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DYNASTIC INEQUALITY COMPARED: MULTIGENERATIONAL MOBILITY IN THE UNITED STATES, THE UNITED KINGDOM, AND GERMANY

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Using harmonized household survey data, we analyze long-run social mobility in the United States, the United Kingdom, and Germany, and test recent theories of multigenerational persistence of socioeconomic status. In this country comparison setting, we find evidence against a universal law of social mobility. Our results show that the long-run persistence of socioeconomic status and the validity of a first-order Markov chain in the intergenerational transmission of human capital is country-specific. Furthermore, we find that the direct and independent effect of grandparents' social status on grandchildren's status tends to vary by gender and institutional context.

JEL Codes: D63, I24, J62

Keywords: dynastic inequality, intergenerational mobility, multigenerational persistence, three generations, grandparental effect

1. Introduction

In many developed countries, the levels of income concentration experienced by current generations are as high as those experienced by their ancestors at the beginning of the 20th century (Piketty, 2014). Although trends of cross-sectional inequality are informative in themselves, they neglect the movement of families within the income distribution—as well as their opportunities to improve their socioeconomic status—over the course of time. Indeed, theories of justice suggest that we should focus on both dimensions of inequality: the static dimension—that is, the income distribution at a given point in time—and the dynamic dimension (Rawls, 1971). The latter can be evaluated by analysing the persistence of inequality between generations, or rather its antonym: social intergenerational mobility.

Recently, the relevance of the intergenerational dimension for distributional analyses has gained increasing attention from researchers and policymakers. A growing number of studies evaluates social intergenerational mobility measuring the degree of association between parents' and children's outcomes (e.g. income, earnings, occupation, or educational attainment). However, while this procedure

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seems to be suitable as a broad measure for equality of opportunity in a society (Corak, 2013; Chetty *et al.*, 2014b), it is still not clear whether it leads to erroneous conclusions about the persistence of inequality in the long run. For instance, empirical studies show that long-run mobility tends to be overestimated if it is extrapolated from the canonical two-generational mobility framework (e.g. Lindahl *et al.*, 2015).

Generally, the existing evidence is still mixed and refers to single countries. Researchers have drawn contrasting conclusions about, first, the long-run persistence of socioeconomic status, and, second, the existence of a direct effect that grandparents exert on the economic outcomes of their grandchildren. Therefore, it is of scientific importance and political relevance to add further evidence and to empirically verify different facets of intergenerational mobility over multiple generations. One of the main contributions of this study is to provide a comprehensive analysis on multigenerational persistence in a common framework using harmonized data for three countries with different welfare regimes, the United States (U.S.), the United Kingdom (U.K.), and Germany. While there is extensive evidence on intergenerational mobility over two generations for these three countries, this is the first analysis providing evidence over three generations in a comparative framework.

From a normative perspective, the analysis of long-run intergenerational persistence of social status is crucial for a social planner who strives to *level the playing field*. Inasmuch as the degree of intergenerational mobility of today's adults reflects the distribution of opportunities of yesterday's children, the analysis of mobility over three consecutive generations mirrors the circumstances faced by parents investing in their children's human capital. Hereby, since the vast recent literature on multigenerational persistence mainly focuses on single countries, it is valuable to evaluate the role played by the historical and institutional context. In this work, we therefore analyze the long-run transmission of social status in three countries with very different institutional characteristics and historical backgrounds, providing comparable and consistent estimates of intergenerational mobility over three generations.

We perform the analysis with data from nationally representative household surveys that allow us to link individuals to their parents and grandparents, and to reconstruct the educational history of families over three consecutive generations. The surveys are highly comparable and enable to perform a harmonized cross-country analysis. To our knowledge, this is the first study testing recent theories of multigenerational persistence such as Gregory Clark's controversial hypothesis of a "universal law of social mobility" (Clark, 2014) in a cross-country framework. Furthermore, we test for the existence of a direct and independent effect that grandparents exert on their grandchildren; that is, the part of the association between outcomes that is not mediated by parents. Additionally, to the best of our knowledge, we are the first to empirically account for ethnic capital—that is, the quality of the ethnic environment in which parents make their investments (Borjas, 1992)—within a multigenerational setup.

Our main findings are the following. We find the strongest association between grandparents' and grandchildren's educational attainment in Germany, with substantially lower associations in the U.K. The U.S. lies in between. These findings confirm and extend the cross-country patterns on educational persistence over two generations found in this and other studies (e.g. Chevalier *et al*., 2009; Hertz *et al*., 2007). A discussion is provided on how these estimates are related to the literature on income mobility for the three countries. Furthermore, we provide evidence that questions Clark's hypothesis of a fairly low and constant rate of social mobility over time and space. Although we cannot reject all of the implications of Clark's hypothetical construct, his strongest conclusion that the long-run persistence of social status is independent of the specific historical and institutional context finds no support in our data, confirming recent findings in single-country setups; for instance, by Braun and Stuhler (2018). In our application, we even find cross-country differences in the effect of direct interaction between grandparents and grandchildren.

The remainder of this paper is organized as follows. In Section 2, we review the literature on multigenerational mobility and introduce some of the most influential theories of long-run persistence. Section 3 describes the data. Section 4 presents descriptive evidence on intergenerational mobility over two and three generations in the U.S., the U.K., and Germany: first, assessing multigenerational mobility as equalizer of dynastic inequality in 4.1; then, accounting for short-run and long-run mobility trends in 4.2; and lastly, applying non-parametric approaches in 4.3. Our test results on the theories of multigenerational persistence are presented and discussed in Section 5. Section 6 concludes.

2. Conceptual Framework and Literature Review

A widely accepted approach to the measurement of intergenerational persistence of socioeconomic status is to estimate the following linear regression model:

$$y_{it} = \alpha + \beta_{-m} \cdot y_{it-m} + \varepsilon_{it}, \quad (1)$$

where y_{it} is an outcome indicator of the socioeconomic status of individual i belonging to generation t, and y_{it-m} of her ancestors' outcomes that date back m generations. The slope coefficient β_{-m} describes how much of the outcome advantage or disadvantage is transmitted within families over m generations on average. Thus, it can be interpreted as the persistence of inequality between families over the course of time.

Such analysis is usually performed on two subsequent generations; that is, on parents and children. Since parents are arguably the most influential source for the formation of human capital, the association between parents' and children's outcomes is certainly of primary interest. Furthermore, although the channels of transmission are still not fully investigated, it generally seems plausible to assume a direct effect of parents on their children. Indeed, seminal theoretical contributions in economics on the intergenerational transmission of inequality build on a mainly two-generational setup (Becker and Tomes, 1979; Loury, 1981; Becker and Tomes, 1986; Solon, 1992). In addition, in many available datasets, it is possible and less complicated to link parents and children, in contrast to higher-ordered ancestors.

If the aim is to predict or extrapolate long-run mobility patterns, the straightforward method that follows from the regression-based procedure presented in equation (1) relies on a restrictive assumption, namely that the process is autoregressive of order one, and implies that

$$\beta_{-m} \approx (\beta_{-1})^m, \quad \forall m \varepsilon \mathbb{N}^+.$$

The finding of a directly estimated coefficient which is higher than the extrapolation would suggest that ($\beta_{-m} > (\beta_{-1})^m$) was defined as "iterated regression fallacy." Stuhler (2014), who introduced the term, proves and extensively discusses the drawbacks of the iteration-based extrapolation procedure for the analysis of multigenerational mobility (see also Braun and Stuhler, 2018).

The topic came up recently because of an increasing interest in the long-run persistence of economic inequality. A new wave of studies by economists and sociologists has emerged that analyzes intergenerational mobility over three or more generations using different methodologies. While older studies mostly did not reject the hypothesis that the underlying process of intergenerational transmission of socioeconomic status is of a Markovian nature—in other words, that the socioeconomic status of grandparents and older ancestors is totally mediated by the status of parents—recent studies basically reject this hypothesis and agree that the iterated extrapolation underestimates the long-run persistence of economic inequality. For instance, earlier empirical works on multigenerational mobility did not find any significant association between grandparents' and grandchildren's outcomes, when controlling for parental outcomes (Ridge, 1974; Peters, 1992; Warren and Hauser, 1997; Behrman and Taubman, 1985).[1] This first line of research was, however, more focused on testing the implications of a negative grandparental coefficient, as theorized by Becker and Tomes (1979), or finding a direct causal effect due to grandparents.

In contrast, recent studies test the iteration procedure against direct or grouped observational data over three or more generations. One of the first empirical studies to show that an extrapolation by iteration might not fully capture the actual degree of intergenerational persistence is that of Lindahl *et al.* (2015), using longitudinal data from the Swedish Malmö study. Other recent studies mainly support these findings, measuring intergenerational associations over three, four, or even more generations.[2] Two prominent approaches try to explain

[1]One exception is Hodge (1966), who rejects the hypothesis of a first-order Markov chain in the transmission of occupations. For a review of earlier literature on multigenerational mobility, see also Warren and Hauser (1997).

[2]Recent studies evaluate the intergenerational persistence of distinct outcomes over three or more generations, such as earnings (Lucas and Kerr, 2012; Lindahl *et al.*, 2015), wealth (Adermon *et al.*, 2018), occupation (Chan and Boliver, 2013; Hertel and Groh-Samberg, 2014; Knigge, 2016), education (Celhay and Gallegos, 2015; Kroeger, 2015; Braun and Stuhler, 2018), cognitive abilities (Hällsten, 2014), longevity (Piraino *et al.*, 2014), and mental health (Johnston *et al.*, 2013). Studies that measure the transmission over more than four generations mostly do not rely on direct family linkages, but instead use the informative content of surnames (Collado *et al.*, 2013; Clark and Cummins, 2014; Barone and Mocetti, 2015). Olivetti *et al.* (2014) estimate intergenerational mobility over three generations using first names. Other studies including higher-ordered ancestors in the analysis of intergenerational mobility are Maurin (2002) and Sacerdote (2005). The only studies, apart from the present work, to analyze multigenerational mobility in a framework including more than one country are Clark (2014) and Hertel and Groh-Samberg (2014). For recent exhaustive overviews, see Pfeffer (2014) and Solon (2014).

this divergence between the predicted and the actual degree of intergenerational persistence. The first argues in favor of a so-called *latent factor* that determines the transmission of socioeconomic status (Clark, 2014; Clark and Cummins, 2014). The second states that there is a direct and causal effect that grandparents exert on their grandchildren (Mare, 2011, among others).

A commonly adopted way to evaluate the statistical association between grandparents and grandchildren, abstracting from the mediating role of parents, is to estimate a regression which includes both the socioeconomic status of parents and grandparents:

$$y_{it} = a + b_{-1} \cdot y_{it-1} + b_{-2} \cdot y_{it-2} + \vartheta_{it}.$$

(2) Hereby, a positive significant coefficient of grandparents is often interpreted in the sense that an independent effect due to grandparents persists over and above the effect of parents. However, as Solon (2014), Stuhler (2014), and Braun and Stuhler (2018) point out, the observation of a significant coefficient for grandparental outcomes does not automatically signalize a causal relationship. A direct causal effect due to grandparents is a possible explanation, but omitted variable bias could explain a positive grandparental coefficient as well. Omitted variables could be, for instance, the education or occupational status of the other parent. *Ethnic capital*, understood as the quality of the ethnic environment in which parents make their investments, might be another factor of interest, and has been found to play an important role for the intergenerational transmission of human capital (Borjas, 1992). Indeed, the *latent factor model* argues that b_{-2} is positive and significantly larger than zero when estimating equation (2), because the variable included to measure the socioeconomic status of grandparents captures an unobserved part of parents' socioeconomic status which is fundamental for the intergenerational transmission mechanism; that is, any kind of endowment, such as abilities, preferences, or cultural heritage (see Clark and Cummins, 2014).

2.1. *The Latent Factor Model*

Braun and Stuhler (2018) formalize the association between the observable outcome y_{it} and the unobservable endowment e_{it} following the *latent factor model* as

$$y_{it} = \rho e_{it} + u_{it}, \tag{3}$$

$$e_{it} = \lambda e_{it-1} + v_{it} \tag{4}$$

in a one-parent one-offspring family setting, assuming that both error terms, u_{it} and v_{it}, are uncorrelated with other variables and past values. The parameter λ can be interpreted as a "heritability" coefficient and captures the degree of unobservable endowments passed on from generation $t-1$ to generation t. The parameter ρ is called the "transferability" coefficient and measures the scope of inherited endowments that can be converted into the observed outcome. If the variances of y_{it} and e_{it} are normalized to one, the observed correlation in outcome y between generation t and generation $t-m$ comes up to

$$\beta_{-m} = \rho^2 \lambda^m. \tag{5}$$

Therefore, multigenerational persistence is higher if both the degree of inheritability λ and transferability ρ are higher. As Braun and Stuhler (2018) show, estimating equation (1) for children's on parents' status and grandparents' status separately, using direct individual observations which can be linked over three generations (instead of grouped observations over surname groups as in Clark and Cummins, 2014), λ and ρ can be identified as follows:

$$\frac{\beta_{-2}}{\beta_{-1}} = \frac{\rho^2 \lambda^2}{\rho^2 \lambda} = \lambda, \tag{6}$$

$$\sqrt{\frac{(\beta_{-1})^2}{\beta_{-2}}} = \rho. \tag{7}$$

Since constant variances are assumed, the regression coefficients equal the correlation coefficients. Adopting this specification, Braun and Stuhler (2018) test the hypothesis made by Clark (2014) on the heritability coefficient λ, and on the existence of a "universal law" of multigenerational persistence; in other words, that the true rate of intergenerational persistence is almost the same in every country and time period. Using their own estimated correlations for Germany and the estimates in Lindahl *et al.* (2015) for Sweden, they find evidence against a constant heritability coefficient. Besides, their estimates for λ are significantly lower than the value suggested by Clark (0.75).[3]

2.2. *The Grandparental Effect Model*

Another branch of research tries to explain the excess persistence by arguing that differences in status inequality across generations are not exclusively transmitted from parents to children. Grandparents might exert a direct and independent effect on their grandchildren, too; for example, by investing in their grandchildren's human capital and by shaping their preferences while living in the same multigenerational household (e.g. Mare, 2011; Pfeffer, 2014). Other sorts of direct effects due to grandparents could lie in the genetic transmission of certain traits that "jump" a generation, the strength of family networks or reputation, and the role of inheritances. A discussion of the ways in which grandparents can affect their grandchildren can be found in, for example, Solon (2014) and Kroeger (2015). All these are possible explanations of a positive significant grandparental coefficient in equation (2) which go beyond technical issues such as measurement

[3]Further evidence against such a high heritability coefficient is provided in a recent study by Nybom and Vosters (2015) within a two-generational setup. Including multiple proxy measures of parental background in a single estimate of status persistence, the authors find no evidence of bias in prior estimates of social intergenerational mobility in Sweden.

error and omitted variable bias as discussed above.[4] So, to test for a direct effect due to grandparents, abstracting from merely technical reasons that drive the statistical relationship, requires an extension of the baseline model displayed in equation (2).

A common approach is to include additional variables to control for other socioeconomic characteristics of the parents. For instance, information on the outcomes of both fathers and mothers are included in the regression instead of taking only the highest or the mean of the two. In this way, unobserved characteristics that might explain the underlying transmission of status are covered more properly and a positive significant grandparental coefficient is a closer indicator of a direct relationship. However, the grandparental coefficient could still be biased upward due to the omission of other characteristics. *Ethnic capital* is an important feature that has been found to largely explain the different patterns of intergenerational transmission from parents to children between blacks and whites or natives and immigrants (e.g. Borjas, 1992). A similar relationship might also exist in a three-generational framework and is, thus, of particular importance. Our data allow us to analyze this aspect controlling for the migration background and race of individuals.

Another approach is to use information on direct contact between grandparents and grandchildren—or on a higher likelihood of contact between them—and compare the regression coefficients of individuals with and without direct contact with their grandparents. This method allows us to account for intergenerational effects from grandparents to grandchildren generated by direct contact abstracting from those direct links that should be the same for individuals with and without direct contact with their grandparents, which includes the genetic transmission of traits or the role of family networks. When information on exposure or coresidence are directly available, the analysis is straightforward. For example, Zeng and Xie (2014) show for rural China that the effect of grandparental education on school dropout is significantly stronger for coresident grandparents than for those who are not living in the same household as their grandchildren. However, when this information is not available, a common procedure is to use information on the year of death of the grandparents and check if the grandparent died before the grandchild was born, which is the identification strategy adopted also in the present study. Braun and Stuhler (2018) apply this strategy too, and find no significant difference between the regression coefficients of grandparents who died before their grandchildren were born and grandparents who were still alive.[5]

2.3. *The Universal Law of Social Mobility and the Role of Institutions*

A remarkable difference between the *latent factor model* and the *grandparental effect model* is related to their implications about the role of institutions to

[4]For an overview of factors that might explain the excess persistence see, among others, Solon (2014). A recent theoretical examination of multigenerational persistence based on *careers* can be found in Zylberberg (2016).

[5]Since Braun and Stuhler (2018) find a significant correlation between year of death and the education of grandparents, they present further applications using World War II as an exogenous source of variation in the time of death. All tests in this regard confirm their main results.

affect intergenerational mobility and the persistence of inequality. While the former argues that social policy interventions can only change short-run patterns of social mobility, without having any effect on the long-run effects of dynasties, the latter stresses the importance of the environment. Mare (2011) argues, for example, that the effect of grandparents on their grandchildren might vary between and within countries, and depend on the historical and institutional context. Indeed, recent empirical findings for different countries seem to confirm this theory. For instance, while the findings of Zeng and Xie (2014) point to the existence of a direct effect of coresident grandparents on their grandchildren in rural China, the application of LaFave and Duncan (2014) to Indonesia shows no effect of grandparental resources on grandchildren's human capital.

To investigate the importance of the institutional context and to test the hypothesis of a "universal law" of social intergenerational mobility, we propose a novel approach. First, we analyze time trends in the intergenerational persistence of human capital over two and three generations for different cohorts. Then, we pool the samples of the three countries and allow for country-specific intercepts. Technically, this procedure should reduce the omitted variable bias deriving from differences in institutions and enable us to evaluate whether a common pattern of behavior exists between societies in the transmission of inequality over two and three generations, while abstracting from characteristics which should be equally transmitted from grandparents and parents to children across countries. In addition, as mentioned above, our data allow us to control for migration or ethnic background. Thus, we are able to model potential between-group differences in intercepts (see Solon, 2014).

3. The Data

Our analysis is based on three very similar and nationally representative longitudinal household surveys: (i) the *German Socio-Economic Panel* (SOEP) for Germany; (ii) the *Panel Study of Income Dynamics* (PSID) for the U.S.; and (iii) the *British Household Panel Survey* (BHPS) for the U.K., which we extend by information from the followup survey *Understanding Society* (UKHLS). The use of these surveys has several advantages for our analysis. First, the datasets are highly comparable and they are designed following similar schemes. Indeed, the SOEP, PSID, and BHPS/UKHLS are part of the Cross-National Equivalent File (CNEF), where different datasets are harmonized for cross-national comparisons (see Frick *et al.*, 2007). Second, socioeconomic conditions of respondents and their family members are carefully reported over time, even when children leave their initial household. Third, the three datasets entail retrospective questions on parental characteristics. This information allows us to reconstruct the educational history of families over three consecutive generations. Since important structural differences affected individuals living in East and West Germany before and after reunification, we restrict our German sample to families residing in West Germany before reunification.

The main challenge is to find a measure for human capital and socioeconomic status that is (i) available for grandparents, parents, and children, and (ii) comparable across countries and generations. An ideal measure would account for generation-specific differences due to educational institutions as well as country- and time-specific differences in the capability to generate income in the labor market. We approximate these concepts with a widely accepted measure for the human capital stock of an individual: completed years of education. Completed years of education includes the regular years of schooling needed to obtain the indicated educational degree (measured in ISCED levels) and accounts for vocational training and tertiary education as well as for the skill level (measured in ISCO levels). Detailed information on the data and the exact codification of completed years of education for children, parents, and grandparents can be found in the appendices (in the Online Supporting Information).

The use of education to measure socioeconomic status reduces the bias generated by measurement error in intergenerational mobility estimates, since individuals tend to be well informed about their own and their parents' highest obtained educational attainment (Black and Devereux, 2011). Furthermore, in contrast to earnings, the highest educational attainment is obtained relatively early in life and is quasi-time-invariant over the life cycle. On the other hand, differential returns to education on labor-market outcomes across countries and over time challenge the usefulness of educational attainments as a proxy for socioeconomic status. In addition, due to the structure of the educational system, in the U.K. it might be less appropriate to adopt a continuous measure such as years of education when measuring intergenerational mobility than in the other two countries (as argued, e.g., by Dearden *et al.*, 1997). We address these issues by measuring mobility also by correlation coefficients (hence accounting for changes in the marginal distributions) and by adopting an outcome variable that indicates the relative standing of individuals and their ancestors.[6] To obtain this measure, which is conceptually even closer to the notion of human capital and is comparable across countries and time periods, we perform a linear transformation of the relevant outcome variables for grandparents, parents, and children. The transformation yields the standard score (Z-score) of educational achievements by cohorts:

$$z_{ijT} = \frac{y_{ijT} - \bar{y}_{jT}}{\sigma_{jT}}. \tag{8}$$

Here, $\bar{y}_{jT}$ and σ_{jT} are the mean and standard deviation of completed years of education of all individuals from generation $T\{t, t-1, t-2\}$ in cohort j. The cohort refers to the year of birth of children. This measurement gives the relative standing (in standard deviations) of an individual, and his or her parents and grandparents, with respect to their reference groups; that is, people competing with them in the labor market.

The main strength of this approach is the higher comparability between countries and time periods, accounting especially for the expansion of educational attainment in the second half of the 20th century that took place in all three

[6]Neidhöfer (2016) shows that measures capturing relative educational positions are closer approximations of socioeconomic status and more comparable over time than completed years of education.

countries under examination.[7] The Z-score is adopted to built quantiles of children's, parents', and grandparents' relative educational position that are used to display transition matrices and mobility curves. As a further robustness check, we also run the complete analysis using the Z-score of educational attainment instead of the completed years of education. As usually done in the literature, we will refer to the parents' and grandparents' education (educational position) as the completed years of education (the Z-score) of the parent and grandparent with the highest educational attainment (educational position) within the family (Black and Devereux, 2011). In further analyses, we also disentangle this measurement and analyze the education (educational position) of fathers, mothers, and all four grandparents, separately.

We draw the same sample in each survey. For our analysis, we need families that participated in the respective survey for at least two generations and where the first participating generation (parents; generation t-1) has available retrospective information on their father's or mother's educational attainments and occupation. We integrate this information to a measure for grandparents' education (generation t-2) and associate it with adult children (generation t) using the available information on educational attainment. Our samples consist of individuals born between 1960 and 1985 with available information on the educational attainment of at least one of their parents as well as their grandparents. In addition, individuals have to be at least 28 years old at the time of their last interview. The age restriction helps us to reduce bias due to uncompleted educational biographies and is justified empirically by observing patterns in our data: the mean of completed years of education is stable from the age of 28 onwards.

In all three countries, educational attainment has substantially increased over generations (descriptive statistics included in the online appendices). The U.S. sample shows the highest averages, while educational attainments are lower and rather similar in Germany and in the U.K. These patterns match with those found in other datasets on cross-national educational achievements.[8]

4. Descriptive Evidence on Multigenerational Mobility

4.1. *Dynastic Inequality*

First, we look at changes in the distribution of educational attainment over time. For this purpose, we measure the degree of inequality in the distribution of completed years of education for each generation and the degree of inequality in the distribution of family means across generations. The resulting analysis is close to that proposed by Shorrocks (1978) and mirrors the concept of dynastic

[7]Standardizing the outcome variables by adopting Z-scores yields regression estimates which are similar to the correlation coefficients (reported below the tables), with one important difference: The correlation coefficient is standardized by the variances of the entire sample, while our transformation compares individuals with their respective cohort. Furthermore, applying the transformation on the outcome variables instead of the estimated parameter allows us to test the coefficient of grandparents against zero, controlling for parents, within a simple regression.

[8]A comparison of mean years of schooling observed in the Barro–Lee data on educational attainment, as well as an analysis of selectivity issues regarding the analyzed sample, are included in the online appendices.

TABLE 1
Multigenerational Mobility as an Equalizer of Dynastic Inequality

	t	*t* – 1	*t* – 2	Family Mean	*M*(*S*)	*M*(*F*)
			(a) Germany			
Gini	0.117	0.107	0.136	0.101	0.719	0.256
s.e.	*0.0011*	*0.0015*	*0.0033*	*0.0016*	*0.0033*	*0.0144*
Theil	0.022	0.020	0.047	0.017	0.811	0.642
s.e.	*0.0004*	*0.0005*	*0.0033*	*0.0005*	*0.0090*	*0.0134*
CV	0.209	0.204	0.276	0.182	0.736	0.339
s.e.	*0.0020*	*0.0023*	*0.0062*	*0.0029*	*0.0052*	*0.0113*
			(b) U.S.			
Gini	0.089	0.100	0.144	0.090	0.711	0.376
s.e.	*0.0011*	*0.0013*	*0.0024*	*0.0012*	*0.0075*	*0.0069*
Theil	0.012	0.018	0.046	0.014	0.769	0.693
s.e.	*0.0003*	*0.0006*	*0.0013*	*0.0005*	*0.0160*	*0.0076*
CV	0.166	0.187	0.276	0.162	0.722	0.412
s.e.	*0.0035*	*0.0027*	*0.0038*	*0.0022*	*0.0087*	*0.0067*
			(c) U.K.			
Gini	0.100	0.153	0.208	0.113	0.754	0.454
s.e.	*0.0029*	*0.0036*	*0.0032*	*0.0020*	*0.0163*	*0.0130*
Theil	0.024	0.049	0.073	0.021	0.854	0.707
s.e.	*0.0017*	*0.0020*	*0.0027*	*0.0010*	*0.0147*	*0.0154*
CV	0.202	0.291	0.375	0.201	0.768	0.463
s.e.	*0.0054*	*0.0054*	*0.0052*	*0.0042*	*0.0114*	*0.0125*

Notes: Gini index, Theil index, and coefficient of variation. t, $t-1$, and $t-2$ are the generation of children, parents, and grandparents, respectively. “Family Mean” is the mean of completed years of education over three generations. *M*(*S*) is the mobility index proposed by Shorrocks: $M(S)=1-\frac{I\left(\sum_{T=t-2}^{t} y_T\right)}{\sum_{T=t-2}^{t} w_T I(y_T)}$, with $w_T=\overline{y_T}/\overline{y_F}$. *M*(*F*) is the mobility index proposed by Fields: $M(F)=1-\frac{I\left(\sum_{T=t-2}^{t} y_T\right)}{I(y_{t-2})}$. $I(\,)$ denotes the inequality index, y_T is the outcome in generation *T*, and $\overline{y_F}$ is the family mean. The closer the value is to one, the greater is the mobility in both indices. Bootstrapped s.e. with 100 replications.

Source: Own estimations based on SOEP (Germany), PSID (U.S.), and BHPS/UKHLS (U.K.).

inequality (Jäntti and Jenkins, 2015). Table 1 shows short- and long-run (dynastic) inequality for each country, as well as two indices to account for multigenerational mobility as an equalizer of long-term inequality. Three different inequality measures are applied that share the characteristic of strong Lorenz dominance, but differ in their sensitivity toward changes along the distribution: (i) the Gini index, which reacts more strongly to changes in the middle of the distribution; (ii) the Theil index, which is sensitive to changes in the lower middle part of the distribution; and (iii) the coefficient of variation (CV), which is more sensitive to changes at the top of the distribution. The two computed mobility measures are the ones proposed by Shorrocks (1978) and Fields (2010). The first relates dynastic inequality to the weighted inequality in all generations, while the second evaluates mobility as an equalizer of long-term outcomes relative to the initial shape of the distribution.

In all countries, we find decreasing inequality in completed years of education from the grandparents’ to the children’s generation. The U.K. shows relatively high inequality of educational attainments in the grandparents’ and

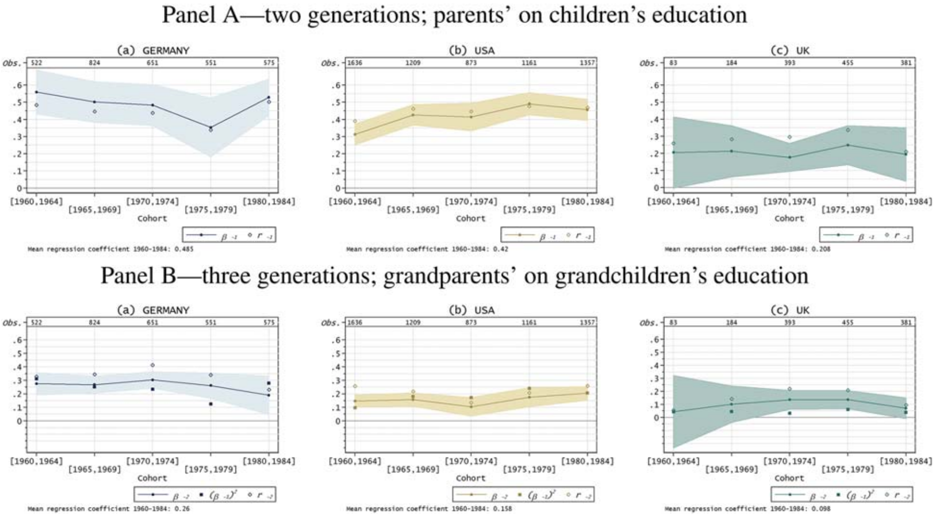

Figure 1. Multigenerational Mobility Trends—Regression (β) and Correlation (r) Coefficients
Panel A—two generations; parents' on children's education
Panel B—three generations; grandparents' on grandchildren's education
Source: Own estimations based on SOEP (Germany), PSID (U.S.), and BHPS/UKHLS (U.K.).

parents' generation, but also the highest degree of mobility. Inequality in children's completed years of education tends to be the largest in Germany. The U.S. tends to be the country with the lowest educational inequality. The evaluation of differences in mobility between Germany and the U.S. depends on the applied measure. Measuring mobility relative to the initial level of inequality—that is, in the grandparents' generation—Germany is less mobile to a larger extent than when measuring it with respect to the overall distribution.

It is expedient to compare short-run inequality with dynastic inequality. It has been argued that whenever dynastic inequality is less than inequality in any given generation, there was some equalizing mobility between generations (Jäntti and Jenkins, 2015). In our analysis, Germany is the only country where dynastic inequality is lower than cross-sectional inequality in every generation and for all measures. In the U.S., inequality in the children's generation is lower than dynastic inequality if measured by the Gini index and the Theil index. In the U.K., inequality in generation t is lower than dynastic inequality measured by the Gini index, but higher or equally as large for the other two measures. In conclusion, mobility acts as an equalizer of dynastic inequality in all three countries, especially in Germany, although the impacts on the distribution are of distinct magnitude.

4.2. *Multigenerational Mobility Trends*

In this section, we show trends in multigenerational mobility. Figure 1 depicts two indicators, which measure the degree of intergenerational mobility over two and three generations experienced by different cohorts: (i) the regression coefficient, β_{-m}, obtained by regressing children's education on parents' ($m = 1$) or grandparents' ($m = 2$) education, measured in completed years of education;

and (ii) the correlation coefficient, r_{-m}, which accounts for changes in the distribution of educational attainments ($r_{-m}=(\sigma_{-m}/\sigma_0)\beta_{-m}$). Here, σ_0 is the standard deviation of educational attainment in the children's generation.

Mobility patterns differ between countries. Panel A shows the two-generation case; that is, parents and children. Educational mobility is the lowest in Germany, with an average regression coefficient of 0.49, and is higher in the U.S. and the U.K., where the coefficients are 0.42 and 0.21, respectively. The development of mobility rates is, however, different between the U.S. and the U.K. Older cohorts show a relatively high degree of mobility in both countries, but mobility decreased in the U.S. by far more for younger cohorts than in the the U.K., where it remained almost unchanged. The correlation coefficients show similar patterns within countries. A major difference is that correlation coefficients tend to be smaller than regression coefficients in Germany, while they tend to be higher in the U.S. and the U.K. This relates to changes in the variance of educational attainment over time.

These results are in line with earlier findings on educational mobility over two generations. For instance, Hertz *et al*. (2007) report a correlation coefficient (r_{-1}) of 0.46 for the U.S. and 0.31 for the U.K. while our point estimates are 0.453 and 0.279, respectively (see also Tables 2 and 3). Unfortunately, the analysis of Hertz *et al*. (2007) does not include estimations for Germany. A comparable cross-country analysis including estimates of the rank correlation of the highest educational qualification of parents and children for the three countries is provided by Chevalier *et al*. (2009). Their average estimates for Germany, the U.S., and the U.K. are around 0.40, 0.38, and 0.25, respectively. The same ranking is confirmed by the analysis using PIAAC data included in OECD (2015).

An insightful finding is that application of the Z-score of educational attainment (described in Section 3) changes the country ranking between Germany and the U.S. regarding the association between parents' and children's outcomes (see the online appendices). Interestingly, as mentioned before, our results as well as previous studies on educational mobility have found the U.S. to be more mobile than Germany, while studies on income mobility over two generations have mostly found the opposite—or, at least, no significant differences—between the two countries (e.g. Couch and Dunn, 1997; Schnitzlein, 2012). Thus, we interpret our finding in the sense that the Z-score yields a better approximation of social status, which, indeed, was our primary goal when applying this transformation.[9]

Panel B shows intergenerational mobility over three generations; that is, grandparents and grandchildren. Although the coefficients are substantially smaller and somewhat more stable within countries, the ranking between

[9]Regarding intergenerational income mobility, the past evidence has been less consistent on the country ranking than on measuring educational mobility. Blanden (2013) surveys the literature and reports intergenerational elasticity estimates (i.e. regression coefficients of parental log income or earnings on the log income or earnings of their children) of 0.41, 0.37, and 0.24 for the U.S., the U.K., and Germany, respectively. This order between the U.S. and Germany has recently been confirmed by Bratberg *et al.* (2015), both in intergenerational elasticity as well as rank correlations. However, Schnitzlein (2012) finds that changing the sampling rules leads to very similar estimates of intergenerational earnings elasticities for the two countries; a result found in earlier studies, such as Couch and Dunn (1997).

countries is basically unchanged. On average, ten years of grandparental education are associated with an increase in grandchildren's education of about three years in Germany, one and a half years in the U.S., and less than one year in the U.K.[10]

4.3. *Transition Matrices and Mobility Curves*

Deeper insights into intergenerational mobility in a cross-country analysis can be derived from non-parametric approaches (Corak *et al.*, 2014). These give further insights into how structural mobility—for example, because of educational expansion—affects intergenerational mobility in each country and in which parts of the distribution mobility takes place.

First, we construct mobility matrices which show the percentage of children with low, middle, and high educational attainment for each class of grandparents' educational position; these are depicted in Figure 2. The educational attainment of children as well as the educational position of their grandparents is hereby based on the *Z*-scores of educational attainment as explained in Section 3. The three quantiles—low, middle, and high—display the position within the respective distribution of the cohort's educational attainment. The highest upward mobility from the bottom to the top of the distribution is observed in the U.S. and the lowest in Germany; 31.7 and 21.9 percent of children with high education have grandparents with low education, respectively. Interestingly, both countries show a similar persistence at the bottom of the distribution. For instance, in our samples for Germany and the U.S., about 53 and 54 percent of children with a low educational position have grandparents in the bottom part of the distribution. In contrast, only 37 percent of the individuals in our U.K. sample show this pattern. Furthermore, Germany shows the highest persistence at the top of the distribution with 47 percent, while in the U.S. and the U.K. the figures are about 37 and 39 percent, respectively.

Second, we compute *mobility curves* over three generations.[11] Figure 3 displays the average years of education and educational position of grandchildren for each level of grandparents' education and educational position. Hereby, the former accounts for absolute changes, while relative changes within the distribution are registered in the second. This method has the advantage of showing how absolute mobility differs over the distribution of grandparents' status. We find the differences between countries—especially between Germany and the U.S.—to be marked in the lower part of the distribution. For instance, the average education of grandchildren in the bottom part of the grandparents' distribution is substantially lower in Germany. In contrast, in the upper part of the distribution, the differences are smaller. Our sample for the U.K. shows a much flatter curve, signalizing higher mobility within the distribution. Generally, differences between countries are less pronounced when measuring social status by educational position rather than years of education. For instance, for lower than average

[10]To provide a further benchmark for our estimates, we can compare them with the regression coefficients estimated by Adermon *et al.* (2016) using Swedish registry data. Their coefficient of parents' on children's schooling is 0.264, while the coefficient of grandparents on children, not conditional on parental education, is 0.146.

[11]Mobility curves are usually applied to measure the mean income rank of children for each rank of their parents (see, e.g., Bratberg *et al.*, 2015). See also Chetty *et al.* (2014a).

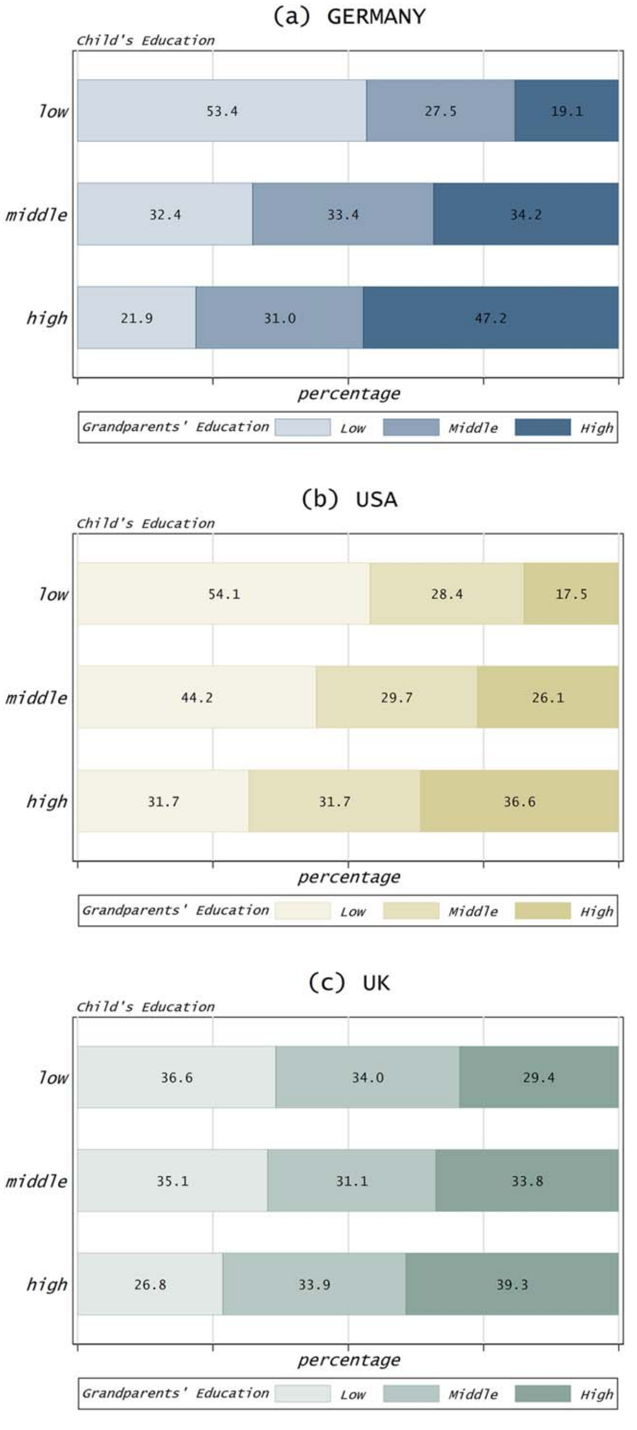

Figure 2. Transition Matrices by Quantiles of the *Z*-Score of Educational Attainment
Source: Own estimations based on SOEP (Germany), PSID (U.S.), and BHPS/UKHLS (U.K.).

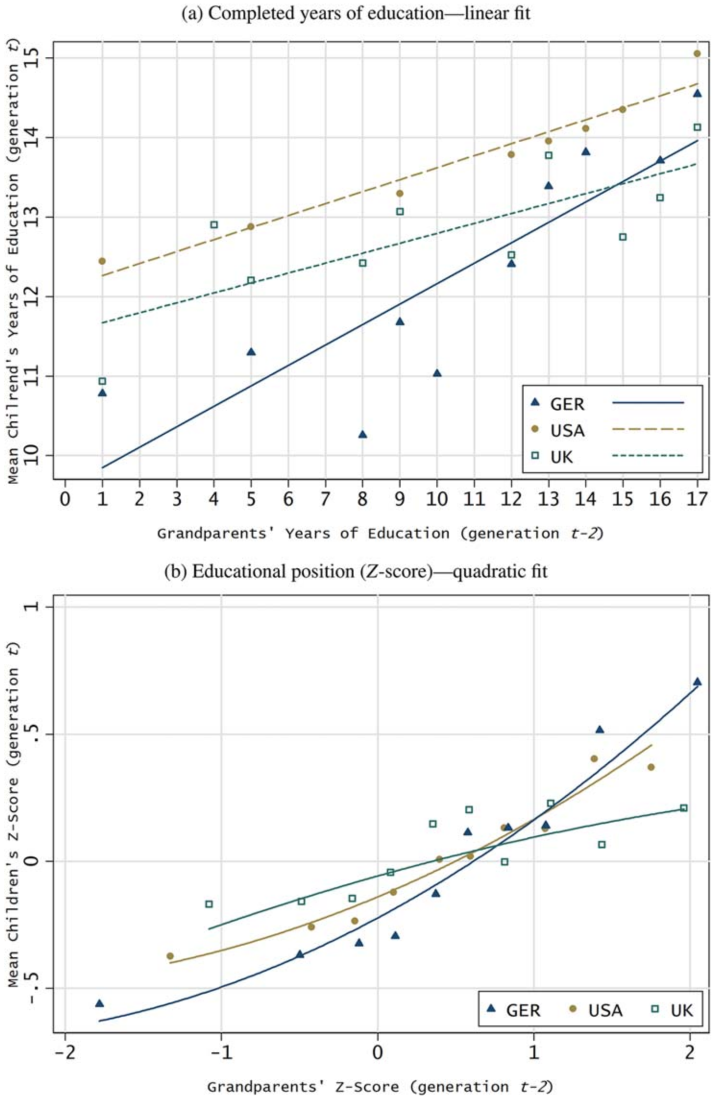

Figure 3. Mobility Curves—Mean Education of Grandchildren by Grandparents' Education
(a) Completed years of education—linear fit
(b) Educational position (Z-score)—quadratic fit
Source: Own estimations based on SOEP (Germany), PSID (U.S.), and BHPS/UKHLS (U.K.).

educational attainment of grandparents, the mean educational position of the children is lower than the mean of their reference group in all three countries.

5. Testing Theories of Multigenerational Persistence

5.1. *Iterated Regression Fallacy*

Table 2 shows our estimates of equation (1), where we separately regress children's education on parents' and grandparents' education, and equation (2),

TABLE 2

Regression Analysis. Outcome: Completed Years of Education

	(1)	(2)	(3)
	(a) Germany		
Parents (β_{-1})	0.484***		0.413***
	(0.0295)		(0.0394)
Grandparents (β_{-2})		0.258***	0.101***
		(0.0243)	(0.0297)
Observations	3,210	3,210	3,210
	(b) U.S.		
Parents (β_{-1})	0.400***		0.386***
	(0.0169)		(0.0195)
Grandparents (β_{-2})		0.167***	0.021
		(0.0137)	(0.0150)
Observations	6,303	6,303	6,303
	(c) U.K.		
Parents (β_{-1})	0.208***		0.189***
	(0.0284)		(0.0288)
Grandparents (β_{-2})		0.111***	0.047**
		(0.0210)	(0.0197)
Observations	1,532	1,532	1,532

(a) Germany: Correlation coefficients: $r_{-1}=0.451$, $r_{-2}=0.327$.
Test $(\beta_{-1})^2=\beta_{-2}$: $F=0.8984$, Prob $> F=0.3433$; $(\beta_{-1})^2=0.235$.
(b) U.S. Correlation coefficients: $r_{-1}=0.453$, $r_{-2}=0.254$.
Test $(\beta_{-1})^2=\beta_{-2}$: $F=0.2221$, Prob $> F=0.6375$; $(\beta_{-1})^2=0.160$.
(c) U.K. Correlation coefficients: $r_{-1}=0.279$, $r_{-2}=0.163$.
Test $(\beta_{-1})^2=\beta_{-2}$: $F=10.4645$, Prob $> F=0.0012$; $(\beta_{-1})^2=0.043$.

Notes: The tables show regressions of children's educational outcomes on the outcomes of the parent or grandparent with highest education within the family. Cluster adjusted s.e. at family level in parentheses. Statistical significance levels: * 0.1; ** 0.05; *** 0.01.

Source: Own estimations based on SOEP (Germany), PSID (U.S.), and BHPS/UKHLS (U.K.).

where we regress children's education on both parents' and grandparents' education. As commonly done in the literature, we only consider the education of the parent and grandparent with the highest educational level within the family (Black and Devereux, 2011). Estimates for the grandfather–father–son and grandmother–mother–daughter lineages are included in the online appendices and discussed below. The intergenerational correlation coefficients are reported below the tables. The outcome variable is completed years of education.

The regression coefficients of parents' education in column (1) and grandparents' education in column (2) confirm the patterns observed before; the U.K. shows the highest degree of intergenerational mobility, and Germany the lowest. In the regression analysis including both parents' and grandparents' education, in column (3), the grandparental coefficient is positive in each application, but only significantly different from zero for Germany and the U.K. According to these first results, we cannot reject the hypothesis for the U.S. that the intergenerational transmission of human capital follows an AR(1) process, while we reject it for Germany and the U.K.

Next, we test whether the directly estimated coefficients of grandparents are equal to those predicted by the iterative regression procedure; that is, squaring

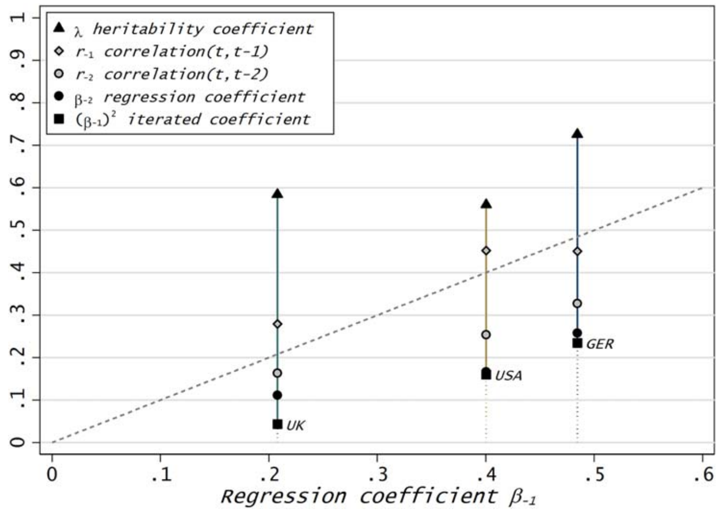

Figure 4. Summary and Comparison of the Estimated Coefficients
Source: Own estimations based on SOEP (Germany), PSID (U.S.), and BHPS/UKHLS (U.K.).

the coefficient of parents ($H_0 : \beta_{-2} = \beta^2_{-1}$). The tests are reported below the tables.[12] Although the estimated grandparental coefficients in column (2) are always greater than the squared parental coefficient, we cannot reject the hypothesis that they are equal for Germany and the U.S. Performing the same analysis for each cohort separately, we find that the squared parental coefficient neither systematically over- nor under-predicts the directly estimated grandparental coefficient (see Panel B of Figure 1).

As a further robustness check, we perform the same analysis adopting the Z-score of educational attainment measured in comparison to individuals of the same cohort. The observed patterns are the same, and the results do not change qualitatively when applying either measurement (see the online appendices).

So far, our cross-country results are mixed and show that the validity of the iterated regression procedure to extrapolate long-run mobility estimates varies by countries. The evidence for the U.S. suggests that there is no direct effect due to grandparents on grandchildren. However, such a clear statement cannot be made for Germany and the U.K. at this point of the analysis.

5.2. *The Latent Factor Model*

Table 3 details the parameter estimates to test the hypotheses of Clark's latent factor model described in Section 2.1. Using the correlation coefficients between children and parents, and children and grandparents, we calculate the heritability coefficient λ and the transferability coefficient ρ as in equations (6) and (7). Figure 4 sums up the estimated coefficients for each country.

[12]So far, this test procedure assumes that the coefficient β_{-1} is constant over generations. In Section 5.2, we relax this assumption, disentangling the analysis by different lineages of intergenerational transmission.

TABLE 3

Estimated Correlation (r), Heritability (λ), and Transferability (ρ) Coefficients

	Years of Education		
	Germany	U.S.	U.K.
r_{-1}	0.451	0.453	0.279
r_{-2}	0.327	0.254	0.163
λ	0.726	0.560	0.584
s.e.	*0.0602*	*0.0314*	*0.0937*
ρ	0.788	0.899	0.692
s.e.	*0.0464*	*0.0274*	*0.0832*

Notes: Bootstrapped s.e. (200 replications).
Source: Own estimations based on SOEP (Germany), PSID (U.S.), and BHPS/UKHLS (U.K.).

In our application, λ varies between 0.560 and 0.726 and ρ between 0.692 and 0.899. Clark's hypothesis that λ is larger than the correlation in observed outcomes is confirmed. However, the differences between countries are statistically significant: The difference between the estimates for Germany and the U.S. is statistically significant at the 10 percent level. The same is true applying the Z-score instead of completed years of education as the outcome variable; the range for the Z-score is 0.506–0.725 for λ and 0.717–0.937 for ρ. Furthermore, the heritability coefficient also varies over time: performing the analysis for different cohorts separately, we obtain different values of λ (see the online appendices). Hereby, in some of our estimations we cannot reject the hypothesis of a heritability coefficient being close to, equal to, or higher than 0.75. In Germany, for instance, some cohorts even display values of λ that are close to unity. However, in the U.S., λ is constantly and significantly lower than 0.75 for the cohorts 1965–9 to 1980–4. The results for the U.K. also suggest that λ is smaller than 0.75. All in all, we find no clear evidence in favor of Clark's hypothesis that the historical and institutional context does not matter for the movements of families along the distribution in the long run.[13]

Extensions: Lineages, Assortative Mating, and Sample Selectivity

As further extensions, we account for lineages within families and estimate the rates of assortative mating. When we disentangle the intergenerational transmission in different lineages following son–father–grandfather and daughter–mother–grandmother triplets, the overall results basically do not change (see the online appendices). However, gender-specific pathways in the transmission of social status across two and three generations are revealed to some degree. For instance, in all three countries, the regression coefficient of maternal education on the education of the daughter is higher than the coefficient of paternal education

[13]As Braun and Stuhler (2018) point out, a large variation in ρ among generations might lead to bias in the estimation of λ. We find large variations in ρ among cohorts in the children's generation, but cannot determinate the direction of the bias, since we have no information on the magnitude of ρ in the parents' and grandparents' generations. This information is necessary for a clear identification of Clark's hypothesis of time-varying λ. Future research with more comprehensive data on three or more generations over multiple cohorts should address this point.

on sons, while the coefficient of grandfathers on fathers is higher than the coefficient of grandmothers on mothers. Regarding the transmission over three generations, the size of the coefficients of grandfathers on sons and granddaughters on daughters is rather similar in all three countries. Disentangling the analysis by lineages helps furthermore to relax the main assumption made before testing the iterative regression fallacy, namely that the coefficient β_{-1} is constant. Identifying family lineages, we can take the coefficient of the association between grandfathers/-mothers and fathers/mothers and the coefficient of the association between fathers/mothers and sons/daughters and test their product with the actually observed coefficient of the direct association between grandfathers/-mothers and sons/daughters. This procedure cannot be applied in the main analysis, which associates the grandparent and parent with the highest degree with the child, since the grandparent and parent could be from different lineages; for example, the grandparent with the highest degree could be the maternal grandfather, while the parent with the highest degree could be the father of the child. Hence, the analysis of different lineages should be a proper sensitivity test for the AR(1) process in intergenerational persistence.

In Germany, the positive and significant effect on grandchildren due to grandparents, controlling for parents, seems to be mainly driven by the influence of grandfathers on their grandsons. These diverging findings might be explained by progressive changes in gender roles, as well as women's educational attainment and labor-market participation experienced in industrialized countries in recent decades that have led to a decrease in the association in observed outcomes between grandmothers and granddaughters. In this sense, the results for the U.S. are even more pronounced: there is a significant positive effect of both, grandfathers on grandsons, and grandmothers on granddaughters, if analyzed separately. These results indicate that there might be a direct, gender-specific grandparental effect on the educational attainment of grandchildren in the U.S. The fact that for both lineages we reject the hypothesis of an AR(1) process for the U.S. gives further support to this hypothesis. Finally, although some common forms of behavior of the intergenerational transmission exist, the country-specific differences found in the main analysis persist when disentangling by different lineages. Regarding the test of the latent factor model, the results point even more strongly at different heritability coefficients between countries, smaller than the hypothesized 0.75.[14]

We find substantial differences in assortative mating between countries and generations. The results discussed in this part of the analysis can be found in the online appendices. Spouse correlations in the parents' and grandparents' generation are about 0.6 and 0.8 in Germany, about 0.4 and 0.8 in the U.K., and about 0.6 in both generations in the U.S., respectively. Hence, assortative mating has decreased in all three countries—with the U.K. showing the largest changes between the grandparents' and parents' generation—but is still a prevalent phenomenon, possibly fostering the intergenerational transmission of social status.

[14]The coefficient r_{-1} used to estimate the heritability coefficient λ is the average of the correlation coefficients of sons (daughters) on fathers (mothers) and of fathers (mothers) on grandfathers (grandmothers).

Interestingly, among the three countries under evaluation, there seems to be a negative association between intergenerational mobility and assortative mating: in our analysis, the U.K. is the country with highest mobility and lowest assortative mating in the parents' generation, while Germany is the one with lowest mobility and highest assortative mating.

Finally, a sensitivity analysis shows that samples drawn from household surveys might be positively selected in educational attainments. We find that the average years of education of individuals in our samples—restricted by the condition of available information on parents' and grandparents' education—are around 0.5 years higher than the mean of the unrestricted sample, weighted by the inverse probability of selection. Furthermore, restricting the sample on the condition to have just information on parental education yields lower regression coefficients, with the bias ranging between 6 and 22 percent. Therefore, our results might be understood as an upper bound for intergenerational persistence. Since the selectivity issue and the direction of a potential bias seem to be the same in the three surveys, the cross-country analysis should hold, as well as the identification of mechanisms.

5.3. *The Direct Grandparental Effect*

Next, we test for the presence of a direct and independent effect due to grandparents following two different strategies. First, we include more variables capturing different features of parental background, to test whether or not the positive significant coefficient of grandparental outcomes is just an artifact of omitted variable bias. Second, we test whether the grandparental coefficient varies with the likelihood of grandchild's exposure to the respective grandparent. For this purpose, we use the time of death of the grandparent as the exogenous source of variation.[15]

Omitted Variables

First, we test for the general existence of a grandparental effect. For this exercise, we pool all datasets and perform a similar analysis as before; the results can be found in Table 4 Panel A. Our data are particularly suitable to control for omitted variable bias, since we mostly have information on both parents and all four grandparents. Furthermore, we can control for the influence of ethnic capital, an essential parental background characteristic, as a possible source of omitted variable bias.[16] In column (1), the coefficient of grandparental education is positive and significant, and gets slightly smaller when allowing country-specific

[15]As argued, for example, by Braun and Stuhler (2018), time of death might be correlated with unobserved factors that influence the intergenerational transmission and, therefore, not suitable as an exogenous source of variation. However, in our samples we do not find any clear association. The regression coefficient of time of death and grandparental education, measured in completed years of education and by the Z-score, is mostly not significantly different from zero. Also, the association between year of death and educational attainment when controlling for year of birth is very weak and mostly not statistically significant.

[16]Borjas (1992) originally controls for ethnic capital in the regressions by including the average skill level (measured in earnings) of migrant groups, clustered by their national origin. We adopt a more general approach, grouping individuals by their migration status in Germany or ethnicity in the U.S. and the U.K. As has been shown in previous studies, the intergenerational mobility of these groups differs significantly from the average mobility of the native population. Hence, controlling for these characteristics should reduce omitted variable bias substantially.

TABLE 4

TESTING FOR A GRANDPARENTAL EFFECT: CONTROLLING FOR MULTIPLE FEATURES OF PARENTAL BACKGROUND

Panel A—full sample. Outcome: completed years of education

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Grandparents	0.060***	0.046***	0.046***	0.042***	0.029**	0.016	0.018	0.014
	(0.0114)	(0.0116)	(0.0117)	(0.0117)	(0.0120)	(0.0122)	(0.0123)	(0.0124)
Parents	0.315***	0.369***	0.368***	0.369***				
	(0.0172)	(0.0186)	(0.0191)	(0.0195)				
Germany (0/1) × Parents		0.083**	0.083**	0.077**				
		(0.0336)	(0.0336)	(0.0353)				
U.K. (0/1) × Parents		−0.180***	−0.179***	−0.176***				
		(0.0333)	(0.0335)	(0.0339)				
Father					0.170***	0.189***	0.192***	0.192***
					(0.0138)	(0.0179)	(0.0180)	(0.0182)
Germany (0/1) × Father						0.128***	0.129***	0.122**
						(0.0472)	(0.0471)	(0.0477)
U.K. (0/1) × Father						−0.082***	−0.084***	−0.081***
						(0.0282)	(0.0284)	(0.0285)
Mother					0.188***	0.226***	0.227***	0.228***
					(0.0152)	(0.0237)	(0.0236)	(0.0238)
Germany (0/1) × Mother						0.065	0.067	0.061
						(0.0489)	(0.0488)	(0.0490)
U.K. (0/1) × Mother						−0.109***	−0.110***	−0.110***
						(0.0313)	(0.0313)	(0.0313)
Country F.E.	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Non-white or migrant	No	No	Yes	Yes	No	No	Yes	Yes
– (interacted with country f.e.)	No	No	No	Yes	No	No	No	Yes
Adj. R^2	0.1788	0.2069	0.207	0.2085	0.1912	0.2217	0.222	0.2237
Observations	11,045	11,045	11,039	11,039	9,769	9,769	9,764	9,764
Clusters	5,768	5,768	5,762	5,762	5,168	5,168	5,163	5,163

Table 4 *Continued*

Panel B—country-wise. Outcome: completed years of education

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	U.S.	U.S.	U.S.	GER	GER	GER	U.K.	U.K.	U.K.
Grandparents	0.020	0.001	0.002	0.096***	0.049*	0.048	0.044**	0.018	0.016
	(0.0152)	(0.0161)	(0.0162)	(0.0316)	(0.0296)	(0.0323)	(0.0198)	(0.0212)	(0.0211)
Parents	0.383***			0.414***			0.192***		
	(0.0202)			(0.0394)			(0.0290)		
Father		0.193***	0.195***		0.304***	0.304***		0.107***	0.110***
		(0.0177)	(0.0180)		(0.0463)	(0.0463)		(0.0223)	(0.0225)
Mother		0.233***	0.233***		0.270***	0.270***		0.117***	0.118***
		(0.0249)	(0.0249)		(0.0437)	(0.0438)		(0.0216)	(0.0215)
Non-white or migrant (0/1)	−0.095		0.074	−0.081		−0.025	0.763*		0.984**
	(0.1040)		(0.1096)	(0.1724)		(0.1853)	(0.4097)		(0.3921)
Adj. R^2	0.2055	0.2267	0.2267	0.2149	0.23	0.2297	0.08382	0.08496	0.09016
Observations	6,303	5,554	5,554	3,210	2,818	2,818	1,526	1,397	1,392
Clusters	2,065	1,898	1,898	2,192	1,890	1,890	1,505	1,380	1,375

Notes: Cluster adjusted s.e. at family level in parenthesis. The base category is the U.S. Statistical significance levels: * 0.1; ** 0.05; *** 0.01.
Source: Own estimations based on SOEP (Germany), PSID (U.S.), and BHPS/UKHLS (U.K.).

intercepts and slopes, as in column (2). To control for ethnic capital, in column (3) a dummy is included in the regression—it is one if the individual is non-white in the U.S. and the U.K., or has a migration background in Germany, and zero otherwise. This dummy is then interacted with the country fixed effects in column (4) to control for country-specific ethnic capital. The coefficient of grandparents decreases when controlling for ethnic capital and country-specific ethnic capital, but is still positive and significantly different from zero.

The next four columns, (5)–(8), control successively for the same characteristics as above, but include the completed years of education of both the father and the mother, instead of only including information relating to the parent with the highest degree. The resulting coefficient of grandparental education in column (5) is still positive and statistically significant, but rather small. The coefficient becomes not significantly different from zero when the father's and mother's education is interacted with the country dummies in the subsequent estimations, shown in columns (6)–(8). The coefficients of the control variables are mostly significantly different from zero and their inclusion increases the adjusted R-squared of the regressions. So, the persistence of a positive and significant coefficient for grandparental education observed before seems to be mainly driven by omitted variables, which cause bias in the estimation of the grandparental effect. We try to further reduce the bias caused by unobserved characteristics of parental social status, performing the same analysis applying the Z-scores of educational attainments. Indeed, in the joint analysis pooling the three samples, the coefficient of grandparental educational position measured by the Z-score is not significantly different from zero as soon as we control for the education of both parents (see the online appendices). The evidence so far, therefore, points against the existence of an independent and direct effect due to grandparents, once parental social status is accounted for properly.[17]

However, the fact that a general rule regarding the direct effect due to grandparents might not exist does not rule out specific differences caused by institutions. As argued, for instance, by Mare (2011), the effect of grandparents might vary by context and institutional characteristics could determine the magnitude of the effect. Indeed, we find heterogeneous profiles comparing the three countries. Panel B of Table 4 reports the estimated coefficients country-wise. For Germany, the coefficient of grandparents is significantly different from zero when controlling, first, for the parent with the highest education, and, then, for the education of both parents. The last evidence seems initially to be in contrast with the findings of Braun and Stuhler (2018), who find statistically insignificant coefficients in most of their applications controlling for both parents. However, Braun and Stuhler (2018) find, indeed, positive significant coefficients in two of their five samples, which are closer to our sample in terms of the years of birth of individuals and their grandparents. In our analysis, the coefficient of grandparents for Germany is no longer significantly different from zero if we additionally control for ethnic capital, besides the mother's and father's educational attainment.

[17]If we include all four grandparents in the regressions, the coefficients of all four are not statistically significant from zero when controlling for the education of the father and the mother (the results are shown in the online appendices).

The results for the U.K. show a positive and significant coefficient of grandparents controlling for parents and ethnic capital. The coefficient is, however, substantially smaller and not significantly different from zero as soon as we control for the education of both parents. Our results, therefore, only partly confirm the findings of Chan and Boliver (2013) on the persistence of social status over three generations in the U.K. For the U.S., the coefficient is persistently not significantly different from zero in all applications. This pattern confirms earlier findings on older cohorts for the U.S. by Peters (1992); Warren and Hauser (1997); Behrman and Taubman (1985).

Our results are qualitatively similar for the three countries when the outcome variable is the Z-score of educational attainment (see the online appendices). Interestingly, the results adopting the Z-score for the U.S. show a negative coefficient of grandparents when controlling for both the father and the mother, as found by previous studies on income mobility over three generations (Peters, 1992; Behrman and Taubman, 1985) and hypothesized by Becker and Tomes (1979). We interpret this as further evidence in favor of our supposition that the Z-score mirrors socioeconomic status properly.

Death of Grandparents

For the second exercise, we test whether the coefficient of grandparental education varies with the likelihood of interaction between grandparents and grandchildren (following Braun and Stuhler, 2018). Here, we use the information on the year of death of grandparents and the year of birth of grandchildren to check whether or not a direct interaction was possible between the two. Since the information on parental year of death is only available in the SOEP and the PSID, we restrict our analysis for this exercise to Germany and the U.S.

The estimation strategy is straightforward: equation (2) is estimated interacting the education of the respective grandparent with a dummy variable which is one if there was no possibility of direct interaction—that is, the grandparent died before the grandchild turned one year old—and zero otherwise. The results are shown in Table 5. If a direct interaction has a substantial effect, we would expect the coefficient of "dead grandparents" to be significantly lower than the coefficient of grandparents who were alive when the grandchild was born.

This hypothesis does not find clear support in our findings. Only dead grandparents on the mother's side show the expected negative coefficient with respect to the coefficient of living grandparents. If we subdivide the analysis, it is evident that this result is completely driven by our German sample. Again, we find cross-country differences in the evaluation of a direct effect due to grandparents. Identical patterns are observed when applying the Z-score as outcome variable. Of course, this strategy rules out only those effects that depend on direct interaction. There still might be important and persistent effects which derive from grandparents regardless of whether they were alive or not; for instance, family wealth, reputation, networks, as well as genetic traits that skip one generation. These cannot be clearly ruled out in this analysis. Our results show that direct interaction might only have a limited effect on

TABLE 5

Testing for a Grandparental Effect: Grandparents₃ Death as Exogenous Source of Variation in the Likelihood of Interaction

Outcome: completed years of education								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Father	0.368*** (0.0250)	0.367*** (0.0296)	0.330*** (0.0266)	0.359*** (0.0306)				
Mother					0.391*** (0.0290)	0.373*** (0.0350)	0.431*** (0.0328)	0.430*** (0.0366)
GF-F	0.047** (0.0186)	0.029 (0.0220)						
GM-F			0.055** (0.0229)	0.033 (0.0236)				
GF-M					0.086*** (0.0200)	0.106*** (0.0241)		
GM-M							0.040 (0.0278)	0.048 (0.0333)
Death=1 × GF-F		0.047 (0.0355)						
Death=1 × GM-F				0.075 (0.0521)				
Death=1 × GF-M						−0.067* (0.0378)		
Death=1 × GM-M								−0.033 (0.0571)

Table 5 *Continued*

Outcome: completed years of education	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Death=1		−0.479						
		(0.5481)						
Death=1 × Father		0.003						
		(0.0462)						
Death=1				0.459				
				(0.7046)				
Death=1 × Father				−0.093*				
				(0.0518)				
Death=1						−0.084		
						(0.5402)		
Death=1 × Mother						0.064		
						(0.0463)		
Death=1								0.425
								(0.8073)
Death=1 × Mother								0.005
								(0.0770)
Country F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,360	3,360	2,241	2,241	2,973	2,973	2,147	2,147
Clusters	1,871	1,871	1,309	1,309	1,797	1,797	1,311	1,311

Notes: GF/GM-F/M, grandfather/grandmother-father's/mother's side. Cluster adjusted s.e. at family level in parentheses. Statistical significance levels: * 0.1; ** 0.05; *** 0.01.

Source: Own estimations based on SOEP (Germany), PSID (U.S.), and BHPS/UKHLS (U.K.).

grandchildren's human capital, and confirm that these effects might vary with the cultural, historical, or institutional context.[18]

Our findings for Germany regarding maternal grandparents seem, however, to confirm earlier findings, and the hypotheses raised by family sociologists and human evolutionary scientists, on differential effects of maternal and paternal grandparents on grandchildren. The former argue that the emotional closeness between mothers and their parents explains the stronger effect of maternal grandparents on grandchildren. Evolutionary explanations instead mostly focus on the degree of assumed genetic relatedness. One theory states, for example, that the bias in grandparental investment might depend on *paternity uncertainty*: maternal grandparents know for sure that their daughter is the mother of their grandchild (although in the case of the maternal grandfather, there might still be some uncertainty about genetic relatedness), while the probability of relatedness on the father's side is usually smaller than one. However, to delve more deeply into the exact reasons and mechanisms behind the differences in grandparental effects would be to go beyond the scope of this work.[19]

6. Conclusions

This study has evaluated multigenerational mobility in a cross-country setting using harmonized survey datasets. On the grounds of highly comparable estimates, we have found some clear patterns. First, multigenerational mobility tends to vary with the historical and institutional context. We even find different effects of grandparental exposure on grandchildren's socioeconomic status by country and gender. Second, our finding of different heritability parameters across countries and time does not support the existence of a "universal law of social mobility." Third, the differences in long-run mobility rates in the U.S., the U.K., and Germany are in line with previous findings on cross-country differences over two generations (Hertz *et al.*, 2007; Chevalier *et al.*, 2009; OECD, 2015). Hence, our findings show that cross-country relationships, at least in this small sample of countries, hold aside from the timing of measurement, and that short-run mobility (i.e. over two generations) does not seriously over- nor under-predict long-run mobility patterns.

A strength of our findings, apart from the cross-country perspective, lies in the adoption of measures which should be suitable as *omnibus measures* for latent socioeconomic status with less measurement error (see Solon, 2014; Nybom and Vosters, 2015). In particular, our analysis using the relative position of grandparents, parents, and children should be especially useful in that sense, since it allows us to compare individuals and their ancestors with the corresponding reference group, namely people competing in the labor market broadly at the same time. An issue challenging our findings, and the analysis of intergenerational mobility

[18]These results are robust to the exclusion of people with a migration background. Furthermore, if we test the effect of overlapping lifetime years as continuous variable interacted with grandparental education, we do not find any significant variation in the association between grandparents and grandchildren by the years of possible interaction (see the online appendices).

[19]For a recent review of theories and empirical findings on differential grandparental effects, see Danielsbacka *et al*. (2015).

with household survey data generally, has turned out to be sample selectivity. We find that more highly educated people are more likely to have available information on their parents' and grandparents' education. In particular, families with higher education (which tend to have lower intergenerational mobility) are more likely (i) to participate in household surveys for more than one generation and (ii) to answer retrospective questions about their parents' education. Our intergenerational persistence estimates over two and three generations might, thus, be understood as an upper bound. Even with these upper bound estimates, we have found no support for a strong unobserved intergenerational transmission of socioeconomic status that is constant across time and space. Furthermore, since selectivity is the same in all three countries, the cross-country analysis should still be valid. On top of this, the identification of the mechanisms of multigenerational persistence should not be affected. Nevertheless, it might be important to address the issue of sample selectivity in future studies dealing with intergenerational transmission using survey data.

Other points worth mentioning are the uncovered different effects by gender and family lineages. Decomposing the analysis by the effect of (grand)fathers and (grand)mothers on (grand)sons and (grand)daughters, we find that significant differences exist between correlations and even direct effects. Interestingly, we find these patterns to differ across countries, confirming that historical, institutional, and cultural features matter for the intergenerational transmission of socioeconomic status.

To conclude, a relevant point is how our findings are related to income mobility. Previous studies covering two generations have demonstrated that rates of intergenerational mobility in education and income show the same broad picture, but are less than perfectly correlated. Since data on permanent income over three generations are rare, we have cross-checked our results by adopting a transformation that yields an outcome measure which is intuitively closer to the concepts of human capital and socioeconomic status than completed years of education. Our analysis has shown that our results adopting this transformation mirror past findings on cross-country comparisons of intergenerational income mobility. It might therefore be useful to deepen this methodological aspect in the future.

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Supporting Information

Appendix A: Data
Table A1: Descriptive Statistics
A.1 Harmonization