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Secondary school track selection of single-parent children: Evidence from the German Socio-Economic Panel

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Secondary School Track Selection of Single-Parent Children – Evidence from the German Socio-Economic Panel *

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Abstract

In present day Germany, one in seven children is raised in a single parent household. We investigate the effect of single parenthood on children's educational attainment, measured by the school track at the age 14, using ordered probit models. We study whether the effect of living in single parenthood during early or late childhood differs. Finally, we ask whether the family effect operates through resources – fewer income and parental time available for the child –, or through adverse effects on psychological well-being. The data used in this study are a nationally representative sample of 14 year old children drawn from the German Socio-Economic Panel.

JEL Classification: I21, J12

Keywords: school choice, educational attainment, ordered response model

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1 Introduction

In present day Germany, one in seven children is raised in a single parent household (Statistisches Bundesamt, 2003). Naturally, the question arises whether children from such families are in any way disadvantaged in their development relative to children from traditional two-parent families, and if so, why this is the case. For example, single parenthood might mean fewer resources – income and parental time – available for the child, and thereby cause a disadvantage. Or it might be detrimental to the psychological well-being *per se*. This paper explores these issues in some detail, by studying a nationally representative sample of 14 year old children using data from the German Socio-Economic Panel. The development indicator we look at is secondary school track choice, i.e., whether the child attends lower secondary school (Realschule); intermediate secondary school (Realschule); or upper secondary school (Gymnasium) at age 14.¹

The benefit of using a general purpose household panel survey for our analysis is not only that it has a wealth of information on family background variables, but also that it provides measurements of these variables over time, as the children grow up. Hence, it becomes possible, for example, to separate the effect of single parenthood during early childhood from the effect of single parenthood during late childhood.

The downside of using such a data source is the relative scarcity of information on the cognitive development of a child. Essentially, we have only information on the type of secondary school attended by a child. An alternative would be to base the analysis on tailored student assessments such as PISA or TIMSS. For instance, Tillmann and Meier (2003) analyse the association between current family structure, Pisa test scores, and school types. While these surveys provide detailed

¹In some areas of Germany, integrated secondary schools have been introduced. These are not considered in this paper.

information on children's cognitive abilities and subject specific knowledge, they give only relatively scant information on family background. For example, there is no information on household income. Therefore, such data are unsuitable for testing the main hypotheses of our paper.

In addition, we think that secondary school track at age 14 is a quite useful indicator of a child's educational opportunities on its own right. The school track has a strong screening and selection function. Whatever the reasons for being selected into Gymnasium, be it cognitive ability or other unrelated factors, the very fact of having been selected into that track bestows the child with a great advantage, since only graduation from Gymnasium allows to access university directly, and to reap the potential benefits of such a higher education. The other two tracks, Hauptschule and Realschule, mainly prepare students for entering the labor market through the apprenticeship system. Thus, any family background factor influencing a child's secondary school track choice will have long-lasting consequences on a child's socio-economic status throughout its adult life.

Previous related research – all based on the German Socio-Economic Panel using school track as the outcome variable – has focused on the importance of parental education (Dustmann, 2004) and income (Büchel et al., 2001, Jenkins and Schluter, 2002, Schneider, 2004). Couch and Dunn (1997) provide a US-German comparison on the intergenerational transmission of education. Spiess, Büchel and Wagner (2003) study whether Kindergarten attendance matters for secondary school placement. Single parenthood is sometimes included as one of the explanatory factors. However, a detailed investigation of the importance of family instability for children's educational opportunities in Germany cannot be found in the previous economic literature.

Evidence for the U. S. and U.K. shows that growing up in a separated family has negative consequences on children's educational attainment. For the U.S. a comprehensive review of methods and findings concludes, among other things, that growing up in a single parent or step-parent family

or experiencing a parental separation or divorce has a negative effect on educational attainment (Haveman and Wolfe, 1995). Moreover, the high school drop out rates in the U.S. are higher for children living in single parent households than for children living in two-parent families. The negative effect of growing up in a single parent household on high school drop out rates is bigger if the child experienced an episode of single parenthood during preschool age (Gransky, 1995). Living under disadvantaged family circumstances during early childhood also has been shown to adversely affect a child's educational attainment using data for the U.K. (Ermisch and Francesconi, 2001a, 2001b, 2002). Parental disruption during early childhood causes substantial reductions in children's later educational attainment (Fronstin et al, 2001). Evidence for the Netherlands confirms the negative effect of single motherhood on children's educational attainments (Dronkers, 1994).

In this paper we extend the existing literature for Germany in three ways. First, we investigate the effects of single parenthood on children's educational opportunities, measured by the school track at the age 14. The second novelty is that we study whether this effect is childhood stage dependent, i.e. if the effect of living in single parenthood in early childhood is stronger relative to that of living in single parenthood during late childhood. Thirdly we identify the channels through which single parenthood affects children's secondary school choice. Is this an effect *per se* or are factors *related* to single parenthood – less income and less time – responsible for the children's lower educational attainments?

The data used in this study are drawn from the German Socio-Economic Panel (GSOEP). While the outcome variable – school attainment at age 14 – is cross-sectional, the annual panel information is used for reconstructing the social and economic environment of the children during early and later childhood.

2 Theoretical and Empirical Framework

In order to model the relationship between educational attainment and single parenthood we assume the existence of an education production function

$$edu = f(p, r) + u \tag{1}$$

where edu is the child's educational attainment measured by the secondary school level at age 14, p is the child's psychological well-being, r is the amount of household resources spent in the upbringing of the child, be it money or time, and u is an i.i.d. error term. We assume that education is an increasing function of household resources and psychological well-being, i.e., $\partial edu / \partial r > 0$ and $\partial edu / \partial p > 0$.

In this framework, the effect of parental separation is mediated through the psychological and the material well-being variables. On one hand, we can write

$$p = g(s, x) \tag{2}$$

where s is an indicator for single parenthood and x is a vector of socio-economic characteristics, excluding resource variables. We take it as evident that $\partial g / \partial s < 0$, based on a large literature that links a child's psychological well-being to the interaction between parents and their children and hence to the family structure (e.g., Coleman, 1988, Seltzer, 1994, Boggess, 1998). On the other hand, single parenthood clearly has also an adverse effect on resources

$$r = h(s, x) \tag{3}$$

with $\partial h/\partial s < 0$, since single parenthood reduces household income as well as the time available for the child.² After substitution, the education production function can therefore be written as

$$edu = f(g(s, x), h(s, x)) + u = \tilde{f}(s, x) + u \quad (4)$$

The reduced-form equation (4) reveals the crucial dependence of a child's educational attainment on single parenthood. Under the assumptions made above, we hypothesize a negative effect of separation on education, both because resources are diminished and because the psychological well-being is compromised. However, based on equation (4), we cannot decompose the overall effect of separation $\partial \tilde{f}/\partial s$ into its two constituent parts. Therefore, in order to identify the relative contributions of the resources and psychological effects, respectively, we consider the alternative model

$$edu = f(g(s, x), r) + u = \hat{f}(s, x, r) + u \quad (5)$$

Since the resources effect is controlled for in this specification, $\partial \hat{f}/\partial s$ is now the pure psychological effect, and a comparison of $\partial \tilde{f}/\partial s$ and $\partial \hat{f}/\partial s$ gives us the relative importance of the two channels.

While the two equations (4) and (5) capture the essence of our empirical approach, there are two additional aspects that complicate the interpretation of these models. The first aspect is the issue of timing of events, the second aspect refers to the selection problem and the potentially non-random assignment of separation. According to this hypothesis, the incidence of single parenthood does not arise randomly but rather is systematically related to other family specific factors that diminish educational outcomes.

²The idea is that time spent with the child declines as the single parent may increase its labor supply. This effect may be not so large if transfer payments reduce the importance of income from work to support the family, or if the increased working hours are taken from a mother's free time rather than "child care time".

We start with the first aspect. In order to address questions of dynamics such as: “does it matter whether separation occurred during early or late childhood?” we can generalize the static equations by conceptualizing the relevant psychological well-being p and resources r as accumulated stock variables. In this interpretation, p is the stock of psychological capital an adolescent is endowed with at time T . The accumulation process can be expressed as follows

$$p = \int_0^T p(t)w_p(t)dt = \int_0^T g(s(t), x)w_p(t)dt$$

and similarly for r

$$r = \int_0^T r(t)w_r(t)dt = \int_0^T h(s(t), x)w_r(t)dt$$

The relative importance of early and late childhood events is then captured by the two weighting functions $w_p(t)$ and $w_r(t)$.

With respect to the selection problem, we can distinguish between *selection on observables*, that arises if s and x are correlated, and *selection on unobservables* that arises if s and u are correlated. In this paper we control for the selection on observables by including as many relevant variables in the regression as possible. Selection on unobservables such as the “quality” of the partnership, i.e., whether it is a happy or an unhappy one, will tend to cause an upward bias of the estimated effect of single motherhood on a child’s educational attainment.

One possible approach for addressing selection on unobservables would be to compare the children’s educational attainments before and after parental separation. In this spirit, Piketty (2003) shows for France that children from divorced parents have lower educational attainments already before the separation. De Galdeano and Vuri (2004) provide similar results for the U.S. Alternative methods require either the availability of an instrument (such as state level variation in divorce laws as in Gruber, 2005), or the availability of siblings data in order to remove the family effect through differencing (see e.g. Ginther and Pollak, 2000, and Björklund and Sundström, 2005). But

neither is there in Germany regional variation in the divorce laws - and thus in the probability of single parenthood -, nor are there sufficiently many siblings observed in the GSOEP data to allow any reasonable analysis. With our data, therefore, we cannot satisfactorily address selection due to unobservables and it is possible that our estimates overstate the causal effect of single motherhood. However, if it is the case that no effect is found once we control for selection on observables, this whole issue can be safely ignored.

For the empirical implementation, we have to understand some basic features of the German school system. Since schooling is the responsibility of the Länder (federal states), there is a substantial amount of variation in rules and regulations. At the risk of oversimplification, the main features are as follows: all German Länder operate a segmented secondary school system, where the differentiation is along the lines of scholastic ability; the tracking is relatively early, often after four years of primary school but latest after the first six years of schooling; changing tracks afterwards remains mostly a theoretical possibility; and only the highest school track, Gymnasium, provides direct access to university. Traditionally, the secondary school level is divided into two additional main tracks, apart from Gymnasium, namely lower level secondary school (Hauptschule), and intermediate secondary school (Realschule). After Hauptschule graduates often start a career as a blue collar worker. At a higher level, there is the Realschule, which prepares pupils for a white collar track or enables them to enroll in schools for further education. Pupils from Hauptschule as well as Realschule often start an apprenticeship after leaving school.

In summary, the school track allocation at age 14 determines to a large extent, although not exclusively, whether a student can obtain a university education later on.³ This distinguishes Germany from the U.K., where the decision for or against a university entrance qualification is

³The main exception is that graduates from Hauptschule and Realschule can enter, with further qualifications, polytechnical schools (Fachhochschulen) which also offer advanced tertiary education.

made at the age of 16, or the U.S. where a large majority of a cohort completes high school.

Because of the three-tiered hierarchical structure of the secondary schooling system, we model educational attainment as a standard ordered probit model (see Greene, 1997, ch. 19.8, for further details).

$$y^* = \eta + u, \quad u|\eta \sim Normal(0, 1)$$

$$y = \begin{cases} 0 & \text{if } y^* \leq \alpha_1 & \text{“Hauptschule”} \\ 1 & \text{if } \alpha_1 < y^* \leq \alpha_2 & \text{“Realschule”} \\ 2 & \text{if } y^* > \alpha_2 & \text{“Gymnasium”} \end{cases}$$

where y^* describes a latent variable dependent on a linear index function of the form $\eta = x'\beta$ and u is an i.i.d. error with a standard normal distribution. As motivated by our discussion above, we want to decompose the overall effect into a resources affect and a psychological effect, controlling for selection as well as we can with the data at hand. Therefore, we consider three alternative models that differ in the assumptions on the index function:

$$\text{Model 1:} \quad \eta = x'_1\beta_1$$

$$\text{Model 2:} \quad \eta = x'_1\beta_1 + x'_2\beta_2$$

$$\text{Model 3:} \quad \eta = x'_1\beta_1 + x'_2\beta_2 + x'_3\beta_3$$

In Model 1 the vector x_1 includes indicators for living in a single parent household, separated by when the event occurred. These are incidence indicators that are one if any episode of single parenthood is recorded in the data, regardless of its length, and zero else. We distinguish between two childhood periods, early childhood from age zero to six, and late childhood from age seven to 14. A third indicator is one if at least one single parent episode was recorder during both childhood periods. These three dummy variables are therefore mutually exclusive, in the sense that a child either lives in a single parent household in early, late or in both childhood periods.

The additional regressors in x_2 in Model 2 control for a potential selection or family effect. These include mothers schooling, an indicator for a foreign household head, and the mother's age at birth. A lower age at birth tends to go together with a higher marital instability. As mentioned above we are only able to control for a selection on observables. To control for the resources effect we include additional regressors in x_3 in Model 3 with information on families average per capita equivalent household income and mother's labor supply separately for child's early and late childhood, the child's gender and the birth order. The latter two variables capture potential resources effects that result from an unequal allocation of the available resources among siblings.

The empirical reasoning is as follows: if we compare the educational attainment of children from two-parent and single-parent families, the difference gives us a combination of the psychological, selection and resources effect (Model 1). In order to decompose the overall effect into its constituent parts, we need to include the vectors containing the controls for the selection and resources effect, x_2 and x_3 respectively in addition to the vector containing the single parenthood indicator, x_1 . The coefficient of the latter measures then the psychological effect, i.e. the specific effect of single parenthood keeping resources constant and controlled for a selection on observables. If the parameter related to the psychological effect becomes insignificant after controlling for selection and resources, whereas the resource effect is significant, we can conclude that single parenthood causally affects children's educational attainments, and that the reasons for this effect are diminished economic resources rather than adverse psychological effects.

3 Data

The data used for this study are drawn from the German Socio-Economic Panel (GSOEP), an annual panel survey of a random sample of households in Germany (see Burkhauser et al, 2001

and Haisken-DeNew and Frick, 2002, for further details). In West Germany, the collection began in 1984, and since 1990 East German households are included in the survey as well. The GSOEP contains a broad amount of information about household and personal characteristics of their members. Each member older than 16 years answers his own personal questionnaire. For younger children some basic information such as current schooling is provided by the household head in a separate questionnaire. This information is essential for the following analysis.

For each year between 1994 and 2001, records for 14 years old children were extracted from the GSOEP and checked for their schooling status. All children who visited either Hauptschule, Realschule or Gymnasium were kept in the sample. The few children visiting a so-called Gesamtschule (comprehensive school) (less than 8.5 percent) had to be dropped since the ordering of this school type relative to the other three dominant types is ambiguous. The age of 14 was chosen because the final decision about the secondary school track has effectively been made by then.

These children live in households with either a West German or “foreigner” household head. Observations from former East Germany are excluded from the sample because the school system was different there. In order to analyze specific childhood period effects, childhood is divided into two periods. Early childhood from zero to six years before children enter school, and late childhood from seven to 14 years after schooling has started.

For each wave, family structure, average household income, mother’s labor force participation, mother’s highest educational degree, mother’s age at birth, the average number of members in household for both childhood periods and the birth order were determined and merged with the information from the children’s sample. A full description of the variables is given in the Appendix. Family structure means here whether the child ever lived in a single mother household as opposed to a two-parent household. Single father households, while a theoretical possibility, are empirically

irrelevant. Also, we cannot be sure in two-parent families, whether the partner is the biological father or not. Unfortunately, this potentially important distinction cannot be made with the GSOEP data. In future work, we plan to refine our measure of family structure by using the fraction of childhood years (or months) spent with one parent only, as for instance in Björklund and Sundström (2005).

Income is measured as an average over the respective childhood periods, i.e. early childhood from age zero to six or late childhood from age seven to 14.⁴ The basis is the annual household income after taxes and government transfers provided in each wave, deflated to 1995 and on a per-capita equivalence scale, where the following weights were used: The first adult in a household has a weight of 1, each additional adult 0.7 and each child in the household 0.5 (Buhmann, 1988). The mother’s labor force participation history is measured as average working hours per weekday, again averaged over the two childhood periods, and the mother’s highest educational degree can be “no degree”, “compulsory school degree”, “completed apprenticeship” or “tertiary education”. It was not possible to include the highest educational degree of the father or partner. Because of the large number of missing data on this variable, the sample size would have been reduced too much.

Finally, the eight subsamples for the years 1994 to 2001 were pooled together. Controlling for missing values, the final data set consists of 704 children. Note that due to the panel structure of the GSOEP and its annual survey, we do not need to rely on retrospective information. The information about the constructed variables stem from the particular year rather than from ret-

⁴For children born before 1983 (those aged 14 in 1994-1996), the first childhood period is incompletely observed. For the cohort of 1980, we miss the first three years (since the 1984 wave of the GSOEP provides information on the income in 1983). In this case, the income average is based on the remaining three years. We proceeded in this way because the base sample is relatively small and we wanted to keep a maximum amount of data. A separate analysis where these cases were dropped did not lead to substantially different results.

respective answers. We consider this a great strength of our analysis that should allow for new insights into the link between separation and educational attainment.

4 Results

A first impression of the data is offered by some basic descriptive statistics in Table 1. First of all, we notice that the incidence of single motherhood is relatively low. Of the 704 14 year olds observed in our sample, only 94 (or 13.4 percent) have ever experienced an episode of single motherhood. Of those 94 cases, 18 involved single motherhood during early childhood only, the majority of 43 cases involved single motherhood during late childhood only, and the remaining 33 cases involved single motherhood during both early and late childhood.

The remainder of the table shows some bivariate associations between family situation during childhood and the main variables of interest, namely children's educational attainment and the main confounding variable highest education of mother, income, and work. First, the school attainment at age 14 seems indeed to vary as a function of family situation. Among those children who never experienced single motherhood, 37 percent attend Hauptschule, 28 percent Realschule and 35 percent Gymnasium. On the other hand, children who had single motherhood periods during both early and late childhood are more likely to attend Hauptschule (49 percent) and less likely to attend Gymnasium (21 percent). However, standard errors are quite large so that neither the +11 percentage point difference in Hauptschule nor the -14 percentage point difference in Gymnasium are significantly different from zero at conventional levels of significance. If one compares the difference between single motherhood during early childhood and single motherhood during late childhood, one finds that the early childhood experience matters more. Indeed, there is hardly any difference in school attainment between children who experience single motherhood during late

childhood only and those who never experience it.

Next, we consider the association between family situation and the educational attainment of the mother. We know that the intergenerational transmission rates of education are quite high. In Table 1, we find no simple relationship between single motherhood and level of formal education. The educational attainment of mothers is measured not by school type – as it makes sense when considering 14 year olds – but rather by highest qualification, including school, vocational or tertiary. As these women went to school some decades ago, we also find women who left school without graduating at all, something that would be very rare at present. Consider again the contrast between “never single mothers” and mothers with episodes of single parenting during both early and late childhood. We see that none of the mothers in the latter group left school without qualification, whereas 10 percent of the mothers in the former group did so, possibly a cohort effect. The university graduation rate is higher among the never single mothers, albeit at a very low level (six percent as opposed to three percent - the difference is insignificant). All in all, the two groups of mothers are quite similar with respect to their schooling. When considering mothers who were single parent either during early or late childhood, the main differences are higher rates of university graduation and lower rates of vocational training. Again, these may be cohort effects. Taken together, it seems unlikely that the mother’s education is responsible for the lower educational attainment of single motherhood children.

By contrast, the income effect points in the expected direction: single motherhood tends to go along with lower disposable household income. The effect is most pronounced for the “always” category: during early childhood the average equivalent income was DM 5200, or by 26 percent, below the average equivalent income of the intact family comparison group. During late childhood the income gap slightly narrows to DM 4800, or 22 percent. Table 1 also contains a justification

for our implicit assumption that income is a resources effect (single motherhood leads to lower income) rather than a selection effect (lower income families are more likely to separate). In particular, we find that the early childhood income of children where the separation occurred in late childhood is the highest among all categories, and in particular also higher (although not statistically significantly so) than the early childhood income of children who never experienced single motherhood.

The working hours effect also goes in the expected direction: single mothers spend more time working than mothers with partner, time that is not available for the child. The effect is most pronounced in late childhood, where single mothers spend on average about 4.8 hours working per day (the weighted average of 4.89 hours and 4.63 hours), whereas partnered mothers spend only 3 hours in market work.

The regression results are displayed in Table 2. The ordered dependent variable is the secondary school track at age 14, with categories (in that order) Hauptschule, Realschule and Gymnasium. A positive regression coefficient means that an increase in the corresponding regressors increase the probability of attending Gymnasium and reduces the probability of attending Hauptschule. The direction of the effect on the middle category is ambiguous - it depends on the other regression coefficients as well as on the values of the regressors. While it would be possible to compute the correct marginal probability effects for all three categories, we for simplicity concentrate in our discussion on the signs – i.e. the direction of the change in the probability of attending Gymnasium –, significance, and relative magnitudes of the coefficients.

We estimated the three different models mentioned in section 2. Apart from a set of time dummy variables and seven federal state dummies, common to all three models, the first specification only includes three additional indicator variables describing the family structure: single motherhood

during early childhood only, single motherhood during late childhood only, and single motherhood during both early and late childhood. In the second specification we added controls for selection on observables: education and age of the mother, and an indicator for foreign household head. The third specification includes the main resource variables, namely income, time spent working plus the family size, birth order, and the child's gender.

From a statistical point of view, Model (3) is the preferred model: a likelihood ratio test of Model (2) against Model (1) has a test statistic of 156 with p -value of 0; A likelihood ratio test of Model (3) against Model (2) has a test statistic of 110, again with p -value of 0. Nevertheless, we will consider the two other models in turn first, mainly, because the changes to the estimated single motherhood coefficients across the three models can tell us something about the nature of the linkage between single motherhood and children's educational attainment.

From Model (1) we can answer the first two questions raised in this paper. Is there an effect of single motherhood on children's educational attainment and if yes, is this effect childhood stage dependent? The regression results show that children who spent both childhood periods with a single mother are significantly (at the 5 percent level of significance) less likely to attend Gymnasium than children from intact families. We can therefore answer the first research question with a "yes". But is this effect stage dependent? The point estimate for the early childhood only group is similar to the children who spent both childhood stages in single motherhood, although the standard error is now larger and the hypothesis of no effect cannot be rejected. Children with a single mother episode only in later childhood are practically identical to children from intact families with respect to school track. The second research question has therefore an inconclusive answer. Based on point estimates, the early childhood effect is larger.

As we move to Model (2), we see that there is indeed a very strong transmission of educational

attainment from mother to child. The coefficient of “mother has a tertiary education” is very large. Statistically significant positive effects on the probability of attending Gymnasium are also observed for the mother’s age and for living in a non-foreign household. Interestingly, these selection variables cannot explain away the single motherhood effect. To the contrary, the effect of having lived in single mother household during both childhood periods has now a larger negative effect on the probability of Gymnasium and the t -statistic increases to 2.4.

Now consider the results for Model (3), our preferred specification. The main additional variables of interest are the resource variables, i.e. the childhood period specific average household income and the mother’s working hours. This model answers our third research question: What are the channels through which single motherhood affects children’s educational attainment? The effects are as expected: the probability of attending Gymnasium depends positively on income. The effect is significant for both periods but, as already reported by Jenkins and Schluter (2002), larger for the later period. On the other hand, a child’s educational attainment is negatively affected by the mother’s working hours during childhood. Here, the time pattern is opposite to the one for income: working during early childhood matters more. The later childhood coefficient is smaller by about one third, and only marginally significant (the p -value is 6.8 percent for a one-sided test). Finally and importantly, all three coefficients of the family structure variables are very close to zero and statistically insignificant in this extended model. Therefore, we find as conjectured that the observed correlation between single motherhood and secondary school track is mostly attributable to the resources effect. According to the evidence in our data, both selection and psychological effects play subordinate roles only.

5 Conclusions

This paper examines the effect of family structure - defined as single motherhood - on children's secondary school track choice at the age of 14 in Germany, using data from the *German Socio-Economic Panel* and ordered probit regression models. An innovative aspect of the paper is that these effects are investigated separately for two childhood periods, namely early childhood, between zero and six years and late childhood, between seven and 14 years.

There are three main findings. First, the observed correlation between single motherhood and secondary school track is mostly attributable to the resources effect. When controlling for household income and mother's labor force participation, the estimated coefficients for the variable "single mother" become insignificant for both childhood periods. The lower educational attainment of children growing up in single mother households appear therefore to be due to the diminished resources associated with single motherhood. Second, there is no systematic evidence that resources during early childhood are more important than resources during later childhood: while this is the case for mother's working hours, the opposite holds for income. Third and finally, as in previous related research, the single most important explanatory factor for secondary school track choice is mother's educational background.

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Tables

Table 1: Sample means by single motherhood

Single motherhood	never	in early-childhood	in late-childhood	always
<i>Hauptschule</i>	0.37 (0.020)	0.50 (0.121)	0.37 (0.075)	0.49 (0.088)
<i>Realschule</i>	0.28 (0.018)	0.22 (0.101)	0.30 (0.071)	0.30 (0.082)
<i>Gymnasium</i>	0.35 (0.019)	0.28 (0.109)	0.33 (0.072)	0.21 (0.072)
<i>Mother's highest education</i>				
<i>None</i>	0.10 (0.012)	0.11 (0.076)	0.05 (0.033)	0.00 (0.000)
<i>School</i>	0.26 (0.018)	0.33 (0.114)	0.28 (0.069)	0.36 (0.085)
<i>Apprenticeship</i>	0.58 (0.020)	0.44 (0.121)	0.49 (0.077)	0.61 (0.086)
<i>Tertiary</i>	0.06 (0.010)	0.12 (0.076)	0.18 (0.060)	0.03 (0.030)
<i>Early-childhood</i>				
<i>Income</i> ¹	1.99 (0.031)	1.95 (0.192)	2.29 (0.190)	1.47 (0.155)
<i>Work</i> ²	2.13 (0.111)	4.28 (0.749)	3.32 (0.397)	2.82 (0.527)
<i>Late-childhood</i>				
<i>Income</i> ¹	2.23 (0.037)	2.17 (0.192)	2.14 (0.106)	1.75 (0.118)
<i>Work</i> ²	3.00 (0.116)	3.86 (0.783)	4.89 (0.449)	4.63 (0.601)
<i>N</i>	610	18	43	33

Data GSOEP, own calculations

Standard errors in parentheses

1: equivalence income per capita in 10000 DM (1995) 2: average hours per weekday

Table 2. Ordered Probit Regression Results ($N = 704$)

<i>Variable</i>	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>
<i>Single mother, child age 0 - 6</i>	-0.313 (0.278)	-0.249 (0.298)	-0.125 (0.306)
<i>Single mother, child age 7 - 14</i>	-0.028 (0.180)	-0.297 (0.191)	-0.150 (0.203)
<i>Single mother, child age 0 - 14</i>	-0.415 [†] (0.208)	-0.511 [†] (0.213)	0.129 (0.254)
<i>Mother's edu: School</i>		0.706 ^{††} (0.192)	0.568 ^{††} (0.199)
<i>Mother's edu: Apprenticeship</i>		1.123 ^{††} (0.195)	0.717 ^{††} (0.205)
<i>Mother's edu: Tertiary</i>		2.336 ^{††} (0.296)	1.672 ^{††} (0.314)
<i>Foreigner HH</i>		-0.275 [†] (0.118)	-0.063 (0.124)
<i>Mother's age at birth</i>		0.036 ^{††} (0.009)	0.045 ^{††} (0.012)
<i>Log Income,¹ child age 0 - 6</i>			0.452 [†] (0.214)
<i>Log Income,¹ child age 7 - 14</i>			0.988 ^{††} (0.225)
<i>Work,² child age 0 - 6</i>			-0.048 [†] (0.022)
<i>Work,² child age 7 - 14</i>			-0.033 (0.022)
<i>Log avg # of persons in HH child age 0 - 6</i>			0.275 (0.211)
<i>Log avg # of persons in HH child age 7 - 14</i>			-0.071 (0.295)
<i>Child is female</i>			0.140 (0.093)
<i>Birth order</i>			-0.287 ^{††} (0.075)
Log-likelihood	-760.9	-682.9	-628.3
χ^2	15.4	171.4	280.6

Notes: Standard errors in parentheses.

Significance levels: [†] 5 percent, ^{††} 1 percent.

All models include 7 time dummies, 7 state dummies, and 2 cut points.

¹ log average equivalence income per capita.

² average hours per working day.

Appendix: Variable Definitions

Variable	Definition
School	Secondary school type when the child is 14 years old, either Hauptschule (0), Realschule (1) or Gymnasium (2).
Single mother	Dummy variable that equals to 1 if the child ever lived in a single mother household during the respective childhood period.
Log avg # of persons in household	Natural logarithm of the average number of persons living in the household during the respective childhood period.
Child is female	Dummy variable that equals to 1 if the child is female and 0 otherwise.
Foreigner household	Dummy variable that equals to 1 if the child lives in a household with a foreign household head and 0 otherwise.
Mother's age at birth	Age of mother at child's birth.
Birth order	Constructed assigning the number 1 to the first born child, number 2 to the second born child and so on.
Mother's highest education	Highest educational degree achieved by the mother: no degree (reference category), a school degree, completed an apprenticeship or a tertiary education.
Income	Equivalence income per capita after taxes and government transfers in 10000 DM deflated to 1995 using the annual average CPI published by the Federal Statistical Office Germany. The first adult in a family is weighted by 1, each additional adult by 0.7 and each child by 0.5.
Work	Mother's average working hours per working day during the respective childhood period.

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