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Crown Princes and Benjamins: Birth Order and Educational Attainment in East and West Germany

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This study expands the literature on the determinants of educational attainment by analyzing the effects of birth order in Germany. These effects are typically attributed to sibling rivalry for parental resources. Using data from the German Life History Study on birth cohorts 1945-1978, we find highly significant effects of birth order on secondary education. The effects are of substantial magnitude, both in West and East Germany. To our knowledge, this is the first study that also examines possible trends in the birth order effects. In West Germany, the effects remained stable over time, whereas in East Germany, the disadvantage for later born children increased. The result for East Germany is surprising because, during the period of the analysis, the care and education of preschool children was more and more shifted from parents to state run institutions, where the treatment of children should have been independent of birth order.

JEL Codes: I21, J13

Key words: birth order, sibling configuration, educational attainment, East and West Germany, gender differences

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1. Introduction

In many western societies, it is discussed to what extent the educational attainment of a child depends on its social origin. The influence of family background factors such as parental education, income and wealth has been subject of countless empirical studies. To summarize the results: “the accident of birth” (Heckman 2008, p. 289) into a certain family environment is a major source of inequality.

In this debate, educational research has generally ignored the fact that education takes place within the families and is therefore also subject to intra-family processes and dynamics. A family constitutes a socio-economic subsystem where economic allocation decisions are made (Becker 1981) and social relationships are established. It is therefore worth investigating whether children with identical parental background, in particular siblings, systematically differ in their educational success.

One important cause for different sibling outcomes is birth order. Together with other components of sibling configuration, i.e. sibship size, spacing and sex composition (Steelman et al. 2002), it determines the position of a child relative to its siblings. Different positions can engender different parental treatment and a different standing in the sibling row, which later translates into differential schooling success. In this context, “the accident of birth *order”* could be a source of inequality.

The influence of birth order on educational attainment in developed countries has already been subject of several empirical studies (Black et. al 2005, Kantarevic and Mechoulan 2006, De Haan 2009, Booth and Kee 2009). They all agree on highly significant negative effects: siblings with higher birth orders ceteris paribus have lower schooling degrees than their older siblings. We contribute to the empirical literature by analyzing the effect of birth order on secondary educational attainment in Germany.

The German case is particularly interesting as between 1949 and 1990, the country was divided into a democratic (Federal Republic of Germany) and a socialist part (German Democratic Republic).[1] This enables us to analyze the birth order effects for two similar populations in different political and educational systems.

To our knowledge, this is also the first study that explicitly examines possible trends in the birth order effects. It is reasonable to assume that e.g. changes in educational styles, family models, and family policy over time affect parents' allocation decisions and the relationships between family members. In particular, in the former GDR, there was a large extension of the state run preschool system during the analyzed period (Geisler 2005). The aim was to promote women's employment and children's political education in accordance with the socialist regime. This policy might have mitigated inequalities among siblings: care and education of small children were more and more shifted from parents to childcare institutions where the treatment of the children should have been independent of birth order.

We use data from the German Life History Study and exploit information on West German siblings born between 1945 and 1978 and East German siblings born between 1945 and 1972. We are interested in the effects of birth order on secondary education. Using a family fixed effects model, we are able to control for family level heterogeneity. Our findings for Germany are largely consistent with those from other countries: we find highly significant negative effects. They are present both in the democratic and the former socialist part of Germany and are systematically stronger for boys. In West Germany, the birth order effects are constant, in East Germany, to our surprise, they strengthened over time.

[1] FRG and GDR in the following.

2. How birth order affects the educational outcome of a child - Theory

When discussing the effects of birth order on child quality, we must bear in mind that family research is multi-disciplinary. The theoretical framework presented in this section therefore comprises complementary explanatory approaches from economics, social science, and psychology. They have in common that the effect of birth order is explained by a “non-shared family environment” (Sulloway 2007a) during childhood: depending on their birth order, children experience a different parental treatment (2.1) and have different relations with their siblings (2.2).

2.1. The parental allocation problem

Human capital theory (e.g. Becker 1981) conceives of the quality of a child as the out-come of a child production function for which parental resources are the crucial input. If there are several children in the family, parents must divide their resources such as money, quality time, attention, and energy among the siblings. Sibling outcomes may differ if parents’ alloca-tion strategy results in an unequal distribution (Behrman and Taubman 1986).

One possible strategy to assign resources can be to favor certain children depending on certain child characteristics, e.g. birth order. Becker and Tomes (1976) argue that rational parents aim to maximize their children’s future wealth. That is, they give the largest part of their resources to the most promising child. Parents often perceive their oldest child as the most capable. Because of the age gap, it always appears physically stronger, more skillful and intelligent in direct comparison to its younger siblings. And indeed, in many human societies there is historical evidence of parental favoritism towards the first born child, for example in terms of inheritance customs, lines of succession, and other practices (Sulloway 2007b).

Investing in the most profitable child is the optimal strategy from an economic point of view and might especially be followed when resources are extremely scarce. Hertwig et al.

(2002), however, argue that in reality, parents are simply not able to follow this strategy because they fail to assess the future returns on their investment. Therefore, they use much simpler allocation strategies such as equal treatment. Strictly speaking, total equality would mean that the cumulative distribution of resources over time is equal for every child. That is, every child gets exactly the same amount of parental resources during childhood. In that case, we would expect no birth order pattern in educational attainment. As this approach is almost impossible to accomplish, parents might draw on a more feasible equity heuristic: they attempt to treat their children equally at every point in time (Hertwig et al. 2002, Price 2008). However, Hertwig et al. (2002) demonstrate how this egalitarian behavior produces inequality among siblings: the first born is an only child for some time whereas the later born have to share parental resources from the beginning with their older siblings.[2] One would expect this allocation strategy to be most harmful for the middle born children and less for the last born child as the last born child will de facto become an only child once its older siblings have grown up. Such reasoning assumes, however, that the last child can equalize the lack of resources in the critical development years at a later age, which is not necessarily the case (Shonkoff and Phillips 2000).

2.2. Sibling interaction

Psychological and sociological theories also focus on sibling interaction. Sulloway (1996) argues that the personality and the future social behavior of a child are largely shaped by its birth order. As siblings have to share their parents' resources, rivalry emerges. The strategy a child adopts to gain parents' devotion differs by birth order. Firstborns are observed to gain their parents' favor by acting as a surrogate parent for their younger brothers and sis-

[2] The disadvantage for the later born only occurs, if the total amount of resources parents are willing and able to supply to their children is constant over siblings, or if at least it is not rising proportionally to the number of children. The latter assumption can be justified by a parental budget constraint (time, money etc.) or by a diminishing marginal utility in parenting with every further child (Behrman and Taubman 1986). Yet, we not only have to consider the quantity, but also the quality of parental resources. There might be learning effects in parenting with a growing number of children. The later born children then also have an advantage as they are brought up by more experienced parents.

ters. They are therefore supposed to be more conscientious, hard-working, and respectful of authority. The later born must find another niche to attract their parents' attention. As they do this by experimentation, they are often more ingenious, unconventional, and tolerant of risk (e.g. Paulhus et al. 1999, Sulloway 2001, Herrera et al. 2003, Healey and Ellis 2007).

Similarly, birth order is decisive for the strategy siblings adopt in relation to one another. Different birth ranks imply differences in age, height, and physical strength, and thus a different standing in the sibling hierarchy. Accordingly, firstborn mainly employ dominating strategies (e.g. intimidation and physical aggression) whereas high birth order siblings use low power strategies (e.g. appealing to parents for help, humor, and social intelligence) (e.g. Paulhus et al. 1999, Sulloway 2001). The different strategies later translate into differences in personality and social behavior.

In this framework, the observed correlation between birth order and schooling success can be explained by different characters of the siblings: children born early in the sibling row are doing better at school because they have certain characteristics that are helpful in the educational system. The power of personal traits in explaining socio-economic outcomes has also been confirmed in the economic literature (Heckman et al. 2006, Borghans et al. 2008).

Naturally, the life of siblings consists not only of rivalry. There are other forms of interaction such as learning and teaching relationships with the younger children learning from the older ones. In this context, Zajonc (1976) developed the much cited "confluence model". According to Zajonc (1976), the intellectual development of a child is determined by the intellectual environment in the family which is modeled as the average of the intellectual level of all family members. With every additional child, the average intellectual environment in the family declines. The first born has the advantage of being an only child for the first few years and profits from the intellectually sophisticated environment in the sole presence of the parents. The following children are born into a successively degrading intellectual environment.

Therefore we would expect a negative effect of birth order on the intellectual development and educational success of the siblings.

Additionally, Zajonc and Markus (1979) stress the importance of the teaching function of older siblings. At first sight, this seems to benefit the younger siblings who learn from their older brothers and sisters. In the long run, however, Zajonc and Markus (1979) argue that teaching benefits the tutor more than the learner. First born children exceed later born children in terms of cognitive abilities at later age. Last born children completely lack the opportunity to teach younger siblings which creates a handicap for their intellectual development.

All of the theories presented above predict a disadvantage for later born siblings in terms of educational attainment. In the following analysis, we investigate whether this phenomenon is present in German families.

3. Data and estimation strategy

3.1. Sample

We use data from the German Life History Study.[3] The data consist of a series of retrospective birth cohort studies. Between 1985 and 1997, individuals born between 1919 and 1974 from both West and East Germany were interviewed about their lives with an emphasis on educational, occupational, family, and residential histories. Among other things, the respondents were asked about their parental background and their siblings. As these data contain the year of birth and the educational qualification of each brother or sister of the respondent, we are able to use the siblings of the respondents as separate observations. We now dispose of a multilevel dataset with families on the first, and siblings on the second level.

[3] For detailed information see http://www.mpib-berlin.mpg.de/en/forschung/bag/projekte/lebensverlaufsstudie/index.htm.

Because of the disruptions of World War II, we only use families whose children were all born after 1945.[4] For East Germany, we furthermore restrict the analysis to siblings born before 1972 so that they were able to complete their schooling in the socialist system. For West Germany we only consider children born before 1978 so that they were able to complete secondary education until the time of the interview.[5]

Similar to the previous studies, we are interested in the birth order effects only in intact families. This restriction accounts for the argument that part of the expected negative birth order effect may be due to family problems (e.g. divorce or dead of a parent), a later born child is more likely to be confronted with than a first born child. To address this problem, we have to exclude a number of families. We dropped a family when the respondent had a stepmother or stepfather, when the respondent was separated from one of the parents during childhood, when the parents of the respondent were never married, or when the biological mother of the respondent was younger than 15 or older than 49 when she gave birth.[6] After these modifications we are confident to have identified and excluded most of the broken families in our sample.

Like most interview based surveys, the German Life History Study suffers from missing values. When a sibling had a missing value in the dependent variable *educational degree,* we removed that one observation from our data. We thereby lose five percent of the observations. When information on a year of birth was missing, we deleted all siblings of the family, as in this case, we were not able to determine the birth ranks. This leads to a further three per-

[4] It is impossible to determine the actual structure of the families that were established before 1945: many children lost their fathers or siblings during the war; infant mortality was much higher so that some of the siblings mentioned by the respondent were actually never part of the family. As for schooling outcomes, some of the siblings were simply not able to complete their schooling because they were recruited by the military or killed.
[5] Here, we did not, however, drop the whole family.
[6] These sample restrictions are entirely based on information on the interviewed sibling. As we do not have the same information on the other siblings, we cannot ensure, e.g., that all the children of a family are biological siblings.

cent reduction in sample size. For all other covariates we replaced missing values by cohort specific means.[7]

Our dataset consists of 9,474 siblings from 3,289 West German families who were born between 1945 and 1978 and 2,398 siblings from 761 East German families who were born between 1945 and 1972. Only families with at least two children are included because in families with only one child there cannot be sibling inequalities.

Problems arise in comparing results for East and West Germany because schooling degrees may differ across countries in their prestige in society and the related professional opportunities. Furthermore, in socialist East Germany, access to higher secondary education did not only depend on students' grades. The decision of the school authorities was heavily based on political and ideological criteria such as social and political activity, SED (Socialist Unity Party of Germany) affiliation of the parents, and being member of the working class. We therefore analyze the two subsamples separately.

3.2. Main variables

Summary statistics of all variables used in the analysis are given in Table 1. Our dependent variable is the completed level of *secondary education*. Many of the previous empirical studies on birth order used *years of schooling* to measure educational attainment. This is not, however, the best variable to model educational success in the German system. In West Germany, after completing four years of primary school, pupils are separated into three different secondary school tracks: *Hauptschule (lower secondary education)* takes between five or six further school years to complete and *Realschule (secondary education)* takes further six years to accomplish. Both prepare students for an apprenticeship, but the degree of *Realschule*

[7] To check the validity of our analysis after these modifications, we created in parallel a multiple imputation dataset using STATA (Rubin 1987, Royston 2004, 2005a, 2005b). The following estimation results are highly similar for both datasets. The presented analysis entirely relies on the original dataset to facilitate certain post estimation procedures, such as calculating marginal effects. The results of the multiple imputation dataset are available from the author upon request.

rates higher as its curriculum is more demanding. The third form of secondary education is *Gymnasium (higher secondary education)*. It takes between eight and nine years to complete and leads to the *Abitur,* which gives access to university education. Using *years of schooling* as dependent variable is problematic, because this suggests equivalence of all years spent in the school system. In the West German system, depending on the track, each year of schooling requires a different effort to accomplish. E.g., one further year of *Gymnasium* is harder to accomplish than one further year of *Hauptschule*. So, we define four outcome categories for the dependent variable: *0 = no secondary degree, 1 = lower secondary education (Hauptschulabschluss), 2 = secondary education (Realschulabschluss) , 3 = higher secondary education (Abitur).*

In formerly socialist East Germany, all children attended the comprehensive *polytechnical schools*. After ten years of *polytechnical school,* only few students (around twelve percent of an age-group) were selected to complete two more years of *expanded upper school* to get a higher secondary education degree (e.g. Philips 1995). In analogy to the western subsample, we define three categories of secondary education, leaving out the category of lower secondary education: *0 = no secondary degree, 2 = secondary education (polytechnical school), 3 = higher secondary education (Abitur).*

Table 2 shows the distribution of our main explanatory variable *birth order.* As for the relationship between birth order and educational attainment, Graph 1a and Graph 1b show that, on a descriptive basis, it is clearly negative in both subsamples. For example, in West Germany, in the group of the first born, more than 30 percent have a higher secondary education degree whereas in the group of the fifth born or later, the share is only eleven percent. The challenge now is to find out to what extent these patterns can be interpreted as causal.

To find this effect, one has to account for the strong collinearity of birth order with two other determinants of child quality: sibship size and age of parents. Let us first deal with *sibship size*. The distribution of the variable is given Table 2. As for the relationship between birth order and sibship size, children with lower birth ranks are more likely to have fewer siblings than children with higher birth ranks. In the, sample the correlation coefficient of birth order and sibship size is about 0.61. First born children have on average almost one sibling less than children with birth order two or higher. At the same time, there is a well established negative relationship between sibship size and schooling outcomes (e.g. Heineck and Riphahn 2009). The most common explanation is the so called resource dilution model (Becker and Lewis 1973, Steelman and Powell 1989): sibship size reduces resources per capita in a family and therefore negatively affects schooling outcomes. Because of the positive correlation between birth order and sibship size, not including the number of siblings in the regression analysis would lead to an overestimation of the birth order effect in absolute values. Still, we must be careful as the number of children is a choice variable of the parents. Parents of large families may differ from parents of small families in observable and unobservable ways. If the unobservable factors also affect average child quality, the estimate of the birth order effect will be biased. In particular, the effect of higher birth orders that only appear in large families may be distorted.

The second covariate to be included in the regression model is *age of parents at birth*. On the one hand, children with low birth orders are more likely to have younger parents than children born later in the sibling row. For the overall sample, the average age of mother at birth is around 27. For children with birth order one, it is only around 24. On the other hand, the age of the parents has itself a positive effect on schooling outcomes (Kalmijm and Kraykaamp 2004). It can be seen as a proxy for the level of parental resources (Kantarevic and Mechoulan 2006). It reflects parents' financial situation and their social capital. For example older parents are supposed be financially better off (Mare and Tzeng 1989), calmer, and more experienced in handling children (Fergusson and Woodward 1999). Sociologists also invoke the evolvement of the parental role model: older parents are more oriented towards occupational achievement and communicate this attitude to their children (Kalmijm and Kraykaamp 2004). Given the positive impact of parental age on child quality, omitting the factor would bias a negative birth order effect towards zero.

3.3. Estimation strategy

To isolate the causal effect of birth order, one has to account for underlying family level heterogeneity. In a pooled regression across families, this can be done by including socio-economic proxy variables such as parents' financial and educational background. If information on all siblings of a family is available, a better strategy is to estimate a family fixed effects model and to compare children within rather than across families. We apply both strategies.

We estimate four types of models: a pooled ordered logit model (*Ologit*), a family fixed effects ordered logit model (*FE Ologit*), a family random effects linear probability model (*RE Linear*), and a family fixed effects linear probability model (*FE Linear*).

Given the ordered nature of our outcome variable, an ordered logit model is an obvious starting point. The dependent variable is *level of secondary education (educ)* with four categories for West and three categories for East Germany. For the log odds between having at most schooling degree *j* and having a lower schooling degree than *j,* we assume the following relationship:

$$\ln\left[\frac{\Pr(educ \leq j)}{1-\Pr(educ \leq j)}\right] = \mu_j - \sum_{b=2}^{5} \beta_b\ bo_b - \sum_{s=3}^{5} \gamma_s\ sib_s - \alpha_1 agem - \alpha_2 agef - \alpha_3 male - \sum_k \delta_k{}'\ z$$

μ_j is the threshold parameter for outcome *j*. Our set of explanatory variables consists of birth order (*bo*), sibship size (*sib*), age of mother at birth (*agem*), age of father at birth (*agef*), and gender (*male*). We furthermore include socio-economic proxy variables to capture family level hetorogeneity: the vector *z* comprises parents' secondary and tertiary education, the employment status of the mother during childhood, and a variable indicating the average educational degree of the child's birth cohort, estimated separately for boys and girls, in order to capture the effect of educational expansion.

To model birth order, we choose a flexible form and created four dummy variables (b =2, 3, 4, 5), leaving the first born as the excluded category. Birth ranks of five and higher were grouped together because of the small number of observations in these categories. We similarly proceeded with sibship size, and generated three indicator variables (*s = 3, 4, 5)* for the number of children in a family, grouping together sibship sizes of five and higher and leaving children from families with only two children as the excluded category. Age of mother and father are measured in years. The other covariates are all included as dummy variables.

If the family background variables do not sufficiently capture family level heterogeneity, the birth order coefficients of the ordered logit model may be biased. Therefore, in a second step, we specify a family fixed effects ordered logit model on the basis of Ferrer-i-Carbonell and Frijters' (2004) extension of Chamberlain's conditional logit model (1980). The idea of Chamberlain's model is that the family mean of the dependent variable constitutes a sufficient statistic for the family fixed effect. By conditioning the likelihood function on the family mean, unobserved family level heterogeneity cancels out. Chamberlain's conditional logit is originally a model for binary outcomes. Ferrer-i Carbonell and Frijters' (2004) showed how to apply it to an ordered dependent variable. We have to dichotomize the dependent variable using family specific threshold values. Ferrer-i-Carbonell and Frijters suggested a simple and reliable approximation method for those values (Brenner 2007, Jones and Schurer 2007): we can use the within family mean of the dependent variable. For siblings who have the same or a better schooling outcome than the family average, the dichotomized dependent variable takes the value one; for siblings that are worse, it takes the value zero. Then, Chamberlain's conditional logit model is applied to the modified data.

The use of Chamberlain's model brings along some disadvantages. First, the form of the likelihood function implies that we can only identify the effects of variables that vary over siblings. We can only keep birth order, age of mother,[8] male, and the control variable for educational expansion.[9] Second, we can only use families with variation in the dichotomized dependent variable between siblings. This restriction does not only lead to a smaller sample; it also means that our results entirely rely on information from families whose children, on a descriptive basis, have heterogeneous schooling outcomes. The third drawback is that it is not possible to estimate marginal effects for Chamberlain's model without additional assumptions. This is because the model does not yield the actual size of the family fixed effects (e.g. Brenner 2007). A common, but highly implausible, additional assumption would be that the fixed effects are zero.

Because of the problems that may arise with both logistic models, we additionally calculate two linear probability models. The dependent variable here is having *higher secondary education* or not. First, we estimate a family random effects model with the same explanatory variables as in the pooled ordered logit model. This specification models the unobserved family level heterogeneity by a family specific error term which is assumed to be uncorrelated with the regressors. As a second model, we estimate a family fixed effects model. Using only the within transformation of the data, all effects that are constant within a family, observed or unobserved, drop out.

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[8] As *age of mother* and *age of father* vary simultaneously across siblings, it is not possible to identify both effects at the same time. α_1 can therefore be interpreted as the effect of having older or younger parents relative to the other siblings; α_2 is not identified.
[9] This is the reason, why we did not use a simple time trend to capture educational expansion: this factor, too, varies simultaneously with *age of mother*.

To account for dependencies between the error terms of siblings from the same family, as well as to address the well known heteroscedasticity problem in the linear probability model, we use robust standard errors clustered by family unit for all models.

4. Results

4.1. West Germany

4.1.1. Baseline model

The results of the ordered logit specification for West Germany are shown in the first column of Table 3a. The results for the socio-economic parental background variables are as expected and are not presented for brevity. If we have a look at the coefficients of the birth order dummies, not being the first born child clearly has a negative impact on educational attainment. The disadvantage grows with rising birth order. To gauge the magnitude of the disadvantage of the later born, we consider the marginal effects (Table 3b, first panel).

For West Germany, not being the first child significantly increases the probability of having no educational degree or only lower secondary education and lowers the probability of having secondary education or higher secondary education. For example the probability of having higher secondary education is seven percentage points lower for second born children in comparison to first born children. For fifth born or later children, the difference amounts to 17 percentage points.

Given these strong negative effects for higher birth orders, the question arises whether our results may be biased by unobserved family heterogeneity. Hence we estimate a fixed effects ordered logit model. Around one third of the observations is lost because there is no variation in the dependent variable *(n = 6,011)*. The estimation results are given in column two of Table 3a. The birth order coefficients of the fixed effects ordered logit model are generally lower than those of the ordered logit model. The hypothesis that the coefficients of the two models are identical is rejected *(p = .008)*.[10] But what about the marginal effects? Under the assumption that the fixed effects are zero, the marginal effects are highly similar for the two models.[11] The results are presented in Table 3b (second panel). However, if we use the family average schooling outcome as a proxy for the family fixed effects, the marginal effects are considerably lower (third panel).[12] Ignoring family level heterogeneity leads to a bias of the birth order effects.

We furthermore estimated two linear models using the probability of having *higher secondary education* as dependent variable. The coefficients of these models should largely equal the marginal effects on higher secondary education in the nonlinear models. The results for the family random effects model are given in column three and those for the family fixed effects model in column four of Table 3a. The birth order coefficients estimated with random effects are highly similar to the marginal effects predicted by the ordered logit model. Those estimated with fixed effects are considerably lower and resemble the marginal effects predicted by the fixed effects ordered logit. The null hypothesis that the estimates of the random effects model are consistent is again clearly rejected in a Hausman test *(p = 0.0041)*.[13]

The necessity of using a family fixed effects model has become apparent in both the logistic and the linear framework. We will opt for the linear family fixed effects model as baseline for further analysis. Though information in the dependent variable is lost, there are

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[10] The Hausman test produced a negative test statistic. We therefore used the *suest* command in STATA to test the hypothesis that the coefficients from both models are the same.

[11] The marginal effects were estimated as follows: we used the coefficients of the fixed effects ordered logit model to create linear predictions $x\hat{b}$. In a second step, these predictions are used as an "offset variable" in an ordered logit model with the original formulation of the dependent variable *level of secondary education* and without any further explanatory variables. The aforesaid "offset option" constrains the coefficient of $x\hat{b}$ to be equal to one. We are interested in the threshold parameters of this estimation. Because of the "offset option" they are just the same as those we would get from estimating an ordered logit model with the same explanatory variables as in the fixed effects ordered logit model and constraining the coefficients of the ordered logit model to equal those of the fixed effects ordered logit model. We then used the estimated thresholds of this ordered logit model together with the coefficients of the conditional logit model to calculate the marginal effects in the framework of a simple ordered logit model.

[12] In this case, the auxiliary ordered logit regression for estimating the threshold parameters additionally comprises the family specific mean of the dependent variable as a regressor.

[13] Because of the obvious heteroskedasticity problem in the linear probability model, we used the Wooldridge (2002) robust version of the Hausman test.

two reasons to do so. First, when estimating the marginal effects for the fixed effects ordered logit model, we can only use a proxy for the family fixed effects, and second, there is a sample selection problem, which has not been discussed yet. The sample used by the fixed effects ordered logit estimator only contains families where siblings have different schooling outcome, i.e. families where, on a pure descriptive basis, there is some type of birth order effect. Calculations based on this restricted sample might overestimate the birth order effect in the population. The problem becomes evident when we rerun the linear fixed effects model with only the families employed in the logistic fixed effects model. The results are provided in column five of Table 3a. The coefficients are much higher than those for the whole sample in column four. Thus, we focus on the linear fixed effects model as our baseline model.

According to this baseline model, being second born instead of first born reduces the probability of having higher secondary education by five percentage points. Being fifth born reduces this probability by twelve percentage points in comparison to the oldest sibling. Is this influence of economic importance? We compare the effects to those of father's education from the family random effects model (not presented). The impact of having birth order five or higher instead of being the first child is half the size of the impact of having a father with no educational degree versus a father with higher secondary education. This is a substantial effect.

4.1.2. Heterogeneities and trend

As our dataset contains a wide range of cohorts, we are also able to look for time trends in the birth order effects. We created a trend variable based on the average year of birth of all siblings of a family and then interacted the birth order dummies in the linear fixed effects specification with this trend variable.[14] We use this family level trend variable instead of a simple time trend to separate time effects from those of parental age in the fixed effects specification.[15]

The results are presented in Table 3c. The interaction terms between the birth order dummies and the trend variables are almost all zero and not even jointly significant. The birth order effects in West Germany seem to be constant over time.

A striking result comes up when we test for differences between boys and girls. We do this by completely interacting the linear fixed effects model with the dummy variable for *male* (Table 3d). The coefficients of the interaction terms between *birth order* and *male* are all negative and jointly significant at the five percent level *($p = 0.03$)*.[16] The coefficients suggest that the disadvantage of coming later in the sibling row is almost twice as strong for boys. [17]

The stronger disadvantage for later born boys is difficult to explain, as we do not know the true mechanism driving the birth order effects. In the following, we discuss some possible lines of reasoning.

Bjerkedal et al. (2007) recently showed in a within and between family study of almost 250,000 Norwegian males that first born boys have higher intelligence test scores than their younger brothers at the same age. Among psychologists the findings are seen as evidence for Zajonc's (1976) confluence model, so we can attribute part of the strong birth order effects for boys to this theory. A study of Paulhus and Schaffer (1981), however, suggests

[14] We initially estimated a completely interacted model. The coefficients of the interaction terms between the trend variable and the regressors other than birth order were not even jointly significant. So, for the sake of efficiency, we only included the interaction terms with the birth order dummies.

[15] To check the robustness of the results in the trend models, we created two further trend variables; one based on the year of birth of the oldest child and one based on mother's age. The results are similar.

[16] Earlier studies find no significant gender differences or stronger effects for girls. The reason for this might be that they did not use a family fixed effects regression when testing for heterogeneous birth order effects. In a cross family regression there might be other gender specific effects interfering.

[17] We also examined possible effects of a sex-specific birth order, i.e., we checked whether being born the first male or first female child has a separate impact on schooling. Such an influence is best explained by a diminishing utility in parenting from the first to the second child, which is less pronounced if the second child is of different sex. Yet, we find no significant effect of the sex-specific birth rank.

that, in contradiction to our results, the advantage of teaching younger siblings is more pronounced for first born girls than for first born boys.

Human capital theory explains the birth order effects by a decline in parental resources with rising birth order. Here, stronger disadvantages for later born boys may be the result of gender-specific differential parental treatment of later born children. Later born boys might get fewer resources with respect to the first born child than later born girls. However, for example Price (2008) showed that this is not the case: the decline in parent-child quality time with birth order cumulated over childhood is rather higher for girls than for boys. If boys are not more seriously neglected, then the only explanation for the stronger birth order effects is that their educational attainment is more sensitive to parental input. They must suffer more from the lack of parental resources than girls.

Support for this hypothesis comes from the missing parent literature where boys suffer more from the absence of one parent than girls.[18] This corresponds to our results: later born boys might be, compared to their older siblings, confronted with a lack of parental resources in their critical developing years.

4.2. East Germany

4.2.1. Baseline model

Next, we reran the above analysis with the East German sample. The coefficients for the four models are given in Table 4a. The marginal effects for the logistic models are shown in Table 4b. In all models not being first born reduces the probability of higher secondary education. The fixed effects ordered logit model only used one third of the observations *(n = 776)*. Its coefficients and the marginal effects are now higher than those of the simple ordered

[18] See for example Krein and Beller (1988). They find that the consequences of living in a single-parent household crucially depend on the length of time a child lived with only one parent. These findings are consistent with the economic parental resources approach. Furthermore, the time effects are stronger and only significant for boys.

logit model. The sample selection problem of the fixed effects ordered logit model again becomes obvious, when we compare the results for the linear fixed effects model for the whole sample (Table 4a, column 4) with those for the sample used by the fixed effects ordered logit model (Table 4a, column 5). The coefficients for the reduced sample are almost three times higher than those for all observations. If we compare the linear probability models, the linear fixed effects model (Table 4a, column 4) reports slightly lower effects than the random effects model (Table 4a, column 3); however, the Hausman test fails to reject the null hypothesis that the random effects estimates are consistent. According to the fixed effect model, the difference in the probability of having higher secondary education is around three percentage points for second born children and around ten percentage points for fourth born children or later in relation to the oldest child. Though one should be careful with direct comparisons, the birth order effects seem to be of similar magnitude in West and East Germany (cf. Table 3a, column 4).

4.2.2. Heterogeneities and trend

We repeat the analysis described in 4.1.2. for the East German sample. Interacting the linear fixed effects model with a dummy variable for *male*, we find again systematically stronger effects for boys, but the interaction terms between the birth order dummies and male are not jointly significant $(p = 0.12)$. This is probably because of the much smaller sample size of $n = 2,398$ in comparison to the West German sample $(n = 9,474)$ (Table 4d).

As for the trend analysis, we find intensifying birth order effects over time (Table 4c). In contrast to the West German sample, the coefficients of the interaction terms between the *trend* variable and the *birth order* dummies are all negative and jointly significant at the one percent level. Thus, the disadvantage for later born children relative to the oldest child of the family increased over time.

For the interpretation of this result, it is of interest that between 1950 and 1980, i.e. for the cohorts in our analysis, the GDR established an extensive free child care system shaped and financed by the state (e.g. Weigl and Weber 1991). For example, in 1950, ten percent of the children below age three had a place in a nursery and 30 percent of the children between three and six years went to kindergarten. In 1975, these figures already went up to 50 and 85 percent respectively (Graph 2a).[19] Educational responsibility was shifted from the parents to social institutions. Our results suggest that during this period, inequalities among siblings did not decrease but were rather reinforced. At first sight, this is somewhat surprising. In the childcare institutions, the treatment of children should have been totally independent of their birth rank. This reasoning, however, assumes that parental resources and those provided by the state's child care institution are substitutes. If we instead consider parental resources a special input, irreplaceable by social and educational institutions, the increased birth order effects can be explained: sibling rivalry for parental resources was intensified, as less time with parents was available.

To corroborate the role of the rising childcare ratios in the intensification of the birth order effects, we substituted the trend variable by a variable (*ratio*) that indicates the average probability of the children in a family of being given to a nursery.[20] We use family means because rivalry for parental resources in a family depends on each sibling's probability of being given to a nursery. The results of this regression are shown in Table 5. Sign and significance of the interaction terms' coefficients are almost identical to those of the trend specification in Table 4d. This strong resemblance, of course, is caused by the strong collinearity between our initial trend variable, average year of birth of the siblings, and the new variable based on av-

[19] The corresponding figures for West Germany are shown in Graph 2b.
[20] More precisely, the variable was generated as follows: For every child in a family, we calculated the probability of being given to a nursery by averaging the childcare ratio of its year of birth and the ratios of the following two years. Then, we calculated the family means of these averaged ratios.

erage childcare ratios (corr = 0.98). Nevertheless the results suggest that the rise in the childcare ratios might provide a good explanation for the intensification of the birth order effects.

When explaining the birth order effects in East Germany, one should also recall that the opportunity of completing higher secondary education was not only determined by school grades but also by students' attitude towards the political regime. In this context, the psychological approach which assigns different sibling characters according to birth order (Sulloway 1996) provides a plausible explanation for the birth order effects. In particular the fact that first born children are supposed to be more adaptive and respectful of authority (e.g. Sulloway 2001) could explain the advantages for first born children in the socialist system.

5. Robustness checks

5.1. Further sibling configuration components

Besides birth order, there are other components of sibling configuration that determine a child's relative position in a family and therefore might affect educational attainment.[21] To check the robustness of our results we add age-spacing, also known as sibship density, and sex composition of the siblings to our model.

There are various theories to explain a possible positive or negative effect of *child-spacing*.[22] According to the resource dilution model, for example, being closely spaced with the other siblings should constitute a disadvantage for a child: the workload, stress and financial burden of parenting are intensified. The amount of resources available for the children is smaller than in widely spaced sibships. To describe the spacing, we create two variables: at family level, we calculate the distance between the first child and the last child. At the indi-

[21] See Steelman et al. (2002) for an overview.
[22] See Steelman and Powell (1993) for an overview.

vidual level, we generate a variable indicating for each child the average time lag to its next older and next younger sibling.[23]

The most general description of *sibling sex composition* is the percentage of boys and girls in a family. There are various theories that predict opposing effects.[24] We shortly outline two, which both predict a negative effect of having brothers. The first theory follows Becker and Tomes' (1976) approach and assumes that parents invest a greater share of resources in the children with the highest returns. Because of the prevailing gender wage gap in favor of men, parents might tend to invest more heavily in the male children so that boys get a greater share of resources than girls. That is, having a sister instead of a brother is an advantage, as more resources remain for oneself. Another theory is based on gender-specific traits a child takes on, depending on sibling sex composition (Butcher and Case 1994). If, e.g., feminine traits are favorable in the school system, children who grow up with female siblings will have an advantage over children with no female siblings as they will be able to acquire more feminine traits. To test the influence of sex composition, we generate for each child a variable that indicates the percentage of brothers among its siblings.

We include the new variables in all four initial models[25] for both East and West Germany (results not presented). Just like in earlier studies (e.g Bauer and Gang 2001), the additional sibling configuration variables are not statistically significant and their inclusion does not change the other coefficients. We also tested whether there are interaction effects between birth order and the other components of sibling configuration, as they jointly determine the relative position of a child, but got no significant results. Sibling configuration aspects other

[23] If it is the oldest child, we use the distance to its next youngest sibling, if it is the youngest child we use the distance to its next older sibling.
[24] See Bauer and Gang (2001) for an overview.
[25] The variable for spacing at the family level could only be included in the ordered logit and the random effects model as it does not vary over siblings.

than birth order apparently play no role in explaining educational success in the German school systems.

5.2. Sample restriction

A common objection to the empirical findings on birth order effects is that the observed patterns are caused by family problems (e.g. divorce or death of a parent), later born children are more likely to experience during their developing years than their older siblings. To rule out this objection for our study, we repeat parts of our analysis with the subsample of families for which we can definitely tell that the biological parents of the respondent never split up. This sample contains only 5,010 siblings of 1,761 West German families with at least two children. The results for the baseline linear fixed effects model are shown in the first column of Table 6. Although the sample size is now halved, the coefficients of the birth order dummies are still significant and negative, and almost identical to those for the entire West German sample (cf. Table 3a, column 4). We then, once again, extend the specification and allow for gender differences in the birth order effects (Table 6, column 2). The interaction terms between the birth order indicators and an indicator variable for male are not significant anymore, but nevertheless quite similar to those we obtained using all West German families in our sample (Table 3d). The birth order dummies and the birth order interaction terms with gender are jointly significant at the 5 percent level.

6. Conclusion

This study investigates the impact of sibling birth order on secondary education in East and West Germany for birth cohorts educated before unification. Information on West German siblings born between 1945 and 1978 and East German siblings born between 1945 and 1972 is provided by the German Life History Study. We initially estimated four models: an ordered logit model, a fixed effects ordered logit model, a linear family random effects model, and a linear family fixed effects model. As, both, the results for the ordered logit model and the linear family random effects model were clearly biased by unobserved family heterogeneity and the use of the fixed effects ordered logit estimator leads to a sample selection problem, we focused on the linear fixed effects model as our baseline.

We find highly significant negative effects of not being first born on the probability of completing higher secondary education. When comparing East and West Germany the effects are, overall, of similar magnitude. Despite of the differences in the political and educational systems, later born children in East and West seem to face very similar disadvantages in relation to their older siblings. Even when we look for gender differences, we find resembling patterns: the effects are systematically stronger for boys. A plausible explanation for these differences is that the educational attainment of boys is more dependent on parental resources than that of girls. This is corroborated by results from the missing parent literature where the lack of parental resources is more harmful for the development of boys than girls.

Special attention should be given to the fact that in East Germany, the birth order effects increased over time, while in West Germany, they remained stable. Between 1950 and 1980, in East Germany, responsibility for the education of preschool children was largely shifted from parents to state run child care institutions. This expansion of childcare service did, however, not attenuate the disadvantage of the later born, but is correlated with an intensification of the birth order effects. An explanation might be that, as time within families became scarce, sibling rivalry for parental resources increased. The result also suggests that sibling inequalities can hardly be mitigated by state intervention. It seems to remain a problem of the intra family allocation and socialization process and is subject to parental responsibility.

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Table 1: Summary Statistics

Variables	West Mean	West Stand. Dev.	East Mean	East Stand. Dev.
Secondary education				
No secondary education (0/1)	0.02	0.15	0.02	0.15
Lower secondary education (0/1)	0.39	0.48	-	-
Secondary education (0/1)	0.30	0.45	0.83	0.36
Higher secondary education (0/1)	0.27	0.44	0.13	0.34
Birth order	2.31	1.4	2.56	1.75
Sibship size	3.68	1.72	4.14	2.30
Male (0/1)	0.52	0.49	0.47	0.49
Age of mother at birth	27.63	5.36	26.28	5.17
Age of father at birth	30.69	6.18	28.70	6.09
Year of birth	1962.65	6.64	1958.11	6.03
Working mother during childhood (0/1)	0.48	0.46	0.87	0.31
Father's education				
No secondary education (0/1)	0.05	0.23	0.08	0.26
Lower secondary education (0/1)	0.70	0.45	-	-
Secondary education (0/1)	0.11	0.31	0.84	0.36
Higher secondary education (0/1)	0.12	0.12	0.08	0.27
Mother's education				
No secondary education (0/1)	0.08	0.26	0.10	0.30
Lower secondary education (0/1)	0.73	0.44	-	-
Secondary education (0/1)	0.14	0.35	0.87	0.34
Higher secondary education (0/1)	0.04	0.21	0.03	0.16
Father's professional education				
No professional education (0/1)	0.06	0.23	0.07	0.25
Apprenticeship (0/1)	0.73	0.44	0.78	0.41
Master craftsman (0/1)	0.11	0.32	0.08	0.27
University (0/1)	0.09	0.28	0.07	0.25
Mother‘s professional education				
No professional education (0/1)	0.19	0.39	0.34	0.47
Apprenticeship (0/1)	0.76	0.42	0.62	0.48
Master craftsman (0/1)	0.01	0.11	0.02	0.13
University (0/1)	0.02	0.14	0.02	0.12
Number of observations:	9,474		2,398	

Source: German Life History Study, own calculations.

Table 2: Distributions of Birth Order and Sibship Size

	West		East	
Birth Order	*Frequency*	*Percent*	*Frequency*	*Percent*
1	3,202	32.85	728	30.36
2	3,187	32.70	735	30.65
3	1,807	18.54	431	17.97
4	830	8.52	228	9.51
5	389	3.99	125	5.21
6	178	1.83	59	2.46
7	81	0.83	39	1.63
8	40	0.41	18	0.75
9	19	0.19	11	0.46
10	7	0.07	10	0.42
11	4	0.04	9	0.38
12	2	0.02	4	0.17
13	1	0.01	1	0.04
Total	9,474	1	2,398	1

Sibship Size	*Frequency*	*Percent*	*Frequency*	*Percent*
2	2,647	27.16	607	25.31
3	2,942	30.18	597	24.90
4	1,789	18.3	424	17.68
5	1,074	11.02	323	13.47
6	562	5.77	107	4.46
7	358	3.67	137	5.71
8	166	3.67	84	3.50
9	128	1.31	9	0.38
10	38	0.39	10	0.42
11	21	0.22	53	2.21
12	9	0.09	34	1.42
13	13	0.13	13	0.54
Total	9,474	1	2,398	1

Source: German Life History Study, own calculations

Note: The differences in the figures for birth order one and birth order two are caused by incomplete families.

Table 3: Estimation Results West

Variables Dependent variable	**Ologit** Level of secondary education	**FE Ologit** Level of secondary education	**RE Linear** Higher secondary education	**FE Linear** Higher secondary education	**FE Linear (FE Ologit sample)** Higher secondary education
	1	2	3	4	5
Birth order					
First (ref.)	Ref.	Ref.	Ref.	Ref.	Ref.
Second	-.474***	-.477***	-.069***	-.050***	-.082***
	(.044)	(.071)	(.009)	(.010)	(.016)
Third	-.589***	-.472***	-.081***	-.042***	-.065***
	(.065)	(.111)	(.012)	(.015)	(.022)
Fourth	-.916***	-.836***	-.128***	-.074***	-.111***
	(.092)	(.157)	(.017)	(.021)	(.031)
>Fifth	-1.210***	-.943***	-.199***	-.126***	-.181***
	(.114)	(.202)	(.019)	(.026)	(.037)
Sibship size					
Two siblings (ref.)	Ref.		Ref.		
Three siblings	-.106	-	-.021	-	-
	(.065)		(.013)		
Four siblings	-.223***	-	-.024	-	-
	(.082)		(.016)		
>Five siblings	-.512***	-	-.0563***	-	-
	(.089)		(.016)		
Age of parents at birth					
Mother	.027***	.040***	.005***	.002	.003
	(.008)	(.014)	(.001)	(.002)	(.002)
Father	.029***	-	.003***	-	-
	(.007)		(.001)		
Sex					
Female (ref.)	Ref.	Ref.	Ref.	Ref.	Ref.
Male	-.044	-.085	.041	.042***	.066***
	(.041)	(.057)	(.007)	(.008)	(.012)
Number of observations:	9,474	6,011	9,474	9,474	6,011

Source: German Life History Study, own calculations.

Note: The table presents estimated coefficients and robust standard errors in parentheses. The standard errors are clustered at family level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent level. All models include controls for gender specific educational expansion. The pooled models (*Ologit, RE Linear*) include further controls for the socio-economic family background.

Table 3b: Marginal Effects West

	Pr(educ=0)	Pr(educ=1)	Pr(educ=2)	Pr(educ=3)
Panel 1				
Marginal Effects Ordered Logit				
First Born	Ref.	Ref.	Ref.	Ref.
Second Born	.011***	.083***	-.025***	-.069***
	(.007)	(.002)	(.002)	(.006)
Third Born	.014***	.103***	-.031***	-.086***
	(.011)	(.011)	(.003)	(.009)
Fourth Born	.022***	.160***	-.048***	-.134***
	(.015)	(.015)	(.005)	(.013)
Fifth Born or later	.029***	.212***	-.064***	-.177***
	(.019)	(.019)	(.006)	(.017)
n = 9,474				
Panel 2				
Marginal Effects Fixed Effects Ordered Logit (fixed effects=0)				
First Born	Ref.	Ref.	Ref.	Ref.
Second Born	.017***	.093***	-.026***	-.084***
	(.003)	(.014)	(.004)	(.013)
Third Born	.017***	.092***	-.026***	-.083***
	(.005)	(.026)	(.008)	(.023)
Fourth Born	.031***	.163***	-.046***	-.147***
	(.008)	(.035)	(.011)	(.032)
Fifth Born or later	.035***	.183***	-.052***	-.166***
	(.011)	(.049)	(.015)	(.045)
n = 6,011				
Panel 3				
Marginal Effects Fixed Effects Ordered Logit (fixed effects proxied by family means)				
First Born	Ref.	Ref.	Ref.	Ref.
Second Born	.016***	.061***	-0.016	-.060***
	(.002)	(.009)	(.003)	(.010)
Third Born	.015***	.060***	-.016***	-.060***
	(.004)	(.017)	(.005)	(.017)
Fourth Born	0.028***	.107***	-.029***	-.106***
	(.006)	(.023)	(.006)	(.023)
Fifth Born or later	0.031***	.121***	-.032***	-.120***
	(.009)	(.032)	(.009)	(.033)
n = 6,011				

Note: The table presents estimated marginal effects on the probability of the defined schooling outcomes. Standard errors are given in parentheses. The standard errors for the marginal effects of the fixed effects ordered logit model were received by bootstrap. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent level.

Table 3c: Trend West

Variables Dependent Variable	**FE Linear** Higher secondary education
Birth order	
First (ref.)	Ref.
Second	-.035
	(.025)
Third	-.019
	(.034)
Fourth	-.062
	(.047)
>Fifth	-.089*
	(.052)
Age of parents at birth	
Mother	.002
	(.002)
Sex	
Female (ref.)	Ref.
Male	.043***
	(.008)
Interaction terms trend	
Second*trend	-.000
	(.001)
Third*trend	-.000
	(.002)
Fourth*trend	.000
	(.003)
Fifth*trend	-.002
	(.003)
Number of observations:	9,474

Note: The table presents estimated coefficients and robust standard errors in parentheses. The standard errors are clustered at family level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent level. The model includes control for gender specific educational expansion.

Table 3d: Gender Differences West

Variables Dependent Variable	FE Linear Higher secondary education
Birth order	
First (ref.)	Ref.
Second	-.032**
	(.015)
Third	-.032
	(.020)
Fourth	-.027
	(.027)
>Fifth	-.086***
	(.032)
Age of parents at birth	
Mother	.000
	(.002)
Sex	
Female (ref.)	Ref.
Male	-.020
	(.046)
Interaction terms male	
Second*male	-.032
	(.021)
Third*male	-.017
	(.025)
Fourth*male	-.088***
	(.032)
Fifth*male	-.073**
	(.031)
Age of mother*male	.003*
	(.001)
Number of observations:	9,474

Note: See Table 3c.

Table 4a: Estimation Results East

Variables Dependent variable	Ologit Level of secondary education	FE Ologit Level of secondary education	RE Linear Higher secondary education	FE Linear Higher secondary education	FE Linear (FE Ologit sample) Higher secondary education
	1	2	3	4	5
Birth order					
First (ref.)	Ref.	Ref.	Ref.	Ref.	Ref.
Second	-.359***	-.508**	-.043**	-.035*	-.108*
	(.153)	(.219)	(.017)	(.019)	(.061)
Third	-.922***	-.968***	-.095***	-.073***	-.196**
	(.217)	(.341)	(.021)	(.027)	(.076)
Fourth	-1.103***	-1.174**	-.136***	-.108***	-.279***
	(.265)	(.512)	(.025)	(.035)	(.103)
>Fifth	-1.128***	-1.060*	-.127***	-.086**	-.228*
	(.369)	(.641)	(.031)	(.043)	(.123)
Sibship size					
Two siblings (ref.)	Ref.		Ref.		
Three siblings	.132	-	.016	-	-
	(.189)		(.026)		
Four siblings	-.110	-	-.004	-	-
	(.223)		(.029)		
>Five siblings	-.064	-	.007	-	-
	(.262)		(.029)		
Age of parents at birth					
Mother	.351	.037	.003	.001	.003
	(.023)	(.040)	(.003)	(.043)	(.008)
Father	.020	-	.002	-	-
	(.019)		(.003)		
Sex					
Female (ref.)	Ref.	Ref.	Ref.	Ref.	Ref.
Male	-.072	-.340	.005	-.000	-.011
	(.121)	(.167)	(.012)	(.014)	(.039)
Number of observations:	2,398	776	2,398	2,398	776

Source: German Life History Study, own calculations.

Note: See Table 3a.

Table 4b: Marginal Effects East

	P(educ=0)	P(educ=1)	P(educ=2)	Pr(educ=3)
Panel 1				
Marginal Effects Ordered Logit				
First Born	Ref.	-	Ref.	Ref.
Second Born	.008**	-	.028**	-.036**
	(.003)	-	(.012)	(.015)
Third Born	.020***	-	.072***	-.093***
	(.005)	-	(.017)	(.027)
Fourth Born	.024***	-	.087***	-.112***
	(.006)	-	(.022)	(.027)
Fifth Born or later	.025***	-	.089***	-.114***
	(.008)	-	(.030)	(.037)
n = 2,398				
Panel 2				
Marginal Effects Fixed Effects Ordered Logit (fixed effects=0)				
First Born	Ref.	-	Ref.	Ref.
Second Born	.032**	-	.065**	-.098**
	(.016)	-	(.027)	(.041)
Third Born	.062**	-	.125***	-.188***
	(.024)	-	(.044)	(.064)
Fourth Born	.075**	-	.152**	-.227**
	(.030)	-	(.064)	(.091)
Fifth Born or later	.068*	-	.137*	-.205*
	(.040)	-	(.078)	(.115)
n = 776				
Panel 3				
Marginal Effects Fixed Effects Ordered Logit (fixed effects proxied by family means)				
First Born	Ref.	-	Ref.	Ref.
Second Born	.023**	-	.049**	-.072**
	(.011)	-	(.020)	(.030)
Third Born	.044**	-	.094**	-.139***
	(.017)	-	(.033)	(.047)
Fourth Born	.054**	-	.114**	-.168**
	(.022)	-	(.049)	(.067)
Fifth Born or later	0.048	-	.103**	-.152**
	(.029)	-	(.058)	(.085)
n = 776				

Note: See Table 3b.

Table 4c: Trend East

Variables Dependent Variable	**FE Linear** Higher secondary education
Birth order	
First (ref.)	Ref.
Second	-.009
	(.043)
Third	.087*
	(.052)
Fourth	-.047
	(.061)
>Fifth	.012
	(.086)
Age of parents at birth	
Mother	.002
	(.002)
Sex	
Female (ref.)	Ref.
Male	.000
	(.014)
Interaction terms trend	
Second*trend	-.002
	(.003)
Third*trend	-.014***
	(.004)
Fourth*trend	-.005
	(.004)
Fifth*trend	-.009
	(.006)
Number of observations:	2,398

Note: See Table 3c.

Table 4d: Gender Differences East

Variables Dependent Variable	FE Linear Higher secondary education
Birth order	
First (ref.)	Ref.
Second	.010
	(.027)
Third	-.029
	(.036)
Fourth	-.084**
	(.042)
>Fifth	-.065
	(.046)
Age of parents at birth	
Mother	-.000
	(.003)
Sex	
Female (ref.)	Ref.
Male	-.053
	(.082)
Interaction terms male	
Second*male	-.094**
	(.040)
Third*male	-.091
	(.046)
Fourth*male	-.052
	(.045)
Fifth*male	-.043
	(.048)
Age of mother*male	.004*
	(.003)
Number of observations:	2,398

Note: See Table 3c.

Table 5: Intensification of Birth Order Effects in East Germany with rising Childcare Ratios

Variables **Dependent Variable**	**FE Linear** Higher secondary education
Birth order	
First (ref.)	Ref.
Second	-.008
	(.039)
Third	.084*
	(.050)
Fourth	-.046
	(.054)
>Fifth	.013
	(.080)
Age of parents at birth	
Mother	.002
	(.003)
Sex	
Female (ref.)	Ref.
Male	.000
	(.014)
Interaction terms ratio	
Second*ratio	-.002
	(.003)
Third*ratio	-.012***
	(.005)
Fourth*ratio	-.004
	(.003)
Fifth*ratio	-.008*
	(.007)
Number of observations:	2,398

Source: German Life History Study, Statistisches Amt der DDR (1990), own calculations

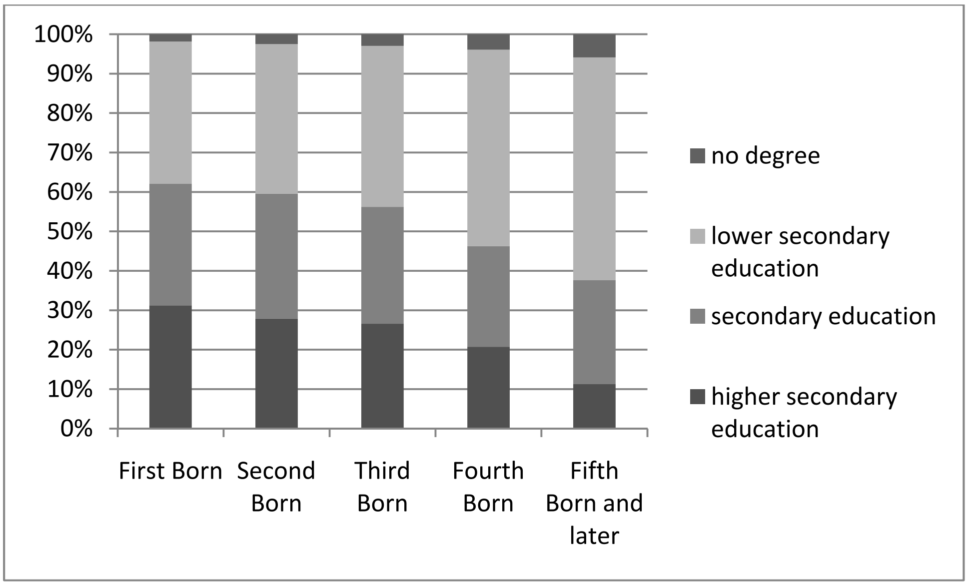
Note: See Table 3c.

Table 6: Robustness Check

Variables	FE linear	FE linear (gender differences)
Dependent Variable	Higher Secondar Education	Higher Secondary Education
Birth order		
First (ref.)	Ref.	Ref.
Second	-.052***	-.027
	(.015)	(.020)
Third	-.041*	-.025
	(.022)	(.029)
Fourth	-.062*	-.057
	(.032)	(.039)
>Fifth	-.128***	-.088*
	(.038)	(.048)
Age of parents at birth		
Mother	.001	.000
	(.002)	(.003)
Sex		
Female (ref.)	Ref.	Ref.
Male	.054***	.011
	(.002)	(.071)
Interaction terms male		
Second*male	-	-.046
		(.030)
Third*male	-	-.029
		(.038)
Fourth*male	-	-.006
		(.048)
Fifth*male	-	-.073
		(.051)
Age of mother*male	-	.002
		(.002)
Number of observations:	5,010	5,010

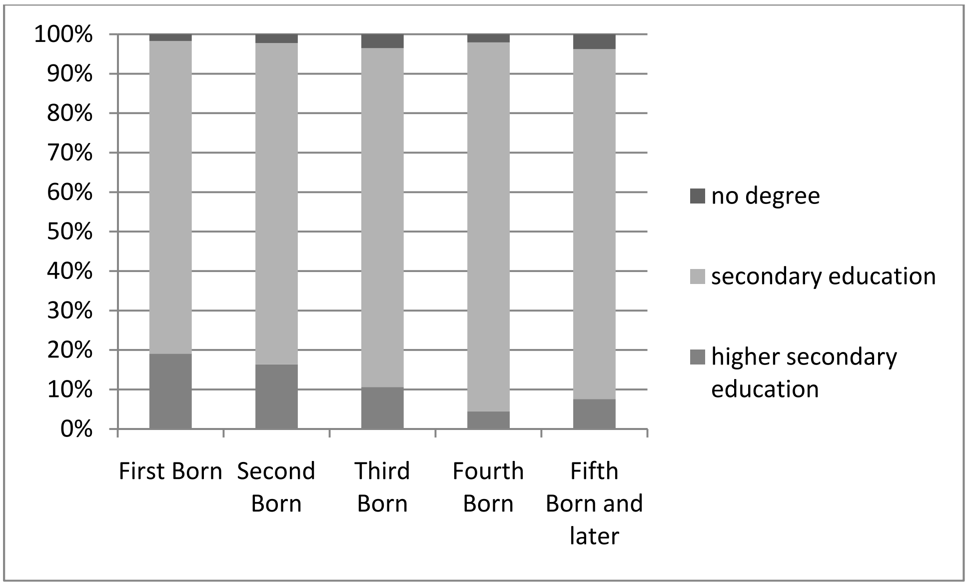
Note: See Table 3c.

Graph 1a: Relationship between Birth Order and Secondary Education (West)



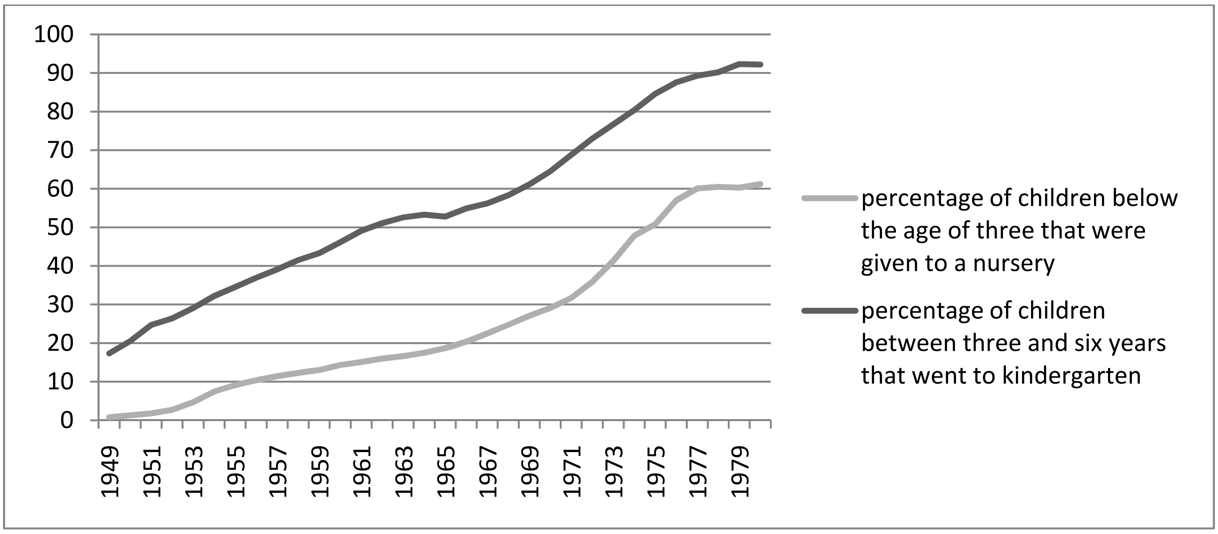
Source: German Life History Study, own calculations.

Graph 1b: Relationship between Birth Order and Secondary Education (East)



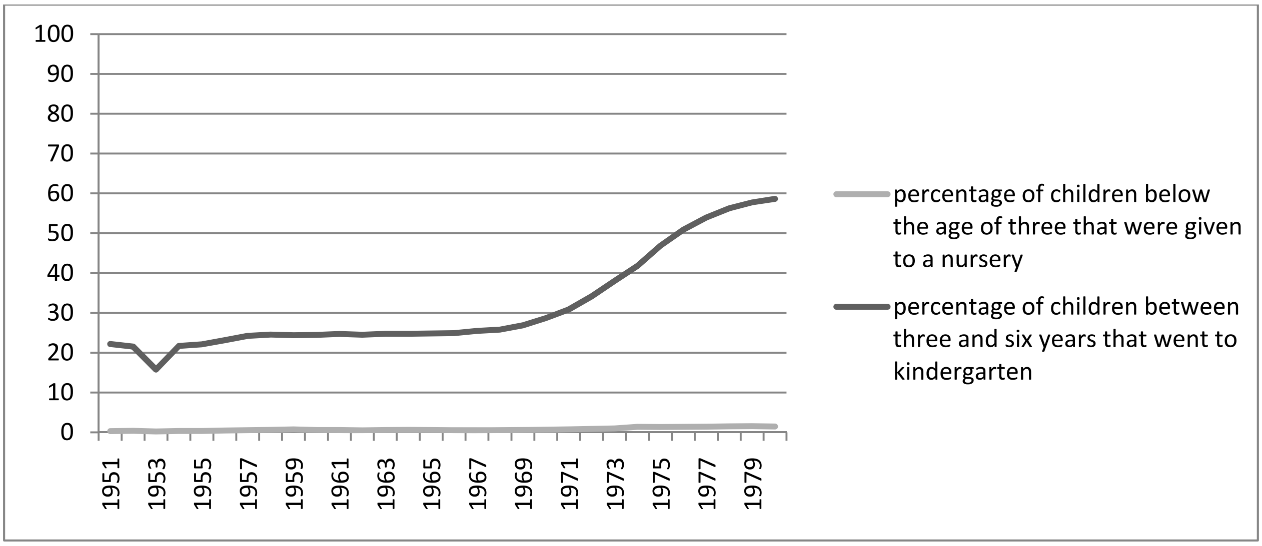
Source: German Life History Study, own calculations.

Graph 2a: Childcare Ratios East Germany



Source: Statistisches Amt der DDR (1990), own calculations.

Graph 2b: Childcare Ratios West Germany



Source: Statistische Bundesamt, own calculations.