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Fewer Siblings, more Wealth? Sibship Size and Wealth Attainment

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Abstract: This study examines the association between sibship size and wealth in adulthood. The study draws on resource dilution theory and additionally discusses potentially wealth-enhancing consequences of having siblings. Data from the German Socio-Economic Panel Study (SOEP, N=3,502 individuals) are used to estimate multilevel regression models adjusted for parental wealth and other important confounders neglected in extant work. The main results of the current study show that additional siblings reduce wealth by about 27 to 39 percent. Parental wealth moderates the association so that sibship size is more negatively associated with filial wealth when parents are wealthier. Birth order position does not moderate the association between sibship size and wealth. The findings suggest that fertility in the family of origin has a systematic impact on wealth attainment and may contribute to population-level wealth inequalities independently from other socio-economic characteristics in families of origin such as parental wealth.

Keywords: siblings, wealth, family of origin, resource dilution

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1. Introduction

The role of the sibship configuration, including aspects such as sibship size (i.e. the number of siblings) and birth order, for attainment processes throughout the life course has been studied since the 19th century (Galton 1874) and remains a contentious issue today (Black et al. 2010; Gibbs et al. 2016; Härkönen 2014; Jacob 2011). Questions of whether and how sibship size and other aspects of the sibship configuration may shape individuals' life chances are important to address to understand the interplay between demographic processes and intra- and intergenerational processes of social stratification (Steelman et al. 2002). For instance, larger sibship sizes may be associated with lower economic wealth attainment, as wealth directly and indirectly transferred from the parental generation is spread more thinly in larger sibships. This may have important long-term consequences for population-level wealth inequality if families with small sibship sizes can more successfully transmit their concentrated wealth across generations (Hansen 2014; Lawson et al. 2013). To understand whether having more siblings is associated with less wealth in adulthood is the central objective of the present study.

Previous studies examined sibship size and wealth and they found negative associations (for the most comprehensive studies see Keister [2003], Keister [2004] and Parr [2006]). Further study of this association is justified because of two important gaps in current knowledge. First, it is not well understood whether having additional siblings is universally harmful for wealth attainment. In particular, other aspects of the sibship configuration such as individuals' birth order positions and, more importantly, the wealth held by individuals' parents may moderate the association between sibship size and wealth. The current study is the first to examine such potential heterogeneity in the association. Second, previous studies mainly examined linear associations between sibship size and wealth. In these studies, the expectation was that each additional sibling similarly reduces wealth. Based on resource dilution theory

and prior research on positive outcomes of having siblings, however, this expectation may be overly simplified. The present study derives new expectations based on relevant theory and scrutinizes potential non-linearity in the association between sibship size and wealth. Taken together, these contributions help to better understand if and for whom more siblings may reduce wealth attainment.

In addition to these substantive advances, the current study contributes empirically to the literature on sibship size and wealth by addressing potential omitted variable bias in prior studies. To this end, data for the current study are drawn from the German Socio-Economic Panel Study (SOEP). The SOEP has a genealogical design and for a substantial number of families in the SOEP, focal individuals and their parents are interviewed even if they live in separate households. This allows examining the association between sibship size and wealth for adult children, while controlling for important characteristics in the parental generation, such as the concurrent parental wealth, which have been mostly unobserved in prior research. This is important because previously unobserved parental characteristics associated with parental wealth may influence fertility and, thereby, may lead to spurious associations between sibship size and children's wealth.

In the next sections, previous studies are briefly reviewed and resource dilution theory is discussed together with alternative theoretical perspectives on the wealth enhancing-consequences of having siblings to derive several hypotheses. The SOEP data are analysed with multilevel regression models to test these hypotheses. In the analysis, it is found that additional siblings reduce wealth by about 27 to 39 percent. Parental wealth moderates the association. Sibship size is more negatively associated with filial wealth when parents are wealthier. Birth order position is negatively associated with wealth, but does not moderate the association between sibship size and wealth. Most results remain robust to a range of alternative model specifications including an internal replication with data from the British Household Panel Survey (BHPS). Finally, the implications of these findings are discussed.

2. Background

2.1 Previous empirical evidence and its limitations

A number of studies have examined the association between sibship size and wealth in adulthood—albeit often in passing using sibship size as a control variable (see Table 1 for an overview). These studies mostly find larger sibship sizes to be linearly negatively associated with wealth in Australia, Norway and the United States. However, the studies have important limitations. First, it remains unclear whether additional siblings are universally harmful for wealth attainment and which conditions moderate the association between additional siblings and wealth. Likely moderators are parental wealth and birth order position as will be discussed in more detail below. Keister (2004) is the only study that finds sibship size to be more negatively related to wealth attainment in non-poor families compared to poor families, where income poverty status is only a coarse proxy for parental wealth. No other research has examined parental wealth as a moderator. The potentially moderating role of birth order position has not been studied in prior work to my knowledge.

Second, previous studies do not consider potential non-linearity in the association between sibship size and wealth. The only exception is Keister (2004) who shows that the estimated negative effect of siblings decreases with larger sibships in non-poor families by testing a quadratic term for sibship size. This approach may conceal more complex non-linearity in the association under study, however, in particular with regard to only children. At the descriptive level, Parr (2006) finds non-linearity between number of siblings and wealth, e.g. female only children have less wealth than women with one sibling, but the author does not further examine this non-linear relationship in a multivariate framework. Other studies use linear specifications without reporting tests for alternative model specifications.

Third, previous studies mostly only control for few parental characteristics such as occupational status and income during respondents' childhood. They do not directly control

for parental wealth (with the exception of Killewald [2013] and Hansen [2014], but the latter study focusses only on the entry into the top 1% of the wealth distribution) and other parental characteristics such as risk preferences, which may simultaneously affect fertility and filial wealth. In addition, without concurrent measures of parental resources, prior studies may also insufficiently account for continuing parental influence on children's wealth during their adult lives. Furthermore, previous studies in most cases do not account for other aspects of sibship configuration such as birth order position. Taken together, these empirical limitations may result in a serious overestimation of the association between sibship size and wealth in prior studies. For instance, Killewald (2013), who controls for parental wealth, reports substantially lower effect sizes for sibship size than other studies. At the same time, previous studies often include a wide range of adult children's characteristics such as education, marital status, and fertility, many of which can be expected to mediate the effect of having siblings on wealth. This may lead to an underestimation of the sibling effect on wealth by over-controlling intervening mechanisms. Therefore, it is important to *not* include these variables in the general estimation of the association between siblings and wealth. Theoretically discussing these mechanisms, which follows in the next sections, is still important to derive meaningful expectations about the association between siblings and wealth.

Table 1: Previous evidence on the association between sibship size and wealth

Study	Country (data)	Outcome	Linear sibship size coefficient	Controlled for parental resources and parental psychological characteristics	Controlled for sibship configuration	Controlled for intervening mechanisms
Hansen 2014	Norway (register data)	Being in top 1% in wealth distribution	-0.06 (logit)	Parents' wealth	No	No
Keister 2003	United States (NLSY 1979)	Net household wealth (started log)	-2.71	Family income, parents' education	No	Yes
Keister 2004	United States (NLSY 1979)	Net household wealth (started log)	-3.76	Family income, parents' education	No	Yes
Keister 2007	United States (NLSY 1979)	Net household wealth (started log)	-3.63	Parents' income, parents' education, parents worked full-time	No	No
Keister 2008	United States (NLSY 1979)	Net household wealth (raw) in USD 1,000 (?)	-2.37	Parents' income, parents' education	No	Yes
Killewald 2013	United States (PSID)	Net household wealth (log with replacement for negative values and 0)	-0.09	Parents' income, parents' education, welfare receipt, parents' occupational prestige, parents' wealth	No	Yes
Parr 2006	Australia (HILDA)	Net household wealth (raw) in AUD	Women: -16,702 Men: -16,659	Mother's occupation	Whether eldest sibling	Yes
Yamokoski and Keister 2006	United States (NLSY 1979)	Net household wealth (raw) in USD 1,000	Women: -2.27	Family income, parents' education	No	Yes

Note: I report the coefficient from the most comprehensive (but if possible without controls for intervening mechanisms) multivariate model excluding interactions. All studies use linear specifications for sibship size.

2.2 Wealth attainment

Wealth is accumulated from surplus income, i.e. incomes less consumption, and through wealth transfers, mostly from parents to their children. The relative importance of both sources of wealth is contested (Spilerman 2000), but during early stages of the life course surplus income can be expected to be more important for wealth attainment as large intergenerational wealth transfers through bequests mostly occur when recipients are older due to the long life expectancy in current parental generations (Charles and Hurst 2003). The family of origin may affect wealth attainment from surplus income beyond direct wealth transfers, however. For instance, the transmission of education across generations affects labour incomes in the offspring generation, which determines surplus income that may be saved (Charles and Hurst 2003). Because the current study mainly draws on a sample of relatively young respondents, wealth attainment from surplus income is assumed to be particularly relevant for the study.

2.3 Sibship size and wealth attainment: A resource dilution perspective

The dominant theory to explain effects of sibship size on attainment outcomes such as wealth or education is the resource dilution model (Anastasi 1956; Blake 1989: 10ff). Building on a human capital perspective, the basic assumption is that parental investment of resources such as attention and money produces positive outcomes in children, such as more wealth and higher educational attainment. Resource dilution theory argues that with increasing sibship size, finite parental resources are spread more thinly across siblings so that fewer resources can be invested which negatively affects children's outcomes. This has been labelled the quantity/quality-trade-off. Parents may invest more in the "quality" of fewer children, or they have more children at the cost of lower "quality" of children (Downey 1995).

Resource dilution theory suggests that sibship size may affect wealth attainment from both sources, reduced savings from surplus income and reduced intergenerational financial transfers (Keister 2003). First, through exposure to diluted resources in families of origin

during childhood and adolescence, educational attainment may be hampered, which leads to lower life-time earnings and reduced savings. Empirical evidence supports a negative association between, on the one hand, sibship size and, on the other hand, cognitive ability and educational attainment (for an overview, see Steelman et al. 2002 and more recently Black et al. 2010; Gibbs et al. 2016). However, there are also null findings, in particular from studies using more advanced methods to account for endogeneity (Angrist et al. 2010; Black et al. 2005; Guo and Vanwey 1999; Workman 2017). The association between sibship size and education is also found to vary across countries, for instance, because education costs differ (Park 2008). There is only little empirical evidence for a negative association between sibship size and employment outcomes such as earnings (Angrist et al. 2010; Black et al. 2005), but even small earning differences may accumulate to substantial wealth differences over time. Additionally, lower educational attainment may also negatively affect wealth independent of income, because less education is associated with less successful financial investment strategies (Cavapozzi et al. 2011).

Second, with larger sibship size, smaller direct wealth transfers (inter vivos transfers and bequests) from parents to each child may occur over children's life courses as the transfers are divided between more siblings (Keister 2003; Powell and Steelman 1995). Evidence shows that in most cases financial transfers are reduced in size with increasing sibship size, but are equally distributed among siblings (Kalmijn 2013). However, unequal giving of parents is found to be more likely (at a low level) with large sibship size (Mechoulam and Wolff 2015). There may also be fewer transfers in large sibships, because several studies suggest that the number of children itself is associated with wealth for parents, where up to three children are positively but more than three children are mostly negatively associated with parental wealth (Vespa and Painter 2011; Zissimopoulos et al. 2015).

Two nuances in the resource dilution model are relevant for the current study. First, not all resources may be equally diluted. Some resources such as income or parental wealth can be

expected to be “more finite”, and thus more likely diluted, than other resources such as parents’ attention (Downey 1995). Downey (2001) additionally distinguishes base and surplus resources. Base resources include those necessary for survival such as food, while surplus resources are additional investments in children’s human capital such as reading to a child. In post-industrialized countries with developed welfare states, base resources are unlikely to be diluted, whereas surplus resources which provide children an advantage in their attainment may be more likely diluted.

Second, resource dilution may take different forms. Previous literature has often tested for linear relationships between sibship size and attainment outcomes. According to a strict reading of resource dilution theory, however, non-linear dilution processes with decreasing marginal effects are more likely than linear relationships. For instance, comparing a family with one child to a family with two children, parental resources that can be invested into each child would be halved, but in a family with three children, one third of parental resources may be invested. Such a non-linear relationship may be particularly likely for “more finite” and dividable resources such as parental wealth (Downey 1995).

A non-linear pattern may also arise because positive consequences of having siblings may counterbalance the negative consequences of sharing some resources with siblings (for a similar argument regarding health, see Baranowska-Rataj et al. 2016). These positive consequences are most likely to affect wealth attainment from surplus income rather than wealth transfers. Theoretical perspectives such as the confluence model (Zajonc and Markus 1975) suggest that only children may miss important developmental inputs from interacting with siblings.¹ For instance, older siblings may benefit in their development from tutoring younger siblings (Härkönen 2014). While many aspects of the confluence model have been empirically rejected (Retherford and Sewell 1991; Steelman et al. 2002), there is some evidence that only children may have personality traits that are negatively related to wealth attainment.

For example, only children may be less competitive and have fewer social skills compared to those with siblings (Cameron et al. 2013; Downey and Condron 2004).

There are additional reasons to think that siblings may positively affect wealth attainment. First, due to efficiency gains and because particular parental resources such as reading out loud can be considered public goods, additional siblings may have the counterintuitive consequence of increasing some resources for each sibling during childhood (Osmanowski and Cardona 2016). Second, later in life, siblings may provide crucial resources, such as financially relevant information, for individuals (Bobbitt-Zeher et al. 2016; Chang 2005). Third, siblings may be related to demographic behaviour and thereby indirectly facilitate wealth attainment. For instance, having siblings increases the likelihood of getting married early and increases the stability of marriage (Angrist et al. 2010; Bobbitt-Zeher et al. 2016), which both positively affects wealth attainment (Wilmoth and Koso 2002). However, it may be expected that these positive effects are strongest when comparing only children to those with one sibling and may be less pronounced for additional siblings (Downey et al. 2015; Downey and Condron 2004).

2.4 Variation in resource dilution and wealth attainment

There are two contrasting positions regarding the moderating role of parental wealth for resource dilution. First, it is argued that resource dilution may be weaker in wealthy families (Blake 1989: 67). There may be an upper limit to the benefits of investments into children. Wealthy families may be able to provide this limit for all their children. Thereby, the negative effect of large sibship sizes may be attenuated (Blake 1989: 88). Thus, sibship size may be most influential in less wealthy families, where investment remains below the limit of benefits (Phillips 1999).

Regarding wealth, it is questionable whether there is an upper limit to intergenerational wealth transfers, however, so that it is likely that resource dilution also occurs in wealthy

families. Even more, resource dilution may be stronger in wealthy families (Lawson and Mace 2009). There is empirical evidence that sibship size is more negatively related to wealth attainment in non-poor families compared to poor families (based on family income: Keister [2004]). These findings may be explained by considering base and surplus resources separately (Downey 2001). Relatively poor families may not be able to provide any surplus resources such as financial wealth which would then be diluted. Only in families with surplus resources, these resources may be diluted leading to “floor effects” (Bernardi and Radl 2014: 1657) at the lower end of the wealth distribution. Independent of sibship size, the wealth outcomes of those with no surplus resources in the family of origin can be expected to be absolutely worse than the outcomes of those with more resources in the family of origin.

Birth order position is an important aspect of the sibship configuration beyond sibship size (Steelman et al. 2002). In general, first-born children have been found to do better on a number of outcomes such as educational attainment and earnings compared to later-born children (Black et al. 2005; Härkönen 2014). One explanation for this advantage is that first-born, and more generally earlier-born, children benefit from a period with less resource dilution before later-born children enter the family (Härkönen 2014). This implies that negative effects of large sibships should be attenuated for earlier born children compared to later born children.² It can be expected that the birth order position is mainly relevant for reduced savings from surplus income and less relevant for intergenerational wealth transfers—at least regarding bequests. Unequal bequests based on birth order are very rare in modern societies (Lawson et al. 2013).

2.5 Hypotheses

With regard to the association between the number of siblings and wealth in adulthood, the following hypotheses are derived. The first set of hypotheses is based on a strict reading of resource dilution theory and emphasizes the negative consequences of siblings on wealth. Such

a reading proposes that *additional siblings are generally negatively associated with individuals' wealth in their adulthood (Dilution Hypothesis)*. Because of decreasing marginal effects predicted by resource dilution theory, it can be that *the negative association between additional siblings and net wealth tapers off with increasing sibship size, but remains significant even at large sibship sizes (Decreasing Effect Hypothesis)*. The next hypothesis, which partly competes with the previous two hypotheses, draws on the potentially wealth-enhancing consequences of having siblings. It may be that *only children have less wealth compared to individuals with one sibling (Only Child Hypothesis)*. The last set of hypotheses deals with additional aspects of the association between the number of siblings and wealth. As wealth is a surplus resource, it may be that *the association between additional siblings and wealth is more negative with more parental wealth (Parental Wealth Hypothesis)*. Earlier-born individuals may be less affected by large sibships, so that *the negative association between number of siblings and net wealth is more negative for later-born children (Birth Order Hypothesis)*.

3. Data and empirical strategy

3.1 Data and sample

Data are drawn from the Socio-Economic Panel Study (SOEP; version 33.1; doi: 10.5684/soep.v33.1). The SOEP commenced in 1984 and is an ongoing, nationally representative, multi-purpose household panel survey for Germany (Wagner et al. 2007). The survey has a genealogical design in which children are followed if they move out of the parental household. The analysis combines wealth data from the 2002, 2007, and 2012 waves of the SOEP with retrospective and prospective information about the total number of siblings of a respondent derived from all survey years from 1984 to 2016.³ For other analytical variables the complete survey waves are used when possible. The wealth data are logically edited and

multiply imputed by the SOEP survey team (Grabka and Westermeier 2015). These data are used for additional imputations for all analytical variables using chained equations in Stata's "mi" procedure (version 14.2) under the assumption of missing at random resulting in 50 sets of imputed values (Allison 2002).

Respondents aged 18 to 59 in private households are selected for the analysis if they were interviewed at least once in 2002, 2007 and/or 2012 and their parents also participated in the survey.⁴ Respondents living with their parents are excluded. Only very few respondents beyond age 59 have parents who are observed in the survey. The focal respondents examined in the analysis are relatively young (median age 33). Most previous studies, which are based on the NLSY 1979 data, have a similarly young sample. Because of their young age, respondents will have accumulated comparatively little wealth and will mostly not have received substantial wealth transfers (yet). In supplementary analysis further described below, older respondents are included at the cost of not directly observing their parents in the data. For the main analysis of younger respondents, 6,388 observations from 3,502 respondents nested in 2,628 families are considered. For 642 families of origin (24%), more than one sibling is directly observed in the data.

3.2 Measures

The outcome variable is *personal net wealth* (see Table 1 for descriptive statistics). Personal net wealth is the sum of all wealth of an individual including real and financial assets, life insurances, private pension plans, business assets and valuable assets such as jewelry. From these assets, debts and loans are subtracted. Respondents may have negative net wealth. An inverse hyperbolic sine (IHS) transformation is applied to adjust the positively skewed wealth distribution which includes negative and 0 values (Burbidge et al. 1988; Friedline et al. 2015). In a supplementary analysis, aggregate measures of household-level net wealth are examined

(further discussed below). Arguably, sibship size should be more directly associated with personal rather than with household-level wealth.

Table 1: Summary statistics

	M	SD	Min	Max
Net wealth	5.94	7.26	-14.57	16.13
Sibship size	1.84	1.38	0.00	6.00
Birth order index	-0.07	0.38	-0.85	3.00
Close birth spacing (less than two years)	0.27		0.00	1.00
Mother's age at birth of respondent	26.63	5.51	14.00	49.00
Sex composition of siblings	0.51	0.35	0.00	1.00
Any step siblings	0.12		0.00	1.00
Parental wealth	10.57	5.23	-12.37	17.91
Parents in homeownership	0.66		0.00	1.00
At least one parent has university degree	0.24		0.00	1.00
Parental risk preferences	3.87	1.70	0.00	9.00
Parental impulsiveness	4.88	1.60	0.00	10.00
At least one grandparent has university degree	0.08		0.00	1.00
Not lived with both parents until age 15	0.12		0.00	1.00
At least one parent died	0.24		0.00	1.00
Age (centred at age 18)	15.98	8.33	0.00	41.00
Women	0.52		0.00	1.00
Immigrant	0.23		0.00	1.00
Lived in East Germany in 1989	0.26		0.00	1.00
N Observations		6,388		
N Individuals		3,502		
N Families		2,628		

Data: SOEP version 33.1 (2002, 2007, 2012); multiply imputed; unweighted.

The main explanatory variable is *sibship size* which captures the total number of siblings individuals ever had. This variable is top-coded at six siblings, because of the very few number of respondents with more than six siblings. The variable will be used as a continuous and as a categorical variable to determine the appropriate specification for the association with wealth.

The moderator variable *parental wealth* captures the average observed net wealth (as described above) of both parents.⁵ If only one parent is observed, for instance because one parent has died, the single parent's wealth is considered. Parental wealth is measured

concurrent with the adult children's wealth. *Parental homeownership* (1=yes, 0=no) captures whether parents are ever observed living in an owner-occupied home as another important aspect of parental wealth. The second moderator variable *birth order index* captures the birth order position of a respondent. The birth order index is constructed as the ratio of respondents' birth order positions relative to the average birth order position in their sibships (Booth and Kee 2008).⁶ The variable is centred at 0. A higher value indicates a later birth order position. This index is orthogonal to sibship size and thereby avoids multicollinearity problems.

While the focus in the current study is on sibship size and birth order, other aspects of the sibship configuration are controlled for. To control for birth spacing, *close birth spacing* is a binary variable that equals 1 if any two siblings in the family are born within two years from each other, otherwise 0 (Powell and Steelman 1993). *Age of mother at birth of respondent* is used to capture the timing of fertility in the family of origin. *Sibship sex composition* indicates the share of men and women among all siblings. The variable ranges from 0 (only men) to 1 (only women). *Any step siblings* is a binary variable which is 1 if the respondent reports to have at least one step or half sibling, 0 otherwise. To capture the parental background (also during childhood) beyond parental wealth, the following variables are included: *not lived with both parents until age 15* (yes—1; no—0), *at least one parent died* (yes—1; no—0), *at least one parent has university degree* (yes—1; no—0) and *at least one grandparent has university degree* (yes—1; no—0). The *risk preferences of parents* and the *impulsiveness of parents* is also controlled for, as both psychological characteristics may be related to wealth accumulation and fertility at the same time.^{7, 8} Both variables are based on 11-point scales and values are averaged across observed time points and across mothers and fathers. Finally, all models are controlled for *age* and *age squared*, *women* (yes—1; no—0), *immigrant* (first and second generation; yes—1; no—0), *lived in East Germany in 1989* (yes—1; no—0), *survey year*, and *origin of sample*, but the related coefficients are not presented (Table S.1 in the Online Appendix shows complete estimation results).

3.3 Empirical strategy

Initially, the unadjusted, bivariate association between sibship size and wealth is examined. Then, the association between sibship size and wealth is modelled in a multivariate framework to formally test the hypotheses. For this, the appropriate specification for sibship size is tested by comparing a fully flexible specification of sibship size categories with a linear specification. For the multivariate analyses, the following multilevel model for repeated observations of individuals nested within families is used to account for the hierarchical data structure:

$$f(y_{tif}) = \alpha + \mathbf{S}_f\boldsymbol{\beta} + \mathbf{X}_{if}\boldsymbol{\gamma} + \mathbf{Z}_{if}\boldsymbol{\delta} + \mathbf{W}_{tif}\boldsymbol{\varphi} + u_f + v_{if} + \varepsilon_{tif}$$

where y_{tif} is the *net wealth* of person i in year t from family f , which is transformed using an IHS function. α is the constant. $\mathbf{S}_f$ is a vector of dummy variables capturing the sibship size or a linear term for sibship size and $\boldsymbol{\beta}$ are the related coefficients. $\mathbf{X}_{if}$ contains other characteristics of the sibship configuration including the *birth order index* as introduced above, $\mathbf{Z}_{if}$ contains parental characteristics including *parental wealth* and $\mathbf{W}_{tif}$ includes additional control variables such as *age* and *period*. u_f is a random term at the level of families and v_{if} is a random term at the level of individuals. ε_{tif} is a random disturbance term across t , i and f . All random terms are assumed to be mutually independent, to have a mean of 0 and to be normally distributed. The model is estimated using full maximum likelihood within Stata's "mixed" procedure. Heteroscedasticity-robust Huber-White standard errors are estimated (White 1980).

In the multivariate analysis, the coefficients in $\boldsymbol{\beta}$ are used to test the Dilution Hypothesis, Decreasing Effect Hypothesis, and Only Child Hypothesis about the association between sibship size and wealth. Models that exclude $\mathbf{X}_{if}$ (other characteristics of sibship configuration) and $\mathbf{Z}_{if}$ (parental characteristics) are also presented to evaluate the importance of controlling for these variables. To test the Parental Wealth Hypothesis and the Birth Order Hypothesis about

the moderation by parental wealth and birth order, respectively, these variables are interacted with the sibship size.

This multilevel regression only yields unbiased estimates of β , the association between sibship size and wealth, under the assumption that u_f , v_{if} and ε_{tif} are not correlated with the number of siblings. Previous research has argued that most importantly parental wealth and psychological characteristics of parents may simultaneously affect number of siblings and wealth (Keister 2003; more generally Sandberg and Rafail 2014). The current study is among the first to include a direct measure of parental wealth and additionally a measure of parental homeownership to rule out such a spurious association. In addition, risk preferences and impulsiveness of parents as two relevant psychological characteristics are controlled for. The potential bias induced by remaining unobservables may be addressed by instrumental variable regression using sibling sex composition or twin births as instruments in future research drawing on register data as has been done for other outcomes such as education or earnings in the past (Angrist et al. 2010; Black et al. 2005). In the context of the current study, this approach is not feasible as the sample size is too limited to estimate the model outlined above including instrumented variables with precision.⁹

A number of supplementary analyses are conducted for which results are presented following the main results. First, the model described above is re-estimated on a sample of respondents aged 18-79. For this sample including older respondents, direct measures of parental wealth and psychological characteristics are not available. These analyses help to investigate whether findings are sensitive to wealth transfers that may occur later in life. Second, instead of personal net wealth, an alternative measure of *household* net wealth is examined, which allows to probe whether household composition may contribute to the relationship between sibship size and wealth. Third, the main analysis is replicated using data from the BHPS (more details for this dataset are available in the Online Appendix) to establish the robustness of results beyond a single dataset and an idiosyncratic institutional context.

4. Results

4.1 Bivariate results

Figure 1 shows the mean net wealth by sibship size. An omnibus test indicates that net wealth varies statistically significantly across sibship size categories at the 99.9% confidence level. The mean net wealth for only children is about 7.10 points on the IHS-transformed scale. With each additional sibling up to three siblings, net wealth decreases. The relationship seems largely linear. Those with one sibling have about 6.00 IHS-transformed points of wealth, which is statistically not significantly different from only children. Those with two siblings (5.49) have significantly less wealth compared to only children, but have similar wealth compared to those with one sibling. Those with three siblings have about 4.09 net wealth. The differences by sibship size then taper off and those with four or five siblings do not have less wealth than those with three siblings. The average wealth of those with six and more siblings is slightly higher than for those with five siblings, but the difference is statistically non-significant and the confidence interval becomes relatively large. Thus, the bivariate evidence suggests that having additional siblings is negatively associated with wealth, but the negative relationship seems to hold only up to having three siblings. However, only about 10 percent of individuals have more than three siblings.

Figure 1: Mean net wealth by sibship size

Data: SOEP version 33.1 (2002, 2007, 2012); multiply imputed; weighted.

Note: Whiskers indicate 95% confidence interval; graph scheme provided by Bischof (2017).

4.2 Multivariate results

Before further examining this relationship in a multivariate framework, I first compare a linear with a flexible dummy specification of sibship size to evaluate the appropriate functional form of the relationship between the number of siblings and net wealth. Table 2 shows model fit statistics for these two specifications (see Model 3 and Model 4 in Table 3 for more details). I report the Akaike information criterion (AIC) and the Bayesian information criterion (BIC) averaged across imputations. Additionally, I report the D_3 statistics based on the likelihood ratio test for multiply imputed data suggested by Meng and Rubin (1992). The AIC and BIC suggest that the linear specification is the preferred model, but the difference between both specifications is small. The D_3 statistic indicates that there is no statistically significant difference in model fits between the flexible dummy specification and the linear specification,

which also suggests that the parsimonious linear specification is to be preferred. Thus, the following analysis mostly focusses on the linear relationship between sibship size and net wealth.

Table 2: Comparison of model fits

	Specification of sibship size	
	Linear	Dummy
AIC	41,917.10	41,921.07
BIC	42,140.25	42,178.04
D ₃	-1.39	
p-value	1.00	

Data: SOEP version 33.1 (2002, 2007, 2012); multiply imputed; unweighted.

Note: Estimation results in Table 3, Model 3 and 4; Fit statistics averaged across imputed data sets; D₃ based on Meng & Rubin (1992).

Table 3 shows the estimation results from multilevel regression models for the outcome net wealth accounting for the hierarchical data structure. Model 1 uses a linear sibship size specification and only adjusts for general control variables such as age and period. In Model 2, other aspects of the sibship configuration such as birth order position are introduced to isolate the association with sibship size. These variables are jointly significantly related to individuals' net wealth ($F[5, 2,490.74] = 7.26, p < 0.001$). Model 3 is additionally adjusted for parental background variables, most importantly parental wealth. Again, these variables are jointly significantly related to individuals' net wealth ($F[8, 3,300.24] = 15.38, p < 0.001$). Adding the parental background variables also substantially reduces the unexplained between-family variance as indicated by the reduction in the variance estimate for families between Model 2 and 3. While adding other aspects of the sibship configuration magnifies the estimated differences by sibship size by about ten percent, entering the parental background characteristics to the model sharply reduces the estimated coefficient for sibship size by about 27 percent. This underlines the importance of adjusting for both set of variables when studying the association between sibship size and wealth.¹⁰

Table 3: Multivariate regression of net wealth with number of siblings

	Model 1 b (SE)	Model 2 b (SE)	Model 3 b (SE)	Model 4 b (SE)
Sibship size	-0.60*** (0.09)	-0.67*** (0.10)	-0.49*** (0.10)	
Sibship size (ref.: Only child)				
One sibling				-0.67 (0.38)
Two siblings				-1.21** (0.40)
Three siblings				-1.97*** (0.50)
Four siblings				-1.89** (0.68)
Five siblings				-3.21*** (0.81)
Six or more siblings				-2.22** (0.86)
Birth order index		-0.98** (0.35)	-0.86* (0.36)	-0.86* (0.36)
Close birth spacing (less than two years)		0.35 (0.29)	0.19 (0.28)	0.22 (0.28)
Mother's age at birth of respondent		0.14*** (0.03)	0.12*** (0.03)	0.12*** (0.03)
Sex composition of siblings		0.13 (0.46)	0.32 (0.46)	0.33 (0.46)
Any step siblings		-0.89 (0.47)	-0.57 (0.48)	-0.58 (0.48)
Parental wealth			0.14*** (0.03)	0.14*** (0.03)
Parents in homeownership			1.94*** (0.32)	1.92*** (0.32)
At least one parent has university degree			0.36 (0.31)	0.39 (0.31)
Parental risk preferences			0.07 (0.10)	0.07 (0.10)
Parental impulsiveness			-0.24* (0.10)	-0.25* (0.10)
At least one grandparent has university degree			0.58 (0.44)	0.55 (0.44)
Not lived with both parents until age 15			-0.46 (0.45)	-0.46 (0.45)
At least one parent died			0.20 (0.32)	0.22 (0.32)
Constant	4.14*** (0.52)	0.40 (0.87)	-1.35 (1.09)	-1.12 (1.14)
Variance components				

Variance family	5.51*** (1.37)	5.13*** (1.36)	3.63*** (1.25)	3.43*** (1.28)
Variance individual	13.81*** (1.74)	13.61*** (1.74)	13.16*** (1.67)	13.24*** (1.68)
Variance residuals	27.74*** (1.28)	27.74*** (1.28)	27.71*** (1.27)	27.73*** (1.27)
N Observations	6,388	6,388	6,388	6,388
N Individuals	3,502	3,502	3,502	3,502
N Families	2,628	2,628	2,628	2,628

Data: SOEP version 33.1 (2002, 2007, 2012); multiply imputed; unweighted.

Note: Linear multilevel regression with outcome variable personal net wealth (IHS-transformed); Huber-White robust standard errors in parentheses; all models include control variables for age, age squared, women, immigrant, lived in East Germany in 1989, period and sample origin; full estimation results in Table S.1 in the Online Appendix; * $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed tests).

Model 3 is the preferred model to test hypotheses on the association between sibship size and net wealth (Table 3). Once all control variables are included in Model 3, the estimated effect of an additional sibling is -0.49 points on the IHS-transformed scale. This coefficient's interpretation is similar to a regression with a logged outcome (Pence 2006). Thus, each additional sibling reduces wealth by about 39 percent ($=100 * [\exp(-0.49) - 1]$). To put this further in perspective, the average yearly increase in wealth over the life course from Model 3 is 0.20. Thus, individuals need to accumulate wealth for about two more years to offset the disadvantage of having an additional sibling. When only considering the upper bound of the 95% confidence interval of the coefficient for sibship size (-0.28), the difference in years of accumulation is about 1.4 years. The lower bound of the confidence interval is -0.70.

Model 4 includes sibship size as a categorical variable and the estimated difference are similar to the descriptive results shown in Figure 1. Again, the results tentatively suggest that the negative relationship between sibship size and net wealth tapers off in large sibships, but the evidence is not strong given that this model fits worse than Model 3. Model 4 also provides no evidence that only children have less wealth than those with at least one sibling. While there is no statistically significant difference between only children and those with one sibling, the

estimated coefficient has a negative sign. For the remainder of the analysis, I focus on the linear relationship between sibship size and wealth.

Overall, these results provide evidence for the Dilution Hypothesis about a general, negative association between additional siblings and wealth. There is only weak evidence in line with the Decreasing Effect Hypothesis, which expected decreasing marginal effects of additional siblings on wealth. The results further suggest that if at all such a decrease in effects only occurs in larger sibship sizes. The results are inconsistent with the Only Child Hypothesis about only children having less wealth than individuals with one sibling.

In Model 3, most aspects of the sibship configuration are not significantly associated with net wealth with two exceptions: First, individuals' birth order position is statistically significantly negatively associated with net wealth. Latter born children are less wealthy on average. Second, the older the mother was at the birth of the respondent, the more wealth the respondent accumulates later in life. Each year in mothers' age increases wealth by about 13 percent ($=100 * [\exp(0.12) - 1]$). When considering parental characteristics, a one point increase in parental wealth increases individuals' wealth by about 0.14 points. This coefficient can be interpreted as an elasticity and, thus, an increase in parental wealth of 1 percent increases children's wealth by 0.14 percent. Parental homeownership is also strongly associated with more wealth in the filial generation (1.94). Parental impulsiveness has a small but statistically significant, negative estimated effect on adult children's wealth (-0.24). Other parental characteristics are not significantly associated with net wealth.

Model 5 in Table 4 is used to test the Parental Wealth Hypothesis. In this hypothesis it was expected that parental wealth compounds the negative association between sibship size and wealth, so that additional siblings are more negatively associated with individuals' wealth at higher levels of parental wealth. The estimated negative and statistically significant interaction between parental wealth and sibship size provides evidence in favour of this hypothesis. With a one unit increase in IHS-transformed parental wealth, the estimated

negative effect of sibship size becomes 0.04 points more negative. When parents have no wealth, the estimated main effect of sibship size suggests that additional siblings are not statistically significantly associated with filial wealth. The main effect of parental wealth indicates a positive and statistically significant association between parental and filial wealth for only children.

Table 4: Multivariate regression of net wealth with number of siblings and interactions with birth order index and parental wealth

	Model 5 b (SE)	Model 6 b (SE)
Sibship size	-0.16 (0.19)	-0.45*** (0.11)
Parental wealth	0.22*** (0.05)	0.14*** (0.03)
Sibship size × Parental wealth	-0.04* (0.02)	
Birth order index	-0.87* (0.36)	-1.67** (0.61)
Sibship size × Birth order index		0.35 (0.23)
Constant	-2.26 (1.18)	-1.43 (1.09)
Variance components		
Variance family	3.50*** (1.24)	3.68*** (1.25)
Variance individual	13.17*** (1.66)	13.08*** (1.66)
Variance residuals	27.72*** (1.27)	27.70*** (1.27)
N Observations	6,388	6,388
N Individuals	3,502	3,502
N Families	2,628	2,628

Data: SOEP version 33.1 (2002, 2007, 2012); multiply imputed; unweighted.

Note: Linear multilevel regression with outcome variable household net wealth (IHS-transformed); Huber-White robust standard errors in parentheses; all models include control variables for close birth spacing, mother's age at birth of respondent, sex composition of siblings, parents in homeownership, one parent has university degree, parental risk preferences, parental impulsiveness, not lived with both parents until age 15 age, at least one parent died, one grandparent has university degree, age squared, women, immigrant, lived in East Germany in 1989, period and sample origin; full estimation results in Table S.1 in the Online Appendix; * $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed tests).

The moderation of the relationship between sibship size and net wealth by parental wealth is further illustrated in Figure 2. The figure shows predicted net wealth by sibship size for three values of parental wealth: mean parental wealth and parental wealth one standard deviation below and above the mean. The figure shows a steeper reduction in predicted net wealth by sibship size for those with wealthier parents compared to less wealthy parents. The figure also shows that the parental wealth advantage in the filial generation vanishes in larger sibships. While individuals with wealthier parents have more net wealth if they are only children or have one or two siblings, these differences are no longer statistically significant once individuals have at least three siblings. For those with six and more siblings, net wealth is estimated to be virtually the same irrespective of parental wealth.

Figure 2: Predicted net wealth by sibship size and parental wealth

Data: SOEP version 33.1 (2002, 2007, 2012); multiply imputed; unweighted.

Note: Prediction based on Model 5 in Table 4; all other variables at their means; whiskers indicate 95% confidence interval.

To test the Birth Order Hypothesis, Model 6 in Table 4 is used. Here, the expectation was that children with a higher birth order position are more negatively affected by additional siblings leading to less wealth. Birth order position is negatively associated with wealth, i.e. latter born siblings have less wealth, on average. Against the expectation, no evidence is found for a moderation of the association between sibship size and wealth by birth order position in the data. The estimated coefficient for the interaction has an unexpected positive sign.

4.3 Supplemental results

The main analysis is based on a relative young sample—similar to most previous studies—for which parental characteristics are directly observed in the SOEP. To probe the potential role of transfers in later life, the analysis is repeated with samples including older individuals (age 18-79), for whom, however, parental characteristics are not directly observed in the data. When including older individuals, the estimated effect of sibship size on net wealth is reduced but remains statistically significant and substantial (Model 8, Table 5). Each additional sibling is found to reduce net wealth by about 27 percent ($=100 * [\exp(-0.32) - 1]$). Results are similar when using the age restriction of the main analysis without controlling for parental wealth and parental psychological characteristics (Model 7). I find to statistically significant interaction between sibship size and birth order.

Table 5: Supplementary model results

	Older sample (SOEP)			Household net wealth (SOEP)				BHPS	
	Age 18-59	Age 18-79		Model 10	Model 11	Model 12	Model 13	Model 14	Model 15
	Model 7	Model 8	Model 9						
				b (SE)	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)
Sibship size	-0.39*** (0.04)	-0.32*** (0.03)	-0.32*** (0.03)	-0.37** (0.13)	-0.04 (0.21)	-0.33* (0.13)	-0.46*** (0.13)	-0.48*** (0.14)	-0.45*** (0.14)
Birth order index	-0.67*** (0.18)	-0.60*** (0.16)	-0.85** (0.28)	-0.88* (0.38)	-0.89* (0.38)	-1.71* (0.66)	0.06 (0.50)	0.05 (0.50)	0.25 (0.82)
Parental wealth	Not included			0.17*** (0.04)	0.25*** (0.06)	0.16*** (0.04)	0.25*** (0.03)	0.22*** (0.04)	0.25*** (0.03)
Sibship size × Parental wealth					-0.04 (0.02)			0.03 (0.02)	
Sibship size × Birth order index				0.10 (0.09)		0.36 (0.25)			-0.10 (0.31)
N Observations	37,032	53,513	53,513	6,388	6,388	6,388	3,288	3,288	3,288
N Individuals	21,268	28,894	28,894	3,502	3,502	3,502	2,013	2,013	2,013
N Families	20,369	27,990	27,990	2,628	2,628	2,628	1,597	1,597	1,597

Data: SOEP version 33.1 (2002, 2007, 2012); multiply imputed; unweighted; BHPS 1995, 2000, 2005, multiply imputed, unweighted.

Note: Linear multilevel regression with outcome variable personal (household in Model 10-Model 12) net wealth (IHS-transformed); Huber-White robust standard errors in parentheses; full model results in Table S.3, S.4, and S.5 in Online Appendix; * $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed tests).

In a second supplemental analysis, personal net wealth is replaced with household net wealth, which was mostly used in previous research, to probe how household composition may contribute to sibship effects. Results are similar to the main analysis with two exceptions (Model 10-Model 12, Table 5). First, the estimated coefficient of sibship size is slightly smaller (-0.37 in Model 10). One explanation for a smaller negative association may be that those with siblings are more likely to form partnerships (Bobbitt-Zeher et al. 2016), which are positively related to wealth (Zissimopoulos et al. 2015). In contrast to the main analysis, the interaction between sibship size and parental wealth is statistically non-significant, but the estimated coefficient and the standard error are virtually identical to the main analysis.

Finally, the main analysis is replicated using comparable British data from the BHPS to establish the robustness of results beyond an idiosyncratic dataset and context (Model 13-Model 15, Table 5). This analysis shows a very similar association between sibship size and wealth compared to the main analysis.¹¹ Each additional sibling reduces net wealth by about 37 percent ($=100*[\exp(-0.46)-1]$). However, the moderation of the relationship between sibship size and net wealth by parental wealth is not evident in the BHPS data. The estimated interaction effect of parental wealth and sibship size is statistically non-significant and in the opposite direction of what was hypothesised in the Parental Wealth Hypothesis.

5. Conclusion

Using data from the German SOEP, this study examines the association between sibship size and wealth in adulthood building on resource dilution theory and considering potential wealth-enhancing consequences of having siblings. The study finds a mostly linear association between sibship size and wealth, which is very robust to different model specification and alternative data from the BHPS. Each additional sibling reduces wealth by about 27 to 39 percent. Parental wealth is a strong predictor of net wealth and the analysis shows that parental

wealth compounds the negative association between having more siblings and wealth in Germany. Having more siblings is more negatively related to net wealth when individuals have wealthy parents. Birth order position is negatively associated with wealth, but does not moderate the association under study.

This study is among the first to consider heterogeneity in the association between sibship size and net wealth. Regarding the moderating role of parental wealth, I show that—in line with theoretical expectations (Lawson and Mace 2009)—resource dilution through siblings seem to be stronger in wealthy families in Germany. This may be explained through “floor effects” (Bernardi and Radl 2014: 1657) at the lower end of the wealth distribution, because only in families with sufficient surplus resources such as parental wealth, these resources may be diluted. In contrast, relatively poor families may not be able to provide any surplus resources which would then be diluted. Similar arguments have also been made to explain larger educational penalties for children after parental separation when parents are highly educated compared to less educated parents (Bernardi and Boertien 2017; Bernardi and Radl 2014). Previously, there was only tentative evidence for such a moderating role by parental resources through family income in the case of wealth attainment (Keister 2004). The present study underlines the relevance of distinguishing surplus and base resources when considering resource dilution. However, the moderating role of parental wealth in Germany was not replicated in the British data.

Parental wealth is not only a moderator of the relationship between sibship size and net wealth, but can also be expected to be an important confounder. Wealthier parents may be less likely to have more children leading to a spurious relationship between sibship size and wealth. The current study is among the first to adjust for parental wealth and additionally controls for parental psychological characteristics. Thereby and by adjusting for additional parental characteristics, the estimated association between sibship size and parental wealth is reduced by more than one fourth. The estimated association is substantially smaller than previously

estimated for the United States without controlling for parental wealth (see Table 1). The association is substantially larger than previously estimated in models which controlled for parental wealth but also controlled for intervening mechanisms with data from the United States (Killewald 2013, see Table 1).

This study carefully considered potential non-linearity in the association between sibship size and net wealth as suggested by resource dilution theory and by the potentially wealth enhancing consequences of having siblings. Weak evidence suggests that the negative association between sibship size and net wealth tapers off in large sibships, but only about ten percent of individuals have such large sibships. Having one sibling is by far the most frequent sibship size category in many post-industrialized countries (Goldstein and Kreyenfeld 2011). Overall, evidence prevails that the relationship between sibship size and net wealth is mostly linear. Thus, this study suggests that the common assumption in previous literature of a linear relationship between the number of siblings and wealth is justified.

It may be surprising that decreasing marginal effects were not observed for the whole range of sibship size categories but only among large sibships given that parental wealth is a highly dividable resource for which a decreasing marginal effect of additional siblings seems likely even for the first sibling (Downey 1995). It is, however, important to note that decreasing negative marginal effects are especially likely when considering the second mechanism through which siblings may reduce wealth: less directly transmitted wealth from parents. This mechanism may be less relevant in the current data due to the relative young sample used in the main analysis. However, also in supplemental analyses with an older sample, generally negative consequences of siblings for wealth are found.

Despite compelling theoretical arguments for wealth enhancing consequences of having siblings, which may counterbalance some of the resource dilution through siblings, the results of the current study by and large do not point in this direction. If there are any wealth enhancing consequences, they are clearly dominated by resource dilution. Supplemental results based on

household wealth in place of personal wealth tentatively indicate that partnership formation influenced by having siblings may attenuate the consequences of sibship size on wealth, but currently this is speculation. Generally, it is difficult to disentangle resource dilution from wealth enhancing consequences of having siblings without examining concrete processes of dilution or enhancement. This would be one important avenue for future research on sibship size and wealth attainment.

While the overall association between sibship size and wealth is estimated to be very similar in Germany and Britain, the estimated effect sizes in the current study are different from those previously estimated for the United States. One interesting difference in results across countries in the current study is that the relationship between sibship size and wealth is moderated by parental wealth in Germany but not in Britain. While these differences across countries may be due to methodological issues, they may also indicate substantial differences in the context of resource dilution as suggested in the conditional resource dilution model (Gibbs et al. 2016). More comprehensive comparative studies are needed to identify how the association between sibship size and wealth may systematically vary across institutional contexts; for instance, the costs of education may moderate the association (Park 2008).

Some limitations of the current study are noteworthy. First, the association between sibship size and wealth found here can only be interpreted as causal under the assumption that no unobserved variables are simultaneously correlated with sibship size and wealth. The current study is among the first to directly adjust for parental wealth and other parental characteristics which would be the most likely candidates for such unobserved variables. However, the measurement of parental wealth and psychological characteristics is concurrent to adult children's outcomes. No measurement of these characteristics before individuals are born is available in the data. Further analyses with alternative identification strategies, e.g. instrumenting sibship size with the sex composition of the sibship using register data, are needed. Second, wealth is prone to measurement error (Riphahn and Serfling 2005). This error

may lead to attenuation bias, so that estimated effects are biased towards 0. Finally, very wealthy respondents are underrepresented in survey data such as the SOEP (Grabka and Westermeier 2015) and so the current results cannot be generalized to the top of the wealth distribution.

In sum, the results underline the important role of the family of origin and more particularly of the number of siblings for wealth attainment. The findings suggest that fertility in the family of origin has a systematic impact on wealth attainment and may contribute to population-level wealth inequalities independently from other socio-economic characteristics such as parental wealth. At the same time, the association between the number of siblings and wealth is shaped by parental wealth in Germany, where additional siblings are more adverse for wealth attainment when parents are wealthier. The relevance of fertility in the family of origin may increase in the coming years because for several years now the unprecedented wealth accumulated during the economic prosperous post-war period in many Western European countries including Germany is transferred to the following generations (Bach and Thiemann 2016), and this is not yet fully captured in the current data. In this context of large direct transfers, for which dilution is most likely, the association between sibship size and wealth may become more critical.

6. Ethical statement

The authors declare that they have no conflict of interest. The informed consent of the interview participants was acquired by the SOEP and BHPS survey teams. The data are available through DIW Berlin and the UK Data Archive.

7. Notes

- 1) The confluence model states that the average intellectual environment in a family is important for child development. Young children reduce the “intellectual average” and, therefore, larger sibship sizes have negative developmental consequences (especially for first-born children). At the same time, interaction between siblings and tutoring of younger siblings by older siblings may improve outcomes for older siblings (Härkönen 2014; Zajonc and Markus 1975).
- 2) Last-born children may also experience less resource dilution as they may benefit from their older siblings having left the parental household. However, even those siblings who have left the household may further drain relevant parental resources, e.g. if parents pay tuition fees or make inter vivos transfers.
- 3) Full, half, step and adopted siblings are all included, as resource dilution may occur through all these different types of siblings. A control variable for half and step siblings is included in multivariate models.
- 4) Respondents from booster samples added in 2012 and thereafter are dropped as they have not participated in the wealth module in 2012 or they provide too few cases where parents and children are observed in separate households.
- 5) Unfortunately, parental wealth before respondents’ birth is not observed in the data. Because childbirth may be associated with changes in wealth (Vespa and Painter 2011), controlling for parental wealth in the current study may control away part of the effect of having siblings on wealth.
- 6) The birth order index is constructed as follows: Birth order index = (Birth order position of individual / ((Number of siblings + 1) / 2)) - 1. For instance, an only child has the value 0.000 ($= [1/1] - 1$), the first-born child in a two-child family has the value -

0.333 ($=[1/1.5]-1$) and the second-born child in a two-child family has the value 0.333 ($=[2/1.5]-1$).

- 7) The question regarding risk preferences is: “Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks?” with answer categories (11-point scale) from “risk averse” to “fully prepared to take risks”. This question has been fielded in 2004, 2006 and then annually since 2008 until 2016. The question regarding impulsiveness is: “Do you generally think things over for a long time before acting—in other words, are you not impulsive at all? Or do you generally act without thinking things over for long, in other words, are you very impulsive?” with answer categories (11-point scale) from “not at all impulsive” to “very impulsive”. The question has been fielded in 2008 and 2013.
- 8) It is assumed that these characteristics do not change after a childbirth.
- 9) Family fixed-effects models cannot be estimated as the sibship size is a family-level characteristic.
- 10) Results are similar when excluding imputed values in the outcome variable (Table S.2 in the Online Appendix).
- 11) Due to data limitations, only financial wealth excluding real assets is examined in the BHPS (see the Online Appendix for more details).

8. References

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9. Supplementary materials for online appendix

9.1 Description of BHPS data and measurement

The British Household Panel Survey (BHPS) is a nationally representative, multi-purpose household panel survey running from 1991-2008 in which information at the household level is combined with detailed information for each household member similar to the SOEP. The BHPS and SOEP are part of the “Cross-National Equivalence File” of internationally comparable panel survey data sets. The original, stratified random sample for the BHPS was drawn in 1990 and is representative of the British population at that time in England, Wales and Scotland south of the Caledonian Canal. The original sample, two regional booster samples for Scotland and Wales added in 1999 and a sample for Northern Ireland added in 2001 are used. Wealth has been recorded in 1995, 2000 and 2005 in the BHPS. The data are multiply imputed under the assumption of missing at random resulting in 50 sets of imputed values.

For the BHPS analysis, the same sample restrictions are applied that are used for the main analysis. Respondents aged 18 to 59 in private households are selected for the analysis if they were interviewed at least once in 1995, 2000 and/or 2005 and their parents also participated in the survey. Respondents living with their parents are excluded.

The outcome variable is *financial net wealth* in the BHPS analysis. This variable is the sum of all financial wealth of a household including savings accounts, national savings certificates, bonds, trusts, personal equity plans, shares and other financial investments. From these assets, debts are subtracted. Respondents may have negative financial net wealth. An inverse hyperbolic sine (IHS) transformation is applied. Real assets, life insurances, private pension plans, business assets and valuable assets such as jewelry are not considered due to data limitations.

The following variables in the BHPS analysis are comparable to the main analysis: *sibship size*, *parental wealth*, *parental homeownership*, *birth order index*, *age of mother at birth of respondent*, *at least one parent has university degree*, *age*, *age squared*, *immigrant*, and *women*. To capture disrupted families of origin the variable *not lived with both parents until age 16* (instead of age 15 in SOEP) is used. The *risk preferences of parents* were measured using a 10-point scale in the BHPS (11-point scale in SOEP). The variables *survey year* and *origin of sample* were adapted to the BHPS survey design. The following variables could not be included in the BHPS analysis due to data limitations: *close birth spacing*, *sibship sex composition*, and *impulsiveness of parents*. The variable *lived in East Germany in 1989* is irrelevant for the BHPS analysis.

9.2 Additional tables

Table S.1: Complete estimation results of multivariate regression of net wealth with number of siblings, birth order index and parental wealth

	Model 1 b (SE)	Model 2 b (SE)	Model 3 b (SE)	Model 4 b (SE)	Model 5 b (SE)	Model 6 b (SE)
Sibship size	-0.60*** (0.09)	-0.67*** (0.10)	-0.49*** (0.10)		-0.16 (0.19)	-0.45*** (0.11)
Sibship size (ref.: Only child)						
One sibling				-0.67 (0.38)		
Two siblings				-1.21** (0.40)		
Three siblings				-1.97*** (0.50)		
Four siblings				-1.89** (0.68)		
Five siblings				-3.21*** (0.81)		
Six and more siblings				-2.22** (0.86)		
Birth order index		-0.98** (0.35)	-0.86* (0.36)	-0.86* (0.36)	-0.87* (0.36)	-1.67** (0.61)
Close birth spacing (less than two years)		0.35 (0.29)	0.19 (0.28)	0.22 (0.28)	0.26 (0.28)	0.18 (0.28)
Mother's age at birth of respondent		0.14*** (0.03)	0.12*** (0.03)	0.12*** (0.03)	0.12*** (0.03)	0.12*** (0.03)
Sex composition of siblings		0.13 (0.46)	0.32 (0.46)	0.33 (0.46)	0.31 (0.46)	0.31 (0.46)
Any step siblings		-0.89 (0.47)	-0.57 (0.48)	-0.58 (0.48)	-0.50 (0.48)	-0.55 (0.48)

Parental wealth			0.14***	0.14***	0.22***	0.14***
			(0.03)	(0.03)	(0.05)	(0.03)
Parents in homeownership			1.94***	1.92***	1.95***	1.96***
			(0.32)	(0.32)	(0.32)	(0.32)
At least one parent has university degree			0.36	0.39	0.35	0.36
			(0.31)	(0.31)	(0.31)	(0.31)
Parental risk preferences			0.07	0.07	0.07	0.07
			(0.10)	(0.10)	(0.10)	(0.10)
Parental impulsiveness			-0.24*	-0.25*	-0.23*	-0.24*
			(0.10)	(0.10)	(0.10)	(0.10)
At least one grandparent has university degree			0.58	0.55	0.60	0.58
			(0.44)	(0.44)	(0.44)	(0.44)
Not lived with both parents until age 15			-0.46	-0.46	-0.45	-0.46
			(0.45)	(0.45)	(0.45)	(0.45)
At least one parent died			0.20	0.22	0.25	0.19
			(0.32)	(0.32)	(0.32)	(0.32)
Age (centered at age 18)	0.30***	0.29***	0.27***	0.27***	0.27***	0.28***
	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)	(0.05)
Age squared	-0.00*	-0.00**	-0.00*	-0.00*	-0.00*	-0.00*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Women	-0.34	-0.32	-0.37	-0.37	-0.36	-0.37
	(0.23)	(0.32)	(0.32)	(0.32)	(0.32)	(0.32)
Immigrant	-1.22**	-1.23**	-0.97*	-0.97*	-0.96*	-0.94*
	(0.45)	(0.45)	(0.44)	(0.44)	(0.44)	(0.44)
Lived in East Germany in 1989	-1.29*	-0.89	-0.47	-0.45	-0.48	-0.48
	(0.51)	(0.51)	(0.51)	(0.51)	(0.51)	(0.51)
Sample origin (ref.: Sample A)						
Sample B	-1.52**	-1.40*	-0.15	-0.15	-0.21	-0.16
	(0.58)	(0.57)	(0.59)	(0.59)	(0.59)	(0.59)
Sample C	-0.52	-0.63	-0.64	-0.69	-0.63	-0.62
	(0.58)	(0.58)	(0.57)	(0.57)	(0.57)	(0.57)
Sample D	-0.31	-0.29	0.29	0.23	0.31	0.31

	(0.79)	(0.79)	(0.77)	(0.76)	(0.77)	(0.77)
Sample E	-0.84	-0.96	-0.85	-0.86	-0.81	-0.85
	(0.81)	(0.82)	(0.83)	(0.83)	(0.83)	(0.83)
Sample F	-0.45	-0.65	-0.68	-0.69	-0.69	-0.68
	(0.43)	(0.43)	(0.42)	(0.42)	(0.42)	(0.42)
Sample G	2.65***	2.29***	1.38*	1.36*	1.34*	1.38*
	(0.56)	(0.56)	(0.57)	(0.57)	(0.57)	(0.57)
Sample H	0.01	-0.32	-0.07	-0.18	-0.12	-0.05
	(1.03)	(1.01)	(0.99)	(0.99)	(1.00)	(0.99)
Sample J	-0.97	-1.15	-0.54	-0.56	-0.50	-0.50
	(1.57)	(1.54)	(1.57)	(1.57)	(1.58)	(1.57)
Period (ref.: 2007)						
2002	0.55**	0.48*	0.55**	0.55*	0.56**	0.56**
	(0.21)	(0.21)	(0.21)	(0.21)	(0.21)	(0.21)
2012	-0.35	-0.29	-0.36	-0.35	-0.36	-0.36
	(0.20)	(0.20)	(0.20)	(0.20)	(0.20)	(0.20)
Sibship size × Parental wealth					-0.04*	
					(0.02)	
Sibship size × Birth order index						0.35
						(0.23)
Constant	4.14***	0.40	-1.35	-1.12	-2.26	-1.43
	(0.52)	(0.87)	(1.09)	(1.14)	(1.18)	(1.09)
Variance components						
Variance family	5.51***	5.13***	3.63***	3.43***	3.50***	3.68***
	(1.37)	(1.36)	(1.25)	(1.28)	(1.24)	(1.25)
Variance individual	13.81***	13.61***	13.16***	13.24***	13.17***	13.08***
	(1.74)	(1.74)	(1.67)	(1.68)	(1.66)	(1.66)
Variance residuals	27.74***	27.74***	27.71***	27.73***	27.72***	27.70***
	(1.28)	(1.28)	(1.27)	(1.27)	(1.27)	(1.27)
N Observations	6,388	6,388	6,388	6,388	6,388	6,388
N Individuals	3,502	3,502	3,502	3,502	3,502	3,502
N Families	2,628	2,628	2,628	2,628	2,628	2,628

Data: SOEP version 33.1 (2002, 2007, 2012); multiply imputed; unweighted.

Note: Linear multilevel regression with outcome variable household net wealth (IHS-transformed); Huber-White robust standard errors in parentheses; * $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed tests).

Table S.2: Multivariate regression of net wealth with number of siblings, birth order index and parental wealth without imputed values in outcome variable

	Model S.1	Model S.2	Model S.3	Model S.4	Model S.5
	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)
Sibship size	-0.63*** (0.10)	-0.71*** (0.11)	-0.51*** (0.11)	-0.14 (0.19)	-0.47*** (0.11)
Birth order index		-1.02** (0.36)	-0.91* (0.36)	-0.92** (0.36)	-1.74** (0.63)
Close birth spacing (less than two years)		0.32 (0.29)	0.18 (0.28)	0.25 (0.29)	0.15 (0.28)
Mother's age at birth of respondent		0.15*** (0.03)	0.12*** (0.03)	0.13*** (0.03)	0.12*** (0.03)
Sex composition of siblings		0.13 (0.46)	0.43 (0.45)	0.43 (0.45)	0.42 (0.45)
Any step siblings		-0.87 (0.50)	-0.48 (0.51)	-0.41 (0.51)	-0.46 (0.51)
Parental wealth			0.14*** (0.03)	0.24*** (0.05)	0.14*** (0.03)
Parents in homeownership			1.90*** (0.33)	1.91*** (0.33)	1.91*** (0.33)
At least one parent has university degree			0.52 (0.32)	0.50 (0.32)	0.52 (0.32)
Parental risk preferences			0.09 (0.11)	0.08 (0.11)	0.08 (0.11)
Parental impulsiveness			-0.25* (0.11)	-0.24* (0.11)	-0.25* (0.11)
At least one grandparent has university degree			0.46 (0.41)	0.50 (0.41)	0.46 (0.41)
Not lived with both parents until age 15			-0.51 (0.45)	-0.50 (0.45)	-0.52 (0.45)

At least one parent died			0.31 (0.34)	0.39 (0.33)	0.30 (0.34)
Sibship size × Parental wealth				-0.04* (0.02)	
Sibship size × Birth order index					0.36 (0.23)
Constant	4.24*** (0.51)	0.27 (0.86)	-1.48 (1.09)	-2.57* (1.19)	-1.55 (1.09)
Variance components					
Variance family	7.54*** (1.58)	7.22*** (1.55)	5.41*** (1.42)	5.24*** (1.41)	5.51*** (1.42)
Variance individual	12.13*** (1.99)	11.89*** (1.97)	11.66*** (1.89)	11.64*** (1.89)	11.55*** (1.88)
Variance residuals	28.09*** (1.44)	28.06*** (1.44)	27.93*** (1.42)	27.97*** (1.42)	27.91*** (1.41)
N Observations	4,334	4,334	4,334	4,334	4,334
N Individuals	2,799	2,799	2,799	2,799	2,799
N Families	2,180	2,180	2,180	2,180	2,180

Data: SOEP version 33.1 (2002, 2007, 2012); imputed values for outcome variable dropped, explanatory variables multiply imputed; unweighted.

Note: Linear multilevel regression with outcome variable household net wealth (IHS-transformed); Huber-White robust standard errors in parentheses; all models include control variables for age, age squared, women, immigrant, lived in East Germany in 1989, period and sample origin;

* $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed tests).

Table S.3: Multivariate regression of net wealth with number of siblings with older samples

	Model 7 Age 18-59 b (SE)	Model 8 Age 18-79 b (SE)	Model 9 Age 18-79 b (SE)
Sibship size (ref.: Only child)	-0.39*** (0.04)	-0.32*** (0.03)	-0.32*** (0.03)
Birth order index	-0.67*** (0.18)	-0.60*** (0.16)	-0.85** (0.28)
Sibship size × Birth order index			0.10 (0.09)
Close birth spacing (less than two years)	-0.08 (0.15)	-0.11 (0.13)	-0.10 (0.13)
Mother's age at birth of respondent	0.11*** (0.01)	0.09*** (0.01)	0.09*** (0.01)
Sex composition of siblings	0.03 (0.19)	-0.05 (0.16)	-0.05 (0.16)
Any step siblings	-0.98*** (0.19)	-0.95*** (0.17)	-0.95*** (0.17)
At least one parent has university degree	1.01*** (0.14)	1.02*** (0.12)	1.02*** (0.12)
Not lived with both parents until age 15	-1.12*** (0.15)	-0.82*** (0.12)	-0.82*** (0.11)
At least one parent died	-0.32** (0.11)	-0.25* (0.10)	-0.25* (0.10)
Constant	0.09 (0.37)	0.96** (0.31)	0.99** (0.31)
Variance components			
Variance intercept family	4.47*** (1.21)	4.15*** (1.07)	4.17*** (1.07)
Variance intercept individual	17.47*** (1.32)	17.19*** (1.13)	17.17*** (1.14)
Variance residuals	20.61*** (0.45)	17.66*** (0.34)	17.66*** (0.34)
N Observations	37,032	53,513	53,513
N Individuals	21,268	28,894	28,894
N Families	20,369	27,990	27,990

Data: SOEP version 33.1 (2002, 2007, 2012); explanatory variables multiply imputed; unweighted.

Note: Linear multilevel regression with outcome variable household net wealth (IHS-transformed); Huber-White robust standard errors in parentheses; all models include control variables for age, age squared, women, immigrant, lived in East Germany in 1989, period and sample origin; * p<.05, ** p<.01, *** p<.001 (two-tailed tests).

Table S.4: Multivariate regression of household net wealth with number of siblings, birth order index and parental wealth

	Model 10 b (SE)	Model 11 b (SE)	Model 12 b (SE)
Sibship size	-0.37** (0.13)	-0.04 (0.21)	-0.33* (0.13)
Birth order index	-0.88* (0.38)	-0.89* (0.38)	-1.71* (0.66)
Close birth spacing (less than two years)	0.17 (0.31)	0.24 (0.31)	0.16 (0.31)
Mother's age at birth of respondent	0.12*** (0.03)	0.12*** (0.03)	0.12*** (0.03)
Sex composition of siblings	0.43 (0.50)	0.43 (0.50)	0.43 (0.50)
Any step siblings	-0.97 (0.62)	-0.91 (0.62)	-0.95 (0.62)
Parental wealth	0.17*** (0.04)	0.25*** (0.06)	0.16*** (0.04)
Parents in homeownership	1.66*** (0.38)	1.66*** (0.38)	1.67*** (0.38)
At least one parent has university degree	0.18 (0.37)	0.17 (0.37)	0.18 (0.37)
Parental risk preferences	0.08 (0.12)	0.07 (0.12)	0.07 (0.12)
Parental impulsiveness	-0.20 (0.13)	-0.19 (0.13)	-0.19 (0.13)
At least one grandparent has university degree	0.47 (0.49)	0.50 (0.49)	0.48 (0.49)
Not lived with both parents until age 15	-0.04 (0.47)	-0.03 (0.47)	-0.04 (0.47)
At least one parent died	-0.09	-0.04	-0.10

	(0.37)	(0.37)	(0.37)
Sibship size × Parental wealth		-0.04 (0.02)	
Sibship size × Birth order index			0.36 (0.25)
Constant	-1.90 (1.24)	-2.84* (1.38)	-1.98 (1.24)
Variance components			
Variance intercept family	3.21** (1.35)	3.05* (1.37)	3.29** (1.35)
Variance intercept individual	16.06*** (1.94)	16.10*** (1.95)	15.95*** (1.93)
Variance residuals	29.26*** (1.61)	29.27*** (1.61)	29.26*** (1.61)
N Observations	6,388	6,388	6,388
N Individuals	3,502	3,502	3,502
N Families	2,628	2,628	2,628

Data: SOEP version 33.1 (2002, 2007, 2012); explanatory variables multiply imputed; unweighted.

Note: Linear multilevel regression with outcome variable personal net wealth (IHS-transformed); Huber-White robust standard errors in parentheses; all models include control variables for age, age squared, women, immigrant, lived in East Germany in 1989, period and sample origin; * p<.05, ** p<.01, *** p<.001 (two-tailed tests).

Table S.5: Multivariate regression of financial net wealth with number of siblings, birth order index and parental wealth with BHPS data

	Model 13	Model 14	Model 15
	b (SE)	b (SE)	b (SE)
Sibship size (ref.: One sibling)	-0.46*** (0.13)	-0.48*** (0.14)	-0.45*** (0.14)
Birth order index	0.06 (0.50)	0.05 (0.50)	0.25 (0.82)
Mother's age at birth of respondent	-0.01 (0.04)	-0.01 (0.04)	-0.01 (0.04)
Parental wealth	0.25*** (0.03)	0.22*** (0.04)	0.25*** (0.03)
Parents in homeownership	-0.55 (0.43)	-0.64 (0.43)	-0.55 (0.43)
At least one parent has university degree	0.06 (0.55)	0.07 (0.55)	0.06 (0.55)
Parental risk preferences	-0.04 (0.10)	-0.04 (0.10)	-0.04 (0.10)
At least one grandparent has university degree	0.00 (0.88)	-0.03 (0.88)	0.00 (0.88)
Not lived with both parents until age 15	-0.63 (0.42)	-0.59 (0.42)	-0.63 (0.42)
At least one parent died	-0.17 (0.44)	-0.14 (0.44)	-0.16 (0.44)
Sibship size × Parental wealth		0.03 (0.02)	
Sibship size × Birth order index			-0.10 (0.31)
Constant	-1.14 (1.37)	-0.95 (1.37)	-1.20 (1.40)
Variance components			
Variance intercept family	4.32**	4.37**	4.31**

	(2.31)	(2.28)	(2.30)
Variance intercept individual	13.68***	13.52***	13.68***
	(2.68)	(2.66)	(2.68)
Variance residuals	33.63***	33.64***	33.62***
	(1.74)	(1.74)	(1.73)
N Observations	3,288	3,288	3,288
N Individuals	2,013	2,013	2,013
N Families	1,597	1,597	1,597

Data: BHPS 1995, 2000, 2005, multiply imputed, unweighted.

Note: Linear multilevel regression with outcome variable personal financial net wealth (IHS-transformed); Huber-White robust standard errors in parentheses; all models include control variables for age, age squared, women, immigrant, period and sample origin; * $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed tests).