*		0.020
		(0.020)		(0.016)
Partner has pension or income		-0.008		0.011
		(0.015)		(0.010)
Net housing wealth		0.020		0.020*
		(0.015)		(0.011)
Inheritance		0.045**		0.050***
		(0.019)		(0.013)
Missing info on other pension		0.090***		0.361***
		(0.029)		(0.040)
Partner info missing		-0.040		-0.005
		(0.031)		(0.050)
Net housing wealth missing		0.001		0.233***
		(0.030)		(0.046)
Info on inheritance missing		0.070***		0.408***
		(0.025)		(0.035)
Self-reported general health		-0.003		0.003
		(0.010)		(0.008)
Self-reported work limitations		-0.002		0.025
		(0.020)		(0.016)
Number of doctor visits in past year		0.002		-0.002
		(0.003)		(0.002)
Sick for > 14 days in past year		0.018		-0.005
		(0.019)		(0.015)
Observations	5,360	4,870	3,899	3,489
R-squared	0.003	0.035	0.022	0.197

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Standard errors in parentheses

Table 6 Do people change their retirement expectations?

	Expected retirement age		Late retirement (retirement > 63 years)		Expected retirement age 5 years ago	
VARIABLES	I	II	III	IV	V	VI
Treated (affected by the policy)	0.221***	0.274*	0.171***	0.154***	-0.080	-0.139
	(0.071)	(0.147)	(0.012)	(0.025)	(0.064)	(0.130)
Age (in days divided by 100)		0.040		0.001		0.004
		(0.035)		(0.006)		(0.031)
Married		-0.220		-0.021		-0.445***
		(0.141)		(0.024)		(0.124)
Lower secondary education		-0.124		-0.040		-0.259**
		(0.146)		(0.025)		(0.128)
Higher secondary education		0.081		-0.006		0.106
		(0.207)		(0.036)		(0.179)
Higher education		0.030		-0.030		0.236**
		(0.126)		(0.022)		(0.114)
Government		-0.344		-0.041		-0.483**
		(0.215)		(0.037)		(0.193)
Education sector		-0.362		-0.027		-0.052
		(0.221)		(0.038)		(0.198)
Energy, public transportation		-0.678***		-0.106***		-0.729***
		(0.234)		(0.040)		(0.222)
Physically demanding work		0.025		-0.004		-0.052
		(0.124)		(0.021)		(0.113)
Mentally demanding work		-0.134		-0.047***		-0.278***
		(0.082)		(0.014)		(0.073)
Fraction of non-routine tasks		0.248		0.094***		0.581***
		(0.184)		(0.032)		(0.163)
Log yearly wage income (/ 100)		-25.755		-0.356		41.410***
		(16.888)		(2.913)		(15.501)
Number of years contributed to the pension fund (/ 100)		-3.888***		-0.891***		-6.821***
		(0.634)		(0.109)		(0.559)
Pension rights at other pension funds		-0.168		-0.006		0.015
		(0.124)		(0.021)		(0.105)
Partner has pension or income		0.119		-0.002		0.092
		(0.089)		(0.015)		(0.075)
Net housing wealth		-0.159*		-0.029*		-0.083
		(0.093)		(0.016)		(0.078)
Inheritance		0.023		0.008		0.099
		(0.113)		(0.020)		(0.095)
Missing info on other pension		-0.111		-0.060**		-0.091
		(0.175)		(0.030)		(0.148)
Partner info missing		0.035		-0.023		0.152
		(0.189)		(0.033)		(0.166)
Net housing wealth missing		0.018		0.016		-0.048
		(0.181)		(0.031)		(0.158)
Info on inheritance missing		-0.017		0.009		-0.148
		(0.149)		(0.026)		(0.126)
Self-reported general health		0.013		-0.027**		-0.188***
		(0.064)		(0.011)		(0.056)
Self-reported work limitations		-0.309**		-0.069***		-0.297***
		(0.121)		(0.021)		(0.107)
Number of doctor visits in past year		-0.002		0.003		0.003
		(0.017)		(0.003)		(0.015)
Sick for > 14 days in past year		-0.035		-0.003		0.004
		(0.115)		(0.020)		(0.103)
Observations	5,319	4,752	5,319	4,752	4,853	4,323
R-squared	0.002	0.019	0.004	0.066	0.000	0.092

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors in parentheses

Table 7 Effects of late retirement on depression (IV-regressions)

VARIABLES	I	II
Expected retirement age	0.116	
	(0.088)	
Late retirement (retirement > 63 years)		0.179**
		(0.078)
Age (in days divided by 100)	-0.001	0.003
	(0.003)	(0.003)
Married	-0.006	-0.031***
	(0.029)	(0.012)
Lower secondary education	0.018	0.010
	(0.023)	(0.012)
Higher secondary education	-0.014	-0.006
	(0.030)	(0.017)
Higher education	0.006	0.012
	(0.018)	(0.011)
Government	0.028	-0.005
	(0.043)	(0.018)
Education sector	0.024	-0.013
	(0.044)	(0.018)
Energy, public transportation	0.051	-0.009
	(0.068)	(0.021)
Physically demanding work	-0.001	0.003
	(0.018)	(0.010)
Mentally demanding work	0.037**	0.030***
	(0.016)	(0.008)
Fraction of non-routine tasks	-0.053	-0.042**
	(0.034)	(0.017)
Log yearly wage income (/ 100)	1.919	-1.129
	(3.375)	(1.379)
Number of years contributed to the pension fund (/ 100)	0.513	0.251***
	(0.330)	(0.087)
Pension rights at other pension funds	0.028	0.010
	(0.023)	(0.010)
Partner has pension or income	-0.031*	-0.017**
	(0.016)	(0.007)
Net housing wealth	0.027	0.013*
	(0.019)	(0.008)
Inheritance	-0.012	-0.012
	(0.016)	(0.009)
Missing info on other pension	0.008	0.010
	(0.026)	(0.015)
Partner info missing	-0.006	-0.004
	(0.027)	(0.016)
Net housing wealth missing	0.024	0.019
	(0.026)	(0.015)
Info on inheritance missing	-0.006	-0.007
	(0.021)	(0.012)
Self-reported general health	0.034***	0.041***
	(0.009)	(0.006)
Self-reported work limitations	0.104***	0.080***
	(0.033)	(0.011)
Number of doctor visits in past year	0.007***	0.006***
	(0.002)	(0.001)
Sick for > 14 days in past year	0.036**	0.031***
	(0.017)	(0.009)
F-statistic weak identification test	2.53	35.90
Observations	4,643	4,643

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors in parentheses. Expected retirement age and late retirement instrumented with the treatment dummy

Appendix

Table A1 The effect of the policy change on mental health (Poisson regressions on CESD8 score)

VARIABLES	I	II
Treated (affected by the policy)	0.066***	0.093***
	(0.021)	(0.034)
Age (in days divided by 100)		0.012
		(0.008)
Married		-0.182***
		(0.036)
Lower secondary education		0.017
		(0.034)
Higher secondary education		0.016
		(0.051)
Higher education		0.040
		(0.029)
Government		-0.013
		(0.055)
Education sector		-0.007
		(0.056)
Energy, public transportation		-0.005
		(0.059)
Physically demanding work		0.020
		(0.025)
Mentally demanding work		0.206***
		(0.018)
Fraction of non-routine tasks		-0.099**
		(0.044)
Log yearly wage income (/100)		-15.650***
		(4.102)
Number of years contributed to the pension fund (/100)		0.169
		(0.139)
Pension rights at other pension funds		0.015
		(0.029)
Partner has pension or income		-0.092***
		(0.020)
Excess housing wealth		-0.009
		(0.021)
Inheritance		-0.042
		(0.026)
Missing info on other pension		0.096**
		(0.046)
Partner info missing		-0.123***
		(0.035)
Excess housing wealth missing		0.000
		(0.042)
Info on inheritance missing		-0.001
		(0.036)
Self-reported general health		0.214***
		(0.013)
Self-reported work limitations		0.285***
		(0.033)
Number of doctor visits in past year		0.013***
		(0.003)
Sick for > 14 days in past year		0.142***
		(0.026)
Observations	5,195	4,765

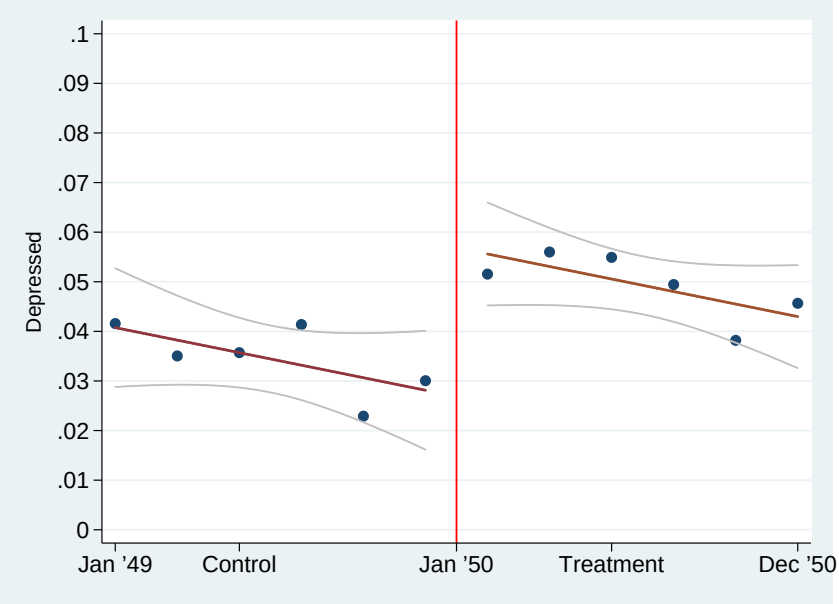
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The table shows marginal effects. Standard errors in parentheses.

Table A2 Persistency of the effect of the policy change on mental health
(Depression indicator; CESD 8 $\geq$ 4): results based on the 2009 wave

VARIABLES	I	II	III
Treated (affected by the policy)	0.012**	0.022**	0.021**
	(0.005)	(0.011)	(0.010)
Age (in days divided by 100)		0.003	0.003
		(0.003)	(0.002)
Married		-0.038***	-0.038***
		(0.010)	(0.010)
Lower secondary education		-0.014	-0.014
		(0.010)	(0.010)
Higher secondary education		-0.001	0.003
		(0.015)	(0.015)
Higher education		0.001	-0.001
		(0.009)	(0.009)
Government		-0.018	-0.020
		(0.015)	(0.014)
Education sector		-0.003	-0.013
		(0.015)	(0.014)
Energy, public transportation		-0.022	-0.028*
		(0.016)	(0.016)
Physically demanding work			0.019***
			(0.006)
Mentally demanding work			-0.011
			(0.009)
Log yearly wage income (/100)		-0.039***	-0.018
		(0.012)	(0.012)
Number of years contributed to the pension fund (/100)		-0.006	-0.012
		(0.044)	(0.043)
Self-reported general health			0.043***
			(0.004)
Self-reported work limitations			0.070***
			(0.008)
Number of doctor visits in past year			0.004***
			(0.001)
Sick for $>$ 14 days in past year			0.021***
			(0.008)
Observations	6,021	5,419	5,337
R-squared	0.001	0.008	0.095

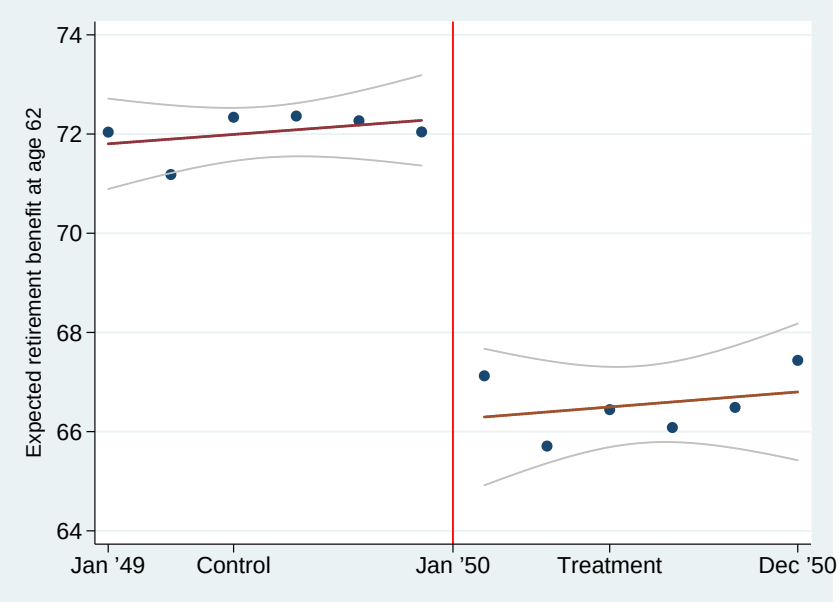
*** p $<$ 0.01, ** p $<$ 0.05, * p $<$ 0.10. Standard errors in parentheses

Figure 1
Mean depression rates around january 1, 1950



This figure presents the mean depression rate (for two birth months). The vertical line in the figure marks the threshold dividing the control and treatment groups.

Figure 2
Validity of the natural experiment: Do the people understand the reform?



This figure presents the mean expected pension benefit at age 62 in percentage of present wage income (for two birth months). The information is based on the following survey question: "Suppose you would retire at the age of 62. How large would your pension benefit be (in percentage of your net wage income)?" The vertical line in the figure marks the threshold dividing the control and treatment groups.

Figure 3a
Expected retirement age ('At what age do you expect to stop working completely'): Treatment group

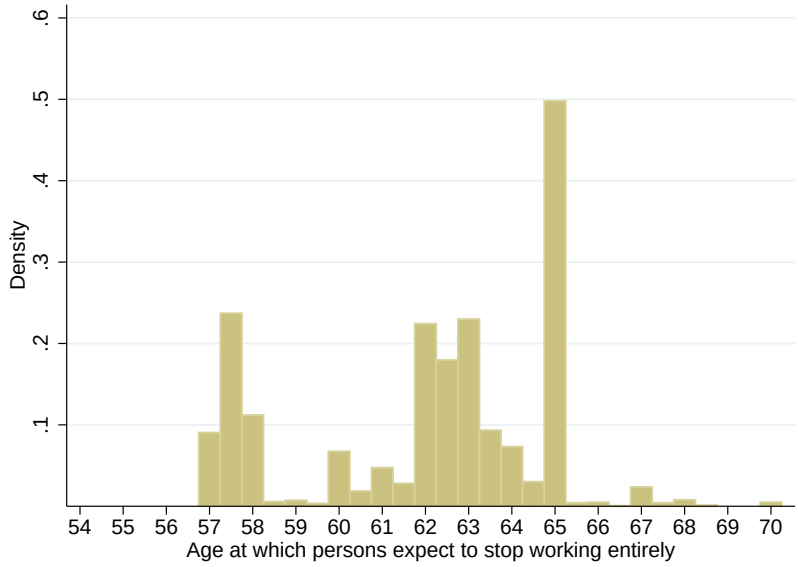


Figure 3b
Expected retirement age ('At what age do you expect to stop working completely'): Control group

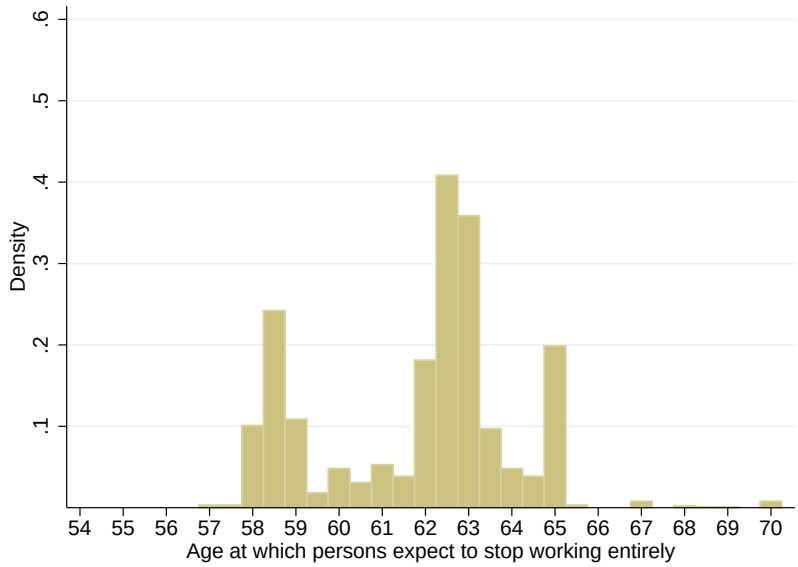


Figure 4a
Expected retirement age five years ago: Treatment group

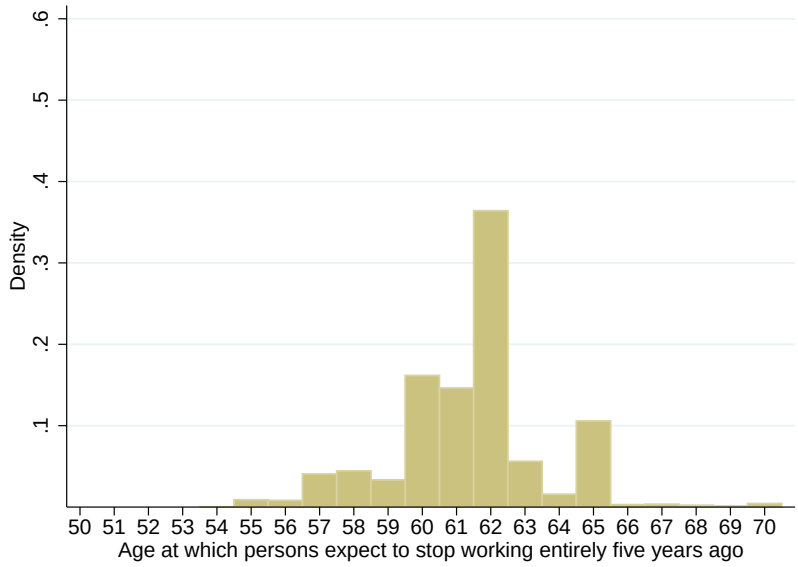


Figure 4b
Expected retirement age five years ago: Control group