SWEDISH ECONOMIC POLICY REVIEW 7 (2000) 71--105

Education policy and returns to education

Anders Björklund*

Summary

■ To form an efficient education policy, politicians need answers to the following types of questions: What are the economic returns to individuals' participation in different types of schooling? How are prospective students' schooling choices affected by the perceived economic returns to schooling before and after taxes and student costs? What are the returns to additional resources, e.g. smaller classes in primary education? In the 1990s, the Swedish government increased the number of study places at colleges and in other institutions for adult education. New subsidies were introduced to stimulate adult education. At the same time, the local governments reduced expenditure per pupil in compulsory education.

This paper summarises Swedish empirical research in this area. Several studies suggest a robust causal relationship between years of education and the logarithm of individuals' earnings. The relationship is remarkably linear with a slope around 0.04, which suggests that an additional year of schooling would on average raise earnings by around four percent. Nonetheless, it is questionable whether adult education, which takes place later in life, yields as high a return as youth education. College enrolment seems to be sensitive to the economic returns to such education. However, the marked increase in enrolment during the 1990s would not have occurred without additional study places. Present Swedish research offers almost no guidance on the effects of the expenditure reductions in primary education during the 1990s. Randomised experiments would probably be needed to fill this serious gap in our knowledge. ■

* *Anders Björklund is professor of economics at the Swedish Institute of Social Research at Stockholm University.*

SWEDISH ECONOMIC POLICY REVIEW 7 (2000) 71-105

Education policy and returns to education

Anders Björklund*

The notion that education fosters economic growth is well-established in Swedish politics. All of the Swedish governments of the 1990s took important measures to expand training and education. At the beginning of the recession in the early 1990s, training became the principal measure to provide opportunities for unemployed workers, in contrast to the temporary "relief" jobs that used to be the most important cyclical labour market policy measure. During the whole decade, the universities received additional resources to raise enrolment rates. In the middle of the decade, the government took a special initiative to stimulate adult education. The "Promotion of Adult Education and Training" scheme *(Kunskapslyftet)* offers unemployed workers with low basic education, the opportunity to obtain regular schooling and receive an allowance equivalent to the unemployment benefit. Although these measures were undoubtedly designed to lower registered unemployment, the notion that education has a long-run impact on the productive capacity of the work force was also probably a factor.

Many of the participants in the public debate have claimed that Swedish education has not been able to foster economic growth as much as it could have done because of deficiencies in the education system and in the labour market. The criticism of the education system is typified by a series of articles by the political editor of the most influential daily newspaper, *Dagens Nyheter*. He has argued that the comprehensive schools do not work well, and that, as a consequence, additional resources to these schools do not pay off in terms of better teaching and more skilled students.[1] It is hard to say how influential this critique has been, but it is reasonable to believe that it has had an impact on the decisions by the local municipalities to reduce expen-

* *I thank Christian Kjellström, Mikael Lindahl, Håkan Regnér, Paul Söderlind and Björn Öckert for useful comments.*

[1] The articles are collected in Bergström (1998).

diture on compulsory youth education during the 1990s. A government commission has reported that real expenditure on compulsory education for 7-16-year-olds declined by six per cent despite a twelve-per cent increase in the number of pupils.[2] Reductions of similar magnitudes were made in expenditure on public child-care.

A common criticism of the Swedish labour market has been that the desire of the unions to narrow wage differentials has reduced the private incentives to enrol in higher education, which has in turn given rise to a less productive work force. The strongly progressive income taxes are believed to have reinforced these effects, particularly during the 1980s. This type of criticism was expressed by the influential SNS Economic Council *(Konjunkturrådet)* in several reports during the 1990s.[3]

My aim is to examine the empirical evidence on these issues. What is the economic return to education in Sweden? Is the return to certain types of education higher than to others? How efficient is the Swedish education sector? What effects can be expected from the recent budget cuts in youth education? What factors influence young people's decisions to enrol in college education after high school? I summarise what we know from existing research, but I also emphasise what we do *not* know. By comparing Swedish research with that from other countries, in particular from the US, I can identify gaps in Swedish research.

Section 1 examines the causal link between education and earnings. Because most economic research has focused on the impact of education on earnings, this is the longest part of the paper. Then I continue to discuss the demand for higher education in Section 2. The main focus is on the impact of the private return to college education on the decision to enrol in such education. Section 3 summarises what research has to say about the efficiency of the education sector and is unfortunately rather short. Finally, I conclude and discuss my findings in Section 4.

1. Effects on skills, productivity and earnings—empirical results

Because my basic aim is to discuss how education contributes to the productive capacity of the economy, it would be natural to concen-

[2] See SOU 2000:3.

[3] See, e.g. Andersen et al. (1997).

trate on the causal link from education to the productivity of the work force, or using my notation: *education → productivity*. But, unfortunately, very little research has focused directly on this relationship. Most research has instead focused on the impact of education on individuals' earnings, or with the same notation: *education → earnings*. In general, it is more or less taken for granted that there is such a causal relationship. However, those who make this claim have a set of mechanisms in mind. First, schooling provides some useful skills. Next, these skills raise the productivity of the individual. And finally, higher productivity leads to higher earnings in the labour market. Such reasoning gives us the following sequence of effects to examine:

- *education → skills,*
- *skills → productivity,*
- *productivity → earnings.*

It is constructive to distinguish between these parts of the causal chain from schooling to earnings. The first part of the chain informs us about the direct output of the schooling system, namely the skills of the graduates. The second one tells us how various skills are used in the production system to generate output. From a detailed analysis of this relationship, we would learn what skills are most useful in this respect. The third relationship tells us how well productivity is rewarded in the labour market. In this survey, I start by summarising the research on the impact of education on earnings. But then I try to look into the "black box" to see what we can say about the separate processes that make up the causal effect of education on earnings.

1.1. Empirical results from microdata: schooling → earnings

There is a huge literature on the relationship between individuals' labour earnings and their schooling, using representative samples of the work force.[4] However, the literature is much smaller if one considers that many studies have used the same basic data set. It is instructive to start with two of the simplest possible analyses that can be made with such data. Figure 1 shows the estimated linear relationship between the logarithm of the hourly wage and years of schooling for Swedish men. The data are from the 1968, 1981 and 1991 Level of Living Sur-

[4] Arai and Kjellström (1999) offer another recent survey of this literature. They also cover the related literature on the impact of work experience and job tenure on earnings.

veys. The diagram also shows 95 per cent confidence intervals for the estimates of dummy variables for each year of schooling. Even if the linear relationship can be considered a simple descriptive one, it is well known from the literature that it can be derived as the long-run equilibrium in a simple economic model with perfect capital markets.[5]

The slopes of the linear curves are .087 (for 1968), .045 (for 1981) and .046 (for 1991), which are the estimated average wage premiums for additional years of schooling. Most of the vertical confidence intervals cover the estimated linear equations. Hence the linear model fits the data quite well. Nonetheless, formal statistical tests reject the linear model in favour of the more flexible one with dummy variables.[6] The deviations from linearity would have been more striking if they were systematic, for example the same for each year. But the "most systematic" deviation is the dummy-variable coefficient for 16 years of schooling, which predicts a higher wage premium than the linear model for two of the three years. The striking linearity of this relationship is also emphasised in the US literature.[7] So the simple economic model that predicts such a relationship seems to be a reasonable first approximation to the data.

There are strong reasons to doubt that such a simple descriptive pattern represents a causal effect, such that the higher hourly wage is caused by the additional education undertaken by the student. For decades, labour economists and other educational researchers have discussed the possibility that the relationship also reflects that those who undertake more schooling are more productive before schooling, so that they would have had earned more without the additional schooling. In that case, the schooling-coefficient estimates in these simple equations would also reflect such differences in pre-schooling ability between individuals with high and low education. Ability-bias is the established concept for this problem. Most often, scholars have suspected that such bias implies that estimates like those in Figure 1 are upwards-biased estimates of the causal effect of the education.

[5] See e.g. Willis (1986).
[6] Palme and Wright (1999) also reject the linear model but use another technique.
[7] See Card (1999a).

Figure 1a. The relationship between the logarithm of individuals' hourly wages and their years of schooling according to estimated earnings equations. Swedish men 1968

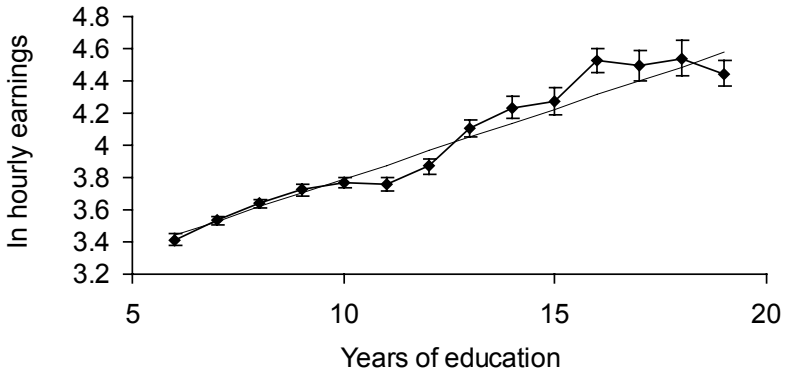


Figure 1b. …Swedish men 1981

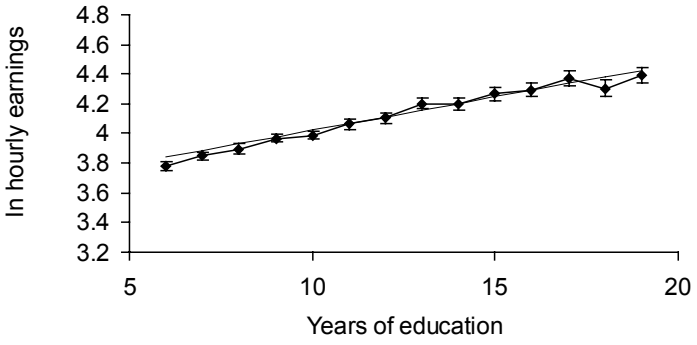
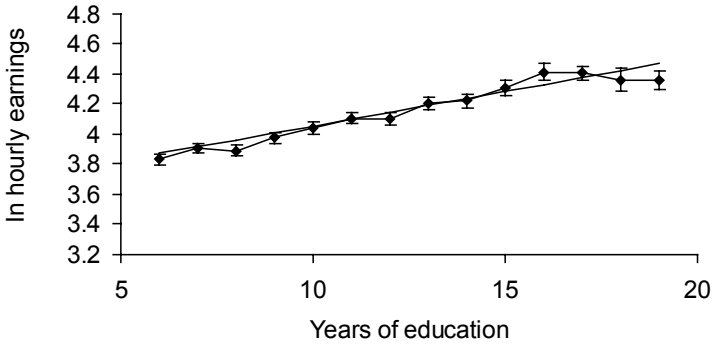


Figure 1c. … Swedish men 1991



Note: The linear curves show predicted logarithmic hourly wages from equations with years of schooling, years of work experience, and years of work experience squared. The vertical lines show 95 per cent confidence intervals from estimated equations with dummy variables for each year of schooling.
Source: Björklund and Kjellström (1999).

A huge literature has addressed the ability-bias problem in different ways. This research has encountered another problem that in general leads to a bias in the other direction, namely the problem of measurement error in the independent schooling variable. This might sound like a trivial problem, but it is not. The reason is that the techniques used to reduce the first problem reinforce the problem caused by measurement error in schooling.

One way of addressing the ability-bias problem is to complement the microdata set with explicit measures of individuals' abilities. Such measures must capture the abilities that the sampled individuals had before the evaluated education took place. Grades and scores from various tests are the candidate variables to be used. This approach has been used in several studies, including some Swedish ones. To a varying degree, these studies have paid attention to the fact that the bias from measurement error in the schooling variable is aggravated when additional variables are added to the estimated equation.

Kjellström (1999) used data on IQ-tests and grades from the end of the sixth grade, i.e. at the average age of about 13 years. Large samples of persons born in 1948 and 1953 were followed up to 1993,

a year for which register data on the level of education and annual earnings was obtained. When IQ-tests or grades were included as additional controls in the earnings equation, the earnings premium for years of schooling fell from .052 till .043. When seven levels of education were used instead of years of schooling, the earnings premium fell by approximately the same magnitude for all levels of education, suggesting that the bias is about the same for all levels of education. Meghir and Palme (1999) used the same data set, but treated the test variables somewhat differently. They got basically the same results. None of these studies took the measurement error explicitly into account, so the reduction of the earnings premiums could be overestimated. US studies, which have applied the same technique, have shown somewhat larger reductions in the estimated premiums.

Another approach has been to use data on twins (or siblings). The idea is that two twins share not only the same social background, but are also genetically alike. The latter holds particularly for identical twins. So if two identical twins have different educations, the argument is that the earnings differential between them can be attributed to education as they are alike in other respects. The technique is therefore to relate twin-pair differences in education to twin-pair differences in earnings. This means that only twin pairs with different educational choices identify the effects. The method also imposes the assumption that these twins are identical in all other aspects that are relevant for earnings differentials, but nevertheless make different education choices.

Isacsson (1999a,b) used a large and representative sample from the Swedish twin register which had been complemented with information on annual earnings and educational level from public registers. When the educational level was transformed into years of education, corrected for measurement error, he estimated earnings premiums that deviated by at most .006 percentage points from those that were obtained when he used the data as an ordinary cross-section set. So the bias due to measurement error and the bias due to ability differentials more or less offset each other. The corresponding US studies, which used smaller and less representative data sets, have given somewhat higher estimates with the twin technique.[8]

A third technique, which has become increasingly popular in recent years, is the instrumental-variable (IV) technique. The idea is to

[8] See Ashenfelter and Krueger (1994).

use the variation in education that is generated by some exogenous force that has affected the educational choice. This exogenous force ("shock") must, on the one hand, affect educational choice directly and thereby earnings indirectly via education, but must also, on the other hand, have no direct impact on earnings. Technically, the estimator can be described as:

IV estimate of the wage premium =
[(wage | shock)-(wage | no shock)] / [(education | shock)-(education | no shock)],

where (wage | shock) denotes the average wage for those who were affected by the shock, and the other expressions in the corresponding way. As can be seen from this expression, it is the individuals who have been exposed to the shock who identify the estimated wage premium. This is a disadvantage if one is interested in the average effect of all education that is taking place in the economy and not in the education generated by the shock. In certain cases, however, this is also a major advantage. For example, if the shock is a school reform, it is appealing to be able to interpret the results as the return to the education that was generated by the reform.

The list of studies using the IV technique is now quite long.[9] For example, Card (1995) used proximity to college as a source of exogenous variation in US data. Angrist and Kruger (1991) used a rule in the US education legislation according to which schooling is compulsory up to a certain age. This rule has forced those who were born late in the calendar year to go to school a longer time than those born early. Even if the precision in the estimates of the return to schooling in these studies is quite low, one has usually obtained somewhat higher estimates than in conventional cross-section based studies.

Meghir and Palme (1999) offer one of the most instructive applications of the IV-technique, and they do it on Swedish data. They exploited the reform of the Swedish school system in the early 1960s when the length of compulsory schooling increased from seven or eight to nine years. To gain experience from the new school system, it was introduced gradually in different parts of Sweden. Some local municipalities were chosen as experimental ones to start with the new system. Then more local municipalities followed until the whole country finally had introduced the new system. The pupils in the ex-

[9] See e.g. Krueger and Lindahl (1999) and Card (1999a,b) for recent surveys.

perimental municipalities therefore obtained a longer education than those who grew up in other municipalities and yet belonged to the same cohort. When Meghir and Palme analysed the final educational outcomes, they found that those who grew up in the experimental municipalities had longer education than those who grew up in other municipalities. Most interestingly, this difference was only partly attributable to the prolongation of primary school from seven (or eight) years to nine. It was also the case that the pupils in the experimental municipalities continued to a larger extent than others to some of the higher levels of voluntary education. In addition, Meghir and Palme could verify their technique by showing that grades and test scores at the age of 12 or 13 years did not deviate between the pupils in the experimental and in the comparison municipalities.

When Meghir and Palme used "growing-up in an experimental municipality" as an instrumental variable to estimate the return to the additional education caused by the reform, they obtained somewhat lower returns than with the traditional technique applied on cross-section data. However, the precision of the estimates was low in this study as well as in most others using the IV technique.

To sum up, this research rather strongly supports the view that there is a causal effect of education behind simple earnings-schooling relationships such as those illustrated in Figure 1. The simple relationship in micro data holds up quite well when controls for tests are made, or when identical twins are compared, or when use is made of an exogenous variation in schooling caused by exogenous forces. Nevertheless, it might be the case that there is a different return to the additional education caused by different school reforms than to increases in the number of school years in a given school system.

1.1.1. Other outcomes than earnings

In addition to an impact on earnings, education could have causal effects on other outcomes like unemployment, working conditions and social status. Not surprisingly, existing studies suggest that there are such beneficial effects. But most of these studies have not used any advanced techniques to reduce the ability-bias problem discussed above.

Cross-section data reveal marked unemployment differentials between educational groups. Kjellström(1999) also shows in regressions that control for test scores at the age of 13 years that education has a significant positive effect on the probability of having positive annual

earnings. This result probably reflects the lower risks of *becoming* unemployed for persons with higher education, whereas the relationship between unemployment *duration* and educational level seems to be more complicated.[10]

Swedish microdata sets contain several measures of self-reported physical working conditions. For example, the widely used Level of Living Surveys ask employed workers whether their working conditions involve "heavy lifting", or "monotonous movements", or are "noisy" etc. Not very surprisingly, a regression with such variables as dependent variables give estimated coefficients, which imply that higher education unambiguously leads to better physical working conditions.[11] One objection to such results could be that workers who have higher education have instead more psychologically demanding jobs. Studies in social psychology suggest, however, that psychologically demanding jobs only lead to worse health if the worker has no autonomy in the job, i.e. if he/she cannot influence what tasks to carry out and how to carry them out. Swedish studies suggest that persons who have higher education have jobs with a combination of psychological stress and autonomy, whereas there is no relationship between education level and psychologically stressful jobs without autonomy (see Erikson and Jonsson, 1993).

Most likely, the higher status of the jobs for higher educated workers has a value *per se* for the individual. For example, higher educated persons appear to be more able to contact authorities to pursue their own interest compared to lower educated persons. But according to Erikson and Jonsson's study, the differences in participation in political activities and membership in political organisations are small between education groups.

These results confirm the view that there are non-monetary rewards from having a higher education. It would be an exciting task to apply techniques from experimental economics to make people reveal the value that they attach to these rewards. It could very well be that people attach quite high values to such rewards. In that case, conventional estimates of the return to schooling based on the impact on earnings would be strongly downwards biased estimates of the total returns.

[10] See Thoursie (1998) and Jansson (1999) who study the relationship between education and unemployment duration on data from the 1990s.

[11] Erikson and Jonsson (1993) present such results and offer references to further research.

1.1.2. The distinction between earnings effects and rates of returns to investment

For at least two reasons, it is important to distinguish between the earnings effect of schooling and the rate of return to an investment in schooling. First, we sometimes want to compare the return to investment in education to the return to other investments. There are no wage premiums to investments in machinery, buildings and roads, so we need a comparable measure such as the internal rate of return, or present values. Second, most economic theories are based on rational behaviour. In order to test such theories, one must use the measures that rational investors are supposed to use, namely rates of return.

As a starting point, it is instructive to note that the coefficient for years of schooling in a log pre-tax earnings equation will approximate the marginal internal rate of return provided that: (i) there are no taxes or transfers; (ii) foregone earnings are the only education cost; (iii) everyone works continuously until retirement and has the same length of working career; and (iv) there is no general earnings growth in the economy. Remember that this coefficient was .046 for Swedish men in 1991. Hence, we want to know how sensitive such estimated returns are to deviations from these assumptions.[12] Swedish studies (see Edin and Holmlund, 1993; and Björklund and Kjellström 1994, 1999) can be summarised as follows.

Using post-tax earnings by deducting income taxes reduces the internal rate of return markedly.[13] It is the progressive part of the income taxes that generates this result. The reason why proportional income taxes (in general) do not affect the internal rate of return is that such taxes affect both the benefits and the costs of education. Note that the major private education cost consists of forgone earnings during schooling. This result is also illustrated by the fact that the post-tax internal rate of return increased markedly after the tax reform in 1991, which reduced tax progressivity.

The internal rate of return is raised markedly when the value of stipends and subsidised student loans are taken into account. Actually, the positive impact of student support and the negative impact of income taxes tend to counteract each other in estimates on Swedish data. The reason is that stipends and student loans are received early

[12] See Willis (1986) for a more complete statement of this result.

[13] Transfers such as housing allowances and social assistance were not taken into account.

in life and therefore obtain a high value in estimations of the return to the investment.

Estimates of the internal rate of return are also sensitive to assumptions about the length of working life for persons who have a long or a short period of education. Swedish data reveal that persons who have a long education work longer than those with a shorter education, which rationalises assumption (iii) above. These estimations neglect, however, the potential leisure value of a shorter working life. Finally, it is easy to forget that each percentage increase in general earnings growth also increases the internal rate of return by one percentage point. For example, the assumption of a two per cent annual earnings growth would therefore make the education investment appear much more lucrative.

These results refer to the private return to schooling. To estimate the social rate of return, direct costs of schooling, such as the costs for teachers and school buildings, should also be taken into account. Externalities of education, which are generally presumed to be positive, should also be included among the benefits. I know of no attempts to make such estimations on Swedish data.

1.1.3. Different types of education

To design education policy efficiently, it would be useful to be able to rank different educations according to their rate of return. One could argue that the more detailed information of this type that one has, the better the education policy. However, it can be difficult to get such detailed information. In some respects it could also be misleading. First, it could be difficult to use a detailed education classification and at the same time apply a technique to reduce the problem of ability bias.[14] In particular, it could be difficult to find exogenous forces that have generated education differentials along a detailed classification. It might also be the case that the problem caused by measurement error is aggravated if a more detailed classification is used.

The reason why the information could be misleading is that the return to education at a detailed level could be more volatile than at a more aggregate level. It is, for example, likely that estimates of the return to training for jobs in the construction sector would have signalled high returns, if they had been carried out on data from the late

[14] Even though such bias does not seem to be severe in estimating the average return to additional years of schooling, it could be more severe in estimations of the return to specific educations.

1980s. However a few years later, the sector was severely hit by structural problems and the prospects for construction workers had substantially deteriorated. Hence it is questionable if such detailed studies are really useful for education policy.

There have been a few Swedish studies on differences in wage premiums between different education levels and between different specialisations at a particular level. The studies that use register information about education levels present such wage premiums.[15] Isacsson (1999a) used information about the number of study years at each level and the twin approach to estimate the wage premium per year at seven different education levels. The most striking difference was that the return to the shorter university educations was lower than the return to the longer university educations (three years or more). However, the premium for high school education was not lower than for long university education. The estimates by Kjellström (1999) and Meghir and Palme (1999), which controlled for test scores at the age of 13, point in the same direction, namely lower premiums per year for short university educations. Note though that all these studies only include men.

It is also possible to use Swedish register data to estimate wage premiums for even more detailed education classifications. But in practice it becomes difficult to apply any advanced techniques to reduce ability-bias. Wadensjö (1991) estimated earnings equations for detailed university educations and computed expected discounted lifetime earnings from the average age of graduation until 65 years of age. He found that a medical education had the highest return, followed by civil engineers and business economists, whereas specialists in social sciences and psychologists had lower returns. With a discount rate of four per cent, the latter groups had lower estimated lifetime earnings than graduates from the technical programmes of the upper secondary school.

1.1.4. Youth versus adult education

The trade-off between youth and adult education involves special problems. Of course, one should expect an optimal education system to provide both youth and adult education. However with limited re-

[15] The education register is primarily based on completed degrees, so e.g. university studies that do not lead to a degree are in general not included in the register. Sensitivity analyses by Antelius and Björklund (2000) suggest, however, that the missing information is not a major problem in such studies.

sources available for current educational expenditure, some trade-offs must be made. Is, for example, the money spent on the "Promotion of adult education and training" (*Kunskapslyftet*) in Sweden, a good use of resources, or would the return be higher if the money was spent on smaller classes in compulsory schools? Can the subsidies to public child-care be justified as investment in human capital? We also have the sensitive issue whether the returns to education for more "talented" pupils are higher than the returns for less talented ones. Needless to say, such issues also involve ethical judgements.

In an almost trivial, but yet important, sense, the return to education at a young age is always higher than to education later in life. For given wage premiums and given direct costs of education, the economic return is higher the earlier it takes place. Obviously, the return can be reaped over a longer period of time. Björklund and Kjellström (1999) illustrate this result by computing the present values that, for *given* wage premiums, accrue to education that take place at different ages. They compare the additions to the present value of lifetime earnings from high-school and college education that take place fifteen years later than the "normal" ages of 16-19 years (high school) and 19-22 years (college). The adult-education alternative gives additions to the present values that are 30 to 50 per cent lower than the youth-education alternative. These results show the cost of allocating a given number of study places at high schools and universities to students who are 35 years old rather than 20. Even though all adult students do not crowd out younger students, some crowding-out might take place in Sweden. In the 1980s, a certain number of university places were allocated to applicants who (i) were at least 25 years old; (ii) had four years of work experience; and (iii) had no high school degree. In the 1990s, adult applicants who receive study assistance equivalent to their unemployment-insurance benefits, compete with young students, who have to take study loans, for the most attractive places at Swedish universities.

Björklund and Kjellström's computations assume that everything else, except study age, is equal. This need not be the case. Adult education could have higher economic returns than youth education, if either the wage premiums are higher, or if the costs in terms of foregone earnings are lower for such education.

Let me start to discuss the wage premiums for adult education compared to youth education. In my view, the estimation of wage premiums for adult education involves a special methodological

problem. The problem applies to those who participate in labour market training, but also to those who participate in *Kunskapslyftet*. These persons have in general previously been unemployed, or have run a risk of becoming unemployed. This means that they have recently experienced a "shock" in their labour market career. This shock is probably to some extent temporary, in the sense that they would have improved their earnings even without any training. But the shock probably also involves the permanent loss of firm-specific and industry-specific skills that have been acquired during a long period of time. To estimate the training impact on subsequent employment and earnings, one needs to control for the shocks. It is not easy for empirical researchers to obtain all the essential information. Different dynamic earnings models, which imply different assumptions about the nature of the labour market shocks, can therefore easily yield widely different estimates of the impact of training. The best way to get more reliable estimates of the training and education that take place in Swedish labour market training and in the *Kunskapslyftet* would be follow the US tradition and run randomised experiments. In such experiments, prospective participants are randomly assigned to a participation group (the experimental group), and a non-participation group (a control group).[16]

There is not, however, a complete lack of knowledge about the impact of Swedish labour market training. It seems, for example, that such training had more beneficial effects on subsequent earnings during the 1980s than during the early 1990s.[17] During the latter period, training programs served the function of making participants eligible for new benefit periods.

Heckman et al. (1994) and Heckman (1998) have presented a number of interesting ideas that are relevant for the trade-off between youth and adult education. The argument is that there is a basic *complementarity* in learning such that (i) the ability to learn from formal schooling varies a lot among individuals; and (ii) the ability to learn is systematically better among those with good basic skills. Heckman writes: "Early learning begets later learning and early success breeds later success just as early failure breeds later failure". Such differences

[16] See Björklund and Regnér (1996) for a discussion of US experiences, and suggestions for experimental designs for European countries.

[17] I draw this conclusion from a comparison of the results in Axelsson (1989) and Regnér (1997).

in learning ability lead Heckman to draw certain general conclusions on education policy.

1. Support children from poor dysfunctional families at an early age so that they get the basic learning skills that are required at school at an early stage.
2. Accept that high-skilled workers get more on-the-job training than low-skilled workers, since the former can benefit more from such training than less-skilled persons.
3. Older laid-off workers should not in the first place get training to come back to new jobs, but would benefit more from job subsidies.

It is undoubtedly important to know about these mechanisms to design an efficient education policy. But one could question how strong the empirical support is for Heckman's hypothesis. Some studies of early support for children in poor families have shown good results, although the number of studies is low. Furthermore, the conclusion about adult training is based on recent evaluations of US labour market training.

Which Swedish studies would shed some light on this issue? A rather direct test would be to examine whether the wage premiums are higher for students with high grades or test scores. Technically, this implies a positive interaction coefficient between test scores and schooling in estimated earnings equations. Meghir and Palme (1999) estimated such interaction coefficients and used principal component analysis to aggregate the information in a number of different tests at 13 years of age. They estimated positive interaction coefficients, i.e. the wage premium to schooling was found to be higher for the high-skilled pupils. Kjellström (1999), who exploited the same data set but used the different tests separately, obtained the opposite results. These two studies are thus contradictory, and I am unable to provide any explanation for this contradiction. The complementarity hypothesis may also explain that highly-educated workers get most on-the-job training, but it is not hard to come up with alternative explanations for this pattern.

Other weak support for the complementarity hypothesis is provided by certain estimates of earnings functions. In such equations, the interaction between work experience and schooling tends to be positive rather than negative, although not always significant (see Björklund and Kjellström, 1999). Another weak support is that "years

since graduation" get a positive coefficient, i.e. for a given age the returns to schooling is higher the earlier the person obtained his degree (see Wadensjö, 1991).

Heckman's hypothesis also highlights the role of early child-care, as provided by the Swedish day-care system. There are a few studies of Swedish child-care using microdata for children. The studies share the following general design. An outcome measure such as performance in subsequent schooling is chosen. Background factors such as parental education and occupation, single parenthood, and region are used as control variables in regressions with the outcome measure as the dependent variable and a dummy for child-care participation. Four studies using three different data sets and alternative outcome measures up to the age of 16 show that child-care participation has a weakly significant positive impact on school performance.[18] None of the studies were able to find significant interactions such that the impact is stronger for children with poor parental background.

Adult education would also yield a higher return than youth education if education costs are lower for adults. The most important social education cost is foregone earnings during the period of training. In the case of involuntary unemployment, there are no foregone earnings. This reasoning suggests that adult education could be a good alternative to unemployment benefits. However, the argument applies to both youth and adult education, as youth unemployment and adult unemployment usually move together. Hence the argument applies at best to periods of particularly high adult unemployment. Permanent subsidies to adult education would also create incentives to postpone education from a young age to later in life. Such behaviour would be costly for society.

1.1.5. Cross-country comparisons

Cross-country comparisons of the returns to schooling are useful for several reasons. Firstly, it is interesting to know whether the wage structure *per se* provides stronger incentives to schooling in some countries than in others. By including the student costs and grants as well as taxes and transfers, one can also compare more complete measures of the private returns to education. A second issue is related to the fact that the work force is becoming more internationally mobile. It is then natural to ask in which country it is most profitable for

[18] See Andersson (1989, 1992), Jonsson (1994) and Söderström et al. (1999).

a person with a certain education to work. An answer to this question requires an analysis that not only accounts for earnings differentials among countries, but also differences in taxes, benefits and the value of the public services that the taxes finance. Thirdly, one could ask in what country it is most profitable to *undertake* studies. The student loans, grants and tuition fees are crucial parts of an analysis of this issue.

Because I know of no systematic analyses of the two latter issues, I concentrate on the first one. However, this literature is quite meagre as well. There are, for example, no cross-country comparisons of the private returns to schooling that account for earnings differentials, costs and study grants, and taxes and transfers. The literature seems to be solely confined to earnings premiums. Even such seemingly straightforward comparisons are quite difficult to carry out. The education systems are different, so that in some countries it makes sense to use years of schooling as the measure of education, whereas the level of education is a more appropriate variable for other countries. Furthermore, cross-country comparisons of the level of education can be complicated when the education systems differ. Finally, the measurement errors of the education variables could differ among countries that have consequently different biases.

The highest degree of comparability has probably been achieved in a recent study by Mellander and Skedinger (1999). They used microdata that have been collected in the same way from private firms in seven countries: Belgium, Denmark, France, Germany, Italy, Sweden and the UK. They estimated wage premiums for the positions that require business and engineering degrees. Their main finding was that the similarities among the countries with regard to these premiums are more striking than the differences. This is particularly the case for degrees in engineering. However, the premiums for positions requiring a business degree are markedly higher in the UK.

Some other comparative studies have tried to achieve comparability by using as similar microdata sets as possible, from about the same time period, and restricting the samples of analysis to the same age intervals.[19] Blau and Kahn (1995) estimated wage premiums for years of schooling for men and women during the 1980s. The Swedish es-

[19] Cohn and Addison (1998) and Psacharopoulos (1994) also contain informative summaries of studies for many countries. They present results from many studies made for different purposes. Consequently the degree of comparability is not clear to me.

timates of 4.3 per cent for both men and women are markedly lower than estimates between 9.3 and 7.0 for the UK and the US, but at about the same level as for Australia, Austria, Hungary, Norway, and West Germany. Asplund et al. (1996) estimated similar earnings equations on microdata for the four Nordic countries on data from around 1990. Their estimated wage premiums were around four per cent per annum for Denmark, Norway and Sweden, but around two percentage points higher in Finland.

To conclude, cross-country comparisons are more difficult to carry out than often believed in the public policy discussion. The available estimates of pre-tax earnings premiums for years of schooling do not suggest that such premiums are exceptionally low in Sweden. But in a European perspective, the premiums seem to be higher in Finland and the UK. The premiums are also much higher in US. How these countries would rank in a comparison of more complete measures of the private returns to schooling, which include costs and grants for students as well as taxes and transfers, is an open question. On the one hand, Swedish taxes and transfers would probably push Sweden further down the league table. On the other hand, Sweden probably offers relatively generous conditions for students in terms of loans, grants and a lack of tuition fees.[20]

1.2. Education → skills

There are not as many studies of the causal effect of education on pupils' skills. As a consequence, we know little about what is going on in the schooling system. By comparing the skills of different cohorts of students at a certain age, we would get useful indications about how well the schooling system teaches certain kinds of skills. Measurements of the skills of the same cohort at different points in time would also yield useful information.

Another reason for studying whether schooling leads to more skills is that we could distinguish between two competing economic theories of education, namely the human-capital and the signalling theories. The human-capital theory emphasises that education raises the productivity of the student by providing new skills. The signalling theory emphasises instead that the schooling helps signal existing skills to employers.

[20] See Daniel et al. (1999) who suggest that public education policy treat Swedish college students generously in an international perspective.

Härnqvist (1968) investigates how the results on IQ tests in Sweden evolved from the end of sixth grade (that is, at approximately the age 13 years) to age 18 when the tests for the military service were made. A random sample of Swedish men (n = 5 000) born in 1948 participated in verbal, spatial and inductive tests in 1961. [21] The military tests were different, but measured the same types of abilities. The schooling careers of the same pupils were also followed from 1961 to 1966. Härnqvist's analysis shows that the change in results from 13 to 18 years of age was strongly positively related to the length and the level of education during the period. Those who attended high school had improvements of a magnitude of 40 per cent of a standard deviation on the military test, whereas those who did not complete compulsory school deteriorated around 90 per cent of a standard deviation. These estimates were obtained after regression controls for family background and measurement errors in the variables. Such results strongly suggest a causal effect of education on the skills used in these tests.

As far as I know, there are no other recent studies like the one carried out by Härnqvist. Such studies would have shed light on the educational reforms that have taken place over the last decades. However, the tests of random samples of Swedish pupils in the sixth grade have been repeated with identical questionnaires. The military tests have also continued, even though they have changed design a couple of times. I have been able to obtain aggregate results from these tests. Table 1a shows that the results for 13-year-old Swedes improved from 1961 to 1980; in particular the average scores improved on the spatial and inductive tests. After 1980 there is a decline in verbal abilities, while the results of the spatial and inductive skills remain relatively unchanged (with the exception of a marked peak in spatial skills in 1985).

How can the stability of the results in relation to spatial and logical ability and the decline in verbal ability be explained? The period coincides with the introduction of child-care for pre-school children. Accordingly, one could argue that there is no evidence of a positive impact of child-care in these aggregate data. The decline in scores on the verbal test is not very surprising as the emphasis on correct writing and spelling seems to have declined over time. Another explanation could be that some words that were common in 1961 are used less

[21] A spatial test measures the ability to understand the relationship between geometrical figures.

frequently in the mid-1990s.[22] It is also true that the proportion of pupils with immigrant background has increased over this period. Such pupils are for obvious reasons less skilled in the Swedish language. Furthermore, pupils with immigrant background might require more attention from the teachers.

Table 1b shows the results for 18-year-olds from the military tests in 1980, 1987 and 1993, when these tests were identical. There is also a decline in verbal ability for 18-year-old men. But the results have improved for the three more technical abilities. These improvements are larger, counted in points, than the decline in verbal ability. To illustrate the magnitude of these changes, one can note that (assuming normality) the improvement in theoretical-technical ability of 1.7 points implies that the result for the median person in 1993 equals the result for the 56th percentile person in 1980. And the result on the verbal test for the median person in 1993 equals the result for the 47th percentile person thirteen years earlier.

During a period when a rising proportion of young people continued in school until the age of 18 years, one can thus see a clear improvement from age 13 to age 18 in three of the four military tests. The decline in verbal ability for 18-year-olds should also be seen in the light of the decline for 13-year-olds. Hence there is not necessarily a deterioration from age 13 to age 18. More detailed results, reported in Björklund et al. (1998), show that in all four tests, including the verbal one, the proportion of boys with very poor results declined. Overall, the development is consequently quite good from age 13 to age 18. One objection could be that these tests only capture academic abilities, whereas many young people in the first place need more vocational skills. [23] However, one can also argue that the future labour market will require a greater deal of numerical and technical skills like those that are included in the military tests.

[22] Svensson et al. (1997) report that the trend in the results differ among the items of the verbal test; the knowledge of more old-fashioned words is falling, whereas the knowledge of words that stem from foreign languages is increasing.

[23] Another objection is that the military tests are not reliable because too many young people do not do their best on these tests. Furthermore, girls do not participate in these tests.

Table 1a. Results from tests of randomly selected pupils in the sixth grade during the spring semesters in 1961, 1966, 1980, 1985 and 1990. Number of correct answers out of 40 test items

	Verbal test		Spatial test		Inductive test	
	Boys	Girls	Boys	Girls	Boys	Girls
1961	22.5	22.5	22.0	20.3	20.0	19.2
1966	24.0	24.2	22.8	21.7	20.8	20.3
1980	22.7	23.4	23.7	23.5	22.5	22.5
1985	23.0	23.7	24.9	25.0	22.5	22.2
1990	22.2	22.4	23.9	23.3	22.5	21.8
1995	21.5	22.1	23.8	23.5	22.9	22.4

Note: The standard deviation is around 7 for 1961 and 1966, and the standard errors were then around .07 for each gender. Because of changed sample design, I cannot compute these measures for later years, but it is unlikely that the accuracy of the results has deteriorated.
Source: Own computations and Svensson et al. (1997).

Table 1b. Results from military tests of 18-year-old men in 1980, 1987 and 1993. Number of correct answers out of 40 test items

	Logic and inductive test	Verbal test	Spatial test	Theoretical and technical test
1980	24.2	24.7	21.1	24.3
1987	24.7	24.4	22.4	25.0
1993	25.3	24.0	22.7	25.4

Note: The standard deviation of the results is around 7. Because almost all those in a cohort were tested, standard errors are irrelevant.
Source: Own computations out of the basic data of the Pliktverket.

1.3. Skills → productivity

To examine the value of the skills that schools provide, we need to know how valuable these skills are in the production process. Ideally, one would like to know the relevant production functions in different parts of the economy. These production functions should be so well specified that they would be able to determine the contribution of

labour with different educational backgrounds to the total production of the economy. I know of no such studies on Swedish data.

Lacking this ideal information, one can instead consider the results from studies that have used individuals' test scores in earnings equations. Such equations tell us how different skills are valued in the labour market. When Kjellström (1999), in addition to completed education, used grades and test scores in different subjects at the age of 13, he found that grades and test scores in maths had an impact on subsequent earnings. Verbal skills and grades in Swedish and English had less significant coefficients in such earnings equations. Similar results are reported in US and Finnish studies (Murnane et al., 1995, for the US; and Uusitalo, 1999, for Finland[24]). These results do not rule out that other skills are also valuable as they could affect earnings and productivity *via* subsequent education. But the results indicate that math skills are particularly important and that such skills have an impact of their own for a *given* education level.

No doubt these results suggest that skills in maths are particularly valuable in the labour market. A tentative interpretation would also be that the positive evolution of more technical skills shown in Table 1 "dominate" the more negative evolution of verbal skills. But it could also be argued that the results refer to historical data and that there will be a shortage of persons with really good verbal skills in the future.

1.4. Productivity → earnings

The relationship between an employee's productivity and his earnings belongs to the classical issues in economics. In our competitive models, the hourly wage equals the value of the worker's marginal productivity. This result is the main reason why economists claim that a causal effect of education on hourly earnings is also an effect on productivity. One objection could be that this relationship is particularly weak in the Swedish labour market with its strong unions and egalitarian ambitions. The studies that we believe capture the effect of education on earnings might therefore even underestimate the impact on workers' productive capacity in Sweden. Even though this might be the case, there are no specific studies available that shed light on this issue. So here we have another gap in research.

[24] Uusitalo used military service tests, i.e. somewhat older persons than in the Swedish and the US studies.

However, I would put forward two arguments in favour of the view that even in the highly organised Swedish labour market, the hourly earnings approximately equals the value of the marginal product. Firstly, the relationship must not hold for every single worker. It is enough if it holds for educational groups so that the expected productivity differentials among education groups equals the expected earnings differential. Secondly, the strongest union equalisation effects on the wage structure should be found among the members of the union for blue-collar workers, the Swedish *LO*. The university wage premium is instead determined by the relative strength of *LO* and the union of the university-educated workers, the *SACO*. Results in Edin and Holmlund (1995) suggest that traditional market forces have influenced the evolution of this wage premium.

2. The rate of return and the demand for education

How important is the perceived return to education for the private decision to enrol in voluntary education? This issue has been widely discussed in Sweden in recent years. The discussion has focused on the decision to acquire a university education. The relevant concept of the return to schooling for this decision is the *expected* return among prospective students. Almost all studies of the return to schooling are, however, based on the return that is implied by the present wage structure. The expectations might very well deviate from the existing wage structure. We know that the wage structure can change quite quickly, for example, the Swedish schooling premium fell quite much from 1968 to 1974.

For this reason, one cannot necessarily infer from conventional estimates of the return to schooling that a low private return has reduced enrolment rates. At least as a first approximation, it is more reasonable to make such an inference by comparing application rates and available college study places. As a matter of fact, the number of applications to many programmes at Swedish colleges has exceeded the number of study places during the last couple of decades. Because there are no time-series data on the expected return to college education, empirical studies of the demand for college education have used conventional estimates based on the existing wage structure.[25]

[25] See Dominitz and Manski (1996) for an interesting approach to estimating the expected return to education from expectations data. In practice it would be ex-

Fredriksson (1997) used time-series data from 1967 to 1991 to examine the determinants of the enrolment rate to college education. The enrolment rate was defined as the proportion of all men aged 22 years or less, eligible for college education, who also participated in such studies. During the first years, this proportion was around .30, then fell to around .15 around 1985 and increased again to around .22 in 1991.

Fredriksson fitted an economic model with the college wage premium, the unemployment rate for white-collar workers, and the value of the student allowance as explanatory variables. In addition, he used dummy variables to take into account that the entry restrictions to college education changed over time. The model explains the observed data quite well with an R-square around .95. All economic variables have the expected sign. The estimates also imply that the restrictions to college education were effective during the 1980s and reduced the actual enrolment rate.

The Swedish experience during this time period is consequently consistent with the standard economic model for the demand for higher education. Nonetheless, certain qualifications are required. Firstly, the results are mainly driven by the marked decline in the wage premium during the first part of the 1970s. Secondly, the capacity constraints have probably also been effective. Hence even if higher wage premiums might have been necessary for markedly higher enrolment rates, it is likely that enrolment rates could also have been raised by only providing more student places.

The rise in enrolment rates between 1985 and 1991, which Fredriksson found in the data, accelerated during the rest of the 1990s.[26] Higher wage premiums for schooling were hardly the main driving force behind this evolution. The most important explanation is to be found in the high youth unemployment rates.

Another important lesson from research on the demand for education is that long cycles in enrolment rates are easily generated. The rapid supply growth of university-trained workers—as in Sweden in

tremely costly to apply their technique to a large representative sample and to get time-series data on such expectations.

[26] It is hard to measure how many are eligible for university studies, so I have not been able to prolong Fredriksson's series. But if one relates the number of persons aged 19-21 years and 22-24 years who are registered as students at a university to the population of these age groups, one finds that the numbers have doubled from 1988/89 to 1995/96.

the early 1970s—tends to be followed by falling wage premiums. After some time, falling wage premiums lead to lower enrolment rates, which in turn after some time create excess demand for university-educated workers. This leads to rising earnings. From this perspective, it will be interesting to follow how the Swedish labour market will absorb the rising supply of young university-educated workers, who enter the labour market in the next few years. It remains to be seen whether the labour market can do so without further lowering the wage premium for university education.

3. The efficiency of the education system

It is also a central task for education policy to make sure that schools work well and that they receive resources as long as these are used efficiently. This brings us to the recent Swedish discussion on public education, in which many of those who have participated in the public debate have claimed that Swedish schools perform poorly and that additional resources would not be used efficiently. The concrete proposal to reduce the class size in order to improve teaching has been rejected by many of the participants in the debate. For example, Bergström (1998) wrote in the *Dagens Nyheter*: "Research is almost conclusive: class size has no impact on school performance". Most likely, such statements have made it easier for local politicians to reduce expenditure on compulsory education during the 1990s.

It is interesting that almost the same discussion has been going on in other countries. The poor performance of public schools and the argument that additional expenditure spent on these schools would not be efficient investments, have been common claims in the US discussion. A meta-analysis by Hanuschek (1986), which summarised the results from several studies of the impact on pupils' school performance of class size, has been a common academic reference in this discussion. His overall conclusion from over 30 studies is that smaller classes do not improve the pupils' performance. This view is challenged by Krueger (1998, 1999a,b). One of these papers has the striking title "Reassessing the View That American Schools are Broken". He presents several types of evidence that supports the opposite view, namely that US public schools function well and that the causal relationship between resources and student performance is positive. Krueger argues that the claim that test scores have fallen over time is wrong. The best available evidence, which (like the

Swedish one presented in Table 1 above) is far from perfect, suggests that pupils' test scores at a given age have improved over time.

Krueger's most compelling evidence comes from a large-scale study in Tennessee, in which over 11,000 pupils *and* their teachers were randomly assigned to classes of different size.[27] The outcomes were measured by means of standardised tests. It turned out that the pupils in the smaller classes did significantly better on these tests. The effects were particularly strong during the first year in school and among pupils from poor parental backgrounds. Most previous US studies used a research design that could not detect the stronger beneficial effect during the first year.

As far as I know, there are only two academic studies of the impact on school performance of class size in Sweden. None of these could use a randomised experiment, but had to use "non-experimental" data on students' achievement and class size as generated by the decisions made by local school authorities. No deep methodological inquiry is needed to realise that it is very difficult to infer *causal effects* of smaller classes from such data. It is for example possible that classes with pupils who have special problems are deliberately reduced to make it easier for the teachers of such classes. As a matter of fact, it is well documented in Swedish school data that resources are allocated in a compensatory way, namely that schools and classes with low-performing pupils obtain more resources than others.[28] Such compensatory allocation of school resources seems to exist in most countries. This is the main motivation why Hanuschek requires some control for parental background in the studies that he includes in his meta-analysis.

The most recent of the two Swedish studies uses data from 1962 (Lindsey and Cherkaoui, 1975). They applied a non-linear model and found a positive relationship between class size and school performance at the mean of the variables used in the model. The authors emphasise, however, that "rigorous experimental data will be needed to test the hypotheses". Marklund (1962) used data from 1959 and summarised his findings by saying that the relationship between school results and class size is not significantly different from zero. I was not able to find out whether this conclusion followed because the relevant parameter was estimated to be close to zero with a high degree of accuracy, or if the parameter estimate was imprecise. More-

[27] Krueger (1999b) provides more detailed information.
[28] See Skolverket (1999) and Lindahl (2000) for recent evidence.

over, no controls for parental background were made in these studies. They would accordingly not qualify to be included in Hanuschek's meta-analysis.

Overall, it seems to me that the lack of convincing studies of the "efficiency of the education system" is particularly marked in Sweden. The contrast to the US, where much more such research has been done, is striking.[29] One reason could be that the variations in school quality are larger in the US. For example, the inter-state variation in school inputs like class size and teachers' salaries can be used for research purposes. It might be that the decentralisation of compulsory education to the local municipalities has created some variation that can be useful for Swedish research purposes. Otherwise, a randomised experiment, like the one in Tennessee, would be needed to generate the variation in school inputs that is required to make a convincing study.

4. Conclusions and discussion

There is substantial Swedish research on the returns to schooling. By international standards, Swedish micro-data sets offer good opportunities to study how schooling affects individuals' earnings and other working conditions. Around 1990 the average wage premium to an additional year of schooling seems to have been around four per cent, and probably somewhat higher for a longer university education and somewhat lower for compulsory education. Furthermore, the wage premium, as conventionally defined, fell markedly from the 1960s to the early 1980s.

In a cross-national perspective, the wage premium in Sweden is quite low, but not extremely low as is often claimed in public policy discussions. Instead, Sweden seems to belong to a group of five to ten European countries with the lowest wage premiums to schooling.

The private returns to schooling most likely affect individuals' decisions to enrol in further education. However, the experience during the 1990s, when enrolment rates in higher education rose considerably, suggests that the youth unemployment rate is also part of a reasonable explanatory model of university enrolment decisions. Further, the low university enrolment rates during the 1980s cannot only be

[29] See e.g. the special issue on school quality in *The Review of Economics and Statistics* from November 1996.

explained by low private returns to such education. Capacity constraints also had an affect.

Despite all of the research that has been carried out, it is easy to identify serious gaps in Swedish research. And more seriously, these gaps prevent us from properly evaluating the major changes in education policy that took place during the 1990s. One major change is the reduction in resources per pupil in compulsory youth education, including child-care. Most likely, this reduction in expenditures was facilitated by the frequent claims that resources do not matter for the performance of pupils in the public schooling system. There is no up-to-date research on Swedish data that substantiate such claims. To infer the consequences of such budget cuts, we need information on two different causal mechanisms. First, we need to know how the budget cuts will affect the performance of the students. Second, we need to know about the effect of student performance on subsequent earnings during adult life.

Another major change is the marked increase in adult education. Even though available estimates of the return to university education might provide reasonable approximations to the expected returns for the large number of 20-25-year-olds, who now are graduating from Swedish universities, special problems pertain to estimating the return to the adult education that is taking place in the *Kunskapslyftet* ("The Promotion of Adult Education and Training"). The students in the *Kunskapslyftet* are much older than ordinary high-school students, they receive a generous income to participate in the education, and they have had a break in their labour market career. For all these reasons, the selection of these students is markedly different from the selection to other educations, and there is no readily available comparison group that can be used to infer the earnings effect of this education.

I am fairly pessimistic about the prospects of estimating the returns to school resources in compulsory schooling, and the return to adult education with the non-experimental data that are generated in the real world. A major breakthrough in knowledge on these issues would require that Sweden follows the US example and uses randomised experiments to learn about the impact of changes in policy, like smaller classes and special programs for adult education.

References

Andersen, T.M., T. Gylfason, S. Honkapohja, A.J. Isachsen and J. Williamson (1997), I otakt med omvärlden (SNS förlag, Stockholm).

Andersson, B.-E. (1989), Effects of Public Day-Care: A Longitudinal Study, Child Development 60.

Andersson, B.-E. (1992), Effects of Day-Care on Cognitive and Sociomotional Competence of 13-year-old Swedish Schoolchildren, Child Development 63.

Angrist, J.D. and A.B. Krueger (1991), Does Compulsory Schooling Attendance Affect Schooling and Earnings? The Quarterly Journal of Economics 106.

Antelius, J. and A. Björklund (2000), How Reliable are Register Data for Studies of the Return to Schooling? An Examination of Swedish Data, Scandinavian Journal of Educational Research, forthcoming.

Arai, M. and C. Kjellström (1999), Returns to Human Capital in Sweden, in: R. Asplund and P. Telhado Pereira (eds.), Returns to Human Capital in Europe (ETLA, Helsinki).

Ashenfelter, O. and A.B. Krueger (1994), Estimates of the Economic Return to Schooling from a New Sample of Twins, American Economic Review 84.

Asplund, R., E. Barth, C. LeGrand, A. Mastekaasa and N. Westergård-Nielsen (1996), Wage Distribution Across Individuals, in: E. Wadensjö (ed.), The Nordic Labour Markets in the 1990's (North-Holland, Amsterdam).

Axelsson, R. (1989), Svensk arbetsmarknadsutbildning: en kvantitativ analys av dess effekter, Ph.D. Thesis, Umeå University.

Bergström, H. (1998), Om konsten att lyfta den svenska skolan. Artiklar och föredrag om tillståndet i och utvecklingen av den svenska skolan (Bertil Ohlin-institutet, Stockholm).

Björklund, A. and C. Kjellström (1994), Avkastningen på utbildning i Sverige 1968 till 1991, in: R. Erikson and J.O. Jonson (eds.), Sorteringen i skolan (Carlssons förlag, Stockholm).

Björklund, A. and C. Kjellström (1999), Estimating the Return to Investment in Education: How Useful is the Mincer Equation?, in: C. Kjellström, Essays on Investment in Human Capital, Ph.D. Thesis No. 36, Swedish Institute for Social Research, Stockholm University.

Björklund, A. and H. Regnér (1996), Experimental Evaluations for European Labour Market Policy, in: G. Schmid et al. (eds.), International Handbook of Labour Market Policy and Labour Market Evaluation (Edward Elgar, Cheltenham).

Björklund, A., P-G. Edebalk, R. Ohlsson and L. Söderström (1998), Välfärdspolitik i kristid—håller arbetslinjen?, Välfärdspolitiska rådets rapport 1998 (SNS förlag, Stockholm).

Blau, F. and L. Kahn (1995), The Gender Earnings Gap: Some International Evidence, in: R. Freeman and L. Katz (eds.), Differences and Changes in Wage Structures (The University of Chicago Press, Chicago).

Card, D. (1995), Using Geographic Variation in College Proximity to Estimate the Return to Schooling, in: L. Christofides, K. Grand and R. Swindinsky (eds.), Aspects of Labour Market Behavior: Essays in Honor of John Vanderkamp (University of Toronto Press, Toronto).

Card, D. (1999a), The Causal Effect of Education on Earnings, in: O. Ashenfelter and D. Card (eds.), Handbook of Labor Economics (Elsevier Science Publishers BV, Amsterdam).

Card, D. (1999b), Estimating the Return to Schooling: Progress on Some Persistent Econometric Problems, Fisher-Schultz Lecture at the European Meeting of the Econometric Society, September 1998.

Cohn. E. and J.T. Addison (1998), The Economic Return to Lifelong Learning in OECD countries, Education Economics 6.

Daniel, H.D., S. Schwarz and U. Teichler (1999), Study Costs, Student Income and Public Policy in Europe, European Journal of Education 43.

Dominitz, J. and C. Manski (1996), Eliciting Student Expectations of the Returns to Schooling, Journal of Human Resources 31.

Edin, P.-A. and B. Holmlund (1993), Avkastning och efterfrågan på högre utbildning, Ekonomisk Debatt 21.

Edin, P.-A. and B. Holmlund (1995), The Swedish Wage Structure: The Rise and Fall of Solidarity Wage Policy, in: R. Freeman and L. Katz (eds.), Differences and Changes in Wage Structures (The University of Chicago Press, Chicago).

Edin P.-A., P. Fredriksson and B. Holmlund (1993), Utbildningsnivå och utbildningsavkastning i Sverige, in: A. Björklund and A. Forslund (eds.), Ekonomiska Rådets Årsbok 1993.

Erikson, R. and J.O. Jonsson (1993), Ursprung och utbildning—social snedrekrytering till högre studier, SOU 1993:8.

Fredriksson, P. (1997), Economic Incentives and the Demand for Higher Education, Scandinavian Journal of Economics 99.

Hanushek, E (1986), The Economics of Schooling: Production and Efficiency in Public Schools, Journal of Economic Literature XXIV.

Heckman, J.J. (1998), Rethinking Myths about Education and Training; Understanding the Sources of Skill Formation in a Modern Economy: Presidential Address, Midwest Economics Association, March 20.

Heckman, J.J. and P. Klenow (1998), Human Capital Policy, in: M. Boskin (ed.), Policies to Promote Capital Formation (Hoover Institution).

Heckman, J.J., R.L. Roselius and J.A. Smith (1994), US Education Policy: A Re-evaluation of the Underlying Assumptions Behind the 'New Consensus', in: A.R. Levinson and L.C. Solomon (eds.), Labour Markets. Employment Policy and Job Creation (Milken Institute for Job and Capital Formation, Santa Monica).

Härnqvist, K. (1968), Relative Changes in Intelligence from 13 to 18, Scandinavian Journal of Psychology 9.

Isacsson, G. (1999a), Estimates of the Return to Schooling in Sweden from a Large Sample of Twins, Labour Economics 6.

Isacsson, G. (1999b), Essays on the Twins Approach in Empirical Labour Economics, Ph.D. Thesis No. 37, Swedish Institute for Social Research, Stockholm University.

Jansson, F. (1999), Rehires and Unemployment Duration—New Swedish Evidence, Licentiate Thesis No. 14, Swedish Institute for Social Research, Stockholm University.

Jonsson, J.O. (1994), Förskola—en strategi för jämlikhet?, in: R. Erikson and J.O. Jonson (eds.), Sorteringen i skolan (Carlssons förlag, Stockholm).

Kjellström, C. (1999), Essays on Investment in Human Capital, Ph.D. Thesis No. 36, Swedish Institute for Social Research, Stockholm University.

Krueger, A.B. (1998), Reassessing the View that American Schools Are Broken, Federal Reserve Bank of New York Economic Policy Review, March.

Krueger, A.B. (1999a), Experimental Estimates of Educational Production Functions, The Quarterly Journal of Economics CXIV.

Krueger, A.B. (1999b), An Economist's View of Class Size Research, mimeo, Princeton University.

Krueger, A.B. and M. Lindahl (1999), Education for Growth in Sweden and the World, Swedish Economic Policy Review 6.

Lindahl, M. (2000), Home vs. School Learning: A New Approach to Estimating the Effect of Class Size on Achievement, mimeo, Ph.D. Thesis No. 43, Swedish Institute for Social Research, Stockholm University.

Lindsey, J.K. and M. Cherkaoui (1975), Some Aspects of Social Class Differences in Achievements among 13-Year-Olds, Comparative Education 11.

Marklund, S. (1962), Skolklassens storlek och struktur (Almqvist and Wiksell, Uppsala).

Meghir, C. and M. Palme (1999), Assessing the Effect of Schooling on Earnings Using a Social Experiment, Working Paper No. 313, Stockholm School of Economics.

Mellander, E. and P. Skedinger (1999), Corporate Job Ladders in Europe: Wage Premia for University vs. High School Level Positions, Swedish Economic Policy Review 6.

Murnane, R., J. Willett and F. Levy (1995), The Growing Importance of Cognitive Skills in Wage Determination, The Review of Economics and Statistics 77.

Palme, M. and R.E. Wright (1999), Changes in the Return to Education in Sweden: 1968–1991, Applied Economics 30.

Psacharopoulos, G. (1994), Returns to Investment in Education: A Global Update, World Development 22.

Regnér, H. (1997), Training at the Job and Training for a New Job, Ph.D. Thesis No. 29, Swedish Institute for Social Research, Stockholm University.

Skolverket (1999), Samband mellan resurser och resultat, Skolverkets rapport No. 170.

SOU 2000:3, Välfärd vid vägskäl, Department of Social Affairs, Stockholm.

Svensson, A., I. Emanuelsson and S.-E. Reuterberg (1997), Changes in Intelligence from 1960 to 1995 in Relation to Cohort. Gender and Socioeconomic Background, paper presented at the annual conference of the AERA in 1997.

Söderström, L., A. Björklund, P-G Edebalk and Agneta Kruse (1999), Från dagis till servicehus: välfärdspolitik i livets olika skeden (SNS förlag, Stockholm).

Thoursie, A. (1998), Studies on Unemployment Duration and on the Gender Wage Gap, Ph.D. Thesis No. 35. Swedish Institute for Social Research, Stockholm University.

Uusitalo, R. (1999), Essays on Economics of Education. Ph.D. Thesis, Helsinki University.

Wadensjö, E. (1991), Högre utbildning och inkomster, in: Expertrapport No. 4 (Produktivitetsdelegationen, Stockholm).

Willis, R. (1986), Wage Determinants: A Survey and Reinterpretation of Human Capital Earnings Functions, in: O. Ashenfelter and R. Layard (eds.), Handbook of Labor Economics (Elsevier Science Publishers BV, Amsterdam).