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Age-dependent Effects of Socio-economic Background on Educational Attainment - Evidence from Germany

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Abstract
The impact of socio-economic background on a child's educational attainment has been discussed as a static concept so far. Existing economic literature as well as the psychology of education literature point however towards a dynamic process where the impact of socio-economic background depends on the age of the child. We explore this possibility using German micro-data. Using instrumental variable methods we estimate the causal effects of parental education and household income on school success of a child at two points in time of his school career. The estimates indicate that household income has a more important effect on the educational success of children in a more advanced point during the education while the effect of parental education seems to be stable.

Keywords: school choice; demand for schooling; human capital

JEL classification: I22; J13 ; J62

1. Introduction

The recent literature on the intergenerational transmission of education mainly concentrates on establishing and quantifying a causal effect of parental education and income on a child's educational attainment. Drawing on instrumental variable techniques this growing body of literature has attempted to disentangle causal effects of parental education and income on the offsprings' education from unobserved explanatory factors, such as hereditary influences and motivation. Results vary strongly across the studies. Clearly, both country-specific effects and cohort effects matter; in addition the age of the child may be important. Black et al. (2005) use a sample of Norwegian parents and grown up children who have finished the complete educational cycle. This is not the case for e.g. Oreopoulos et al. (2006), who rely on data collected while students were still in school; consequently, they use grade repetition as dependent variable. Black et al. (2005) point out that the effects found by Oreopoulos et al. (2006) may still change because some decisions regarding education still have to be taken. Similar problems exist when discussing the effect of parental income on a child's educational attainment. While Maurin (2002) stresses that information about parental income is most reliable when collected from the parents themselves rather than retrospectively, this usually implies collecting data while children are still in school, i.e. have not yet finished their education. In addition, Chevalier et al. (2005) as well as Jenkins and Schlüter (2002) suggest that parental income later in childhood may matter more for the educational achievement of a child than in early childhood.

This paper addresses the question whether the effects of parental education

and income on a child's educational attainment change as their children grow older. We draw on some of the results from the psychology of education literature to gain more insight into why effects of parental education could change over time. We use the example of Germany to estimate the causal effects of parental education and income using instrumental variable methods for two samples of children, one before having finished mandatory schooling and one afterwards. Germany lends itself to this analysis since its schooling system allows us to estimate the effects while children still have to attend school due to the strong and early sorting of students and compare it to the educational attainment after the age for mandatory schooling. Our estimates suggest that the educational attainment of the parents as well as the household income have a significant causal effect on the educational attainment of children during the entire schooling career. We find that the effect of household income is larger for the sample of children surveyed after mandatory schooling was finished, making household income a relatively more important factor with respect to parental education which has a constant effect.

The remainder of the paper is organized as follows. Section 2 shortly discusses the relevant economic and psychological literature and gives a detailed motivation for our approach. Section 3 discusses the particularities of the German education system and section 4 presents the data and variables used. Section 5 introduces the regression model, and discusses the instruments used. Section 6 presents and discusses the regression results. Section 7 concludes.

2. Motivation

2.1 The approach in the economics literature

When discussing the effect of parental education or income on a child's

school success, the economics literature has lately focused on disentangling the effects of selection from causation. Some work related to intergenerational transmission of human capital has used information on monozygotic twins or adoptive children, but most of the recent studies have relied on an IV strategy. Several studies have attempted to measure the causal effect of education by exploiting exogenous changes in parental education due to natural experiments as e.g. changes in schooling laws (for England: Chevalier, 2004, for Norway: Black et al., 2005, for the US: Oreopoulos et al., 2006) and political upheaval (for France: Maurin and McNally, 2005).[1] They all estimate basically the set of equations (1) and (2).

(1) $$educ_c = \beta_0 + \beta_1 educ_p + \beta_2 inc_p + \gamma' X + \varepsilon$$

(2) $$educ_p = \alpha_0 + \alpha_1 Z_1 + \alpha_2' X + \eta$$

where $educ_c$ refers to some measure of the education of the child, $educ_p$ and inc_p to the education and income of the parent, respectively. Z_1 represents the instrument used, and the vector X refers to all control variables. ε and η are the respective error terms. The effect of parental income on school attainment, thus estimating equations (3), has been estimated e.g. for France by Maurin (2002) using grandparents' socio-economic status as instrument.

(3) $$inc_p = \delta_0 + \delta_1 Z_2 + \delta_2' X + \upsilon$$

1 A different strand of literature discusses changes in intergenerational transmission of education over time. For Germany, Heineck and Riphahn (2007) discuss changes in intergenerational educational transmission for the cohorts 1929-1978 using a multinomial logit model. They conclude that past school reforms did not contribute sufficiently to intergenerational mobility, and that the objective of equal access to education in Germany has not yet been realized. They do not control for unobserved heterogeneity, such that their results have to be interpreted with care since especially the coefficients both on parental education and on the number of siblings may be biased due to omitted variable bias.

where Z_2 refers to the instrument and ν the error term. To our knowledge, all three equations (1) – (3) simultaneously have only been estimated by Chevalier et al. (2005) so far, who rely again on a change in schooling laws to instrument education and on the father's union status to instrument income.

All these studies have estimated the effect of socio-economic background on educational attainment of the child at one point in time. However, almost all point out that the timing of these estimations is crucial for understanding and evaluating their results. Clearly, this implies that both, parental income and education may have different effects at different times. With respect to parental income, the case is quite clear: Higher income at all times will, all else equal, give parents the opportunity to provide their children with higher quality of life. Higher income when a child has finished mandatory education will however directly impact on the decision to continue education. The case for changes in the impact of parental education on child academic attainment is less obvious. While Black et al. (2005) just point out that the effects of parental education may differ, depending on the educational advancement and thus age of the children in the sample, they do not offer an explanation why this may be the case. In order to shed some more light on this question, we turn to the insights from the psychology of education literature.

2.2 The contribution of psychology of education

Rather than focusing on the estimation of causal effects of parental education on child's education, the psychology of education literature is mainly concerned with the exact channels by which parents influence the educational outcomes of their children. Large parts of the literature are qualitative in nature, and the focus of quantitative studies are, certainly due the nature of the data

available as well as the variables used, restricted to correlations. Due to the difference in focus their results are especially interesting and can increase the understanding specifically of intergenerational transmission of human capital.

While a multitude of very specific questions (e.g. about parental aid with homework and effects on achievement) are discussed in the literature, general findings are that there exists a positive and meaningful correlation between parental expectations, parental involvement and academic achievement of children as well as between socio-economic status and parental expectations and involvement. Specifically, Fan and Chen (2001) find in a meta-analysis that mainly the aspirations and expectations parents have influence the academic outcomes of a child, and that the aspirations of the parent depend on his socio-economic status. This result is corroborated by Dandy and Nettelbeck (2002) who compare the educational aspirations parents have for their children of different ethnic groups in Australia. While Ganzach (2000) focuses in his study mainly on interactions between ability, education, and expectations he shows for the US that changes in education of the parents above the minimum level of 12 years affect attitudes towards education of parents and their children. Milgram and Toubiana (1999) find however that the impact of parental attitudes declines during the adolescence due to lower levels of involvement of the parents. Spera (2005) confirms this finding in his review of the relevant literature and recommends research into the phenomenon of changing effects.

In general, the psychology of education literature sees a large role of parental expectations in intergenerational transmission of education. Parts of these expectations express themselves via parental involvement in school activities as

e.g. help with school work. This involvement however declines as children grow older, partly because children start to resent it. Hypothetically, this could imply that children are therefore less influenced by their parents and therefore parental education and their school performance is therefore to a larger extent due to innate ability and other unobservables.

2.3 Synthesis

Overall, economists have found evidence indicating that parental income does not matter equally at all times for a child's education. Reasons may include that only after mandatory schooling opportunity cost due to possibility to work start to matter, while at the same time attending education becomes more costly. Even if budget constraints are often not binding with respect to education choices (as it is suggested e.g. by Carneiro and Heckman, 2002) low income may thus still prevent students from choosing education more appropriate to their ability. Economics has less to say about parental education with regard to the stability of its effects on children's educational attainment. While intuition (as expressed by Black et al., 2005) suggests that there may be changes, no evidence exists currently. The psychology of education however has found that as children grow older, parental involvement which is positively correlated with parental education as well as the child's education decreases.

<Figure 1>

Overall, we have therefore reasonable evidence suggesting that the effect of income changes over time, while at best circumstantial evidence suggesting changes in the effect of parental education. Figure 1 gives a graphic overview of the discussion in the previous sections.

1. PARENT: This column displays the three parental factors we discuss in this paper which influence the academic attainment of the child. Genetic disposition of the parent influences however both his education and income, and education by itself can influence income. We can disentangle these effects by instrumenting.
2. PARENT: Based on the discussion of the economic and psychological literature, a short overview of some possible channels by which the socio-economic background can effect child's education.
3. CHILD: Splitting of parental influences in time-invariant (age-independent) and time-variant (age-dependent) factors.
    - Time-invariant effect of parental education: all factors that directly affect the academic ability of a child.
    - Time-variant effect of parental education: all factors that are dependent on actual parental attitude and involvement and the child's acceptance of both.
    - Time-invariant effect of parental income: all factors that directly affect the academic ability of a child.
    - Time-variant effect of parental income: financial constraints which can only arise after mandatory schooling.
4. CHILD: Observed educational attainment of the child.

As has become clear from this discuss there are basically two distinct mechanisms in which the socio-economic background of a child can causally effect its academic achievement. The first is, broadly speaking, creation of an environment that enables children to develop more easily capabilities which are

instrumental to achieve academic success. This implies that the opportunity cost of education will become lower and the ideal level of education for a child will rise. The second mechanism concerns broadly speaking choices made during the educational career of a child. Several factors apart from the expected returns to education will influence the choices of parents and children at successive stages of schooling, including the taste for school and the ambitions and expectations of the parents, the developed taste for school of the children, and potentially the available resources that allow education to be treated like a consumption good rather than like an investment. Those factors that affect ability should be fairly stable, while those factors that affect choices or reflect circumstances in which choices are made may change over time (if money plays no role in choice a, but it does in choice b, we will find that income prior to choice b matters more than choice a).

We therefore would like to estimate an equation where we can differentiate between the age-dependent and age-independent effects and control for ability of the child as well:

$$(4) \qquad educ_c = \beta_0 + \beta_1 educ_p + \beta_{11} educ_p * age_c + \beta_2 inc_p + \beta_{21} inc_p * age_c + \\ + \kappa_1 age_c + \gamma' X + \varepsilon$$

Both cross term in $educ_p$ and *age* and the cross term in inc_p and *age* pick up the effect that parental education and income may have a different impact on $educ_c$ over time. Thus the marginal effects of $educ_p$ and inc_p change over time. It is of course possible to estimate equation (4) using OLS when ignoring the fact that we cannot observe ability. Clearly, this would lead to an omitted variable bias, and we

could therefore not interpret any of the four effects.[2] In order to identify the changes in the time-varying marginal effects of $educ_p$ and inc_p, we apply instrumental variables to estimate separately

$$(5) \qquad educ_c = \beta_{0,t} + (\beta_1 + \beta_{1,t})educ_p + (\beta_2 + \beta_{2,t})income_p + \kappa_{1,t}age + \gamma_t' X + \varepsilon$$

$$t = 1, 2$$

for two sets of students at consecutive stages of their educational career instead. We refer to both stages as t=1,2. We can use the same instruments for parental education and income in both cases, making comparison therefore easier.

<Figure 2>

3. Application to the German educational system

In order to be able to interpret our results correctly we discuss the main features of the German educational system. One particularity of the German educational system is the sorting of students into different types of secondary schools when they are only about 10 years old. Figure 2 gives a schematic overview of educational careers; while there are options and some variations per federal state which are not discussed here (for a more detailed discussion, see e.g. Steedman (1993)).

After having visited primary schools for 4 years, children continue their education in one of three secondary school types. In most federal state the final decision on which type of school is to be visited by the child lies with the parents.

2 Theoretically, it is of equally possible to instrument parental education, parental income as well as the interaction terms. Practically however, it poses the problem that we would need four distinct instruments. Apart from the fact that it is difficult to find a single valid instrument for both education and income, we need to consider that additionally, most instruments do not affect everyone in a population equally strongly. Using two different instruments for education and the interaction of education and the child's age, we would therefore get potentially into difficulties because we cannot interpret the increase in education in both cases in the same way. This obviously would make

This choice of school type is particularly important since the choice of tertiary education is partly constrained by the type of secondary school visited. Thus, at the age of about 10 or 12 in some federal states, a first choice regarding education has to be made. Clearly, at this age it may be difficult to make the decision most appropriate to the academic abilities of a child and in addition, parents may want to set their children onto a path which keeps choices regarding higher education open since only students who went to the highest type of secondary school, the *Gymnasium* are allowed to continue their education at the university. Visiting this level implies attending school for a total of 12 to 13 years.[3] It is also possible to attend the *Fachgymnasium* which is usually offered from grade 11 on only. Graduating from that type of high school will give you the opportunity to study at technical colleges. About 30 % of adults surveyed in 2001 had attended one of the two highest high school types, and about 20 % of them did in fact move on to graduate from either university or technical college. The intermediate type of high school, the *Realschule* as well as the lowest type, the *Hauptschule* both prepare students for different levels of vocational training, either in firms as apprentices or in vocational schools. Education in these school types takes in total 10 and 9 years, respectively. For our purpose, it is important to point out that students attending the highest secondary school type can also leave school after 9 or 10 years; they are treated as having the equivalent diploma of the lowest or intermediate secondary school type respectively. Also, students who have high grades in the two lower school types can decide to continue their schooling and go on to technical college

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interpretation difficult.

3 The amount of years depends on the respective federal state; the current tendency is to lower it to 12.

or even university. Nevertheless, switching school types upwards is difficult and costly since the different school types are geared towards different curricula; while the *Gymnasium* curriculum focuses on subjects as languages, math, natural and social sciences, the lower school types' curricula include also practical subjects as accounting or crafts. Even though the numbers above show that the choice of secondary school type of a child does not mean that a certain career will be followed, it is still a good estimation of actual educational attainment later in life (see e.g. Dustmann (2004)). While thus the first choice at age 10 is very important, it does not preclude that students or their parents choose a different educational path after the minimum school requirement around the age of 16 has been fulfilled. This may imply continuing school towards the *Abitur* despite having chosen for the low or intermediate level initially, or to drop out of the highest level in order to continue with vocational training. There is thus a second point in time where a specific choice has to be made regarding the education of the child. This time, the academic abilities of the child may be much clearer and parental expectations have possibly adjusted to actual performance of the child. Most importantly, household income may now be important since students aiming for a university education will have to be supported longer by their parents, while a student earning money as an apprentice may actually contribute to family income quite early. Clearly, the parental background may play a different role during each of the two choices.

4. Data

We use data from the years 2000-2005 of the German Socio-Economic Panel (GSOEP) data.[4] We use two different samples derived from the GSOEP child

4 We restrict our analysis to these years since the questionnaire for youths has been introduced in

and youth data sampled at about the same time. The first is a matched set from individual observations, children observations and household observations from 2001. It includes information on the mother and her children up to the age of 16. The second set uses specific youth observations collected in the years 2000-2005 (between the age 17-19) instead of the children observations. The main difference here is that in the former case the mother actually answered the questionnaire, while the youth questionnaire is answered by the children themselves. We restrict the first sample to children aged 12-16 in order to ensure that we can identify clearly the type of school visited. At the age of 16, students who initially were sorted into the lowest type of secondary school may then decide to continue school or go directly into vocational training such that it would be more difficult to identify the different impacts the socio-economic status of the parents have on the initial and second schooling decision. In the second sample, students report not only the school diploma achieved but in case of current school attendance also the diploma type they plan to acquire.

We measure the educational attainment of the mother in years of education received.[5] The variable for children's education is derived from the type of secondary school visited. We use a dummy variable which is equal to one for

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2000. While the ideal data would allow us to test the change in effects with an unchanged sample of children at different stages of their education we have not enough observations for such a panel.

5 As however the type of education/diploma received is surveyed rather than the time spent in education, this variable is generated according to the years that are institutionally assigned to the type of education received. This generated variable is provided in the data. An amount of education of either 9 or 10 years indicates that the parent did not take part in any type of tertiary education, and has not attended school longer than required. Mothers whose education is coded with values lower than 9 dropped out of school without a diploma. 11 to 14 years of education represent a low or intermediate secondary diploma and some sort of tertiary education (usually vocational training of 3-4 years), or a high secondary diploma without further tertiary education. Any value above 14 represents either a high secondary diploma and tertiary education, or lower secondary education, vocational training and either technical college or advanced vocational education.

children visiting the highest secondary school type, the *Gymnasium*.[6]

<Tables 1, 2>

Tables 1 and 2 show the distribution of educational attainment for parents and children as well as the share of children attending the *Gymnasium* in relation to the years of education of the parents. The total read horizontally shows the shares of mothers according to years of education for each sample, the total read vertically shows the total share of children attending the *Gymnasium* or other schools in each sample. The descriptive statistics indicate that there is a strong correlation between the education of the mother and that of the child in both samples. The share of children attending the high secondary school after the mandatory schooling age is slightly higher than that of younger children. This may indicate that more students take advantage of continuing school after having reached the intermediate schooling level than students deciding to stop after 10 years of education to pursue an apprenticeship even though they initially attended high secondary education.

<Tables 3,4>

The variable *income* is the defined as the (logarithm of) the monthly net household income including government transfers for at least two and at most five years prior to the sample year; we used this variable rather than wages since we are interested in the effect of total resources available to a family; we took the average of previous years in order to ensure that we do not measure the effect of short-term liquidity constraints. Table 3 shows the distribution of children attending the

6 For the sample of young children, this variable can be computed directly from the information given by the mother on the school type visited. For the sample of older children, this variable is constructed from the information of the secondary diploma received already; if children are still attending school despite having received a diploma already or have not finished their secondary education yet, the information was derived from the answer given to the question of the highest

highest type of secondary school over the income quartiles. For both samples we see that higher household income is correlated with the share of children attending the highest school type. We further control for age of parent and child, gender of the child, and nationality of the parent. Table 4 gives a summary of all variables. Both samples are almost identical with respect to their descriptive statistics.

5. Empirical strategy

As the other relevant literature we estimate the system of equations (1), (2) and (3), in our case for two samples of children of different age (age 12-16 and age 17-19). The education of the child, $educ_c$, is a dummy equal to one if the child is attending academically oriented secondary school (*Gymnasium*); the education of the mother, $educ_p$, is measure in years. Income of the household is the (logarithm) of the average disposable household income of the last 2-5 years. The vector X consists of the age of the child, age of the mother, gender of the child, and nationality of the mother. All regressions are estimated by OLS and standard errors for the second stage are bootstrapped.

According to Angrist, Imbens and Rubin (1996) we can interpret our instrumental variable estimates causally if he following conditions are satisfied:

- the type of school attended by any child may not be correlated with the treatment status of parents other than their own;
- once all observable characteristics are accounted for, innate ability has to be distributed randomly across treatment groups;
- the effect of being treated on schooling and income has to be monotonous;
- the fact that the parent has been treated may have no causal impact on the

planned secondary education.

school type attended by the child.

<Table 5>

We use two different instruments since we are working with a system which includes two endogenous variables on the right hand side and include different instruments as to avoid problems arising from correlations of the instruments. To instrument parental education (Z_1 in equation (2)) we choose the type of place the parent lived at age 15.[7] This information is used to construct a dummy variable equal to one if the parent lived in the countryside and equal to zero if the parent lived in any type of city. Becker and Siebern-Thomas (2004) use the same instrument to estimate returns to education and provide a detailed discussion of how the differences in supply of schools in the countryside in comparison to cities of different sizes induce exogenous variation in schooling attainment. Table 5 shows that mothers in our sample who grew up in the countryside have on average less years of education.

To ensure that we can interpret the impact of parental education on the school type attended by the child as causal effect the instrument needs to fulfill the four conditions discussed above. First, there may be no correlation of the area other parents grew up in on the school type attended by a child. We see no reason why this assumption should be violated.

Second, ability and other unobservables may not be correlated with the place of dwelling at age 15 once observable characteristics are accounted for. Becker and Siebern-Thomas argue that it is unlikely that this type of self-selection by ability has taken place, but point out that the assumption of random distribution

7 We follow the method of Chevalier et al. (2005), so that we do not include the instruments Z_2 in (2)

of ability and other unobservables cannot be formally tested. It is not completely unimaginable that families with lower innate ability or other unobserved traits have self-selected into farming and that therefore the assumption of random distribution is violated. In order to control for this potential difficulty as well as possible, we include the type of secondary school diploma received by the grand-parent in the regression. The instrument thus measures the effect of regional differences in school supply on the educational attainment of parents conditional on the school achievement of the grandparents.

Third, the effect of being schooled in the country side has to be monotonous for all individuals. This means that all parents who grew up in the city have to have at least as much education as if they had grown up in the countryside. This assumption can be tested by showing that the cumulative density functions of individuals schooled in the countryside and in cities do not cross. We refer to Becker and Siebern-Thomas for this proof.

Finally, we need to make sure that there is no direct causal effect of the instrument on the type of school a child attends. This could be the case if there was very low mobility of parents away from the localities where they grew up while school infrastructure remained unchanged; this would imply that the children would be affected by the same school supply issues as their parents. Given the educational expansion Germany has gone through, we think that we can safely assume that this is not the case.

<Table 6>

To instrument average household income we use the marital status of the

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and Z_1 in (3). Consequently, we bootstrap the standard errors of the estimated parameters.

mother (Z_2 in equation (3)). It is a dummy variable that equals one if the mother is neither married nor lives with a partner. Being single has no correlation with the educational attainment of the mother (for both samples the value of Spearman's rho is very small highly insignificant), but it has a large impact on the level of household income (see table 6).

We can also argue that there is no reason to believe that the marital status of parents other than the childrens' own have any correlation with the school type attended by a child. Also, there is no reason to believe that unobserved ability is correlated with the marital status. Finding no correlation of education and marital status corroborates this assumption. There is also no possibility for a single mother to earn more than in combination with a partner, which ensures the monotonicity of treatment. The most difficult condition concerning this instrument is to show that growing up with a single mother has no causal effect on children's educational attainment. This question has in fact been debated for some time. Ricciuti (2004) finds for the US that there is no impact of single motherhood on childrens' education if controlling for the lower income of single parents and Mahler and Winkelmann (2004) come to the same conclusion for Germany using the same data we do. We therefore argue that the final assumption is met as well.

<Table 7, 8>

6. Estimation results

The regression results are presented in table 7 and 8 for respectively the sample of children aged 12-16 and the sample of children aged 17-19. The first column gives the OLS-estimates of equation (1). The next two columns give the first-stage estimates of equation (2) and (3), respectively. These estimates underlie

the second-stage IV-estimate of equation (1) that is presented in Column (4). The first-stage estimates of Table 7 give satisfactory F-statistics of the instruments. The first-stage regressions of Table 8 indicate that both instruments have significant effects on the dependent variable, although the F-statistic is slightly on the low side for maternal education.

When comparing the OLS results to the IV approach, we find that the coefficients on parental education are strongly biased downwards when using OLS. With respect to income, estimations are basically the same for the sample of children ages 12-16, while estimations for the sample of older children (aged 17-19) are somewhat biased downwards when using OLS. From both samples we can conclude that parental education and household income have a significant and economically relevant effect on the probability that a child will attend high secondary education, regardless of the age at which education is measured. All else equal, an increase of one year in mother's education increases the probability of her child attending high secondary school by 18 percentage points. In comparison, an increase in household income by 10 percentage points increases the probability of the child attending high secondary school by about 2 percentage point for children aged 12-16, and by about 3 percentage points for children aged 17-19.[8]

Next, we compare the estimated coefficients between both age categories. The first surprising result is that the effect of maternal education seems to be completely stable. This implies that worries such as expressed by Black et al.

8 We do not express these effects in terms of standard deviations since maternal education is not distributed normally. For completeness we can state that for the sample of children aged 12-16, a one standard deviation increase in maternal education increases the probability of the child to attend high secondary school by about 24 percentage points, for the sample of children aged 17-19 by about 47 percentage points. An increase in household income by one standard deviation translates into increases in the probability of attending high secondary education of about 9 and 13 percentage

(2005) concerning measurement of education while children still attend school seem to be irrelevant for Germany. More interestingly, it also implies that the lowering of the level of parental involvement, which itself is a function of parental education, does not translate into a lower causal effect of parental education on a child's educational attainment. Having said this, we need to point out that the strong and early educational sorting practiced in Germany may partly be responsible for this result. Investigation into changing effects in countries where education systems allow more mobility during students' school careers may lead to different findings.

With respect to the income effect, we find that the probability of a child in the 12-16 year old sample to attend high secondary school increases by about 2 percentage points with a 10 percentage point increase in household income, while it increases by about 3 percentage points for the sample of 17-19 years old students. According to recent research credit constraints are not binding with regard to education. Considering that in Germany financial aid for students with low-income parents is available, and that the returns to university education are substantial it is likely that budget constraints are also in this case not the reason for the increased effect of household income on the child's school attainment. Rather, we suspect that the increased importance of household income for the probability of attending high secondary schools for the sample of children aged 17-19 stems from the increased opportunity cost of attending school which enters the decision making process. Before the decision between vocational training and university education has to be taken, there is no alternative to attending school, such that the costs in attending higher education is solely due to the larger effort the marginal student has to make

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points respectively.

in order to succeed in that school type. After mandatory schooling however, he could decide to enter vocational training which, in the dual system, would earn him a degree in at most 3 years as well as a small salary during that time. Deciding to stay in higher secondary education would prolong time in school by about 2-3 years, after which university training would take at least another 4 years of unpaid education. While the marginal student might strictly speaking be able to afford continuing education and going to university, lower household income may tip the scales towards pursuing vocational training, as also Jenkins and Schlüter (2002) have already suggested.

In general, our estimates suggest that parental education has a more important and stable impact on a child's education than household income, whose effect depends on the stage of schooling and the age of the child. Our findings are therefore in line with findings by Jenkins and Schlüter (2002), who suggests that late childhood parental income is more relevant to educational achievement than early childhood parental income, and that parental education is in comparison a much more relevant factor than income. We can add to this insight that parental education has in comparison to income a stable effect, suggesting that it is working less via the interactions regarding schooling such as help with homework or parental involvement in school activities, but rather by affecting ability directly, possibly at a very early age. In addition, the rather rigid German school system would translate lower or higher achievement in school due to parental involvement probably rather into higher or lower grades or potentially in class repetition.

This comparison shows that the relative importance of household income increases for older children. Intuitively, this makes sense: children in the younger

sample have no choice but to visit a secondary school; there are no extra costs involved in attending the highest level. Since parents usually have a large influence in deciding which type of school should be visited, their preferences and opinions will matter strongly, while the income should be relatively unimportant to the decision and may matter only in so far as it proxies expected income. This reasoning also explains the fairly high impact of parental education. Children in the older sample are in a different situation; with 17, those who attend either of the two lower secondary school types will definitely have graduated, and children who attend the highest secondary school type will have attained an equivalent diploma just by passing the 10^{th} grade. Thus, *all* these children are now in the potential position to continue their education in vocational training. Due to the extensive apprenticeship system in Germany, this is an attractive alternative: young apprentices are educated for about 3 years partly in government financed vocational schools and partly in firms, who also pay them a small salary. In comparison, the decision to continue school and to pursue a study at the university will entail about 7-9 more years of full-time education. Obviously, the decision between these alternatives will be more strongly influenced by ability and income then the initial sorting into secondary schools: the large investment into education will only be worthwhile if a student has the necessary ability to successfully finish the academic studies, while for households with lower income, the (opportunity) cost of studying may be more important than it is for richer households.

7. Concluding remarks

In this paper we have set out to determine whether the causal effects of

parental education and household income on a child's educational attainment contain an age dependent factor. The existing economic literature indicates that this could well be the case for income, and suggests that it might be a possibility for education. The psychology of education literature evokes the clear possibility of an age depending effect of parental education due to evidence linking parental involvement, which decreases with the age of the child, to the levels of parent and child alike.

In order to identify the age dependent effect we have used two samples of German children in different stages of education. For both samples, we have regressed the probability of a child being sorted into the highest secondary school type on the education of the mother and household income. The IV-estimates suggest that the importance of maternal education remains constant while that of income increases as children grow older.

With respect to the income effect, these results make sense: in the younger sample the children are between 12 and 16 years old and have to attend either type of school anyway. In the older sample the children are 17-19 years old and are in the position to decide to start working, continue education in vocational training or continue secondary school until they receive the *Abitur* which allows them to pursue university education. Since university education is costly, and vocational training earns some income, it is no surprise that household income has a larger influence on school choice in this situation compared with the choice of school type when schooling is mandatory. However, the size of the effect remains comparatively small, and indicates that further policy lowering the cost of university education may not be a good investment of public funds.

While expectations regarding the effects of income are confirmed, our findings show no support for the theory that lower parental involvement in a child's education during adolescence actually translates into significant changes in educational attainment. We should however not completely dismiss the notion that the effect of parental education changes during the course of a child's education. First of all, it is possible that school performance does indeed change due to lower parental involvement without going as far as necessitating a switch in school types. Detailed information on grades in each school year would be needed to investigate this possibility. Second, our division of samples is determined by the German educational system, and cannot be freely chosen. It is possible that parental involvement in Germany is high until children are sorted into the secondary school types around the age of 10-12, after which it declines. As no information on school performance in primary school is available to us, we could not test for this possibility.

Clearly, more research into this issue is needed. Similar evidence from other countries with different education systems may differ strongly, giving more insight into how socio-economic background is transmitted in different education systems, and how important educational choices are at different ages.

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Table 1.: Educational attainment of mothers and children aged 12-16

	Education of the mother in years			
	< 11 years	**11-14 years**	**> 14 years**	**Total**
gymnasium	14.74	38.46	66.67	34.67
other school	85.26	61.54	33.33	65.33
Total	34.24	50.40	15.36	100.00

Table 2.: Educational attainment of mothers and children aged 17-19

	Education of the mother (in years)			
	< 11 years	**11-14 years**	**> 14 years**	**Total**
gymnasium	14.74	38.46	66.67	34.67
other school	85.26	61.54	33.33	65.33
Total	34.24	50.40	15.36	100.00

Table 3: Household income quartiles and childrens' education

	Income quartile household				
children aged 12-16	**1st**	**2nd**	**3rd**	**4th**	**Total**
gymnasium	19.59	27.99	32.55	58.65	34.67
other school	80.41	72.01	67.45	41.35	65.33
children aged 17-19					
gymnasium	21.60	30.45	39.51	63.71	38.81
other school	78.40	69.55	60.49	36.29	61.19

Table 4: Summary statistics

	children aged 12-16		children aged 17-19	
Variable	**Mean**	**Std. dev.**	**Mean**	**Std. dev.**
Education of mother(in years)	11.82	1.270	12.110	2.591
Log(household income)	8.402	0.408	7.868	0.433
Dummy: Mother grew up in countryside	0.375	0.484	0.377	0.485
Dummy: Mother is single	0.123	0.328	0.184	0.387
Dummy: Child is male	0.505	0.500	0.489	0.500
Age of child	14.090	1.390	17.195	0.535
Age of mother	40.913	5.018	44.061	4.929
Age of mother sq/100	17.00	4.233	19.667	4.991
Dummy: Mother is non-german	0.108	0.311	0.086	0.280
Dummy: Grandmother has intermediate education	0.125	0.331	0.117	0.322
Dummy: Grandmother has high education	0.034	0.180	0.035	0.184
Dummy: Grandfather has intermediate education	0.118	0.322	0.106	0.308
Dummy: Grandfather has high education	0.680	0.252	0.082	0.274
Number of observations	1376		1943	

Table 5: Average years of education of the mother by area of dwelling

	children aged 12-16		children aged 17-19	
	years of education mother	**(Std. dev.)**	**years of education mother**	**(Std. dev.)**
countryside	10.140	(0.419)	11.796	(0.086)
other	11.843	(0.067)	12.300	(0.078)

Table 6: Household income quartiles and partner status of mother

	income quartile				
children aged 12-16	1st	2nd	3rd	4th	Total
single	33.04	9.33	4.40	2.35	12.29
children aged 17-19	1st	2nd	3rd	4th	Total
single	40.33	16.46	10.29	6.39	18.37

Table 7: Regression results sample children aged 12-16

Explanatory Variables	OLS (eq (1))	IV-first stage (eq (2))	IV-first stage (eq (3))	IV-second stage (eq (1))
Education of mother (in years)	0.053***	-	-	0.180***
	(0.006)			(0.068)
Log(household income)	0.229***	-	-	0.212**
	(0.030)			(0.085)
Dummy: Mother grew up in countryside	-	-0.378***	-	-
		(0.121)		
Dummy: Mother is single	-	-	-0.420***	-
			(0.030)	
Dummy: Child is male	-0.064**	-0.051	0.009	-0.057**
	(0.023)	(0.115)	(0.019)	(0.024)
Age of child	-0.016	-0.020	0.012	-0.013
	(0.009)	(0.042)	(0.007)	(0.009)
Age of mother	-0.014	0.751***	0.114***	-0.105*
	(0.028)	(0.144)	(0.024)	(0.061)
Age of mother sq/100	0.023	-0.810***	-0.113***	0.122*
	(0.332)	-1.698	(0.289)	(0.667)
Dummy: Mother is non-German	-0.024	-2.035***	-0.133***	0.226
	(0.034)	(0.189)	(0.032)	(0.141)
Dummy: Grandmother has intermediate education	0.095**	0.995***	0.071**	-0.035
	(0.043)	(0.198)	(0.034)	(0.081)
Dummy:Grandmother has high education	0.111	2.721***	0.102*	-0.245
	(0.070)	(0.337)	(0.057)	(0.201)
Dummy: Grandfather has intermediate education	0.025	0.997***	0.042	-0.106
	(0.044)	(0.201)	(0.034)	(0.084)
Dummy: Grandfather has high education	0.061	1.512***	0.163***	-0.138
	(0.052)	(0.247)	(0.042)	(0.123)
Intercept	-1.791***	-4.920	5.527***	-1.103
	(0.601)	-3.019	(0.514)	(0.823)
Adjusted R-squared.	0.196	0.262	0.224	0.092
MSE	0.427	2.11	0.359	0.439
F-test instruments: F(1,1356)	-	9.78**	200.53***	-
Number of observations	1376	1376	1376	1376

Significance levels * : 10% ** : 5% *** : 1%
Standard errors between parentheses

Table 8: Regression results sample children aged 17-19

Explanatory Variables	OLS (eq (1))	IV-first stage (eq (2))	IV-first stage (eq (3))	IV-second stage (eq (1))
Education of mother (in years)	0.056***	-	-	0.181**
	(0.004)			(0.087)
Log(household income)	0.197***	-	-	0.299***
	(0.026)			(0.071)
Dummy: Mother grew up in countryside	-	-0.257**	-	-
		(0.109)		
Dummy: Mother is single	-	-	-0.382***	-
			(0.022)	
Dummy: Child is male	-0.105***	0.136	0.004	-0.122***
	(0.020)	(0.104)	(0.017)	(0.023)
Age of child	-0.009	-0.067	0.004	0.000
	(0.019)	(0.098)	(0.016)	(0.021)
Age of mother	0.006	0.881***	0.158***	-0.123
	(0.026)	(0.142)	(0.023)	(0.082)
Age of mother sq/100	0.001	-0.903***	-0.155***	0.132
	(0.029)	(0.155)	(0.026)	(0.085)
Dummy: Mother is non-German	-0.029	-1.943***	-0.154***	0.225
	(0.034)	(0.188)	(0.031)	(0.167)
Dummy: Grandmother has intermediate education	0.025	0.851***	0.062**	-0.089
	(0.038)	(0.187)	(0.031)	(0.084)
Dummy: Grandmother has high education	-0.008	1.614***	0.152***	-0.234
	(0.060)	(0.307)	(0.051)	(0.153)
Dummy: Grandfather has intermediate education	0.064	1.227***	0.094***	-0.101
	(0.039)	(0.191)	(0.032)	(0.118)
Dummy: Grandfather has high education	0.060	2.110***	0.220***	-0.232
	(0.043)	(0.214)	(0.035)	(0.192)
Intercept	-1.909**	-8.082**	3.925***	-1.232
	(0.686)	-3.629	(0.600)	-1.022
Adjusted R-squared.	0.201	0.218	0.234	0.088
MSE	0.436	2.292	0.379	0.466
F-test instruments: F (1,1932)	-	5.54**	293.57***	-
Number of observations	1943	1943	1943	1943

Significance levels * : 10% ** : 5% *** : 1%
Standard errors between parentheses.

Figure 1: Effects on the education of child

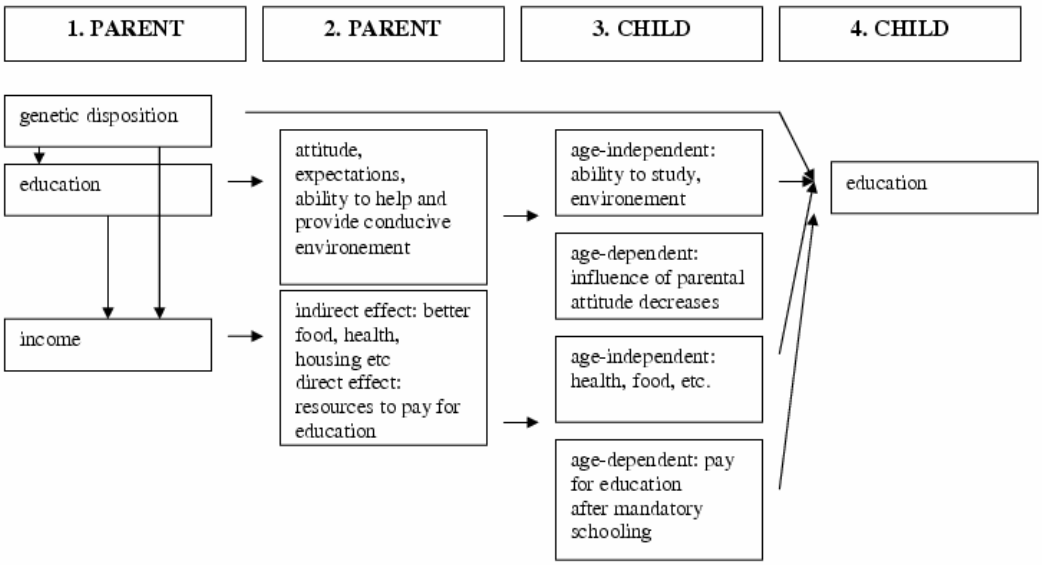

Figure 2: The German education system (data from 2001)