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Ilmakunnas, Pekka and Ilmakunnas, Seija

Aalto University School of Business, Jyväskylä University School of Business and Economics

2018

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PEKKA ILMAKUNNAS[1], SEIJA ILMAKUNNAS[2]

[1]*Aalto University School of Business, Espoo, Finland*, [2]*Jyväskylä University School of Business and Economics, Jyväskylä, Finland*

Correspondence: Pekka Ilmakunnas, Aalto University School of Business, PO Box 21210, FI-00076 AALTO, Espoo, Finland, pekka.ilmakunnas@aalto.fi

Abstract

Aim: We examine the relationship between the subjective assessment of health status and retirement by using information on expected and actual retirement ages. *Methods:* Subjective data from cross-sectional surveys, conducted in Finland in 2003 and 2008, are linked to information on actual retirement age from register data from 2003-2013. Regression models are estimated for actual and expected retirement ages. *Results:* While the health status is positively correlated with both actual and anticipated full-time retirement age, the actual age of retirement is less sensitive to health. On average, individuals tend to retire later than they had anticipated. We examine potential biases in the health-retirement relationship. Measurement error in regard to health status biases the results downwards. Using data on observed retirement ages, omitting those who do not retire during the data period, leads to a selection problem. Ignoring the selection also leads to a downwards bias in the health - retirement age connection. As a more exogenous health variable we use health shocks, which are measured by average annual days of absence due to sickness in the follow-up period. These shocks are negatively related to retirement age in a subsample of initially healthy individuals. *Conclusions:* When subjective assessment of health is used for explaining retirement behavior, the effects of health can often be underestimated rather than overestimated. To lengthen working careers, attention should be given to both the ability (health) and willingness (perceptions of proper retirement age) of people to continue longer at work.

Key words: self-assessed health, sickness absences, retirement, expectations

Background

Aim of the study

Good health is not equally distributed in society. Individuals and socioeconomic groups with frequent health problems are likely to face higher poverty risk. With ageing this risk increases if those with poor health retire early with low pensions. They are also affected when early retirement channels are abolished and old-age pensionable ages are raised. Poor health may lead to withdrawal from the labor market if there are no early exit options or to forced continuation at work despite a lower work capacity. However, the increase in the healthy lifespan has been at odds with the downward trend in the labor supply of older workers [1]. The relationship between health and retirement is likely to be affected by attitudes and preferences as well as the pension and labor market institutions. There is clearly a need for better understanding of the role of health in retirement.

Extensive research evidence indicates that health status plays an important role in retirement decisions. There are many mechanisms that shape the relationship between health and retirement [1, 2]. Firstly, poor health is likely to increase the disutility of work regardless of age. These negative effects on labor supply are likely to gain strength as people get older since ageing typically brings with it an increasing number of health risks. This effect is typically amplified by pension and social security systems that often include early exit options, which thus reinforce the effects of health deterioration on retirement. Secondly, health problems may also hamper work performance and labor productivity and contribute negatively to labor demand and earnings, as individuals who have poor health may have fewer job opportunities. In a more dynamic setting, health status can also influence individuals' expectations of their life expectancy and their plans on how to use their presumed remaining time in and outside of the labor market. Accordingly, health status already at a prime working age can influence expectations related to the length of the working career and timing of retirement. In line with this, changes in health status make individuals reformulate their expected labor supply choices. The analysis of the connection between health and retirement is in practice made difficult by various statistical problems, including appropriate measurement of health and possible two-way causality between health and work status. A large literature exists on different ways of solving these problems [1, 2].

Earlier studies on the health-retirement connection mostly use actual retirement time (e.g. [3, 4, 5, 6, 7, 8, 9, 10]), sometimes expected retirement time [11, 12], and sometimes both (e.g. [13, 14, 15, 16, 17]). Expected retirement has been used both because this information may be easily available from surveys and because the anticipations of individuals – the expected retirement age – can be seen as good predictors of their actual behavior. Comparison of expectations and realization has indeed been one issue in the studies.

This paper analyzes the role of health in retirement decisions by modeling the relationships between self-assessed health (SAH) status, expected full-time retirement age, and actual full-time retirement age. Compared to the earlier studies that use both expectations and realizations, we emphasize a systematic analysis of the measurement issues. Specifically, the purpose of this paper is as follows: i) to compare SAH as a predictor of actual retirement age, expected retirement age, and expectation error; ii) to examine the use of other health measures as alternative variables or as instruments for SAH to solve the problem of SAH as an incomplete measure of health; iii) to examine the role of future health shocks for retirement to solve the problem of reverse causality; and iv) to investigate potential health-related sample selection problems as retirement timing is more likely to be observed when health is poor. We use Finnish survey data combined with longitudinal register data. This allows us to have information on expectations and SAH from the survey and actual retirement time from the follow-up data.

Methodological issues in the connection of health and retirement

The studies on labor supply and retirement decisions of older workers typically find that health status variables together with incentives have the most predictive power. This result is not surprising since health typically declines with age, and at some stage this decline is likely to create a mismatch between the work requirements of an individual and their work capacity. This creates a link between poor health and earlier retirement. Some studies have particularly aimed to compare the relative importance of financial incentives and health in retirement decisions [8], finding that the former are the most important in relation to other early retirement schemes, and the latter is dominant in explaining transitions to disability and unemployment insurance.

Furthermore, the effect of health on retirement is clearly dependent on various institutions like pension systems and on various factors linked to the position of the individual in the labor market. The role of institutions is analyzed for example in studies where different retirement channels are analyzed separately [8]. There are also interactions between health, work ability, and working conditions. While chronic health problems are likely to affect productivity negatively, these effects can be buffered if resources and demands at work are adapted to the needs of employees suffering from health problems.

While the studies are quite consistent in finding a relationship between health and retirement, there is still a lot of uncertainty regarding it. The most disputed questions are related to measuring the health status and to the endogeneity of health in the labor supply analysis. The most common method of measurement is to use self-reported health status [18], and questions arise about the accuracy of this subjective indicator.

There are various possible sources of bias in the estimation of the relationship between health and (actual or anticipated) retirement [2]. First, SAH may be correlated with the unobservables in the error term, because health and work status can be simultaneously determined. That is, just being at work, especially the content of work and working conditions, likely affect the health status. Therefore unobservable, work-related effects correlate with the health measure. For example, the factors that affect health positively may also influence the willingness to continue at work beyond the official retirement age.

Second, SAH may be correlated with the error term because of justification bias. People who have psychic or financial incentives to retire early may overstate their health problems to justify their non-employment status.

Third, there is likely to exist an errors-in-variables problem, as the SAH measure is not perfect and does not necessarily measure well the work-related health which is relevant for retirement [3, 9, 19]. It has been suggested that the biases caused by endogeneity and measurement error may be in different directions [3]. Further, the health measure based on survey data is typically measured in a Likert scale (e.g. 1 to 5). Using this ordinal measure as if it were cardinal creates a measurement error. One potential problem is related to comparability of individuals when assessing the scale for the health status. They may use different scales for defining poor and good health [7, 9].

Fourth, when the relationship between health and retirement age is studied, there are sample selection issues. Since in an analysis of retirement behavior people are still working at the beginning of the data period, those with good health are likely to be overrepresented as those with the poorest heath have already withdrawn from the labor market, e.g. through disability retirement. This is the so-called healthy worker effect [20]. On the other hand, among those in the data, actual retirement age is more likely to be observed for those with poor health if healthier individuals are more inclined to continue working. Therefore, people with good health are underrepresented in the sample of completed employment spells. Ignoring this selection problem leads to a bias in the health - retirement age connection.

Earlier research has suggested various ways of dealing with some of these issues. Endogeneity of health has been tackled by modeling the health stock. In this case, health is modeled as a function of other health measures, personal characteristics, past health, etc. [5, 8, 11]. Use of panel data also helps in wiping out time-invariant factors but does not work if unobservables, like true health, change over time [3]. Health shocks, like self-reported big health changes, accidents, or newly diagnosed health events [4, 6, 10, 12], are health measures which are less likely to be endogenous, although the results are restricted to fairly extreme cases and cannot necessarily be extended to small changes in health.

More objective measures of health, e.g. indicators for diagnosed diseases or sickness absences, have been used instead of SAH [3, 7, 19, 21]. These may have less justification bias, but they also may have measurement errors or may not measure work-related health. This has motivated studies where one compares results when using both self-reported and more objective measures for health. These studies do not give unambiguous results, but some studies [8] find that subjective health measures overstate the effect of health on retirement. On the other hand, the alternative health measures could be used as instrumental variables for SAH [22]. This is based on the idea that two erroneous measures can be used as instruments for one another if the measurement errors are not correlated [23]. In addition, modeling of the response behavior to health questions has been examined as a way of taking into account the variation in scales between respondents [9].

Finally, use of selection models to deal with sample selection is possible, although it may be difficult to find variables that can be argued to affect selection into the sample (retirement observed) but not the timing of retirement. An alternative is to treat retirements after the observation period as censored observations.

Retirement expectations and realizations

There are several studies where the connection between retirement expectations and actual retirement has been examined. These studies use the terms retirement “expectations”, “anticipations”, “intentions”, “preferences”, and “plans”. Sometimes these are used as synonyms or the wording comes from the survey that is used. The term that is used may also reflect the process of retirement. In organizational psychology it has been suggested that retirement is a process with steps from retirement intentions to decision to retire and from the decision to actual retirement [24]. Further, it has been argued that retirement considerations, preferences, and decisions represent different levels of firmness of retirement intentions [16].

In economics the emphasis has been on the properties of retirement expectations in relation to actual retirement and on how shocks or new information affect expectations and/or decisions [25]. Some studies that have used both expectations and realizations of retirement include comparisons of actual and expected retirement dates or ages as continuous variables. Bernheim [26], who pioneered this kind of analysis, tested the rationality of retirement expectations by regressing realized years of retirement on expected years. Rationality was clearly rejected (as also in [27]), and his tabulation of actual retirement times (years) by fixed expected times showed that the distributions were skewed and that the modes corresponded best to the expected times. He therefore concluded that retirement expectations are ”most probable retirement ages” rather than the means of a distribution. This has been confirmed also in other studies [13, 14]. Bernheim [26] also estimated models where expectation error (actual minus expected retirement year) was explained by the characteristics of the individuals, including health. Individuals with better than average health had lower expectation errors.

There are also studies where the purpose has not been to examine the discrepancy of retirement expectations and realizations quantitatively but by coding actual retirement as being before, at, or after expected retirement age. This trichotomous variable has then been explained by the characteristics of the individual, including health, as explanatory variables [13, 14, 16]. Sometimes multinomial models are used for different combinations of expectations and realizations of retiring or continuing to work [15].

The studies have concluded that poor self-rated health (at the time of the survey) was positively associated both with retiring at an earlier age than preferred and with retiring earlier than decided [16], deterioration of health between the survey of expectations and actual retirement had a positive effect on the probability of retiring earlier than expected [13, 14], and those who planned to retire and did so were in worse health, and negative health shocks made realized retirement timing differ from the anticipated one [15].

One variant of this kind of analysis is the estimation of a duration model for actual retirement time with categorical indicators of expected retirement as covariates [17]. Even less formal comparisons of actual and expected retirement are studies where the outcome is a binary indicator for (actual) early retirement and where one of the covariates is an indicator for having early retirement intentions [28, 29] or where there are separate estimations for the probabilities of expecting and actually retiring after a certain age [30]. The general result from this kind of study is that indicators for having retirement intentions are positively associated with subsequent retirement.

The Finnish pension system

Our data period covers the years 2003-2013. There was a major pension reform in 2005, so we describe both the pre-reform system and the post-reform system. In the old system, the official retirement age in the private sector was 65 years. Most public sector (state or municipality) employees and some special groups had a lower retirement age, often 60 years or even lower. The pension accrual rate for the private sector employees was 1.5% of annual income earned before the start of the year when the person became 60 years old, and the rate was 2.5% after that. In the public sector, the accrual rate for new employees was the same as in the private sector but somewhat higher for employees with longer tenures.

However, even in the private sector actual retirement ages were much lower than 65 due to different early exit routes. The routes of early exit from the labor market were related to the following: (i) early old-age pension, (ii) disability, (iii) unemployment, and (iv) reduction of working hours. The early old-age pension meant the possibility to retire at ages 60 to 64 with a somewhat lowered pension. On the other hand, it was possible to delay retirement from 65 with a somewhat increased pension. The disability pension was connected to reduced work ability and required medical verification. With no particular age limit, it concerned large population groups, but its incidence decreased during the past decades. Also part-time disability retirement was possible. The early exit route related to unemployment was a scheme with extended unemployment-linked benefits for older workers who lose their job to bridge the time until they receive the old-age pension. The lower age limit for this so-called unemployment pension tunnel was 55 years. The part-time pension was the third form of early-retirement, which had the aim of bringing flexibility to the later years of working life. It could be granted to an employed person, 58 years or older, who changes from full-time to part-time work.

In 2005 a pension reform was carried out, with the purpose of increasing the retirement age. The main changes in the system concerned the mandatory retirement age and the pension accrual rate. After the pension reform, old-age retirement became flexible between ages 63 to 68 years. The private and public retirement ages were harmonized for new employees, but incumbent public sector employees were given a personal retirement age, i.e. an age when they receive full public pension. These personal retirement ages increased gradually, based on age and the length of tenure, from the previous retirement ages to the new ones.

After the reform, the new pension accrual rate was 1.5 % until age 52, 1.9% for ages 53 to 62, and 4.5 % for ages 63 to 68. The purpose of the “super accrual” from age 63 was to improve incentives to continue working longer. As to the early exit routes, after the reform early old-age retirement with lower pension was available only for 62 year olds. The full and part-time disability pension and part-time pension remained the same as before and the lower age limit of the unemployment pension tunnel was gradually increased. In practice, the pension reform led to an increase in the average retirement age but also to the concentration of retirements to certain ages. After our data period, a new reform took place in 2017, which concerned the mandatory retirement age, pension accrual, and part-time pension, but full and part-time disability pension remained the same as before. Therefore, the current system partly differs from that described above.

Data

We use cross-sectional Quality of Work Life Surveys (QWLS) of Statistics Finland from 2003 and 2008 and link them to longitudinal register data. The initial samples of QWLS are derived from monthly Labor Force Surveys. The response rate in QWLS was 77.9% in 2003 [31] and 67.6% in 2008 [32]. The surveys are cross-sectional random samples of individuals who are working and who are 16 to 64 years old. Statistics Finland has matched the QWLS data to longitudinal register data FLEED (Finnish Longitudinal Employer-Employee Data) and to information on pension related variables from the Finnish Centre for Pensions and the Social Insurance Institution of Finland (KELA). This enables us to follow the employees over the period 2003-2013 for the 2003 QWLS and 2008-2013 for the 2008 QWLS.

We concentrate on those employees in the 2003 survey whose age was 50 or above at the end of 2003 and those in the 2008 survey who were 55 or above at the end of 2008. They all reached at least age 60 by the end of the follow-up. The number of such cases is 2136. Out of these, we drop persons who were on a full pension already during the surveys but who were still doing some work, persons who died before reaching retirement, persons with missing expected retirement age, and inconsistent answers (expected retirement age lower than their current age). In total, we drop 149 (7%) observations and the number of remaining observations is 1987. Further, in baseline analyses we require that the timing of retirement be observed so it can be compared to the expected retirement time. Because of this restriction, there are 728 observations (37% of those remaining) with censored retirement age, and we use 1259 observations (63%) in the baseline estimations. In some estimations, we allow for censoring and use the larger sample.

QWLS includes questions on the personal characteristics of the respondents, self-assessed health, absences, health symptoms, and expected retirement age, as well as a large set of work-related questions. From registers we get information on the timing of actual retirement, personal and family characteristics, and variables related to income and pension.

Our measure of the expected retirement age is from the surveys and is measured in full years. The wording of the question in QWLS is as follows: "At what age do you reckon you will retire on a full-time pension?" As this refers to full-time retirement, we also define actual retirement as full-time retirement. The wording of the question does not make it clear whether it refers to expected or actually planned retirement age. In this paper, we use the terms "expected" and "anticipated" retirement age interchangeably in a loose sense. The pension reform was carried out during our data period in 2005, which raises the question about how it should be taken into account. The pre-reform system concerns only the participants of the first survey, which was conducted between October and December 2003. We can assume that the survey participants knew about the forthcoming pension reform and took its effects into account, since information on future changes to the official retirement age and pension accrual was given in the survey. However, we include an indicator for the 2008 survey to account for changes in retirement behavior over time and the fact that during the last months of 2003 and in 2004 it was still possible to retire under the old rules. Naturally, differences in retirement behavior between the surveys may have been caused, besides the pension reform, also by various other policies like taxation. Even the business cycle can have had an effect, as the financial crisis had started before the 2008 survey. The indicator for the survey wave indirectly accounts for any such systematic differences between the two surveys.

The actual retirement variable is retirement age in years and months from the pension registers. As we define it to include only full-time retirement, it includes old-age pension (85.1%), early old-age pension (7.9%), and disability pension (7.0%). In contrast, those in part-time retirement (either already during the QWLS surveys or later) are still working part-time, so we examine their actual or expected transitions to full-time retirement. When the expectation error is calculated, there is some measurement error as the actual retirement age is measured with greater precision. However, rounding the actual retirement age to full years to make it comparable to the expectation variable makes no difference in the results. This is understandable as the measurement error in the dependent variable should not bias the estimates.

We include an indicator for being in partial retirement during the survey in the estimated models and an indicator for being in the public sector pension system to control for differences between the public and private sectors.

Health variables include SAH on a scale of 1 (lowest) to 5 (highest) as well as a binary indicator for having a permanent injury or a medically diagnosed chronic illness. In addition, the surveys have several questions on health symptoms, which can be used for forming indicator variables. We use an indicator for having some kind of pains (in shoulders, neck, arms, legs, or back). The surveys also have information on self-reported days of absence. There are questions on the number of absences that have lasted 1-3 days, 4-9 days, and 10 or more days, and in the case of the last category the total number of days absent. We approximate the days of absence as (number of times with 1-3 days)×2 + (number of times with 4-9 days)×6.5 + total number of days in long absences. There is data on absences also from registers in the form of sickness absence days compensated by KELA. Sickness allowance is paid after 10 days of (continuous) sickness absence, although most employees get a wage or salary during this period.

Personal characteristics are age during the survey, education (indicators for secondary and tertiary education, with basic education as reference), and gender (an indicator for females). As family variables, we use information on age difference between the spouses (an indicator for having a younger spouse) and the retirement status of the spouse. Financial variables include the logarithm of labor income in the year before the survey and pension accrual rate after the survey. For each person we calculate the average age-dependent accrual rate for two additional years of working, 2004-2005 for those in the 2003 survey, and 2009-2010 for those in the 2008 survey. For simplicity, we use the private sector accrual rates also for the public sector in the pre-reform period. This variable is a proxy for the financial incentives to delay retirement.

There is detailed information on the private sector employers available from registers on firms, but since this would mean leaving out the public sector, we use only plant size to characterize the employers (size classes 10-49, 50-249, 250-999, and 1000- employees, with less than 10 as reference).

Table I presents descriptive statistics of the variables in the baseline analysis.

Table I. Descriptive statistics.

Variable	Mean	Standard deviation
Retirement age	62.908	2.045
Expected retirement age	62.233	2.293
Expectation error	0.676	2.163
SAH	4.112	0.866
Pains	0.724	0.447
Chronic illness	0.473	0.499
Self-reported sickness absences	12.172	29.396
Sickness absences from register data	5.101	20.385
Age during the survey	57.541	3.002
Female	0.573	0.495
Secondary education	0.364	0.481
Tertiary education	0.338	0.473
log(earnings)	10.227	1.167
Accrual rate (%)	2.380	0.975
Part-time pension	0.092	0.289
Public sector pension system	0.535	0.499

Spouse younger	0.408	0.492
Spouse retired	0.295	0.456
Survey 2008	0.371	0.483
Plant size 10-49	0.388	0.488
Plant size 50-249	0.264	0.441
Plant size 250-999	0.107	0.310
Plant size 1000-	0.036	0.186

N=1259.

Results

Descriptive analysis

Figure 1 shows the distributions of expected and actual retirement ages and the expectation error by self-assessed health status for the sample where retirement ages are observed. The error is defined as *Expectation error = Actual retirement age – Expected retirement age*. Because of the small number of observations in the lowest health category (SAH = 1), categories 1 and 2 have been combined in the figure. The distribution of expected retirement ages is concentrated on values 60, 63, and 65, which are sort of "focal points". Those with the poorest health expect to retire earlier, and among them 60 years is the mode rather than 63 years as among those with a better health status. Explanations for the concentration of retirement at certain ages include social norms, certain ages as default options, and reference dependence (planned retirement income as a reference point) [33]. In the Finnish case, age 63 is understandable as the lowest retirement age in the post-2005 pension system and 65 as the "traditional" official retirement age in the old system. Age 60 may be related to some public sector pensions or just to the use of a round number as an approximate retirement age.

[Insert Figure 1 here]

Actual retirement ages are concentrated in Figure 1 on the range 63-65 with a clear mode at 63 years, except for those with lowest health status. In our data the argument of expectations as "most probable retirement ages" [26] was not fully supported, as the modes were not systematically closer to the expected retirement ages than the means. This may be related to the relatively small number of observations for some expected retirement times and the high concentration of retirements at age 63. The distribution of expectation errors is skewed: people are more likely to work longer than they expect, but the mode is still at zero error. Those with poor health expect to retire early and often do, which means that both expected and actual retirement ages are low. However, this does not mean that there is no room for making errors. In fact, the variances of both retirement ages and expectation errors are negatively related to SAH (Panel A of Table 1). One interpretation of this is that for people with low SAH the timing of retirement is more unpredictable.

Table II presents the unconditional connection of health and retirement in slightly aggregated form (but in our statistical analysis we treat the variables as continuous). The expectation error is classified into three groups: retirement before expected age (negative error), retirement at expected age (zero error), and retirement after expected age (positive error). Again, SAH categories 1 and 2 are combined. Panel A shows the connection of the error with health in the sample where censored retirement times are excluded. Among those with the poorest health, 46% retire later than they had expected, and 23% earlier than expected. Of those with the best self-assessed health status, 45% work longer than they had anticipated, and 18% retire earlier than they had expected. The differences in working longer than expected between the health statuses are therefore relatively small. The main difference between the health levels comes from those with poor health retiring earlier than expected and therefore more often making negative expectation errors.

Table II. Comparison of actual and expected retirement age by health status.

Panel A: Retirement observed

	Health (SAH)				
	Lowest			Highest	
	1 or 2	3	4	5	All
Actual vs. expected retirement					
Before expected age, %	23.26	18.58	18.78	18.00	18.59
At expected age, %	30.23	33.20	34.81	36.81	35.11
After expected age, %	46.51	48.22	46.41	45.19	46.31
Total, %	100.00	100.00	100.00	100.00	100.00
Number of observations	43	253	474	489	1259
Average retirement age	61.64	62.82	62.87	63.10	62.91
Std.dev.	(3.72)	(1.81)	(2.06)	(1.89)	(2.04)
Average expected retirement age	60.77	61.88	62.23	62.55	62.23
Std.dev.	(2.78)	(2.21)	(2.21)	(2.30)	(2.29)
Average expectation error	0.87	0.93	0.65	0.55	0.68
Std.dev.	(4.00)	(2.31)	(2.09)	(1.91)	(2.16)

Panel B: Retirement observed or censored

	Health (SAH)				
	Lowest			Highest	
	1 or 2	3	4	5	All
Actual vs. expected retirement					
Before expected age, %	18.52	13.78	12.14	10.24	11.78
At expected age, %	24.07	24.63	22.51	20.95	22.24
After expected age, %	44.44	47.51	44.07	42.61	44.04
Unknown order, %	12.96	14.08	21.28	26.19	21.94
Total, %	100.00	100.00	100.00	100.00	100.00
Number of observations	54	341	733	859	1987

In Panel B of Table II we include into the group “After expected age” also those who have not yet retired but who have passed their expected retirement age. Panel B also shows the share of those who did not reach their expected retirement age by the end of the follow-up period and had not yet retired. For them we cannot tell when retirement happens compared to the expected retirement age.

This group is clearly more common among those with better health. Comparison of the two panels shows that there may be a selection problem in the health-retirement relationship because retirement age is more likely to be observed for those with poor health.

The table shows that it is most difficult for persons with poor health (SAH 1 to 3) to estimate their timing of retirement. This group includes both persons who retire earlier than they expected and have negative errors and also persons who underestimate their future ability or willingness to continue to work and hence make positive forecast errors. The discrepancy between the expectations and realizations may also be related to being in a position where one has to continue working for financial reasons or because of a rejected disability pension application. Positive forecast errors are common also in the other health groups but perhaps for different reasons. If good health is positively correlated with socioeconomic position, those with good health may have more opportunities to choose the timing of retirement, and they may also have more enjoyable working conditions.

Estimation results

We have estimated regression models where actual retirement age, expected retirement age, and expectation error are regressed on SAH and the controls. Since the same variables are used in all of the models, the estimates of the expectation error model are simply the differences between the coefficients of the actual and expected retirement age models. The baseline results are shown in Table III.

Table III. Baseline estimates.

	Retirement age	Expected retirement age	Expectation error

SAH	0.193**	0.351***	-0.158*
	(0.069)	(0.068)	(0.086)
Age	0.419***	0.320***	0.099*
	(0.039)	(0.035)	(0.045)
Female	-0.096	0.074	-0.170
	(0.114)	(0.126)	(0.138)
Secondary education	-0.048	-0.066	0.018
	(0.122)	(0.146)	(0.162)
Tertiary education	-0.145	-0.086	-0.059
	(0.126)	(0.148)	(0.155)
log(earnings)	-0.011	0.016	-0.027
	(0.034)	(0.037)	(0.040)
Accrual rate	-0.041	0.290**	-0.331**
	(0.087)	(0.091)	(0.102)
Part-time pension	-0.468**	-0.135	-0.333
	(0.180)	(0.190)	(0.238)
Public sector pension system	0.305**	0.428***	-0.123
	(0.111)	(0.121)	(0.134)
Spouse younger	-0.032	-0.151	0.119
	(0.113)	(0.125)	(0.141)
Spouse retired	-0.260*	-0.205	-0.055
	(0.109)	(0.124)	(0.132)
Survey 2008	-0.820***	-0.170	-0.650***
	(0.120)	(0.129)	(0.133)
Plant size 10-49	-0.262*	-0.483**	0.221
	(0.133)	(0.149)	(0.174)
Plant size 50-249	0.004	-0.498**	0.502**
	(0.138)	(0.164)	(0.184)
Plant size 250-999	-0.195	-0.589**	0.395
	(0.183)	(0.214)	(0.234)
Plant size 1000-	0.002	-0.389	0.391
	(0.329)	(0.333)	(0.349)
Constant	38.750***	41.894***	-3.145
	(2.202)	(1.906)	(2.523)
R squared	0.274	0.282	0.052

Robust standard errors in parentheses. Significance: *** 1%, ** 5%, * 10%. N = 1259. SAH = self-assessed health, higher value refers to better health.

The estimates concerning the health variables are collected in Table IV. The estimates are presented there so that they tell the connection of one standard deviation change in a health variable with months of retirement age, expected retirement age, and expectation error. The baseline results in the first row of Panel A of Table IV (based on the first line of Table III) show that health is clearly correlated with both actual and expected retirement ages, when these are regressed on health and controls. Health has a stronger connection with expected retirement age, which produces a negative connection between health and expectation error. In terms of months, the results imply that one standard deviation improvement in health (0.87) is associated with 2 months later retirement, 3.6 months later expected retirement, and 1.6 months smaller expectation errors. However, as the descriptive evidence in the previous section showed, these results may have been influenced by sample selection, which leaves out many of those with good health who are working longer than they expected.

Table IV: Connection of health and retirement.

Data, estimation method, and health variable	Retirement age	Expected retirement age	Expectation error
Panel A: Retirement age observed; OLS estimation; alternative health variables			
SAH	2.006***	3.644***	-1.639*
	(0.716)	(0.704)	(0.890)
Pains	-0.998	-1.194*	0.196
	(0.594)	(0.717)	(0.703)
Chronic illness	-1.250**	-1.298*	0.048
	(0.596)	(0.679)	(0.724)
Self-reported sickness absences	-2.593***	-3.798***	1.205
	(0.979)	(0.711)	(1.027)
Sickness absences from register data	-2.264**	-2.354***	0.090
	(0.908)	(0.783)	(0.595)
Panel B: Retirement age observed; instrumental variables estimation			
SAH (pains as instrument)	3.470*	4.149*	-0.680
	(2.042)	(2.442)	(2.424)
SAH (chronic illness as instrument)	3.464**	3.596*	-0.132
	(1.637)	(1.846)	(1.992)
SAH (both pains and chronic illness	3.466**	3.787**	-0.321
as instruments)	(1.430)	(1.653)	(1.736)
Panel C: Retirement age observed, healthy individuals; OLS estimation; health shock			
Average absences during follow-up	-2.746**	0.807	-3.554***
	(1.183)	(1.094)	(1.352)
Panel D: Retirement age observed or censored; censored regression			
SAH	3.228***	3.858***	-0.082
	(0.709)	(0.594)	(0.837)
Panel E: Retirement in intervals defined by age and expected retirement age, or censored; interval regression			
SAH	3.655***		
	(0.687)		

Robust standard errors in parentheses. Significance: *** 1%, ** 5%, * 10%. N = 1259 in panels A and B; N = 466 in panel C; N = 1987 in panels D and E. The entries are months associated with one standard deviation change in the health measure. SAH = self-assessed health, higher value refers to better health.

Among the other variables (reported in Table III), age is positively related to expected and actual retirement age. Gender, education, and earnings have no effect on the results. The pension accrual rate is positively related to expected retirement age, which supports the incentive role of the age-related pension accrual. Those who are already in partial retirement or whose spouse is retired tend to have lower actual retirement ages, but these variables have a weak relationship to expected retirement age. Public sector pensions are positively related to both actual and expected retirement age. There is evidence that in the smallest plants (reference group under 10 employees) employees expect to retire later, but the relationship of plant size to actual retirement age is not as clear. Finally, the indicator for the 2008 survey has a negative and significant coefficient for actual retirement age. This may be related to the pension reform, which has made the lower limit 63 years a clear focal point in retirement behavior. This is so even though average retirement age has increased partly through restrictions on some of the early exit routes (average observed retirement age in our data is 62.8 for those in the 2003 survey and 63.2 for those in the 2008 survey). The focal point has been observed also in other studies [34].

As discussed above in section 3, there are potential sources of bias. We give attention to biases arising from measurement error, endogeneity, and sample selection. The results of the health variables are presented in different panels of Table 2.

First, we address the issue of measurement error in health. It can be argued that the indicators for chronic illness and pains and the number of days of sickness absence are more objective measures of health even when they are self-reported. Therefore, they themselves may contain some measurement error. We first use them as health variables instead of SAH. We use both self-reported absences in the past 12 months and register information on absences for which sickness allowance has been paid during the calendar year preceding the survey. Since the variables are measured differently (SAH from 1 to 5, pains and chronic illness as binary indicators, and absences as days), we report the results in terms of one standard deviation change in each health variable. Rows 2 to 4 of panel A in Table IV summarize the coefficients of the health variables scaled in this way and are expressed in months. Naturally, SAH has a sign which is different from the signs of the other health variables, as a higher value of SAH means better health, whereas the reverse is true for the other variables. Generally, SAH and sickness absences as explanatory variables give fairly similar results, whereas the other health variables give lower values for the relationships. The main difference between self-reported and register-based sickness absences is that the former has a stronger relationship with the expected retirement age. The result that SAH overstates the relationship compared to objective health measures is in line with the results of some earlier studies [8]. On the other hand, the number of sickness absence days may be a better summary measure of health than the binary indicators, and it gives results similar to those with SAH.

An alternative way to proceed is to use these other health measures as instruments for SAH. This is the so-called multiple indicator solution [23]. The true health status is unobserved, and when SAH is used as a proxy for health the measurement error in SAH is part of the error term of the model. Assume that there are two health indicators that have uncorrelated measurement errors and which are ignorable in the sense that if true health could be controlled, the indicators would have no explanatory power for retirement. Under these assumptions, one health indicator is a valid instrument for another. Panel B of Table IV shows the associations of one standard deviation change in SAH with the retirement variables when indicators for pains and chronic illness are used as alternative instruments. The point estimates of the coefficient of health increase (in absolute value) in instrumental variable estimation, which is consistent with attenuation caused by measurement error. Using sickness absences (either self-reported or register-based) as an instrument produced very highest estimates in absolute value (not reported in the table).

The under-identification and weak identification tests showed that the instruments are relevant, i.e. sufficiently correlated with SAH. When at least two instruments are used overidentification can be tested, i.e. that the set of instruments is not correlated with the error term. We tried using different pairs of two instruments at the same time. Hansen's J test led to the conclusion that the instruments are valid in all of the three equations only if pains and chronic illness are used together as instruments. In this case, the estimate for the relationship of one standard deviation improvement in health with actual retirement age is 3.5 months and with expected retirement age 3.8 months. When the number of absences was used together with either of the other instruments, the J-statistic was high in the equation for expected retirement age, and the null hypothesis of no correlation with the errors was rejected. Sickness absence seems to be a problematic variable as an instrument and it may be correlated with the measurement error in SAH, as both are summary measures of health.

Secondly, we have examined the role of health shocks. They are health-related events in the follow-up period that are more exogenous because they happen after the survey. Health measured in the survey may not play a big role if there are later severe health events. We measure the health shock by the average number of annual sickness absence days between the survey year and retirement, using register information on absences for which the Social Insurance Institution has paid sickness allowance. Use of absences may be problematic, since there may be latent health symptoms that affect both SAH and later sickness absences. To reduce this problem, we concentrate on initially healthy individuals. These are defined as those who have not had absences with sickness allowance during a 2-year period (survey year or the year before), have answered in the survey that they have no chronic illnesses, and have a good health status (SAH equal to 4 or 5). These restrictions leave 466 observations among which the average number of annual sickness absence days in the follow-up period has mean 4.96 and standard deviation 14.54. The correlation of the shock measure with SAH is negative and low in absolute value, -0.05, so the problem of latent health effects should not be serious. Even this measure is subject to justification bias, if people who would like to retire early, for example because of dissatisfaction with their work, take sickness absences to justify the need for early retirement even when their health is not poor. However, obtaining sickness allowance requires a medical certificate, and the allowance is paid only after 10 days of sickness. Therefore, just low job satisfaction without any observed medical symptoms is not sufficient.

Figure 2 shows the unconditional relationship between the shock and actual retirement age. Panel C of Table IV shows that in the retirement age model the health shock is significant with a negative coefficient. An adverse health shock, measured as a one standard deviation increase in absences, is associated with 2.7 months earlier retirement than expected. This is probably closest to a causal effect that we can get with our data. The estimate is close to the OLS estimates with absences as the health variable. One interpretation of this result is that the endogeneity of health is not a serious problem, at least when the number of absence days is the health measure. The shock is naturally also negatively related to the expectation error, i.e. adverse health shocks lead to earlier retirement. However, the future shocks should not be related to the (earlier) expectations. This is confirmed by the estimations, which supports the assumption that the health shock measure is not related to latent health that is likely to influence retirement expectations.

[Insert Figure 2 here]

Thirdly, we have investigated the sample selection issue. We expect that there is a selection bias toward zero in the coefficient of health in the retirement age equation when only observed retirement ages are used, since those with better health are overrepresented among those who have not yet retired during the observation period. For the expected retirement age there is no selection effect, as it is observed for all. The individuals with unobserved retirement times can be treated as censored observations. In practice the censoring limit, i.e. the highest age at which a non-retired individual is observed, is age at the end of the follow-up period in 2013. The limit therefore varies across individuals. We estimate the censored regression model using interval regression [23]. When the retirement age is observed, we have point data (actual retirement age), whereas for the censored observations we know that retirement happens in the interval from age at the end of 2013 to infinity.

The results in Panel D of Table IV show that censored regression indeed produces higher estimates. One standard deviation change in SAH is now associated with 3.2 months later retirement. As the expected retirement age is observed for all, the censored regression naturally produces the same estimates for the expected retirement age equation as would ordinary least squares. The difference in this case between Panels A and D is caused by the larger sample in Panel D. The estimate for health in the expectation errors equation is no longer the simple difference between the estimates in the retirement age and expected retirement age equations, since the models are nonlinear. When censoring is taken into account, health is no longer significantly related to the errors. The negative relationship between SAH and expectation errors in the baseline OLS estimates seems to be caused by more common censoring of retirement ages among healthy individuals.

Finally, as another estimation, where censoring is taken into account, we have used interval regression using information on the age intervals when retirements happen, rather than retirement age as a continuous variable. Using ordered models (ordered probit or logit) for retiring before, at, or after expected retirement age would not take into account the fact that individuals are observed at different ages and at different distances from their expected or actual retirement. In interval regression we can take this information into account. Specifically, retirement can happen in the following cases: in the interval between age at time of survey and expected retirement age; at expected retirement age (point data); in the interval between expected retirement age and age at the end of the follow-up in 2013; or retirement age can be right-censored. This estimation therefore combines information on both expected and actual retirement. Since the values for the limits of the intervals are used, the estimation produces association of health with actual retirement age. According to the results (Panel E of Table IV), one standard deviation increase in SAH is associated with 3.6 months later retirement. Since the intervals are based on expected retirement ages, the estimation does not produce results on expected retirement ages or expectation errors.

Robustness analyses

We have done various robustness analyses, which we briefly describe without presenting the results in a table. So far, we have used SAH as a cardinal measure. An alternative is to use indicators for different levels of health. We used indicators for SAH levels 3, 4, and 5, with levels 1 and 2 combined as the reference. The coefficients of the indicators had an increasing pattern in the models for actual and expected retirement age and a decreasing (negative) one in the model for expectation error. Cardinality implies certain restrictions on the coefficients of the indicators: coefficients of adjacent indicators increase by the same amount and there are multiplicity constraints, e.g. the coefficient of the fourth indicator is twice the coefficient of the second one. These constraints were accepted in the estimations with the indicators for health levels. Therefore, the use of a cardinal health measure is justified.

To investigate the heterogeneity of the health-retirement relationships, we tried including interactions of the health variable with education (indicators for secondary and tertiary education), gender, and income. The only statistically significant result from this exercise was that the interaction of the indicator for tertiary education and health was positive and significant in the model for actual retirement age. In the expected retirement age equation even this interaction was insignificant. However, in the censored regression model none of the interactions were significant.

We have examined the sensitivity of the results to the choice of the sample. Since there may be disability retirements among those below age 60, we tried including in the estimations also those in the 2008 survey who were 50 to 54 years old in the end of 2008 and who therefore did not reach age 60 by the end of the follow-up. The baseline results were close to those reported above, as one standard deviation change in SAH was associated with 2.4 months later retirement. The similarity of the results is natural, since only 19 additional observations with observed retirement age were included. However, at the same time the extension of the sample added 547 new censored observations. Censored regression with this larger sample resulted in a somewhat higher estimate for SAH than in the baseline model. However, it is difficult to tell whether this was due to the larger sample size or the higher share of censored observations. As another robustness check we estimated the model using only the 2003 survey. Censoring should be a smaller problem in this group. On the other hand, the number of observations in the OLS estimations dropped to 792. The estimate for the health effect dropped and became insignificant, whereas the relationship between SAH and expected retirement age remained almost the same as with the larger sample. In the censored regression model, the health effect on retirement age was again significant. A one standard deviation change in SAH was associated with 3 months later retirement. This is close to what we obtained in the baseline estimations. Again, it is hard to tell whether the differences in some of the results are due to less censoring or smaller sample size.

A limitation of our analysis is that we deal with full-time retirement only. This restriction is dictated by the survey, which does not ask about expected part-time retirement age. We can still speculate how part-time retirement might affect the results. Had the survey respondents been asked about both expected part-time and full-time retirement age, it is possible that we would find a stronger relationship between health and expected retirement, as those with poor health would be more likely to plan to take part-time retirement. For actual retirements we can examine how part-time retirement affects the relationship between health and retirement. To do this we dropped from the data those who were already in part-time retirement during the surveys, added those who were observed to retire part-time but not full-time, and defined the actual retirement age according to part-time retirement for those for whom both part-time and later full-time retirement were observed. The analysis of our baseline model with this sample showed that one standard deviation increase in SAH was associated with 2.4 months later retirement, which indicates 0.4 months stronger association than in panel A of Table 2. It is difficult to say how part-time retirement would affect the connection of expectation errors and health if both expected and actual retirement age were affected. Including more flexible retirement channels would possibly lead to more negative expectation errors (retirement earlier than expected) for those with poor health.

Discussion

We have investigated the relationship between health and full-time retirement by taking into account both anticipated and actual retirement age and their difference, ie expectation error. People do not predict their retirement age perfectly but still relatively well. In baseline estimates that use the sample for which retirement age is observed, subjective assessment of health status is positively correlated with actual and expected retirement age and negatively with the expectation error (actual minus expected retirement age).

We have examined potential biases in this health-retirement relationship, like measurement error, endogeneity, and sample selection. The main result in regard to positive correlation of health and retirement is relatively robust, but the evidence shows that these estimation problems may produce biases. Use of other, perhaps more objective, health measures give much smaller estimates. However, Bound [3] has concluded that "objective" measures that themselves have measurement error may give a less accurate estimate of the relationship of health and labor market status than "subjective" measures. This may explain our result. However, using absences as the health measure gives similar results as self-assessed health. This holds irrespective of whether self-reported or register-based absences are used. This increases confidence in the use of the SAH measure. Use of other health indicators as instruments for self-assessed health showed that measurement error in health status may bias the results downward. Bound [3] concluded that this kind of instrumenting has drawbacks as it may actually strengthen the downward measurement error bias that exists when the self-assessed health measure is used alone. However, our instrumental variable estimates are relatively high, which seems to indicate that there is no such downward bias.

Including observations with censored retirement times showed that concentrating on only those whose retirement is observed also leads to downward biased results. This issue does not seem to have been discussed much in the literature. As a more exogenous health variable, we have used a health shock, which is measured by average annual days of absence with sickness allowance in the follow-up period. In a sample of initially healthy individuals, the shock is negatively related to actual retirement and through that to the expectation error. These estimates can be considered more causal impacts of health than the ones obtained with self-assessed health. Since the results using the absence shock and results using absences before the survey as an alternative health variable are relatively similar, endogeneity of health does not seem to lead to a large bias. Our results are consistent with earlier results that health shocks cause actual retirements to deviate from the expected [13, 15].

We found that on average individuals tend to retire later rather than earlier than they had anticipated. However, also overestimation of retirement time is common, especially among those with poor health. The discrepancies between expectations and realizations arise possibly for different reasons. Those with poor health may have fewer opportunities. Very bad health may force early retirement through disability or part-time retirement and often with a relatively low pension. On the other hand, some of those with poor health may be forced to stay reluctantly in the working life because it is financially necessary or they are denied the opportunities to take an early exit. In contrast, those with good health (and often with high education and higher earnings) may have more opportunities to choose their retirement timing. They may have a job that makes it possible and enjoyable to stay longer at work and to earn a higher pension. Inequalities in health are therefore intertwined with inequalities in welfare at work and inequalities in retirement.

A policy lesson from our work is that to lengthen working careers, attention should be given to both the ability and willingness of people to continue longer at work. This means that both financial incentives (pension accrual, age limits to retirement channels) and soft measures (improvement of working conditions and work-related health) are needed. Another lesson is that it is also important to pay attention to retirement expectations that are tied to focal points. In the Finnish system the lower limit of the flexible retirement age has become such. Affecting the focal points of expectations is likely to affect also actual retirements.

Acknowledgements

Funding from the Strategic Research Council at the Academy of Finland (project 293120, Work, Inequality, and Public Policy (WIP)), is gratefully acknowledged. We are thankful to the Finnish Centre for Pensions, and especially Noora Järnefelt, for arranging the data for our use. Earlier versions of this paper have been presented in the seminars "Connections between Health and Employment" and "Policies Aiming to Prolong Working Careers – Perspectives on Retirement Age" at National Institute for Health and Welfare in Helsinki, at the "Work, Age, Health and Employment" (WAHE) conference at University of Wuppertal, in the workshop "Subjective Survey Data in Labour Market Research" at Trier University, in the WIP consortium workshop at University of Tampere, and in seminars at HECER and CHESS in Helsinki. Thanks go to the workshop participants and the referees for comments.

References

[1] French E and Jones JB. Health, health insurance, and retirement: A survey. *Annu Rev Econ* 2017; 9: 383–409.

[2] Blundell R, French E, and Tetlow G. Retirement incentives and labor supply. In: Piggott J and Woodland A (eds) *Handbook of the Economics of Population Ageing,* Vol. 1B. Amsterdam: North-Holland, 2016, pp. 457-566.

[3] Bound J. Self-reported versus objective measures of health in retirement models. *J Hum Resour* 1991; 26: 106-138.

[4] Christensen BJ and Kallestrup-Lamb M. The impact of health changes on labor supply: Evidence from merged data on individual objective medical diagnosis codes and early retirement behavior. *Health Econ* 2012; 21: 56-100.

[5] Disney R, Emmerson C, and Wakefield M. Ill health and retirement in Britain: A panel data-based analysis. *J Health Econ* 2006; 25: 621-649.

[6] Jones AM, Rice N, and Roberts J. Sick of work or too sick to work? Evidence on self-reported health shocks and early retirement from the BHPS. *Econ Model* 2010; 27: 866-880.

[7] Kalwij A and Vermeulen F. Health and labour force participation of older people in Europe: What do objective health indicators add to the analysis? *Health Econ* 2008; 17: 619-638.

[8] Kerkhofs M, Lindeboom M, and Theeuwes J. Retirement, financial incentives, and health. *Labour Econ* 1999; 6: 203-227.

[9] Lindeboom M and Kerkhofs M. Health and work of the elderly: Subjective health measures, reporting errors and endogeneity in the relationship between health and work. *J Appl Economet* 2009; 24: 1024-1046.

[10] Riphahn RT. Income and employment effects of health shocks. A test case for the German welfare state. *J Popul Econ* 1999; 12: 363-389.

[11] Dwyer DS and Mitchell OS. Health problems as determinants of retirement: Are self-rated measures endogenous? *J Health Econ* 1999; 18: 173-193.

[12] McGarry K. Health and retirement: Do changes in health affect retirement expectations? *J Hum Resour* 2004; 39: 624-648.

[13] Anderson KH, Burkhauser RV, and Quinn JF. Do retirement dreams come true? The effect of unanticipated events on retirement plans. *Ind Labor Relat Rev* 1986; 39: 518-526.

[14] Disney R and Tanner, S. *What can we learn from retirement expectations data?* Institute for Fiscal Studies. Working Paper W99/17, 1999.

[15] Dwyer DS and Hu J. Retirement expectations and realizations: The role of health shocks and economic factors. In: Mitchell OS, Hammond PB, and Rappaport AM. *Forecasting Retirement Needs and Retirement Wealth*. Philadelphia: University of Pennsylvania Press, 2000, pp. 274-287.

[16] Solem PE, Syse A, Furunes T, et al. To leave or not to leave: Retirement intentions and retirement behavior. *Aging Soc* 2016; 36: 259-281.

[17] Örestig J, Strandh M, and Stattin M. A wish come true? A longitudinal analysis of the relationship between retirement preferences and the timing of retirement. *J Popul Ageing* 2013; 6: 99-118.

[18] Jylhä M. What is self-rated health and why does it predict mortality? Towards a unified conceptual model. *Soc Sci Med* 2009; 69: 307-316.

[19] Butler JS, Burkhauser RV, Mitchell JM, et al. Measurement error in self-reported health variables. *Rev Econ Stat* 1987; 69: 644-650.

[20] Li C-Y and Sung F-C. A review of the healthy worker effect in occupational epidemiology. *Occup Med-Oxford* 1999; 49: 225-229.

[21] Baker M, Stabile M, and Deri C. What do self-reported, objective, measures of health measure? *J Hum Resour* 2004; 39: 1067-1093.

[22] Stern S. Measuring the effect of disability on labor force participation. *J Hum Resour* 1989; 24: 361-395.

[23] Wooldridge JM. *Econometric Analysis of Cross Section and Panel Data*. 2nd ed. MIT Press, 2010.

[24] Feldman DC and Beehr TA. A three-phase model of retirement decision making. *Am Psychol* 2011; 66: 193-203.

[25] Bissonnette L and Van Soest A. *Retirement Expectations, Preferences, and Decisions*. Netspar Panel Paper 18. Tilburg, 2010.

[26] Bernhein BD. The timing of retirement: A comparison of expectations and realizations. In: Wise DA (ed) *The Economics of Ageing*. Chicago: University of Chicago Press, 1989, pp. 335-358.

[27] Haider SJ and Stephens M Jr. Is there a retirement-consumption puzzle? Evidence using subjective retirement expectations. *Rev Econ Stat* 2007; 89: 247–264.

[28] Henkens K and Tazelaar, F. Explaining retirement decisions of civil servants in the Netherlands. Intentions, behavior; and the discrepancy between the two. *Res Aging* 1997; 19: 139-173.

[29] Harkonmäki K, Martikainen P, Lahelma E, et al. Intentions to retire, life dissatisfaction and the subsequent risk of disability retirement. *Scand J Public Health* 2009; 37: 252-259.

[30] Tuominen E, Karisalmi S, Takala M, et al. How do intentions affect future retirement? A case study of the Finnish flexible old-age pension scheme. *Eur J Soc Secur* 2012; 14: 111-131.

[31] Lehto A-M and Sutela H. *Threats and Opportunities. Findings of Finnish Quality of Work Life Surveys 1977-2003*. Helsinki: Statistics Finland, 2005.

[32] Lehto A-M and Sutela H. *Three decades of Working Conditions. Findings of Finnish Quality of Work Life Surveys 1977-2008*. Helsinki: Statistics Finland, 2009.

[33] van Erp F, Vermeer N, and van Vuuren D. Non-financial determinants of retirement: A literature review. *Economist-Netherlands* 2014; 162: 167-191.

[34] Leinonen T, Laaksonen M, Chandola T, et al. Health as a predictor of early retirement before and after introduction of a flexible statutory pension age in Finland. *Soc Sci Med* 2016; 158: 149-157.

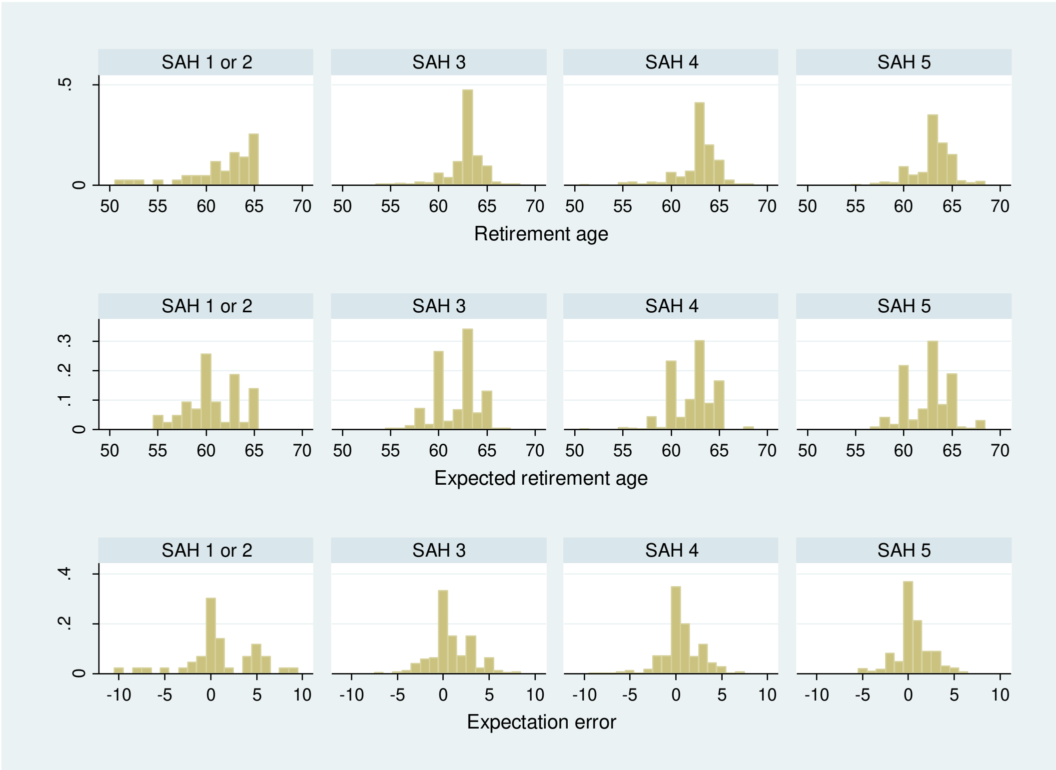

Figure 1. Distributions of actual and expected retirement ages and expectation error by health status.
SAH: self-assessed health, higher value of SAH refers to better health.

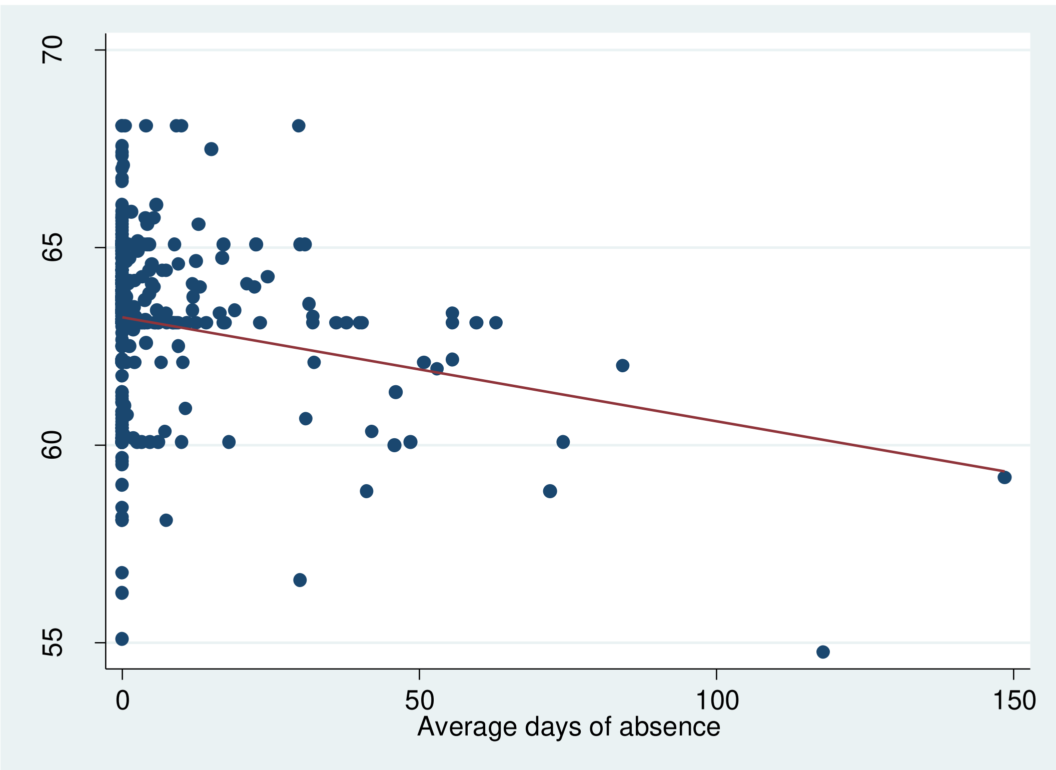

Figure 2. Retirement age and average annual sickness absence days.