Education Economics, Vol. 12, No. 1, April 2004

Higher Education and the Determination of Aggregate Male Employment by Age

ANDERS STENBERG & MAGNUS WIKSTRÖM

ABSTRACT *This paper studies the determinants of age-specific employment rates among Swedish males, focusing on the effect of education on employment. We use cohort specific data for the time period 1984–1996 covering male cohorts aged 21–45. It is found that aggregate age-group-specific employment rates increase with the proportion of the cohort with an academic degree. Two states of the labour market are then compared; the high employment period 1984–1990 and the downturn 1991–1996. The effect is stronger in the downturn period as compared with the boom period. However, we do not find any strong evidence in favour of the hypothesis that the effect of higher education on employment is declining with age. A measure of relative education is used to capture crowding out effects. The results indicate a significant effect in the high employment period.*

Introduction

One characteristic feature of most labour markets is that the unemployment rate is lower for skilled workers as compared with unskilled workers. For instance, Jackman *et al.* (1991) report that unemployment rates for 'highly' educated workers are in the range of one-third to one-fifth as low as those for 'less' educated people when measured among the European countries. Microevidence on the determinants of unemployment points to the same conclusion. Well-educated individuals are less likely to experience unemployment than those with lower educational levels (see, for example, Ashenfelter & Ham, 1979; Nickell, 1979; Pedersen & Westergaard-Nielsen, 1993), which suggests that education is a good way to hedge against unemployment risks and that unemployment risks may be an important part of the private returns to schooling.

It is a different question to what extent education affects employment at the aggregate level of the economy. Since the early part of the 1990s a number of theoretical studies addressing questions of aggregate employment and education have emerged (Fields, 1995; Jackman *et al.*, 1991, chapter 6; Saint-Paul, 1994, 1996a, 1996b; McKenna, 1996; Gregg & Manning, 1997). The general conclusion is that an increase in the relative supply of skilled workers has an ambiguous effect on the aggregate employment rate in the short run. Saint-Paul (1996a) contains one

A. Stenberg, SOFI, Stockholm Uni, SE-106 91 Stockholm, Sweden. E-mail: anders.stenberg@sofi-.su.se. M. Wikström, Department of Economics, Umeå University, SE-901 87 Umeå, Sweden. E-mail: Magnus.wikstrom@ econ.umu.se.

ISSN 0964-5292 Print; 1469-5782 Online/04/010087–15
DOI: 10.1080/0964529042000193961

example of the different effects involved. A larger fraction of educated workers changes the composition of the labour force such that a larger fraction of the workers face a lower unemployment rate. This is referred to as the *composition effect*. However, in his model, the technology is specified in such a way that increased education also decreases the physical demand for skilled *and* unskilled workers. Therefore, in the short run, the aggregate unemployment rate may move in either direction when educational attainment increases.

Another line of literature, rendering additional uncertainty to the effects of education on employment, has put the emphasis on the crowding out effects from education. Presumably, one of the important effects of education is that it may lead to substitution of workers among different groups. Thurow (1972) advances a hypothesis of job competition where the best qualified workers are in the front of the job queue, and in the event of an excess supply situation the qualified may crowd out employment opportunities for those with less qualifications. Okun (1981) instead proposes that it may be optimal for employers to increase educational requirements during recessions if wages are downward rigid, leading to the same observation. Empirical studies of crowding out effects include Teulings and Koopmanschap (1989) and van Ours and Ridder (1995). Both studies find evidence of crowding out between educational groups. However, van Ours and Ridder find less crowding out as their definition of crowding out is limited to new-hirings, whereas Teulings and Koopmanschap also include lay-offs.

To our knowledge, there is no systematic study of the educational effects on the aggregate employment level. This paper is a first attempt to study this question. Using Swedish cohort-specific data of higher education and of employment from 1984 to 1996, covering male cohorts aged 21–45, the employment effects of increased educational attainment are estimated. Educational attainment is measured as the proportion of a cohort that has received at least one academic degree, and employment as the fraction of the cohort that is employed. Controlling for other observable characteristics, our results show that educational attainment has a positive effect on cohort-specific employment rates. Moreover, we test formally for differences in the magnitudes of the effects over time and across age groups. Evidence is found that the effects of education on employment are more important in times of low employment. This is consistent with the view that composition effects are important in explaining the short-run impact of educational attainment on aggregate employment. The evidence on differences in effects across age groups is less conclusive. Finally, we use a measure of relative education between the own cohort and neighbouring cohorts. The hypothesis that an increase in the proportion of educated in neighbouring cohorts adversely affects the own cohorts employment level cannot be rejected for the period of high employment 1984–1990.

The outline of the paper is as follows. The next section discusses the data-set used and presents some rudimentary facts about cohort employment and higher educational attainment in Sweden. The third section sets up an empirical model of employment determination and discusses different hypotheses regarding the effects of higher education on the aggregate employment rate. The subsequent section presents the empirical results and the final section concludes.

Description of the Data

The empirical analysis in this paper uses Swedish data on employment and college level degrees among males.[1] Data are reported on a cohort-specific level of ages

21–45 years old for the period 1984–1996. The employment data are taken from the Labor Force Surveys (*Arbetskraftsundersökningar*), executed by Statistics Sweden (*Statistiska Centralbyrån*). The observations are yearly averages based on labour market figures that have been surveyed on a monthly basis. The surveys were made through telephone interviews, with sample sizes varying between 16 000 and 24000 individuals. The sample has continually been rotated so that one-eighth has been substituted by new individuals on each occasion of an interview.

The employment data are specified such that the population is divided into those participating in the labour force and those who are outside the labour force. The labour force is in turn divided in three subgroups consisting of unemployed, employed and absentees. People involved in labour market training programmes are reported as outside the labour force while people participating in relief works are considered as employed. Full-time students are considered outside the labour force, but it is sufficient to have worked for one hour in the preceding week to be reported as employed. In addition, students that are on temporary leave from their work are included among the absentees. The fact that students are reported both outside and inside the labour force makes it potentially inappropriate to use the labour force to scale the employment figures. To avoid this we define the employment rate as the number of employed divided by the cohort population.

The educational data are provided by Statistics Sweden. These data report the number of male persons within a cohort, in a specific year, that attained at least one academic degree. We accumulate the cohort-specific number of individuals with a degree and calculate the educational ratios as the accumulated number divided by the cohort population. Data are reported from 1957, meaning that by 1984 the oldest cohort we have accumulated figures on is 45 years of age. To keep the data balanced in terms of age groups we exclude those older than 45 years from the analysis. For reasons to be explained, the educational data are reported with a lag; that is, the individuals that got their degree during the course of year t are reported as educated for the first time at $t + 1$.

The variation of the employment ratio over time and across age groups is shown in the form of box-plots in Figures 1 and 2, respectively. The boxes are ranging from the upper to the lower quartile, with the median indicated. If an observation is further from the box than 1.5 times its height, it is marked with a point. In the absence of such outliers the vertical lines extend to the highest and lowest values. In Figure 1 the most important characteristic is the general difference in employment levels between the 1980s and the 1990s, reflecting the economic recession that hit Sweden in 1991. Note how the variation among the cohorts within each year is slightly larger in recessional years. The median employment ratios emphasize the non-stationarity of the employment distribution over time and the yearly distributions appear to be skewed over age groups. This asymmetry is apparent in Figure 2 where it can be seen that the age groups with median employment rates, approximately 31–35 years old, are much closer to the age groups at the top employment rates than to the bottom ones. The low employment rates among the young is well known and is usually explained by their lack of working experience.[2] Here, the low youth employment levels are also due to the full-time students who are reported as outside the labour force. Figure 2 shows, furthermore, in a pattern reminiscent of the one we saw over time, that lower median employment rates appear in combination with larger variations.

Turning now to the educational variable, Figure 3 shows how the number of graduated has varied across age groups. It reveals that the vast majority of academic

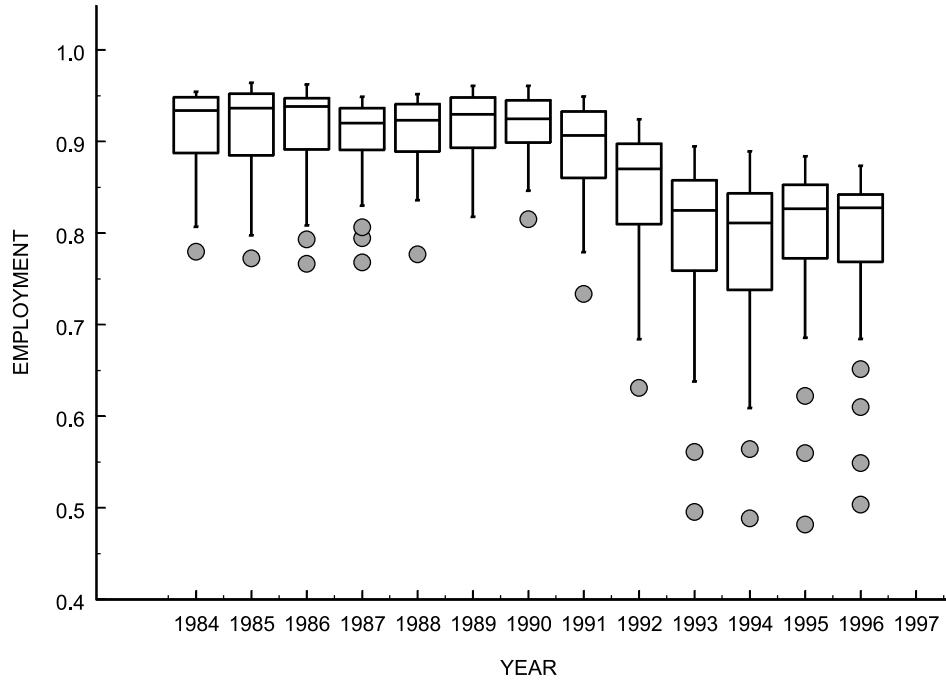

Fig. 1. Relative employment among 21–45 year olds over time.

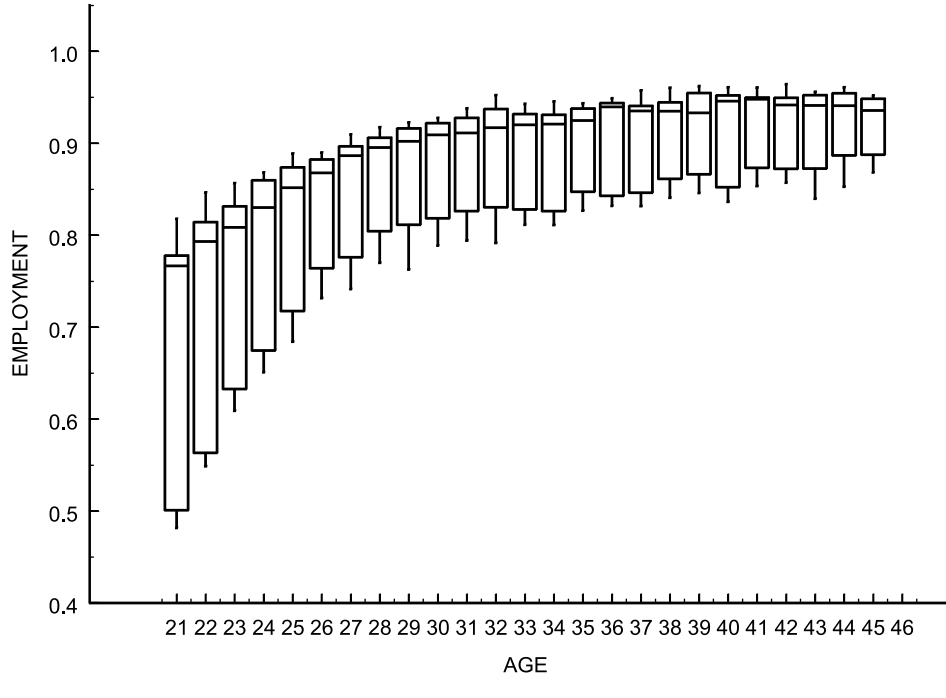

Fig. 2. Relative employment 1984–1996 across age groups.

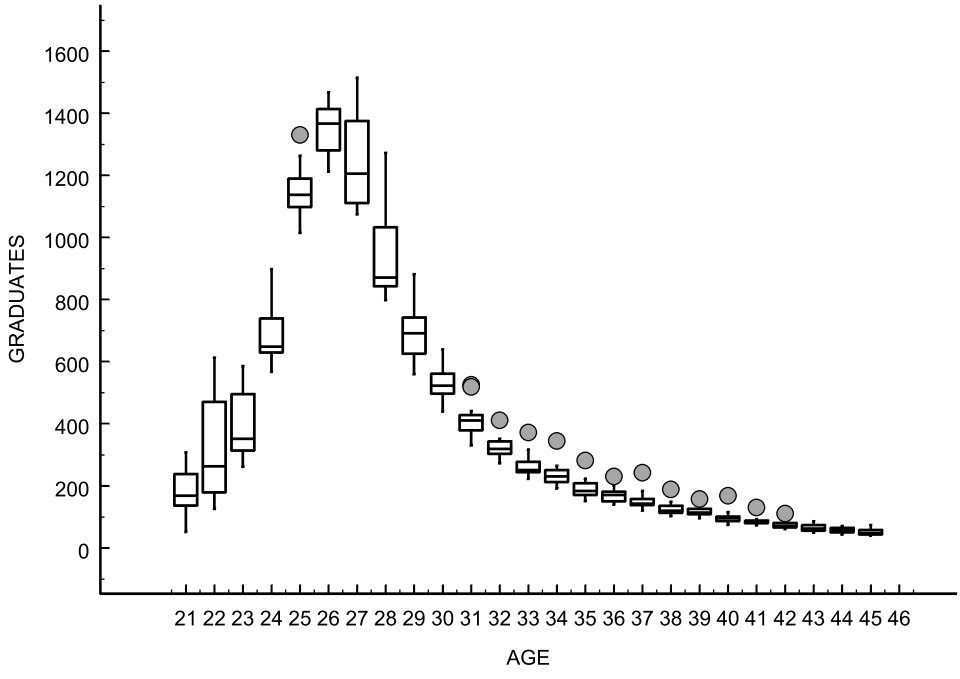

Fig. 3. Number of graduated in each age group 1984–1996.

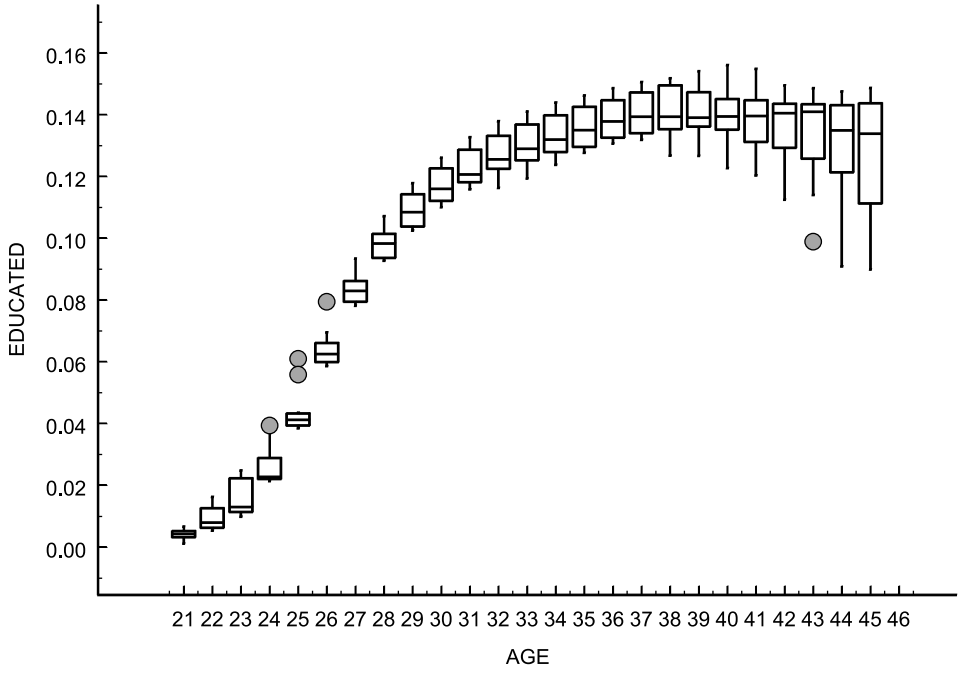

Fig. 4. Fraction of educated in each age group 1984–1996.

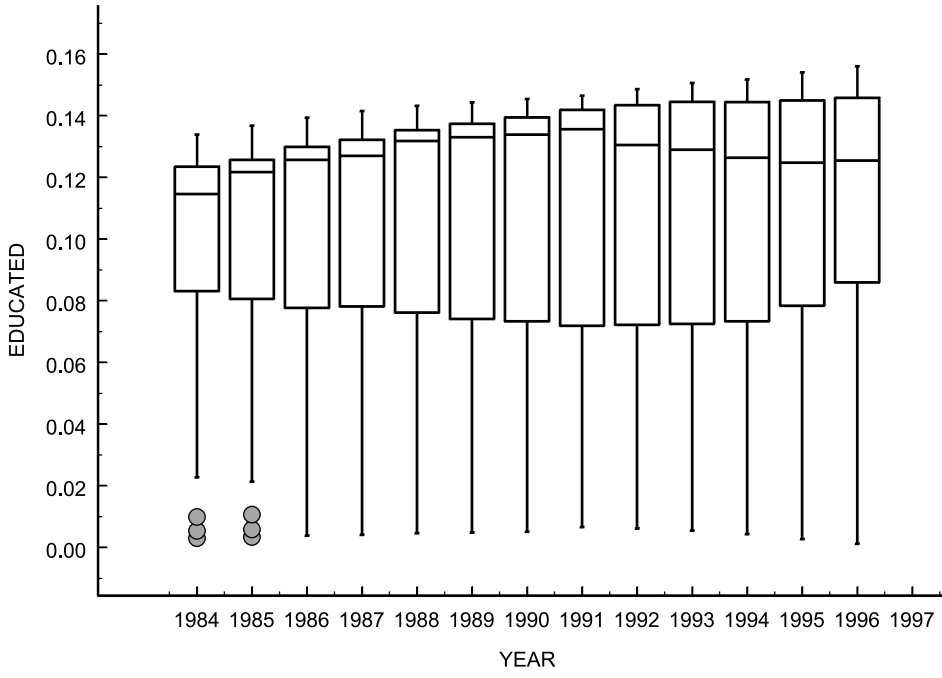

Fig. 5. Fraction of educated among 21–45 year olds over time.

degrees are attained before the age of 30, and it also gives an idea of how the age of graduated individuals is distributed for a typical year.

Figures 4 and 5 show the accumulated educational ratio across age groups and over time, respectively. In Figure 4 education is defined as a cumulative ratio and naturally increases with age. Here, as well as in Figure 3, it is striking how little variation there is between the different cohorts within each age-group, (i.e. between, for example, the 21 year olds in 1984 and 1996). The variation is clearly more important across age groups than over time (or *within* age groups). The slightly larger variations among the age groups older than 40 are due to an increase in the education in the 1960s when the generation of the baby boom after the Second World War entered higher education. In Figure 5 the impression of a small variation over time is confirmed. The fall in the median value between 1991 and 1992 actually reflects a fall in educational ratios among younger age groups at the start of the 1980s. This seemed to happen as a consequence of a second baby boom (after the one that followed the Second World War) that took place in the 1960s, which was not followed by a subsequent increase in educational attainment. Quite on the contrary to what can be seen from the median values, an important increase in the fraction of enrolled in higher education began in 1988. In fact, the number of enrolled students rose by more than 50% between 1988 and 1995. In Figure 5 it can be discerned in the decreasing variation within each year of the 1990s.

Empirical Model

This section will discuss how aggregate age-group-specific employment rates are affected by changes in the educational composition. The discussion will guide us

towards an appropriate empirical model to analyse the determinants of the employment rates in the short run. For our purposes, a convenient starting point is to decompose the age-group-specific aggregate employment, N_i, as follows:

$$N_i = N_i^e + N_i^u + N_i^s \tag{1}$$

where $N^e{}_i$ denotes employment of those with a university degree, $N^u{}_i$ is employment of the uneducated and $N^s{}_i$ is the number of employed students. Assume that the uneducated workers share a common labour market with students while only a (fixed) proportion of the students, α, are active job-seekers. Let foot-index j indicate other cohorts (i.e. $i \neq j$) and let us express the aggregate age-group specific employment rate of cohort i as:

$$n_i = e_i n_i^e (e_i, e_j, \bullet) + (u_i + \alpha s_i)\, n_i^u(u_i + \alpha s_i, u_j + \alpha s_j, e_i, e_j, \bullet) \tag{2}$$

where e_i is the proportion educated within the population of cohort i and $n^e{}_i$ is the employment rate of the educated. u_i is the proportion of uneducated and S_i is the proportion of students; consequently $(u_i + \alpha s_i)$ is the proportion of uneducated attached to the labour market. The employment rate among the uneducated labor force is denoted by $n^u{}_i$. The reader should note that the education-specific employment rates may include factors that affect demand directly as well as indirectly through wage bargaining. The latter channel may (but does not necessarily) imply that the educational composition itself affects the education-specific employment rates. This is why we have indicated that the employment rates depend on, *inter alia*, educational composition. Note that the uneducated employment rate depends on the supply of both educated and uneducated labour. This assumption reflects an asymmetry in working opportunities as the educated can seek for jobs in both employment markets. A similar thought can be found in McKenna (1996). Note that if there are more vacancies for the educated than there are unemployed educated, the assymetry disappears. It is straightforward to allow for complementarities or for the uneducated to affect the demand for educated directly as well. This would complicate matters slightly, but would not affect our main conclusions.

The data of the empirical analysis consist of the fraction of degrees and the employment rate within age groups. This means that we do not control for the inflow into education. Given that we are not able to estimate how the inflow into education affects employment, the empirical analysis most closely corresponds to a case where the fraction of educated men increases and the fraction of students decreases holding the fraction of uneducated non-students constant. Given the definition in Equation (2), a larger fraction of educated men in a cohort, conditional on the fraction of uneducated non-students, affects the aggregate age-specific employment rate according to:

$$\frac{\partial n_i}{\partial e_i}\Big|u_i = [n_i^e - \alpha n_i^u] + e_i \frac{\partial n_i^e}{\partial e_i} + (u_i + \alpha s_i) \frac{\partial n_i^u}{\partial e_i} - \alpha(u_i + \alpha s_i) \frac{\partial n_i^u}{\partial (u_i + \alpha s_i)} \tag{3}$$

which is ambiguous in sign. The term within square brackets is a *composition effect*. Given that employment is higher among the educated than among the uneducated,

the composition effect will contribute to a positive dependence between employment and educational attainment. A small α value will contribute to increasing the composition effect as it means that a larger fraction of the students was not attached to the labour market. The three final terms on the right-hand side of Equation (3) contain the *behavioural responses* from changes in the educational composition of the age group. The second term reflects the increasing supply of educated workers on their own labour market. The third term reflects that educated workers may take work opportunities from uneducated workers, and the final term reflects how this effect is reduced with α as it represents the fraction of the newly graduated that was already in the labour market of the uneducated.

A few theoretical studies mentioned in the Introduction have explicitly analysed behavioural responses and the consequences for aggregate (un)employment. The behavioural responses hinge crucially on the assumptions made. The standard case, as provided by Jackman *et al.* (1991), appears to be that a larger proportion of educated will tighten the low-skill labour market, leading to a higher low-skill employment rate and an upward pressure on the low-skill wage. Correspondingly, it will also lead to a downward pressure on the high-skill wage and a lower high-skill employment rate.

Saint-Paul (1996a) provides another example by assuming perfect substitutability and rigid relative wages between the two skill groups. In his model, the technology is specified in a way such that a larger fraction of skilled workers decreases the physical demand for skilled *and* unskilled workers. In the short run, therefore, the behavioural responses are negative. In Saint-Paul (1996b) assumptions concerning labour market rigidities are made within a search model. He shows that the total effect on the aggregate employment rate is a non-linear function of the fraction of skilled workers. Assuming a Cobb–Douglas production function, simulations of his model indicate that unless the fraction of skilled workers is very high, around 80%, employment is a decreasing function of education.[3] Gregg and Manning (1997) study wage and unemployment consequences of skilled-biased technological change. They provide a useful taxonomy regarding the long-run where their general focus is on the supply elasticity of skills and relative wage behaviour. Following changes in technology, the aggregate employment rate may move in either direction as supply of skills respond.

For completeness of our exposition, let us also consider the employment effects of an increase in other cohorts educational level e_j, given by:

$$\frac{\partial n_i}{\partial e_j}\Big|_{u_j} = e_i \frac{\partial n_i^e}{\partial e_j} + (u_i + \alpha s_i)\frac{\partial n_i^u}{\partial e_j} - \alpha\,(u_i + \alpha s_i)\frac{\partial n_i^u}{\partial (u_j + \alpha s_j)} \tag{4}$$

which can be interpreted as the crowding out effects across cohorts. The first term is the effect on the educated while the last two terms are related to the uneducated. The second term reflects the crowding out effect and the final term dampens the effect as more educated workers in the model means fewer uneducated. We would expect the first two terms to be negative and the third positive. According to Thurow (1972) and Okun (1981), referred to in the Introduction, the second term should be larger in times of recession as education becomes more important when competition for jobs is harder.

To sum up, theory suggests that the employment response to a larger fraction of college-level degrees in the population is not necessarily positive. The composition

effect may be outweighed by behavioural responses and crowding out effects (between educational levels and across cohorts).

Turning now to our empirical model, the proportion employed in age group i at time t, n_{it}, is assumed to be determined by:

$$n_{it} = d_t + \gamma n_{it-1} + \boldsymbol{z}'_{it}\theta + \delta \frac{e_{it}}{e_{jt}} + \sum_{m=1}^{k} \beta_m e_{it} + \nu_{it} \tag{5}$$

where we condition on lagged employment, n_{it-1}, d_t denotes year dummies, $\boldsymbol{z}_{it}$ is a row vector that includes age and the size of the age group relative to the male population aged 21–45, θ is a vector of parameters. e_{it}/e_{jt} is a measure of the relative level of education that, along the lines of Equation (4), is supposed to capture other cohorts' detrimental effect on the own cohort employment. The term e_{jt} in the relative measure of educational attainment is constructed as an average of the four age groups around each observed cohort; that is, with e_{i-1} denoting the age group that is 1 year younger than the observed cohort: $\frac{1}{4}(e_{i-2} + e_{i-1} + e_{i+1} + e_{i+2})$.

For the own-cohort effects the sample is divided into age groups of equal span, denoted by subscript m. We take 5-year intervals, meaning that there are $k = 5$ groups defined over the ages 21–25, 26–30, 31–35, 36–40 and 41–45 years of age. The parameters $(\beta_1, \ldots, \beta_5)$ will reveal any age pattern of the effects of educational attainment. Finally, ν_{it} is an error term assumed to be normally distributed with mean zero and constant variance.

We emphasize that the derivatives in Equations (3) and (4) depend on the state of the labour market. It is well known that the skilled–unskilled employment difference is higher in downturns than in boom years, suggesting that even though the underlying behavioural relationships (the education-specific demand functions) may be stable over time, the total effect is not. Further, the attachment to the labour market among students, reflected by α, can reasonably be expected to be smaller in times of recession making the composition effect more influential. In the empirical estimations we will allow the effect of educational composition on employment to vary over time. For our purposes, using data over the period 1984–1996, the sample is divided into two subperiods (denoted by T), the high employment period 1984–1990 ($T = 1$), and the downturn 1991–1996 ($T = 2$), creating an age-group-specific effect for each time period, β_{mT}.

Finally, students' choice of graduation date potentially cause simultaneity problems between educational attainment and employment as they may hang on to school a little longer during downturns. To take account of this simultaneity problem education is defined with a 1-year lag (see second section).

Results

The estimation results of Equation (5) are presented in Table 1 and we find the coefficients of the educational level positive and significant. In Table 2 the estimations are repeated but the effects between the boom period (1984–1990) and the period of relative recession (1991–1996) are separated. The signs of the coefficients remain positive but the levels of significance differ. The boom period only show one coefficient significant at the conventional 5% level, indicating that the effects of education on employment are stronger when overall employment rates are low. These results would imply that the composition effect in Equation (3)

Table 1. Estimation results

Parameter	Coefficient	*t*-value
Constant	0.241	8.95
Employment lagged	0.737	20.33
Age	−0.006	1.29
Relative cohort size	0.510	1.16
Relative education	−0.085	0.45
Education 1984–1996		
β_1 age group 21–25 years	0.073	0.38
β_2 age group 26–30 years	0.196	2.42
β_3 age group 31–35 years	0.199	3.09
β_4 age group 36–40 years	0.226	3.40
β_5 age group 41–45 years	0.278	3.46
N =	324	
R^2	0.9748	
Log L	913.09	

Note: Standard errors are heteroscedastic consistent. Year dummies are included in the regressions.

Table 2. Estimation results, separating the effects between 1984–1990 and 1991–1996

Parameter	Coefficient	*t*-value
Constant	0.385	13.54
1984–1990		
Employment lagged	0.464	13.80
Age	0.015	3.84
Relative cohort size	0.384	0.88
Relative education	0.041	3.01
Education 1984–1990		
β_{11} age group 21–25 years	0.192	1.20
β_{21} age group 26–30 years	0.111	1.73
β_{31} age group 31–35 years	0.116	2.05
β_{41} age group 36–40 years	0.112	1.77
β_{51} age group 41–45 years	0.065	0.88
1991–1996		
Employment lagged	0.629	17.20
Age	0.0005	0.452
Relative cohort size	1.697	1.79
Relative education	−0.009	0.50
Education 1991–1996		
β_{12} age group 21–25 years	0.841	2.52
β_{22} age group 26–30 years	0.634	4.64
β_{32} age group 31–35 years	0.565	4.45
β_{42} age group 36–40 years	0.528	3.84
β_{52} age group 41–45 years	0.570	3.31
N =	324	
R^2	0.9854	
Log L	1001.44	

Note: Standard errors are heteroscedastic consistent. Year dummies are included in the regressions.

dominates the behavioural effects and also that the composition effects are different between the two subperiods.

Looking at the other coefficients in Tables 1 and 2 the ones for the lagged dependent variable are positive, as expected, and highly significant.[4] The parameters of the age variable are, except for the economic boom, insignificant and the parameters of relative cohort size are all insignificant.[5] Large cohorts should stiffen the competition for work and, at least in the short run, decrease the employment level (for example, Welch, 1979; Wachter & Kim, 1982; Zimmermann, 1991). One explanation that this implication did not come about in Table 2 is that, in the panel we study, the relative population sizes are larger for older age groups than for younger age groups. This is a consequence of the baby-boom that followed the Second World War and coincided with the birth years of the older part of our sample.

Turning now to the parameters of the relative educational level their coefficients are insignificant except for the economic boom period. This is contrary to the expectations on possible differences between the time periods. A possible explanation is that the fraction of uneducated workers has varied. As mentioned earlier, enrollment to studies rose dramatically from 1988. This means that the term $(u_i + \alpha s_i)$ in Equation (4) was larger in the 1980s and that, in the 1990s, there were fewer individuals, especially younger, that could be affected by the crowding out. However, it may also be the case that the effects from relative education are poorly identified for the 1990s period. If we exclude e_{it}/e_{jt} from the regression, all parameters of education become significant. We will shortly return to this issue.

The estimations in Table 2 allow us to test various special cases by imposing the relevant parameter restrictions. In Table 3, we present Wald tests of the relationships between educational level and employment. The first row in the table tests the null hypothesis that educational effects on employment are the same for all age groups and over the entire estimation period. Using the 5% level of significance as the cut-off, we can reject the null hypothesis in row one, meaning that parameter stability in general can be rejected. Row two of Table 3 tests the null hypothesis of no differences in educational effects between the two subperiods allowing for differences across age groups. This hypothesis is also rejected and strengthens the impression of differences in educational effects between the two periods.

Table 3. Testing differences in effects across age groups and over time

		Ordinary least squares	
	Null hypothesis	Chi-square	*p* value
(1)	No difference in effects between age groups and subperiods[a]	27.13	0.001
(2)	No difference in effects between subperiods; each age group separated[b]	19.27	0.002
(3)	No difference in effects between age groups; whole sample period[c]	15.05	0.058
(4)	No difference in effects between age groups; subperiod 1984–1990[d]	9.40	0.052
(5)	No difference in effects between age groups; subperiod 1991–1996[e]	5.64	0.227

Note: The null hypotheses formulated in terms of the parameters (see Table 2) are given by:[a] $\beta_{11} = \ldots = \beta_{51} = \beta_{12} = \ldots = \beta_{52}$, [b] $\beta_{11} = \beta_{12}, \beta_{21} = \beta_{22}, \beta_{31} = \beta_{32}, \beta_{41} = \beta_{42}, \beta_{51} = \beta_{52}$, [c] $\beta_{11} = \ldots = \beta_{51}, \beta_{12} = \ldots = \beta_{52}$, [d] $\beta_{11} = \ldots = \beta_{51}$ and [e] $\beta_{12} = \ldots = \beta_{52}$.

Row three tests the null hypothesis that the coefficients of the educational effects are equal across age groups, allowing for differences between subperiods. Rows four and five of Table 3 repeat the test for the subperiods 1984–1990 and 1991–1996. In rows three to five, the hypotheses are not rejected at the 5% significance level. The result for the period of relative recession, in row five, more clearly indicates no differences in educational effects between age groups. If e_{it}/e_{jt} is excluded from the regression, all the implications in Table 3 remain the same.[6]

Summing up, we have found evidence in favour of the hypothesis that the short-run effect of educational composition on employment is positive but that it differs between the subperiods. The interpretation is that education has a more important short-run effect on employment in recessions than during economic booms. Second, formal testing cannot reject the null hypothesis of no differences across age groups.

It is tempting to conclude that a large part of the differences between subperiods is due to the composition effect. In the 1980s, the employment rates were relatively high for both university graduates and for those with lower educational attainment, so the composition effect should have been relatively modest. When the labour market is tight, as was the case in the 1980s, it is also easier for students to find part-time jobs. Therefore, the proportion of students that were attached to the labour market was probably larger during the 1980s (increasing $n^u{}_i$ in Equation (2)). In the 1990s, the differences in employment rates between educational groups widened, offering a larger scope for composition effects.

Given that the composition effect is a main driving force behind our results, we should also expect to find age-group differences. Let us focus on the two factors that make 20 year olds less employed than 40 year olds: the lack of education and the lack of experience. Possessing education when young probably creates a substantial advantage as individuals around their age lack experience. As the cohort grows older there will still be an advantage for the educated but it will now be less important when most of their age group have work experience as a means of competition and the overall employment level of the cohort will have risen. The role of education is thereby played down with age and it would mean that relative employment rates move in favor of the non-educated as the cohort grows older. However, the contraction of the composition effect with age is small once a cohort has reached a certain level of experience. Looking back at Figure 2, the differences in employment levels are relatively modest from the age of 30, generating the results in Table 3.

Concluding Discussion

We have analysed aggregate cohort-specific data on Swedish male employment and education. Employment is measured as the fraction of the cohort employed, and education as the fraction with at least one academic degree. Our results show a significant effect of education on employment for all age groups. However, caution is called for because, when separating the effects between the period of the economic boom 1984–1990 and of the recession 1991–1996, the significance of the effects disappears for the boom period. Formal testing confirms that the effects are significantly different between the two periods.

There are no significant differences across age groups in either period. It is plausible that this result is due to the relatively small differences in employment rates between age groups once the age of 30 has been reached.

As for policy, education appears rather attractive as a short-run device to increase aggregate employment during downturns. The data does not allow us to interpret the long-run consequences of a higher level of educational attainment in the population. For example, a higher level of education may crowd out other age groups so that their employment rates are adversely affected.

Tentative estimations using a measure of relative education indicate crowding out effects between age groups in the economic boom period. It must be stressed that age groups may not be the ideal dimension to measure crowding out effects. Nevertheless, if the distribution of employment among age groups is a big concern, education may give the young a relative advantage.

Acknowledgements

The authors wish to thank Thomas Aronsson, Jean-Pascal Bénassy, Pierre Cahuc, Fabrice Collard, Fernando Delrio, Xavier de Luna, Patric Fève and Francois Langot, as well as participants at seminars in Paris at CEPREMAP and CREST and two anonymous referees. Any remaining errors are of course the authors' own.

Notes

1. Females are excluded from the study because of the difficulties associated with defining a consistent measure of academic degrees. A number of educations strongly related to female labour markets, foremost nurses and day care teachers, were from 1977 defined as academic degrees by Statistics Sweden.
2. For an overview of the topic, see Freeman and Wise (1982).
3. One should bear in mind that Saint-Paul (1996a, 1996b) studies the case where the fraction of educated is increased unconditional on the number of uneducated non-students. In his case, the total effect can be expressed as $\partial n_i/\partial e_i = [n^e{}_i(\bullet) - n^u{}_i(\bullet)] + e_i \partial n^e{}_i(\bullet)/\partial e_i + (1 - e_i)\partial n^u{}_i(\bullet)/\partial e_i$.
4. In Table 2 the inclusion of year dummies and a lagged dependent variable alone creates an R^2 value of 0.977. However, an F-test that other variables should be of no explanatory power is rejected with a p value of 0.00005.
5. Cohort sizes are constructed as fractions of the population aged 21–45 in each year.
6. The major change is that the p values of tests three and four both become around 0.20. The implications of Table 3 also rest unchanged if we, instead of the relative measure, use the residual of the regression $e_{jt} = \alpha + \beta e_{it}$.

Appendix: Deriving Equation (3)

First note that $e_i = 1 - u_i - s_i$, where u_i is assumed fixed. This means:

$$\frac{\partial(u_i + \alpha s_i)}{\partial e_i} = -\alpha$$

and

$$\begin{aligned}\frac{\partial n_i}{\partial e_i}\Big|_{u_i} &= n_i^e + e_i \frac{\partial n_i^e}{\partial e_i} + \frac{\partial(u_i + \alpha s_i)}{\partial e_i} n_i^u + (u_i + \alpha s_i)\frac{\partial n_i^u}{\partial e_i} \\ &\quad + (u_i + \alpha s_i)\frac{\partial n_i^u}{\partial(u_i + \alpha s_i)}\frac{(u_e^i + \alpha s_i)}{\partial e_i} \\ &= [n_i^e - \alpha n_i^u] + e_i \frac{\partial n_i^e}{\partial e_i} + (u_i + \alpha s_i)\frac{\partial n_i^u}{\partial e_i} - \alpha(u_i + \alpha s_i)\frac{\partial n_i^u}{\partial(u_i + \alpha s_i)}\end{aligned}$$

Table A1. Descriptive statistics

	Maximum	Mean	Minimum	Standard error
1984–1990 (175 observations)				
Employment	0.964	0.912	0.767	0.048
Cohort size	70223	61736	50273	4748
Educated 1984–1990				
Age 21–25 years	0.044	0.017	0.003	0.014
Age 26–30 years	0.126	0.097	0.061	0.021
Age 31–35 years	0.144	0.131	0.116	0.007
Age 36–40 years	0.143	0.135	0.123	0.005
Age 41–45 years	0.145	0.124	0.090	0.015
Total	0.145	0.101	0.003	0.046
1991–1996 (150 observations)				
Employment	0.949	0.811	0.482	0.099
Cohort size	69565	61859	56046	3442
Educated 1991–1996				
Age 21–25 years	0.061	0.023	0.001	0.016
Age 26–30 years	0.116	0.092	0.059	0.018
Age 31–35 years	0.146	0.129	0.116	0.009
Age 36–40 years	0.156	0.146	0.137	0.005
Age 41–45 years	0.155	0.144	0.136	0.004
Total	0.156	0.107	0.001	0.048

References

Ashenfelter, O. & Ham, J. (1979) Education, unemployment, and earnings, *Journal of Political Economy*, 87, pp. S99–S116.

Fields, G. S. (1995) Increasing private returns to education, *Mimeo* (New York, Cornell University).

Freeman, R. B. & Wise, D. A. (Eds) (1982) *The Youth Labor Market Problem: Its Nature, Causes and Consequences* (Chicago, IL, The University of Chicago Press).

Gregg, P. & Manning, A. (1997) Skill-biased change, unemployment and wage inequality, *European Economic Review*, 41, pp. 1173–1200.

Jackman, R., Layard, R. & Nickell, S. (1991) *Unemployment: Macro-economic Performance and the Labour Market* (Oxford, Oxford University Press).

McKenna, C. J. (1996) Education and the distribution of unemployment, *European Journal of Political Economy*, 12, pp. 113–132.

Nickell, S. (1979) Education and lifetime patterns of unemployment, *Journal of Political Economy*, 87, pp. 117–131.

Okun, A. M. (1981) *Prices and Quantities* (Blackwell, Oxford).

Pedersen, P. J. & Westergaard-Nielsen, N. (1993) Unemployment: a review of the evidence from panel data, *OECD Economic Studies*, 20, pp. 65–114.

Saint-Paul, G. (1994) Unemployment, wage rigidity, and the returns to education, *European Economic Review*, 38, pp. 535–543.

Saint-Paul, G. (1996a) Unemployment and increasing returns to human capital, *Journal of Public Economics*, 61, pp. 1–20.

Saint-Paul, G. (1996b) Are the unemployed unemployable?, *European Economic Review*, 40, pp. 1501–1519.

Teulings, C. & Koopmanschap, M. (1989) An econometric model of crowding out of lower education levels, *European Economic Review*, 33, pp. 1653–1664.

Thurow, L. C. (1972) Education and economic equality, *The Public Interest*, Summer, pp. 66–82.

Wachter, K. & Kim, C. (1982) Time series changes in youth joblessness, in: Freeman, R. B. & Wise, D. A. (Eds) *The Youth Labor Market Problem: Its Nature, Causes and Consequences* (Chicago, IL, The University of Chicago Press).

van Ours, J. C. & Ridder, G. (1995) Job matching and job competition: are lower educated workers at the back of job queues?, *European Economic Review*, 39, pp. 1717–1731.

Welch, F. (1979) Effects of cohort size on earnings: the baby boom babies financial bust, *Journal of Political Economy*, 87, pp. 65–97.

Zimmermann, K. F. (1991) Ageing and the labor market. Age structure, cohort size and unemployment, *Journal of Population Economics*, 4, pp. 177–200.