Children's Educational Attainment

Effects of parents' education, living conditions, and other background factors

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Mette C. Deding* and Mohammad Azhar Hussain**

Abstract: *The importance of parental education and living conditions on children's educational attainment is quantified. Two estimation strategies are followed: the least squares estimation uses number of years of education as the dependent variable, and the "double probit"-model with endogenous selection uses a two class categorisation of education. It is found, that parents' education, and especially mother's education, matters for children's educational attainment, and that living conditions also has some importance. The model with endogenous selection gives varying results dependent on the educational group under consideration. When the probability of children attaining high education, conditional on parents having high education is modelled, the effects of living conditions vanish. But there is strong state dependence, that is, the selection of parents into the high education group is endogenous. For children from low education families, the result is the opposite: no state dependence, but a larger effect of living conditions. It thus seems that parental educational background is less important for children from lower educated families, leaving scope for education-inducing policies.*

JEL code: I21, N3

Key words: Children, parents, educational choice, living conditions, intergenerational transmission, unobserved heterogeneity

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1. Introduction

The educational attainment of young people is important for a number of reasons. First, the level of education is an important determinant of how well the individual succeeds in the labour market and generally of how well off he or she will be in economic terms (Solon, 1999). Numerous studies demonstrate higher risk of unemployment, low pay, poverty, or labour market marginalization for individuals with low education compared to individuals with higher education. Second, education is one of the fundamental sources of long-term macro economic growth. As one out of three Danes never attains an educational level sufficient for job competence, ways to influence this are crucial. The model in Benabou (1996) shows that inefficiently low levels of human capital investment in poor children can adversely affect aggregate productivity and growth. Third, since there is a positive correlation between educational attainment and poverty, it is important from a political point of view to secure maximum education in order to prevent social and political unrest.

The motivation for this paper is to study the intergenerational transmission of educational attainment in Denmark. Children's educational attainment relative to their parents is considered, furthermore the impact of other factors like family composition, type and stability, and living conditions during the childhood are studied. It is well known from both national and international studies that the education obtained by children is positively correlated with the educational level of the parents. The importance of parents' education relative to living conditions in the childhood may not be as well known, however. From a policy point of view, this relationship is very important: If the main determinant of educational attainment is the parents' education, then public policy can only affect the general education standard in the very long run. On the other hand, if childhood living conditions are very significant in determining the educational attainment, public policy can have an effect in the shorter run by ensuring that families with children have a sufficient standard of living. The paper is an extension of previous Danish research, because *final* educational attainment is modelled. Further, the paper estimates state dependence, e.g. the effect of parents' educational level per se.

The paper is organised as follows. In the next Section previous literature on the determinants of education is reviewed. Section three contains some theoretical and econometric considerations about the intergenerational educational transmission. Data are presented in Section four, and the educational choice of the children in the sample is discussed in Section five. Section six contains the results from the econometric analysis, and finally conclusions are drawn in Section seven.

2. Previous research on the determinants of educational attainment

Looking through the literature, many factors affect the educational attainment of children. The final educational achievement of a child is the outcome of a very complex decision process, involving choices and decisions by government, parents, and children (see for instance Haveman and Wolfe (1995)). The final educational choice depends on both economic and social considerations: In the classical human capital framework, the optimal level of schooling is determined by marginal cost and marginal benefit of education. But an educational decision is also a social decision with consequences for the relationship with social networks, e.g. family, friends and relatives, see Akerlof (1997). Therefore, also social or non-economic factors are likely to be important. In the following, determinants of educational attainment studied in the literature are discussed.

Parents' education

Parents' education is likely to be an important factor for the educational outcome of their children. Parents are potential role models for their children. A home with books on the shelves and a daily newspaper in the letterbox is likely to make reading more natural for children. More educated parents are probably also more capable of helping the children with homework. But also the genetic heritage could be a source of intergenerational transmission of educational attainment. This unobserved child ability is addressed in Dearden (1998), who applies OLS to years of full-time education and an ordered logit to highest qualification on British data. Especially mother's education is found to be an important determinant of children's educational attainment. This finding is typical regarding the importance of parent's educational level and the greater effect of mother's education. Gang and Zimmermann (2000) represent one of the rare cases, where father's education has significantly higher effect than mother's education on children's educational attainment.

Few studies of the effect of parents' education in Denmark exist. Zangenberg and Zeuthen (1997) find through cross-tabulations that the share of children who obtain a high school diploma increases strongly with the educational level of the parents. Hansen (1995) finds a positive relationship between children's education and parents' social class, also through cross-tabulations. Nielsen et al. (2001) estimate a logit model for having completed a qualifying education for 2nd generation immigrants and ethnic Danes. In their model a significant effect of parents' education (defined as the maximum value of either mother's or father's education) is found for the ethnic Danes, but not for the 2nd generation immigrants.

The logit framework is also used in Davies, Heinesen and Holm (2002). In this paper a variety of pathways is studied: The choice of 10^{th} grade (an optional grade in the Danish school system), the choice of continuing education after compulsory school, and the choice between upper secondary school and vocational education. The richness of data allows inclusion of an index of academic ability at lower secondary school concerning reading, writing and mathematics. The estimations are used to test implications of a relative risk aversion hypothesis: that educational choices are made so as to minimize the risk of ending up with a lower level of education than one's parents, and evidence is found partly in favour of this hypothesis.

Living conditions

Living conditions during the childhood can be both material and non-material. Money problems, malnutrition, insufficient housing, bad neighbourhood and sick parents are some examples of bad living conditions. Bad neighbourhood may result in adaptation of negative behaviour, attitudes and aspirations, e.g. crime and drug abuse. Insufficient housing may imply that the child cannot do his or her homework in a quiet place. Physically or mentally ill parents can be a burden on the child, so that educational achievement becomes less important. Data on especially non-material living conditions are seldom available, but material well-being and factors like maternal praise have been stressed in a case study by O'Brian and Jones (1999).

Family composition

Most children are born into a nuclear family consisting of a mother and a father. Deviations from this norm, for instance one-parent families, can create problems in terms of missing role models and thus disorientation and stress leading to low educational attainment, see Wu and Martinson (1993). With the increased divorce rates, it could be argued though that this negative effect will decrease over time, because norms change similarly. Furthermore, although fewer children live with both biological parents due to more divorces, many still live with a couple (the biological parent and a new partner). Family structure effects are for instance found in Haveman, Wolfe and Spaulding (1991), and McLanahan and Sandefur (1994). Another consequence of being a lone parent is lack of economic resources, see McLanahan (1985) and Chapter 1. The latter study estimates a reduction in consumption possibilities by about 33% for Danish singles relative to couples, which reduces to 6% when controlling for unobserved heterogeneity. In addition the consumption possibilities effect of

having children is negative. Also Ermisch and Francesconi (2001) find evidence for Britain that part, if not all, of the negative effect on the educational attainment of living in a single-parent family reflects fewer economic resources in such families. In addition, they find a negative effect on the investment in a child if a step parent is present, which is consistent with an economic model of educational investment in the absence of child neutrality, see Case, Lin and McLanahan (2000). Negative effects of family dissolution and restitution is also present in Swedish data, although the net effect is small after controlling for socio-economic background factors, see Jonsson and Gähler (1997).

Child neutrality is also violated when investment in daughters' and sons' education differ, for instance as a result of differences in expected returns to education for males and females. Rosholm and Smith (1996) thus find that in Denmark return to education is indeed gender specific. Alderman and King's (1998) model of the gender gap in education thus results in gender differences in educational investment, if the investment returns realized by parents, e.g. the probability of transfers from the child to the parents, differs between girls and boys. Also birth order can be expected to matter for the educational attainment, since the first-born may get more attention than his or her younger siblings.

Ethnicity

The role of race or ethnicity in the determination of children's educational attainment has been analysed in a number of studies. The importance of ethnicity could be due to discrimination against minorities, or a result of the fact that differences in culture, ambitions, physical and mental health, genetic code, etc. between different ethnic groups matter. In American studies, race is primarily used to distinguish between Blacks and Whites. Examples include a study of time-series of cross-sections, with the conclusion that dramatic increases in average parental education for Blacks contributed to rising college enrolment among their children (Kane, 1994). Datcher-Loury (1989) finds evidence that apart from parental education, socio-economic status and economic well-being, much of the variation in educational attainment of young children from low-income black families is the result of differences in behaviour and attitudes among the families. In Europe, the concern is with the broader defined group of immigrants. Gang and Zimmermann (2000) find for German data that ethnicity does matter, since there is an effect of country of origin on educational attainment even in the second generation. For Britain, Taylor (1981) analyses educational attainment for Afro-Caribbean children and Taylor and Hegarty (1985) for South Asian children, and find evidence that both under-perform compared to native English children.

A recent Danish study investigates the educational attainment for young 2nd generation immigrants and young ethnic Danes (Rosholm et al., 2002). The educational level of immigrants in Denmark is low compared to ethnic Danes, and the aim of the study is to determine whether there is a catching-up effect in the educational system. However, based on ordered probit estimations of six educational groups, the conclusion is that the transmission of human capital between generations appears to be at the same level for immigrants and ethnic Danes. Thus, the children inherit the lower qualifications of the immigrant parents to a certain extent. Especially children of Turkish origin inherit their parents' educational level, while children of Pakistani origin are relatively more successful. In addition, it is found that growing up in neighbourhoods with a high concentration of immigrants is associated with negative labour market prospects both for young natives and 2nd generation immigrants.

Parents' employment

Employment of parents and especially of the mother has also attracted some attention. The expected effect is ambiguous, because employment increases income and therefore resources invested in the child, but at the same time the amount of time spent on the child might be reduced. A recent contribution is Ermisch and Francesconi (2000), who develop an economic model providing conditions under which a causal interpretation can be given between parental employment during childhood and subsequent educational attainment of children. They control for genetic endowment heterogeneity through sibling estimations and the response variable is the probability that a child passes at least A-levels. They find a negative and significant effect on the child's educational attainment of the extent of mother's full-time employment when the child was aged 0-5. Furthermore, a negative effect of mother's part-time employment and father's employment is found.

School quality

Other important determinants, which are rarely recorded, are the quality of schooling and how well pupils and teachers get along, see e.g. Connell and Halpern-Felsher (1997). If a child does not get along with the teacher that alone could negatively affect school attendance and educational attainment. The effect of school quality is positive, for instance if schools with more economic resources attract good teachers with better skills in teaching children. The issue of school quality is related to educational production function studies, where school inputs affect student test scores or educational attainment, see Pritchett and Filmer (1999), Cooper and Cohn (1997). Durlauf's (1996) model shows that in the case of income stratified communities and locally financed schools, public education may reduce social mobility.

Heinesen and Graversen (2001) investigate the effect of school resources on educational attainment in Denmark. Expenditure per pupil in primary and lower secondary school is found to have a significant, but small positive effect on the probability of passing upper secondary or vocational education. Replacing expenditure with the teacher-pupil ratio makes the estimated effect of school resources less significant.

The aim of the present study is to investigate the relative effect of parents' education and childhood living conditions on a sample of Danes aged 25-35 years. Contrary to other Danish studies, the individuals in the sample are adults. Therefore it is possible to analyse *final* educational attainment, rather than *youth* education.

3. Theoretical and econometric considerations

Consider the following model of the determinants of educational attainment in an intergenerational framework. The model is a modified version of Becker and Tomes (1979), and Solon (1999). Assume that a family distributes the lifetime earnings of the father (subscript *f*), Y_f, and the mother (subscript *m*), Y_m, between consumption, C (at the price P_C), and investment in the only child's education, I. The family's budget constraint is then

$$Y_f + Y_m = P_C C + I \tag{1}$$

Let S_j denote parents' years of schooling, and let E_j denote all other determinants of lifetime earnings combined into one variable ($j=f,m$). The parents' earnings relations are given by

$$Y_f = \alpha_f S_f + \beta_f E_f \tag{2}$$

$$Y_m = \alpha_m S_m + \beta_m E_m \tag{3}$$

where α_j is the return to human capital and β_j is the return to the other determinants. The utility function is a simple Cobb-Douglas type

$$U = \gamma_1 \ln C + \gamma_2 \ln I \tag{4}$$

where the parameters $?_1$ and $?_2$ represent the family's taste for consumption and investment in education, respectively. Maximizing utility with respect to the budget constraint (1) gives[1]

$$I ? \frac{?_2}{?_1 ? ?_2}(Y_f ? Y_m) \tag{5}$$

Now substitute (2) and (3) into (5)

$$I ? \frac{?_2}{?_1 ? ?_2}(?_f S_f ? ?_f E_f) ? \frac{?_2}{?_1 ? ?_2}(?_m S_m ? ?_m E_m) ?$$

$$I ? ?_1 S_f ? ?_2 S_m ? ?_3 E_f ? ?_4 E_m \tag{6}$$

$$\textit{where } ?_1 ? ?_f, ?_2 ? ?_m, ?_3 ? ?_f, ?_4 ? ?_m, ? ? \frac{?_2}{?_1 ? ?_2}$$

This simple model thus indicates a linear relationship between investment in children's education on one hand, and the years of schooling and other determinants of the parents' earnings on the other hand. Since $?_2$ and $?_j$ are (assumed) positive, the correlation between parents' and the child's educational attainment must also be positive. In general, the child's education will be higher, if parents have high taste for education relative to consumption ($?_2$). Differences in the $?$-parameters are purely earnings-driven in this framework. Thus, if $?_1$ or $?_2$ is low compared to $?_3$ or $?_4$ this indicates that schooling is not very important in parents' earnings relations. Likewise, if $?_2$ and $?_4$ are low compared to $?_1$ and $?_3$ this is an indication of the mother having lower returns to education and other determinants relative to the father.

One problem with this framework is that the children's actual level of education is observed, but not the investment in schooling. A simple representation of the actual educational level, *S*, is

$$S ? I ? e ? u \tag{7}$$

where *e* is the child's "schooling capacity" and *u* is "market luck". Schooling capacity is a combination of the child's own ability and anything else in its surroundings (apart from investment in schooling), and market luck could for instance include school quality. However, it is natural to assume that the schooling capacity of the child is positively correlated with the

[1] Since the Cobb-Douglas utility function produces constant budget shares, the optimal schooling level is independent of the price of consumption, P_C.

capacity of the parents, or corr(e,e_f)>0 and corr(e,e_m)>0. Not only purely intellectual abilities (intelligence) may be inherited, but also other family characteristics of importance may be hereditable (a special family culture). The parental capacities are expressed not only in the parents' educational level, but also the other determinants of parents' earnings are likely to depend on a capacity parameter. The expectation is thus that e is correlated both with parents schooling, S_j, and the other earnings determinants of the parents, E_j, or corr(e,S_j)>0 and corr(e,E_j)>0.

Econometric models

Econometrically this problem could be viewed in several ways. Ideally the correlation of the unobserved ability factors (e, e_f and e_m) should be taken into account. But the data do not allow this, and therefore the first model is an ordinary least squares regression (OLS) with the length of education as the dependent variable. The advantage of the least squares model is that an immediate estimate of the marginal effect of parents' years of education is provided. Interpretation is thus straightforward. The disadvantage however, is that due to the expected correlations mentioned above, estimates are likely to be biased (see also the discussion later about defining the dependent variable).

An alternative is to model the state dependence, like the Stewart and Swaffield (1999) approach. This requires a categorisation of educational attainment into low and high education, so that the probability of obtaining high education in generation 2 (children), conditional on the level of education in generation 1 (parents), is estimated. The unit of analysis is the family broadly defined, meaning over two generations, whereas the unit of analysis in Stewart and Swaffield was the individual. The dependent variable is whether (1) or not (0) high education is attained, see (8). But conditioning on the initial state (parents' education) produces biased estimates if the initial state was not exogenous at the time when parents' attained education. Exogeneity of the initial state implies a situation where the observed persistence of high education only depends on the observed explanatory variables. But if the unobserved explanatory variables are correlated over time then conditioning on high education in generation 1 generates sample selection bias, the so-called initial conditions problem, see Heckman (1981). A solution to the problem is to use a bivariate probit model in which endogenous sample selection is modelled and the autocorrelation in the disturbance from generation 1's educational attainment and the disturbance from the highly educated in generation 2's educational attainment are restricted to be of first order. Probable determinants

of the selection into the initial state could be grandparents' characteristics[2]. Since there are two possible initial states, one can model either the probability of attaining high education for a child from a high education family, or the probability of attaining high education for a child from a low education family. The "double probit" model implies that in the first case family *i*'s contribution to the log-likelihood function is given by (see Stewart and Swaffield (1999) for more a detailed explanation of the derivation)

$$\ln L_i = y_{i1}y_{i2}\ln \Phi_2(x_{i1}\beta, z_{i2}\gamma, \rho) + y_{i1}(1-y_{i2})\ln \Phi_2(x_{i1}\beta, -z_{i2}\gamma, -\rho) + (1-y_{i1})\ln \Phi(-x_{i1}\beta) \qquad (8)$$

where the indicator variable (dependent variable) y_{i2}=1 (y_{i1}=1) if the child (parent) had high education, and otherwise y_{i2}=0 (y_{i1}=0).[3] Thus, the first probability component on the right-hand side in (8) represents the situation where generation 1 and 2 are both observed to have high education, the middle term represents families with high education in the first generation, but low education in the second generation, while the last probability captures the fact that some families are initially low educated. x_{i1} are the determinants of parents' endogenous selection into the initial state, while z_{i2} are determinants of whether or not the child obtains higher education. Φ is the univariate cumulative normal distribution function representing the probability of not being highly educated initially. Φ_2 is the bivariate cumulative normal distribution representing the probability of either high education in the first generation *and* high education in the second generation, or high education initially *and* low education in the second generation. ρ is the correlation between unobservables in generation 1 and 2, or ρ=corr(e,e_p), where e_p is the ability factor for the parent with the highest education (see footnote 9). Endogenous initial state implies a significant ρ ($\neq$0). In the case of an insignificant ρ, the conditional probability $P(y_{i2}=1|\ y_{i1}=1)$ degenerates to the univariate normal probability distribution, where it is sufficient to use only the sample where y_{i1}=1, while the whole sample is used in the estimation of (8).

Since the dependent variable is not the same in the two models, results are not immediately comparable. However, since the state dependence model takes correlation between unobservables into account, bias of the estimated parameters is reduced in this model.

[2] When conditioning on parents education the initial conditions problem has to be addressed, and the same argument could be forwarded when using grandparents' education. But in this setting, grandparents' education is actually not conditioned upon, but only used as one regressor among others to determine the parents' selection into the initial state.

[3] The other case – the probability of attaining high education for the child from the low educated family – is found by assigning the indicator variable y_{i1} the opposite values.

Other econometric concerns: defining the dependent variable

In the state dependence model, the dependent variable can only take on two values - low and high. The reason for this is purely computational. If the dependent variable for instance had three categories (low, medium, and high), the likelihood would involve calculation of a trivariate normal distribution, which does not have a closed form solution.

In the case of the least squares regression, however, an alternative is to use the education categories instead of years of education and estimate an ordered probit or logit regression. The advantage of the years of education regression is, that it imposes the knowledge that the distance between the educational categories differs. The distance between short further education and medium further education, or between medium further education and long further education is thus not the same as the distance between vocational education and short further education. On the other hand, a potential problem is exactly the implied ordering of educations. In particular, it can be difficult to determine the ranking of vocational education versus short further education. This problem is present both in the linear model and in the ordered probit or logit model. To avoid the ranking a multinonomial logit model has been estimated on the data. But with six educational categories each for child, mother and father, the number of estimated coefficients relative to number of observations is too large. Consequently, the coefficients are very poorly estimated. Since the multinomial logit model also requires independence of irrelevant alternatives, these estimations are not presented in the paper.

4. Data

Data material

The basis for the analysis is three waves of a Survey of Living Conditions in Denmark linked with register data. The Danish National Institute of Social Research has collected the Survey of Living Conditions in 1976, 1986, and 2000. The first survey, in 1976, included a representative sample of individuals between 20 and 79 years. The same persons were interviewed again in 1986 with a sub-sample of the 1976-questions (few persons were added in order to correct for sample attrition). In 2000, the individuals were re-interviewed with basically the same questions as in the first wave in 1976. As the youngest in the original sample had aged to 44 years in 2000, a new random sample of people aged 20-43 years was added. The survey includes questions on demographic variables and numerous living

condition variables, including labour market attachment, neighbourhood characteristics, housing quality, childhood living conditions and the interviewees' parents' employment and education.

About 4,900 individuals in the 2000 survey accepted that survey information was linked with administrative files for research purposes. For all these persons, the register data include information about the interview person, the spouse (if present sometime during the period 1980-1998) and his or her biological children (whether living with the parents or not). The register data include information on education, demographics (gender, age, family type and composition, etc.), wages, income, and labour market attachment, for most variables from 1980 to 1998.

Dependent variable

The dependent variable in the study is the education of children of interviewed persons. The age of the children is restricted to 25-35 years in 1998. The lower age limit of 25 years is imposed, because a large share of the younger individuals has not yet completed education. The upper age limit of 35 years is imposed for data reasons: Being 35 in 1998 implies being 17 in 1980, which is the first year for which we have register data. If individuals are older than 35, they are only in the register as adults. Education is defined as the highest completed degree of the individual and grouped into the following six categories: Lower secondary school, Upper secondary school, Vocational training, Short further education, Medium further education, and Long further education. These categories are transformed into years of education, as defined in Table 1, which follows earlier classifications in Danish research, see e.g. www.cls.dk. For a detailed description of the Danish educational system see Davies, Heinesen and Holm (2002).

Table 1. Transformation of type of degree into number of years of education

Years of education	Type of Degree
9	Lower secondary school (folkeskole): 9^{th} or 10^{th} grade
12	Upper secondary school: E.g. general (gymnasium) or business school (højere handelseksamen)
13	Vocational training (erhvervsfaglig uddannelse eller mesterlære): Eg. office clerk, plumber
14	Short further education (kort videregående uddannelse): E.g. policeman, laboratory assistent
16	Medium further education (mellemlang videregående uddannelse): Teacher, nurse
18	Long further education (lang videregående uddannelse): Masters degree, e.g. economist, doctor

Explanatory variables

The explanatory variables are both from the survey data and the register data. From the survey, information is found on home ownership (i.e. whether the family owns or rents its'

housing) and on the size of the home (number of rooms per person in the family). Furthermore, we use information on whether the interviewed individual – that is either the father or the mother of the child - had:

- Substantial unemployment: main occupation during the year
- Health problems: illnesses or other deficiencies reducing physical mobility or movements, and
- No friends (an indicator of poor social relations): e.g. no friends frequently visited, no friends who can be visited without invitation, or no friends with whom personal problems can be discussed.

Finally, the survey also includes some information on the interviewed person's own childhood. Thus, information on number of siblings and parents' education (i.e. the education of one set of grandparents) is included. Of course, it should be kept in mind that these living conditions indicators are only for the interviewed person, and could be very different for the interviewee's spouse.

The survey variables should ideally relate to the point in childhood, where the child's' decisions regarding future education are taken, e.g. in the early teens. In the present study, we only have the choice of survey information for two points in time – 1976 and 1986. We have chosen to attach information from the survey, which was carried out closest to when the youngster was approximately in his or her early teens. The survey variables for children aged 25-30 years in 1998 are thus taken from the 1986 survey, at which time the children were aged 13-18 years. Similarly, the variables for children aged 31-35 years in 1998 are from the 1976 survey, when the children were aged 9-13.

From the register data, information is found on educational attainment of both the mother and the father of the child. Furthermore, variables on family composition are constructed. These include number of siblings, family type (whether the child lives with two adults, one adult, or no adults), and number of family type changes (i.e. the child is living with two adults in year t, but only with one adult in year $t+1$ or the other way around) that occur during the period the child is in the register (between 1 and 11 years). Because the children are in the register for varying durations, these variables are normalised with respect to the register duration.

The sample consists of a total of 1,814 children: 931 boys and 883 girls. Sample means are presented in Table 2 for all the children and in Tables A1 and A2 in the Appendix for boys and girls, respectively.

Table 2. Sample means: All children.

	Mean	St.dev.
Girl	0.4868	(0.5000)
Age of child	29.9013	(3.1384)
Education		
Years of education	12.9090	(2.6203)
Lower secondary school	0.2172	(0.4125)
Upper secondary school	0.0783	(0.2687)
Vocational training	0.4394	(0.4964)
Short further education	0.0557	(0.2294)
Medium further education	0.1235	(0.3291)
Long further education	0.0860	(0.2804)
Parents' education[a]		
Father's schooling (years of education)	12.1087	(2.8135)
Father: Lower secondary school	0.3842	(0.4866)
Father: Upper secondary school	0.0120	(0.1071)
Father: Vocational training	0.3989	(0.4898)
Father: Short further education	0.0458	(0.2091)
Father: Medium further education	0.0929	(0.2903)
Father: Long further education	0.0666	(0.2494)
Mother's schooling (years of education)	11.4747	(2.6287)
Mother: Lower secondary school	0.4877	(0.5000)
Mother: Upper secondary school	0.0123	(0.1104)
Mother: Vocational training	0.3325	(0.4713)
Mother: Short further education	0.0535	(0.2250)
Mother: Medium further education	0.0928	(0.2903)
Mother: Long further education	0.0212	(0.1439)
Living conditions during childhood		
House owner	0.7122	(0.4528)
Number of rooms per person	1.2437	(0.5283)
Father or mother were unemployed[c]	0.0485	(0.2149)
Father or mother had health problems[c]	0.2144	(0.4105)
Father or mother had no friends[c]	0.2023	(0.4018)
Number of family dissolutions per year	0.0431	(0.1079)
Living with single parent	0.1079	(0.2673)
Child living alone	0.0294	(0.1366)
Number of siblings	1.2288	(0.8956)
Father's or mother's childhood[b]		
Grandfather's schooling (years of education)	8.5733	(2.1982)
Grandmother's schooling (years of education)	7.6608	(1.4607)
Siblings of father or mother	2.6670	(2.3136)
Number of observations	1,814	

[a] The data includes 1,637 observations of father's education and 1,702 observations of mother's education.
[b] The data includes 1,636 observations of grandfather's education and 1,657 observations of grandmother's education.
[c] See text for definitions.

5. The choice of education (aggregate measures)

From the sample means in Table 2 above, we see that the children in the sample on average are more educated than their parents (12.9 years for children versus 12.1 years for the fathers and 11.5 years for the mothers). Furthermore, the daughters are on average better educated than the sons – 13.0 and 12.8 years, respectively (Table A1 and A2). This finding reflects the educational development in Denmark over the past decades: The general educational attainment has increased, especially for girls (the majority of students are now female in many university departments). The question is, however, whether this general lift in the educational level is independent of the parents' education, or whether background is an important determinant. The first attempt to answer this question is found in the transition matrices in Table 3 and Table 4.

Table 3. Educational attainment of children, given education of the father, %

	Father's educational distribution	Child's education								
		Low	Upper	Voc	Short	Med	Long	All	Non ac.	Ac.
Father's education										
Lower secondary school	38.4	26.1	5.2	**48.0**	4.6	11.3	4.8	100		
Upper secondary school	1.2	5.3	26.3	26.3	5.3	5.3	**31.6**	100		
Vocational training	39.9	20.1	6.4	**50.5**	5.8	11.3	5.8	100		
Short further education	4.6	13.3	5.3	**48.0**	13.3	12.0	8.0	100		
Medium further education	9.3	5.9	18.4	23.0	6.6	21.7	**24.3**	100		
Long further education	6.7	10.1	16.5	18.3	4.6	22.0	**28.4**	100		
All	100	19.9	7.9	**44.5**	5.7	13.0	9.0	100	78.0	22.0
Non academic	84.1								82.9	17.1
Academic	15.9								52.1	47.9

Note: 1,637 observations used, thus excluding 177 representing missing father's. Both generation's education is defined in the same way

In Table 3, children's educational destinations are mapped against their fathers' educational group (both generation's education is defined in the same way). The table thus describes where the children go, dependent on their father's education. From the marginal distributions, the shift in educational attainment between the generations is evident. For instance, in the fathers' generation 38% has only completed lower secondary school, and only 1% had completed upper secondary school. For the children, these figures are 20% and 8%, respectively. Likewise, the share that has completed long further education has increased from 7% to 9%.

Looking at each father educational group, we see that the largest share (the bold numbers in the table) of the children does at least as well as their fathers. The one exception is children of fathers with short further education, where the highest fraction of the children gets vocational education. However, as discussed earlier the ordering of vocational education versus short further education is very tight. A positive outlier is the children of fathers with upper secondary school, where the majority of the children attain long further education. This group is very small, however (only 19 observations), implying a large variance of this figure.

The relationship between fathers' and children's education can be summarised by comparing the fraction of children attaining non-academic (9-14 years education) versus academic educations (16-18 years education), conditional on their father's academic or non-academic degree (the lower right hand corner of Table 3). The probability of attaining an academic education is almost three times higher for children whose father has an academic education: 17% of the children of fathers with non-academic educations get academic educations themselves, while this is true for 48% of the children of fathers with academic educations.

Table 4. Educational attainment of children, given education of the mother, %

	Mother's educational distribution	Child's education								
		Low	Upper	Voc	Short	Med	Long	All	Non ac.	Ac.
Mother's education, years										
Lower secondary school	48.8	27.2	4.8	**50.6**	5.1	9.3	3.0	100		
Upper secondary school	1.2	14.3	19.0	**23.8**	4.8	**23.8**	14.3	100		
Vocational training	33.3	15.9	8.0	**45.6**	7.2	14.8	8.5	100		
Short further education	5.3	14.3	13.2	**27.5**	4.4	24.2	16.5	100		
Medium further education	9.3	10.1	13.3	27.2	6.3	14.6	**28.5**	100		
Long further education	2.1	5.6	27.8	5.6	5.6	16.7	**38.9**	100		
All	100	20.6	7.8	**44.2**	5.9	12.7	8.8	100	78.5	21.5
Non academic	88.6								81.5	18.5
Academic	11.4								54.6	45.4

Note: 1,702 observations used, thus excluding 112 representing missing mother's

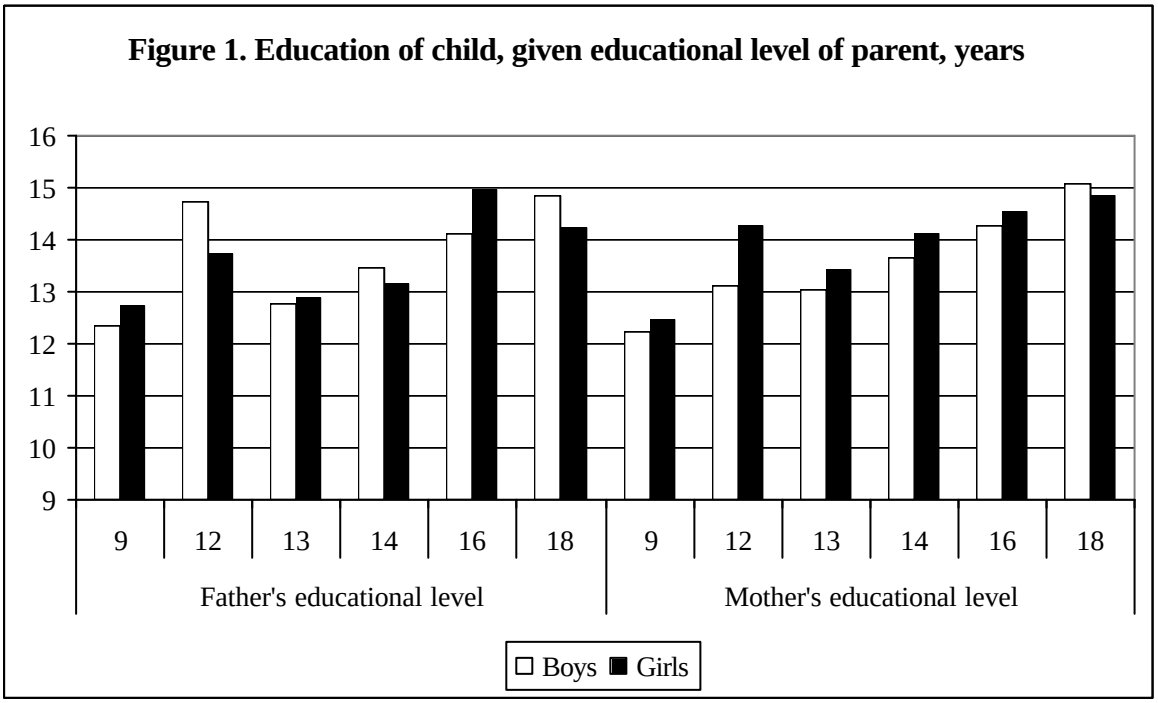
In Table 4, we find the same categorization of children's educations, this time conditional on the mother's education. The overall picture matches Table 3. One difference is that children of mothers with upper secondary school get a little less education, but again the sample size of this educational category is very small. Again, the aggregate probability of getting an academic education is much larger for children of academic educated mothers compared to

children of non-academic educated mothers, although the ratio between the two is a little smaller than in Table 3 (19% and 45%).

In the Appendix, Tables A3-A6, gender specific transition matrices are found. From these matrices, it is clear that the daughters on average attain higher education than the sons, regardless of parental educational level: low education parents' sons have a probability of 15-16% of attaining high education, while this percentage is 19-21% for daughters, and high education parents' sons have a high education probability of 42-44%, while the daughters' probability is 50-52%. Furthermore there is some indication that for daughters, the mothers' education is more correlated with own education, than is their fathers' education. While for the boys this does not seem to be the case.

The intergenerational education link can also be illustrated by looking at the average educational attainment of children, given educational level of parents, see Figure 1. Except for 12 years of education, which only has few observations, children attain more education, the higher the education of either the mother or the father.

Figure 1. Education of child, given educational level of parent, years



The figures above indicate that children's educational attainment is related to the educational attainment of their father and mother. Children of lesser-educated parents on average attain less education than children of higher-educated parents. However, as the relationship is not

one-to-one, it is not possible to deduce from the aggregated transition matrices how much parents' education matter, especially taking individual characteristics (heterogeneity) into account. Therefore, in the next section results from the econometric analysis are presented.

6. Econometric analysis of the choice of education

In this section the results of the empirical models outlined in Section three are presented.

6.1. Linear model of educational attainment

The dependent variable is years of education for the children. In Table 5, the estimation of years of schooling for all children is presented – for the entire group 25-35 years old, and for the two cohorts 25-30 years and 31-35 years. Looking first at the model for the entire age group we find that a higher educational level for both parents significantly increases the educational level for the child. Mother's education has an effect of 0.22 years, while father's effect is 0.09 years. Evaluated at sample means of the response variable (from Table 2), the effects can be calculated as "semi-elasticities", that is the percentage change in child's education when father's or mother's education is increased by one year. This would here be equivalent to the estimated parameter divided by the average education of children, or 1.68% (100%*0.2174/12.909) effect of mother's education and 0.70% of father's education. So the mother's education is found to matter much more than the father's education.

As stated in Section 2, this finding is in line with the other findings in the literature, see comparisons with other studies under the gender specific estimations. An explanation could be that an educated mother is more seldom than an educated father, so that the mother has a larger impact as a role model. It could also be that the high education of the mother better represents unobserved factors than high education of the father. However, the result depends on both a mother and a father being present in the household. If the father is missing (i.e. the child lived with a single mother) the additional effect of the mother's education in this case is estimated, and likewise if the mother is missing from the household. Interestingly, there is no further effect of mother's education, if the father is missing. But if the mother is missing, there is an additional effect of father's education of approximately 0.15 years bringing the total effect of father's education up to 1.79%. It thus seems, that in single headed families the direct educational effect of parental education is about 1,68%-1.79%, while in double headed families the total effect is larger, but is divided between mother's and father's educational level.

Table 5. Estimation of years of schooling for all children (OLS)

	All children		25-30 years		31-35 years	
	Parameter	St. error	Parameter	St. error	Parameter	St. error
Intercept	6.6197	0.6964	4.1799	1.3148	10.2241	2.2142
Girl	0.2525	0.1125	0.3333	0.1469	0.1200	0.1751
Age of Child	0.0762	0.0190	0.1545	0.0438	-0.0185	0.0646
Parent's education						
Father's education	0.0900	0.0246	0.0836	0.0314	0.1013	0.0394
Mother's education	0.2174	0.0261	0.2485	0.0331	0.1670	0.0422
Father is missing*mother's education	0.0139	0.0305	-0.0086	0.0391	0.0507	0.0493
Mother is missing*father's education	0.1405	0.0309	0.1596	0.0399	0.1155	0.0493
Living Conditions						
House Owner	0.5137	0.1447	0.5247	0.1968	0.5130	0.2160
Number of rooms per person	0.4118	0.1313	0.3888	0.1813	0.3833	0.1929
Father or mother were unemployed	-0.7819	0.2676	-0.7823	0.3012	-0.5588	0.5569
Father or mother had health problems	-0.2527	0.1388	-0.1592	0.1790	-0.3807	0.2201
Father or mother had no friends	-0.3719	0.1417	-0.6718	0.1881	0.0280	0.2167
Number of family breaks per year	-2.1348	0.5563	-2.1561	0.8318	-2.2544	0.7687
Child not living with parents	-0.8015	0.4415	-2.1814	0.9224	-0.4121	0.5219
Has no siblings	-0.3676	0.1691	-0.1742	0.2580	-0.4728	0.2366
Has at least two siblings	-0.2219	0.1296	-0.0669	0.1622	-0.4317	0.2136
Number of observations	1,814		1,009		805	
Adjusted R^2	0.1685		0.2183		0.1111	

Turning to the living conditions variables, we find the expected effects. There is a significant and positive effect from being a house owner and the number of rooms per person. If the family owns its own residence, this may indicate a better and more stable financial situation and thus less stress on the child. Likewise, the larger the dwelling the better the circumstances might be for the child to study in peace and quiet. But the size of the dwelling could also represent an income effect, because house size and income are likely to be positively correlated. If the father or mother experienced unemployment during the child's childhood, this has a negative effect – unemployment can be influential in several ways: first of all the family's financial situation will be affected, but also social relations both within the family and with others outside the family may be influenced (stigmatisation). The family's (parents') social relations are important for children's educational attainment, as the parameter for father or mother having no friends is also significantly negative. There is no evidence of father or mother's health problems having any effect. Bad living conditions defined as "bad finances" also negatively affect educational attainment in Britain (Dearden, 1998) and in the USA, when defined as a low "income/needs"-ratio, see Duncan (1994).

The number of breaks in the family is an indicator of family stability. Family instability causes stress on both children and parents, and is thus expected to have a negative impact on educational attainment. This is also confirmed in the analysis: Family changes – i.e. adults

moving in or out of the family – have a strong negative impact on the child's educational attainment. Each time the child experiences this, years of schooling are decreased with about two years, other things being equal. Another "instability-indicator" is a child not living with any of the parents. This could be due to either foster care or the child moving away from home at a very young age. However, the effect of this is insignificant in the model.

For neighbouring Sweden, both longitudinal and cross-sectional estimations demonstrate that children experiencing family dissolution show lower educational attainment at age 16, than children in stable two-parent families (Jonsson and Gähler, 1997). For the USA the number of parental separations negatively affects the probability of high school graduation, and parental remarriages has a positive effect, but both effects are insignificant (Haveman, Wolfe and Spaulding, 1991). Also on American data, but with length of education as the dependent variable, Graham, Beller and Hernandez (1994) find a negative effect of "non-intact families".

The expected effect of siblings is ambiguous. If the time spent on children is constant, then another child in the family will lower the time per child. On the other hand, elder siblings may help and support young ones, and effectively the total amount of time spent on the children might be constant or higher. Furthermore, there can be a financial consequence of having more children: Families with many children might live with tighter budget constraints and thus less money to invest in the children's education. In the model, we find a negative effect of having no siblings relative to having one sibling, while the effect of having two siblings or more is insignificant. This indicates that children with no siblings are disfavoured compared to children with siblings. Also with British data the effect of two siblings or more is insignificant (Dearden, 1998). Birth order has not been included, but that usually matters when analysing children's attainments.

Finally, it is seen that both being a girl and being older significantly increases education, just as expected. Higher educational attainment for girls reflects the descriptive measures in Section five. The age effect is somewhat artificial, because it probably reflects the fact that some students complete education at later ages.

In the right-hand columns of Table 5, the model is estimated for the two cohorts 25-30 years and 31-35 years old. A rationale for this division is that many young Danes do not finish their education until the end of the 20's. Selecting a sample of individuals with completed educations will thus probably underestimate the educational attainment of the youngest individuals. The findings point to the very interesting fact that the model specification, with parental background and childhood factors being the main determinants of educational

attainment, seems to capture the 25-30 year old better than the 31-35 year olds. The adjusted R^2 is thus twice as high for the young cohort as for the older cohort. Especially the living conditions variables are more significant for the younger cohort. Both house ownership, number of rooms, family breaks, unemployment, no friends, and child living alone have significant effect for the young cohort, while the three latter effects are insignificant for the older cohort. In the other direction is the large family effect, which is significant for the older cohort, but not for the younger. An interpretation of this could be that in the longer run (i.e. for the older children) the effects of the "demographic living conditions" persist (house ownership and size, family breaks, and many siblings), whereas the "social living conditions" (unemployment, no friends, and not living with parents) decrease in importance. Thus, poor circumstances during the childhood may imply that the child "postpones" its education, but ends up with the same level of education as children from better circumstances. On the other hand, the result could also be due to the fact that unemployment was higher during the younger cohort's childhood. Since it is known from other studies (Agerbo et al., 1998) that unemployment is the cause of anxiety and other illnesses, it may well be the case that the children of the 1980s are more hit by parents' unemployment than the children of the 1970s. In the present analysis, it is not possible to distinguish between these two hypotheses.

Gender specific estimations

In Tables 6 and 7 estimations are presented for sons and daughters, respectively. Looking at the effects of parents' education for the entire age group, we find interesting statistically significant deviations between the sons and the daughters. For sons, the estimations mirror the ones for both genders. There is a positive effect of both father and mother's education, the latter being the largest (0.94 and 1.57%). Dearden's (1998) estimate for the UK finds that mother's education has an effect of 2.02% (own calculation of semi-elasticity) on sons' education, while father's education affects sons' educational attainment with 1.1% years. Both in the UK and Denmark mothers' education has approximately twice the effect of fathers'. If the mother is missing, there is an additional effect of father's education of approximately 0.15 years. Estimation was also tried (not shown) with an interaction term representing the effect of one parent's education, given the other parent's education, but both parents' education became insignificant, and this was also true for the interaction parameter.

Table 6. Estimation of years of schooling for sons.

	All sons		25-30 years		31-35 years	
	Parameter	St. error	Parameter	St. error	Parameter	St. error
Intercept	5.7465	0.9550	3.9890	1.8786	8.6536	3.0134
Age of Child	0.0975	0.0265	0.1423	0.0632	0.0241	0.0888
Parent's education						
Father's education	0.1207	0.0344	0.1352	0.0443	0.1186	0.0546
Mother's education	0.2001	0.0365	0.2487	0.0464	0.1394	0.0582
Father is missing*mother's education	0.0190	0.0423	0.0116	0.0547	0.0497	0.0674
Mother is missing*father's education	0.1487	0.0422	0.1337	0.0553	0.1588	0.0659
Living Conditions						
House Owner	0.8056	0.2053	0.8203	0.2867	0.7729	0.2963
Number of rooms per person	0.2815	0.1897	0.0761	0.2667	0.5068	0.2726
Father or mother were unemployed	-0.6335	0.3737	-0.6264	0.4256	0.0160	0.7624
Father or mother had health problems	-0.1356	0.1895	0.1859	0.2498	-0.5205	0.2905
Father or mother had no friends	-0.5414	0.1962	-1.0867	0.2594	0.1805	0.3002
Number of family breaks per year	-1.6585	0.8001	-1.1739	1.1674	-2.5848	1.1218
Child not living with parents	-0.6454	0.6074	-0.7222	1.1153	-0.5656	0.7404
Has no siblings	-0.4353	0.2401	-0.0113	0.3540	-0.8577	0.3413
Has at least two siblings	-0.1721	0.1826	-0.0759	0.2304	-0.3715	0.2952
Number of observations	931		517		414	
Adjusted R^2	0.1813		0.2355		0.1345	

Table 7. Estimation of years of schooling for daughters.

	All daughters		25-30 years		31-35 years	
	Parameter	St. error	Parameter	St. error	Parameter	St. error
Intercept	7.9534	1.0150	4.4858	1.8410	11.7164	3.3029
Age of Child	0.0486	0.0275	0.1638	0.0609	-0.0559	0.0957
Parent's education						
Father's education	0.0603	0.0353	0.0491	0.0443	0.0818	0.0580
Mother's education	0.2317	0.0378	0.2579	0.0476	0.1904	0.0616
Father is missing*mother's education	0.0064	0.0442	-0.0171	0.0555	0.0442	0.0731
Mother is missing*father's education	0.1155	0.0457	0.2133	0.0584	0.0153	0.0762
Living Conditions						
House Owner	0.2232	0.2047	0.2698	0.2689	0.1704	0.3204
Number of rooms per person	0.5456	0.1828	0.6565	0.2466	0.4120	0.2778
Father or mother were unemployed	-0.9563	0.3875	-0.8291	0.4271	-1.0785	0.8448
Father or mother had health problems	-0.3836	0.2048	-0.6372	0.2581	-0.1335	0.3380
Father or mother had no friends	-0.1685	0.2059	-0.1802	0.2744	-0.1686	0.3180
Number of family breaks per year	-2.5917	0.7788	-2.5257	1.2229	-2.2341	1.0682
Child not living with parents	-0.7397	0.6517	-5.1509	1.7649	-0.1277	0.7563
Has no siblings	-0.2858	0.2391	-0.5154	0.3784	-0.1706	0.3329
Has at least two siblings	-0.2964	0.1844	-0.0922	0.2267	-0.5363	0.3111
Number of observations	883		492		391	
Adjusted R^2	0.1536		0.2107		0.0965	

For daughters, the picture is different. In case both the father and the mother is present, we only find a significant effect of mother's education (0.23 years or 1.78%), while father's education is only significant when the mother is missing (total effect of 0.18 years or 1.35%). Since the fathers on average are better educated than the mothers, a possible interpretation of this is that girls are increasing their educational level so fast these years that they are less dependent on parental background. The mother might be important as a role model, though, so that daughters of mothers with higher education are even more inclined to educate themselves. The sons, however, may find it more difficult to break the traditional pattern ("as father, so son") and therefore seem more dependent on their fathers' educational level. In Halpern-Felsher et al.'s (1997) American study, which excludes father's education, the effects (own calculation of elasticities) of mother's education for sons is found to be 1.72% (Whites) and 0.75% (Blacks) and for daughters the effects are 1.82% (Whites) and 1.29% (Blacks). Thus for Whites, the American estimates are close to the Danish estimates. Beller and Chung (1992) find mother's education to affect children's educational attainment by only 0.82%, but in their estimations all children (Whites, Blacks and Hispanics) are pooled.

Turning to the living conditions variables, family breaks have a negative impact on the educational attainment for both sons and daughters. The magnitude is almost one year larger for the daughters than for the sons, but the difference is statistically insignificant. Somewhat contrary to this gender difference, Krein and Beller (1988) find American boys to be more sensitive to "number of years in single-parent family" than girls, who are not affected. For the boys, there is a positive effect from the family owning its residence, and a negative effect from father or mother having no friends. For the daughters, on the other hand, the number of rooms in the residence is found to have a positive effect, while father or mother's unemployment and having at least two siblings affect educational attainment negatively. The evidence thus points in the direction of daughters being somewhat more dependent on living conditions than sons, while at the same time they are less dependent on parents' education than sons.

The cohort estimations for sons and daughters, respectively, do not change the results concerning the differences in intergenerational transmission of parents' education. Regarding the living conditions variables; the cohort estimations largely confirm the findings from the model with both genders. For the older cohort, only housing variables (ownership and number of rooms) and family type variables are significant, while the variables regarding health and friends only are significant for the young cohort. The observed differences between cohorts are statistically significant for both boys and girls.

To conclude from this analysis, we find evidence of intergenerational transmission of education from parents to children, and especially from the mothers to the children. Every additional year of schooling for the parents imply that the children get more schooling other factors being equal. Also living conditions during the childhood are found to be important. As expected, the effect of owning/having a large residence is positive, while the effect of for instance unemployment and family breaks are negative. In addition, a negative effect of living in a large family is found.

Sons and daughters perform differently. Daughters are thus less dependent on the parents' level of education, but more dependent on living conditions than the sons. Children generally attain more education than their parents, and this is especially true for the daughters who nowadays attain even more education than the sons. The daughters thus on average get well educated (more or less) independent of their parents educational level, but depend on good living conditions to be able to do so.

6.2. State dependence model

As discussed in Section three, a problem with the OLS estimation is the potential correlation of unobserved heterogeneity between parents and children. In Table 8 and 9 results are presented from a probit model with endogenous selection, see (8). The estimated probability is the probability of having medium (16 years) or long further education (18 years), conditional on the parents having either high education (Table 8) or low education (Table 9)[4]. The interpretation of the model is that given the educational group, the child is born into (high or low), what is then the estimated effect of the variables on the probability of attaining high education.

Looking at the probability of attaining high education for children from high-educated families, results are found in Table 8 for all children, and for sons and daughters, respectively. First of all we find that in all cases the selection into the initial state is highly significant, where grandparents' education and parent's number of siblings are used as instruments for the selection. Furthermore, it is found that there is significant correlation between the initial state (the parents' education) and the subsequent state (the children's education), since the parameter ? is very significant. It can thus be concluded, that the initial state (i.e. the high education of the parents) matters for the probability of attaining higher education.

[4] Parent's education is defined as the maximum of mother or father's education.

Besides the state dependence parameter ? not many parameters are significant when looking at all children. Girls, older children, and children who had a parent with health problems have higher probabilities of attaining high education, the latter effect not being quite intuitive. The picture differs somewhat between sons and daughters, however. For daughters, only few coefficients are significant, while for sons the majority of coefficients are significant. Sons thus seem to be more dependent on the living conditions' variables in crossing the threshold of higher education than daughters. However, the sample sizes are rather small for this estimation when dividing into genders, implying that interpretation should be cautious.

Table 8. The probability of attaining academic education, conditional on parent having academic education. Estimation of (8)

	All children		Sons		Daughters	
	Parameter	St. error	Parameter	St. error	Parameter	St. error
Parent's education						
Intercept	-1.1674	0.0807	-1.1675	0.0435	-1.1757	0.1496
Grandfather's schooling	0.0577	0.0077	0.0530	0.0027	0.0618	0.0173
Grandmother's Schooling	0.0119	0.0025	0.0235	0.0007	0.0018	0.0171
Siblings of father or mother	-0.0989	0.0172	-0.0965	0.0042	-0.1034	0.0261
Child's education						
Intercept	-1.5672	0.6265	-0.8996	0.1370	-2.0162	1.0807
Child's gender	0.3101	0.1148	-	-	-	-
Age of child	0.0674	0.0201	0.0437	0.0055	0.0909	0.0300
House Owner	0.1642	0.1668	0.2783	0.0629	0.0455	0.2154
Number of rooms per person	0.0649	0.0885	-0.0674	0.0206	0.2673	0.1880
Father or mother were unemployed	0.1274	0.4180	0.6611	0.4142	-3.8640	315.2062
Father or mother had health problems	0.3108	0.1576	0.4038	0.1205	0.1608	0.2268
Father or mother had no friends	-0.0540	0.1300	-0.1204	0.0301	0.0935	0.2142
Number of family breaks per year	-0.7829	0.8318	-1.9963	1.1092	-0.1713	0.9122
Child living alone	-2.7540	2.2326	-20.9274	19.2468	-0.5518	1.3969
Has no siblings	-0.2616	0.1770	-0.0594	0.0339	-0.6791	0.3372
Has at least two siblings	-0.0159	0.0336	0.0413	0.0105	-0.0763	0.1654
Missing parent	-0.4256	0.2593	-0.4241	0.1415	-0.5623	0.3842
?	-0.5949	0.1554	-0.5544	0.0979	-0.6044	0.2373
Number of observations	1,814		931		883	
Log-likelihood	-1,074.88		570.97		497.24	

Table 9. The probability of attaining academic education, conditional on parent not having academic education.

	All children		Sons		Daughters	
	Parameter	St. error	Parameter	St. error	Parameter	St. error
Parent's education						
Intercept	1.1799	0.0966	1.1646	0.1489	1.2023	0.1525
Grandfather's schooling	-0.0591	0.0108	-0.0479	0.0165	-0.0726	0.0211
Grandmother's Schooling	-0.0134	0.0106	-0.0298	0.0216	0.0037	0.0275
Siblings of father or mother	0.1018	0.0165	0.0993	0.0212	0.1089	0.0257
Child's education						
Intercept	-2.0059	0.2765	-2.4821	0.5755	-1.3740	0.6878
Child's gender	0.1291	0.0625	-	-	-	-
Age of child	0.0179	0.0089	0.0285	0.0182	0.0073	0.0158
House Owner	0.1687	0.0890	0.4449	0.1494	-0.0377	0.1608
Number of rooms per person	0.2236	0.0789	0.2078	0.1287	0.2299	0.1752
Father or mother were unemployed	-0.6170	0.2535	-0.7735	0.4139	-0.5268	0.3449
Father or mother had health problems	-0.1998	0.0895	-0.0481	0.1194	-0.3952	0.1402
Father or mother had no friends	-0.0425	0.0810	0.0676	0.1257	-0.1266	0.1239
Number of family breaks per year	-0.2973	0.3830	0.5287	0.5939	-1.2944	0.8336
Child living alone	-0.7388	0.3650	-1.0636	0.7575	-0.4607	0.6795
Has no siblings	-0.0692	0.0937	-0.1559	0.1599	0.0111	0.1679
Has at least two siblings	-0.0846	0.0848	-0.2465	0.1364	0.0132	0.5644
Missing parent	-0.1982	0.1047	-0.1773	0.1740	-0.2326	0.1622
?	0.9727	4.0253	0.2880	0.5628	0.9742	1.9806
Number of observations	1,814		931		883	
Log-likelihood	-1447.60		-726.94		-710.90	

Turning to the model of the probability of attaining high education, conditional on coming from a low education family (Table 9) a very different picture emerges, however. The selection variables – grandfathers' schooling and parent's number of siblings – are still very significant. But contrary to the children from high education families, the correlation between parents' and children's education (*?*) is not significant for children from low education families. On the other hand, more of the living conditions' variables are significant. The number of rooms per person in the family thus has a positive effect on attaining high education, while parental unemployment or health problems, as well as the child not living with any of the parents, affect education negatively. For sons and daughters, respectively, most of these effects vanish, but again sample sizes are rather small.

Based on the state dependence model it can thus be concluded that there are major differences in the determination of educational attainment for children from high versus low educated families with regard to especially state dependency and the effect of living conditions variables. For the children from high-educated families, the selection into this educational group in itself is important for the probability of the child attaining higher education. Whether

living conditions are poor or bad is then less important. For the children from lower educated families, it is the other way around. The state – being from a low educated family – does not itself impose any restrictions on the probability of attaining high education. Instead, this probability for a greater deal depends on observed living conditions characteristics. From a policy point of view, this result is very reassuring. There is scope for policies improving educational standards, when parental background is less important than childhood living conditions for the less well off (in educational terms). And since parental educational background matters more for the children from higher educated families, these children will be more or less alright no matter the specific childhood living conditions.

7. Conclusion

In this paper we have analysed the educational attainment of children conditional on their parents' education. The children included are children of interviewees from a survey of living conditions aged 25-35 years in 1998. We use information on living conditions from three waves of the survey – 1976, 1986, and 2000. Information on education and family composition is from register data.

The children are found to be better educated than their parents on average. However, the aggregate intergenerational transition probabilities indicate a positive correlation between parents' and children's education. We investigate whether this correlation could be due to the following factors: state dependence, i.e. that the level of the parents' education in itself matters for the educational attainment of the child, living conditions, or social circumstances during the childhood. A least squares model of years of education indicates a strong relationship between parents' and children's educations. Especially mother's education is important for the children's educational attainment. Also living conditions during the childhood have significant effects. Dividing into genders we find that background – both in terms of parental education and childhood living conditions – is especially important for sons, while the educational attainment of daughters is more independent of background.

In addition, a state dependence model has been estimated. This model gives the interesting result that state dependence is important for children from high education families, but not important for children from low education families. On the other hand, childhood living conditions are more important for children from less educated families. The conclusion is thus, that background does matter – both in terms of parental educational attainment and in terms of childhood living conditions – but the relative importance depends on the group of

children. The less fortunate the background in terms of parents education, the more good childhood living conditions can affect the child's education in a positive respect. The problem with both models is that "true" state dependence cannot be distinguished from unobserved heterogeneity. If ability is inherited from parents to children, then this may be the true explanation of the fact that children from low-education families on average get less education than children from high-education families. A possible extension of the paper will be to pursue this, for instance by applying a difference in siblings' estimator. Furthermore, the birth-order of the children can be investigated.

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Appendix

Table A1. Sample means: Sons.

	Mean	St.dev.
Age of child	29.9162	(3.1598)
Education		
Years of education	12.7830	(2.6592)
Lower secondary school	0.2374	(0.4257)
Upper secondary school	0.0677	(0.2513)
Vocational training	0.4576	(0.4985)
Short further education	0.0505	(0.2191)
Medium further education	0.0924	(0.2898)
Long further education	0.0945	(0.2927)
Parents education[a]		
Father's schooling (years of education)	12.0905	(2.8392)
Father: Lower secondary school	0.3917	(0.4884)
Father: Upper secondary school	0.0131	(0.1138)
Father: Vocational training	0.3869	(0.4873)
Father: Short further education	0.0452	(0.2079)
Father: Medium further education	0.0952	(0.2937)
Father: Long further education	0.0679	(0.2517)
Mother's schooling (years of education)	11.5201	(2.6853)
Mother: Lower secondary school	0.4868	(0.5001)
Mother: Upper secondary school	0.0115	(0.1067)
Mother: Vocational training	0.3268	(0.4693)
Mother: Short further education	0.0483	(0.2146)
Mother: Medium further education	0.1013	(0.3019)
Mother: Long further education	0.0253	(0.1572)
Living conditions		
House owner	0.7143	(0.4520)
Number of rooms per person	1.2391	(0.5217)
Father or mother were unemployed[c]	0.0494	(0.2168)
Father or mother had health problems[c]	0.2320	(0.4223)
Father or mother had no friends[c]	0.2084	(0.4064)
Number of family dissolutions per year	0.0419	(0.1062)
Living with single parent	0.1105	(0.2715)
Child living alone	0.0295	(0.1393)
Number of siblings	1.2470	(0.9212)
Father's or mother's childhood[b]		
Grandfather's schooling (years of education)	8.5614	(2.1942)
Grandmother's schooling (years of education)	7.6526	(1.4726)
Siblings of father or mother	2.7132	(2.4147)
Number of observations	931	

[a] The data includes 840 observations of father's education and 869 observations of mother's education.
[b] The data includes 839 observations of grandfather's education and 855 observations of grandmother's education.
[c] See text for definitions.

Table A2. Sample means: Daughters

	Mean	St.dev.
Age of child	29.8856	(3.1174)
Education		
Years of education	13.0419	(2.5735)
Lower secondary school	0.1959	(0.3971)
Upper secondary school	0.0895	(0.2856)
Vocational training	0.4202	(0.4939)
Short further education	0.0612	(0.2398)
Medium further education	0.1563	(0.3633)
Long further education	0.0770	(0.2668)
Parents education[a]		
Father's schooling (years of education)	12.1280	(2.7879)
Father: Lower secondary school	0.3764	(0.4848)
Father: Upper secondary school	0.0100	(0.0997)
Father: Vocational training	0.4115	(0.4924)
Father: Short further education	0.0464	(0.2105)
Father: Medium further education	0.0903	(0.2868)
Father: Long further education	0.0652	(0.2471)
Mother's schooling (years of education)	11.4274	(2.5692)
Mother: Lower secondary school	0.4886	(0.5002)
Mother: Upper secondary school	0.0132	(0.1142)
Mother: Vocational training	0.3385	(0.4735)
Mother: Short further education	0.0588	(0.2354)
Mother: Medium further education	0.0840	(0.2776)
Mother: Long further education	0.0168	(0.1286)
Living conditions		
House owner	0.7101	(0.4540)
Number of rooms per person	1.2487	(0.5355)
Father or mother were unemployed[c]	0.0476	(0.2130)
Father or mother had health problems[c]	0.1959	(0.3971)
Father or mother had no friends[c]	0.1959	(0.3971)
Number of family dissolutions per year	0.0444	(0.1097)
Living with single parent	0.1053	(0.2630)
Child living alone	0.0292	(0.1339)
Number of siblings	1.2095	(0.8678)
Father's or mother's childhood[b]		
Grandfather's schooling (years of education)	8.5859	(2.2036)
Grandmother's schooling (years of education)	7.6696	(1.4489)
Siblings of father or mother	2.6183	(2.2024)
Number of observations	883	

[a] The data includes 797 observations of father's education and 833 observations of mother's education.
[b] The data includes797 observations of grandfather's education and 802 observations of grandmothers education.
[c] See text for definitions.

Table A3. Educational attainment of sons, given education of father, %

	Father's educational distribution	Child's education								
		Low	Upper	Voc	Short	Med	High	All	Non ac.	Ac.
Father's education										
Lower secondary school	39.2	29.5	4.0	48.3	4.9	7.9	5.5	100		
Upper secondary school	1.3	9.1	18.2	27.3	0.0	0.0	45.5	100		
Vocational tra ining	38.7	19.4	7.1	53.5	4.9	8.9	6.2	100		
Short further education	4.5	13.2	2.6	47.4	13.2	15.8	7.9	100		
Medium further education	9.5	11.3	13.8	31.3	5.0	15.0	23.8	100		
Long further education	6.8	8.8	12.3	22.8	5.3	14.0	36.8	100		
All	100	21.4	6.8	46.7	5.2	9.6	10.2	100	80.2	19.8
Non academic	83.7								84.8	15.2
Academic	16.3								56.2	43.8

Note: 840 observations used, thus excluding 91 representing missing father's

Table A4. Educational attainment of sons, given education of mother, %

	Mother's educational distribution	Child's education								
		Low	Upper	Voc	Short	Med	High	All	Non ac.	Ac.
Mother's education										
Lower secondary school	48.7	30.0	4.5	49.9	4.7	6.6	4.3	100		
Upper secondary school	1.2	20.0	10.0	50.0	0.0	0.0	20.0	100		
Vocational training	32.7	17.6	7.4	48.2	7.0	12.3	7.4	100		
Short further education	4.8	16.7	4.8	38.1	4.8	23.8	11.9	100		
Medium further education	10.1	11.4	9.1	36.4	4.5	8.0	30.7	100		
Long further education	2.5	4.5	31.8	4.5	4.5	9.1	45.5	100		
All	100	22.7	6.7	46.3	5.4	9.4	9.6	100	81.0	19.0
Non academic	87.3								84.3	15.7
Academic	12.7								58.2	41.8

Note: 869 observations used, thus excluding 62 representing missing father's

Table A5. Educational attainment of daughters, given education of father, %

	Mother's educational distribution	Child's education								
		Low	Upper	Voc	Short	Med	High	All	Non ac.	Ac.
Father's education										
Lower secondary school	37.6	22.3	6.7	47.7	4.3	15.0	4.0	100		
Upper secondary school	1.0	0.0	37.5	25.0	12.5	12.5	12.5	100		
Vocational training	41.2	20.7	5.8	47.6	6.7	13.7	5.5	100		
Short further education	4.6	13.5	8.1	48.6	13.5	8.1	8.1	100		
Medium further education	9.0	0.0	23.6	13.9	8.3	29.2	25.0	100		
Long further education	6.5	11.5	21.2	13.5	3.8	30.8	19.2	100		
All	100	18.3	9.2	42.2	6.1	16.4	7.8	100	75.8	24.2
Non academic	84.4								81.0	19.0
Academic	15.6								47.6	52.4

Note: 797 observations used, thus excluding 86 representing missing father's

Table A6. Educational attainment of daughters, given education of mother, %

	Father's educational distribution	Child's education								
		Low	Upper	Voc	Short	Med	High	All	Non ac	Ac
Mother's education										
Lower secondary school	48.9	24.3	5.2	51.4	5.4	12.0	1.7	100		
Upper secondary school	1.3	9.1	27.3	0.0	9.1	45.5	9.1	100		
Vocational training	33.9	14.2	8.5	42.9	7.4	17.4	9.6	100		
Short further education	5.9	12.2	20.4	18.4	4.1	24.5	20.4	100		
Medium further education	8.4	8.6	18.6	15.7	8.6	22.9	25.7	100		
Long further education	1.7	7.1	21.4	7.1	7.1	28.6	28.6	100		
All	100	18.4	8.9	42.1	6.4	16.2	8.0	100	75.8	24.2
Non academic	89.9								78.6	21.4
Academic	10.1								50.0	50.0

Note: 833 observations used, thus excluding 50 representing missing father's