Can Adult Education Delay Retirement from the Labour Market?[1]

Xavier de Luna ♣

Anders Stenberg ♦

Olle Westerlund ♠

Abstract

Several studies have suggested that education is associated with later retirement from the labour market. In this paper, we examine whether adult education, involving enrolees aged 42 or above, delays retirement to potentially increase labour force participation among the elderly. With Swedish register data of transcripts from adult education and annual earnings, which encompasses 1979-2004 and 1982-2004 respectively, we exploit the fact that adult education is a large-scale phenomenon in Sweden and construct a measure of the timing of the transition from being self-supported by productive work to being supported by pension transfers. We match samples of treated and controls on the propensity score and use non-parametric estimation of survival rates. The results indicate that adult education has no effect on the timing of the retirement from the labour force. This can be contrasted with the fact that adult education is one of the cornerstones of the OECD strategy for "active ageing" and the European Union's "Lisbon strategy" for growth and jobs.

Keywords: Human capital, Pensions, Elderly, Adult schooling

JEL classification: H52, H55, H75, I28, J14, J26

[1] Financial support from The Swedish Research Council through the Ageing and Living Condition (ALC) program at Umeå University and The Bank of Sweden Tercentenary Foundation is gratefully acknowledged.
♣ Department of Statistics, Umeå University, SE-901 87 Umeå, Sweden, and IFAU, Uppsala, xavier.deluna@stat.umu.se
♦ SOFI, Stockholm University, SE-106 91 Stockholm, Sweden. anders.stenberg@sofi.su.se
♠ Department of Economics, Umeå University, SE-901 87 Umeå, Sweden, olle.westerlund@econ.umu.se

1 Introduction

The developed economies face increasing shares of their populations in retirement rather than productive work. To protect future individual and societal welfare, it may therefore be crucial to delay the average age of the transition from the labour force into retirement. To improve the incentives for this, governments in many countries have already issued changes in the pension systems. Besides such policies, OECD proposes measures within the concept of "active aging", e.g. measures to encourage retraining of older workers (OECD, 1998, 2001). The underlying view is that inadequate education, particularly among the low skilled, is an important reason for decisions to retire early as it increases the risk of becoming unemployed and decreases the chances of receiving job offers.

The purpose of this paper is to study whether adult education at the compulsory or upper secondary level (henceforth AE), which takes place at the age of 42 or later, affects the timing of the transition from productive work to a life financed by pensions. To our knowledge, this topic has not been addressed before, presumably since it requires very long time-series data on earnings and training. The analysis is based on Swedish register data of AE transcripts 1979-2004 and labour earnings 1982-2004. Sweden is a suitable country for our study as it is mandatory, since 1969, that municipalities offer education for adults at the compulsory and upper secondary level. Participation is free of charge and full-time students are eligible to apply for financial support amounting to about €780 per month (2004 value) where one third is a grant and the rest is a loan to be repaid under favourable conditions. In the 1980s, around 100,000 individuals were enrolled yearly. Although the numbers include those who were only enrolled in a single course, it can be compared to the about 300,000 adolescents enrolled in regular upper secondary school for youths. In an international comparison, the numbers in AE are thus high.

The standard human capital model implies that the returns to education decrease with age, thus questioning the rationale of policies promoting AE. However, extending the standard model to include e.g. changes regarding information, relative wages, preferences, health and/or borrowing constraints (Altonji, 1993, Iwahashi, 2004, Killingsworth, 1982, Monks, 1998, Sjögren and Sällström, 2004, Wallace and Ihnen, 1975, Weiss, 1971), it is possible that an optimal timing of investment in education occurs at a fairly late stage of the life cycle.

Another standard assumption of the human capital model is a fixed time for retirement. In reality, at the point of investment in education, the actual timing of retirement is unknown. Some workers leave the labour force before the officially stated age of retirement. This is

presumably more common among individuals endowed with skills that are obsolete or in decreasing demand, especially as technological changes have been claimed to work to the relative disadvantage of older workers (Aubert *et al*., 2006, Borghans and Weel, 2002). AE is a potential insurance against such a scenario as broadened and updated skills may increase the employability of individuals and, in a longer perspective, enhance the relative insensitivity to structural changes in labour demand. Empirical evidence suggests that high skilled older workers are less likely to leave full-time employment (Peracchi and Welch, 1994), are more closely attached to the labour market and less sensitive to labour market shocks (Blau, 1994). This may partly work through an apparent complementarity between on-the-job-training and formal education, observed among older workers by Schils and Fouarge (2007).[2] Another possible channel is that education is correlated with health. Kalwij and Vermeulen (2005) argue that health is an important part in explaining labour force participation among the elderly, while Lleras-Muney (2005) shows evidence of education having a causal effect on decreasing mortality. Concerning the influence of AE on earnings, several studies have found that the earnings returns of education among individuals aged above 40 are comparable to those of younger age groups (Jacobson et al., 2003, 2005, Stenberg and Westerlund, 2008 and Stenberg, 2008).[3]

In the present study, our contribution is to directly address the issue of whether AE prolongs the working career. The study thereby adds to the literature on labour supply among the elderly. Unlike earlier studies of the effect of AE on earnings, this paper analyzes the potential effects on labour supply up to and beyond the official retirement age. An extension of working life among the elderly may mitigate the negative economic and social impacts of ageing populations. Moreover, given labour market imperfections, increased labour force participation has beneficial effects on the economy at large, irrespective of the earnings effects, as it increases the competition for jobs and moderates labour supply shortages in times of economic booms. Our main finding is that AE has no effect on the timing of retirement from the labour market.

The paper is divided into four sections. The next section presents the data and the design of the study. The empirical method and results are given in Section 3, followed by a summary and discussion in Section 4.

[2] On-the-job-training typically involves high-skilled individuals (e.g. Brunello 2001, Arulampala *et al.* 2004). Bartel and Sicherman (1993) found that workers in industries with high rates of technological change retire later to recoup the returns to late investments in on-the-job-training, but also that a technological shock would induce workers to retire sooner as the costs of re-training become too high.

[3] These studies take into account that returns differ due to earnings prior to enrolment. Merely introducing an interaction variable between age and AE or comparing point estimates between samples of "young" and "old" renders mixed results (Albrecht et al., 2004, Ekström 2003, Light 1995, Monks 1997, Zhang and Palameta 2006).

2 Data and design of the study

The data used in this study originates from various registers of the Swedish population administered by Statistics Sweden. Yearly data on AE transcripts and labour earnings is available from 1979 and 1982, respectively, until 2004. The sample is conditioned to include individuals with a year of birth from 1931 to 1944 (aged 42 to 55 in 1986 and 60 to 73 in 2004), with eleven years of schooling or less. The restriction on prior education makes the sample members ineligible for tertiary education and excludes about one third of the population.[4] Further, we do not consider individuals enrolled in AE 1979-1985 or individuals with zero earnings in 1984 and 1985 (i.e. not active on the labour market).

The treatment group is defined as first-time AE enrolees in 1986 or later who by 1989 at the latest had been registered for at least 125 course credits, equal to half a semester of full-time studies. The control group consists of individuals who were not registered at all or who were registered in courses amounting to less than 125 course credits. The institutional setting for adult education in Sweden makes it plausible that participants are in the AE as a consequence of their own initiatives. Employees are entitled by law to be on (unpaid) leave to attend any kind of training and to be reinstated with the same working conditions and the same pay. There is a vast supply of AE, free of charge, as Swedish municipalities have a legal obligation to offer adult schooling at compulsory and upper secondary level. Moreover, participants are eligible for study allowances sufficient to cover modest living expenses.

Descriptive statistics of treated and control group members are presented in Table 1. The large number of individuals in the control group is an advantage, as it will ease the process of finding control group members who are comparable to those in the treatment group.

[4] Until the beginning of the 1960s, the schooling systems varied somewhat between municipalities but in essence, pupils attended seven or eight years of compulsory school. Pupils with better marks were selected to attend their seventh year at junior secondary school (*realskolan*) which was at least three years and a prerequisite for upper secondary school. Among those not selected, there was a second chance to enrol in junior secondary school at a later point in time.

Table 1: Sample means of treated and controls, males and females.

	Males		**Females**	
Born 1931-1944	AE	Controls	AE	Controls
N	1348	354529	4982	334647
Age in 1986	46.33	48.15	46.92	48.42
Child(ren) at home	1.272	1.080	1.244	.933
Less than 9 years of schooling	.373	.588	.280	.470
9-10 years of schooling	.142	.083	.115	.118
1 year of upper secondary school	.022	.009	.302	.127
2 years of upper secondary school	.464	.320	.302	.285
Earnings 1982 (SEK in 1000's)	75.7	79.5	45.4	49.2
Earnings 1985 (SEK in 1000's)	93.9	101.3	61.4	63.5
Foreign born	.162	.110	.107	.113
Unemployment benefits 1985 > 0	.116	.065	.098	.063
Stockholm county	.177	.150	.174	.159
Inland of Norrland	.060	.059	.064	.053
Regional employment	.835	.834	.835	.834
Born in 1944				
N	215	31362	647	26992
Age in 1986	42	42	42	42
Child(ren) at home	1.519	1.449	1.772	1.529
Less than compulsory school	.265	.468	.219	.347
Compulsory school	.181	.128	.122	.151
1-year upper secondary school	.019	.013	.309	.138
2-year upper secondary school	.535	.391	.349	.365
Earnings 1985 (SEK in 1000's)	90.7	103.5	57.6	64.0
Foreign born	.163	.100	.097	.099
Unemployment benefits 1985 > 0	.126	.070	.114	.069
Stockholm county	.195	.158	.170	.169
Inland of Norrland	.037	.055	.060	.048
Regional employment	.837	.834	.835	.835

The number of AE enrolees reveals that education late in life is predominantly a female phenomenon. We do not explore the mechanisms as to why this pattern arises but greater family commitments are likely to be correlated with a greater need and/or wish to go back to schooling when aged above 40. Importantly, those in AE are, on average, slightly younger, by 1.8 years (males) and by 1.5 years (females). We also note that the treated have a higher level of education, but lower average earnings prior to 1986. This somewhat unexpected pattern may indicate that the treated have been disproportionately hit by structural changes. They also received unemployment benefits more often during 1985, although the proportions receiving unemployment benefits in 1985 are only around 10 per cent.[5]

[5] The policy at the time was that in order not to generate perverse incentives, formal education was not offered as an active labour market program.

Regional labour market conditions potentially influence the effects of AE. Helpfully, the means of the regional employment rates are almost identical between treated and controls. We do not take migration into account when assessing the potential effects of AE since mobility may be an endogenous outcome of treatment.[6] The lower half of Table 1 contains the corresponding descriptive characteristics of individuals born in 1944, i.e. controlling for age. The differences in averages between treated and controls display patterns similar to the upper half.

Table 2 presents descriptive data on the actual AE undertaken by the treated. The average is 390 course credits for males and 458 course credits for females (500 corresponding to a schooling year). The proportion in AE who attended courses at the elementary level in the period 1986-1989 was 28 per cent among women and 50 per cent among men. Almost 60 per cent of the males attended at least one course labelled vocational. For females, the corresponding proportion is 36 per cent, but if one includes health related courses in the concept "vocational", the share is 83 per cent.

Table 2: Content of adult education.

	Males	Females
N	1348	4982
Total course credits	390.6	458.3
Compulsory level		
Proportion registered	.503	.280
Registered compulsory credits	175.7	94.3
Upper secondary level		
Proportion registered	.774	.871
Registered upper secondary credits	208.5	350.4
Frequency of upper secondary subjects		
English	.455	.278
Swedish	.372	.206
Mathematics	.389	.178
Social sciences	.398	.307
Natural sciences	.217	.120
Human sciences	.079	.057
Computer sciences	.056	.054
Health sciences	.044	.474
Vocational course	.584	.360

[6] Migration to another regional labour market is a very uncommon event in these age cohorts.

To define a transition from productive work to dependence on transfers related to retirement pensions of different forms (the outcome of interest in this study), our approach is to use a ratio, r_{it}, for individual i in year t, between pension transfers[7] p_{it} and annual labour earnings e_{it} which can be written explicitly as

$$r_{it} = \frac{p_{it}}{(e_{it} + 1)_{it}}.$$

Individuals are defined as active in the labour market as long as $r_{it} < 1$, meaning that the duration outcome is defined as the number of years an individual has labour earnings larger than or equal to pension transfers, starting from 1990. Durations may be censored due to e.g., death, migration abroad, or if enrolment in AE occurs. [8] The latter is only possible for individuals in the control group. For our purposes, it is important that an observation satisfying our definition of retirement ($r_{it} > 1$) is not followed by re-entries on the labour market ($r_{it} \leq 1$) in subsequent years. However, such events are rare and concern less than one per cent among the samples of treated and untreated.

Using the above definition, Figure 1 and Figure 2 describe separately for treated and controls the duration in the labour force through Kaplan-Meier survival functions, i.e. the proportion of individuals surviving at least up to time t. For both males and females, the survival rates are significantly higher for the treated. This descriptive data is not expected to reflect a causal effect of AE. In particular, the average age of the treated is slightly lower, something which may drive the differences in survival rates.[9]

[7] p_{it} is the sum of part-time pensions, retirement (old-age) pension, national supplementary pensions (ATP), early retirement pension, including sickness pension and various occupational pensions.
[8] Until 2004, the last year of observation, the proportion of censored individuals is below 4.5 per cent.
[9] The macroeconomic background made the probability of retirement higher during the economic downturn at the beginning of the 1990s, but note that the regime under which individuals retire is the same for the sample at different points in time.

Figure 1: Male labour market survival rates 1990-2004. Unmatched samples of treated and controls.

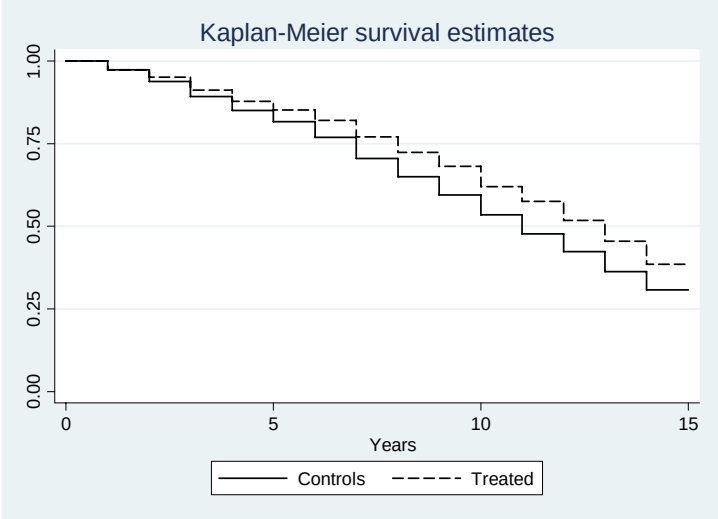


Figure 2: Female labour market survival rates 1990-2004. Unmatched samples of treated and controls.

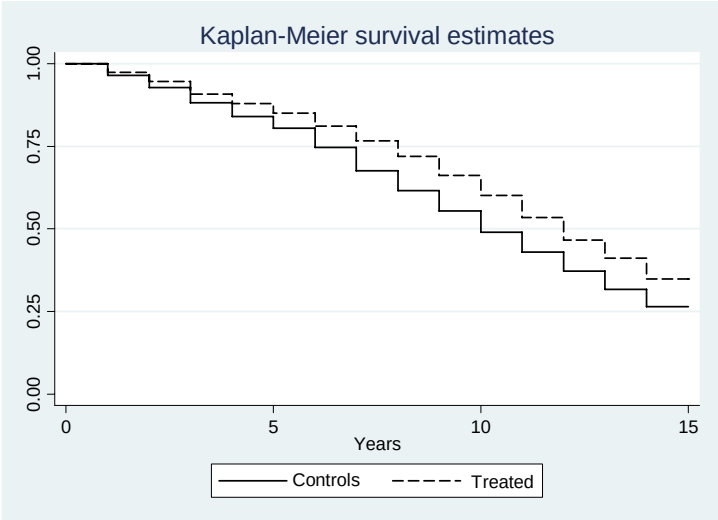


Table 3 presents the cohort-specific proportions still active on the labour market ($r_{it} < 1$) for treated and controls as recorded in 1997 (numbers in italics). As expected, the proportions who are "active" tend to decrease with age, in particular as the age of 65 is approaching. In most occupations, the official stated age of retirement is 65 but early retirement is generally allowed from the age of 60.[10] With our definition of r_{it}, more than 40 per cent of our sample is still active on the labour market in the year they turn 64 and thereafter, the percentages decrease to about 15 at the age of 65 and below 2 per cent at the age of 66. Among treated females, the proportions of active on the labour market are

[10] Among the population aged 55-64, labour force participation and employment rates are higher in Sweden than the OECD average. For the active population, Blöndahl and Scarpetta (1999) estimate the average age of transition to inactivity in 1995. For Sweden, it was found to be 63 for males and 62 for females (rounded figures). The corresponding figures for the US were 64 and 62 years of age and for Germany, the largest economy in Europe, 61 for males and 58 for females.

higher than in the control group. For males, the treated observations are somewhat scarce when separated into different cohorts, but a relatively stable pattern emerges that treated have lower proportions of active individuals compared with the control group, indicating that the higher survival rate of treated males, displayed in Figure 1, is driven by their lower average age.

Table 3: Proportions in 1997 still active on the labour market.

		Males			**Females**		
			Proportions with $r_{it} < 1$			Proportions with $r_{it} < 1$	
Born	Age in 1997	N_T / N_C	AE	Controls	N_T / N_C	AE	Controls
1940	57	116 / 25151	*.767*	*.798*	425 / 22536	*.798*	*.765*
1939	58	112 / 25796	*.741*	*.765*	387 / 23508	*.796*	*.729*
1938	59	92 / 24685	*.696*	*.737*	356 / 23436	*.778*	*.706*
1937	60	66 / 24160	*.591*	*.674*	335 / 23184	*.719*	*.656*
1936	61	66 / 23697	*.545*	*.585*	302 / 23195	*.702*	*.603*
1935	62	70 / 23395	*.629*	*.536*	220 / 22780	*.659*	*.554*
1934	63	53 / 22983	*.321*	*.462*	241 / 23096	*.668*	*.506*
1933	64	43 / 22710	*.442*	*.407*	209 / 23073	*.545*	*.454*
1932	65	36 / 23491	*.111*	*.136*	180 / 24502	*.150*	*.120*
1931	66	26 / 23700	*.000*	*.013*	173 / 24685	*.017*	*.011*

Note: N_T / N_C gives the number of individuals in the treated and the control group, respectively.

3 Empirical method and results

Model and method

We aim at estimating a causal effect of the treatment AE (as defined in Section 2) on the time to exit from the labour force, where we have defined exit as $r_{it} > 1$. For this purpose, we use the Rubin causal model (Rubin, 1974, Holland, 1986) and the matching estimators adapted for duration outcomes in Fredriksson and Johansson (2008) and de Luna and Johansson (2007).

For a given individual, let *T(1)* and *T(0)* denote her/his time to exit from the labour force when treated and not treated, respectively. One of these two potential outcomes will be missing because we either observe the outcome with or without treatment. We define the causal effect of interest as the difference in survival functions whether treated or not. Under a set of identifying assumption given below, the Kaplan-Meier estimator of the survival functions provides an unbiased estimate of this causal effect for the treated group

and a set of matched control group individuals.[11] We match on the propensity score (see Rosenbaum and Rubin, 1983, for a theoretical justification) as matching on all covariates may be difficult due to "the curse of dimensionality". The identifying assumptions are (see de Luna and Johansson, 2007, for a formal account):

(A) An individual's choice of AE does not affect the outcomes of other individuals.
(B) The propensity score, the probability of being treated given the covariates, is strictly positive and strictly smaller than one.
(C) Given the set of characteristics observed before enrolment in AE, the assignment mechanism is independent of the potential outcomes.
(D) Conditional on the covariates, the different censoring mechanisms are independent of the outcomes.

The propensity scores are estimated with probit models, only including explanatory variables with p-values of .2 or below as over-parameterization has been shown to increase the mean squared error and exacerbate the support problem (Caliendo and Kopeinig, 2005, Waernbaum 2008). This rule-of-thumb is circumvented if covariates were necessary for balancing observable characteristics between treated and controls.[12] We use nearest neighbour matching with four control group observations on common support for each participant in AE. According to the balancing tests, the matched samples are comparable: the equality of the mean values can not be rejected for any of the covariates.

The identification strategy adopted is based on the assumption of selection on observable characteristics (Assumption C). The validity of this assumption in our context is made plausible due to the availability of longitudinal records of pre-treatment income and unemployment. These records are expected to catch systematic differences in individual productivity, ability and motivation before entering AE, which are major confounding factors (Glazerman 2003, Heckman et al., 1999, Smith and Todd, 2005). Moreover, the administrative registers allow us to control for other important individual and regional characteristics, many of which do show signs of being potential confounders. As will be shown in the next section, the unconditional positive effect of Figure 1-2, coinciding with the theoretically expected positive effects of AE, translate into AE having no effect when matching on observable covariates.

[11] As mentioned in Section 2, censoring is associated with death, migration abroad and, for controls also with enrolment in AE.
[12] The balancing tests concern all covariates, including 14 year-of-birth-dummies, also interacted with earnings in 1985 and earnings squared in 1985. Other variables are the earnings difference between 1985 and 1982, the same earnings difference squared, the level of regional employment, a dummy indicating unemployment benefits were above zero in 1985 and a variable giving the amount of unemployment benefits received. Further, dummies for educational levels, foreign born, Nordic or non-Nordic country of origin, regional residence in Stockholm, inland of Norrland and for one to five (or more) children living at home.

Results

Figures 3 and 4 display the Kaplan-Meier estimates of post-adult education survival in the labour force for matched observations of males and females. The dashed lines indicate the estimated survival for participants in AE. Labour force participation is below 50 percent after thirteen years for males, while a similar level is reached about a year earlier for females. For males, the differences in point estimates between participants in AE and controls are small over the entire follow-up period. Point-wise 95% confidence intervals consistently overlap between treated and controls (Table A.1 in the Appendix lists the confidence intervals).[13]

Figure 3 Post-education survival in the labour force; Males, matched samples.

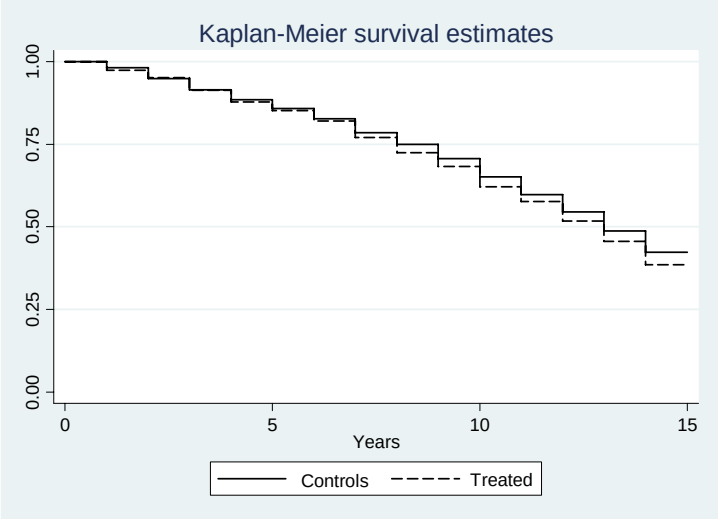
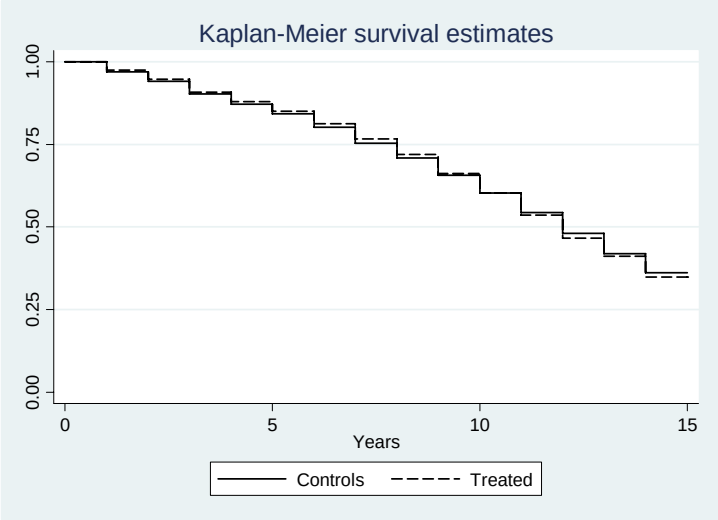


Figure 4 Post-education survival in the labour force; Females, matched samples.



[13] An estimator for the variance of the estimator is given in de Luna and Johansson (2007, Sec. 4.2), with which confidence intervals can be computed with a normal approximation.

For females, the estimated survival rates are marginally higher for participants in AE the first nine years after education and marginally lower thereafter. However, the difference in point estimates of survival rates only ranges between .5 up to one percentage point. Again, the 95-percent confidence intervals around the point estimates do not indicate any significant differences between participants and non-participants (see Table A.1 in the Appendix).

We can note that the substantial differences in survival rates indicated by the raw sample means presented earlier in Section 2 (Figures 1 and 2) do not apply when heterogeneity in observables is controlled for. To check the stability of these results, the procedure of matching on the propensity score was repeated with several selected sub-samples, separately for males and females, conditioning on the level of educational attainment prior to education; place of residence in Stockholm; year of birth in 1940-1944 and 1934-1939. Similar to the full sample results, the differences in point estimates of the survival rates are generally small and we find no indication of significant differences in the timing of the transition into retirement between the samples of treated and controls.

The results were also robust with respect to alternative definitions of the outcome variable. One may consider what constitutes permanent versus non-permanent transfers, in particular concerning unemployment insurance transfer payments. Most definitions of the labour force include employed and unemployed, which speaks in favour of adding unemployment benefits to the wage earnings, i.e. resulting in an overall increase of survival in the labour force according to our measure. This does not alter the general message of the results presented earlier – we find no indications of significantly different timing into retirement between treated and controls. Moreover, using a minimum of 250 credits as the definition of treatment yields nothing substantially different from what has been presented above. The same applies if the limit number of course credits is set to 500 (i.e. equal to a schooling year). To summarize, our analyses provide no sign of a positive effect of AE on the survival in the labour force.

Although it seems a reasonable hypothesis that additional investments in human capital, at later stages of working life, would influence the retirement age, we do not find any such indications. One may speculate on possible explanations for our findings. It may be the case that we capture many individuals who merely "consumed" education, implying that the motives behind the enrolment decisions were not related to labour market outcomes. This argument is, however, at odds with the fact that the results are robust to rather large amounts of course credits. A different interpretation is that there is a positive earnings effect, as reported in Jacobson (2003), Stenberg and Westerlund (2008) and

Stenberg (2008), but that it also generates an income effect which makes individuals retire early, potentially counterbalancing a positive effect on labour supply.

4 Summary and discussion

This paper has analysed whether adult education of prime-aged individuals at the compulsory or upper secondary level (AE) can be used as a policy measure to increase labour force participation during the later stages of working life. To answer such a question, it is important to have long time-series of data on AE and earnings. We use unique panel data on AE transcripts and annual earnings which encompasses 1979-2004 and 1982-2004, respectively. We further exploit the fact that, by international standards, AE has been exceptionally large in Sweden.

The empirical analysis is based on a sample of individuals aged 42-55, with short educations, who enrolled in AE during the period 1986-1989. Using a control group of non-participants, and considering censoring from this group into future participation in AE, potential effects on duration in the labour force are examined up to and beyond the officially stated age of retirement. Our findings indicate that AE had no positive effect on survival in the labour force. The results are robust with respect to alternative definitions of the outcome variable, definitions of treatment, and are also unchanged if we study subsamples conditioned on year of birth, prior-to-enrolment educational level or Stockholm residents. However, the timing of enrolment in our sample, 1986-1989, coincides with a strong economic expansion period with low levels of unemployment. Therefore, we would not necessarily expect our results to generalize to all phases of a business cycle as different macroeconomic conditions may attract different groups of participants.

Retraining of the older workforce is presumed to extend working life and is a cornerstone of both the European Union's so-called "Lisbon strategy" for growth and jobs and the OECD campaign for "active ageing". The results in this study indicate no effects on the timing of the transition from labour force participation into retirement, thus weakening the economic rationale for AE in this case. Proponents of AE for older workers would, according to our findings, have to argue on the basis of potentially positive effects on productivity while in the labour force or provide motives related to non-monetary issues such as fairness, social equity, increased democracy and similar aspects often included in the officially stated goals for publicly financed AE.

References

Albrecht, J.W., van den Bergh, G. and Vroman, S.B. (2004). The knowledge lift: The Swedish adult education program that aimed to eliminate low worker skill levels, *IFAU Working Paper* 2004:17, Institute of Labour Market Policy Evaluation, Uppsala.

Altonji, J. (1993). The Demand for and Return to Education When Education Outcomes are Uncertain. *Journal of Labor Economics* 11(1) 48-83.

Arulampalam, W., Booth, L. A., Bryan, M. .A. (2004) 'Training in Europe', *Journal of the European Economic Association*, vol 2, no 2-3, pp 346-60.

Aubert, P., Caroli, E. and Roger, M. (2006). New Technologies, Organisation and Age: Firm-Level Evidence. *The Economic Journal*, 116(509), 73-93.

Bartel, A.P. and Sicherman, N. (1993). Technological Change and Retirement Decisions of Older Workers. *Journal of Labor Economics* 11(1), 162-183.

Blau, D. (2005). Labour Force Dynamics of Older Men. *Econometrica* 62(1).

Blöndahl, S. and Scarpetta, S. (1999). The Retirement Decision in OECD-countries. OECD Working Papers No. 202.

Borghans, L. and Weel, B. (2002). Do Older Workers Have More Trouble Using a Computer Than Young Workers? *Research in Labour Economics* 21, 139-173.

Brunello, G. (2001) *On the Complementarity between Education and Training in Europe*, IZA Discussion Paper Nr 309, Bonn, IZA Institute for the Study of Labor.

Caliendo, M. and Kopeinig, S. (2005). Some Practical Guidance for the Implementation of Propensity Score Matching. IZA Working Paper 1588.

de Luna, X. and Johansson, P. (2007). Matching estimators for the effect of a treatment on survival times. IFAU Working paper 2007:1, Institute of Labour Market Policy Evaluation, Uppsala.

Ekström, E. (2003). *Essays on Inequality and Education*. Avhandlingsuppsats, Economic Studies 76, Uppsala Universitet.

Fredriksson, P. and Johansson, P. (2008). Dynamic Treatment Assignment -- The Consequences for Evaluations using Observational Data. Forthcoming in *Journal of Business and Economic and Statistics*.

Glazerman, S., Levy, D.M. and Myers, D. (2003). Nonexperimental versus Experimental Estimates of Earnings Impacts. *The Annals of the American Academy*, 63-93.

Heckman, J., LaLonde, R. and Smith, J. (1999). The Economics and Econometrics of Active Labor Market Programs. In Ashenfelter, O. and Card, D. (eds) *Handbook of Labor Economic*, Volume 3A, Ch. 31.

Holland, P.W. (1986). Statistics and Causal Inference. *Journal of the American Statistical Association* 81, 945-960.

Iwahashi, R. (2004). Getting the Lay of the Land: A New View to Education. *Mimeo, Kyoto University*.

Jacobson, L.S., LaLonde, R.J. and Sullivan, D.G. (2003). Can You Teach Old Dogs New Tricks? The Impact of Community College Retraining on Older Displaced Workers. Manuscript, University of Chicago.

Jacobson, L.S., LaLonde, R.J. and Sullivan, D.G. (2005). The Returns to Community College Schooling for Displaced Workers. *Journal of Econometrics*, 271-304.

Kalwij, A. and Vermeulen, F. (2005). Labour Force Participation of the Elderly in Europe: The Importance of Being Healthy. IZA discussion paper 1887.

Killingsworth, M. (1982). "Learning by Doing" and "Investment in Training": A Synthesis of Two "Rival" Models of the Life Cycle. *Review of Economic Studies*, 263-271.

Light, A. (1995). The Effects of Interrupted Schooling on Wages. *Journal of Human Resources* 30(3) 472-502.
Lleras-Muney, A. (2005). The Relationship Between Education and Adult Mortality in the United States. *Review of Economic Studies* 72, 189-221.
Monks, J. (1997). The Impact of College Timing on Earnings. *Economics of Education Review* 16(4), 419-423.
Monks, J. (1998) The effect of uncertain returns on human capital investment patterns, *Atlantic Economic Journal*, 26 (4), 413-419.
OECD (1998). *MaintainingProsperity in an Aging Society*. Paris: OECD.
OECD (2001). *Ageing and income: Financial resources and retirement in 9 OECD countries*. Paris.
Peracchi, F. and Welch, F. (1994). Trends in labor Force Transitions of Older Men and Women. *Journal of Labor Economics* 12(2).
Rosenbaum, P. and Rubin, D. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika* 70(1), 41-55.
Rubin, D. (1974). Estimating Causal Effects of Treatments in Randomized and Non-Randomized Studies. *Journal of Educational Psychology*, 688-701.
Schils, T. and Fourage, D. (2007). Participation in training and its effect on the decision to retire early. Seminar Paper at the Research Centre for Education and the Labour Market, Maastricht University.
Sjögren, A. and Sällström, S. (2002). Trapped, Delayed and Handicapped. CEPR, DP3335.
Smith, J. and P. Todd, 2005. Does matching overcome LaLonde's critique of non-experimental estimators? *Journal of Econometrics* 125, 305-353.
Stenberg, A. (2008). Upgrading Low Skilled Adults; is Public Provision of Formal Education a Sensible Policy? Mimeo, Institute for Social Research, Stockholm University, presented at EALE conference Amsterdam September 2008.
Stenberg, A. and Westerlund, O. (2008). Does Comprehensive Education Work for the Unemployed? *Labour Economics* 15(1), 54-67.
Waernbaum, I. (2008). *Covariate selection and propensity score specification in causal inference*. PhD Thesis, Statistical Studies 38. Department of Statistics, Umeå University.
Wallace, T.D. and Ihnen, L.A. (1975). Full-Time Schooling in Life-Cycle Models of Human Capital Accumulation. *Journal of Political Economy*, 83, 137-155.
Weiss, Y. (1971). Learning by Doing and Occupational Specialization. *Journal of Economic Theory* 3(2) 189-98.
Zhang, X. and Palameta, B. (2006). Participation in Adult Schooling and its Earnings Impact in Canada. Statistics Canada Research Paper, Business and Labour Market Analysis Division.

Appendix

Table A.1: Survival rate confidence intervals of AE participants and control group members.

	Males			**Females**		
		Survival rate, 95 % confidence intervals			Survival rate, 95 % confidence intervals	
Time	N_T / N_C	AE	Controls	N_T / N_C	AE	Controls
1990	1246 / 4936	.964 - .982	.977 - .985	4723 / 17309	.970 - .979	.967 - .972
1991	1208 / 4812	.938 - .962	.942 - .955	4591 / 16733	.940 - .953	.938 - .945
1992	1176 / 4625	.896 - .927	.906 - .922	4451 / 16201	.900 - .916	.899 - .908
1993	1120 / 4428	.859 - .896	.876 - .893	4253 / 15508	.870 - .889	.867 - .877
1994	1070 / 4258	.830 - .870	.848 - .868	4114/ 14932	.840 - .861	.837 - .848
1995	1030 / 4101	.798 - .840	.815 - .837	3960 / 14391	.800 - .823	.796 - .807
1996	986 / 3918	.746 - .794	.774 - .797	3763 / 13645	.755 - .779	.746 - .759
1997	923 / 3705	.698 - .748	.736 - .761	3540 / 12778	.707 - .732	.702 - .716
1998	859 / 3505	.655 - .707	.693 - .719	3307 / 11992	.648 - .675	.649 - .663
1999	802 / 3290	.593 - .648	.637 - .664	3022 / 11046	.588 - .616	.595 - .610
2000	726 / 2996	.548 - .604	.583 - .611	2737 / 10099	.521 - .550	.536 - .551
2001	668 / 2726	.490 - .546	.530 - .559	2425 / 9068	.452 - .481	.474 - .489
2002	597 / 2465	.427 - .483	.473 - .502	2103 / 7985	.397 - .426	.412 - .427
2003	523 / 2184	.357 - .413	.409 - .438	1844 / 6924	.335 - .363	.354 - .368
2004	440 / 1889	.357 - .413	.409 - .438	1553 / 5930	.335 - .363	.354 - .368

Note: N_T / N_C gives the number of individuals in the treated and the control group.