Evidence on the Impact of Adult Upper Secondary Education in Sweden

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Abstract

This paper evaluates the earnings impact of comprehensive adult upper secondary education in Sweden (AE). In contrast with earlier studies of AE which have treated it as a binary event, data on credits actually attained is explored to generate a direct measure of schooling. Difference-in-differences estimates are based on register data of the cohort born in 1970. For males enrolled in AE 1994-96, credits equal to one year of AE are found to increase annual earnings in 2002 by 10.6 per cent. However, evidence is mixed, at best, when applied on females and samples enrolled in 1997-99, regardless of gender. Further analyses suggest that the relatively short follow up period of the latter samples may conceal more affirmative results for males. Overall, the estimates demonstrate the importance of including information on credits and conflicting results from earlier studies are partly reconciled.

Keywords: Adult education, wage earnings

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1 Introduction

In the past two decades or so, trade and technological changes have given policy makers increasing impetus to raise the educational level of the workforce. The focus has primarily been on vocational training, or specific human capital, whereas comprehensive schooling for adults seems globally as scarce (e.g. OECD, 2004). Sweden is in this perspective an unusual country as upper secondary education for adults plays a large role in the educational system. It is free of charge, connected to significant study allowances and each municipality is required by law to supply the necessary courses and, from a research point of view, register data containing detailed records of AE are available. This is interesting, especially as the economics literature comprises very few evaluation studies of adult education which concern investments in general human capital. It is remarkable given that theory predicts general training to be less sensitive to structural changes than specific training and a typical finding in the literature is also that formal education is correlated with workplace training.

The basic question asked in this study is whether upper secondary education for adults (henceforth AE) has beneficial effects on annual earnings. For the first time, this is examined by estimating the returns on earnings of accomplished credits at upper secondary AE in Sweden. Measuring schooling directly makes it possible to discriminate between individuals with different amounts of schooling and to present estimates of the payoff to a year of full-time AE. The analyses are based on register data of the cohort born in 1970, the oldest cohort on which there is uninterrupted data available on credits earned, and concerns participants from 1994 when the curricula of AE became identical to that of regular upper secondary education for youths.

There are only a handful of empirical evaluations of the effects of AE in Sweden. One explanation is that the register data transcripts are relatively time consuming to arrange. Studies so far have therefore disregarded information on course credits or the level of the grades and treated AE as a binary state variable. This practice may partially explain why evaluations of AE have reported rather mixed results. Ekström (2003) studied a sample of participants enrolled in AE within the period 1988-1993 and OLS regression results on log annual earnings in 2000 implied a negative impact of AE for men, 6 per cent for those aged 43-55 and 3 per cent for men aged 25-42.

No effects were found for females. Albrecht et al. (2004) studied enrolees 1997-98 and reported no significant effects on earnings in 2000 while Stenberg and Westerlund (2007) focused on long-term unemployed, also in AE from 1997, and found a positive earnings effect by 2002 of 14 per cent for males and 23 per cent for females. As this study presents estimates which are proportional to the amount of AE, an also related literature concerns the returns to schooling for youths in Sweden which has been found to be in the region of 3.5 to 4.5 per cent (Isacsson 1999, Kjellström 1999, and Meghir and Palme, 2005). Of course, it is far from certain that education for adults render returns similar to regular youth education if e.g. AE is of insufficient quality (Heckman and LaFontaine 2006, and Boesel et al. 1998, both on the General Equivalency Diploma in the US), if adults experience more family- work and/or other commitments, if the returns to education decrease with age (Ekström 2003, Zhang and Palameta, 2006, Light 1995, Monks 1997) or if AE individuals tend to pursue education due to bleak employment prospects (Stenberg 2007, and Stenberg and Westerlund, 2007).

In an international perspective, estimates of the returns to a year of adult schooling are primarily found in evaluations of community college in the US and in Canada. Jacobson *et al.* (2005) studied a sample of displaced workers aged 20 to 59 in Washington State and found estimated effects of credits equal to a year of studies to be positive; 9 per cent for men and 13 per cent for women. Marcotte (2006) used a nationally representative sample and found more modest effects of around 5 per cent. On Canadian data, Zhang and Palameta (2006) reported an average earnings gain of 9 per cent for males aged 17-34 but insignificantly different from zero for males aged 35-59. The point estimates for females indicated a similar story but for females aged 17-34 the results were then only significant at a ten per cent level. Compared with AE in Sweden, community college is different as it offers mainly post-secondary education and a rich supply of vocational courses. In addition, the US and Canada have greater wage differences, less generous financial conditions for adult students and a wider dispersion in knowledge of reading, mathematics etc (OECD and Statistics Canada, 1995). All these factors should increase the expected payoff to adult schooling.

The contribution of this study is to present estimates of the returns to earnings of upper secondary AE in Sweden by using information on AE credits accomplished. It allows a more careful investigation of the underlying mechanisms between AE and

earnings which can not be detected with binary estimates, e.g. to estimate the proportional payoff to credits. An effort is also made to reconcile the earlier conflicting evidence of studies on AE in Sweden.

The report unfolds as follows. Section two provides a background describing the Swedish educational system while descriptive data is presented in section three. Section four contains empirical strategies and results. Section five concludes.

2 The Swedish educational system

In Sweden, compulsory school usually starts at age seven and encompasses nine years. It is followed by upper secondary school, which until 1996 was either for two or three years depending on program choice. Two-year upper secondary school programs consisted of some 15 relatively heterogeneous educations, mainly vocational and with strong gender patterns, e.g. construction, house-painting and electronics attracted males while nursing attracted females. Three-year upper secondary school, on the other hand, mostly involved theoretical studies in human science, social science, business administration, natural science or technical studies, this last also with an optional fourth year.

Eligibility to higher education is obtained by fulfilling a general admission requirement which is roughly equal to a three-year upper secondary diploma. Individuals at least 25 years old may also be admitted to higher studies if with a minimum of four years of work experience and passing grades in Swedish and English at a three year upper secondary level.

Komvux is foremost intended for individuals aged at least 20 but younger persons are accepted if seats are available. Individuals with compulsory school or a two-year upper secondary school naturally enrol at Komvux to improve their formal qualifications. It is also very common that persons with a three-year upper secondary education enrol to either slightly re-direct their education or study one or more subjects required for eligibility to university. From 1997 it also became allowed to study at komvux to improve grades, even if they were passed, to enhance the competitive position for admittance to studies at university. The majority at Komvux, 85-90 per cent, participate at upper secondary level. The remainder are compulsory level

courses or so-called supplementary courses (*påbyggnadsutbildning*) which are vocational and at post secondary level.

In the mid 1990s, an extraordinary expansion took place which made AE similar in size to regular upper secondary school for 16-18 year olds. It was largely a consequence of the economic recession that hit the Swedish labour market at the start of the 1990s when open unemployment rocketed from 1.7 per cent to 8.2 per cent in three years. From the autumn of 1993, the government supplied the municipalities with extra funds earmarked for financing extra seats at Komvux for the unemployed. From the autumn of 1997, when the so-called Adult Education Initiative (AEI, *Kunskapslyftet*) was introduced, these represented more than 50 per cent of the seats at Komvux. This policy was matched with enlarged access to study allowances for adults and with the AEI, individuals eligible for unemployment insurance (UI) were offered a year of full-time studies at Komvux with the special grant UBS, a financial scheme equal to a maintained level of UI. At the time, this represented 80 per cent of previous income and for the majority of the participants it meant very generous economic conditions for continuing studies. Almost 84 per cent of those with UBS were unemployed before enrolling in AE (SOU 1998:51).

3 Data and descriptive statistics

The register data of this study originate from several sources. *Komvuxdatabasen* provides data on adult education at Komvux and contains information on course credits, course subjects, interruptions and the grades attained. Data on individual characteristics, transfer payments and earnings are supplied by *Louise* (Longitudinal data on education, income and employment) and data on higher education is collected from The Register of Universities and University Colleges.

The population of the study consists of the full cohort born in 1970 with 2-year upper secondary school. Individuals are restricted to those residing in Sweden from 1988 and onwards (in total 50,681 individuals). To make the sample adequate for the analysis in the empirical section it is further adjusted as AE individuals are divided into three groups:

1) First and last registration at Komvux within the period 1994-96.
2) First and last registration at Komvux within the period 1997-99 without receiving the special grant for education and training UBS.

3) First and last registration at Komvux within the period 1997-99, receiving the special grant for education and training UBS.

The motivation for this set-up is that the first group has a substantial amount of time elapsed before outcomes are measured in 2002, while the separation between groups two and three is based on the thought that if there are heterogeneous effects of AE, UBS appears a quite distinct group which is relevant to study separately. Chiefly, one would expect their higher level of financial support while in AE to attract individuals with lower expected payoff to human capital.

Two features of the AE participants are worth noting. First, those who continued from AE to higher education are excluded at this stage (about one in four continue with higher education). A second aspect is that AE individuals who did not complete a single course with the grade pass are excluded. Both these conditions will be relaxed temporarily in the empirical section. Course credits are set to zero if the grade is missing, if course interruption is reported or if the grade is 'fail'. This is done to make the credits better correspond to some true human capital improvement. For each AE participant, course credits at upper secondary level are accumulated over the semesters. As a guideline, Skolverket (2000) suggests that 500 credits at Komvux correspond to a school year.[1] The fractions with zero credits are less than ten per cent in the samples with UBS but in samples 1) and 2) they represent one in three among males and one in four among females. These individuals interrupted between 35 and 55 per cent of their courses. The remainder either had grades not reported or the grade 'fail'.[2]

Figure 2 below presents an image of how the number of credits attained is distributed across individuals. Each column covers 50 credits. It is apparent that quite a number of individuals, about one fourth of the participants, complete less than 100 credits. At the other end of the scale, a large number of credits is necessary for those who re-direct their upper secondary level.

[1] Unfortunately, there are no records of formal attainments such as a completed three year upper secondary diploma.
[2] Statistics Sweden has since 1993 followed up missing grades for Maths, Swedish and English. Comparing the fractions with a passing grade with other subjects, these appear similar before and after 1993, suggesting that missing grades are primarily 'fail' or interruptions.

Figure 2: Distribution of the number of credits attained, all AE samples accumulated.

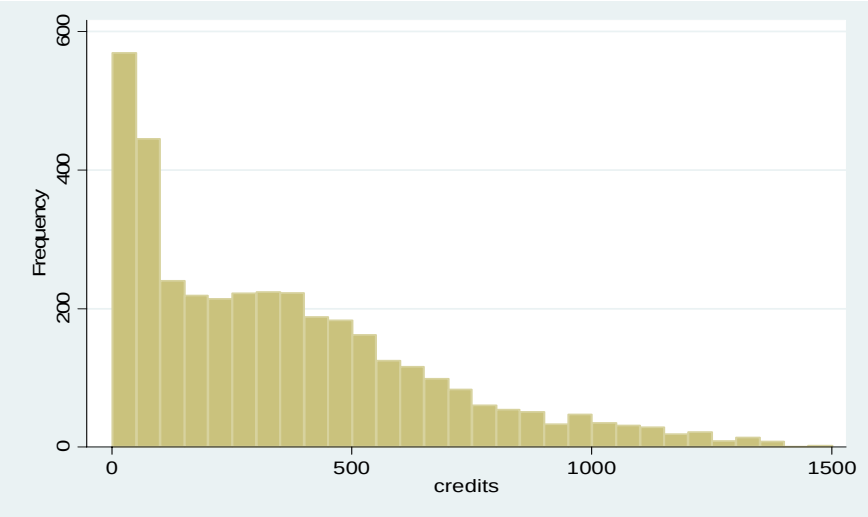


Table 1 below presents some descriptive data of the different samples and their respective control groups. There are a large number of curricula in AE, but categorising the subjects studied the most frequent are in social science, Swedish, English, mathematics and computer science which grew in popularity during the 1990s. This is a potentially important aspect as the labour demand in the IT-sector fell sharply from the start of 2000. The earnings levels are expressed in 2002 values and only include labour income. They are lower among AE individuals whether measured in 1993 or in 1996. Consistent with this observation is that the occurrence of receiving unemployment insurance benefits is 20 to 25 per cent higher among AE samples, except, naturally, for those with UBS who display a markedly higher fraction of UI recipients. The samples with UBS are also in general further from the control group in terms of observable characteristics than the other AE samples. Comparing the groups of AE participants, UBS individuals have lower earnings prior to enrolment and their completed course credits are at least twice as high, reflecting their weaker attachment to the labour market and more intensive AE studies. Note also that the parental leave benefits in Sweden are very generous in an international perspective, 80 per cent of the previous earnings level or minimum € 600 a month net of taxes. Parents are entitled to 13 months of benefits and most of this is used before the child is two years old.

Table 1: Descriptive statistics of AE sample and control groups. Column numbers represent: (1) in AE 1994-96, (2) in AE without UBS 1997-99, (3) in AE with UBS 1997-99, (4) control group.

	Males				Females			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
AE upp. secondary credits	223.7	204.3	478.1		281.2	262.9	531.8	
AE courses								
interrupted	.098	.049	.066		.065	.056	.060	
compulsory level	.039	.026	.050		.038	.041	.042	
supplementary level	.041	.043	.019		.043	.021	.012	
Pass in mathematics	.387	.244	.514		.327	.250	.493	
Pass in English	.355	.181	.528		.385	.248	.529	
Pass in Swedish	.310	.181	.478		.357	.296	.575	
Pass in social sciences	.558	.335	.676		.682	.499	.826	
Pass in computer sciences	.385	.603	.737		.420	.579	.713	
Pass in human sciences	.087	.033	.063		.102	.059	.092	
Pass in health sciences	.117	.070	.186		.236	.229	.340	
Pass in vocational course	.109	.124	.206		.045	.059	.119	
Foreign born	.027	.033	.034	.025	.035	.032	.031	.028
Annual earnings in 1993[a)]	100.7			119.7	85.5			95.2
Change 1993 – 1992 [a)]	- 16.8			- 9.1	- 14.5			- 11.9
Married 1993	.022			.031	.069			.104
No. of children 1993	.136			.184	.400			.457
Annual earnings in 1996 [a)]		151.1	105.7	164.0		95.9	78.3	103.2
Change 1996 – 1995 [a)]		7.9	.8	11.5		6.5	1.0	6.3
Married 1996		.063	.061	.095		.185	.206	.208
No. of children 1996		.222	.281	.395		.878	1.070	.881
Sample % with transfers:								
Sick-leave 1993	.213			.188	.279			.287
Parental leave 1993	.010			.006	.093			.051
Study allowance 1993	.020			.008	.030			.017
Unemp. benefit 1993	.548			.446	.480			.356
Sick-leave 1996		.105	.119	.087		.259	.244	.219
Parental leave 1996		.074	.073	.109		.420	.516	.425
Study allowance 1996		.018	.018	.005		.023	.005	.009
Unemp. benefit 1996		.325	.616	.253		.379	.573	.327
Regional statistics 1993:								
Municipal % of low skilled[b)]	.631			.651	.631			.642
Regional employment level	.738			.740	.739			.740
Regional statistics 1996:								
Municipal % of low skilled[b)]		.639	.649	.651		.641	.656	.642
Regional employment level		.785	.784	.786		.785	.785	.786
N	403	541	506	16.787	462	729	1.104	8.268

Note: [a)]Earnings are expressed in 2002 values, thousands of SEK.
[b)]Low skilled are defined with less than a 3-year upper secondary school as their highest attained education.

Figures 2 (males) and 3 (females) provide the earnings trajectories of the different samples of AE participants and their respective control groups. It is useful to keep in mind that the economic recession hit Sweden in 1990 and that there are years when average earnings actually decreased. As one would perhaps expect, the earnings

trajectories of individuals with UBS are below the others but it is noteworthy that the samples in AE, already at the start of the period, are linked to lower annual earnings vis-à-vis the control group. In the years that follow, the gap increases both for the 1994-96 samples and for those who later enrolled with UBS. The latter is related to unemployment rather than foregone earnings. In the second half of the period, males in AE 1994-96 display an earnings improvement which surpasses the control group and in 2002 there is a gap of about SEK 10,000 to the advantage of AE 1994-96. In turn, there is an equally wide gap downwards separating the control group with AE participants 1997-99. In the case of females, the trajectories instead tend to converge and there is less than SEK 3,000 (€ 350) between three of the groups in 2002 earnings. It is visible that the variation between the respective groups in 2002 is larger between the male samples, despite the fact that the vertical scale of Figure 2 covers a wider range.

Figure 2: Males earnings in 2002 values 1990-2002, AE samples and control group.

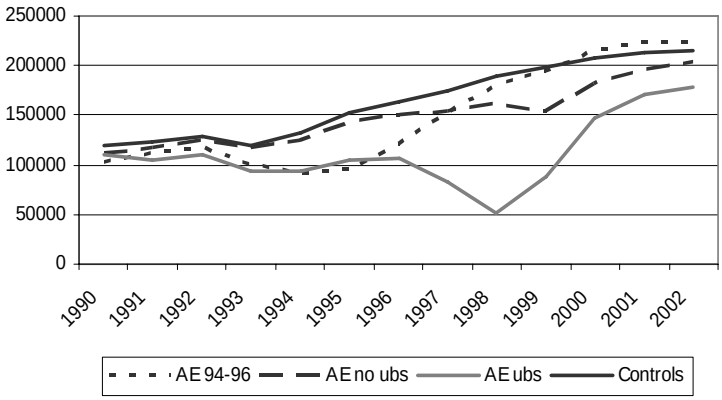
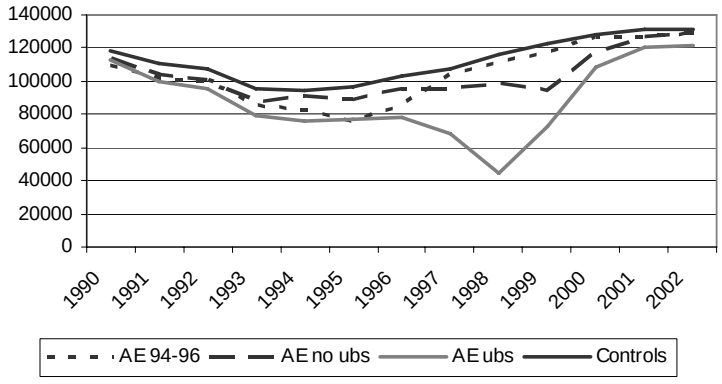


Figure 3: Female earnings in 2002 values 1990-2002, AE samples and control group.



4 Estimation methods and results

When evaluating (program) effects of education with non-experimental data, the biggest challenge constitutes sources of selection bias that may exaggerate or underestimate a true underlying effect. Productive individuals who possess some form of ability could on average get a higher payoff to AE and, if aware of this, they should be overrepresented among the participants and create an upward bias in estimations of the returns. Conversely, more able individuals could also be deterred from enrolment as they face higher opportunity costs in terms of foregone earnings. Concerning AE, an additional source of heterogeneous effects arises from the timing of enrolment. Two identical individuals who enrol in AE in different years may experience diverse payoffs due to macro-economic fluctuations. Also, it is an open question whether age *per se* or prior work experience plays a part in the payoff to AE.

Ideally for the researcher, enrolment in a program is independent of the outcome variable either through a social experiment or through some exogenous variable, uncorrelated with outcomes, which explains the enrolment decision. If none of these circumstances apply, stronger assumptions about the decision to enrol are necessary to identify causal effects. This increases the risk for biased estimates and no method exists that is without problems. Bias in non-experimental estimators of program effects has been studied by way of replicating experimentally derived results with non-experimental methods. Glazerman et al. (2003) surveyed the findings from twelve such studies and reported that the distribution of the bias in non-experimental estimators was centred around zero, but that policy-relevant divergences often arose. Opinions differed quite sharply between the authors of the twelve articles as to whether one should conclude that non-experimental estimators produce reliable estimates or not. However, a repeated finding was that bias is substantially reduced if one uses pre-program earnings to control for individual differences (see also Heckman et al., 1999, Smith and Todd, 2005). Therefore, the outcome variable analyzed in the following is based on the change in annual earnings as compared pre- and post-program. In addition, pre-program earnings are explored at several points in time to take into account that earnings dynamics may have differed between individuals already before AE participation.[3]

[3] Formally, if training occurs at time t, the change in earnings before-after is denoted Δ_{t+1} (= earnings_{t+1} – earnings_{t-1}) and the earnings change before enrolment Δ_{t-1} (= earnings_{t-1} – earnings_{t-2}). To put it simply, Δ_{t+1} is the outcome variable and Δ_{t-1} is among the explanatory variables.

To obtain the average treatment effect of the treated, propensity score matching (PSM) is an estimation method with some appealing features. The basic idea behind PSM is that AE individuals should be compared with control group members who, statistically, are as similar as possible. The estimation of the propensity score $P(X_i)$, where X_i denotes observable characteristics of individual i, will be equivalent to the estimation of $\Pr[D_i=1 \mid X_i]$ where $D_i=1$ denotes participation in AE and $D_i=0$ otherwise. The advantage of PSM is that it allows the researcher to consider heterogeneous program effects by attaching greater weights to the outcomes of control group members whose $P(X_i)$ are closely matched to participants in AE. In contrast, given the effects of AE differ between individuals; the coefficient estimate of an OLS regression does not reflect the average treatment effect on the treated (see Angrist 1998, Cobb-Clarke and Crossley, 2003). [4] However, standard PSM estimators are designed for binary variables such as D_i above, whereas the regression framework easily allows estimates of returns to credits. OLS regressions will therefore be used to assess the proportional effects of AE, but performed only following a PSM procedure in which each AE participant is matched to control group members with similar values of $P(X_i)$. The number of credits attained is included in the set of explanatory variables of the OLS regression, divided by 500 so that the coefficient pertaining to credits will express the estimated returns of a year of full-time studies in AE. As pointed out in Jacobson et al. (2005, p 279), the use of a continuous variable makes the effects of AE identified also from differences in the outcome of participants who obtain different numbers of credits. If one assumes the payoff to be proportional in the number of credits, it is not even necessary to include data on non-participants to generate an estimate of the yearly returns to AE, as the participants, in a manner of speaking, serve as their own group of reference, but the precision of the estimates improves when data on non-participants are included.

Before turning to the results, it may be instructive to point out that if the average number of credits is low, it is possible that the proportional estimate is positive but the binary is zero. If binary estimates are positive but proportional ones are insignificant, the variation in outcomes between participants is not sufficiently correlated with the number of credits. It could be a signal that some courses have not

[4] The OLS estimator is instead proportional to how often a value of X occurs and to the variation in the enrolment decision for this value, but the identifying assumption of both PSM and OLS is that AE enrolment is uncorrelated with future earnings changes.

had a positive effects on earnings. The same interpretation may apply if the proportional estimate is positive, but not the binary, when the average number of credits is high.

Table 2 presents results from estimates of the earnings effects of AE, including a descriptive estimate with no explanatory variables as a reference point. The last two columns contain PSM estimates which treat AE as a binary event and OLS regressions estimates based on the number of credits expressed in years of AE.[5] The point estimates of both approaches are presented in 2002 values of SEK. To ease the ensuing discussion, these are translated in the into percentage effects by setting them in relation to the mean earnings in 2002 of each sample of AE participants.

Males in AE 1994-96 are associated with a significantly positive PSM estimate which corresponds to 5.5 per cent. The coefficient pertaining to the proportional measure represents an earnings increase of 10.6 per cent which is considerably higher than the 3.5 – 4.5 per cent reported on the return to regular youth education in Sweden. Explanations to this include that returns to schooling typically concern hourly wages while the present estimates on annual earnings also include labour supply effects. In addition, the period under study coincide with an age span where one would expect rapid earnings increases. If differences develop between groups, these aspects could contribute to make them substantial.

The proportional estimate is about twice the average return reported with PSM. Since the mean number of credits attained in the sample is 225, it is perhaps expected that the point estimate of the proportional effect is higher. Of course, the proportional estimate also hinges on the degree of linearity between the outcome and the number of credits. Non-linearity may arise if AE participants, after completing only a few credits, interrupt their studies to accept a job-offer or, conversely, if difficulties in finding a job induces individuals to remain in AE and complete further course credits. Plotting the relation between outcome and credits (not displayed) indicates that both these phenomena are present. Nevertheless, the positive estimates

[5] There are more than 50 explanatory variables in the OLS estimations, including several measures of earnings changes prior to enrolment, regional characteristics and 20 regional dummies, indicator variables of the number of children and their age and levels and indicators of various transfers. The estimation of $P(X_i)$ must not be over-parameterised as it risks to increase variance and exacerbate the support problem. A trial and error procedure based on goodness-of-fit considerations only included variables with a *p*-value of .15 or less (see e.g. Caliendo and Kopeinig, 2005 for an excellent guidance to PSM).

remain by and large stable through a number of robustness checks (see Table A.1 in the Appendix). As a final note, if individuals who continued with higher education are included, the PSM estimate rises to 8.7 per cent (SEK 19,679, not displayed).[6]

Table 2. Estimates of the earnings effect of AE performed with difference-in-differences (DiD) propensity score matching and OLS regression.

		Males		
AE enrolees (av. earnings 2002)	[a] N^{TOT} / N^{AE}	Descriptive difference	[b] PSM – dummy	[c] OLS – credits/500
1994-96	17190 / 403	21,782***	12,360**	23,854***
(225,013)		(5,199)	(5,611)	(8,678)
1997-99 no UBS	17328 / 541	- 1,588	4,388	- 7,165
(204,831)		(4,265)	(4,016)	(6,777)
1997-99 with UBS	17293 / 506	7,827*	- 4,357	1,694
(179,055)		(4,424)	(4,831)	(5,044)
		Females		
AE enrolees (av. earnings 2002)	[a] N^{TOT} / N^{AE}	DiD – dummy	[b] PSM – dummy	[c] OLS – credits/500
1994-96	8730 / 462	4,481	- 1,701	6,622
(128,667)		(4,280)	(4,569)	(5,388)
1997-99 no UBS	8997 / 729	3,067	- 71	5,391
(128,761)		(3,436)	(3,205)	(4,112)
1997-99 with UBS	9372 /1104	9,067***	- 2,954	3,615*
(121,231)		(2,863)	(2,752)	(2,188)

Note: *** significant at the 1 % level. ** at the 5 % level. * at the 10 % level.

[a] N^{TOT} / N^{AE} report total numbers in control group and AE.

[b] Matching has been performed by using Stata9.0 and psmatch2 (Sianesi and Leuven, 2003) and estimates are based on the Epanechnikov kernel with bandwidth .02 and a common support restriction. Five percent of the AEI observations are deleted where the propensity score density of the control observations are the lowest. Bootstrap standard errors based on 100 replications in parentheses. Balancing tests confirm that mean values of variables used in the estimation of the propensity score are insignificantly different between AE and control group.

[c] Control group individuals are selected from a PSM procedure prior to estimation, and are reduced to approximately four times that of N^{AE}.

[6] However, a follow up on those with tertiary education is probably premature with 2002 earnings. Separate PSM estimates also involved difficulties finding comparable individuals in the control group, with large standard errors as a consequence.

To continue downwards in Table 2, males enrolled 1997-99, without UBS, are not associated with a positive earnings effect of AE. Given the results of the preceding sample, it is somewhat unexpected. One possibility is that the time horizon is too short for positive effects to shine through. Estimates where individuals in AE are only included from the first half of 1997-99, with completed AE before the autumn of 1998, reveals a positive proportional estimate of 18.7 per cent (see Table A.1 in the Appendix) while the PSM estimate remains insignificantly different from zero (average number of credits 147). This interpretation is supported in that the otherwise stable results for males 1994-96 also become insignificant when the follow up period is shortened to 1999. An alternative rationalization is the sharp fall in the IT-sector at the start of 2000, which made the number of vacancies in the private sector fall by some 50 per cent from 2000 to 2001 (but not visibly influence the overall level of unemployment). It may have had an adverse affect on the estimates as it decreased the probability of finding work in the first year post AE. [7]

Turning to the results which concern females, these are overall insignificant. A tempting intuitive explanation is here that the estimates are influenced by their traditionally larger responsibility for household work. In fact, the fractions receiving parental leave transfers in 2002 are consistently around 45 per cent in every female sample (including control groups), but the estimates remain insignificant if these are excluded. On the other hand, when the samples are restricted to the Stockholm commuting area, the proportional measure of AE 1994-96 is linked to a significantly positive coefficient corresponding to 19.4 per cent, indicating that a relatively differentiated labour market is important for the effects of AE. This is not altogether unexpected as the estimates in Table 2 are averages which quite naturally may hide heterogeneous effects. The insignificant estimates are otherwise stable to a number of alternative set ups, e.g. to the exclusion of AE participants in the second half of the 1997-99 samples or, for females in AE 1994-96, to the inclusion of those who continued from AE to higher education (see Table A.1 in the Appendix).

Individuals enrolled with UBS are not linked to any significant effects, this holds for both males and females, and implies that individuals with UBS have a lower pay off to human capital investments. The robustness checks in Table A.1 confirm this

[7] Men aged 25-34 comprised more than one out of four employed in the IT-sector. In addition, the fractions with a passing grade in computer science increased gradually during the 1990s from 38 per cent among AE 1994-96 to 74 per cent of those in AE 1998-99.

observation except for males when enrolees in the last three semesters of 1997-99 are excluded, PSM estimate of 10.0 per cent and proportional estimate of 9.0 per cent, and in the case of women in the Stockholm commuting area where the proportional estimate represents a 9.8 per cent earnings boost.[8] It is worth noting that among enrolees 1997-99, the average number of credits is twice as high among UBS individuals. This is expected as their AE participation was associated with relatively low opportunity costs in that a) UBS was relatively generous financial scheme b) AE participants with UBS qualified for a new period with 300 days of unemployment insurance benefits and c) UBS individuals more frequently enrolled from unemployment and had weaker prospects of finding employment. Both Stenberg (2007) and Stenberg and Westerlund (2007) found similar signs of locking-in effects.

The estimates reported above are difficult to compare with the earlier studies on AE in Sweden. The samples here are based on a specific cohort and a given educational level prior to enrolment while previous research has used data on the age span 25-55 with no educational level constraints. Albrecht et al. (2004) found no earnings effects of AE for enrolees in 1997-98 and the results presented here have contradicted their findings for males both with and without UBS. However, to make the set up more alike, the follow-up period is shortened to 2000, AE participants with zero credits are included and males with and without UBS are pooled. The resulting PSM estimate is then insignificant while the proportional estimate corresponds to a 6.1 per cent earnings impact, significant at a ten per cent level. Ekström (2003) found negative effects of AE on the log of annual earnings in 2000 for males and no effects for females. Taking the log value excludes zero earners and setting this condition for earnings in 2002, the PSM estimates for males 1997-99 become significantly negative, in both the samples with and without UBS (5.2 and 4.1 per cent respectively). However, Ekström's estimates were based on AE participants 1988-93, so the period post-AE was longer, and included individuals with zero credits and those still in higher education. Extending the sample of males in AE 1994-96 in similar fashion, the estimates become insignificant. Female estimates are, as before, insignificantly different from zero throughout.

[8] Supporting the view that, respectively, the differentiation of the labour market and the short time horizon (or temporary decline of the IT-sector) are of importance for the estimates.

One may wonder how the estimated returns should be understood in relation to the costs incurred. The Swedish National Agency for Education report that the costs per year of a full-time AE participant are SEK 37,500, including study allowances and administrative costs at government and municipal level. The sample of this study occupied in total about 3,400 full year seats of AE (4,853 individuals). Their foregone earnings varied strongly between samples but estimates land on average at SEK 50,400 a year. The individuals assumed to compensate the society are limited to those with at least one credit in AE (3,745 individuals). These accomplish on average slightly below ¾ of a year of full time studies. With a three per cent discount rate and, say, a five per cent proportional return on AE credits, the costs are covered after 16 years. The return is calculated in relation to the average earnings of these individuals in 2002, SEK 155,000, and the rise in productivity includes payroll taxes (around 40 per cent), but disregards spill-over effects of AE in terms of productivity and democratic values. Of course, these back-of-the-envelope calculations can be questioned on several grounds. One aspect is that even if these approximations were correct, covering the costs does not necessarily justify the investments made as other investments may be more efficient or the presence of heterogeneous effects could imply that certain regions or groups of individuals should be given a higher priority.

5 Concluding discussion

This study analyzes the earnings impact of upper secondary adult education (AE) in Sweden by exploring information on credits attained as a measure of schooling. Difference-in-differences estimates are generated both treating AE as a binary state variable and assuming a proportional payoff to AE. The results indicate AE credits attained 1994-96 have a positive effect on male earnings in 2002. The binary estimate is 5.5 per cent and the proportional 10.6 per cent. These positive estimates are not reproduced with the male sample in AE 1997-99. When participants in AE are limited to the first half of that period, 1997-98, the estimates tend to be significant, possibly indicating that the time-frame of the evaluation is too short when including enrollees in 1999. This is a potentially important issue if the focus on vocational training has emerged from its short term effects. In a longer perspective, theory predicts general training to compare more favorably with specific training as it should be less sensitive to structural changes and is regarded as a complement to on-the-job-training.

Female estimates are generally insignificant but the samples comprise fractions on parental leave benefits which vary around 45 per cent. Still, the insignificant estimates remain if these individuals are excluded. When the samples instead are restricted to the Stockholm commuting area, the proportional estimates are significantly positive for those in AE 1994-96 and females with UBS.

It is probably fair to say that the implications drawn from this study partly depend on the reader. However, without unreasonable interpretations, the mixed results obtained so far suggest that AE warrants further research. AE is a potentially powerful tool to provide re-schooling to individuals who no longer feel attached to their schooling choice made at a young age. One expressed concern has involved boys who perform weakly in school, which in turn has consequences for their working careers ("the boy problem"). In similar fashion, AE could assist females who wish to leave household work and (re-)enter the labour market. Research on the effects of AE could make important progress if data covered a longer time-period and/or if larger samples allowed us to discern patterns in the effects which originate from different subjects studied. Also, there is still no study with a more compelling identification strategy than difference-in-differences. In fact, the present study arguably offers the most vigorous estimates so far of the impact on earnings of AE in Sweden or Europe.

Appendix:

Table A.1. Robustness checks using various alternative sample definitions.

	AE participants					
		Males			Females	
Sample restrictions:	1994-96	1997-99 no UBS	1997-99 with UBS	1994-96	1997-99 no UBS	1997-99 with UBS
Stockholm area						
PSM	26,455*	-5,650	14,237	8,437	-3,017	5,051
Proportional	58,476***	4,665	4,427	29,214**	4,969	14,437**
1993/1996 earnings = 0						
PSM	31,833**	- 9,438	- 14,872	18,040	- 9,379	10,372
Proportional	57,702***	3,701	18,909	6,349	642	7,113
1993/96 earnings > 80000						
PSM	15,674**	- 2,478	- 11,649*	- 9,671	- 1,181	- 12,915**
Proportional	18,290	- 12,602	- 8,718	3,186	1,042	1,830
Earnings in 2000>0						
PSM	11,151**	- 8,958**	- 10,212**	- 38	- 2,382	- 2,856
Proportional	18,839**	- 10,909*	- 5,465	6,621	762	3,354
Computer science						
PSM	24,039**	- 3,405	- 2,414	- 150	4,193	892
Proportional	31,498***	- 3,863	3,596	5,086	1,184	4,139*
AE with zero credits						
PSM	7,483	- 3,606	- 4,912	- 2,674	95	- 4,219
Proportional	26,606***	- 5,215	- 704	5,103	5,321	3,585*
Parental leave 2000 = 0						
PSM				8,894	1,833	- 3,304
Proportional				4,442	431	3,172
AE only in 1997-98						
PSM		13,375*	19,185**		- 487	- 340
Proportional		42,707***	17,328*		871	1,393

Note I: *** significant at the 1 % level. ** at the 5 % level. * at the 10 % level.

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