DISCUSSION PAPER SERIES

IZA DP No. 6301

Training and Retirement

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January 2012

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

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Discussion Paper No. 6301
January 2012

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IZA Discussion Paper No. 6301
January 2012

ABSTRACT

Training and Retirement*

This paper presents results on the effect of formal life-long learning on the decision to retire early. Specifically, I estimate an Option Value model based on individual employer-employee longitudinal data including comprehensive government co-sponsored training records dating back more than 30 years. Human capital theory predicts that the amount of training and the length of working life will be positively correlated in order to recoup investment and yield a higher return. Significant upper bound effects of training in prolonging working life are found for certain types of training and certain groups of workers. However, out-of-sample simulations indicate that on average one year of training only adds up to one month to the career length. This means that training in itself is not enough to substantially prolong careers and increase the workforce.

JEL Classification: H55, I21, J26

Keywords: training, retirement, option value, upper bound identification

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* I thank Paul Bingley for many helpful discussions and detailed comments. I also thank Bent Jesper Christensen, Tor Eriksson, Nabanita Datta Gupta, Søren Leth-Petersen, Hessel Oosterbeek, Marianne Simonsen, Lars Skipper, Ian Walker, Frederic Warzynski and seminar participants at the Norwegian University of Science and Technology (Trondheim), AKF, Copenhagen and at the 3rd NOCE-ELE meeting in Ebeltoft for helpful comments. The usual disclaimer applies.

1 Introduction

In this paper, I evaluate the effect of accumulated government co-sponsored training on older workers retirement age. The key question I seek to answer is whether formal life-long learning postpones retirement or not? There are several reasons why this is an important question to answer:

Ageing OECD populations increase the need for older workers to stay longer in the labor market in order to maintain a balance between the active and the inactive parts of populations.[1] Training is broadly considered a key ingredient in obtaining this balance as it may assist older workers in keeping up with dynamic labor market requirements. This is arguably the main reason why life-long learning has been promoted repeatedly in recent years.

Furthermore, government-sponsored training programs have been criticized for yielding low, and sometimes negative, returns (Heckman, 2000; Carneiro and Heckman, 2003). However, if government-sponsored training results in prolonged worklife of trainees, this may constitute an important but usually neglected part of cost-benefit analyses of government sponsored training programs.

In addition, seminal works of Becker (1964) and Ben-Porath (1967) make clear how returns to human capital critically depend on the number of years left in the labor market. Inspite of the clear theoretical predictions and the vast empirical literature related to retirement, there is little in the way of existing empirical literature that links life-cycle training accumulation and retirement.[2] One exception, although somewhat different in method and sample of interest, is de Luna et al. (2010), who focus on upper secondary education of at least 1/4 annual full-time study compared to less or no adult education, and find that this type of adult education has no impact on the timing of retirement.

Bartel and Sicherman (1993) is another important exception although

[1] Explicit goals have been set by the EU in the so-called "Barcelona targets" from 2001, which state that "a progressive increase of about 5 years in the effective average age at which people stop working in the European Union should be sought by 2010", Commission of the European Communities (2003).

[2] See Bingley and Lanot (2007) for a recent overview of the empirical retirement literature.

accumulated training is not their main focus. They study the effects of technological change on careers of older workers and find support for two theoretical predictions. First, workers in industries with high technological change will retire later in order to recoup returns to late investments in their human capital made necessary by technological changes. Second, an unexpected technological shock may induce older workers to retire sooner than they would otherwise have done if the costs of re-training outweigh the returns.

The Bartel-Sicherman study builds on NLS data, which only provide information about recently obtained training. For this reason, they match the mean response from employed male heads of households in the PSID 1978-survey about how long it would take an average worker to become fully trained and qualified for his job. Subsequently, the mean is matched by occupations in NLS. These training data are far from ideal.

In contrast, I have access to an unusally long panel of individual training records dating back more than 30 years, i.e. spanning almost entire career paths of workers. The training records are very detailed and include, among other variables, a measure of the type of training as well as a measure of the course load measured in units of annual full-time training (details given in section 3). By accumulating the course load year by year, depreciated to take the timing of training over the career into account, it is possible to link these data to the workers' early retirement decision and estimate whether training accumulation postpones retirement or not.

The available data have other virtues besides the unusually long individual training records. In particular, the data are matched employer-employee records, and hence it is possible to observe a proxy for Mergers and Acquisitions (M&A), which should work much like the technological shocks observed by Bartel and Sicherman (1993). In the wake of M&A, organizational changes and new work routines often follow. Such changes may therefore induce elderly workers to retire earlier. Furthermore, the data include detailed information about spouses as well as number and age composition of children and grandchildren. This last feature may be an important control variable. Yet, to my knowledge, it has never been included in a study of

early retirement.[3]

Lacking a suitable and convincing instrument, I estimate upper bounds of the effect of training in postponing retirement. I find significant effects of Basic and Vocational training in expanding working life. Out-of-sample simulations indicate that one year of full-time training only yields about one month extended working-life.

The paper is organized as follows. The next section outlines what economic theory has to say about life-cycle training and age of retirement. In section 3, data and the institutional background are presented. Section 4 describes the option value model approach and discusses identification. This is followed by presentation of results (section 5), discussion (section 6) and conclusion (section 7).

2 Economic Theory

Human capital theory as developed by Mincer (1958), Becker (1964) and Ben-Porath (1967) makes clear how human capital accumulation shall be viewed as optimal investments made by rational agents, and that returns to human capital investments are closely linked to time until retirement. As an outcome of this, economic theory predicts that investments in human capital will be intensive early in life and gradually decline to become zero at the time of retirement.[4] Economic theory also predicts that there will be a positive correlation between the amount of training accumulated over the life-cycle and the age of retirement.

Training decisions over the life-cycle depends on other factors than just time to retirement. For instance, the Ben-Porath model also yields the

[3] Soldo and Hill (1995) describe the rationale for and the measures of family structure and inter-vivos giving in the Health and Retirement Study (HRS). Using the baseline HRS, they describe the quality of data on kin attributes and the correlations among family structures, transfers, and work. However, their study is purely descriptive and does not include any estimate of the relationship between grandparenthood and early retirement.

[4] Exceptions may occur as noted by Ben-Porath. In particular, in phase II of his model the costs of training may drop faster than the decrease in returns that comes about as $t \rightarrow T$, and as a result human capital investments may increase over time. Eventually, they will decline though.

prediction that, given a positive correlation between technological change and on-the-job training (OJT), the amount of OJT is positively correlated with the slope of the wage profile. Steeper profiles reward work late in life vis-a-vis earlier in life and industries with high OJT levels will therefore attract workers who plan to retire late.

Furthermore, technological and organizational changes will, according to human capital theory, influence retirement decisions in two distinct ways (Bartel and Sicherman, 1993). First, workers in industries with high technological (or organizational) changes will stay longer in the labor market because they will be required to undertake more OJT throughout their careers and because their foregone earnings, should they retire, increase. This induce them to retire later. Secondly and countering this effect, higher levels of technological or organizational change also imply higher levels of human capital depreciation and hence reduced training. An *unexpected* change in technology (or organization) is equivalent to an increase in the depreciation rate and this may induce elderly workers to retire sooner since the required amount of re-training may be too costly.[5]

Other factors that theoretically will affect workers' retirement decision include value of time, which in turn depends on outside options. The larger the stock of human capital, the larger the foregone earnings from diverting time away from the market (Becker, 1965). In the same vein, the value of leisure time (or being retired) depends on factors such as having a spouse and having children and grandchildren. In addition, outside options depend *i.a.* on the workers' financial situation and health.

3 Institutional Background and Data Description

3.1 Institutional Background

This subsection includes a brief description of the two main schemes for early retirement. A more detailed description can be found in Bingley et al.

[5] Mainly due to the short period in which they can recoup returns but possibly reinforced by higher costs of learning new work practises vis-à-vis younger colleagues.

(2004).

Post-Employment Wage (PEW) was introduced in 1979. The intention was to offer a possibility of early retirement to workers physically or psychologically worn-out. Up through the 1980s and 1990s, the program became very popular also among healthy elderly workers thus making the program increasingly burdensome for public finances. In order to partly neutralize the increased popularity of the program, eligibility requirements and economic incentives have changed over the years. For the cohorts considered here, workers aged 60-66 are eligible if they have been members of an UI fund since 1992. The PEW offers the same remuneration as for Unemployment Insurance benefits, but after 30 months it is reduced to 80% of this level. Also, benefits are bounded by an upper ceiling of 80% of the worker's former wage. The PEW is economically most attractive to low-wage earners since the wage replacement rate is highest for this group.

As an alternative to PEW, civil servants may be eligible to the Public Sector Employees Pension (PEP). Eligibility is a function of years served in the public sector and the amounts offered are actuarially adjusted, i.e. workers who delay their early retirement receive higher PEP once they do retire and forever after.[6],[7]

In general, individuals often retire early in Denmark, cf. Table 1. One in three retire when they are 60 years old, and less than 20 percent continue working after age 63.[8] We find that females and public-sector workers tend to retire earlier than males and private-sector workers. Not surprisingly, low educated are also found to retire sooner than higher educated - a reflection of differences in physical wear down and foregone earnings (low educated have less steep wage profiles).

[Table 1 about here]

[6] Individual administrative records on public employment pension (ATP) date back to 1964, and these records have been used in computing PEP seniority.

[7] Other early retirement pension schemes include health and disability pensions. Individuals who enter one of these schemes are excluded from the sample.

[8] The numbers in Table 1 are conditional on 60-67-year-olds being in the cohorts analyzed here and who retire sometime during these years of their life.

However, apart from the highest (university) and lowest (primary) levels of education the differences across education groups do not appear very pronounced.

3.2 Data

The selected sample consists of the entire 1936-1944 birth cohorts conditional on being active in the labor market in 2001, in which year the selected cohorts were aged 57-65. The analysis is based on the Danish employer-employee register data, which includes information from the Integrated Database for Labor Market Research (IDA) linked with the Course Database.

3.2.1 Labor Market Data

The administrative IDA database, maintained by Statistics Denmark, contains labor market information on all individuals aged 15 to 74 (demographic characteristics, education, labor market experience, tenure and earnings) and employees in all workplaces in Denmark over the period 1980-2004. This database includes, amongst many other things, identifiers for both the firm and the establishment where the individual works.

As noted in the introduction, the data also enable us to identify Mergers and Acquisitions as well as the general turnover at both the firm level and the plant level. In addition, the database includes information about spouses' labor market activities, wage histories etc., and number and age of children and grandchildren. Wealth was available until 1996, and hence I use the reflated value of the 1996 wealth as a proxy for household wealth from 2001 to 2004.[9]

[9] Information on wealth was available until 1996 as it was collected for tax purposes. After 1996, wealth was no longer taxed and wealth data became less reliable.

3.2.2 Course Data and Institutional Set-up

The course database goes back as far as 1958 but has increased in scope over time, in particular since the 1970s. The purpose of this database is to provide a collection of information about course activities related to adult post-school training and education. The database includes individual level information about formal, external courses, which are co-financed, organized and controlled by a publicly certified course supplier. The courses may take place either outside the workplace or with a controlled examination at the workplace. Being offered only by publicly certified suppliers, the courses are anchored in the public sector, but a large proportion of the users are nevertheless private-sector firms.[10]

I group the government co-sponsored training courses into the following three broad categories, Simonsen and Skipper (2007):

- basic courses
- vocational and technical courses
- post-secondary courses.

The basic courses target individuals with low to medium levels of formal education (from 3rd grade up to and including high school) and focus on basic literacy and numerical skills as well as language classes (some of the most popular courses include English and French classes at high school level). Education takes place either at one the 75 adult educational centers or at high schools.[11]

The vocational and technical courses target all groups of workers. They have a relatively short duration, oftentimes a few days and usually less than two weeks. These courses are often firm-specific, designed to meet demands

[10] Courses offered change over time in accordance with demand. In year 1990 (2000) there were about 640 (4,100) different types of courses.

[11] Note that Denmark only measures about 42,000 m^2 (4,667 ft^2), which means that very few will have more than a 30 km. (18 miles) travel distance, and most will be within half that distance.

in private companies, but may also target much broader groups.[12] These courses can be further divided into *vocational* courses and *continuous vocational* courses targeted mainly at skilled blue-collar workers.[13] The overall range of vocational and technical courses is very wide (the database includes about 450 different educational codes for this group alone) and changes over the years in response to demands. Examples include china painting, book printing/repro techniques and team work at the plant. Education takes place at one of 20 labor market training centers, at vocational or technical colleges or at the workplace.

Post-secondary courses include general as well as more specific training from college education and up to university level. The database includes about 900 different codes for this type of training alone.

Basic courses and post-secondary courses can broadly be considered as general training while vocational and technical courses can be general but also more firm-specific, cf. below. For all three types of courses, employers or the employees directly get a refund equivalent to that of the maximum unemployment insurance benefits should participation take place during working hours. This is the case for about 80 percent of all vocational and technical training, while the corresponding numbers for basic training and post-secondary training is 5 and 10 percent, respectively. The government compensation typically amounts to between 60 to 80 percent of earnings. Employers will often, but not always, compensate the workers for the remaining 20 to 40 percentage-points to leave them fully compensated.[14] In

[12] One of the most well-known of this type of course is a so-called "IT-drivers license". This particular type of course has been taken by about 250,000 individuals since its introduction in the mid-1990s. This corresponds to about 10% of the entire Danish workforce.

[13] Admittedly, these names are hard to distinguish. "Continuous vocational" means update-training or brush-up courses for skilled workers with some experience (although unskilled also attend) while "Vocational" covers other types of vocational and technical courses such as "first-time" training.

[14] We do not observe in the data whether the employees receive further compensation from the employer. However, 95 percent of the government compensation in connection with vocational and technical courses is passed on directly to the employer. For basic (post-secondary) education the number is 36 (45) percent (Ministry of Finance, 2006). It is likely that employers who receive compensation from the government simply pay workers their normal wage and take care of the wage-deficit and all administrative burdens.

order to avoid mixing effects of ordinary main education with post-school training, which is the focus in this paper, the sample is confined to individuals who have completed their full-time education before 1982.[15]

The course database contains very detailed information for each individual, including date of entry, date of completion and the course load.[16]

The course database is limited in the sense that it does not include any informal training or formal but internally organized private-sector training. Hence, for the analysis to be valid we have to assume that the unobserved courses are missing at random (MAR) and that the effect of training on the decision to retire early is linear in the level of training. Of some concern here is whether or not substitution bias exists, i.e. workers who do not spend time in the courses observed here may substitute by taking other types of courses with a higher propensity than workers observed in the database as participants.[17] Countering this argument, note that workers observed as participants in the database have revealed their preference for training and they may therefore be more prone to accumulate even more training than observed non-participants.

In order to accomodate this potential problem of substitution bias, I identify three groups of workers that are deemed more likely than others to participate in governement co-sponsored training - should they participate in training at all. These three groups are

- skilled workers
- unskilled workers
- public-sector group

The latter group does not include all public sector workers but is here defined to consist of school and kindergarten teachers, nurses and public

[15] In this way, we avoid individuals who undertake general training as their main education. The choice of 1982 is arbitrary but leaves a minimum of about 20 years for training to accumulate. This reduces the sample by about 4 percent.

[16] Course load is measured in full-time equivalents, i.e. it is a measure between 0 and 10,000 where 10,000 constitutes one year of full-time course work.

[17] Heckman et al. (2000) show that substitution bias may be important.

administration personnel.[18]

3.3 Descriptive Statistics[19]

There are very substantial cohort effects in training participation. Among workers in the oldest cohort included in this paper (born 1936), about 40 percent of the workers are registered as participating in one or more courses. This number increases almost linearly up to about 63 percent of the workers in the 1944-cohort, cf. Table 2.

[Table 2 about here]

Vocational training is the type of training which most workers attend (44 percent of all workers in the sample have undertaken some Vocational training) with highest attendance (49 percent) among private-sector workers compared to public-sector workers (39 percent) and highest among males (50 percent) compared to females (38 percent). There are also substantial industry differences in vocational training participation ranging from 25 percent in *education* to 68 percent in *food, drink and tobacco*. Basic and post-secondary training, on the other hand, is attended by women and public-sector employees much more often than by private-sector employees and males.[20] In particular, females attend basic courses about 3 times as often as males. Less than 10 percent of the sampled individuals have participated in Post-

[18] Skilled and unskilled workers are identified from their status in 1995 (due to data break). Sensitivity analyses with respect to their tenure since then and/or years of accumulated experience in that occupation before 1995 reveal little difference in the results. The "public-sector group" is chosen somewhat arbitrarily among large groups of public-sector workers known to have high participation in government co-sponsored training programs.

[19] The statistics described here focus on accumulated training. A list of means and standard deviations of other important control variables is included as Table 4.

[20] Partly reflecting that the share of females in the public sector is 59 percent compared to a share of 43 percent in the selected sample.

Secondary training whereas almost half of the individuals in the *education* industry classification have participated in Post-Secondary training.

Splitting the sample by educational achievement reveals that low educated (primary education) participate about as much as higher educated, and that the highest educated (masters degree or similar level) is the group with the lowest degree of participation. This is somewhat surprising and may indicate that unobserved training is not missing at random.[21] Basic training is attended more often by individuals with a college degree than by lower educated. This reflects a somewhat arbitrary distinction between types of courses as well as the popularity of high school level language classes. Lastly, note that Post-Secondary training has a remarkably high participation rate among individuals with a *college, high* education. Many of these are school teachers.

Conditioning the sample on employees with a stricly positive level of accumulated training reveals, Figure 1, that individuals who enter into training usually accumulate about one month (full-time equivalent) of training but that some individuals accumulate much more (median about 5 weeks and mean about 2-3 months).

[Figure 1 about here]

The key question asked in this paper is whether or not a higher level of accumulated training has a causal impact delaying time of retirement. Looking at the univariate relation between mean accumulated training and age of retirement, conditional on cohort, we should find a higher average level of accumulated training as the age of retirement increases. This does appear to be the case for Basic and Vocational training while, in fact, the

[21] The training intensity is not taken into account in the numbers included in Table 1. However, comparing mean and median intensity levels across educational groups reveals a pattern similar to the one shown in Table 1.

opposite picture emerges for Continuous Vocational training, Table 3. Post-secondary training shows a mixed pattern.

[Table 3 about here]

4 Econometric Approach

In this paper, I estimate the probability of early retirement, i.e. retirement before age 67.[22] The choice of whether to retire or not can be considered an optimal stopping problem that lends itself to a discrete choice stochastic dynamic programming (DP) model, such as Rust and Phelan (1997). A more simple approach is to estimate an Option Value model in the vein of Stock and Wise (1990). This model offers a simple alternative while staying close in spirit to DP models. In particular, the Option Value model excels by inclusion of potential future compensation and by allowing for update of information, and in this way it maintains the forward-looking feature of DP models.[23] Next, I describe the Option Value model and the identification strategy.

4.1 The Option Value Model

In the Option Value model (Stock and Wise, 1990), an individual makes a choice each period whether to retire or not. The individual will continue

[22] Since 2004, the official retirement age in Denmark has been 65 years whereas prior to 2004 it was 67 years. Old Age Pension (OAP) is universally available to all pensioners above the threshold age. Means-tested supplements have been introduced in recent years. These are relatively small and not included in this analysis as they are not observed in the data.

[23] The key difference between a DP model and the Option Value model is, as pointed out by Stock and Wise (1990), that the decision rule in the Option Value model considers the maximum of expected values while in a DP model the decision rule adheres to the expected value of the maximum. The expected value of the maximum of two random variables is greater than the maximum of their respective expected values (Jensen's inequality). If the variance of the random components is small (i.e. if new information does not differ much from earlier information), the difference in the probability of retirement between the two models will be small.

working at any age if the expected present value of continuing to work is greater than the expected present value of immidiate retirement. In other words, the individual compares the expected maximum value of retiring in the future with the value of retiring now. Individuals then re-evaluate this retirement decision as more information about future earnings becomes available with age. However, retirement is treated as an absorbing state that is never revoked.[24]

Suppose an individual derives indirect utility $U_w(Y_s)$ from the real income if working in year s, and utility $U_r(B_s(r))$ from pension benefits if retired in year s. Assuming the individual discount factor is β, the net present value of working until age r and then retire can be written as

$$V_t(r) = \sum_{s=t}^{r-1} \beta^{s-t} U_w(Y_s) + \sum_{s=r}^{S} \beta^{s-t} U_r(B_s(r)). \tag{1}$$

Stock and Wise (1990) set S to be time of death, while in the present context $S = 67$ years of age.[25] I use cohort- and gender-specific survival tables, which yields more accurate option value computations.

Let the expected gain in year t from postponing retirement to age r be given by $E_t V_t(r)$. Furthermore, let $r^* > t$ be the future retirement yielding the highest expected value, i.e. $r^* = \max E_t V_t(r)$, $r \in \{t+1, t+2, ..., 67\}$. We can then write the option value of postponed retirement as

$$G_t(r^*) = E_t V_t(r^*) - E_t V_t(t). \tag{2}$$

This gives the individual a very simple decision rule: Postpone retirement if $G_t(r^*) > 0$, and retire now if $G_t(r^*) \leq 0$.

Following Stock and Wise (1990), the utility functions are assumed to take the form of constant relative risk aversion (CRRA), with additive individual disturbance terms, distributed independently over income and age.

[24] Bingley et al. (2004) and Danø et al. (2005) verify that this is a sensible approach in a Danish context where retirement states are virtually never revoked.

[25] This simplification is valid provided the actuarial adjustments of PEP, which accrue until time of death, are taken into account, and because all individuals are assumed to retire no later than age 67.

The utility from working and retirement then becomes

$$\begin{aligned} U_w(Y_s) &= Y_s^{\gamma}, \\ U_r(B_s) &= (kB_s(r))^{\gamma}. \end{aligned}$$

Instead of estimating all parameters in the CRRA specification, I use the values found by Danø et al. (2005) for Denmark.[26],[27]

Controlling for other covariates, X, and accumulated life-long training, AT, the probability of retirement in year t can be written as a simple binary choice (e.g. probit) model

$$\begin{aligned} \Pr(\textit{retire} \text{ in year } t \mid \text{active in } t-1) &= \\ \Pr[\delta X_{it} + \varphi G_{it}(r^*) &+ \lambda AT_{it-1} + \alpha_i > -\varepsilon_{it}], \end{aligned} \quad (3)$$

where, it are indices for individual i in period t, α_i are time-constant individual random effects and ε_{it} are idiosyncratic gaussian distributed period-specific shocks. The expected sign for the option value is negative ($\varphi < 0$), as this indicates that a higher value of postponing retirement makes it less likely that an individual retires now.[28] Possible wage effects of training are not included. Kristensen and Skipper (2009) analyze such wage effects using similar Danish register data. They find no wage effects of basic courses nor

[26] Danø et al. (2005) find $k = 1.39$ and $\gamma = 0.87$. Stock and Wise (1990) find $k = 1.5$ and $\gamma = 0.75$. The value of $\beta = \frac{1}{1+sir} \simeq 0.952$, where sir is the individual subjective interest rate ($sir = 0.05$ by assumption). Note that k>1 means that any given nominal income yields more utility while retired than while working. γ is the parameter for risk aversion.

[27] Note how the Option Value framework allows us to take actuarial adjustments of all future pensions among PEP eligible into account. The lowering of the OAP age was in force for individuals born after July 1, 1939. It was announced before July 1, 1999, and thus only affected individuals aged less than 60 years at that point in time.

[28] The Option Value model requires forecasts of expected wage earnings and expected income streams arising from being retired, respectively. These are calculated for all individuals until and including their 66^{th} year (and for PEP eligible including their actuarially adjusted life-long additional gains based on survival tables). Unobserved future earnings are projected using the last observable full-time wage of the individual. A real growth rate of 2% was added and a sensitivity analysis using 0% and 4%, respectively, has also been performed. Vice versa for pension benefits.

vocational and technical courses, while some positive wage effect is found for post-secondary courses. Given the identification strategy (see below) this only serves to underscore that we here identify an upper bound of the effect of training on postponing retirement.

The accumulated training is likely endogenous, and ideally we should therefore use an instrument (see below) for this key variable. The parameter estimate (λ) is expected to be negative without an instrument (as discussed below) and, provided training actually yields longer working lives, remain negative albeit smaller in absolute value if a valid instrument was available.

4.2 Identification

A standard identification problem arises since workers with the highest motivation and preference for working likely also have the highest motivation and preference for training. The "naive" parameter estimate for training from a binary model without applying an instrument or a selection model might therefore be expected to partly reflect selection on unobservables. Training is expected to prolong working life but those who undertake (a lot of) training are also expected to stay longer in the work-force, and as a result we do not identify an isolated effect from training. In addition, there may also be positive wage effects from training (empirically found among post-secondary trainees only, Kristensen and Skipper, 2009) which will also tend to make training participants stay longer on the labour market.

Note that while we cannot separately identify the effect of training on the probability of retirement, we can, under the right assumption, identify an *upper bound*, Manski and Pepper (2000). Assume persons with higher accumulated training have weakly lower probability of early retirement. In this case, the bias will unilaterally *increase* the value of the parameter estimate (the absolute value, i.e. the parameter estimate will likely become more negative than an unbiased estimate). In other words, the bias will in that case have a monotone impact on λ in Equation (3).

Is the effect here likely to adhere to this type of monotonicity? One argument against this monotonicity assumption would be if our course database

included a mix og training courses that are part of Active Labor Market Programs (ALMP) for unemployed combined with training courses for employees. The latter group are likely subject to positive self-selection whereas the former might accumulate training as an outcome of loose ties to the labor market and a legislation that coerces unemployed to participate in training activities. However, courses that are part of ALMP are not in our data and the monootonicity assumption appear quite reasonable. In addition, while we cannot observe a worker's entire labor market history, we can, however, control for her degree of unemployment (annually measured on a continous scale from zero to one) from 1980 and until 2003, and by doing this we may expect monotonicity to hold and the upper bound (in absolute value) to be identified.

If we were to find an insignificant or significantly positive effect of training accumulation on probability of early retirement, we would have a strong indication that our measure of formal life-long learning does not result in prolonged careers. Still, a significantly negative parameter estimate for λ could be a result of selection or (partly) identifying an effect from increased training accumulation on career spans.

An alternative identification strategy would be to instrument for accumulated training participation. However, no convincing and strong instrument appears plausible here, and the upper bound strategy is therefore preferred; in sync with the recommendation by Manski and Pepper (2000).

5 Results

In the retirement literature, it is well-documented that couples make joint retirement decisions, see e.g. An et al. (2004). This suggests that it would be advisable to either model joint decisions or, following Danø et al. (2005), focus on the retirement decision of singles only. However, as we can observe several spouse characteristics, we may be able to condition for enough covariates to render the joint-decision making less important to model.[29] This

[29] Modelling joint-decision making would complicate matters a lot so I choose to follow most retirement papers and model individual behavior, cf. Gruber and Wise (2004).

would have the advantage that we can work with many more observations, split the sample by groups of workers and still have large sub-samples. I therefore estimate the base model for all observations as well as for singles alone in order to compare the parameter estimates.

5.1 Baseline Results

Accumulated Training Parameters The key parameter estimates of this study adhere to the accumulated training covariates, cf. Table 5.

[Table 5 about here]

The probit model estimates yield the expected negative, significant, parameter estimates for Basic and Vocational training whereas the parameter estimates for Continuous Vocational training turn up positive and even significant (borderline-significant for singles). Post-secondary training is found completely insignificant. As discussed at length above, the significantly negative parameter estimates might reflect selection or they might reflect a causal effect, i.e. that Basic and Vocational training postpones retirement. The positive parameter estimate for Continuous Vocational training is disturbing - also for the interpretation of Vocational training since it is hard to conceive of a story where Vocational training and Continuous Vocational training (as defined by the data set here) should have opposite effects on the decision of early retirement. It therefore raises a flag of concern that, possibly, substitution bias is prevalent. We shall return to this issue below where we consider parameter estimates for selected sub-groups.

A comparison of parameter estimates based on the full sample (All) versus singles shows comparable results. As the full sample is 4.5 times larger than the sample of singles, the significance levels are higher for the full sample. As a concequence of this, and because the other covariate estimates also are largely comparable (cf. below), I subsequently choose to work on with couples as well as singles and divide the sample into relevant sub-groups.

Other Control Variables Parameter estimates of other control variables generally turn up with expected sign and size. In particular, the option value of postponing retirement has a negative parameter, i.e. the higher the gain from postponing retirement the less likely it is that a person retire early. I follow a recommendation made by Gruber and Wise (2004) and include a social security wealth control variable for the level of NPV of retirement benefits. The higher the level the more likely early retirement becomes, cf. Table 6.

[Table 6 about here]

Manager status is included among the control variables and is expected to reflect higher foregone earnings due to steeper wage profiles for managers. Indeed, the parameter estimate for manager is negative and significant thus corroborating this interpretation.

The model also includes controls for wealth, wealth interacted with single-status, and spouse's income. We should perhaps expect that high wealth would induce earlier retirement. However, no clear (linear) relationship appears. The covariates age of spouse and number of children (including a distinction between those living at home and the total number of children) have clear expected signs that are confirmed here: the older the spouse the more likely is early retirement and the more children the less likely is early retirement - especially if the children are still living at home.

The data permit us to include control variables for number and age composition of grandchildren. We would expect that the outside option of spending time with grandchildren would induce earlier retirement, and that possibly this effect would be strongest among females. This is largely also what we find. Interestingly, and quite intuitive, we find that 0-2-year-old grandchildren have a positive and statistically significant impact on female retirement but no significant effect on male retirement decisions. Older grandchildren have similar positive effects on males' and females' early re-

tirement decisions.

Among the other control variables, we may mention that females, public-sector workers and low educated workers have a higher probability of early retirement than males, private-sector workers and/or higher educated workers.[30] Likewise the indicator for manual work has a positive parameter estimate in line with the expectation that physical wear down will induce earlier retirement. Lastly, note that 60-year-olds are the most likely to retire early. There is also a small spike in early retirement around age 62, which among singles is statistically significant. Generally, the joint (all) and the single parameter estimates are of similar order of magnitude (marginal effects not shown) and of the same sign.

5.2 Extensions

In the following, I present results from probit model estimates conditional on subsamples and focus attention on parameter estimates for accumulated training. Parameter estimates for all other covariates are available upon request.

Selected Sub-groups Three groups were identified as possibly being more prone to undertake government co-sponsored training (and thus appear in the sample) and not undertake other forms of training to the same degree as other groups in the labor market, such as high educated private-sector employees. Substitution bias, and missing information in general, should therefore be of less concern among these three groups, skilled, unskilled and the public-sector worker sub-group.[31]

Re-estimating the model for these groups separately results in more credible and more intuitive results, cf. Table 7. In particular, the parameter estimates for Continuous Vocational training change from significantly positive (Table 5) to negative (albeit insignificant). Furthermore, the parameter

[30] Note that among singles the parameter estimate for "female" is very insignificant. This is somwhat surprising in the light of Danø et al. (2005) who find evidence of pronounced gender differences in early retirement decisions among singles in Denmark.

[31] Note that these groups were selected on a priori expectations about their training activities; they are in no way cherry-picked based on subsequent results.

estimates for Basic and Vocational training are higher (in absolute value). The parameter estimates for post-secondary training are very insignificant for the skilled and the public-sector group but is actually very significant and negative for unskilled.[32]

[Table 7 about here]

For the groups selected here, the MAR assumption is probably more likely, although unfortunately there is no way we can test this maintained hypothesis. Another important assumption is that of monotonicity, i.e. that across all individuals the effect of accumulated training bias the training parameter in the same direction. The main appeal against this assumption is, as noted above, that unemployed workers might participate in training involuntarily. In order to tentatively "test" whether this concern has any merit to it, I re-estimate the probit models for each of the three subgroups, cf. Table 8, but condition on the average unemployment degree and compare the results with the results reported in Table 7.

UE Degree When we condition the sample on individuals who, during the years 1980 to 2000, experienced less than 1.5 percent and less than 1 percent unemployment, respectively, we should further diminish potential problems with mixed selection, i.e. that most individuals who undertake training do so because they want to and because they expect to gain a lot from training (positive selection) while others enter training because they are forced or coerced by the legislation (negative selection). To the extent that we can limit the sample to the positive selection group, the argument of identifying the upper bound of the effects of training on retirement becomes more credible.

Indeed, the parameter estimates are generally somewhat higher (in absolute values), notably for basic and vocational training - the two most

[32] This should be interpreted with care since very few unskilled undertake post-secondary training. As a result, the parameter estimate is identified from very few observations.

significant set of estimates - when the sample only consists of individuals with less than 1.5 percent of accumulated unemployment; and slightly higher when we condition the sample further to individuals with less than 1 percent unemployment-accumulation, cf. Table 8.[33]

[Table 8 about here]

Few observations would remain if we were to condition on no unemployment ever, which in principle would be needed in order to identify the upper bound. However, whether we condition the sample on 1.5 or 1.0 percent makes very little difference. This is comforting and indicates that these estimates likely are close to the upper bound (at least to the extend that we can identify this by conditioning on UE levels).

Mergers and Acquisitions Following Bartel and Sicherman (1993), who analyze technological change and retirement decisions of older workers, we here seek to estimate how M&A may cause early retirement and particularly how accumulated training may insulate workers from the "shock" that M&A may be if they are followed up by organizational changes and new work practices. Adaptation to (large) organizational changes likely imposes a bigger challenge to older workers than younger workers, partly as an outcome of loosing more firm-specific knowledge due to longer tenure among older workers. In this vein, organizational changes function much like technology changes and may require workers to undertake more training, and notably older workers may decide the costs of doing so outweigh the benefits. Older workers who have accumulated relatively high levels of training earlier in their careers may be less prone to retire as a result of such organizational changes.

Empirically, I estimate probit models for the three selected sub-groups for 2001-2003 (so that we observe whether there was in fact a M&A), and

[33] Since the samples change slightly, the parameter estimates are not directly comparable. However, marginal values (not shown) reveal a similar pattern.

include an indicator for M&A (level) as well an indicator for each type of training interacted with the M&A indicator. The results generally do not support the "insulation-hypothesis" as all interaction effects except one are insignificant, cf. Table 9.

[Table 9 about here]

The M&A level indicator, however, does enter strongly significantly positive, i.e. M&A's make elderly workers retire sooner rather than later.[34]

Simulations Reduced form models do not allow for valid out-of-sample simulations since they are subject to the Lucas-critique. However, with this caveat in mind I nevertheless use the models estimated for the three subgroups and simulate how many days workers extend their careers as a result of one year of training. I only simulate for Basic and Vocational training as the effects here are the strongest and by far also the most significant. The parameter estimates I use are the (assumed) upper bounds presented in Table 8 (the lower panel where the sample is conditioned on workers with less than 1 percent average UE degree).

Table 10 shows the upper bound of the average treatment effect.

[Table 10 about here]

One year of Basic training yields 6-25 days longer careers on average while one year of Vocational training yields 24-40 days longer careers. In the following section, I interpret these results and discuss their implications.

6 Discussion and Implications

The simulation results indicate that training has a very limited effect on length of careers. Furthermore, since the effects are so modest there is little

[34] It could also be a firm decision to let go of elderly workers in relation to M&A's.

reason to be concerned about the lack of suitable instruments. The reason for this is that any bias in all likeliness is upward, and hence even though the effects simulated here are modest they may be yet even smaller.

One of the main arguments for promoting formal life-long training is that it will allow elderly workers to keep up with dynamic labor market requirements. The results presented here suggest either that training does not achieve this objective *or* that having the skills is not enough. For the type of training measured here the end result is meager in terms of extended work life.

We could also expect that M&A (and more broadly a flexible labor market) would be easier to "digest" if a lot of training was accumulated. Perhaps in particular if the training was general in nature as the Basic and Post-secondary training considered in this paper. Again, there is no indication that this is the case, and hence training does not appear to insulate workers from the "shock" following M&A's.

The very low direct effect of training on a prolonged working life can in itself not justify government spending on training. Still, the effect, however small, should be added to other potentially positive outcomes of training, notably increased productivity. In this light, the effect on extending careers may potentially have an important impact and perhaps even change conclusions in cost-benefit analyses.

The results found here indicate that there is a need for a whole palette of policy instruments in order to induce workers to stay longer in the labor market. Training may (or may not?) increase workers' productivity and enable them to stay longer, but without further initiatives it is not likely to have much effect on lengths of working lives.

7 Conclusion

Government co-sponsored training programs have been critized for being too costly and yielding low (sometimes even negative) returns, Heckman (2000). In this light, it is of interest to gain an understanding of whether there are "hidden" benefits in the form of prolonged working life - as human capital

theory suggests there should be. This could potentially not only change the conclusion of cost-benefit analyses but could also, and more importantly, give policy makers a tool to increase the workforce and uphold a balance between active and inactive parts of OECD populations.

The results in this paper show that workers do appear to behave rationally in the sense that those who undertake a lot of formal government co-sponsored training retire later. However, the results also show that formal life-long learning appears to have only a marginal impact (if any) in postponing retirement. This does not necessarily mean that government co-sponsored training is incapable of increasing elderly workers' productivity but it does suggest that, as a minimum, the tool box of policy makers has to include more than expanding government co-sponsored training programs.

A series of extensions to this study could be relevant. For instance, it would be interesting to analyze the effect of accumulated formal government co-sponsored training on the retirement age of workers who are not eligible to PEW or PEP. It may be that the economic incentive for early retirement is so strong that it decimates any effect from training. Along the same lines, although the effects of training on postponing retirement are found to be modest, they may be more substantial for specific groups in the labor market (e.g. specific industries) and for more narrowly defined types of training. A better understanding of this issue could be achieved by estimating a model that allow for mixed parameter estimates, such as a finite mixture with type-parameters for training parameters. A further look into the nature of M&A's could also be useful. Organizational changes that follow M&A's likely depend on a series of factors such as firm size and industry. If we were to identify expected and unexpected M&A's (e.g. from industry averages), we would perhaps find the expected results that fail to appear here.[35]

[35] The distinction between expected and unexpected changes might be important, as noted by Bartel and Sicherman (1993). Expected changes likely prolong working life because they attract certain individuals, while unexpected changes (shocks) lead to an immidiate depreciation of human capital that may induce retirement.

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Appendix B Model Validation

The in-sample fit of the estimated models is evaluated by comparing predicted and actual retirement rates. The results given in Table B1 below indicate an extremely good in-sample fit across all retirement ages and all three groups. The results are based on the most homogeneous sample where we condition on accumulated unemployment being below 1 percent. Possibly, the fit would be less good if it was estimated for broader parts of the sample or the entire sample.

Table B1 Predicted and Actual Age of Retirement, by Subgroup

Age of	Skilled		Unskilled		Public sector group	
retirement	actual	predict	actual	predict	actual	predict
60	8.51	8.48	19.50	19.36	20.90	20.33
61	4.46	4.44	7.56	7.54	12.25	12.02
62	17.63	17.74	23.35	23.42	24.13	23.94
63	13.78	13.96	17.02	17.16	20.91	20.73
64	10.30	10.38	10.09	10.08	15.43	15.21
65	9.74	9.94	12.28	12.49	15.51	14.61
66	9.07	9.14	6.94	7.32	15.42	15.46

Appendix C Tables and Figures

Table 1 Age of retirement, in percent

Age of retirement	Gender		Education						Sector		Total
	males	females	primary	high school	vocational	short college	long college	university	private	public	
60	27	39	37	31	33	29	29	17	31	35	33
61	15	18	17	14	16	15	17	11	15	16	16
62	22	19	20	20	22	19	19	17	23	19	21
63	15	11	12	13	13	15	13	14	14	12	13
64	8	5	6	7	6	8	7	11	6	6	6
65	6	3	4	6	4	5	6	12	5	4	5
66	4	2	2	6	3	3	4	10	3	3	3
67	4	3	3	4	3	4	3	9	3	4	3
Total	100	100	100	100	100	100	100	100	100	100	100

Table 2 Prevalence of Some Accumulated Training, in percent

	Basic	Vocational	Post-secondary	Some training
Education				
primary	15.4	53.1	1.4	60.1
high school	14.1	30.0	6.5	41.7
vocational/apprentice	17.9	51.7	1.8	60.1
college, low	20.3	49.2	5.7	60.8
college, high	18.7	23.7	37.5	63.4
master	9.3	14.0	8.0	26.7
Gender				
female	26.5	37.6	10.6	58.4
male	9.2	49.5	6.6	57.4
Cohort				
born 1936	11.4	27.9	5.9	39.4
born 1937	12.4	30.0	7.2	43.1
born 1938	13.0	33.7	6.8	46.2
born 1939	14.4	37.7	7.5	51.1
born 1940	15.4	42.7	7.3	55.8
born 1941	16.5	44.3	7.9	57.8
born 1942	16.9	46.0	8.5	59.8
born 1943	17.6	47.0	9.1	61.1
born 1944	18.4	48.8	9.1	62.8
Sector				
public	21.2	38.6	15.2	60.5
private	13.0	49.0	2.9	56.2
Industry				
agriculture	11.0	37.4	1.5	44.6
raw material	4.2	49.3	1.4	50.7
food, drink and tobacco	12.5	67.6	1.5	71.5
textile	15.3	40.9	1.6	49.4
wood	11.9	51.9	2.5	58.6
chemical	16.9	61.9	3.2	68.6
clay and glass	21.3	63.0	1.9	72.1
metal	13.2	67.2	2.1	71.5
furniture	13.2	59.0	1.4	63.9
energy	13.5	58.3	3.6	64.9
manufacturing	8.9	45.5	1.0	49.9
cars	9.6	36.3	1.2	42.5
engros trade	11.6	38.3	2.9	46.1
detail trade	16.8	38.8	2.2	49.0
hotel	16.0	34.8	2.2	44.9
transport	10.4	60.7	1.3	64.1
finance	13.7	50.3	5.6	58.3
home rental	12.1	44.0	2.9	51.7
business service	13.8	29.9	6.4	41.5
public adm	18.4	50.4	6.4	60.6
education	17.0	24.5	46.3	69.3
health	28.4	38.5	2.1	54.8
social inst	30.9	38.8	1.8	57.4
renovation etc	16.9	44.4	4.0	54.9
unknown	0.0	38.9	5.6	44.4
Total	16.6	43.9	9.1	58.1

Note: For year 2001.

Table 3 Mean Accumulated Training, by type of training, age of retirement and cohort

Basic

	Cohort								
Age of retirement	**1936**	**1937**	**1938**	**1939**	**1940**	**1941**	**1942**	**1943**	**1944**
60	--	--	--	--	--	--	580	609	689
61	--	--	--	--	--	576	540	651	--
62	--	--	--	--	506	482	575	--	--
63	--	--	--	537	481	475	--	--	--
64	--	--	428	476	531	--	--	--	--
65	--	388	409	423	--	--	--	--	--
66	394	377	485	--	--	--	--	--	--

Vocational

	Cohort								
Age of retirement	**1936**	**1937**	**1938**	**1939**	**1940**	**1941**	**1942**	**1943**	**1944**
60	--	--	--	--	--	--	77	100	130
61	--	--	--	--	--	73	101	128	--
62	--	--	--	--	91	96	120	--	--
63	--	--	--	88	98	120	--	--	--
64	--	--	65	86	104	--	--	--	--
65	--	66	79	86	--	--	--	--	--
66	55	64	109	--	--	--	--	--	--

Continuous Vocational

	Cohort								
Age of retirement	**1936**	**1937**	**1938**	**1939**	**1940**	**1941**	**1942**	**1943**	**1944**
60	--	--	--	--	--	--	423	440	513
61	--	--	--	--	--	370	455	471	--
62	--	--	--	--	400	486	496	--	--
63	--	--	--	344	416	428	--	--	--
64	--	--	289	318	375	--	--	--	--
65	--	282	280	340	--	--	--	--	--
66	188	225	264	--	--	--	--	--	--

Post-Secondary

	Cohort								
Age of retirement	**1936**	**1937**	**1938**	**1939**	**1940**	**1941**	**1942**	**1943**	**1944**
60	--	--	--	--	--	--	176	204	172
61	--	--	--	--	--	227	222	243	--
62	--	--	--	--	174	128	180	--	--
63	--	--	--	140	133	197	--	--	--
64	--	--	177	221	221	--	--	--	--
65	--	197	208	138	--	--	--	--	--
66	135	164	173	--	--	--	--	--	--

Notes: Censored observations denoted -- . 10,000 is equivalent to one year of full-time training.

Table 4 Means and Standard Deviations of Key Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Age	190,849	59.27	2.11	57	65
Female (0/1)	190,849	0.43	0.49	0	1
Public (0/1)	190,849	0.44	0.50	0	1
Manual work	190,849	0.04	0.19	0	1
Tenure	190,849	8.69	7.67	0	21
Education					
primary	190,849	0.29	0.45	0	1
high school	190,849	0.02	0.14	0	1
vocational/apprentice	190,849	0.40	0.49	0	1
college, low	190,849	0.04	0.20	0	1
college, high	190,849	0.16	0.37	0	1
master	190,849	0.06	0.24	0	1
Children and grandchildren					
number of children	190,849	1.93	1.05	0	14
number of grandchildren aged 0-2	190,849	0.49	0.74	0	9
number of grandchildren aged 3-6	190,849	0.58	0.86	0	13
number of grandchildren aged 7-17	190,849	0.73	1.22	0	15
Earnings and Wealth					
ln(income)	190,717	12.61	0.47	0.15	17.01
ln(earnings)	190,849	12.40	0.71	0.54	16.17
wealth(1996)	190,849	422,161	2,928,034	-155,000,000	590,000,000
Relative UE degree 1980-2000 (in %)	190,849	3.08	7.05	0.00	82.02
Organizational change (0/1)	190,849	0.18	0.38	0.00	1.00
Spouse related					
spouse' age	82,554	59.10	5.14	22	74
spouse income	82,554	248,832	211,328	-1,152,050	10,600,000
single	190,849	0.21	0.41	0	1
widow	190,849	0.06	0.23	0	1

Note: For year 2001.

Table 5 Probability of Early Retirement, Parameter Estimates for Accumulated Training

	All			Singles		
	Parameter Estimate		z-stat	Parameter Estimate		z-stat
basic	-0.128	**	-5.660	-0.095	*	-2.320
vocational	-0.359	**	-4.480	-0.265		-1.580
cont. vocational	0.202	**	4.830	0.166		1.940
post-secondary	0.028		0.770	0.041		0.560

Notes: Other control variables given in Table 6. ** significant at 1%; * significant at 5%.

Table 6 Probability of Early Retirement, Other Control Variables

	All			Singles		
	Parameter Estimate		z-stat	Parameter Estimate		z-stat
Demographic variables						
61 years (ref=60)	-0.539	**	-47.240	-0.471	**	-18.330
62 years	-0.030	**	-2.680	0.117	**	5.140
63 years	-0.229	**	-17.150	-0.056	*	-2.080
64 years	-0.489	**	-29.690	-0.330	**	-9.960
65 years	-0.431	**	-23.740	-0.226	**	-6.340
66 years	-0.815	**	-32.690	-0.661	**	-13.360
female	0.056	**	4.740	0.015		0.670
single	0.069	**	4.790			
Education (ref=primary)						
high school	-0.227	**	-7.250	-0.228	**	-3.780
vocational/trainee	-0.041	**	-4.660	-0.032		-1.650
college, short	-0.107	**	-5.550	-0.135	**	-3.140
college, long	-0.007		-0.550	-0.001		-0.030
university	-0.367	**	-18.690	-0.282	**	-6.900
Foregone earnings & outside options						
option value	-0.312	**	-82.430	-0.337	**	-40.890
log(NPV retirement benefits)	0.057	**	51.850	0.054	**	22.270
manager	-0.056	**	-2.930	-0.012		-0.220
Wealth (ref group: (0; 500,000))						
wealth (-inf; 0)	-0.062	**	-6.160	-0.092	**	-4.820
wealth [0]	-0.072	**	-2.930	-0.347	**	-3.790
wealth [500,000; 1,000,000)	0.006		0.550	0.011		0.460
wealth [1,000,000; inf)	-0.195	**	-11.790	-0.095	**	-3.110
single x wealth (-inf; 0)	-0.037		-1.730			
single x weatlh [0]	-0.288	**	-3.030			
single x wealth [500,000; 1,000,000)	0.021		0.820			
single x wealth [1,000,000; inf)	0.135	**	3.940			
Family related variables						
spouse's income (-inf; 0]	-0.115	**	-3.300			
spouse's income (200,000; 500,000]	-0.076	**	-7.570			
spouse's income (500,000; inf)	-0.251	**	-10.550			
spouse's age	0.004	**	3.450			
number of children living at home	-0.069	**	-15.660	-0.058	**	-6.450
number of children	-0.361	**	-7.280	-0.109		-0.460
number of children squared	0.070	**	3.080	0.016		0.110
number of grandchildren aged 0-2	0.001		0.110	-0.034		-1.480
number of grandchildren aged 3-6	0.015	**	2.530	0.022		1.170
number of grandchildren aged 7-17	0.056	**	14.160	0.069	**	5.970
female x number of grandchildren aged 0-2	0.031	**	3.080	0.046		1.710
female x number of grandchildren aged 3-6	0.001		0.170	-0.014		-0.630
female x number of grandchildren aged 7-17	-0.005		-0.930	-0.029	*	-2.200
Labor Market variables						
tenure (years)	0.007	**	15.270	0.009	**	9.110
relative ue degree 1980-2000 (%)	-0.003	**	-4.460	-0.007	**	-5.730
public sector (0/1)	0.209	**	18.380	0.203	**	8.380
manual work (0/1)	0.166	**	8.970	0.210	**	4.970
Other						
27 industry indicators		yes			yes	
13 regional indicators		yes			yes	
constant	1.791	**	10.160	2.294	**	4.710
Number of individuals		142,621			32,003	
Number of observations		327,063			72,863	

Note: ** significant at 1%; * significant at 5%.

Table 7 Probability of Early Retirement, Accumulated Training for Selected Sub-groups

	Skilled			Unskilled			Public-sector group		
	Parameter Estimate		z-stat	Parameter Estimate		z-stat	Parameter Estimate		z-stat
basic	-0.385	**	-2.720	-0.192	**	-3.070	-0.190	**	-2.930
vocational	-0.810	*	-1.970	-0.946	*	-2.470	-0.591		-1.680
continuous vocational	-0.047		-0.600	-0.114		-1.350	-0.417		-0.550
post-secondary	-0.248		-0.360	-2.561	**	-2.220	0.108		1.200
Number of individuals	13,999			23,878			11,416		
Number of observations	31,212			51,519			23,723		

Notes: Other control variables as in Table 6, left model (All). * significant at 1%, ** significant at 5%.

Table 8 Probability of Early Retirement, Conditional on Sub-groups and Low Levels of Unemployment

		Skilled			Unskilled			Public-sector group		
		Parameter Estimate		z-stat	Parameter Estimate		z-stat	Parameter Estimate		z-stat
1.5 percent	basic	-0.944	**	-4.130	-0.111		-1.300	-0.188	**	-2.570
	vocational	-0.913		-1.810	-1.155	*	-2.390	-0.627		-1.580
	continuous vocational	-0.112		-0.960	-0.071		-0.530	-1.214		-0.960
	post-secondary	-0.421		-0.490	-0.134		-0.120	0.128		1.310
	number of observations	21,708			32,062			21,358		
1 percent	basic	-1.026	**	-4.280	-0.102		-1.140	-0.192	**	-2.580
	vocational	-0.986		-1.870	-1.106	*	-2.210	-0.713		-1.770
	continuous vocational	-0.152		-1.260	-0.046		-0.330	-0.483		-0.380
	post-secondary	-0.404		-0.470	0.078		0.070	0.142		1.450
	number of observations	20,406			29,958			21,014		

Notes: Other control variables as in Table 6, left model (All). * significant at 1%, ** significant at 5%.

Table 9 Probability of Early Retirement, Interacting Training and Organizational Changes

	Skilled			Unskilled			Public-sector group		
	Parameter Estimate		z-stat	Parameter Estimate		z-stat	Parameter Estimate		z-stat
basic	-0.190		-0.980	-0.174	*	-2.140	-0.217	**	-2.730
vocational	-0.951		-1.590	-0.732		-1.500	-0.126		-0.300
continuous vocational	0.043		0.430	-0.015		-0.140	-0.196		-0.220
post-secondary	-1.306		-0.900	-1.360		-1.020	0.191		1.840
organizational change	0.163	**	3.920	0.169	**	5.230	0.082		1.470
Interaction effects									
organ.change x basic	-0.365		-0.950	-0.125		-0.700	0.266		1.440
organ.change x voc	0.811		0.720	-0.344		-0.280	-3.771	**	-2.380
organ.change x cont.voc	-0.274		-1.240	0.022		0.090	0.393		0.160
organ.change x post-sec	1.580		0.900	-1.022		-0.200	0.190		0.580
Number of observations	20,168			34,670			15,807		

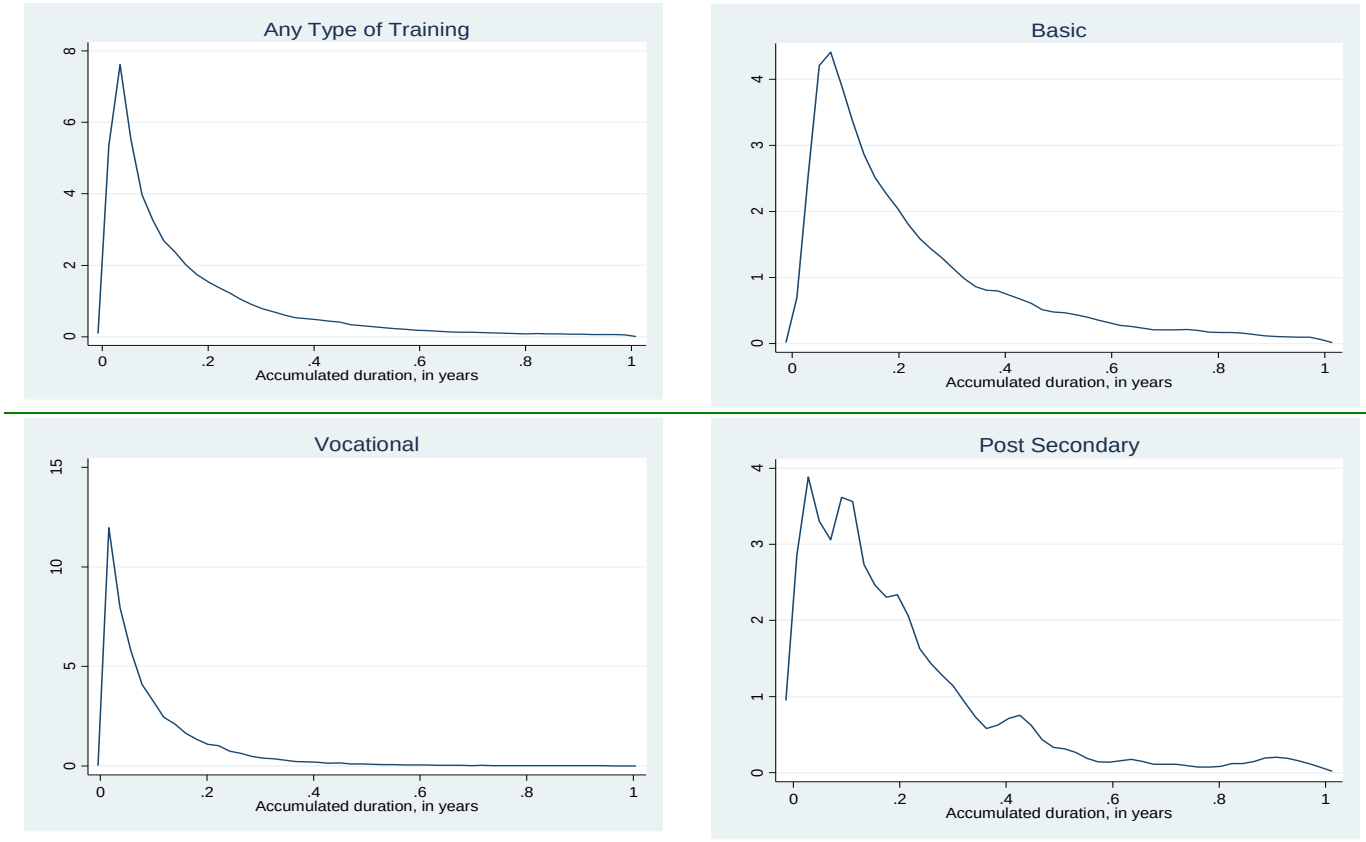
Note: Based on 2001-2003.

Table 10 Out of Sample Simulations: Number of Days Extra in Workforce from One Year Training, Upper Bound ATE

	Skilled	Unskilled	Public sector group
Basic	25	6	11
Vocational	24	40	32

Notes: I simulate the effects of one year training to all workers in each skill group. One type of training at a time. The simulations are based on the parameter estimates shown in the lower panel of Table 8.

Figure 1 Amount of Accumulated Training, in annual full-time equivalents



Note: The samples are conditional on individuals with a strictly positive level of training.