Upgrading Low Skilled Adults;

Is Public Provision of Formal Education A Sensible Policy?

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Abstract

Upgrading the educational level of low skilled adults is in theory linked to numerous benefits for society. However, employers are reluctant to train low skilled, who in their turn are unwilling to participate due to financial constraints and/or a perception of low quality and/or returns to training. If this is a market imperfection, a remedy is suggested by public provision of formal education where enrollees are eligible for financial support. Drawbacks include that the costs involved are potentially large and, in addition, the economic return to formal adult education (AE) for low skilled, a crucial measure to assess if expenses should be increased or decreased, is a virtually unexplored issue. These uncertainties may partly explain why AE is used very differently across countries. In Sweden, registration in AE yearly attracts about two per cent of the labour force. Using register data 1990-2004 of low skilled siblings, aged 24-43 in 1994, the results indicate a year of AE increase earnings by 3.9 per cent, but calculations imply that it is insufficient to cover the total costs incurred for society.

Keywords: Adult education, wage earnings

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1 Introduction

Adjustments in the demand for skills have been proposed to follow a secular pattern which favours high skilled workers (Katz and Murphy 1992, Machin and Van Reenen 1998, Acemoglu 2002, Autor *et al*. 2008). In this perspective, upgrading the qualifications of low skilled workers is potentially associated with substantial gains for the individual and for the society as it may boost their productivity and employability. It could also have more far-reaching effects as education is believed to, *inter alia*, improve overall economic growth and contribute to social cohesion and democracy (Krueger and Lindahl 2001, Gradstein and Justman 2002, Glaeser *et al*. 2007). Empirical data indicate that while the incidence of training among employed in many countries is between 25 and 50 per cent per year (OECD 2004, 2006), a consistent pattern is that it is of short duration and mainly involves high skilled (e.g. Brunello 2001, Arulampala *et al.* 2004). It partly reflects employers' preferences to invest in already productive individuals but also unwillingness among low skilled to participate due to a perception of low quality and/or returns to training and/or due to financial constraints (OECD 2003, 2006). If this is a market imperfection, a remedy is suggested by public provision of formal education, i.e. schooling integrated into well known, structured and certified programs, where participants are eligible for financial support. It would alleviate financial constraints, improve the quality of training and (information on) the returns and also circumvent employers reluctance to engage low skilled in training. However, returning to education to obtain complementary or higher qualifications occurs almost exclusively at early stages of working life, taking the form of extended initial education (Müller and Kogan, 2008). This is perhaps understandable since policies encouraging adults to return to education may incur large costs to society, not least in terms of foregone production value. Also, empirical evaluations of labour market training programs have shown mixed results (Heckman *et al.* 1999, Kluve, 2006) but until now, the direct empirical research on the economic returns of formal education for low skilled, a crucial measure to assess if expenses should be increased or decreased, is virtually non-existent. The present paper seeks to fill some of this gap in the economics literature.[1]

The purpose of this article is to evaluate the earnings impact of formal adult education among low skilled by analyzing Swedish register data on siblings 1990-2004, aged 24-43 in 1994. Sweden is a suitable country for this kind of evaluation as considerable investments have been made to supply adult education (henceforth AE) at compulsory level,

[1] AE is sometimes set in contrast to early intervention policies. However, rather than merely assisting individuals who were low-achievers in school, the demand for AE is related to dynamic issues such as structural changes, changes in information, relative wages, preferences, health, borrowing constraints or in the individual's discount rate (Weiss, 1971, Iwahashi, 2004, Wallace and Ihnen, 1975, Killingsworth, 1982, Altonji, 1993, Sjögren and Sällström, 2004, Warner and Pleeter 2001).

upper secondary level and tertiary level. Participants are eligible for study allowances, sufficient to cover modest living expenses. The numbers registered in AE represent each year about 2 per cent of the labour force and data on course transcripts are available.

Studies of AE in Sweden have so far presented rather incoherent results. Ekström (2003) reported *negative* earnings effects of 3-6 per cent for males, and insignificant effects for females. Albrecht, Van den Bergh and Vroman (2004) found no returns for males or females while Stenberg and Westerlund (2008) reported positive effects of AE for long-term unemployed, but with point estimates decreasing for those with the longest duration in AE. These studies regard participants aged 25-55 but a drawback is that binary variables are used to indicate registration/no registration in AE. Information on course credits at compulsory and upper secondary level are disregarded, as is any further education at tertiary level. Studies in the US have had less reason to take an interest in AE at upper secondary level (high school) as the completion of the General Equivalency Diploma is linked to eligibility for higher education. Research on the economic return to AE has instead been based on accomplished course credits at community college, which mainly involve education at tertiary level. Jacobson, LaLonde and Sullivan (2005) analyzed a sample of laid-off workers aged 20-59 in Washington State, including 16,000 participants in community college. With access to data on quarterly earnings two years before and four years after displacement, individual specific fixed effects estimates indicated a year of studies was associated with a 9 per cent earnings gain for men and 13 per cent for women, a payoff which was found to cover the costs incurred by the society. A major difference compared with AE in Sweden is that there is generally no financial aid for participants and low skilled are less likely to enroll. More than 90 per cent of their sample had at least a high school degree and about 50 per cent had completed some college earlier in life. Thus, their results are not necessarily applicable to low skilled and/or to a situation where study allowances decrease the opportunity costs, aspects which potentially influence participation, the amount of studies and the expected returns.[2] Compared with the present study, one may also expect the returns to be lower as labour markets in Europe are characterized by more compressed distributions of wages as well as of skills than in the US (e.g. Harjes, 2007, IALS, 2000).

The contribution of this study is to evaluate the earnings return to accomplished formal education for individuals who are ineligible for tertiary education at the outset, but eligible for study allowances (app. €800 per month). To identify causal effects, a difference-

[2] Zhang and Palameta (2006), using Canadian survey data collected over six years, studied a smaller sample of participants (1,462 individuals). Positive earnings effects were only found for individuals aged 17-34 who had completed a certificate. No significant effects were found for individuals aged 35-59. Other studies on U.S. data have evaluated college for individuals returning after a couple of years of work experience (Light 1995, Monks 1997, Leigh and Gill 1997, Grubb 2002).

in-differences framework is used assuming family fixed effects for individuals with the same parents. The estimated returns are also set in relation to the costs incurred. The main finding is that a year of AE on average increases earnings by 3.9 per cent, implying that AE is a tool to assist low skilled workers against a fall in employment and/or wages. However, calculations indicate that the returns are insufficient to cover the total costs for society.

The plan of the paper is the following; the next section briefly outlines the educational system in Sweden and the role of AE. Section 3 contains a description of the data and the empirical method and estimates of the earnings return are presented in Section 4. In Section 5, the results are set in relation to the costs incurred. The findings are summarized and discussed in a concluding section.

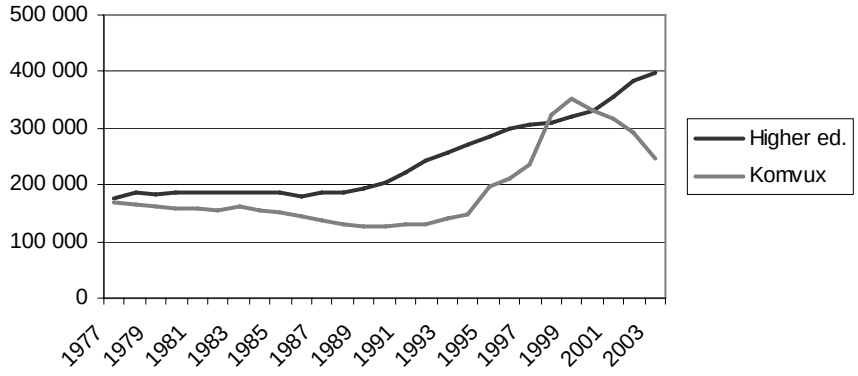
2 The Swedish educational system

All public education in Sweden is free of charge. Compulsory school is nine years, carried out between the age of seven and fifteen. It is followed by upper secondary school, which until 1996 consisted of about 20 two year programs, mainly vocational, and five different theoretical three year programs (roughly equal to senior high school). The latter also meet the general admission requirement for entering university studies. For individuals at least 25 years old, this could also be achieved through four years of work experience and passing grades in Swedish and English at a three year upper secondary level.

AE at upper secondary level offers those with short educations the opportunity to improve and/or redirect educational qualifications, and also to obtain eligibility for studies at tertiary level. The institutional set up encourages adults to enrol in AE. First, participants are eligible for study allowances sufficient to cover modest living expenses (app. €800 per month). One third is a grant and two thirds are to be repaid under favourable conditions. Second, legislation since 1974 entitles employees to be on leave to attend any kind of training and to be reinstated with the same working conditions and the same pay. Third, the supply of AE is vast and free of charge as Swedish municipalities since 1969 are demanded by law to offer adult schooling at compulsory and upper secondary level. The institute responsible for these courses is *Komvux*. For those who wish to continue with tertiary education, it is offered in about 30 cities (in a population of 9 million), ranging from traditional (theoretical) university studies to vocational programs where one third of the education takes place in a workplace (*Kvalificerad yrkesutbildning*). Thus, tertiary level studies are to some extent designed for specific occupations and professions.

Figure 1 illustrates the numbers registered in Komvux and in higher education since the late 1970s. As a point of reference, the population aged 16-64 varied around 5.6 million. At the start of the 1990s, the participation rates were influenced by that Sweden underwent a deep recession. Unemployment soared 1990-1993 from 1.7 to 8.2 per cent before gradually decreasing to 4 per cent in 2000. From 1993, the government started to support municipalities in providing seats at Komvux for unemployed individuals. It preceded the introduction of "The Adult Education Initiative" from the autumn of 1997 until 2002 which involved a year of full-time studies at Komvux with participants entitled to a Special Grant for Education and Training (UBS), equal to a maintained unemployment insurance benefit. In the second half of the 1990s, the numbers in Komvux were comparable to the roughly 300,000 per year in regular upper secondary school for youths. The public expenditures in Komvux then amounted to about one fourth of that for regular upper secondary education. During these years, the expansion of tertiary education gradually increased the geographical access as well as the probability of being accepted to various study programmes.

Figure 1. Number of enrollees in higher education and Komvux 1977 – 2003.



Looking at the Swedish educational structure in a broader context, it is a common feature that comprehensive schooling of some length is followed by choices regarding the emphasis on theoretical or vocational skills. However, countries diverge, sometimes substantially, in the degree of stratification. With a high level of stratification, the differences in educational contents are greater between adults whereas in Sweden, all educational paths share a relatively large element of general education and this element of "commonality" may facilitate both re-schooling for adults and future on-the-job learning. An analysis of this topic is important when designing an appropriate supply of AE, but beyond the scope of this paper.

3 Data and descriptive statistics

The longitudinal data of this study originate from several registers administered by Statistics Sweden. They provide information on participation in AE, transfer payments, annual wage earnings, studies in higher education and records on siblings and parents. The registers cover the whole population residing in Sweden from 1981 and onwards. Participation and course registration in AE is available from 1979 but information on course completion and grades is only reliable from 1994.

The sample is limited to consists of individuals 24-43 years old in 1994 with an educational level conditioned to be two year upper secondary level or shorter.[3] Foreign born are excluded if their latest immigration occurred after they were 6 years old, as are individuals registered in AE between 1979 and 1993. AE participants are considered in the "treatment group" if they completed their first semester in AE at some stage 1994-1995 while the control group is conditioned to not have enrolled in AE before 1996. This constitutes what will be referred to as the "population sample". From the population sample a "sibling sample" is extracted consisting of those in the treatment group who have at least one sister or brother with the same parents who fulfil the conditions mentioned above. The non-participating siblings then constitute the control group. Table 1 shows descriptive statistics of treated and control group members of the population sample and the sibling sample. Males are overrepresented among low skilled (.532) and even more so as those in AE 1993 or earlier are excluded (.584). Among AE enrollees, about two thirds are female. Descriptive data of males and females (brothers and sisters) are presented in Tables A.1 and A.2 in the Appendix.

[3] In 1994, this condition includes about 60 per cent of each cohort.

Table 1. Descriptive statistics of enrollees and control groups of population sample and sibling sample.

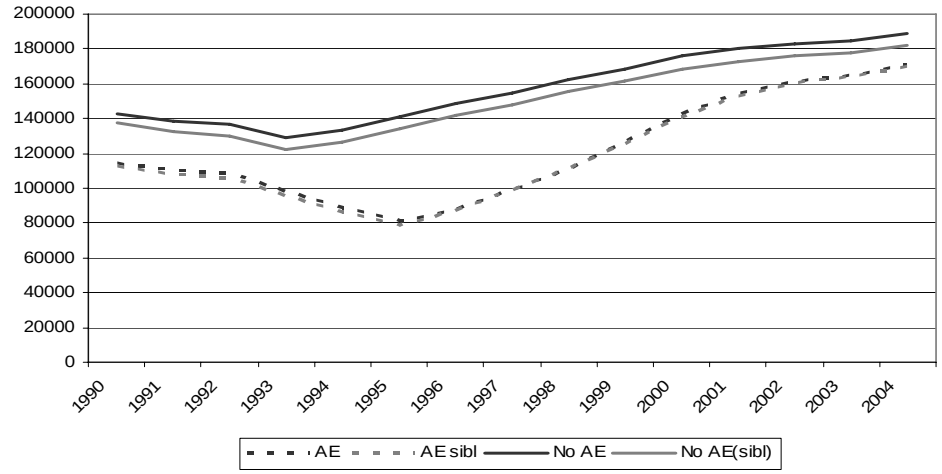
	Population sample		**Sibling sample**	
	AE	Control group	AE	Control group
N	29300	782643	13728	19696
Male	.366	.594	.340	.599
Age	30.75	33.17	31.23	32.48
Years of schooling	10.38	10.27	10.32	10.23
Less than compulsory school (< 9 years)	.009	.027	.011	.023
Compulsory school (9 years)	.245	.275	.270	.307
1-year upper secondary school (10 years)	.093	.070	.096	.065
2-year upper secondary school (11 years)	.653	.629	.623	.605
Zero annual earnings 1992	.134	.115	.141	.130
Child(ren) at home	1.167	1.138	1.306	1.177
Parental leave transfer 1993 > 0	.233	.175	.253	.193
Unemployment insurance 1993 > 0	.313	.214	.314	.235
Other unemployment related transfers > 0	.185	.112	.177	.131
Sick-leave 1993 > 0	.275	.203	.284	.224
Pension 1993 > 0	.015	.031	.016	.030
Social welfare 1993 > 0	.165	.087	.175	.120
Foreign born	.024	.019	.022	.022
Regional employment	.725	.723	.723	.722
Stockholm county	.180	.142	.160	.142
Inland of Norrland	.052	.059	.056	.062

The 29,300 defined as AE enrollees represent 3.7 per cent of the population sample or, put differently, 1.4 per cent of the labour force aged 24-43.[4] They are on average slightly younger but participation is pertinent across all age groups, ranging from 2 per cent to 7.5 per cent (youngest cohort). Participants were more likely to receive unemployment benefits, sick-leave or social welfare transfers during 1993. As one would expect, the differences in mean values between treated and controls are overall smaller in the sibling sample, the exception being the number of children at home.

Figure 2 displays the annual earnings trajectories of the samples. The sibling control group earnings are throughout the period between 5 and 7 per cent below the population sample control group. In contrast, the treated of the sibling sample and the population sample display very similar earnings pre-program, during program and post-program, , making the pre-program earnings gap between treated and untreated about one fifth smaller in the sibling sample.

[4] Although Pont (2004) finds the extent of adult training difficult to compare between countries as it takes many shapes and financing arrangements vary, it appears safe to say that formal AE is exceptionally large in Sweden.

Figure 2. Annual earnings (SEK 2004); AE enrollees 1994-95 and control groups.



There is a rather long period of low earnings following the first enrolment in 1994, although the gaps vis-à-vis the control groups are smaller in 2004 compared to the pre-enrolment years 1990-1992. Table 2 presents percentage increases in average earnings, using 1992 as the base year. In 1999, five years after the first registration in AE, the increases are larger for the control groups relative to participants. Two years later, in 2001, the relation has switched to the advantage of the AE individuals.

Table 2. Annual earnings of AE enrollees in 1994-95 and control groups.

Annual earnings stated in thousands of SEK 2004 prices.
Percentage earnings changes as measured from 1992.

	Average 1990-1992	**1999**		**2001**		**2004**	
Population sample							
Controls	139.4	168.8	21.1%	180.7	29.6%	188.8	35.4%
AE	111.2	126.5	13.7%	154.8	39.2%	171.1	53.8%
Sibling sample							
Controls	133.5	161.1	20.7%	172.5	29.2%	182.0	36.3%
AE	109.0	126.0	15.6%	153.1	40.6%	170.0	56.0%

The long period of low earnings is partly explained by that enrollees often returned to AE several years after their initial registration. About 55 per cent of the enrollees had their last registration in AE in 1998 or earlier, by 2001 this figure was 78 per cent. The delay in full re-entry to the labour market is presumably driven by the generous conditions to re-enrol from the autumn of 1997 when the Adult Education Initiative was implemented. It is essential to keep these aspects in mind and they will be addressed again in the empirical section.

As long as registration concerns credits at Komvux, each course is linked to a number of lecture hours which is equal to its number of credits. The course credits of each individual are accumulated (1) within each semester and (2) across semesters. The sum of credits is the number of *registered* course credits.[5] Adding the condition that a passing grade has been reported; the sum constitutes the *completed* number of credits. As for higher education, there are no records of registrations but any completed tertiary studies are added to constitute the "Total years of AE". Figure 3 presents the distribution of accomplished AE among the treated, as recorded from 1994 to 2004, all levels accumulated and given at least one credit (11.6 per cent completed zero credits). Almost one third of the enrollees recorded less than half a year of full time studies.

Figur 3. Distribution of completed AE among treated in the population sample.

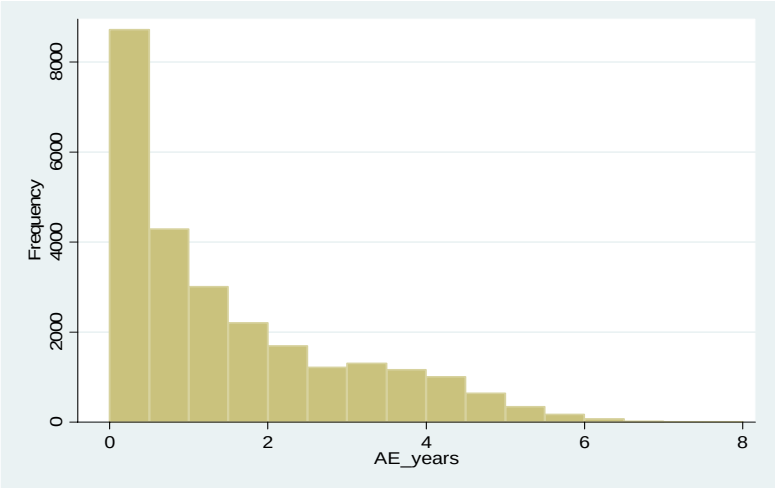


Table 3 presents a detailed account of the studies at Komvux and ensuing higher education. Corresponding gender specific statistics are provided in Table A.3 and A.4 in the Appendix. About two thirds of the registered credits at compulsory and upper secondary level are completed (completion rates are stable regardless of age prior to enrolment) with the majority attending traditional subjects like Swedish, English, mathematics and social science. Concerning those in higher education, Statistics Sweden separates seven main study directions and there were strong gender patterns with more than one third of the males in technical subjects and a third of the females in health related educations (not displayed). Males were otherwise more evenly dispersed between the other categories (4 to 14 per cent) while larger fractions of females were observed in pedagogy and social sciences (20 per cent) but otherwise below 5 per cent (the others are services, human sciences and natural sciences).

[5] Following Skolverket (2000), credits at Komvux are divided by 500 to express the amount of education in years. The records of Statistics Sweden do not contain information on upper secondary school diplomas attained via AE.

Table 3: Adult education accomplished.

	Population sample		Sibling sample	
	AE	Control group	AE	Control group
N	29300	782643	13728	19696
Share in adult schooling until 2004	1.00	.209	1.00	.234
Compulsory				
Fraction registered	.255	.023	.276	.030
Registered compulsory credits (years)	.144	.021	.168	.032
Completed compulsory credits (years)	.056	.007	.064	.009
Upper secondary				
Fraction registered	.826	.151	.813	.170
Registered upper secondary credits (years)	1.012	.216	1.013	.250
Completed upper secondary credits (years)	.697	.133	.692	.152
Frequency of upper secondary subjects				
Mathematics	.544	.077	.522	.094
English	.546	.074	.519	.089
Swedish	.517	.074	.496	.092
Social sciences	.688	.118	.681	.137
Natural sciences	.322	.036	.307	.045
Human sciences	.218	.033	.206	.037
Computer sciences	.611	.131	.618	.147
Health sciences	.300	.054	.313	.063
Vocational course	.111	.028	.102	.030
Fraction with higher education until 2004	.277	.041	.247	.044
Fraction with less than 1 year	.043	.005	.048	.005
Fraction with 1-2 years	.053	.011	.045	.013
Fraction with 2-3 years	.042	.010	.036	.010
Fraction with 3-4 years	.112	.013	.098	.014
Fraction with 4 years or more	.023	.002	.020	.002
Total years of higher education	.580	.082	.506	.085
Total years of AE [a)]	1.333	.222	1.263	.246

Note: [a)] Accomplished upper secondary and tertiary level AE.

4 Empirical method and results

In this section, the empirical model used to estimate the impact of a year of AE on annual earnings is presented. The main results follow in Section 4.2 while further estimates explore heterogeneous effects in Section 4.3. The presented results are reconciled with earlier conflicting evaluations of AE in Sweden in Section 4.4.

4.1 Empirical model

To identify causal effects of AE on annual earnings, the strategy in this paper is to estimate OLS regressions using difference-in-differences and family fixed effects. To be explicit, assume for the moment AE is a binary variable *D* which takes the value one for

participation and zero otherwise. AE occurs at time *t* and subscripts *t+* and *t-* denote observations pre- and post-AE respectively. Let further subscripts denote individual *i* and family *j*, so that:

$$\Delta Y_{ijt+} = \alpha + X_{ijt-}\beta + \gamma D_{ijt} + f_{ij} + \varepsilon_{ij}. \qquad [1]$$

The dependent variable is the change in annual earnings *Y* (expressed in SEK 2004 prices) compared pre- and post treatment; defined $\Delta Y_{ijt+} = (Y_{2004} - (Y_{1992}+Y_{1991}+Y_{1990})/3)$. The difference-in-differences framework takes into account time consistent individual unobservable characteristics which influence earnings (e.g. motivation, work ethics).[6] It is assumed to take into account any remaining difference in ability and/or motivation which is not captured by the explanatory variables in the vector X_{ijt-} or by the family fixed effects, f_{ij}. The variables in X_{ijt-} are essentially based on those presented in Table 1 and on measures of earnings dynamics prior to enrolment.[7] The family fixed effects net out differences in omitted variables reflected in permanent family characteristics. There is ample evidence that family background is associated with characteristics such as psychological distress, educational attainment and labour market outcomes, including the probability to withdraw from the labour market (e.g. Björklund and Sundström 2005, Ermisch and Francesconi, 2001). However, the family fixed effects also filter out exogenous variation, and the benefit in terms of reducing bias in the regression estimates of γ hinges on that the proportion of the variation in AE which is endogenous is smaller between siblings compared with the case of the population sample (Griliches, 1979, Bound and Solon, 1999). Table A.5 displays the mean standard deviations between and within families of the sibling sample, indicating that f_{ij} primarily absorbs exogenous variation in regional characteristics, age and foreign background.

The binary event variable D_{ijt} is the traditional indicator used in the program evaluation literature. As the present data measure AE directly, the OLS framework makes it easy to introduce a continuous measure of AE, denoted E_{ijt}, which corresponds to the variable in Table 3 labelled "Total years of AE", such that

$$\Delta Y_{ijt+} = \alpha + X_{ijt-}\beta + f_{ij} + \gamma D_{ijt}E_{ijt} + \varepsilon_{ij}. \qquad [2]$$

[6] In a meta analysis of bias in non-experimental estimators, Glazerman *et al*. (2003) explore in total 1,150 estimates of program effects where experimentally derived results have been replicated with non-experimental methods. The distribution of the bias was centred on zero but policy-relevant divergences arose. However, a repeated finding was that pre-program earnings, to control for individual differences, substantially reduce bias (see also Heckman *et al*., 1999, Smith and Todd, 2005).

[7] X_{ijt-} encompasses earnings change 1990-1992 and squared, and 1992-1993. This is sometimes referred to as the difference-in-difference-in-difference estimator. Other variables in X_{ijt-} are family birth-order, age dummies, age squared and cubic, regional characteristics, indicator variables of the number of children, of five age-spans of children, of zero earnings in 1992, of foreign background, indicators and levels (and squared levels) of parental leave benefits 1991, 1992 and 1993, indicators and levels of unemployment benefits and of the other transfers in Table 1. All variables are interacted with gender dummies in the pooled regressions.

The estimate of γ now reflects a proportional effect of AE, comparable to estimates obtained in the return to schooling literature. The coefficient is identified by siblings with identical parents who complete different amounts of AE, meaning that it is identified not only by the variation in participation (D_{ijt}) between siblings, but also between siblings with different amounts of AE, reflected in E_{ijt}. Note also that if a participant returns to AE in 2004, and subsequently earns less than in previous years, it is seen as part of the outcome. This aspect is further discussed below.

4.2 Main results

Table 4 presents a first set of estimation results which cover both the binary and the proportional measures of AE discussed above. The top of the table shows estimates obtained with the population sample. The sibling sample estimates are presented in two separate parts where family fixed effects are introduced in the segment at the bottom (corresponding gender specific estimates are found in Table A.6 and A.7 in the Appendix). The first two columns concern descriptive estimates where the explanatory variables in X_{ijt-} have been left out whereas in columns (3) and (4), the explanatory variables in X_{ijt-} are included. The estimates indicate an overall positive relationship between AE and changes in earnings.[8] All estimates tend to decrease with the amount of explanatory variables, whether X_{ijt-}, family ID or both. The proportional estimate with family fixed effects of SEK 6,793 represents about €760 and is considered the most compelling. Besides the argument of additional controls, the sibling sample is by itself likely to reduce selection bias as the characteristics of the explanatory variables to a greater extent overlap between the individuals identifying the treatment effect (Heckman *et al.* 1999, section 8.2).[9]

[8] Propensity score estimations can be compared to the parameters D_{ijt}, the value obtained with the sibling sample is, 9,789, about 5 per cent higher than the coefficient presented above. These are based on the Epanechnikov kernel with bandwidth .02, a common support restriction and 5 percent of the observations are deleted where the propensity score density of the control observations are the lowest.

[9] It is well known that family fixed effects aggravate downward bias from measurement errors in the AE variable. However, this is probably not a big problem as the collection of the data forms the basis for the distribution of resources at the municipal level (Komvux) and the government level (tertiary education).

Table 4. Estimates of earnings effects of AE (SEK 2004 prices).

Dependent variable: Earnings difference $\Delta Y_{ijt+} = (Y_{2004} - (Y_{1992}+Y_{1991}+Y_{1990})/3)$

	Population sample			
	(1)	(2)	(3)	(4)
Average effect (D_{ijt})	10523***		6828***	
	(663)		(631)	
Proportional effect (E_{ijt})		7833***		5807***
		(332)		(314)
Including X_{ijt-}	No	No	Yes	Yes
Including f_{ij}	No	No	No	No
	Sibling sample			
	(1)	(2)	(3)	(4)
Average effect (D_{ijt})	12595***		9384***	
	(1234)		(1231)	
Proportional effect (E_{ijt})		9273***		7429***
		(552)		(541)
Including X_{ijt-}	No	No	Yes	Yes
Including f_{ij}	No	No	No	No
	Sibling sample - Family fixed effects			
	(1)	(2)	(3)	(4)
Average effect (D_{ijt})	10546***		7305***	
	(1293)		(1337)	
Proportional effect (E_{ijt})		8107***		6793***
		(682)		(684)
Including X_{ijt-}	No	No	Yes	Yes
Including f_{ij}	Yes	Yes	Yes	Yes

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

Table 5 summarizes the main results. To make parameter values intelligible, they are expressed in percentage terms relative to the earnings level in 2004 of the respective treated samples. With this definition, the sibling sample coefficient of the total effect represents 3.9 per cent which is in line with the 3.5 to 4.5 per cent payoff reported in Swedish returns to schooling literature (Isacsson 1999, Kjellström 1999, and Meghir and Palme, 2000), and higher than the 3.3 per cent obtained with the population sample. The coefficient of the brother sample is lower and in percentage terms it corresponds to 2.4 per cent compared with 4.2 per cent for sisters. The coefficient 6,793 of the sibling sample is higher than the estimates of both the brothers and the sisters. It appears as if the returns for both males and females are slightly higher if at least one sibling is of the opposite gender, and individuals from such families are by definition underrepresented in the samples of brothers and sisters respectively. [10] Introducing an interaction term as a test of whether the earnings payoff of AE differs from the average, the coefficient is negative with a *p*-value of .21 (with the population sample .15). As these families are on average larger, numerous tests were run but without discerning the mechanisms behind this pattern.

[10] Estimates of gender specific coefficients with the full sibling sample are 5,240 and 7,545, corresponding to 2.5 per cent and 4.8 per cent respectively. The parameters are not significantly different from one another.

Table 5. Estimates of earnings effects of AE (SEK 2004 prices).

Dependent variable: Earnings difference $\Delta Y_{ijt+} = (Y_{2004} - (Y_{1992}+Y_{1991}+Y_{1990})/3)$

	Population sample		**Family fixed effects**	
	Full sample		Full sibling sample	
Proportional effect (E_{ijt})	5807***	3.3 %	6793***	3.9 %
	(314)		(684)	
	Males		Brothers	
Proportional effect (E_{ijt})	4454***	2.1 %	4983***	2.4 %
	(600)		(1731)	
	Females		Sisters	
Proportional effect (E_{ijt})	6468***	4.1 %	6440***	4.2 %
	(327)		(1028)	

Notes: ***significant at the 1 % level. **at the 5 % level. *at the 10 % level.
Percentages express the coefficient value in relation to average earnings of treated with non-zero accomplished AE.

Among the treated AE individuals, more than 20 per cent was enrolled in education in 2002 or later. They do not continuously remain in AE, only 2.8 per cent was registered every year from 2000, but treated individuals tend to return for further studies. Also among controls, the fractions enrolled in AE post 2001 was about 10 per cent. To check if the estimated value in Table 5 is sensitive to the timing of the evaluation, one may pretend earnings data is only available until 2003, then until 2002 and so forth. Table A.8 in the Appendix shows, as expected, that the parameter values increase over time and had 2001 been the evaluation year, or earlier, there would have been no way for us to discern a figure in the region of 4 per cent. The results from 2002 and onwards only vary by .1 per cent but given that average earnings do not decrease once the enrolment period is over, future estimates could hypothetically continue to increase. Alternatively, some negative shock could also reduce the average returns to AE and/or increase the flow back into AE. Data obviously sets a limit for the possibilities to pursue this issue.

4.3 Heterogeneous effects

To test if there are heterogeneous effects of AE on earnings, the model is augmented with interaction terms between the amount of AE (E_{ijt}) and indicator variables of gender, age, education or earnings prior to enrolment. The results are displayed in Table 6. Parameters of the interaction terms are overall negative, but insignificant when estimated with the sibling sample, *p*-values are between .14 and .22 except for the group with earnings in 1992 below SEK 100,000 (to be further discussed below). If one includes singletons (all treated from the population sample) to reduce the standard errors of the sibling sample estimates, the *p*-values remain in the interval .14 to .20. Using brother or sister samples, the *p*-values increase except for sisters with some upper secondary school which is significantly negative at a 10 per cent level. In sum, there is no convincing evidence of differ-

ences in the returns which depend on prior education, gender or age. The latter result corroborates Jacobson *et al.* (2003), who concluded there was no significant difference in the payoff between young and old (20-34 compared with 35-59).

Table 6. Interaction variable estimates based on gender, education, age and earnings prior to enrolment.

Dependent variable: Earnings difference $\Delta Y_{ijt+} = (Y_{2004} - (Y_{1992}+Y_{1991}+Y_{1990})/3)$

	Population sample			
Proportional effect (E_{ijt})	6459***	8894***	7312***	- 602
	(383)	(735)	(670)	(398)
Interaction variable * (E_{ijt})	Male	High educ.[a)]	Age 24-33	Low earnings[b)]
	- 1994***	- 3772***	- 1930**	12509***
	(670)	(812)	(758)	(634)
	Sibling sample - Family fixed effects			
Proportional effect (E_{ijt})	7545***	8506***	8526***	2341***
	(851)	(1558)	(1386)	(866)
Interaction variable * (E_{ijt})	Male	High educ.[a)]	Age 24-33	Low earnings[b)]
	- 2305	- 2139	- 2325	11467***
	(1556)	(1748)	(1618)	(1373)

Notes: ***significant at the 1 % level. **at the 5 % level. *at the 10 % level.
[a)] "Low educ." refers to compulsory school or less; "High educ." to some upper secondary school.
[b)] "Low earnings" refers to nominal earnings below SEK 100,000 in 1992.

Low earnings prior to enrolment are associated with significantly higher returns, a result which mirrors the composition of the earnings impact. With access to data on both hourly wages and earnings, Jacobson *et al.* (2005) estimated "about a third" of the earnings impact to consist of higher hourly wages and the rest originating from more hours worked. In his survey of the returns to schooling literature, Card (1999) reported approximately two thirds originated from wage increases. Although the classification is rather blunt, the result in Table 6 is reasonable as one would expect fewer incentives and/or possibilities to increase working hours the closer employees are to full-time work. Thus, even though low earnings prior to program may signal a negative selection in terms of motivation, health and/or self-esteem, it also suggests a large "room for improvement" in terms of the number of hours worked. [11]

Heterogeneous effects of specific studying paths are awkward to disentangle as course subjects are combined in numerous ways. If one singles out subjects studied at tertiary level, the returns to AE for those in human sciences are significantly lower compared

[11] An objection to the conditioning on low earnings is that a classical problem in evaluations is an earnings dip prior to enrolment. However, changes in earnings prior to enrolment are controlled for in the regression specification. In addition, descriptive statistics in Figure A.1 in the Appendix do not show any such signs. The limit value of 100,000 represents the 41st percentile of the population sample, 43rd of the sibling sample. It is not entirely arbitrary but based on Antelius and Björklund (2000) who estimated Mincer equations on annual earnings (register data) and hourly wages (survey data). They found that the education-earnings estimate converged to the education-wage estimate when earners below SEK 100,000 (in 1991) were excluded.

with average whereas it is significantly higher for educations in health related subjects and for technical subjects (not displayed).

The main estimates so far presume a linear relation between AE and earnings. To explore how sensitive the results are to this assumption, Table 7 presents results where a step function of binary variables, indicating yearly intervals of completed AE, allows the returns to be non-linear. Also, proportional returns *within* each category are estimated by including interaction terms with the exact amounts of AE. The results indicate non-linear and even non-monotonic returns. Focusing on the sibling sample, it particularly concerns those with 2-3 years of AE. The coefficient of the binary variable is slightly lower compared with 1-2 years, and the point estimate of the proportional return is relatively small and significant only at a 10 per cent level.[12] While at odds with theory, a tempting hypothesis is that non-linear patterns partly arise because groups differ systematically in their year of last AE registration. While excluding individuals in AE in 2002 or later violates the conditional mean independence assumption, a more regular and linear pattern is in fact obtained with such a regression (the exclusion also involving some 10 per cent of the controls). Of course, it does not exclude the hypothesis of non-linear returns to AE but it indicates that the distortions from a more regular pattern are related to the individuals in re-enrolment.[13]

Table 7: Estimates allowing for non-linear returns to AE.

Dependent variable: Earnings difference $\Delta Y_{ijt+} = (Y_{2004} - (Y_{1992}+Y_{1991}+Y_{1990})/3)$

	Population sample			**Sibling sample - Family fixed effects**		
	N^{AE}	Binary [a]	Proportional[b]	N^{AE}	Binary [a]	Proportional[b]
Zero completed credits	3,388	- 10445***		1,667	- 12267***	
		(1809)			(3431)	
< 1 year of AE	12,897	5575***	5718***	6,177	4543	4526
		(934)	(1979)		(1852)	(3882)
1-2 years	5,277	- 339	- 306	2,591	8902***	5371***
		(1452)	(992)		(2839)	(1939)
2-3 years	2,880	6431***	2382***	1,286	7604*	2677*
		(1960)	(803)		(3954)	(1622)
3-4 years	2,550	28877***	8379***	1,037	30846***	8831***
		(2083)	(601)		(4423)	(1275)
4 years or more	2,308	31854***	6680***	970	36339***	7603***
		(2188)	(458)		(4617)	(963)

Notes: ***significant at the 1 % level. **at the 5 % level. *at the 10 % level.
N^{AE} = Number of treated in stated interval of studies.
[a] Dummy variables indicating the stated interval of studies.
[b] Amount of AE (E_{ijt}) interacted with dummy variable indicating the stated interval of studies.

[12] For the group 1-2 years, the difference between the sibling and population samples in the outcome variable is visible already in descriptive statistics. The distribution is typically more compressed in the sibling sample, but for this particular group, all percentile values of the sibling sample are higher (i.e. not only those below the 50th percentile).

[13] Except for the group with less than one year of AE, the proportional returns of the sibling sample vary around 10,000 (from 8,656 to 11,665), and the estimates of the dummy variables rise monotonically by 7,200 or more with each interval year of AE. The average "year of last registration" also rises monotonically.

A disturbing result in Table 7, unrelated to the last year of AE registration, is that the group of treated with zero accomplished credits is associated with large negative effects. Scrutinizing the statistics for this group of individuals, their fractions prior to enrolment on social welfare (31.0 per cent), and with zero earnings (23.7 per cent), are both more than twice as high compared with participants who only completed some but less than .25 years of AE (and whose fractions, in turn, are very similar to the groups with less than one year, 1-2 years and 2-3 years of AE). The coefficient stays roughly unchanged despite the inclusion of additional explanatory variables based on social welfare and zero earnings (lags from 1990-1992, received welfare squared, interactions). As zero credits among registered can be seen as a binary event, propensity score matching can further test the result. Although the precision is unstable for some matching specifications, the estimate remains and is mostly significantly different from zero.[14] Realistically, the result is driven by unobservable attributes, as it seems implausible that zero credits would have a causal effect on earnings. If pre-program earnings are the chief control for selection, downward inconsistency would be more difficult to capture as earnings are truncated at zero. One possible interpretation is that fraudulent behaviour is more frequent in this group (to get hold of the study allowances merely requires registration in AE). Comparing again with those who completed some but less than .25 years of AE, data shows that the group with zero credits registered in 21 per cent fewer course credits, but still received study allowances with a frequency which was 47 per cent higher.[15]

4.4 Reconciling results

In the introduction, a brief summary was given of conflicting results from earlier evaluations of AE in Sweden. These differ mainly in the sampling and the time horizons which both may influence the results (cfr Table 5 and Table A.8). By making simple adjustments in the present data, it is possible to roughly mimic their studies in order to reconcile the results.[16] Albrecht *et al.* (2004) analyzed AE participants in 1997-98 and found earnings effects, as measured in 2000, insignificantly different from zero. To comply with their set-up, the treated are conditioned to have completed AE within a window of two years (1994-95) and the timing of the evaluation is set to 1997, i.e. 2-3 years later. The estimate, associated with a binary AE variable, is then insignificant. Stenberg and Westerlund (2008) also studied enrollees in 1997. They used a sample of long-term unemployed, restricted to have zero earnings in both 1996 and 1997, and estimated difference-in-differences as they had access to earnings data from 1993 until 2003. If one here sets the

[14] This includes when applying "thick support" (Black and Smith 2004, p111-113), which only considers observations in the middle third of the propensity score distribution. The purpose is to reduce bias caused by unobservable characteristics which, under certain assumptions, is larger in the tails of the distribution.
[15] When estimating the proportional estimates, the group with zero credits is part of the controls. Excluding them reduces the estimate obtained in Table 5 by about .05 per cent.
[16] Details about the estimates in this subsection are available from the author on request.

restriction of zero earnings in 1993-1994, and use 1990 as pre-program earnings, the effects obtained by the year 2000 are positive; 11 per cent for males and 15 per cent for females. It compares reasonably with their estimates of 14 and 23 per cent respectively (the high percentage increases arise from low prior earnings). Ekström (2003) studied AE enrollees 1988 – 1993 aged 25-42, and reported negative effects of 3 per cent for males and insignificant for females. The outcome was the log of earnings in 2000 (seven years after 1993), a feature which excludes individuals with zero earnings. If one similarly uses the log of earnings in 2004 as outcome, it reduces the parameter estimate to be insignificant from zero for males and 1.8 per cent for females. If one also shortens the follow up period to 2002 (seven years after latest possible enrolment, in 1995), the estimate becomes significantly negative for males, 3.7 per cent, and insignificant for females.

5 Discussion on costs, benefits and study allowances

Rather than limiting the analysis to the benefits, this section provides simplified calculations of how the estimated returns compare with the direct costs and the foregone production value. The aim is to give a transparent account and while I will argue that the benefits are insufficient to cover the costs, the overall implications are sensitive to how precisely foregone production value is measured, and to what one assumes about "unmeasured" effects of AE. The latter are briefly discussed but, for simplicity, assumed to be zero in the computations below.

From the point of view of the participating individuals, the benefits are based on future discounted values of the estimates presented in Table 5 (see Appendix II for details on the calculations in this section). As attending AE is free, the costs are assumed to equal the foregone disposable incomes which are defined as foregone earnings minus received study allowances. For males, the average amount of study allowances received corresponds to about 50 per cent of the calculated foregone earnings. For females, who are less likely to be first earners; the amount is almost the same as the foregone earnings (i.e. close to 100 per cent). An average earnings return of 3.9 per cent covers the costs within five years (assuming a discount rate of 3 per cent). Looking specifically at males, the benefits only cover the costs after 13 years. This is extended to 24 years if one uses the estimated earnings return of 2.4 per cent, obtained with the brother sample. The results are thus ambiguous as the retirement of the oldest cohort, 53 years old in 2004, is only 13 years away if one assumes retirement occurs at 65 years of age (but 32 years away for the youngest cohort).

For the Swedish society at large, the average direct costs of AE per full-time student are given by the responsible authorities. These include administrative costs and study allow-

ances and are multiplied by the average amount of *registered* studies at Komvux (actual) and tertiary level (approximated). When computing the present value of the benefits, the fraction remaining on the labour market is assumed to gradually decrease from the 12th to the 32nd year when it becomes zero.[17] With an earnings impact of 3.9 per cent, the benefits actually cover the *direct* costs within 8 years, or 11 years if one uses the gender specific estimates of 2.4 per cent for males and 4.2 per cent for females. However, the foregone production value, to be discussed in detail shortly, increases costs by 200 per cent. For the benefits to break even with the costs, it is necessary that the average earnings return is 5.6 per cent. [18] With the 3.9 per cent earnings return, only 70 per cent of the total costs are covered by the time the youngest cohort retires and, assuming the gender specific estimates, the benefits cover 52 per cent of the costs.

A large foregone production value is logical in the sense that study allowances decrease the individual opportunity costs. However, in the absence of plant level data, foregone production is approximated by foregone earnings. It means that the production loss to society is overestimated whenever increased working hours among non-treated individuals replace absences caused by participation in AE. If a work hour is replaced by a non-treated with the probability .45 (making the foregone production value equal to .55 times the foregone earnings), the benefits would break even with the costs after 31 years. If all individuals were equally likely to find work, the employment rate among the low skilled population aged 25-64 would be an indication of the true probability of a replacement. It varies around .7 but more realistically, assuming non-employed are a negative selection in terms of job-finding, a probability of .7 is an upper bound and whether the true probability is above .45 is an open question.[19]

Before continuing, it is appropriate to mention some "unmeasured" effects of AE which are typically difficult to quantify. Additional costs come from both deadweight losses, as taxes are raised to finance AE, and crowding out effects on the labour market, including that teachers who are needed in AE may reduce teacher quality in regular upper secondary school (Björklund *et al*. 2005). The general equilibrium effects of AE in Sweden, from 1997 until 2006, were assessed in Albrecht *et al.* (2008). Their model implied that

[17] de Luna *et al*. (2008) find no evidence that AE in Sweden influences the timing of retirement.
[18] Unlike calculations of costs and benefits of traditional returns to school, these are not too sensitive to changes in the assumed discount rate; a one per cent increase decreases the fraction of costs covered by 5 per cent. Another aspect is that regressions indicate both that AE reduces the probability to receive transfers, and the amount if transfers are received (about 2 per cent of average). These are insignificant results, but even if taken at face value, the share of the costs covered only increases by 3 per cent.
[19] The stable unit treatment value assumption (SUTVA) made in the evaluation literature would presume there is no change in the number of hours worked among non-treated, and thus that foregone earnings is an appropriate measure of foregone production. This is of course a very strong assumption. At the other extreme, Johnson and Layard (1986) assume a queue of low skilled unemployed where non-treated may replace *all* vacant hours such that foregone production value is zero.

those who remain low skilled suffer economic losses, but a general equilibrium "multiplier effect" makes the aggregate effect larger than the effect of the treatment on the treated, by a factor between 1.5 and 2. This follows from changes in job composition and spillover effects on medium and low skilled. Their argument is thus related to that of externalities of education. Moretti (2004) finds support for such spillover effects but other studies have found no or only small effects (Acemoglu and Angrist, 2000, Ciccone and Peri, 2004, Isacsson, 2005). It has also been argued that there is a positive relation between democracy and education (Putnam, 2001), but hard evidence is elusive also in this respect (Milligan *et al*. 2004). Other studies imply that education influences the labour market outcomes of off-springs (Black *et al*. 2005, Björklund *et al*. 2006), that education improves health (Lleras-Muney, 2005, Arendt, 2005), economic growth (Krueger and Lindahl, 2001) and/or that the presumed influence of AE on social and economic equality is beneficial for society at large (Persson and Tabellini, 1994, Krueger, 2002). AE may also reduce tension between groups in society as it offers low skilled a way to respond to e.g. increased competition from immigration and/or structural changes.[20]

The large AE sector in Sweden reflects a tradition of optimism regarding the unmeasured effects on society. Still, since covering the costs is not a sufficient condition to motivate the expenses, only necessary, one could argue that a reasonable interpretation of the calculations above is that the AE sector in Sweden is too large to be efficient. Let us for the sake of argument accept this reasoning, and consider reductions in the study allowances to balance the costs. It is an interesting policy variable as one would expect it to decrease participation in AE among individuals who are risk-averse, who have low expected returns and/or high expected foregone earnings. Thus, the effects of AE on society potentially improve through an increase in the average earnings return to AE, through a lower foregone production value and a decrease in the direct expenditures on study allowances. Of course, the ensuing question is *how* sensitive these aspects are to changes in study allowances. Seftor and Turner (2002) found changes in the Pell grant had sizeable effects on the probability of college enrolment among adults, markedly more so than traditionally aged students.[21] To analyze the relation between foregone earnings and the amount of study allowances, denoted G_{ijt}, eight regressions were run of the type

$$\Delta Y_{ijt} = \alpha + X_{ijt-}\beta + G_{ijt}\delta + f_{ij} + \varepsilon_i$$

where the earnings change by time t = 1994, 1995, 1996…, 2001 (ΔY_{ijt} is otherwise defined as ΔY_{ijt+} in Section 4.1). The coefficient estimates of δ range from .86 to 1.49, indi-

[20] There is rather convincing evidence that education for youths decreases criminality (Lochner and Moretti, 2004), but the role of AE is in this respect not clear-cut as most criminals are males below the age of 24.
[21] In the present data, comparing descriptive statistics from 1996 with 1998, the average study allowances received were 50 per cent higher in 1998 (via the introduction of UBS, see Section 2) and the numbers enrolled increased by 53 per cent. However, it partially arose as the number of seats at Komvux expanded.

cating that a unit of G_{ijt} may decrease earnings by a factor larger than one. There is thus rather convincing indications of a notable influence of study allowances on both participation and foregone earnings.[22]

6 Summary and discussion

The possibilities for low skilled workers to adapt to changes in the demand for skills are hampered by employers who prefer to train high skilled employees, but also by their own reluctance to participate due to a perception of low returns and/or financial constraints. Consequently, most OECD countries are developing policies to enhance the qualifications of the low skilled as it has become increasingly recognized that these are necessary for a well functioning labour market.

This paper provides a rare evaluation of public provision of formal education for low skilled adults at compulsory, upper secondary and tertiary level. The policy improves the quality of training and (information on) the returns and financial constraints are alleviated as education is free of charge and participants are eligible for study allowances. The analysis is based on register data of siblings in Sweden, where the supply of formal adult education (AE) is historically large. The return to AE for low skilled, which is a virtually unexplored issue, is thereby possible to estimate with relatively large samples. For first-time enrollees in 1994-1995, aged 24-43 with short educations, the point estimate of the effect of a year of AE represents a 3.9 per cent earnings increase in 2004. The positive return implies that AE, at least hypothetically, could generate benefits which exceed the costs for society. It also refutes the idea that low skilled are uneducable, an argument which traditionally has appeared when educational reforms have made schooling more universally accessible.

As always with non-experimental data, the issue of selection can not be completely ruled out, but I would argue that the estimates are worth taken seriously as the regression framework includes individual specific and family specific effects, as well as a large number of observable variables prior to enrolment indicating e.g. earnings dynamics, labour market status, health and regional attributes. Also, of the enrollees in 1994-1995, one in five was again enrolled in education in 2002 or later, plausibly having a conservative impact on the estimate of future earnings. For positive selection to drive the results, it requires that e.g. motivation 1992-2004 on average grew more among treated individuals. It would not be captured by the difference-in-difference set-up and could also elude the

[22] Reducing study loans would open up for market solutions, but study loans are linked to favourable repayment conditions and not preceded by any credit rating (presumably important for low skilled individuals with on average low earnings). Study grants may also in part be a substitute for other transfers, but this aspect is taken into account in the regressions on earnings change.

observable variables. However, even if this scenario were true, it could be argued that AE served as a stimulus for motivation to grow.

Calculations comparing costs and benefits of AE indicate that the beneficial effects on earnings only cover between 52 and 70 per cent of the total costs, but the overall implications are sensitive to how much foregone earnings overstates the foregone production value, and to the assumptions regarding unmeasured effects of AE on the society. Still, the findings reasonably imply that the resources of the AE sector in Sweden are used inefficiently. Since this study is the first of its kind, and as educational systems differs between countries, more research on AE from other environments is required before any strong policy recommendations can be issued, not least concerning the influence of study allowances on average returns of AE, on foregone earnings and on participation.

Political issues influencing the size of the AE sector in a country have not been addressed in this paper. As AE enhances the possibilities to career changes, it constitutes a form of individual freedom which could be defended on ideological grounds, both egalitarian and liberal, rather than on economic arguments. Conversely, political opposition might come from influential groups e.g. high earners or highly educated, who may feel they pay a disproportionate part of taxes while benefits mainly accrue to the low skilled who upgrade their qualifications. The political influence of different demographic groups may therefore explain why countries invest so differently in AE and perhaps economic reasons have not been among the main arguments driving the decisions.

Appendix I

Table A.1. Descriptive statistics of males.

	Population sample		Brothers sample	
	AE	Control group	AE	Control group
N	10715	464929	3026	3580
Age	30.05	33.09	30.87	32.24
Years of schooling	10.45	10.28	10.38	10.25
Less than compulsory school (< 9 years)	.012	.031	.017	.029
Compulsory school (9 years)	.242	.293	.265	.310
1-year upper secondary school (10 years)	.019	.014	.021	.012
2-year upper secondary school (11 years)	.727	.662	.698	.649
Zero earnings 1992	.133	.115	.142	.134
Child(ren) at home	.639	.949	.734	.945
Parental leave transfer 1993 > 0	.085	.097	.099	.115
Unemployment insurance 1993 > 0	.344	.234	.351	.260
Other unemployment related transfers	.243	.135	.235	.156
Sick-leave 1993 > 0	.244	.174	.262	.188
Pension 1993 > 0	.014	.025	.015	.025
Social welfare 1993 > 0	.167	.085	.195	.130
Foreign born	.024	.019	.021	.022
Regional employment	.725	.722	.724	.723
Stockholm county	.183	.141	.161	.155
Inland of Norrland	.047	.062	.053	.062

Table A.2. Descriptive statistics of females.

	Population sample		Sisters sample	
	AE	Control group	AE	Control group
N	18585	317714	4595	5179
Age	31.15	33.29	31.75	32.57
Years of schooling	10.34	10.27	10.25	10.21
Less than compulsory school (< 9 years)	.008	.020	.008	.019
Compulsory school (9 years)	.247	.248	.286	.285
1-year upper secondary school (10 years)	.136	.152	.142	.143
2-year upper secondary school (11 years)	.609	.580	.564	.553
Zero earnings 1992	.134	.115	.140	.131
Child(ren) at home	1.472	1.414	1.657	1.530
Parental leave transfer 1993 > 0	.318	.289	.335	.321
Unemployment insurance 1993 > 0	.295	.184	.299	.199
Other unemployment related transfers	.152	.077	.150	.090
Sick-leave 1993 > 0	.292	.247	.303	.266
Pension 1993 > 0	.016	.041	.016	.041
Social welfare 1993 > 0	.163	.091	.178	.120
Foreign born	.023	.019	.022	.022
Regional employment	.724	.723	.723	.722
Stockholm county	.178	.143	.149	.134
Inland of Norrland	.055	.055	.058	.059

Table A.3: Male adult education accomplished.

	Population sample		Brother sample	
	AE	Control group	AE	Control group
N	10715	464929	3026	3580
Share in adult schooling until 2004	1.00	.127	1.00	.158
Compulsory				
Fraction registered	.215	.011	.242	.017
Registered compulsory credits (years)	.132	.013	.169	.019
Completed compulsory credits (years)	.048	.003	.059	.006
Upper secondary				
Fraction registered	.781	.082	.745	.105
Registered upper secondary credits (years)	.813	.104	.753	.140
Completed upper secondary credits (years)	.553	.060	.511	.081
Frequency of upper secondary subjects				
Mathematics	.540	.044	.498	.068
English	.510	.040	.470	.058
Swedish	.467	.038	.427	.062
Social sciences	.576	.055	.544	.075
Natural sciences	.315	.018	.288	.030
Human sciences	.174	.013	.150	.021
Computer sciences	.539	.073	.526	.092
Health sciences	.160	.013	.157	.018
Vocational course	.153	.024	.150	.028
Fraction with higher education until 2004	.278	.025	.246	.031
Fraction with less than 1 year	.048	.004	.046	.003
Fraction with 1-2 years	.061	.008	.054	.009
Fraction with 2-3 years	.030	.006	.046	.011
Fraction with 3-4 years	.092	.006	.078	.007
Fraction with 4 years or more	.027	.002	.022	.001
Total years of higher education	.561	.045	.482	.056
Total years of AE [a)]	1.152	.108	1.052	.142

Note: [a)] Accomplished upper secondary AE credits/500 + years of completed higher education.

Table A.4: Female adult education accomplished.

	Population sample		Sister sample	
	AE	Control group	AE	Control group
N	18585	317714	4595	5179
Share in adult schooling until 2004	1.00	.330	1.00	.366
Compulsory				
Fraction registered	.278	.039	.300	.052
Registered compulsory credits (years)	.151	.033	.181	.048
Completed compulsory credits (years)	.061	.012	.071	.015
Upper secondary				
Fraction registered	.852	.253	.837	.279
Registered upper secondary credits (years)	1.127	.380	1.144	.432
Completed upper secondary credits (years)	.780	.241	.777	.270
Frequency of upper secondary subjects				
Mathematics	.547	.124	.519	.148
English	.566	.125	.528	.146
Swedish	.546	.128	.514	.153
Social sciences	.752	.209	.746	.239
Natural sciences	.326	.060	.305	.074
Human sciences	.244	.061	.223	.067
Computer sciences	.652	.216	.655	.238
Health sciences	.380	.115	.399	.130
Vocational course	.087	.034	.082	.037
Fraction with higher education until 2004	.276	.065	.235	.065
Fraction with less than 1 year	.047	.006	.047	.006
Fraction with 1-2 years	.048	.016	.040	.017
Fraction with 2-3 years	.037	.016	.028	.015
Fraction with 3-4 years	.123	.024	.104	.025
Fraction with 4 years or more	.021	.003	.017	.002
Total years of higher education	.591	.136	.487	.135
Total years of AE [a)]	1.432	.388	1.335	.420

Note: [a)] Accomplished upper secondary AE credits/500 + years of completed higher education.

Table A.5. Mean standard deviations between and within families.

	Sibling sample		
	Between	Within	
Treated	.214	.455	
Years of AE	.746	.862	
$\Delta Y_{ijt+} = (Y_{2004} - (Y_{1992}+Y_{1991}+Y_{1990})/3)$	81.3	80.9	
Age	4.514	2.974	
Years of schooling	.748	.686	
Earnings 1992 = 0	.250	.245	
Child(ren) at home	.900	.896	
Parental leave transfer 1993 > 0	.298	.304	
Unemployment insurance 1993 > 0	.323	.322	
Sick-leave 1993 > 0	.312	.318	
Social welfare 1993 > 0	.261	.245	
Foreign born	.128	.076	
Stockholm county	.335	.145	
Inland of Norrland	.210	.105	
Number of individuals			33,424

Table A.6. Male estimates of earnings effects of AE (SEK 2004).

Dependent variable: Earnings difference $\Delta Y_{ijt+} = (Y_{2004} - (Y_{1992}+Y_{1991}+Y_{1990})/3)$

	Population sample			
	(1)	(2)	(3)	(4)
Average effect (D_{ijt})	13765***		7013***	
	(1170)		(1125)	
Proportional effect (E_{ijt})		8281***		4454***
		(626)		(600)
Including X_{ijt-}	No	No	Yes	Yes
Including f_{ij}	No	No	No	No
	Brother sample			
	(1)	(2)	(3)	(4)
Average effect (D_{ijt})	7150**		6271**	
	(2983)		(2951)	
Proportional effect (E_{ijt})		8065***		5045***
		(1384)		(1371)
Including X_{ijt-}	No	No	Yes	Yes
Including f_{ij}	No	No	No	No
	Brother sample including family ID			
	(1)	(2)	(3)	(4)
Average effect (D_{ijt})	4401		3999	
	(3000)		(3083)	
Proportional effect (E_{ijt})		5637***		4983***
		(1725)		(1731)
Including X_{ijt-}	No	No	Yes	Yes
Including f_{ij}	Yes	Yes	Yes	Yes

Notes: *** significant at the 1 % level. ** at the 5 % level. * at the 10 % level.
Percentages express the coefficient value in relation to average earnings of treated with non-zero accomplished AE.

Table A.7. Female estimates of earnings effects of AE (SEK 2004).

Dependent variable: Earnings difference $\Delta Y_{ijt+} = (Y_{2004} - (Y_{1992}+Y_{1991}+Y_{1990})/3)$

	Population sample			
	(1)	(2)	(3)	(4)
Average effect (D_{ijt})	8840***		6731***	
	(743)		(680)	
Proportional effect (E_{ijt})		7720***		6468***
		(358)		(327)
Including X_{ijt-}	No	No	Yes	Yes
Including f_{ij}	No	No	No	No
	Sister sample			
	(1)	(2)	(3)	(4)
Average effect (D_{ijt})	8990***		7248***	
	(2048)		(1914)	
Proportional effect (E_{ijt})		8998***		7430***
		(877)		(817)
Including X_{ijt-}	No	No	Yes	Yes
Including f_{ij}	No	No	No	No
	Sister sample including family ID			
	(1)	(2)	(3)	(4)
Average effect (D_{ijt})	7772***		4348**	
	(2110)		(2014)	
Proportional effect (E_{ijt})		8463***		6440***
		(1093)		(1028)
Including X_{ijt-}	No	No	Yes	Yes
Including f_{ij}	Yes	Yes	Yes	Yes

Notes: *** significant at the 1 % level. ** at the 5 % level. * at the 10 % level.
Percentages express the coefficient value in relation to average earnings of treated with non-zero accomplished AE.

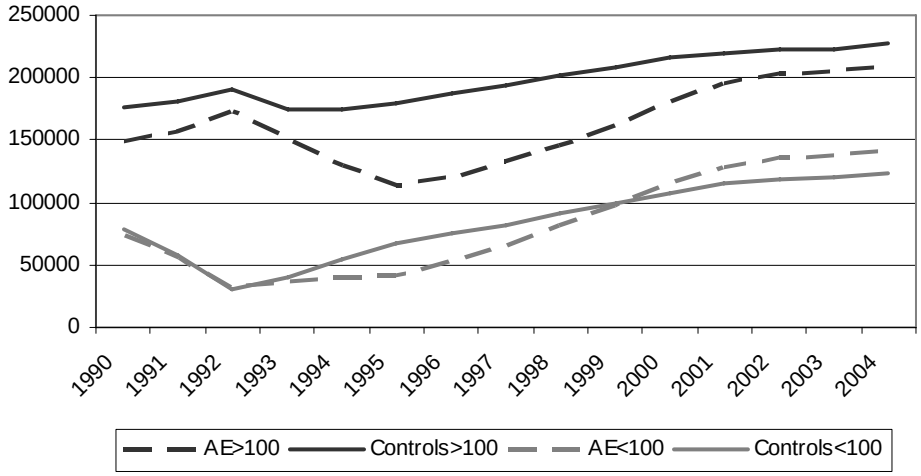
Table A.8. Total family fixed-effect estimates of AE (SEK 2004), conditioning on final year of observation.

Dependent variable: Earnings difference $\Delta Y_{ijt+} = (Y_{2004} - (Y_{1992}+Y_{1991}+Y_{1990})/3)$ [a)]

Final year	**Population sample**		**Sibling sample**	
2004	5807***	3.3 %	6793***	3.9 %
	(314)		(683)	
2003	6452***	3.7 %	6602***	4.0 %
	(337)		(736)	
2002	5525***	3.2 %	6384***	3.9 %
	(364)		(797)	
2001	3117***	1.8 %	3100***	2.0 %
	(410)		(869)	
2000	- 2006**	- 1.3 %	- 2249**	- 1.6 %
	(435)		(985)	
1999	- 7602***	- 5.2 %	- 8795***	- 7.1 %
	(494)		(1139)	
1998	- 13283***	- 9.7 %	- 11567***	- 10.5 %
	(599)		(1398)	

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

Figure A.1. Male and female annual earnings (in SEK 2004) conditioned on earnings in 1992 above or below SEK 100000; AE enrollees 1994-95 and control groups.



Appendix II – Estimating costs and benefits

Direct costs of providing AE:

Compulsory and upper secondary education; average cost is SEK 37,500 per year.
1. Male number (4,668) * Male average (1.29 years) * 37,500 = 226 million.
2. Female number (9,060) * Female average (1.43 years) * 37,500 = 484 million.

Tertiary education; average cost is SEK 44,000. The total amount of accomplished tertiary education is divided by .75 to give a proxy of courses *registered*.
3. Male number (1,112) * Male average (1.97 years /.75) * 44,000 = 97 million.
4. Female number (2,240) * Female average (2.09 years /.75) * 44,000 = 206 million.

The sum of 1-4 above is the **total direct costs: 1.01 billion SEK**.

Indirect costs of AE:

Foregone earnings are calculated by using the fact that 1990-1992 earnings of treated is an almost constant fraction of untreated earnings. The thin line in Figure A.2 below illustrates the principle as the counterfactual earnings of treated siblings are assumed .816 of the untreated earnings 1990-2004 (the ratio only diverges by .003 in the years 1990-1992).

The distance between the dotted line (actual average earnings of treated) and the thin line (counterfactual earnings of treated) is the calculated foregone earnings. The amount appears reasonable in relation to the average amount of AE, which exceeds one year, and the average earnings levels recorded.

For society; calculated separately for males and females; **foregone earnings are in total SEK 2.50 billion**.[23]

Total costs: Direct costs + Indirect costs: 2.50 + 1.01 = **3.51 billion SEK**.

For individuals; foregone disposable income is foregone earnings subtracted by the average amount of study allowances received between 1994 and 2001.

Total revenues/benefits
[.039 * (male average earnings 2004) * (number of males)] + [.039 * (female average earnings 2004) * (number of females)] = revenue first year = SEK 144 million.

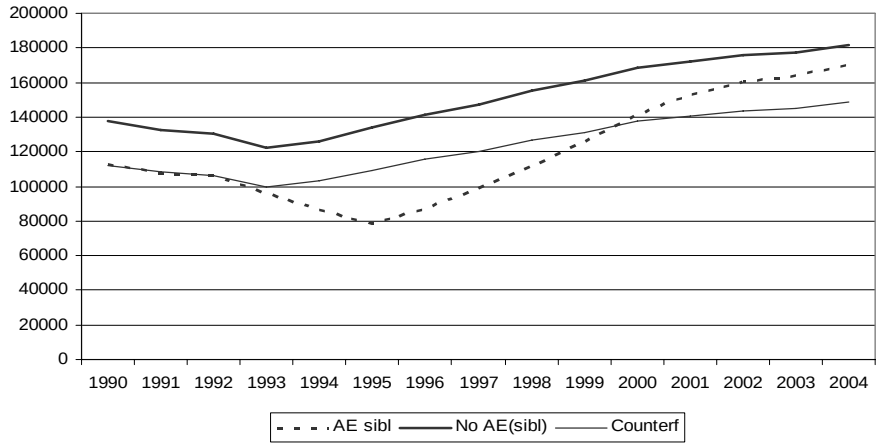
From year 13, individuals born 1951 are no longer included and in year 32, those born 1970 are also excluded and the revenues cease.

Total revenues after 31 years: **2.46 billion SEK** (3 per cent discount rate).

Revenues represent 70 per cent of the total costs (2.46 / 3.51).

[23] Using matching on the propensity score to calculate foregone earnings gives a 10 per cent higher estimate. Regression based calculations of the foregone earnings are awkward as there are no records of course registration at tertiary level.

Figure A.2. Annual earnings of AE enrollees 1994-95, control group and hypothetical foregone earnings of participants had they not enrolled.



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