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# Siblings, Their Sex Composition and Educational Attainment in Germany\*

By Thomas Bauer\*\* and Ira N. Gang\*\*\*

## Summary

*We address the role of sibling rivalry in schooling attainment in Germany, distinguishing between a sibling size effect and a gender composition effect. Using the German Socio-Economic Panel, we analyse how the effects of sibling rivalry vary by cultural affiliation, i.e., among families of West German, East German and foreign origin. We compare these outcomes with results for the United States.*

## 1. Introduction

A burgeoning literature on developing economies and a few papers using United States data explore the issue of sibling rivalry in the allocation of household resources. The literature on developing economies generally finds that resources are channeled more into boys with consequent outcomes (Strauss and Thomas 1995). The studies on the United States, however, produce conflicting results. Butcher and Case (1994), for example, find that female educational attainment in the United States has been systematically affected by the sex composition of siblings, while male choices have not. Their estimations show that women who grew up with a sister received less education than women raised only with brothers. However, using a different data set, Kaestner (1997) cannot confirm the results of Butcher and Case (1994). He finds that black teenagers between the ages of 15 and 18 and black adults who grew up with a sister receive more education than persons without a sister. Kaestner's (1997) results show for whites and Hispanics that educational attainment is independent of sibling sex composition.

We contribute to this discussion by addressing the role of sibling rivalry in human capital investment in Germany. Using the German Socio-Economic Panel (GSOEP) we are able to distinguish how the effects of sibling rivalry vary by cultural affiliation, i.e., among families of West German, East German and foreign origin. We compare these outcomes with results for the United States. The outline of the paper is as follows. Section 2 briefly reviews some theoretical explanations of sibling rivalry in the allocation of scarce household resources. Section 3 describes the data set and the empirical strategy. In Section 4 we discuss the estimation results. Section 5 concludes.

## 2. Theoretical Framework

Economic explanations of sibling rivalry in the allocation of parental resources for education are based on theoretical models of household behavior developed by

Becker and Tomes (1979, 1986) and Becker (1991).<sup>1</sup> According to these models, parents invest in the education of their children until the rate of return of each child's education is equal to the market rate of interest. If the parents follow this strategy case where the budget constraint is binding and parents cannot finance the unconstrained optimal level of education for each child, household resources are allocated to those with the highest rate of return to human capital investments. The education of children then depends on the size and composition of siblings. Additional siblings lower the available resources per child. If the rate of return to education is higher for men than for women, boys will receive a greater share of the household resources available for investment in education and therefore will have higher levels of educational attainment than females. The theory further predicts that when the return to education is higher for men than for women, a girl with only sisters will receive more education than a girl with brothers and that a boy with only brothers will receive less education than a boy with at least one sister.

Assuming that parents do not have a strong aversion to earnings inequality among their children, the above prediction of the impact of the sibling sex composition holds even in cases where budget constraints are not binding.<sup>2</sup> If, however, parents allocate household resources not only on the basis of the return to educational investments, but also attempt to minimize earnings inequality among their children, the above prediction is reversed. Here, children with a relatively low return to human capital investments will receive relatively more resources than children with a high return to human capital investments. In this case a girl with only sisters will receive fewer resources than a girl with brothers, and boys will receive more education if they grow up in a family with only male children (Becker and Tomes 1979, 1986; Behrman, Poliak, and Taubman 1982).

Another source of sibling sex composition effects on educational attainment may be differences in the costs of raising boys and girls, or different costs with respect to human capital investments. In this situation, educational attainments of male and female children depend on the

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<sup>1</sup> Kaestner (1997) provides a survey. See also Strauss and Thomas (1995) for a survey of related literature in development economics.

<sup>2</sup> Behrman, Rosenzweig and Taubman (1994) present empirical evidence that parents do not have a strong aversion to earnings inequality and invest in children in ways which reinforce differences in innate earnings ability. Kaestner (1997) points out that analogous reasoning holds for differences in social environmental factors that influence earnings (i.e., gender discrimination).

percentage of male or female children in the household. For example, in some cultures the parents pay the marriage costs of their daughters. If the parents have to save for their daughters' marriages, fewer resources are available for educational purposes. On the other hand, if a daughter's higher education increases the probability that she finds a rich husband, parents will allocate more resources to the education of their daughters. A similar argument applies to differences in the costs of human capital investments between boys and girls. For example, if, due to a higher earnings potential in their teen years, the opportunity cost of investing in girls compared with boys is higher, daughters and sons might have different effects on the budget constraint of the household (see Butcher and Case 1994; Strauss and Thomas 1995).

Butcher and Case (1994) offer two additional explanations for sibling sex composition effects. The first explanation focuses on external effects between older and younger siblings. They argue that different sibling sex compositions result in differences in the amount of particular gender specific traits that a child acquires. For example, if girls with an older brother exhibit more masculine traits and if classroom instruction favors these masculine traits, females (males) who grew up with older brothers (sisters) will receive more (less) education than females (males) who grew up only with older sisters (brothers). The second explanation argues that the sex composition of the children alters the preferences of the parents: „Parents with only one daughter may measure her achievements on the same scale used to measure their sons' and may provide her with an equal share of the households' educational resources. [...] When a second daughter enters the household, a daughter's reference group may change. Parents may group the daughters together and apply a different standard for homework, grades, and course loads" (Butcher and Case 1994, p. 536). According to this argument a girl with only brothers will receive more education than girls with at least one sister.

In a sum, the literature provides several explanations for a sibling sex composition effect on educational attainment. The direction of this effect is ambiguous. Moreover, there are competing theories on the effects of sibling sex composition with similar predictions regarding the direction of this effect. These factors make deriving *a priori* testable hypotheses difficult. Following the Butcher and Case (1994) and Kaestner (1997) analyses for the United States, we focus our empirical analysis on Germany and ask: 1) Is there a sibling size effect on educational attainment? 2) Is there a sibling sex composition effect? 3) How large are these effects and how do they vary among different groups present in Germany?

### 3. Sample Description and Empirical Strategy

We use the 1996 wave of the German Socio-Economic Panel (GSOEP), in which respondents were asked detailed

questions about their parents, the number of siblings they have, and the sex of their siblings. The empirical analysis of the next section is restricted to individuals aged 25 to 46 in 1996, who have completed their education (including occupational education), and for whom information on their mother is available.<sup>3</sup> We differentiate among West Germans, East Germans and foreigners living in Germany. These groups correspond to samples A, B, and C of the GSOEP, respectively. Since the international version of the GSOEP does not include information on nationality, we are not able to distinguish the ethnicity of the foreigners.<sup>4</sup>

Following Butcher and Case (1994) and Kaestner (1997), we regress the years of schooling of an individual on variables indicating the number of siblings and sibling sex composition in a family. As in Butcher and Case (1994) and Kaestner (1997), the measures for sibling sex composition consist of dummy variables indicating the presence of any sisters, the presence of any brothers, and the proportion of female children in the family. The regression further controls for possible cohort effects by including the age of the respondent, and household income at the time the respondent was a child (proxied by the educational level of the mother and the father and the occupational status of the father). Since our sample includes observations with missing information on the father, we include a dummy variable that takes the value 1 if information on the father is available. We further control for personal and family background characteristics by including variables indicating the religious affiliation of the mother, and whether the children support their parents by paying them money or by looking after them in their own household. Descriptive statistics for the variables used in the analysis are reported in Table 1.

### 4. Estimation Results

We estimate several ordinary least squares regressions to examine whether sibling size and sibling sex composition affects educational attainment in Germany. Table 2 reports the estimation results for the effect of sibling size on educational attainment and compares our results with those of Butcher and Case (1994) and Kaestner (1997).<sup>5</sup> The specifications chosen by Butcher and Case (1994) and Kaestner (1997) differ, with Butcher and Case (1994) using the number of siblings and the number of siblings squared, and Kaestner (1997) using a series of dummy variables indicating the number of siblings. Consistent with the empirical results for the United States we find an overall significant negative relationship between the number of siblings and educational attainment. The exception is foreign

<sup>3</sup> We assume that missing information on mothers is random.

<sup>4</sup> In 1996, of the 2,170 foreigners in the GSOEP, 36 percent were Turkish, 20 percent Yugoslavian, 12 percent Greek, 17 percent Italian, and 6 percent Spanish.

<sup>5</sup> The full set of estimation results is available upon request.

Table 1

## Descriptive Statistics: 1996 Cross-Section

	Male			Female		
	West German	East German	Foreign	West German	East German	Foreign
Mother Catholic	0.186	0.014	0.188	0.120	0.010	0.189
Mother Protestant	0.182	0.091	0.004	0.122	0.052	0.005
Mother high school degree	0.037	0.149	0.007	0.038	0.122	0.026
Mother secondary schooling degree	0.911	0.775	0.339	0.913	0.813	0.416
Information on father available	0.956	0.969	0.952	0.966	0.976	0.942
Father high school degree	0.116	0.237	0.033	0.110	0.192	0.042
Father secondary schooling degree	0.820	0.667	0.528	0.826	0.703	0.558
Father skilled worker	0.447	0.525	0.151	0.458	0.500	0.168
Father worker: other	0.178	0.132	0.362	0.189	0.144	0.484
Payments to parents	0.077	0.086	0.151	0.030	0.038	0.100
Age	34.536 (5.827) <sup>a)</sup>	35.962 (6.167)	31.288 (4.746)	34.821 (6.097)	35.752 (6.184)	30.216 (5.144)
Number of siblings	2.213 (1.678)	2.070 (1.442)	2.904 (1.970)	2.270 (1.600)	2.143 (1.626)	2.753 (1.599)
Brother present	0.702	0.664	0.775	0.715	0.681	0.768
Sister present	0.681	0.707	0.786	0.708	0.711	0.758
Proportion of sisters (including respondent)	0.307 (0.241)	0.322 (0.236)	0.346 (0.225)	0.680 (0.237)	0.699 (0.239)	0.654 (0.244)
Years of schooling	12.201 (2.699)	12.374 (1.292)	10.520 (2.202)	11.714 (2.407)	12.615 (1.419)	10.176 (2.367)
Observations	1 067	583	271	1 131	630	190
<sup>a)</sup> Standard deviation in parentheses. Source: GSOEP (1996); own calculations.						

males, whose education is not significantly affected by the number of their siblings. Compared with the United States, the negative effect of an additional sibling on the education of females is much higher in Germany. The effect of an additional sibling on the education of males in Germany is lower if compared to Butcher and Case (1994) and similar to the effect found by Kaestner (1997). Referring to the estimated coefficients for the total sample, in Germany an additional sibling is associated with a reduction in education of about half a year for females, whereas Butcher and Case (1994) estimated that an additional sibling reduces the education of females in the United States by roughly a fifth of a year.

More siblings significantly reduce the educational attainment of West German males. The effect is only marginally significant for East German males and insignificant for foreigners. Compared with males, all groups of females are more negatively affected by additional siblings with the

effect being highest for foreign females followed by West Germans and East Germans. The inverse relationship between the number of siblings and educational attainment may be attributed to a reduction in the availability of family resources per child (see Strauss and Thomas 1995). Furthermore, these results are a first indication that the behavior of parents from different cultures differ with respect to intra-household resource allocation in the face of binding budget constraints. With more children foreign households reduce only the share of resources allocated to female children. To the extent that educational policy in the former German Democratic Republic focused relatively more on equality, budget constraints in large families are not as severe as in West Germany.

The empirical evidence on the relationship between sibling sex composition and educational attainment in the United States and Germany is summarized in Table 3. The empirical evidence for the United States is mixed. Butcher

Table 2

## Sibling Size and Educational Attainment in the United States and Germany

	Number of Siblings	(Number of Siblings) <sup>2</sup>	Sibling = 2	Sibling = 3	Sibling = 4	Sibling = 5	Sibling = 6 or more	Observations
United States								
<i>Butcher and Case (1994)</i>								
Male	-0.507** (0.079) <sup>a</sup>	0.027** (0.007)	—	—	—	—	—	1816
Female	-0.186** (0.067)	0.006 (0.006)	—	—	—	—	—	2010
<i>Kaestner (1997)</i>								
Male	—	—	-0.207* (0.114)	-0.497** (0.119)	-0.684** (0.131)	-0.774** (0.143)	-0.971** (0.130)	4212
Female	—	—	-0.015 (0.112)	-0.280** (0.118)	-0.318** (0.126)	-0.542** (0.141)	-0.594** (0.127)	4271
Germany								
<i>Male</i>								
Total	-0.295** (0.084)	0.011 (0.009)	-0.310** (0.124)	-0.507** (0.161)	-0.756** (0.202)	-0.849** (0.271)	-1.258** (0.239)	1921
West German	-0.334** (0.131)	0.001 (0.014)	-0.377** (0.187)	-0.515** (0.255)	-1.152** (0.343)	-1.217** (0.425)	-1.447** (0.355)	1067
East German	-0.183* (0.109)	0.004 (0.014)	-0.050 (0.127)	-0.426** (0.165)	-0.429** (0.196)	-0.579* (0.316)	-0.971** (0.294)	583
Foreigner	-0.024 (0.188)	0.004 (0.017)	-0.471 (0.362)	-0.311 (0.408)	0.018 (0.463)	0.434 (0.592)	-0.515 (0.560)	271
<i>Female</i>								
Total	-0.462** (0.075)	0.030** (0.008)	-0.366** (0.114)	-0.842** (0.144)	-0.951** (0.186)	-1.175** (0.246)	-1.036** (0.234)	1951
West German	-0.442** (0.124)	0.028* (0.014)	-0.294* (0.164)	-0.850** (0.207)	-0.995** (0.274)	-1.252** (0.361)	-0.913** (0.324)	1131
East German	-0.301** (0.082)	0.020** (0.008)	-0.323** (0.136)	-0.603** (0.176)	-0.629** (0.236)	-0.517* (0.309)	-0.671** (0.323)	630
Foreigner	-0.898** (0.321)	0.062 (0.040)	-1.199** (0.444)	-1.597** (0.482)	-1.821** (0.534)	-2.379** (0.717)	-2.205** (0.755)	190
<sup>a</sup> ) Standard deviations in parentheses. — * Statistically significant at the 10 percent level. — ** Statistically significant at the 5 percent level. Source: Butcher and Case (1994), Table 4, Columns (2) and (6); Kaestner (1997), Appendix Table B, Columns (6)-(9); GSOEP (1996), own calculations.								

and Case (1994) find a marginally significant negative effect for the presence of sisters and a marginally significant positive effect of the presence of brothers on the education of females. Kaestner (1997) finds a significant positive effect for the proportion of sisters in the family only on the education of black males and a positive effect for the presence of sisters only on the education of black females. Except for East German males and foreign females, where we find significant positive effects for the presence of any sisters, educational attainment in Germany does not appear to depend on the sibling sex composition.

Table 4 reports the effects of the other explanatory variables on educational attainment for the specification where we include only a dummy variable showing the presence of any sisters. The religious affiliation of the mother appears to have only a significant effect for the very small group of foreign females. Foreign females with a Protestant mother receive more education than those with Catholic mothers or with mothers who were neither Catholic nor Protestant. As expected, educational attainment is positively related to parents' education for all groups considered. Finally, for all groups under considera-

Table 3

Sibling Sex Composition and Educational Attainment in the United States and Germany<sup>a)</sup>

	Any Sisters	Any Brothers	Percent Female Siblings <sup>b)</sup>	Observations
United States				
<i>Butcher and Case (1994)</i>				
Male	0.052 (0.146) <sup>c)</sup>	0.094 (0.155)	-0.123 (0.251)	1,816
Female	-0.302* (0.134)	0.227* (0.134)	-0.399 (0.220)	2,010
<i>Kaestner (1977)</i>				
<i>Male</i>				
White	-0.101 (0.121)	0.028 (0.120)	-0.214 (0.204)	4,212
Black	0.168 (0.190)	0.069 (0.185)	0.771** (0.279)	4,212
Hispanic	0.068 (0.217)	-0.181 (0.249)	-0.168 (0.351)	4,212
<i>Female</i>				
White	-0.086 (0.119)	0.071 (0.123)	0.076 (0.202)	4,271
Black	0.333* (0.191)	0.174 (0.192)	-0.059 (0.284)	4,271
Hispanic	-0.276 (0.219)	-0.315 (0.232)	0.110 (0.345)	4,271
Germany				
<i>Male</i>				
Total	0.115 (0.115)	-0.042 (0.117)	0.182 (0.213)	1,921
West German	0.050 (0.174)	0.001 (0.177)	0.153 (0.324)	1,067
East German	0.229* (0.118)	-0.132 (0.119)	0.278 (0.219)	583
Foreigner	0.130 (0.321)	0.088 (0.344)	-0.434 (0.571)	271
<i>Female</i>				
Total	0.124 (0.107)	0.022 (0.108)	0.077 (0.393)	1,951
West German	0.051 (0.154)	0.038 (0.158)	0.014 (0.286)	1,131
East German	-0.036 (0.128)	-0.016 (0.124)	-0.088 (0.231)	630
Foreigner	0.985** (0.389)	-0.661 (0.401)	1.309** (0.663)	190

a) The regressions include mother's religious affiliation, payments from the child to parents, whether information on the father is available, and indicators for parents' schooling degrees, father's occupation, the age of the individual, and the presence of a sister. The sample is restricted to respondents aged 25 to 46 in 1996, with completed education, with at least one sibling and for whom information on the mother is available. — <sup>b)</sup> Including respondents. — <sup>c)</sup> Standard deviations in parentheses. — \* Statistically significant at the 10 percent level. — \*\* Statistically significant at the 5 percent level.

Source: Butcher and Case (1994), Table 5; Kaestner (1997), Table 5, Column (2) and (6); GSOEP (1996), own calculations.

Table 4

## Sibling Sex Composition and Educational Attainment: Germany, 1986

	Male			Female		
	West Germans	East Germans	Foreigners	West Germans	East Germans	Foreigners
Constant	0.070 (2.983) <sup>a)</sup>	-8.251** (1.848)	5.450 (4.955)	6.614** (2.344)	-5.144** (1.956)	8.358 (5.527)
Mother Catholic	0.121 (0.219)	-0.221 (0.445)	0.372 (0.335)	-0.150 (0.222)	-0.198 (0.563)	-0.182 (0.402)
Mother Protestant	0.184 (0.224)	0.096 (0.183)	-2.297 (2.116)	-0.259 (0.222)	-0.189 (0.254)	6.551** (2.163)
Mother high school degree	2.556** (0.587)	0.768** (0.278)	-1.639 (1.519)	2.274** (0.524)	0.704* (0.365)	3.084** (1.107)
Mother secondary schooling degree	0.271 (0.459)	0.460* (0.265)	0.908** (0.332)	0.131 (0.400)	0.351 (0.328)	-0.436 (0.367)
Father information available	0.054 (0.384)	0.526 (0.360)	0.866 (0.633)	-0.594 (0.373)	0.991** (0.400)	-0.955 (0.708)
Father high school degree	3.001** (0.468)	0.506* (0.267)	3.576** (0.807)	2.661** (0.408)	0.535* (0.306)	0.874 (0.898)
Father secondary schooling degree	0.779* (0.422)	0.052 (0.269)	0.318 (0.309)	0.486 (0.358)	-0.266 (0.284)	0.943** (0.394)
Father skilled worker	0.066 (0.172)	0.098 (0.112)	0.122 (0.396)	0.138 (0.150)	-0.090 (0.122)	0.528 (0.462)
Father worker: other	0.135 (0.221)	0.269 (0.173)	0.013 (0.305)	0.078 (0.187)	-0.090 (0.173)	-0.668* (0.354)
Payments to parents	-0.110 (0.292)	-0.455** (0.183)	0.002 (0.377)	-0.312 (0.390)	0.409 (0.284)	-0.126 (0.545)
Age	0.605** (0.168)	0.115 (0.104)	0.199 (0.300)	0.326** (0.134)	0.371** (0.109)	0.209 (0.332)
Age <sup>2</sup>	-0.008** (0.002)	-0.001 (0.001)	-0.003 (0.004)	-0.005** (0.002)	-0.005** (0.002)	-0.003 (0.005)
Number of siblings	-0.334** (0.131)	-0.183* (0.109)	-0.025 (0.188)	-0.442** (0.124)	-0.301** (0.082)	-0.898** (0.321)
Number of siblings <sup>2</sup>	0.009 (0.014)	0.004 (0.014)	0.004 (0.017)	0.028* (0.014)	0.020** (0.008)	0.062 (0.040)
Sister present	0.005 (0.174)	0.229* (0.118)	0.130 (0.405)	0.051 (0.154)	-0.036 (0.128)	0.985** (0.389)
Adjusted R <sup>2</sup>	0.172	0.135	0.135	0.183	0.109	0.242
Observations	1,067	583	271	1,131	630	190

a) Standard errors in parentheses. — \* Statistically significant at the 10 percent level. — \*\* Statistically significant at the 5 percent level.

Source: GSOEP (1996), own calculations.

tion, the effect of age on educational attainment shows an inverted U-shaped pattern, although this effect is not significant for foreigners and East German males.

### 5. Summary

This paper examines the appearance of sibling sex composition and sibling size effects on educational attainment for three groups of different cultural affiliation in Germany,

i.e., West German, East German and foreign families. The results are compared with the existing empirical evidence for the United States. Using the 1996 wave of the GSOEP, we regress different indicators of sibling sex composition on the years of schooling of an individual, holding family size, family background and person-specific characteristics constant. The estimation results indicate that educational attainment in Germany is independent of the sibling sex composition, this is consistent with United States results. There are two exceptions: for East German males

we find a marginally significant positive effect of the presence of a sister, and for foreign females we find a significant positive effect of the presence of a sister and the percentage of female siblings in the family. However, there are significant differences of the effect of family size on the educational attainment of different groups and on males and females, and these results differ from those found in the studies on the United States. For males we may find a strong negative effect of family size on educational attainment only for West Germans. Compared with males, all

groups of females are more negatively affected by additional siblings with the effect being strongest for foreign females, followed by West Germans and East Germans.

In this paper we have followed the literature as closely as possible given the inherent differences in data. We have not taken up several important issues, including the endogeneity of fertility. We have also not taken advantage of the panel nature of our data. In Bauer and Gang (1998) we use the structure of the GSOEP to handle estimating issues that usually go unanswered.

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