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EVIDENCE ON THE IMPACT OF ADULT UPPER SECONDARY EDUCATION IN SWEDEN

by

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Evidence on the Impact of Adult Upper Secondary Education in Sweden

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Abstract

This study is the first to explore the earnings effects of credits attained in adult education at upper secondary level (AE) in Sweden. It is also investigated whether individuals with and without AE prior to enrolment in higher studies differ in their achievements at university and/or in their subsequent earnings. The analyses are based on register data of the cohort born in 1970 of which more than one third at some point has been registered in AE. In the preferred specification, credits equal to one year of AE are found to increase annual wage earnings by 4.1 per cent for males and 3.6 per cent for females. The results are mainly driven by course credits with an element of specific knowledge such as health related subjects and computer science, while more general subjects such as Mathematics, Swedish or English are linked with zero returns. Concerning higher education, the results indicate a lower payoff for AE individuals if higher studies are limited to less than two years. There is also evidence of a lower probability of completing four years of higher studies, in particular among females.

Keywords: Adult education, wage earnings

JEL classification: J68, H52

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1 Introduction

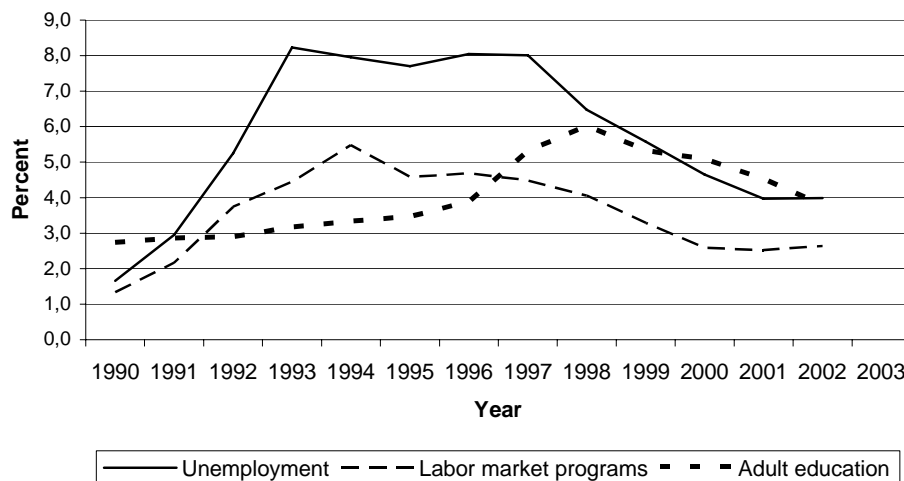
In the past two decades or so, it has almost become a truism that trade and technological changes give policy makers impetus to raise the educational level of the workforce. In this context, lifelong learning has emerged as a popular notion, not least as a potentially powerful tool to enhance the employability and productivity of the low skilled. However, despite this discourse in political as well as academic circles, and despite the fact that the numbers indicate that even in countries like the UK and France, the shares with a completed upper secondary school are markedly lower compared with several East European countries, the US or the Nordic countries (OECD, 2006), evaluation studies of lifelong learning, or adult education, concerning investments in general human capital are surprisingly few in the economics literature. This may reflect that such classroom training for adults is globally sparse and instead mostly involves vocational training, or specific human capital. In that case, Sweden is an exception as it is probably the country in the world where upper secondary education for adults (henceforth AE) has the largest role to play in the educational system. Since 1969, each municipality in Sweden has been required by law to offer compulsory and upper secondary education to adults. Municipal institutes known as *Komvux* became responsible for providing the service, and the number enrolled was instantly in the region of 100,000 per year. This figure remained relatively stable until the mid 1990s when an extraordinary expansion took place. In 1999, around 300,000 individuals were enrolled in AE, making it similar in size to regular upper secondary school for 16-18 year olds.

This study examines the returns on annual wage earnings of a year of upper secondary credits accomplished at *Komvux*. It is also investigated if individuals with and without AE prior to enrolment in higher studies differ in their achievements in higher education and/or in their subsequent annual wage earnings. None of the above issues have previously been subject to a systematic analysis. From a perspective of lifelong learning, *Komvux* constitutes a highly interesting policy tool in view of its large scale and in that it essentially offers general education. The analyses are based on register data of the cohort born in 1970, of which more than one third was registered in AE (until

2001). The cohort turned 18 in 1988, the year from which uninterrupted data is available on credits earned at Komvux.

The increase in AE in Sweden in the 1990s was largely a consequence of the economic recession that hit the Swedish labour market. Figure 1 illustrates how open unemployment more than quadrupled between 1990 and 1993. During these years, the fraction of the labour force registered in active labour market programs rose while there were only small changes in the participation rate at Komvux.

Figure 1. Percentages of the total labour force in unemployment, labour market programs and adult education in Sweden 1990 – 2002.



Note: ‘Adult education’ denotes the number of individuals enrolled in at least one course during a calendar year. This includes a large fraction attending only short courses. Unemployment and labour market programs are measured as yearly averages.

From the autumn of 1993, the government supplied the municipalities with extra funds earmarked for financing extra seats at Komvux for the unemployed. These represented around 20 per cent of the seats at Komvux in 1994 and in 1996 around 30 per cent. From the autumn of 1997, when the so-called Adult Education Initiative (AEI, *Kunskapslyftet*) was introduced, government funding became in excess of 50 per cent. This policy was matched with a gradually 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 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.

Empirical evaluations of the effects of AE in Sweden are relatively few despite the fact that register data of high quality is available. One explanation for this lack of research is that the register data on course credits at Komvux is relatively difficult to arrange. Studies so far have therefore simplified the reporting of AE studies to binary variables indicating term-wise registration at Komvux, thereby, and in contrast to the present study, not taking into account the subjects studied, the course credits or the level of the grades. This practice may partially explain why previous research, to be presented in detail below, has reported rather mixed results. The effects of AE were found to be negative in Ekström (2003), insignificant in Albrecht et al. (2004) and positive in Axelsson and Westerlund (2005) and Stenberg and Westerlund (2007). Another unexplored issue concerns the large fraction of AE participants that continue to higher studies. If their performance is markedly weaker than average, a policy maker might prefer to change the rules for admission to university studies. This could arise if e.g. AE is of insufficient quality as preparation for university studies (Heckman and LaFontaine 2006, and Boesel et al. 1998, both on the GED in the US), if adults experience more family- work and/or other commitments, if there are decreasing returns with age (Ekström 2003, Light 1995, Monks 1997) or if AE individuals tend to pursue education due to bleak employment prospects (Stenberg 2007, and Stenberg and Westerlund, 2007).

The report unfolds as follows. Section two provides a background describing the Swedish educational system and section three presents theoretically and empirically related literature. Descriptive data is found in section four while section five contains empirical strategies and results. Section six concludes.

2 The Swedish educational system

Compulsory school in Sweden is nine years and usually takes place from age seven to fifteen. 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, normally a three-year upper secondary diploma. Specific requirements apply in some cases, depending on the type of education. 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 upper secondary level. At the universities, many undergraduate programs and specific courses have more applicants than there are seats. At least one third of the seats must be offered based on grade point averages (GPA) attained at upper secondary level. Those who feel unsure whether their GPA from upper secondary school is sufficiently high to gain admission can also write the Swedish Scholastic Aptitude Test (*högskoleprovet*). A minimum of one third of the seats are offered to the highest ranked in this category, conditional on fulfilling the general admission requirement. Higher education is free of charge and students receive financial support of about €780 a month where one third is a grant and the rest is a loan.

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 can enrol at Komvux to improve their formal qualifications. Persons with a three-year upper secondary education may also enrol, e.g. in order to take the optional fourth year of technical education. Much more common, however, is that they either slightly re-direct their education or study one or more subjects required for eligibility to university. From the autumn of 1997, it also became allowed to improve grades at Komvux even if they were passed, and so enhance one's competitive position for admittance to university studies. Komvux actually encompasses studies at three different levels, although the majority, 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. Since 1997 there were also introductory courses, intended for adults who were reluctant to re-start schooling.

3 Related literature

The human capital model introduced by Becker (1964) predicts that an individual will participate in education if the present value of its expected benefits minus its expected costs is greater than zero. Postponing education in this framework would only shorten the post-education period of assumed higher wages and thereby reduce the beneficial effects. To explain the occurrence of adult education, some factor must be allowed to vary over time so the expected value of the individual's decision rule change.¹ One such change is that the wage premium increases sufficiently to make re-enrolment in education a rational decision (Weiss, 1971 and Iwahashi, 2004). Other examples include relaxed borrowing constraints (Wallace and Ihnen, 1975), that the relative prices of leisure and schooling change (Killingsworth, 1982) or that the information set changes, not least completion uncertainty (Altonji, 1993, Sjögren and Sällström, 2004). Another possibility is that the individual's discount rate changes over time. An individual with a stronger preference for immediate income will, all else the same, be more likely not to enrol in education. But if the discount rate is liable to be reduced with age, the sign of the decision-making equation may switch from a negative to a positive value. Warner & Pleeter (2001), studying how individuals had chosen between different offers at the time of the military drawdown in the US in the early 1990s, found young individuals to have higher than average discount rates.

Empirical evaluations of education in Sweden have, until a few years ago, only considered youth education. The syllabus of Komvux at upper secondary level was until 1994 somewhat adapted for adults but has since been the exact same as for youth education. An interesting point of departure, therefore, is Swedish evaluations of upper secondary education for youths that have found

¹ Ben-Porath (1967) is an exception to this rule. He assumed decreasing marginal productivity of human capital, inducing individuals to spread formation over a long period of time to maintain a high marginal payoff to effort.

payoffs in the region of 3.5 to 4.5 per cent (Isacsson 1999, Kjellström 1999, Meghir and Palme 2005). It is of course far from certain that these results can be generalized to education for adults. AE usually offers more options in terms of at what speed it is carried out and when, at what age, education is (re-) initiated and completed. Individuals in AE also often have work experience, possibly making their choices of study based on better information. These features not only make AE different from youth education but also further complicate the selection mechanisms faced by the researcher. Similar to Card (1999), the above mentioned studies report modest bias in conventional OLS estimators. Although in a sense encouraging, there have been no studies of AE with a set-up resembling a social experiment. Consequently, there is little knowledge about if and how the additional selection mechanisms have influenced the results of AE evaluations.

Studies of AE in Sweden have exclusively considered data collected from participation at Komvux. Ekström (2003) focused on participants at upper secondary level Komvux from 1988 to 1993, with annual wage earnings in 2000 as outcome variable. The regression results implied negative effects of AE for men born in Sweden but positive effects for female immigrants. No effects were found for females born in Sweden and male immigrants. The negative effects for men were 6 per cent for those aged 43-55 and 3 per cent for men aged 25-42. This is the only study so far *not* based on the mainly unemployed participants in the Adult Education Initiative (AEI), introduced in 1997. Axelsson and Westerlund (2005) found AE participants to increase annual earnings by SEK 12,800, roughly corresponding to an effect of 10 per cent.² Albrecht *et al.* (2004) instead reported no significant effects on wage earnings but a higher probability for men aged 25-40 to find employment. Stenberg and Westerlund (2007) studied long-term unemployed and their results showed positive earnings effects of 14 per cent for males and 23 per cent for females. However, the estimates were insignificant for those registered only one semester in the AEI and for males registered the maximum four semesters. The latter result appeared to be driven by individuals residing in regions with high unemployment rates. Stenberg (2007) and Axelsson and Westerlund (2005) compared enrollees in 1997 in the AEI with those in La-

² The value of € 1 was SEK 8.00 - 9.00 during the period covered by this study.

bour Market Training (LMT), which was mainly vocational. Both studies reported LMT to have more beneficial effects on wage earnings. Stenberg (2005) made a similar comparison with LMT but found ambiguous effects on unemployment immediately following program.

In the US, there are a few evaluations of adults in community college where the courses often are vocational and/or at post-secondary level. Some of the studies are reminiscent of the present paper as they estimate the payoff to a year's worth of credits to generate results comparable to the returns to schooling literature. Jacobson *et al.* (2005) had access to data on a large sample of individuals aged 20 to 59 in Washington State who were displaced by their employers in the period 1990 – 1994. Data were collected quarterly and covered earnings and hours worked, both before and after the displacement. Some 15 per cent of their sample was at some stage enrolled at community college and transcripts of their credits attained were available. The estimated effects of credits equal to a year of studies were positive; 9 per cent for men and 13 per cent for women. They found no evidence of decreasing returns with age, a result in line with Leigh and Gill (1997) but contrary to Light (1995) and Monks (1997). However, in comparison with Sweden, the US has greater wage differences and less generous financial conditions for adult students, as well as a wider dispersion in knowledge of reading, mathematics etc. These are all factors that would increase the expected payoff to AE.

Studies in the UK have primarily focused on mature graduates. Information on the returns to non-graduate studies is sparse. Jenkins *et al.* (2003) and Jenkins (2004) are based on data from the National Child Development Study on individuals born in 1958. Surveys were made in 1991 and in 2000 and respondents stated whether they had attended AE since the last survey. Generally, there were no positive effects from adult comprehensive education. Exceptions concerned low qualified men (on wages) and women out of work (less probability of unemployment) who participated in AE that led to a qualification.

4 Data and descriptive statistics

This section presents the sources of the data, the sampling procedure and descriptive statistics primarily on AE participation and annual wage earnings. Further descriptive statistics are presented in the Appendix. To make the exposition conform to the set-up of the empirical analysis, those registered in higher education, whether with or without prior AE, are presented in a separate part.

The register data of this study originate from several sources. *Komvuxdatabasen* provides data on adult education at Komvux and contains information on course subjects, course credits, interruptions and the grades attained. This detailed level of analysis has not been used in earlier evaluations and represents one of the major contributions of this report. Data on individual characteristics, transfer payments and wage earnings are supplied by *Louise* (Longitudinal data on education, income and employment). Data on higher education is collected from The Register of Universities and University Colleges (*Universitets- och högskoleregistret*). The highest attained education of each individual is reported yearly by Statistics Sweden in their Standard Classification of Education in Sweden (*Svensk utbildningsnomenklatur, SUN*). The SUN codes referred to in this report vary depending on the nature of the analysis, e.g. the educational level before enrolment in AE is indicated by SUN1990 while SUN2001 is used to analyse the returns to higher education.

The population of the study consists of the full cohort born in 1970 and residing in Sweden from 1988 to 2001 (in total 126,604 individuals). Those who immigrated to Sweden after 1982 are excluded (106,727 individuals remaining) as the educational achievements have been shown to differ if immigration occurs at the age of 12 or 13 (see Böhlmark 2005).³ From 1988 there is uninterrupted register data on studies at Komvux which, naturally, is most interesting for individuals with a short education. Table 1 presents frequencies of the educational levels reported in SUN1990, i.e. before enrolment in AE. In total, 34.1 per cent have at some point before 2001 been registered at

³ Schooling becomes more individualized from the age of 13. Pupils no longer remain in the same classroom and instead of having one teacher to cover most subjects there are several specialized teachers.

upper secondary Komvux. These shares are 25.6 per cent among men and 43.3 per cent among women. Like the overall trend in Sweden, enrolment is skewed towards the latter part of the period and peaked in 1998 when AE was a widespread labour market measure for unemployed. With increased access to grants, studies also became more intense. The average number of completed credits per year tripled from 1993 to 1997 and the average number of courses increased from 2.2 at the start of the 1990's to 4.5 from 1996/97 onwards. Another development was that the fraction of evening courses decreased from 19 per cent in 1992 to 7 per cent in 1999.

Table 1: Individuals at some point attending upper secondary AE in 1988 – 2001 across various educational levels (in 1990).

	Males	% of total	% in AE	Females	% of total	% in AE
Less than 9 years of compulsory school	114	.2	14.0	81	.1	34.6
Compulsory school	7,261	13.4	28.2	7,123	13.7	51.9
Upper secondary \leq 2 years	27,045	50.0	27.1	23,636	45.5	47.2
Upper secondary \leq 3 years	14,073	26.0	23.7	18,610	35.8	36.6
Post-secondary < 3 years	5,603	10.4	19.5	2,456	4.7	32.2
Post-secondary \geq 3 years	24	.0	21.7	28	.0	21.4
Missing	398	.7		275	.5	
Total	54,518			52,209		

4.1 Upper secondary adult education

This section considers individuals that until 2002 had no registration in higher studies. A set of conditions, to be presented shortly, further adjusts the sample to make it adequate for the regression analysis in the empirical section. The statistics presented concern this restricted sample. Table 2 summarizes the sampling procedure. Besides those at some point registered in higher education, individuals are excluded if registered at Komvux prior to 1992 or after 1999 (to leave a period of “undisturbed” wage earnings before and after AE participation) or if more than five years between first and last registration in Komvux. AE participants are also restricted to those who at least once prior to enrolment have registered annual wage earnings of SEK 20,000 or more.

This avoids absurdly high percentage increases in earnings following AE (for a study of low earners in AE, see Stenberg and Westerlund, 2007).

Table 2: Successive selection criteria and remaining sample sizes. See text for detailed description of the sampling conditions.

MALES						
Condition	Compulsory		2-year upper sec.		3-year upper sec.	
	AE	Non-AE	AE	Non-AE	AE	Non-AE
Original no. of ind.	2,046	5,215	7,340	19,705	3,334	10,739
No reg. at university	1,572	5,035	4,814	18,563	1,132	3,695
No AE post 1999	850		2,696		622	
Earnings > 20,000	724	3,505	2,550	16,339	602	3,192
FEMALES						
Condition	Compulsory		2-year upper sec.		3-year upper sec.	
	AE	Non-AE	AE	Non-AE	AE	Non-AE
Original no. of ind.	3,696	3,427	11,158	12,478	6,807	11,803
No reg. at university	2,913	3,296	7,218	10,398	2,194	4,087
No AE post 1999	1,282		3,474		1,024	
Earnings > 20,000	1,067	1,747	3,287	7,837	994	3,157

For the comparison groups, the condition is set that there should be at least five observations of annual wage earnings above SEK 20,000. This is somewhat arbitrary, but the intention is to exclude individuals who are essentially outside the labour market. Among AE participants, the dropout rate caused on the margin by the condition of being registered in higher education is 64 per cent in the group with three years of upper secondary school, 34 per cent among those with a two-year upper secondary level and 19 per cent among those with compulsory school. Of the total sample, 45,001 individuals remain, of which 20.5 per cent at some stage were registered at Komvux. Judging by the shares with at least one day registered as unemployed 1990-2000, AE participants appear as a weaker selection as their fractions in the different samples are higher by between 20 and 30 percent (or 13 to 17 percentage points, see Table A.1).

Course credits are only counted as long as the reported grade of a course is at least three on a scale of one to five or, after 1993/94, at least a pass. If the grade is missing, if course interruption is reported or if the grade is below three (or after 1993/94 ‘fail’), the credit is set to zero.⁴ This is done to make the credits better correspond to some true human capital improvement. For each AE participant, course credits are accumulated over the semesters. Table 3 presents frequencies of AE participants as well as non-participants, dividing the AE individuals into six groups based on credits accumulated from 1992 to 1999. As a guideline, Skolverket (2000) suggests that 500 credits at Komvux correspond to a school year.⁵

The fraction of AE participants with zero credits represents 19.4 per cent of the total number enrolled in AE, meaning that a binary variable indicating registration in AE would be partly misleading. These individuals interrupted on average 43 per cent of their courses. The remainder either had grades not reported or a reported grade below three (or from 1993 ‘fail’).

Table 3: Number of individuals and distribution of AE individuals across interval number of credits.

Males/Females	Compulsory		2-year upp. sec.		3-year upp. sec.	
	M	F	M	F	M	F
Not participated	3,505	1,747	16,339	7,837	3,192	3,157
Zero credits	196	251	637	608	154	225
1-250	243	270	1,016	1,055	312	541
251-500	148	219	482	784	78	129
501-1000	106	231	330	653	48	82
1001-1500	28	87	75	164	8	17
1501-	3	9	10	23	2	0
Median no of credits	136	260	113	238	70	65
Mean no of credits	267	369	246	333	171	168
Total no of ind.	4,229	2,814	18,889	11,124	3,794	4,151

⁴ Statistics Sweden has since 1993 followed up missing grades for Math, Swedish and English. Comparing the grades of these subjects with grades of other subjects, the fractions with at least the grade ‘three’ appear similar both before and after 1993. This suggests that missing grades in the majority of cases are interruptions or grades below three.

⁵ The credits attained only indicate courses passed. It is possible to fail a course and still receive an upper secondary diploma, but there are no records of such formal attainments.

The credits in Table 3 only refer to those at upper secondary level. Of the individuals with zero credits, 7.1 per cent participated in courses at compulsory level, 4.8 per cent in supplementary courses and 0.6 per cent in introductory courses (described in section 2). Those who attended all their courses outside the framework of upper secondary level are excluded (1,580 individuals).

Table 4 presents the subjects AE participants studied, conditioned they had a positive number of credits attained. Swedish, English and Mathematics, often referred to as “core subjects”, are among the more popular ones. The courses have otherwise been grouped somewhat arbitrarily based on their names. The label “Social sciences” includes both geography and history while the category “Health, nursing” encompasses behavioural sciences. The median number of courses is 14 for those with a prior compulsory level, ten if two-year upper secondary level and four if three-year upper secondary level. The fractions that pass the various courses are mostly above 75 per cent and are positively correlated with female gender and prior educational level.

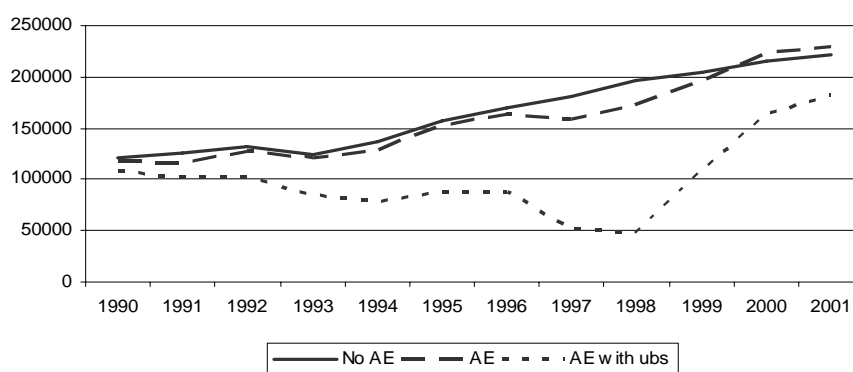
Table 4: Fractions of participants with at least one AE credit, across course subjects.

Males/Females	Compulsory		2-year upper secondary		3-year upper secondary	
	M	F	M	F	M	F
Maths (M)	.388	.406	.412	.408	.326	.260
Swedish (S)	.428	.511	.345	.445	.210	.190
English (E)	.413	.489	.387	.448	.297	.299
M S E	.216	.308	.202	.258	.074	.061
Natural sciences	.203	.240	.192	.235	.147	.131
Computer science	.574	.559	.527	.580	.386	.367
Human sciences	.093	.134	.071	.106	.087	.162
Health, nursing	.178	.402	.146	.312	.089	.150
Social sciences	.608	.746	.540	.706	.339	.468
Vocational	.161	.113	.143	.079	.096	.084
N	528	816	1,913	2,679	448	769

One can not identify the individuals who enrolled at Komvux as part of a labour market program. However, from the autumn of 1997, it is possible to see whether participants received the special grant UBS, which was associated with the Adult Education Initiative. Almost 84 per cent of those with UBS were unemployed before enrolling in AE (SOU 1998:51). This could therefore be used as a proxy variable to indicate enrolment as unemployed. In the present sample of AE participants, 16 per cent of the men and 24 per cent of the women received UBS at some stage.

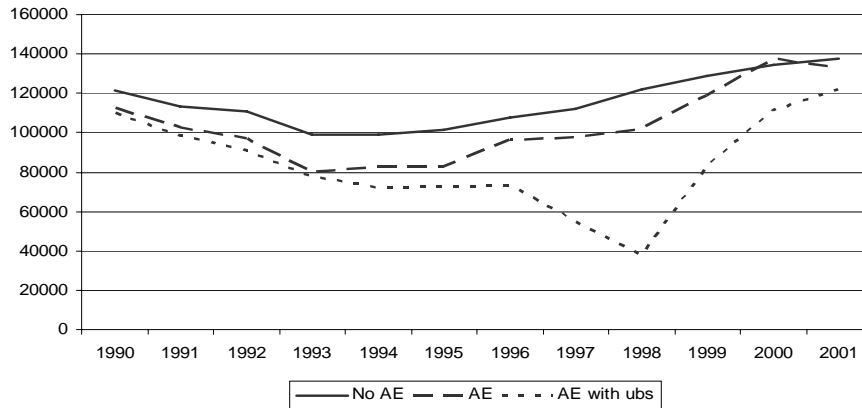
Figures 2 (males) and 3 (females) provide a comparison between the annual wage earnings trajectories of AE participants with a prior two-year upper secondary school and non-participants. The AE participants are conditioned to be registered for the first time in the autumn of 1997 and for the last time not later than the spring of 1999. Choosing this window provides us with a reasonably large number of AE participants and permits us to set up a separate trajectory for individuals with the UBS grant. As expected, this latter group has an overall low pre-AE earnings level. Participants without UBS have higher earnings both prior to and during enrolment, reflecting a closer attachment to the labour market and a weaker intensity of studies. Among them, the fraction with more than 500 credits is 17 per cent compared with 54 per cent among the UBS individuals. Post-AE, participants without UBS surpass the trajectory of the non-participants, although it switches back for females in 2001.

Figure 2: Males with two-year upper secondary school; earnings 1990-2001, AE sample registered from the autumn of 1997 until 1999.



Note: Number of observations in AE are 111 with no UBS and 201 with UBS. Annual wage earnings expressed in SEK 2001 values.

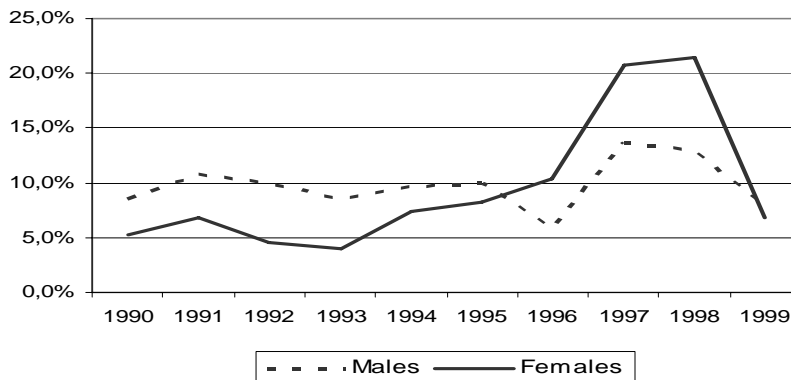
Figure 3: Females with two-year upper secondary school; earnings 1990-2001, AE sample registered from the autumn of 1997 until 1999.



Note: Number of observations in AE are 134 with no UBS and 412 with UBS. Annual wage earnings expressed in SEK 2001 values.

Before proceeding, an important note is that enrolment in AE seems related to the presence of a child at home and in this respect shows strong gender patterns. Figure 4 displays the timing of the first year in AE for males and females with at least one child below four at home in 1995. From 1990 through 1995 the fractions of males is higher until the relation is reversed from 1996 onwards. A plausible interpretation is that females who stay at home with their child(ren) often enrol in AE before returning to the labour market. For males, the rearing of a small child tends to follow after AE is completed. This has important consequences if one uses difference-in-differences estimators and is therefore further discussed in the empirical section.

Figure 4: Year of first registration in AE for participants with at least one child at home below four in 1995.



4.2 Adult education and higher studies

Of the original sample displayed in Table 1, about 36 per cent were at some point up to 2002 registered in higher education. Among participants in AE the fraction was 43.7 per cent. As one would expect, AE individuals enrolled and completed their university studies a little later than those with no AE. For example, by 1995, the fraction of AE individuals that had finished their studies was 19 per cent, whereas it was 41 per cent among non-AE individuals.

The annual wage earnings following higher education are analysed using register data from 2002. Individuals are excluded if registered in studies after 2000 and if annual earnings are zero in 2002.⁶ The sample with a prior AE is then reduced by 54 per cent and the group of non-participants is reduced by 29 per cent. The excluded mostly concern individuals that were still actively studying in 2001 and 2002, especially so in the sample of AE participants (39 per cent). These are briefly reconsidered in the empirical section.

Table 5 describes the numbers across completed years of higher education and their respective average earnings in 2002. The classification is based on SUN2001 and follows the criteria that the number of years stated is the least that have been completed. Exceptions to this rule are in the group with one year of studies which includes individuals with “more than one semester” of university studies. Those with postgraduate studies are few and therefore include both licentiate degrees (6 years of studies) and doctoral degrees (8 years of studies). Counting the classifications as the actual years of higher studies, the mean number is 2.62 for those without AE and 2.27 for AE individuals. Credits attained in AE are negatively correlated with years of education (-.131). A Bachelor’s or a Master’s degree encompass three and four years of studies respectively. The groups with less than three years thereby include drop-outs from programs that are three years or longer.⁷ The fraction with more than three years of higher studies is 28 per cent among individuals with no registration in AE while it is 20 per cent for AE individuals with prior

⁶ Wage earnings are more interesting if individuals have completed their education. Records of registration at Komvux are available until 2001 and for higher education until 2002. This is why individuals are followed a year longer here than in the preceding section.

⁷ There are no records on drop-outs. The SUN-code just states the highest achieved educational level.

three-year upper secondary school and about 10 per cent in the other AE groups. The study directions only display minor differences between females with and without AE. Among males, the major difference is that technology or manufacturing is more frequent among non-AE individuals, 45 versus 35 per cent.

Table 5: Average annual wage earnings (thousands SEK) in 2002 across years in higher education as reported in SUN2001. Fractions of column totals within parentheses.

Years in higher education	Males				Females			
	No AE		AE		No AE		AE	
Total	341.2	8,548	282.9	3,468	198.2	8,124	182.0	5,368
< 1 year	297.3	(.098)	241.4	(.179)	177.2	(.083)	153.0	(.160)
1 year	311.1	(.175)	269.1	(.192)	210.1	(.100)	167.2	(.120)
2 year	320.8	(.164)	281.3	(.155)	162.8	(.251)	165.1	(.189)
3 year	340.5	(.235)	283.6	(.291)	198.2	(.333)	186.1	(.391)
4 year	382.8	(.279)	334.4	(.158)	235.0	(.193)	237.8	(.120)
5 year	403.2	(.020)	371.7	(.019)	254.1	(.025)	257.2	(.016)
≥ 6 year	348.4	(.030)	337.5	(.007)	256.0	(.016)	208.9	(.003)

Note: The sample includes individuals with positive wage earnings in 2002, not registered in higher education later than 2000.

One would expect the average earnings of AE individuals to be slightly lower as they have fewer years post-education, but this pattern is irregular among females. In fact, females with one year of university studies show overall higher annual wage earnings than those with two or three years. This is partly explained by different study directions. Females with two years display large shares in educations typically suited for the public sector where the wage structure is compressed and where there is possibly also an over-representation of part-time employees. Males with two years are far more dispersed across study directions. For example, 27 study directions are found where the number of males represent more than one per cent. This figure is twelve for females with two years. A similar picture, albeit less extreme, is present for individuals with three years of higher education.

5 Estimation methods and results

This section begins with a discussion on estimation methods and is followed by two separate parts that correspond to the structure in the descriptive section, i.e. individuals who never registered in higher education are studied apart from those who at some point have had such a registration. A third part contains tentative calculations that seek to set the estimated results in relation to the costs of AE.

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 or higher education. 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* and/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. Glazer 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 reli-

able estimates or not. However, a repeated finding was that bias is substantially reduced if one uses estimators in the form of difference-in-differences, thereby taking into account individual time-invariant unobservable attributes (see also Heckman et al., 1999, Smith and Todd, 2005). This can be performed e.g. through propensity score matching (PSM) or, which is described in section 5.1, an individual fixed effects regression model. The PSM estimator is less appropriate in the present case as individuals enrol and re-enter the labour market at different points in time, making the outcome variable heterogeneous between individuals. The regression framework is more flexible in this respect and has the additional advantage that it easily allows estimates of marginal returns to credits which standard PSM estimators do not catch. On the other hand, the identifying assumption of both models is that the decision to enrol in AE is uncorrelated with future changes in earnings, i.e. changes in earnings post AE are attributed to the participation in AE. This is further discussed below.

In section 5.2, the focus is on individuals participating in higher education. Annual earnings before education are then more problematic to use as many individuals go straight from upper secondary school to university studies. The strategy is instead to make estimates on the cross section of log wage earnings registered in 2002 and to use grade point averages from upper secondary school as a control for ability bias.

5.1 Individuals with no enrolment in higher education

To estimate the influence on annual wage earnings of upper secondary credits attained at Komvux, OLS regression estimates of fixed effects models are used to control for time-invariant unobserved heterogeneity across individuals. Included are also yearly dummies to control for economic fluctuations. Formally, the model can be written

$$y_{it} = \alpha + \mu_i + \theta_t + \beta x_{it-1} + \gamma D_{it} c_i + \lambda D_{it} z_i + \varepsilon_{it} \quad (1)$$

where y_{it} represents the logarithmic annual wage earnings of individual i at time t (from 1990 to 2001). Explanatory variables are the individual specific fixed effects μ_i , the time-specific effects θ_t and individual characteristic x_{it-1}

which is a binary variable indicating child(ren) under four years old living at home (to be commented shortly). The dummy D_{it} takes the value one for AE participants *after* they have concluded their spell at Komvux and the variable c_i is the number of credits attained divided by 500, which is assumed equal to a year of AE.⁸ The vector z_i contains controls of the fraction of interrupted courses, the fraction of courses taken at compulsory level, as supplementary courses or as introductory courses and ε_{it} is the error term.

The coefficient γ will express the estimated returns on annual earnings of a year of full-time studies in AE. As pointed out in Jacobson et al. (2005, p 279), also working within a fixed effects model approach, the use of a continuous variable of the credits 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 c_i , it is not even necessary to use 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. A second strategy adopted here is to replace the continuous variable c_i with five binary variables, d_{jit} , which are one if the interval number of credits is j , otherwise zero ($D_{it} = \sum_j d_{jit}$). The restriction of a linear relationship between the number of credits and the returns is then avoided, but at the cost of increased standard errors as the number of observations is reduced for each estimated γ coefficient.

As was shown in Figure 4 in the descriptive part, registration in AE does not seem strictly exogenous as females tend to enrol in AE before returning to the labour market after a period of parental leave. In such a case, the average pre-AE annual earnings are reduced because of the parental leave and a fixed effects model estimator will overestimate the effects of AE on earnings. Males instead tend to complete their education before the rearing of a child. If they decide to take advantage of the daddy month of the parents' allowance and/or the right to two weeks at home in connection with the delivery of the child, post-AE earnings will be reduced and the effects of AE underestimated. The

⁸ The value of the variable c_i is zero both for individuals never registered in AE and for those who were registered but never gained any credits.

inclusion of the binary variable of child(ren) at home is a way of addressing potential bias due to an omitted explanatory variable. It affects the coefficient magnitudes (throughout in the expected manner) and is sometimes also important for the qualitative implications of the estimates. For completeness, estimates from excluding the lagged variable are presented in the Appendix.

Table 6 presents coefficient estimates pertaining to a year of AE credits. The parameters of the first four columns concern individuals with less than a prior three year upper secondary school and are straightforward to interpret as they imply an addition to the level of formal education. The estimates are significantly positive and very high for individuals with compulsory school, 14 per cent for males and almost 9 per cent for females. Possibly, many individuals only needed a few more passing grades to gain a three-year upper secondary diploma, something which could induce a strong signalling effect. The parameter values of those with a prior two-year upper secondary school appear perhaps as more reasonable, 4.1 per cent for males and 3.6 per cent for females. These are less likely to reflect signalling effects and are also based on larger samples. Credits earned by individuals with a prior three-year upper secondary schooling are more complicated to interpret as they may reflect an improvement of earlier grades and/or a re-direction of an earlier education. The estimates are insignificantly different from zero for females and significantly negative for males.

To check that the estimates are not an artefact of increases in annual earnings from initially low levels, results are also presented of samples where the AE participants are conditioned to have registered annual wage earnings above SEK 100,000 at least in one year both before the first and after the last registration at Komvux. Estimates then tend to converge to levels of 10 to 11 per cent for those with compulsory school and 7 to 9 per cent for individuals with a prior two year upper secondary school.

Table 6: Estimation results of a year in adult education, defined as Credits attained / 500.

Dependent variable: log annual wage earnings 1990-2001

Males/Females	Compulsory school		2-yr upper secondary		3-yr upper secondary	
	M	F	M	F	M	F
Total sample	.141 ^{***}	.087 ^{***}	.041 ^{***}	.036 ^{**}	-.083 ^{**}	.043
	(.0320)	(.0275)	(.0146)	(.0146)	(.0374)	(.0356)
N ^{TOT} / N ^{AE}	4229/528	2814/816	18889/1913	11124/2679	3794/448	4151/769
Earnings > 100000	.107 ^{***}	.097 ^{***}	.068 ^{***}	.089 ^{***}	-.096 ^{**}	-.010
	(.0339)	(.0325)	(.0155)	(.0162)	(.0404)	(.0394)
N ^{TOT} / N ^{AE}	4015/390	2288/434	18483/1616	10297/2013	3662/349	3921/605
With UBS	.033	.036	-.001	.032 [*]	-.102	.065
	(.0456)	(.0350)	(.0195)	(.0189)	(.0879)	(.0792)
N ^{TOT} / N ^{AE}	3662/138	2118/332	16913/523	9035/1099	3217/21	3207/48
No UBS	.247 ^{***}	.171 ^{***}	.085 ^{***}	.042 [*]	-.086 ^{**}	.049
	(.0432)	(.0396)	(.0214)	(.0219)	(.0416)	(.0395)
N ^{TOT} / N ^{AE}	4072/390	2443/484	18315/1390	9926/1580	3769/427	4101/721

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

Note II: N^{TOT} / N^{AE} report total number of individuals and the number with positive number of credits from AE at Komvux. (defined in section three). The number of observations is 8.4 – 10.6 times larger.

Note III: More complete regression results are found in Table A.5 in the Appendix.

Antelius and Björklund (2000), using data from the Swedish Level of Living Survey, found estimates of (youth) educational attainment on earnings to become similar to the estimates on hourly wages when excluding *all* observations on earnings below SEK 100,000. When applied here, the coefficients (not displayed) in the first four columns become insignificant or close to zero, suggesting that the results foremost reflect employment effects. The effects of those with a three-year upper secondary education become significantly negative for both males and females.

The coefficients associated with AE participants receiving UBS are generally insignificantly different from zero. A rather large fraction, 47 per cent, was still enrolled in AE in 1999, but the implications remain if one excludes those registered in AE after 1998 to make their follow-up period longer. This is at odds with earlier evaluations of the AEI, based on individuals aged 25-55, but

where there has been evidence of stronger effects among the older half of the participants (Stenberg and Westerlund 2007, Stenberg 2007). The present estimates could also partly reflect decreasing returns to the large amounts of credits many of them accomplished.

Table 7 presents coefficient estimates of versions where binary variables represent different intervals of accomplished credits (the mostly insignificant results of those with three-year upper secondary school are not displayed). The results imply that the positive parameters reported in Table 6 are driven primarily by individuals with a high number of credits. A few estimates indicate earnings to be enhanced by less than 500 credits. As one would perhaps suspect, these are linked with individuals who have passing grades in vocational courses. If they are excluded (seven per cent), there are no significantly positive coefficients associated with less than 500 credits (excluding other subject categories than vocational do not have this effect). Note, however, that a zero estimate may still imply a positive return to AE credits. If attending AE imparts reduced work experience, a locking-in effect associated with foregone earnings and/or less intense job-search, one would expect a zero payoff to generate negative estimates. This is found for females with 1-250 credits and a prior two-year upper secondary education.

Table 7: Estimation results of different intervals of credits attained in adult education

Dependent variable: log annual wage earnings 1990-2001

	Prior compulsory school		Prior two-year upper secondary	
	Males	Females	Males	Females
Total sample				
AE credit interval				
a. Zero credits	.084	.070	-.062**	-.058
N ^{AE} : 196/251/637/608	(.0773)	(.0980)	(.0310)	(.0414)
b. 1 – 250	.011	-.060	.031*	-.121***
N ^{AE} : 243/270/1016/1055	(.0515)	(.0691)	(.0179)	(.0254)
c. 251-500	.090	.075	-.002	-.042
N ^{AE} : 148/219/482/784	(.0584)	(.0652)	(.0250)	(.0293)
d. 501-1000	.392***	.170***	.067**	.038
N ^{AE} : 106/231/330/653	(.0686)	(.0633)	(.0303)	(.0302)
e. 1000 -	.187	.209**	.119**	.156**
N ^{AE} : 31/96/85/187	(.1280)	(.0938)	(.0600)	(.0563)
R ² within	.113	.081	.133	.079
Sample with earnings > 100,000				
AE credit interval				
a. Zero credits	.118	.161	-.008	-.008
N ^{AE} : 120/107/528/447	(.0854)	(.1242)	(.0319)	(.0456)
b. 1 – 250	-.006	.083	.037**	-.049*
N ^{AE} : 179/139/886/804	(.0557)	(.0812)	(.0184)	(.0272)
c. 251-500	.049	.200**	.040	.039
N ^{AE} : 105/119/394/581	(.0640)	(.0788)	(.0262)	(.0307)
d. 501-1000	.235***	.175**	.088***	.135***
N ^{AE} : 81/126/269/498	(.0741)	(.0744)	(.0320)	(.0330)
e. 1000 -	.285**	.210*	.181***	.200***
N ^{AE} : 25/50/67/130	(.1343)	(.1142)	(.0643)	(.0634)
R ² within	.111	.091	.138	.084

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

Note II: Reference group is non-participants. The row N^{AE} report the number of AE participants of the respective samples in a particular credit interval. See Table 7 for total number of observations.

To extend the analysis of how the subjects studied influence the returns, a rudimentary check is made by running regressions where AE participants are constrained to have at least one passing grade in a particular subject category. The samples are then reduced, sometimes considerably, so regression results, presented in Table 8, only concern those with a two-year upper secondary

school. The evidence suggests that subjects related to more specific knowledge, e.g. computer science and health related subjects, are more fruitful in enhancing productivity and/or employability.⁹ General subjects are associated with zero or negative returns. It is possible that general knowledge has a weaker payoff to individuals drawn from the lower half of the income or productivity distribution. Borghans and Golsteyn (2005) and Gathmann and Schonberg (2006) argue that general human capital is complementary to other types of skills. It would in that case be indirectly beneficial as it enhances the ability to take in specific knowledge, but there is no support for this idea in Table 8. Interestingly, subject specific estimates of the UBS individuals (not displayed) show the same patterns as in Table 8, implying their larger share of general subjects explain the insignificant estimates in Table 6 (their share of passed grades was more than twice as high in the core subjects while “only” 50-60 per cent higher in health, nursing and computer science).

Table 8: Payoff to AE participants with a prior two-year upper secondary school, conditioning on passes in various subjects.

	Males		Females	
	S.E.	N ^{AE}	S.E.	N ^{AE}
Maths (M)	.001 (.0232)	687	-.040* (.0229)	1,028
Swedish (S)	.016 (.0240)	591	-.040* (.0224)	1,119
English (E)	.033 (.0231)	656	-.057** (.0230)	1,103
M S E	-.008 (.0279)	342	-.077*** (.0269)	646
Natural sciences	.013 (.0298)	308	-.027 (.0284)	598
Computer science	.046** (.0203)	855	.038** (.0179)	1,397
Human sciences	.044 (.0538)	109	-.019 (.0441)	249
Health, nursing	.083*** (.0296)	241	.109*** (.0253)	783
Social sciences	.010 (.0200)	900	.032* (.0167)	1,715
Vocational	-.013 (.0266)	275	.031 (.0386)	212

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

Note II: N^{AE} report number of AE participants.

⁹ Probably due to decreasing returns, individuals with passing grades in vocational courses tend to blur the results. These are therefore excluded from samples except “vocational”.

To sum up so far, the estimated effects of AE are very sensitive to a) the educational level prior to enrolment in AE, b) to whether the studies encompass at least 500 credits and c) to what extent the subjects studied include elements of specific knowledge. Among the average estimates, the preferred ones are those pertaining to a prior two-year upper secondary schooling, 4.1 per cent for males and 3.6 per cent for females. The estimates are high compared with Ekström (2003) and Albrecht et al. (2004), but substantially below Axelsson and Westerlund (2005) on participants in the AEI and Stenberg and Westerlund (2007) on long-term unemployed in upper secondary AE. These studies have approximated the human capital investment in AE by the number of semesters registered. A good guess is that the mixed results partly reflect varying amounts of credits attained. For example, participants in Ekström's sample were registered in AE in 1993 at the latest. The average number of credits was then considerably lower than a few years later when the financial conditions for adult studies had become more generous.

5.2 Individuals in further education

We now restrict the analysis to the part of the sample at some point registered in higher education. The main purpose is to explore whether individuals with and without prior AE differ in their study achievements at university and/or in their wage earnings premium. When comparing the different outcomes, the grade point average (henceforth GPA) from upper secondary school is used to control for otherwise unobservable differences in ability. The samples are adjusted to create common support in GPA values as it reduces bias and the sensitivity with regard to incorrect functional form assumptions (Rubin, 1973a, 1973b). The samples in the following are therefore trimmed and individuals are excluded if their GPA is lower than the 5th percentile of the group classified with four years of university studies or if higher than the 95th percentile of those with less than one year (the GPA is positively correlated with years of studies). The limit values of the GPA are calculated separately for each sample but stay within the range from 2.67 to 4.19, excluding roughly one fourth of the observations. This includes what will be referred to below as the “reduced samples” which only consider AE individuals with less than a three-year upper secondary school diploma prior to AE enrolment. This group

conducted a larger amount of AE studies before gaining eligibility to tertiary education.

To assess the accomplishment in higher studies, logit models are employed to estimate the probability of completing four years, as reported in SUN2003. A sampling condition is that a first registration in higher education should not occur later than in 1997 (when individuals are 27 years old), thereby including 88.9 per cent of the enrolees in higher education until 2002. Table 9 displays the results. Prior enrolment in AE is first represented by a continuous variable of the number of credits in AE. In a second version, the individuals with prior AE are associated with an indicator variable of their interval number of credits attained. A third version builds on the same model specification but concern the reduced sample, i.e. excluding individuals with a three-year upper secondary school diploma prior to AE. The results do not imply any differences for males in the first two versions but with the reduced sample, individuals with less than 250 credits show a lower probability of completing four years. The results of females indicate a lower probability regardless of specification or sample. This raises questions related to the quality of preparation offered by AE. However, gender differences suggest that the responsibility for household work may be elusive to the variables included (dummy-variables of small children).¹⁰

¹⁰ Apart from Komvux, it was possible to complete eligibility for university either through reattending the old school, through Labour Market Training, through National School for Adults (*Statens skolor för vuxna*), which is based on self-instruction, through a specialized course program (*gymnasieskolans specialkurser*), primarily for pupils with problems in school, or through a foreign upper secondary education.

Table 9: Logit estimates of the probability of accomplished university studies.

Dependent variable: 1 if at least four years of studies as measured in SUN2003, otherwise zero.
Reference group: No registration at Komvux.

	Males		Females			
AE number of credits	- .097 (.0864)		- .282*** (.0943)			
AE; zero credits		- .016 (.1056)	- .946*** (.2791)	- .138 (.0876)	- .965*** (.2319)	
AE 1-250 credits		- .014 (.0747)	- .509*** (.1411)	- .213*** (.0636)	- .694*** (.1255)	
AE 251-500 credits		- .001 (.1206)	- .004 (.1459)	- .407*** (.1221)	- .556*** (.1704)	
AE > 500 credits		- .158 (.1485)	.134 (.1335)	- .198 (.1523)	- .074 (.1746)	
Excl. AE with prior 3 year upper sec. sch.	No	No	Yes	No	No	Yes
N	9,822	9,822	8,640	12,561	12,561	9,648
Pseudo-R ²	.056	.056	.062	.066	.067	.078

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

Note II: Explanatory variables included; dummies for foreign born and first year of registration in higher education 1992 – 1997.

Table 10 presents estimates from regressions on the logarithmic value of annual wage earnings in 2002. The interesting parameters in this set-up pertain to the interaction variables, years of studies times participation in AE, which indicate whether there is a difference in the payoff to higher studies between individuals with and without AE. The estimates in the first male/female columns are based on samples that include individuals registered in education in 2001 and 2002. As expected, prior AE participants then display significantly lower returns as they more frequently were still registered in studies. In the second columns, those registered in studies after 2000 have been excluded. The overall estimates indicate yearly returns to university studies of 8.2 per cent for males and of 5.4 per cent for females, and, importantly, differences between individuals with and without a prior AE disappear. The third columns concern the reduced samples. Estimates for male AE participants then

point towards lower returns by a third and for females, alarmingly, the payoff to higher education of those with AE appears to be close to zero.

Table 10: Wage earnings regression on individuals with registration in higher studies.

Dependent variable: Log annual wage earnings in 2002.

	Males		Females			
Years of studies	.070 ^{***} (.0071)	.082 ^{***} (.0073)	.078 ^{***} (.0075)	.072 ^{***} (.0097)	.054 ^{***} (.0111)	.052 ^{***} (.0127)
AE * yrs of studies	-.027 ^{***} (.0070)	-.011 (.0073)	-.026 ^{**} (.0108)	-.019 ^{**} (.0077)	-.013 (.0089)	-.051 ^{***} (.0138)
Excl. AE with 3 year upper sec. school	No	No	Yes	No	No	Yes
Studying post 2000	Yes	No	No	Yes	No	No
N	8,794	7,350	6,669	11,300	8,465	6,432
Adj R ²	.121	.074	.068	.045	.044	.049

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

Note II: Explanatory variables include dummies indicating foreign born, children living at home in 1999, transfers received in 1999 from unemployment insurance, sick-leave, pensions, adult education grants and binary variables indicating year of exam 1991-1999.

Note III: More complete regression results are found in Table A.6 in the Appendix.

Now, before addressing why these diverging payoffs arise, let us relax the assumption of constant returns to higher education. Table 11 presents parameter estimates of binary variables indicating the years of completed studies. The coefficients of main interest are in the lower part, associated with interaction variables between prior registration in AE and years of higher education. Those with less than two years mostly display significantly lower returns for AE individuals. However, the estimates of the reduced female sample imply significantly lower effects also for three years. When the binary variables approach is extended to include 244 dummy variables, which represent different directions of study as well as the number of years, the negative results of the reduced female sample with more than one year of tertiary education vanish.

This implies that career choices, or at least educational choices, partly explain their weaker outcomes.¹¹

Table 11: Wage earnings regression on individuals with registration in higher studies.

Dependent variable: Log annual wage earnings in 2002.
Reference group: no AE with less than 1 year of higher studies.

	Males		Females	
1 year	.090** (.0395)	.063* (.0369)	.119* (.0694)	.104 (.0718)
2 years	.177*** (.0382)	.152*** (.0362)	-.087 (.0597)	-.102* (.0616)
3 years	.237*** (.0390)	.209*** (.0373)	.051 (.0604)	.033 (.0629)
4 years	.287*** (.0400)	.256*** (.0388)	.219*** (.0660)	.198*** (.0686)
5 years	.458*** (.1063)	.434*** (.1096)	.213 (.1517)	.187 (.1534)
AE + less than 1 yr	-.097* (.0525)	-.136** (.0548)	-.076 (.0752)	-.189** (.0939)
AE + 1 year	-.095** (.0449)	-.183*** (.0600)	-.184*** (.0713)	-.355*** (.1130)
AE + 2 years	-.078* (.0455)	-.088 (.0599)	-.012 (.0502)	-.016 (.0662)
AE + 3 years	-.048 (.0343)	-.062 (.0463)	-.028 (.0371)	-.168*** (.0542)
AE + 4 years	.004 (.0424)	-.097 (.0717)	-.047 (.0628)	-.073 (.1156)
AE + 5 years	-.048 (.1735)	.066 (.3012)	.240 (.2488)	-.318 (.4825)
Excl. AE with prior				
3-year upper sec. sch.	No	Yes	No	Yes
Studying post 2000	No	No	No	No
N	7,350	6,669	8,465	6,463
Adj R ²	.074	.070	.048	.054

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

Note II: Explanatory variables include dummies indicating foreign born, children living at home in 1999, transfers received in 1999 from unemployment insurance, sick-leave, pensions, adult education grants and binary variables indicating year of exam 1991-1999.

¹¹ This also seems to explain the irregular pattern in the overall female returns to higher education. Adding two broad indicator variables representing vocational and general education, with roughly 30 per cent untagged as a reference group, the coefficient of three and five years imply positive returns of 14 and 42 per cent respectively.

An interpretation of the lower payoff to small amounts of tertiary education is that AE individuals have a weaker attachment to the labour market while those with no prior AE use a short higher education to get promoted at a present employer. Another hypothesis is that AE individuals more often drop out from longer educations. However, this interpretation raises the question why this would be the case? One possibility is that AE provides a poorer preparation for higher education but it could also be that AE individuals have a lower study motivation, perhaps because they enrol in higher education due to a relatively low probability of finding employment.

5.3 Costs and benefits to the society

One may wonder how the estimated returns reported in this section compare with the costs of the education offered. A cost-benefit-analysis from the point of view of the society is a very complex task and well beyond the scope of this article. However, disregarding aspects such as spill-over effects of AE in terms of productivity and democratic values, it is possible to make back-of-the-envelope calculations which relate the educational costs and foregone earnings to the estimated pecuniary benefits. A discount rate of three per cent is assumed and the average estimates in Table 6 (first row) and Table 10 (second columns) are used to approximate the earnings effects. For the part of the sample with no registration in higher studies, the earnings increase following AE is found to generate benefits that surpass the costs within five to six years.¹² For those in AE who continued to higher education, a similar calculation imparts that the costs are covered within ten years. That is based on an implicit payoff to AE *per se* that is equal to the estimates found in Table 6. If one instead assumes their AE payoff to be zero, which is not unreasonable as their fractions of passing grades in computer science and health related subjects is much lower, the costs are not covered until 23 years have passed. This is reduced to 15 years if one includes payroll taxes (around 40 per cent) when calculating the rise in productivity.¹³ These calculations can of

¹² The yearly costs of an AE participant are set to SEK 34,000 (Swedish National Agency for Education), which is multiplied by the number of registered credits (not necessarily passed) and divided by 500. Foregone earnings per year are estimated separately for each sample and range from SEK 14,000 to SEK 40,000.

¹³ The foregone earnings of AE individuals in higher studies are assumed identical to the preceding sample, both during AE and when in higher studies. The costs of higher education are based on the compensations paid per full-time student distributed to university departments.

course be questioned on several grounds but a first impression, despite the very heterogeneous effects detected, is that the AE investments made within the studied cohort might have been justified.

6 Concluding discussion

The purpose of this study is to analyze improvements in general human capital within a lifelong learning framework. This is done by studying upper secondary adult education (AE) in Sweden. A first purpose is to present estimates of the effects of a year of full-time AE on annual wage earnings. As 40 per cent of the enrollees in AE went on to higher education, a second purpose is to study whether the accomplishments and/or the returns to university studies differ between prior AE participants and non-participants.

Fixed effects regression model estimates indicate that a year of full time AE renders very different returns depending on educational attainment prior to AE enrolment. The preferred estimates apply to those with a two-year upper secondary school and point toward a return of 4.1 per cent for males and 3.6 per cent for females. These estimates are based on the assumption of a proportional payoff. When this is relaxed, positive returns are only associated with at least one year of full time studies unless vocational courses are included among the passing grades. Further, the positive results appear to be driven by more specific knowledge acquired in computer science and health related subjects while general subjects like Swedish, Mathematics, English or social and human sciences are linked to insignificant returns for males and negative returns for females. It is important to stress that, similar to previous studies, the data contains no source of exogenous variation in AE participation. This is problematic as the decision to enrol in AE is non-random and the fixed effects model does not address why participation occurs. Nevertheless, the present study offers the most vigorous estimates so far of the impact on earnings of AE in Sweden or Europe.

Concerning the enrollees in higher education, ability differences are controlled for via the grade point average attained in upper secondary school. Evidence is found of a lower probability to complete four years of tertiary education, particularly compelling in the case of the female sample. The pay-

off on annual wage earnings is generally not found to be different for individuals with prior AE if the university studies amounted to two years or more, but for shorter educations there are significantly lower returns for AE individuals. The result questions the quality of AE as a preparation for higher studies but other candidate explanations include unobservable lower motivation among AE individuals or that non AE individuals have better opportunities to use short educations to get promoted at present employers.

Rough calculations imply that the estimated average effects of AE are sufficient to cover the costs incurred, within six years for those not enrolled in higher education and within 15 years for AE individuals continuing to university.

The results have some important implications for Sweden as well as countries contemplating to introduce AE-like programs. For individuals uninterested in tertiary education, courses associated with specific human capital emerge as a beneficial option while general education does not render any positive returns. The latter appears to primarily serve as a preparation for post-secondary studies. A possible explanation is that there is a weaker payoff to general knowledge for individuals drawn from the lower half of the productivity or income distribution. Recipients of UBS, of which five out of six were unemployed when enrolling in AE, are linked to zero effects. This may be influenced by their studying choices which to a larger extent were in general subjects. Concerning the size of Komvux, the Swedish expansion in the late 1990s was certainly very large, but even in this period; calculations imply that AE was beneficial to the society. This is an interesting result which may be related to the relative ease of access to tertiary education in Sweden, not least through the system of study allowances available to all.

Future studies seeking to evaluate effects of AE would improve our knowledge greatly if some exogenous variation could be found in the enrolment decisions. Important progress could also be made if data would cover a longer time-period and several different (older) age-groups.

Appendix:

Table A.1: Descriptive statistics of males with no registration in higher education.

Prior education	Compulsory		2-year upper sec- ondary		3-year upper sec- ondary	
	AE	Non-AE	AE	Non-AE	AE	Non-AE
% AE courses						
interrupted	.205	-	.187	-	.167	-
compulsory level	.121	-	.042	-	.010	-
supplementary level	.029	-	.040	-	.063	-
introductory level	.006	-	.006	-	.001	-
Foreign born	.060	.039	.035	.024	.031	.026
% on unemployment benefits 1990-1999	.817	.638	.768	.632	.665	.538
Characteristics in 2000:						
Married	.146	.185	.178	.204	.210	.249
Child(ren) aged 0-3	.225	.275	.271	.333	.249	.313
Child(ren) aged 4-	.142	.260	.174	.254	.132	.163
N	639	3,505	2,275	16,339	559	3,192

Table A.2: Descriptive statistics of females with no registration in higher education.

Prior education	Compulsory		2-year upper sec- ondary		3-year upper sec- ondary	
	AE	Non-AE	AE	Non-AE	AE	Non-AE
% AE courses interrupted	.176	-	.135	-	.162	-
compulsory level	.161	-	.050	-	.008	-
supplementary level	.031	-	.029	-	.103	-
introductory level	.011	-	.007	-	.001	-
Foreign born	.071	.044	.045	.028	.040	.030
% on unemployment benefits 1990-2000	.824	.653	.767	.601	.700	.533
Characteristics in 2000:						
Married	.254	.272	.292	.313	.322	.364
Child(ren) aged 0-3	.335	.346	.370	.439	.376	.432
Child(ren) aged 4-	.603	.588	.473	.536	.273	.320
N	975	1,747	3,075	7,837	929	3,157

Table A.3: Descriptive statistics of individuals at some stage registered in higher education.

	Males		Females	
	Prior AE	Non-AE	Prior AE	Non-AE
Grade Point Average	3.30	3.63	3.50	3.71
Foreign born	.028	.021	.038	.024
Characteristics in 1999:				
% on unemployment benefits	.184	.073	.229	.137
Married	.158	.204	.277	.340
Child(ren) aged 0-3	.204	.211	.432	.332
Child(ren) aged 4-	.073	.060	.154	.150
N	2,434	5,989	4,244	6,897

Table A.4: Estimation results of a year in adult education, defined as Credits attained / 500, excluding indicator variable of child below four living at home.

Dependent variable: log annual wage earnings 1988-2001

Males/Females	Compulsory school		2-yr upper secondary		3-yr upper secondary	
	M	F	M	F	M	F
Total sample	.109*** (.0299)	.125*** (.0261)	.014 (.0139)	.096*** (.0141)	-.106*** (.0368)	.154*** (.0347)
N ^{TOT} / N ^{AE}	4229/528	2814/816	18889/1913	11124/2679	3794/448	4151/769
Earnings > 100000	.084*** (.0319)	.129*** (.0312)	.045*** (.0148)	.158*** (.0157)	-.114*** (.0401)	.094** (.0387)
N ^{TOT} / N ^{AE}	4015/390	2288/434	18483/1616	10297/2013	3662/349	3921/605
With UBS	.006 (.0442)	.096*** (.0339)	-.033* (.0189)	.097*** (.0184)	-.175** (.0891)	.207*** (.0792)
N ^{TOT} / N ^{AE}	3662/138	2118/332	16913/523	9035/1099	3217/21	3207/48
No UBS	.192*** (.0393)	.177*** (.0369)	.062*** (.0200)	.089*** (.0206)	-.103** (.0407)	.148*** (.0384)
N ^{TOT} / N ^{AE}	4072/390	2443/484	18315/1390	9926/1580	3769/427	4101/721

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

Note II: N^{TOT} / N^{AE} report total number of individuals and the number with AE. The number of observations is 8.4 – 10.6 times larger.

Table A.5: Estimation results of a year in adult education, defined as Credits attained / 500.

Dependent variable: log annual wage earnings.

Males/Females	Compulsory school		2-yr upper secondary		3-yr upper secondary	
	M	F	M	F	M	F
AE credits	.210 ^{***} (.0383)	.114 ^{***} (.0294)	.054 ^{***} (.0177)	.032 ^{**} (.0157)	-.067 (.0429)	.085 ^{**} (.0421)
% interruptions	.335 ^{***} (.0707)	.179 ^{**} (.0857)	.165 ^{***} (.0290)	-.009 (.0444)	-.142 ^{**} (.0583)	-.043 (.0611)
% compulsory AE	.327 ^{***} (.1158)	-.103 (.1081)	-.131 (.0853)	.171 [*] (.0980)	-.174 (.3938)	-1.559 ^{***} (.3821)
% supplement AE	.703 ^{***} (.2515)	-.424 (.2601)	-.016 (.0792)	.240 ^{**} (.1181)	.176 (.1174)	.079 (.0853)
% introductory AE	.083 (.9084)	.127 (.5566)	-1.345 ^{***} (.2609)	.319 (.3771)	-1.893 (1.399)	-5.156 ^{***} (1.535)
Lag child(ren) 0-3	-.002 (.0105)	-.350 ^{***} (.0136)	-.009 ^{**} (.0040)	-.456 ^{***} (.0060)	-.031 ^{***} (.0105)	-.556 ^{***} (.0099)
R-sq within	.112	.082	.134	.078	.226	.100
N ^{TOT} / N ^{AE}	4144/639	2722/975	18614/2275	10912/3075	3751/559	4086/929

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

Note II: N^{AE} / N^{TOT} report number of individuals with AE and total number of individuals. The number of observations is 8.4 – 10.6 times larger.

Table A.6: Wage earnings regression on individuals with registration in higher studies.

Dependent variable: Log annual wage earnings in 2002.

	Males	Females
Years of studies	.082 ^{***} (.0073)	.054 ^{***} (.0111)
AE * yrs of studies	-.011 (.0073)	-.013 (.0089)
Grade point average	.001 ^{***} (.0003)	.001 ^{***} (.0004)
Foreign born	-.192 ^{***} (.0576)	.042 (.0687)
Married in 1999	.051 ^{**} (.0232)	-.201 ^{***} (.0265)
Child(ren) 0-3 in 1999	-.003 (.0184)	-.065 ^{***} (.0204)
Child(ren) 4-6 in 1999	-.015 (.0383)	.065 ^{**} (.0333)
Child(ren) 7-10 in 1999	.046 (.0635)	.146 ^{***} (.0559)
Transfers received in 1999:		
Unemp. benef.	-9.7*10 ⁻⁶ ^{***} (7.0*10 ⁻⁷)	-6.8*10 ⁻⁶ ^{***} (9.1*10 ⁻⁷)
Study allowance	-9.6*10 ⁻⁷ (3.1*10 ⁻⁶)	-4.4*10 ⁻⁶ (3.2*10 ⁻⁶)
Sick-leave	-7.4*10 ⁻⁶ ^{***} (1.5*10 ⁻⁶)	-1.0*10 ⁻⁵ ^{***} (1.1*10 ⁻⁶)
Pensions	-3.2*10 ⁻⁵ ^{***} (5.8*10 ⁻⁶)	-3.9*10 ⁻⁵ ^{***} (7.8*10 ⁻⁶)
N	7,350	8,465
Adj R ²	.077	.044

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

Note II: Coefficients on dummies of last year in higher education, 1991-2000, are not displayed.

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