Schnitzlein, Daniel D.

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# How important is the family? Evidence from sibling correlations in permanent earnings in the United States, Germany, and Denmark

Daniel D. Schnitzlein

*DIW Berlin*

*University of Erlangen-Nuremberg*

*Correspondence to:*

Daniel D. Schnitzlein

DIW Berlin

SOEP Department

Mohrenstr. 58

10117 Berlin

Germany

Tel.: +49 30 89789–322

Fax: +49 30 89789–115

E-mail: dschnitzlein@diw.de

## Abstract

This paper is the first to analyze the impact of family background on permanent earnings based on sibling correlations in Germany and to provide a cross-country comparison of Germany, Denmark, and the United States. The main findings are that family and community background has a stronger influence on permanent earnings in Germany than in Denmark and a comparable influence to that found in the United States. This holds true for both male and female siblings. A deeper analysis of Germany shows that family background also plays an important role in explaining variations in family income, wages, education, and risk attitudes.

**Keywords:** Sibling correlations, intergenerational mobility, REML, Germany, SOEP

**JEL-Code:** D1, D3, J62

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# 1 Introduction

The last three decades have witnessed substantial growth in the economic literature on intergenerational income mobility, with results covering a large number of countries.[1] These studies have addressed numerous questions, ranging from simple linear estimates of the intergenerational association in earnings to international comparisons of non-linearities in the intergenerational transmission of labor market outcomes. Most of these studies focus on the calculation of intergenerational correlations (hereafter IGCs) or intergenerational elasticities (hereafter IGEs), which measure the association between parental income and children's economic success. Intergenerational mobility in this sense answers the question: "*How strong is the relationship between parental income and children's income as adults?*"

Intergenerational mobility has attracted a great deal of attention in the literature and has come to be seen as a key indicator of equality of opportunity. This interpretation suggests that it might not be enough to analyze the association between parental earnings and child earnings, but that the more relevant question might be: "*To what extent do children's later economic outcomes depend on the economic situation of the family in which they were raised?*"

A family's economic situation is not defined by parental income alone, but by a wide range of family factors[2] and community factors.[3] In this constellation of influences potentially affecting child outcomes, parental income is clearly important, but cannot be assumed to be the primary factor. Recent research on sibling correlations has shown that parental income and correlated factors explain less than half of the total impact of family and community characteristics on adult children's economic outcomes (Björklund et al. 2010; Mazumder 2008). In order to draw firm conclusions about the level of equality of opportunity in a

[1] See Solon (1999), Black and Devereux (2011), and Björklund and Jäntti (2009) for an extensive overview of the literature on intergenerational mobility.
[2] In addition to parental income, these include parental education, parents' social networks but also parental attitudes and parenting styles.
[3] Two examples would be the neighborhood and the quality of the available schools.

country, a broader measure than IGC or IGE is needed that captures—in addition to parental income—the wider influence of family and community background on child outcomes in adulthood.

Sibling correlations provide such a measure: if family and community factors have a significant impact on children's outcomes, two siblings should resemble each other more than two randomly selected individuals (Solon 1999). While calculating sibling correlations is a well-known method in sociological research, it has rarely been used in the economic literature.[4]

One way to evaluate the importance of family background as an indicator of equality of opportunity is to compare the situation in different countries. The three countries considered in this paper represent three distinct types of modern welfare states with different institutional settings. We know from the existing literature on sibling correlations and IGCs/IGEs that the influence of family background is lower and intergenerational mobility is higher in the Scandinavian countries than it is in the United States (Björklund et al. 2002; Corak 2006). The evidence on Germany remains scarce and largely inconclusive. One aim of this paper is to contribute to the literature by providing internationally comparable estimates of sibling correlations in permanent earnings for Germany.

Based on data from the German Socio-Economic Panel Study (SOEP), the Panel Study of Income Dynamics (PSID) in the United States, and the Danish Integrated Database for Labor Market Research (IDA), the results show, first, that family background has an equally strong influence in Germany as in the United States. More than 40 percent of the variance in permanent earnings of men in the two countries can be attributed to family and community factors. The comparable estimate for Danish men is only 20 percent. For women, the

[4] In contrast to the economic literature, the sociological literature on sibling correlations or sibling resemblance has focused primarily on educational outcomes or prestige score measures. See, for example, Hauser and Wong (1989) for the US and Sieben et al. (2001) for Germany.

corresponding estimates are 39 percent for Germany, 29 percent for the United States, and 19 percent for Denmark. Thus, an individual's economic success or failure is, especially for men but also for women, much more dependent on family background in Germany and the United States than it is in Denmark.

After describing Germany's position in the international comparison, the paper provides a more detailed analysis of the situation in Germany. The findings presented show a high importance of family background for further monetary outcomes (family income and wages) as well, thus supporting the findings for earnings. To gain further insights into the role of the family, I also present selected sibling correlations in non-monetary outcomes that are known to influence the monetary outcomes analyzed. The brother (sister) correlation in years of education is estimated to be 0.66 (0.55). In addition, 40 (36) percent of the variation in risk attitudes of men (women) can be explained by family and community factors.

The results show that family and community factors have an important impact not only on children's monetary outcomes, but also on a number of non-monetary outcomes. The high share of explained variance is particularly interesting, given that a sibling correlation still represents a lower bound of the influence of family and community background (Björklund and Jäntti 2012).[5]

The remainder of the article is structured as follows: section 2 presents a simple statistical model of a sibling correlation and describes the empirical strategy. Section 3 gives a short overview on the existing literature on sibling correlations in earnings and individual income. Section 4 discusses the applied data sets. Section 5 provides the empirical results, and section 6 concludes.

[5] For details, see next section.

## 2 Statistical model and empirical implementation

To illustrate how sibling correlations can be defined and analyzed, I start this section with the simple statistical model introduced by Solon et al. (1991) and Solon (1999). Let $y_{ij}$ be a measure of permanent or long-run earnings for child $j$ of family $i$. The role of family background (including community effects) and individual effects can be characterized as the sum of two components, a family component $\alpha_i$ and an individual component $\mu_{ij}$.

$$y_{ij} = \alpha_i + \mu_{ij} \tag{1}$$

The family component in this framework represents the combined effect of all factors that are shared by siblings from family $i$. The individual component covers all factors that are purely idiosyncratic to sibling $j$. As one child is only observed in one family, $\alpha_i$ and $\mu_{ij}$ are orthogonal to each other by construction. So the variance of permanent earnings $\sigma_y^2$ can be expressed as the sum of the variances of the family component $\alpha_i$ and the individual component $\mu_{ij}$:

$$\sigma_y^2 = \sigma_\alpha^2 + \sigma_\mu^2 \,. \tag{2}$$

In the present case, the measure of interest is the correlation coefficient between the permanent earnings of two siblings. One therefore needs an expression for the covariance between the permanent earnings of two siblings $j$ and $j'$ of the same family $i$. This covariance can be shown to be:

$$Cov(y_{ij}, y_{ij'}) = \sigma_\alpha^2 \quad with \quad j \neq j', \tag{3}$$

which equals the variance of the family component. With this information, the correlation coefficient $\rho$ of the permanent earnings of two siblings $j$ and $j'$ equals the ratio of the variance of the family component $\sigma_\alpha^2$ and the variance of the complete permanent earnings $\sigma_\alpha^2 + \sigma_\mu^2$:

$$\rho = corr\left(y_{ij}, y_{ij'}\right) = \frac{\sigma_\alpha^2}{\sigma_\alpha^2 + \sigma_\mu^2} \; with\, j \neq j'. \quad (4)$$

The intuitive interpretation of this ratio is that the correlation in permanent earnings between two siblings (therefore referred to as the sibling correlation) equals the proportion of the variance of permanent earnings that can be attributed to factors shared by siblings. If variance is interpreted as a measure of inequality, the sibling correlation denotes the share of inequality in a permanent outcome that can be attributed to factors shared by the siblings.

As $\sigma_\alpha^2$ and $\sigma_\mu^2$ cannot be negative, $\rho$ takes on values between 0 and 1. A correlation of 0 indicates that there is no influence of family and community factors and 1 indicates that there is no influence of the individual. The first case would describe a fully mobile society and the latter a fully deterministic one.

Solon (1999) shows that the relationship of the sibling correlation defined above and the often estimated IGC is:

$$\rho_{earnings} =$$

$$IGC_{earnings}^2 + other\ shared\ factors\ uncorrelated\ with\ parental\ earnings \quad (5)$$

The sibling correlation in earnings equals the square of the IGC in earnings plus the influence of all shared factors that are uncorrelated with parental earnings. Thus, if parental earnings are the only important factor in family and community background, the sibling correlation should equal the square of the IGC. With an estimate for the IGC for father-son pairs in the United States of 0.4, one would then expect the brother correlation in the United States to be $\rho = 0.4^2 = 0.16$ (Mazumder 2008). With recent estimates for the brother correlation in earnings in the United States ranging between 0.4 and 0.5 (see discussion in the next section), there is clear evidence that an IGC only reveals part of the full (true) influence of family background.

It should nevertheless be noted that a sibling correlation is still a lower-bound estimate for the full influence of family background as there are factors associated with the family that are not shared by siblings. For example, on average two siblings share only about half of their genes (see Björklund and Jäntti 2012 for a thorough discussion).

The sibling correlations presented in section 5 are estimated as the within-cluster correlation in the following linear multilevel model,

$$y_{ijt} = X_{ijt}\beta + \alpha_i + \mu_{ij} + \nu_{ijt} \quad (6)$$

with $y_{ijt}$ being an annual observation of a specific outcome (for example, log earnings), $X_{ijt}$ being a matrix of fixed year and age effects (including year dummies and polynomials of age) and the remaining three parts being the family ($\alpha_i$), individual ($\mu_{ij}$), and transitory components ($\nu_{ijt}$).[6] The sum ($\alpha_i + \mu_{ij}$) represents the permanent part of the observed outcome. Following Mazumder (2008), I apply Restricted Maximum Likelihood (REML) to estimate this model and to estimate the variances of $\alpha_i$ and $\mu_{ij}$. In the results section, I will report the variance components along with the sibling correlation. The standard error for the sibling correlation is calculated using the delta method.[7]

The existing literature on sibling correlations is mainly of an empirical nature and lacks an all-encompassing theoretical model. Nevertheless, the idea of a sibling correlation is closely related to existing models of intergenerational transmission of earnings and education (for example, Becker and Tomes 1979; Becker and Tomes 1986; Solon 2004). These contributions

[6] Solon et al. (1991) showed that not controlling for transitory fluctuations leads to serious underestimation of sibling correlations. See Solon (1992) for a similar result for IGEs.

[7] There is a discussion in the literature on whether the model should be estimated allowing for serial correlation of the transitory individual component. As gaps of different lengths in the series of yearly earnings observations are common especially in the survey data, I did not incorporate a serial correlations model. If serial correlation were a problem, the correlations presented in this paper would be downwardly biased. Björklund et al. (2002) showed that accounting for autocorrelated errors in the Danish data changed the brother correlation only slightly from 0.25 to 0.29. Mazumder (2008) argued that estimating the model allowing for serial correlation has no effect on his estimates for the US. Nevertheless if there were a problem with serial correlations, the corrected German estimates would be even higher than those presented in this paper. This would leave the main results unaffected.

provide a theoretical model of the (causal) effect of, for example, parental income on child income. Björklund and Jäntti (2012) called this effect the "tip of the tip of the iceberg" in relation to the larger influence of family background. In line with the empirical model presented above, the existing theoretical model tells us about the causal part of the IGC in equation 5, which would only be part of the full IGC and is therefore only a minor part of the estimated sibling correlation. As Björklund and Jäntti (2012) concluded, the literature could clearly benefit from new theoretical insights. While a theoretical contribution is beyond the scope of the present article, the empirical results presented here—together with recent studies of sibling correlations over a variety of outcomes,[8] and studies providing a decomposition of the estimated correlations (Mazumder 2008; Björklund et al. 2010)—can contribute the insights needed to build a broader theoretical framework. As implied by this caveat, the results in section 5 are interpreted mainly based on the empirical results in the existing literature.

## 3 Literature review

Table 1 provides an overview of the existing literature on sibling correlations in permanent earnings or individual income.[9] The existing results on sibling correlations in additional monetary and non-monetary outcomes are discussed in section 5 along with the corresponding results for Germany. With one exception (China), the literature to date has focused on the United States and the Scandinavian countries.[10]

[8] See, for example, Mazumder (2008) for economic and related non-economic outcomes, and Mazumder (2011) for health outcomes.

[9] Most authors have focused on brother pairs and sister pairs. Given the differences in labor market attachment between brothers and sisters, allowing for mixed sibling pairs would lead to estimates that depend heavily on how many brother-sister pairs are observed in each family.

[10] Comi (2010) calculated sibling correlations in early career earnings for seven European countries including Germany. The results are not listed in Table 1 as they focus exclusively on early career outcomes and therefore cannot be seen as a proxy for equality of opportunity. Schnitzlein (2012) presented brother correlations in permanent earnings for different ethnic groups in Denmark. As the results in Table 1 do not distinguish between

### 3.1 Existing literature on sibling correlations in permanent earnings and individual income

One of the earliest studies on sibling correlations in earnings was conducted by Solon et al. (1991), who used US data from the PSID.[11] In it, the authors argued that it is important to separate transitory fluctuations from the earnings measure. Their results showed much lower equality of opportunity in the United States measured by sibling correlations in permanent economic outcomes than suggested by previous studies based on short-term measures.[12] They found the brother correlation in earnings to be 0.34–0.45, depending on which assumptions they imposed on their model. They also estimated a sister correlation in income to be 0.28.[13]

< Table 1 around here >

These results were updated by Levine and Mazumder (2007) and Mazumder (2008). Using the PSID and the National Longitudinal Survey of Youth (NLSY), Mazumder (2008) found the brother correlations in earnings to be 0.49 (NLSY) and 0.39 (PSID). The corresponding estimate for sisters was 0.34 (NLSY). He also presented estimates of the contribution of specific factors explaining sibling correlation: for example, he showed that only 36 percent of the brother correlation in earnings can be explained by parental income measures. Human capital factors and occupation are each able to explain about half of the sibling correlation.

Österbacka (2001) presented results for IGCs, IGEs and sibling correlations using Finnish data. She found a brother correlation in earnings of 0.26 and a lower sister correlation in earnings of 0.13.

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ethnic groups, these results are also not included. Björklund and Jäntti (2012) presented brother and sister correlations in earnings in Figure 1 in their article. The results are very similar to the results in Björklund et al. (2002) and Björklund et al. (2004).

[11] A few studies were published before Solon et al. (1991), but as they suffer from various sources of bias as described in Solon et al. (1991) I did not include them in Table 1. See Solon (1999) for a survey.

[12] This is very similar to the findings in Solon (1989, 1992) for IGEs.

[13] The corresponding brother correlation in income was 0.34.

A more detailed study on the question of which factors determine sibling correlations in individual income was conducted by Björklund et al. (2010) based on Swedish data. Besides parental income, human capital, and occupation, the authors found that measures of parental behavior (indicators such as parental involvement in schoolwork, parenting practices and maternal attitudes) have substantial explanatory power.

In another study using Swedish data, Björklund et al. (2009) showed that the influence of family background decreased substantially in Sweden with the rise of the welfare state. They found brother correlations in individual income of about 0.49 for cohorts born in the 1930s and brother correlations of about 0.32 for cohorts born in the 1950s, with a slight increase to 0.37 for cohorts born in the 1960s. The authors found that factors related to schooling account for a large part of this development but were not able to determine which factors were the most important determinants after eliminating changes in returns to schooling and changes in the brother correlations in schooling. In their conclusion, the authors suggested that this change was most likely driven by school reforms.

In a study based on Chinese data, Eriksson and Zhang (2012) found a very high influence of family background in China even compared to the United States, but no evidence of differences within China between coastal and interior provinces.

### 3.2 Cross-country comparisons

Up to now, only two studies have provided results on cross-country comparisons of sibling correlations in permanent earnings. In the first of these, Björklund et al. (2002) compared the United States to Denmark, Finland, Sweden, and Norway, focusing on brother correlations. They concluded that the influence of family background is much less important in the Scandinavian countries than in the United States. In the second, Björklund et al. (2004)

extended the results for Finland, Sweden, and Norway to sisters and found the same cross-national pattern but lower overall correlations for sisters.

These findings for sibling correlations are in line with results on intergenerational mobility based on IGCs/IGEs. This results in the following stylized fact, which is widely accepted in the literature:[14] in international comparisons of industrialized countries, the United States ranks at the bottom and the Scandinavian countries rank at the top of the intergenerational economic mobility scale.

The evidence for Germany is less clear. As there are no previous results on sibling correlations, all prior comparisons have been based on IGCs or IGEs. Couch and Dunn (1997) carried out the first comparison of intergenerational mobility between Germany and the United States, using data from the PSID and the SOEP to estimate IGCs and IGEs for both countries. Their German sample of sons and daughters was very young due to the short duration of the SOEP at the time. When they constructed a US sample that was comparable in age to their German data, they found no significant differences between the two countries. Haider and Solon (2006), however, pointed out that observing children at very young ages could lead to serious bias in the estimation of the intergenerational association, suggesting that the results of Couch and Dunn (1997) could be biased. This skepticism was supported by Vogel (2006), who reported higher intergenerational mobility in Germany than in the United States. In addition, recent estimates of IGEs for Germany from single-country studies are much lower than the consensus estimate for the United States, indicating higher intergenerational mobility in Germany than in the United States (Eisenhauer and Pfeiffer 2008; Schnitzlein 2009; Yuksel 2009).[15] But as these studies were on individual countries, it remains unclear how comparable the results are to the US estimates.

[14] See, for example, Corak (2006).
[15] Further estimates of intergenerational mobility in Germany can be found, for example, in Grawe (2004) and Wiegand (1997). For a detailed overview, see Table 1 in Schnitzlein (2009).

# 4 Data

For the United States and Germany, I use data from the PSID and the SOEP[16] (Wagner et al. 2007). Both data sets come from nationally representative household surveys that are widely used in economic and sociological research. Both surveys started with a set of households that have been interviewed on annual basis since their inception (in the case of the PSID, biannually since 1997). When the children in the original panel households reached adulthood and founded their own families, their new households were added to the survey. This feature enables me to link siblings of adult age. An important strength of the SOEP and the PSID, in addition to the vast amount of information available in the two data sets, is that both surveys are included in the Cross-National Equivalent File (CNEF) project carried out at Cornell University. The CNEF data contain internationally comparable scaled variables for a subset of the information in the original surveys.[17] I extracted family relations information from the original survey data in both countries and used the information on individual annual labor earnings provided in the CNEF data. I defined two individuals as being siblings if they are linked to the same father and mother identification number.[18]

For Denmark, I had access to data from the Danish Integrated Database for Labor Market Research (Integreret Database for Arbejdsmarkedsforskning, IDA) which combines information from various administrative registers collected by the Danish government and administered by Statistics Denmark.[19] Being administrative data, the IDA database has some desirable properties. First, it covers the entire Danish population so there is no sample selection or panel attrition. Second, the earnings information from administrative data sources

[16] I used SOEP version SOEPv25.
[17] See http://www.human.cornell.edu/pam/research/centers-programs/german-panel/cnef.cfm for an overview of the available data and Frick et al. (2007) for additional information.
[18] In an earlier version of this article, I presented robustness tests including different alternative definitions on whom to count as siblings (Schnitzlein 2011). As the results remained virtually unchanged, I focus on this strict definition here.
[19] Unfortunately there is no English documentation available. An English description of the database can be found in Timmermans (2010).

is likely to be more precise than from interviews. Third, it covers an extremely large number of individuals (all Danish residents). As it would be computationally very burdensome to use the entire Danish population for the analysis, I had to draw a sample comparable to the ones from Germany and the United States. A natural choice would be a random sample of the Danish population. But this would be different from what is given in the SOEP and the PSID. In the latter two surveys, the initial unit is the parental household and not the child, as is the case in the Danish data. To take this into account, I first defined a family indicator for every individual covered in the most recent years (2002–2007). Again, comparable to the survey data, I defined two individuals to belong to one family, and thus to be siblings, if their data contained the same mother and the same father identification number. Then I drew a 10 percent random sample of these families and included all children from the sampled families in the analysis and used the annual labor earnings variable available in the IDA dataset.

One notable difference between the survey data and the register data is the definition of parenthood, which in turn affects the definition of siblings. In the PSID and the SOEP data, parenthood is defined mainly by cohabitation, which means the siblings identified are social siblings. The Danish register data reports the biological (or legal) parents. This can cause a problem in cross-country comparison if genetics are an important channel of influence. I argue that the main result in the cross-country comparison is not influenced by this difference in parental definitions. If genetics are important, biological siblings should show stronger similarities in outcomes than social siblings (see also discussion in Björklund and Jäntti 2012). This means that restricting the survey data to biological siblings would raise the estimated sibling correlations in Germany and the United States. The main result that the sibling correlations in these two countries are higher than in Denmark would then be amplified.

In line with the existing literature, I applied a lower earnings limit of 9000 DKK, 1200 EUR, and 1200 USD (in 2006 prices)[20] and restricted the age range for observations to 31–49 years of age.

Table 2 contains descriptive statistics for the sample used in the cross-country comparison. The first column in each part of the table contains the number of individuals observed in each year.[21] These are clearly higher in the Danish administrative data than in the household surveys from Germany and the United States. This explains why the results in the next section are estimated more precisely for the Danish sample. The table also contains median earnings and mean age for the three countries.

< Table 2 around here >

# 5 Results

## 5.1 Results of the cross-country comparison

Table 3 shows the results of the cross-country comparison. In the first three rows, the estimated variance components are presented along with their standard errors. As all figures in the table are at least statistically significant at the five percent level, the significance is not explicitly marked. The resulting sibling correlations are presented in the row of the table in boldface type.

< Table 3 around here>

For brothers, the correlation in permanent earnings is 0.20 in Denmark, 0.43 in Germany, and 0.45 in the United States. According to these results, family and community background is of

[20] I will provide a robustness test to show that the established international ranking is robust to variations in this restriction.

[21] These numbers include siblings as well as singletons. In the estimation, I follow the existing literature and estimate the model including singletons. For a discussion, see Solon et al. (1991) and Mazumder (2008).

about the same importance in Germany and the United States and is much less important in Denmark. Thus, in Denmark, around 20 percent of the inequality in permanent earnings can be attributed to factors shared by siblings. The corresponding figures are 43 percent for Germany and 45 percent for the United States.

Comparing the 95 percent confidence intervals reveals a significant difference between Germany and Denmark and between the United States and Denmark. The intervals of the German and the US estimates, however, clearly overlap. Given the argumentation above that sibling correlations can be interpreted as a measure of equality of opportunity, the results for brothers can be summarized as: (i) for brothers there is significantly less equality of opportunity in Germany and the United States than in Denmark, and (ii) for brothers there is no significant difference in equality of opportunity between Germany and the United States.

The first three rows of Table 3 contain the estimated variance components. A closer look at these estimates underscores that a sibling correlation is a relative measure. For example, whereas the brother correlations are very similar in the United States and Germany, the overall variance of both annual earnings and permanent earnings for brothers is clearly higher in the United States than in Germany. So in both countries, family and community background explain the same share of variance but based on different levels of inequality. On the other hand, Germany and Denmark are much more similar in terms of the variance of permanent and annual earnings, but differ significantly in terms of the estimated brother correlation.

The situation is not as clear-cut for sisters as for brothers. The estimated correlations are 0.19 for Denmark, 0.39 for Germany, and 0.29 for the United States, meaning that 19 percent of the inequality in permanent earnings can be attributed to factors shared by sisters in Denmark compared to 39 percent in Germany and 29 percent in the United States. These estimates are in line with prior results showing that sister correlations are lower than the corresponding

brother correlations. [22] Due to the lower number of observations available, especially in the German data, the estimates are less precise than the estimates for brother pairs. As a result, the 95 percent confidence intervals for the three countries are overlapping, even with the Danish point estimate being only half of the size of the German one. However the differences between Germany and the United States on one side and Denmark on the other are statistically significant at the 10 percent level, indicating that there is a cross-country difference in the importance of family background for sisters in Denmark compared to the two other countries. Thus, again given the interpretation stated in the introduction, the summary for sisters resembles that for brothers: (i) for sisters there is significantly less equality of opportunity in Germany and the United States than in Denmark, and (ii) for sisters there is no significant difference in the level of equality of opportunity between Germany and the United States.[23]

Björklund et al. (2002) showed that the estimates for sibling correlations are to some extent sensitive to variations in the sample selection rules applied. As this might be especially true regarding the lower earnings limit, Table A.1 in the electronic appendix presents results for all three countries in which I varied the lower earnings limit. These results underscore the need for cross-country comparisons. While the estimated correlations decrease when the lower earnings limit decreases for Danish and German brothers as well as for all sisters, the

[22] Note that women's labor market participation rates clearly differ across countries. In 2010, 71.1 percent of Danish women aged between 15 and 64 were employed. The corresponding rates were 66.1 percent in Germany and 62.4 percent in the US (OECD 2012). The women reporting positive earnings in my sample therefore might be a more homogeneous group in the US and Germany than in Denmark. To test the reliability of the results, estimates were made using family income instead of labor earnings for Germany (presented in Table 5 and Table A.3). The observed pattern of estimates for women being lower than the estimates for brothers remains stable.

[23] As stated in the note to Table 3, the average number of yearly individual earnings observations varies among the countries. In Denmark and Germany the average numbers are very similar: 4.5/4.8 years for brothers and 4.6/ 4.2 years for sisters. Due to the biannual rhythm of the PSID the corresponding numbers for the US are 3.2 years. This difference can lead to downwardly biased estimates for the US (for a discussion see Solon et al. 1991). While this supports the finding that there is a significant difference between Denmark and the US, it is unclear what would happen to the difference between Germany and the US. As a robustness check, I reestimated the model for the US using additional years from the CNEF data back to 1994. This specification contains 4.5 individual yearly earnings observations for US brothers and US sisters. The sibling correlations in this specification remain largely unaffected (brothers: 0.44 / sisters: 0.29). As I wanted to ensure that the data covers a comparable period in time in all three countries, I did not include the additional years in the main analysis. The full results from this specification are available from the author upon request.

correlation increases for US brothers. These different reactions to a change in the sampling rules show that it might be misleading to draw conclusions based on national studies when it is not possible to vary the sample restrictions of all countries involved.

The consequences of the variations in the lower earnings limit for the cross-country comparison are shown in Table 4. The table shows the specifications in which the established cross-country differences remain statistically significant.[24]

<Table 4 around here>

For brothers (left part of Table 4), the established ranking is robust to all variations in the lower-earnings limit. Based on all sample specifications, the United States-Denmark and Germany-Denmark comparisons show significant differences. The Germany-US difference is always insignificant.

For sisters, the difference between Germany and Denmark is a robust finding, as is the lack of a difference between Germany and the United States. While in the main specification there is at least a difference at the 10 percent level between women in the United States and women in Denmark, this is not the case when I allow for earnings lower than 100 USD per month. Nevertheless, with this exception in mind, the established ranking is stable to variations in the lower earnings limit.[25]

### 5.2 Discussion of the results of the cross-country comparison

The results presented indicate a higher importance of family and community background and thus a lower level of equality of opportunity in Germany and the United States compared to Denmark. As it is beyond the scope of this paper to identify (causal) mechanisms in the determination of the importance of family background, I want to offer a short discussion of

[24] Table A.2 in the electronic appendix contains the associated number of observations, individuals, and families.
[25] In an earlier version of this article I presented additional robustness tests including different age restrictions. These can be found in Schnitzlein (2011).

the potential reasons for the observed differences. The question that has to be addressed is: are the observed differences due to differences in the cultural background of the individuals in the three countries or due to differences in the institutional settings? While this cannot be tested within a cross-country comparison, because cultural background and institutional settings vary jointly between the three countries, recent results from the literature show that cultural background might not be a major determinant for the level of equality of opportunity. First, Björklund et al. (2009) showed that the rise of the Swedish welfare state, which can be interpreted as a variation of the institutional framework controlling for cultural background, was accompanied by a clear decrease in the importance of family and community background over time. Second, in a previous article (Schnitzlein 2012), I found no differences in brother correlations among different groups of second-generation immigrants in Denmark, which is a variation of cultural background within a given institutional framework. These results indicate that instead of cultural background, the institutional setting plays a major role in the determination of the level of equality of opportunity.

Given these results from the literature, together with the results from the cross-country comparisons in Björklund et al. (2002) and the present paper, future research should try to identify the role of specific institutions in the determination process.

### 5.3 A closer look at Germany

Following on the discussion above, which established the position of Germany in an international ranking of sibling correlations in permanent earnings, this section takes a closer look at Germany. I started by including further monetary outcomes in the analysis. The extended sample was constructed as a balanced panel. Included were only individuals observed between 31 and 49 years of age. As lower limit for individual earnings and family income I again used 1200 EUR (in 2006 prices) per year and the lower limit for wages was 2 EUR per hour. Family income is defined as pre-government household income including

labor earnings, income from assets, private transfers and private retirement income on the household level. Annual observations were only included if the individuals met all these criteria in a given year.[26] This ensures that differences in the estimated correlations are not due to differences in sample composition or differences in the observed number of years.

Table 5 shows results for the different monetary outcomes for brothers and sisters. The results for earnings are supplemented by estimates using family income and wages as outcomes. Based on this more restrictive sample, the estimated brother correlation in earnings rises a bit to 0.48. The corresponding estimates for family income and wages are 0.53 and 0.46. These estimates therefore support the finding that family background is of high importance for monetary outcomes in Germany, and the results show that this is not only a finding for individual earnings but can be generalized to further monetary outcomes. Mazumder (2008) reports the corresponding US estimate for brother correlations to be 0.47 for family income and 0.54 for wages. Thus the similarity between the United States and Germany is supported by the results.

< Table 5 about here >

The right part of Table 5 shows the corresponding sister correlations. In the balanced panel, the estimate for the sister correlation in earnings is 0.35. The estimates for family income and wages are 0.39 and 0.44. These estimates again support the finding that there is substantial influence of family background for women in Germany. Also these results confirm the pattern found in the literature that the estimated sister correlations are usually lower than the estimated brother correlations (Björklund et al. 2004).

[26] The main difference between the samples in Tables 3 and 5 is not the inclusion or the exclusion of individuals with missing information for one of the outcomes, but the restriction that for each individual, only years with full information on all three outcomes were considered. Thus the biggest difference is found in the number of observations and not in the number of families or individuals. The results from an unbalanced panel can be found in Table A.3 in the electronic appendix.

Especially for women, it may be very restrictive to limit the analysis to this balanced sample. Table A.3 in the electronic appendix therefore presents results from an unbalanced panel that also allows women without their own labor earnings to be included in the sample. The estimated sister correlations for family income from this unbalanced panel is 0.32. This is a little lower than the estimate in the balanced case, but it still confirms that family background is important.

But is this important role of family background only a phenomenon restricted to monetary outcomes or can this also be found among further economically important outcomes in Germany? To shed some light on this question, Table 6 presents brother and sister correlations of two selected non-monetary outcomes that are known to be important determinants of monetary outcomes. First and most obvious, it is important to look at education. The first column in both parts of the table shows the estimated brother and sister correlations in years of education.[27] The results of 0.66 for brothers and 0.55 for sisters again show a very high dependence on family and community background, and if interpreted as an indicator for equality of opportunity, they suggest a low level thereof in Germany.

< Table 6 around here >

As comparison, Table A.4 in the electronic appendix presents brother and sister correlations in height, which is a mainly genetically defined outcome. The estimated brother correlation is 0.50 and the estimated sister correlation is 0.47.[28] In both cases, the point estimates are clearly higher for education than for height, and for men this difference is significant on the 10

[27] Included were all individuals that are at least 25 years of age. For each individual the most recent level of education achieved was included. As there is no yearly variation on the level of the individual, the model was only estimated with two levels. Therefore, the number of observations and the number of individuals is identical in Table 6 for education.

[28] Comparable estimates for Sweden can be found in Björklund and Jäntti (2012) and for the US in Mazumder (2008) and Mazumder (2011). All estimates are very close to the ones presented in this paper for Germany.

percent level. That means the similarity between brothers in education is even stronger in Germany than the similarity in height.[29]

The German estimates based on years of education are again very close to previous US results. For example, Mazumder (2008) estimated a brother correlation in years of education of 0.60 and a sister correlation of about 0.62 for the United States, whereas for comparison, Björklund and Jäntti (2012) reported brother and sister correlations of about 0.4 for Sweden.[30] Given these results and the discussion in section 5.3, the educational system appears to be an important institution that deserves closer examination as determinant of cross-country differentials in sibling correlations.

Second, attitudes towards risk are an important determinant of economic decisions. In a recent study, Dohmen et al. (2012) showed that there is a significant intergenerational relationship in risk attitudes. I applied the same measure of self-rated willingness to take risks[31] to estimate brother and sister correlations. The results are 0.40 for brothers and 0.36 for sisters. These numbers can be compared to the R-squared of the intergenerational models in Dohmen et al. (2012). The authors reported an R-squared of 0.21[32] which means that the intergenerational model explains about 21 percent of the variation in the willingness-to-take-risks measure. So, similar to the case of monetary outcomes, sibling correlations show that the role of family background is more important, also for the willingness-to-take-risks measure, than what can be measured by an intergenerational model.

To summarize, the additional results show that the high importance of family background is not only a symptom of monetary outcomes but is also present for non-monetary outcomes.

[29] A similar result for the US is found by Mazumder (2008).
[30] An overview of the literature on education and family background can be found in Björklund and Salvanes (2010).
[31] Respondents are asked to answer the question *Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks?* on an 11-point scale ranging from 0 (*risk averse)* to 10 (*fully prepared to take risks)*. This question has been included in the SOEP questionnaire in 2004, 2006, and 2008. See also discussion in Dohmen et al. (2011).
[32] See Table 1, specification 3 in Dohmen et al. (2012).

# 6 Conclusion

This paper is the first to analyze sibling correlations in permanent earnings in Germany and the first to analyze Germany in a cross-country comparison with Denmark and the United States. As previous studies showed that these two countries mark the two ends of the scale of intergenerational mobility, this paper has sought to determine where to position Germany in this ranking.

The importance of family and community background in Germany is higher than in Denmark and comparable to the United States. This holds true for brothers and sisters. In detail, I find that in Denmark, only 20 percent of the inequality in permanent earnings can be attributed to family and community factors that are shared by brothers while the corresponding estimates are 43 percent in Germany and 45 percent in the United States, meaning that about half the variance in permanent earnings can be explained by factors shared by siblings. This is remarkably high, given that a sibling correlation is still a lower-bound estimate of the (true) influence of family and community background. For sisters the estimates are 19 percent for Denmark, 39 percent for Germany, and 29 percent for the United States. The results also show a high importance of family background in Germany for family income and wages, as well as for education and willingness to take risks.

Given the results in the literature that cultural background is not a major determinant of the level of equality of opportunity, it appears likely that the differences between the three countries arise from differences in the institutional settings and can therefore be influenced by policy decisions. To provide detailed policy advice, future research should focus on the role of specific institutions, especially differences in the educational system.

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**Table 1: Existing literature on sibling correlations in permanent earnings**

| Country | Sibling correlation | Cohort | Method | Author(s) |
|---|---|---|---|---|
| | | *Brothers* | | |
| *China* | *0.57* | not reported | REML | Eriksson and Zhang (2012) |
| USA | 0.49 | 1947–1955 | REML | Mazumder (2008) |
| USA | 0.45 | 1944–1952 | REML | Levine and Mazumder (2007) |
| USA | 0.45 | 1951–1958 | ANOVA | Solon et al. (1991) |
| USA | 0.43 | 1951–1967 | ANOVA | Björklund et al. (2002) |
| *Sweden* | *0.37* | 1962–1968 | GMM | Björklund et al. (2009) |
| *Sweden* | *0.27* | 1953 | REML | Björklund et al. (2010) |
| Sweden | 0.25 | 1948–1965 | ANOVA | Björklund et al. (2002) |
| *Sweden* | *0.22* | 1962–1968 | REML | Björklund et al. (2007) |
| Sweden | 0.19 | 1951–1968 | ANOVA | Björklund et al. (2004) |
| Finland | 0.26 | 1953–1965 | ANOVA | Björklund et al. (2002) |
| Finland | 0.26 | 1950–1960 | ANOVA | Österbacka (2001) |
| Finland | 0.24 | 1955–1965 | ANOVA | Björklund et al. (2004) |
| Denmark | 0.23 | 1951–1968 | ANOVA | Björklund et al. (2002) |
| Norway | 0.14 | 1950–1970 | ANOVA | Björklund et al. (2002) |
| Norway | 0.14 | 1953–1969 | ANOVA | Björklund et al. (2004) |
| | | *Sisters* | | |
| *USA* | *0.28* | 1951–1958 | ANOVA | Solon et al. (1991) |
| USA | 0.34 | 1947–1955 | REML | Mazumder (2008) |
| *Sweden* | *0.17* | 1953 | REML | Björklund et al. (2010) |
| Sweden | 0.15 | 1951–1968 | ANOVA | Björklund et al. (2004) |
| Finland | 0.13 | 1950–1960 | ANOVA | Österbacka (2001) |
| Finland | 0.11 | 1955–1965 | ANOVA | Björklund et al. (2004) |
| Norway | 0.12 | 1953–1969 | ANOVA | Björklund et al. (2004) |

Note: sibling correlations in italics are based on individual income otherwise the estimates are based on earnings. If an article contains both, estimates on earnings and individual income, earnings estimates are preferred. In each case the most comparable estimate to the estimates in section 5 is selected.

**Table 2: Descriptive statistics (cross-country comparison)**

| Year | Brothers N | Brothers Median Earnings | Brothers Age | Sisters N | Sisters Median Earnings | Sisters Age |
|---|---|---|---|---|---|---|
| | | | Denmark | | | |
| 2002 | 53,027 | 51,636 | 39.3 | 47,794 | 40,205 | 38.8 |
| 2003 | 54,058 | 53,737 | 39.4 | 49,611 | 42,331 | 39.1 |
| 2004 | 54,963 | 56,015 | 39.6 | 51,540 | 43,972 | 39.4 |
| 2005 | 56,013 | 58,184 | 39.7 | 53,014 | 45,685 | 39.6 |
| 2006 | 56,817 | 61,564 | 39.7 | 54,599 | 48,307 | 39.7 |
| 2007 | 56,931 | 65,657 | 39.9 | 55,341 | 51,423 | 39.9 |
| | | | Germany | | | |
| 2002 | 666 | 42,112 | 36.3 | 336 | 23,967 | 35.4 |
| 2003 | 692 | 43,482 | 36.8 | 374 | 25,043 | 35.6 |
| 2004 | 700 | 44,149 | 37.2 | 418 | 25,289 | 36.0 |
| 2005 | 708 | 46,024 | 37.6 | 433 | 24,104 | 36.5 |
| 2006 | 712 | 46,073 | 37.9 | 439 | 24,476 | 37.1 |
| 2007 | 693 | 46,453 | 38.5 | 462 | 26,410 | 37.3 |
| 2008 | 703 | 47,953 | 38.6 | 483 | 27,027 | 37.3 |
| | | | US | | | |
| 1999 | 933 | 30,400 | 39.9 | 968 | 18,400 | 39.8 |
| 2001 | 936 | 35,700 | 40.1 | 1,012 | 21,250 | 39.9 |
| 2003 | 914 | 35,600 | 40.0 | 998 | 23,140 | 40.2 |
| 2005 | 938 | 42,300 | 39.9 | 970 | 25,380 | 40.4 |
| 2007 | 923 | 48,500 | 39.8 | 958 | 30,000 | 40.3 |

Note: the table shows descriptive statistics for the three different national samples. Individuals are between 31 and 49 years of age, annual earnings > 9000 DKK, 1200 EUR, 1200 USD. N is the number of observed individuals including singletons. For better comparability earnings are given in USD using the following exchange rates: 1 DKK = 0.1876 USD and 1 EUR = 1.3992 USD.

Source: IDA (2002–2007), SOEP (2002–2008), PSID (1999–2007).

**Table 3: Sibling correlations in permanent earnings in Denmark, Germany, and the United States**

| | Brothers | | | Sisters | | |
|---|---|---|---|---|---|---|
| | **Denmark** | **Germany** | **US** | **Denmark** | **Germany** | **US** |
| Family component | 0.072 | 0.165 | 0.239 | 0.053 | 0.230 | 0.154 |
| | (0.003) | (0.033) | (0.028) | (0.003) | (0.066) | (0.026) |
| Individual component | 0.284 | 0.218 | 0.293 | 0.231 | 0.358 | 0.386 |
| | (0.003) | (0.030) | (0.024) | (0.003) | (0.064) | (0.027) |
| Transitory component | 0.109 | 0.096 | 0.191 | 0.129 | 0.220 | 0.233 |
| | (0.000) | (0.002) | (0.005) | (0.000) | (0.007) | (0.006) |
| **Correlation** | **0.202** | **0.432** | **0.450** | **0.187** | **0.391** | **0.285** |
| | (0.008) | (0.078) | (0.043) | (0.009) | (0.107) | (0.045) |
| | [0.187 ; 0.217] | [0.279 ; 0.585] | [0.365 ; 0.535] | [0.170 ; 0.205] | [0.182 ; 0.600] | [0.196 ; 0.374] |
| Observations | 331,806 | 4,874 | 4,644 | 311,897 | 2,945 | 4,906 |
| Individuals | 73,554 | 1,014 | 1,435 | 68,062 | 704 | 1,538 |
| Families | 55,190 | 858 | 996 | 52,222 | 642 | 1,067 |

Note: the table contains estimates of sibling correlations (separate estimations for brothers and sisters). The variance components used to calculate the sibling correlations are estimated via Restricted Maximum Likelihood. The standard errors of the correlations (in parentheses) are calculated using the delta method. The 95 percent confidence intervals are given in brackets. All calculations are based on the following sample restrictions: individuals are 31–49 years of age. The lower annual earnings limit is 9000 DKK, 1200 EUR or 1200 USD. The matrix of fixed effects $X_{ijt}$ in the multilevel model contains dummy variables for each year and three polynomials of age. All outcomes are measured as logs.
Average number of yearly earnings observations: 4.5 (Brothers Denmark), 4.8 (Brothers Germany), 3.2 (Brothers US), 4.6 (Sisters Denmark), 4.2 (Sisters Germany), 3.2 (Sisters US).

Source: IDA (2002–2007), SOEP (2002–2008), PSID (1999–2007).

**Table 4: Robustness of the established cross-national ranking**

| | Brothers | | | Sisters | | |
|---|---|---|---|---|---|---|
| | **DK - Ger** | **Ger - US** | **DK - US** | **DK - Ger** | **Ger - US** | **DK - US** |
| annual earnings > 9000 DKK, 1200 EUR, 1200 USD | ** | n.s. | ** | * | n.s. | * |
| annual earnings > 4500 DKK, 600 EUR, 600 USD | ** | n.s. | ** | ** | n.s. | n.s. |
| No lower limit | ** | n.s. | ** | ** | n.s. | n.s. |

Note: the table indicates which pairwise cross-country comparisons (according to different earnings restrictions) lead to non-overlapping confidence intervals. **: non-overlapping 95 percent confidence intervals; *: non-overlapping 90 percent confidence intervals; n.s. : overlapping confidence intervals.

Source: IDA (2002–2007), SOEP (2002–2008), PSID (1999–2007).

**Table 5: Sibling correlations in different monetary outcomes in Germany (balanced panel)**

| | Brothers | | | Sisters | | |
|---|---|---|---|---|---|---|
| | **Earnings** | **Family income** | **Wages** | **Earnings** | **Family income** | **Wages** |
| Family component | 0.155 | 0.176 | 0.091 | 0.193 | 0.171 | 0.070 |
| | (0.026) | (0.026) | (0.016) | (0.067) | (0.050) | (0.019) |
| Individual component | 0.168 | 0.157 | 0.108 | 0.363 | 0.266 | 0.091 |
| | (0.023) | (0.021) | (0.015) | (0.066) | (0.048) | (0.019) |
| Transitory component | 0.088 | 0.082 | 0.066 | 0.207 | 0.128 | 0.134 |
| | (0.002) | (0.002) | (0.002) | (0.006) | (0.004) | (0.004) |
| **Correlation** | **0.479** | **0.529** | **0.457** | **0.347** | **0.391** | **0.437** |
| | (0.072) | (0.066) | (0.075) | (0.116) | (0.108) | (0.116) |
| | [0.337 ; 0.621] | [0.400 ; 0.657] | [0.311 ; 0.603] | [0.121 ; 0.574] | [0.178 ; 0.604] | [0.210 ; 0.663] |
| Observations | 4,682 | 4,682 | 4,682 | 2,846 | 2,846 | 2,846 |
| Individuals | 982 | 982 | 982 | 685 | 685 | 685 |
| Families | 830 | 830 | 830 | 626 | 626 | 626 |

Note: the table contains estimates of sibling correlations (separate estimations for brothers and sisters). The variance components used to calculate the sibling correlations are estimated via Restricted Maximum Likelihood. The standard errors of the correlations (in parentheses) are calculated using the delta method. The 95 percent confidence intervals are given in brackets. All calculations are based on the following sampling criteria: individuals are 31–49 years of age; annual earnings and family income are higher than 1200 EUR and hourly wages are higher than 2 EUR. Only annual observations with valid values on all outcomes are included in the sample. The matrix of fixed effects $X_{ijt}$ in the multilevel model contains dummy variables for each year and three polynomials of age. All outcomes are measured as logs.

Source: SOEP (2002–2008).

## Table 6: Sibling correlations in non-monetary outcomes in Germany

| | Brothers | | Sisters | |
|---|---|---|---|---|
| | **Education** | **Willingness to take risks** | **Education** | **Willingness to take risks** |
| Family component | 5.131 | 0.839 | 4.121 | 0.739 |
| | (0.384) | (0.198) | (0.452) | (0.254) |
| Individual component | 2.687 | 1.271 | 3.360 | 1.334 |
| | (0.256) | (0.200) | (0.368) | (0.259) |
| Transitory component | - | 2.506 | - | 2.561 |
| | - | (0.082) | - | (0.091) |
| **Correlation** | **0.656** | **0.398** | **0.551** | **0.357** |
| | (0.035) | (0.089) | (0.050) | (0.119) |
| | [0.589 ; 0.724] | [0.223 ; 0.573] | [0.452 ; 0.650] | [0.123 ; 0.590] |
| Observations | 1,480 | 3,303 | 1,245 | 2,785 |
| Individuals | 1,480 | 1,437 | 1,245 | 1,202 |
| Families | 1,253 | 1,213 | 1,086 | 1,045 |

Note: the table contains estimates of sibling correlations (separate estimations for brothers and sisters). The variance components used to calculate the sibling correlations are estimated via Restricted Maximum Likelihood. The standard errors of the correlations (in parentheses) are calculated using the delta method. The 95 percent confidence intervals are given in brackets. All calculations are based on the following sampling criteria: individuals are more than 24 years of age. Only the most recent observed level of education is included. The matrix of fixed effects $X_{ijt}$ in the multilevel model contains dummy variables for each year and three polynomials of age.
The models for education are only estimated with two levels as there is no variation on the individual's level. Therefore, the number of observations equals the number of individuals.

Source: SOEP (2002–2008).

## Electronic Appendix

### Table A.1: Sibling correlations in permanent earnings in Denmark, Germany, and the United States (different earnings restrictions)

| | Brothers | | | Sisters | | |
|---|---|---|---|---|---|---|
| | **Denmark** | **Germany** | **US** | **Denmark** | **Germany** | **US** |
| annual earnings > 9000 DKK, 1200 EUR, 1200 USD | 0.202<br>[0.187 ; 0.217]<br>[0.178 ; 0.205] | 0.432<br>[0.279 ; 0.585]<br>[0.303 ; 0.560] | 0.450<br>[0.365 ; 0.535]<br>[0.378 ; 0.521] | 0.187<br>[0.170 ; 0.205]<br>[0.172 ; 0.201] | 0.391<br>[0.182 ; 0.600]<br>[0.216 ; 0.566] | 0.285<br>[0.196 ; 0.374]<br>[0.211 ; 0.359] |
| annual earnings > 4500 DKK, 600 EUR, 600 USD | 0.188<br>[0.173 ; 0.203]<br>[0.172 ; 0.199] | 0.429<br>[0.274 ; 0.583]<br>[0.299 ; 0.558] | 0.461<br>[0.374 ; 0.547]<br>[0.388 ; 0.533] | 0.176<br>[0.159 ; 0.193]<br>[0.161 ; 0.190] | 0.400<br>[0.208 ; 0.591]<br>[0.239 ; 0.560] | 0.263<br>[0.174 ; 0.352]<br>[0.188 ; 0.338] |
| No lower limit | 0.158<br>[0.143 ; 0.173]<br>[0.132 ; 0.159] | 0.344<br>[0.184 ; 0.505]<br>[0.209 ; 0.479] | 0.495<br>[0.407 ; 0.582]<br>[0.421 ; 0.568] | 0.154<br>[0.137 ; 0.172]<br>[0.139 ; 0.168] | 0.387<br>[0.186 ; 0.587]<br>[0.219 ; 0.555] | 0.216<br>[0.126 ; 0.306]<br>[0.141 ; 0.291] |

Note: the table contains estimates of sibling correlations (separate estimations for brothers and sisters). The variance components used to calculate the sibling correlations are estimated via Restricted Maximum Likelihood. The standard errors of the correlations (in parentheses) are calculated using the delta method. The 95 percent confidence intervals and the 90 percent confidence intervals are given in brackets. All calculations are based on the following sample restrictions: individuals are 31–49 years of age. The annual earnings limit varies. The matrix of fixed effects $X_{ijt}$ in the multilevel model contains dummy variables for each year and three polynomials of age. All outcomes are measured as logs.

Source: IDA (2002–2007), SOEP (2002–2008), PSID (1999–2007).

**Table A.2: Number of observations, individuals, and families (corresponding to Table 4 and Table A.1)**

| | Brothers | | | Sisters | | |
|---|---|---|---|---|---|---|
| | **Denmark** | **Germany** | **US** | **Denmark** | **Germany** | **US** |
| Observations | 331,806 | 4,874 | 4,644 | 311,897 | 2,945 | 4,906 |
| Individuals | 73,554 | 1,014 | 1,435 | 68,062 | 704 | 1,538 |
| Families | 55,190 | 858 | 996 | 52,222 | 642 | 1067 |
| Observations | 333,809 | 4,892 | 4,658 | 313,975 | 3,001 | 4,962 |
| Individuals | 73,943 | 1,017 | 1,436 | 68,406 | 712 | 1,550 |
| Families | 55,414 | 861 | 997 | 52,431 | 646 | 1075 |
| Observations | 336,974 | 4,908 | 4,678 | 317,100 | 3,040 | 5,022 |
| Individuals | 74,604 | 1,018 | 1,443 | 68,896 | 713 | 1,564 |
| Families | 55,809 | 862 | 1,001 | 52,735 | 647 | 1,083 |

Source: IDA (2002–2007), SOEP(2002–2008), PSID(1999–2007).

## Table A.3: Sibling correlations in different monetary outcomes in Germany (unbalanced sample)

| | Brothers | | | Sisters | | |
|---|---|---|---|---|---|---|
| | **Earnings** | **Family income** | **Wages** | **Earnings** | **Family income** | **Wages** |
| Family component | 0.165 | 0.201 | 0.091 | 0.230 | 0.163 | 0.077 |
| | (0.033) | (0.032) | (0.016) | (0.066) | (0.055) | (0.021) |
| Individual component | 0.218 | 0.224 | 0.109 | 0.358 | 0.340 | 0.090 |
| | (0.030) | (0.028) | (0.015) | (0.064) | (0.055) | (0.020) |
| Transitory component | 0.096 | 0.120 | 0.067 | 0.220 | 0.159 | 0.142 |
| | (0.002) | (0.003) | (0.002) | (0.007) | (0.004) | (0.004) |
| **Correlation** | **0.432** | **0.473** | **0.455** | **0.391** | **0.323** | **0.463** |
| | (0.078) | (0.067) | (0.074) | (0.107) | (0.106) | (0.117) |
| | [0.279 ; 0.585] | [0.342 ; 0.604] | [0.310 ; 0.601] | [0.182 ; 0.600] | [0.115 ; 0.532] | [0.233 ; 0.693] |
| Observations | 4,874 | 5,051 | 4,690 | 2,945 | 3,693 | 2,902 |
| Individuals | 1,014 | 1,036 | 983 | 704 | 792 | 692 |
| Families | 858 | 873 | 831 | 642 | 710 | 630 |

Note: the table contains estimates of sibling correlations (separate estimations for brothers and sisters). The variance components used to calculate the sibling correlations are estimated via Restricted Maximum Likelihood. The standard errors of the correlations (in parentheses) are calculated using the delta method. The 95 percent confidence intervals are given in brackets. All calculations are based on the following sampling criteria: individuals are 31–49 years of age; annual earnings and family income are higher than 1200 EUR and hourly wages are higher than 2 EUR. The matrix of fixed effects $X_{ijt}$ in the multilevel model contains dummy variables for each year and three polynomials of age. All outcomes are measured as logs.

Source: SOEP (2002–2008).

## Table A.4: Sibling correlations in height in Germany

| | Height | |
|---|---|---|
| | **Brothers** | **Sisters** |
| Family component | 0.0008 | 0.0007 |
| | (0.0001) | (0.0001) |
| Individual component | 0.0008 | 0.0008 |
| | (0.0001) | (0.0001) |
| **Correlation** | **0.498** | **0.466** |
| | (0.061) | (0.067) |
| | [0.379 ; 0.618] | [0.335 ; 0.598] |
| Observations | 1,106 | 981 |
| Individuals | 1,106 | 981 |
| Families | 954 | 870 |

Note: the table contains estimates of sibling correlations (separate estimations for brothers and sisters). The variance components used to calculate the sibling correlations are estimated via Restricted Maximum Likelihood. The standard errors of the correlations (in parentheses) are calculated using the delta method. The 95 percent confidence intervals are given in brackets. All calculations are based on the following sampling criteria: individuals are more than 24 years of age and have a valid observation on their height in 2008. The matrix of fixed effects $X_{ijt}$ in the multilevel model contains three polynomials of age. The models are only estimated with two levels as there is no variation on the individual's level. Therefore, the number of observations equals the number of individuals. The outcomes are measured as logs.

Source: SOEP (2002–2008).