

INTERGENERATIONAL WEALTH MOBILITY AND THE ROLE OF INHERITANCE: EVIDENCE FROM MULTIPLE GENERATIONS*

Adrian Adermon, Mikael Lindahl and Daniel Waldenström

This study estimates intergenerational wealth correlations across up to four generations and examines the degree to which the wealth association between parents and children can be explained by inheritances. Using a Swedish data set with newly hand-collected data on wealth and bequests, we find parent-child rank correlations of 0.3–0.4 and grandparent–grandchild rank correlations of 0.1–0.2. Bequests and gifts appear to be central in this process, accounting for at least half of the parent–child wealth correlation while earnings and education can account for only a quarter.

This article studies the persistence of wealth status across multiple generations and how much of the intergenerational persistence is driven by direct inheritances from parents to their children. A large empirical literature has studied the intergenerational mobility of incomes (Solon, 1999; and Black and Devereux, 2011; for surveys) but much less is known about the transmission of wealth from parents to their children and the mechanisms underlying it.¹ This lacuna is unfortunate for several reasons. First, as is evident from the literature on life-cycle bias (Haider and Solon, 2006), it is important to find more permanent measures of economic status than what is captured by yearly income measures. In fact, wealth may be a better proxy for long-term economic success than earnings or income, as wealth reflects cumulative net incomes. Second, there has been an increased interest in questions related to multigenerational mobility in recent years (Solon, 2015). However, wealth has received limited attention in this literature.² Third, the importance of inherited wealth for economic inequality has recently attracted much attention in the academic literature (Piketty, 2011). One crucial yet largely overlooked

* Corresponding author: Adrian Adermon, IFAU, Box 513, 751 20, Uppsala, Sweden. Email: adermon@ifau.uu.se.

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¹ Exceptions include Menchik (1979), Wahl (2002), Charles and Hurst (2003), and Arrondel and Grange (2006). There are also a few recent papers by Boserup *et al.* (2014), Black *et al.* (2015), Fagereng *et al.* (2015) and Pfeffer and Killewald (2015). The classical article on the theoretical underpinnings is Becker and Tomes (1979).

² There are some recent exceptions: Boserup *et al.* (2014), using population-wide high-quality administrative data from Denmark and Pfeffer and Killewald (2015), using survey data from PSID, both have access to wealth data for three generations. However, in both these studies, in their main analysis, wealth is measured when grandparents and parents are relatively young: grandchildren (parents) are 37 (35) years of age on average in Pfeffer and Killewald (2015) and 23 (35) on average in Boserup *et al.* (2014). Given life-cycle considerations, this feature of their data sets will likely result in biased estimates of the associations between the wealth of grandchildren and grandparents.

aspect is the extent to which inheritance also influences inequality of opportunity, as measured by the degree of persistence of wealth status across generations.

This article makes two main contributions. First, we estimate the persistence of wealth inequality across several generations. We have access to wealth data observed at mid-life for individuals in three generations and during childhood/early adulthood for individuals in the fourth generation, which enables us to perform intergenerational wealth mobility estimations across adjacent generations as well as across three and four generations. We build on a growing body of literature that investigates the importance of multigenerational associations using data on outcomes such as income, education and occupation. A prime finding in this literature is that grandparents provide additional information about grandchildren's outcomes, conditional on parent's outcomes, and that long-run social mobility is slower than predicted from an estimate using data on parents and children.³ We follow the approach in earlier papers and estimate bivariate regression models of child's wealth on ancestors' wealth and we extend the standard first-order autoregressive (AR(1)) parent-child model by also including grandparents' wealth – and in some specifications, even great grandparents' wealth – in the regressions. These estimates constitute an improvement over earlier studies of long-term intergenerational wealth mobility in at least two regards: we are the first to estimate models for three generations, measuring the wealth of middle-aged individuals. Moreover, we are the first to present any evidence on the transmission of ancestors' wealth to the wealth of great grandchildren (although still young), where we are able to link families across generations through individual identifiers.⁴

Our second contribution is to quantify the importance of transfers to the intergenerational persistence in wealth. Bequests and gifts constitute an obvious channel through which wealth persistence arises across generations, and yet, there are few studies of how much of wealth mobility can be attributed to these transfers.⁵ Using

³ This statement is based on findings from a number of recent papers studying different outcomes and data sets from different countries: In addition to the few references studying wealth listed in footnote 2, additional studies include Adermon *et al.*, 2016; (outcomes: education, earnings and occupation; country: Sweden); Braun and Stuhler, 2017; (education and occupation; Germany); Clark, 2014; (education and occupation; various countries); Dribe and Helgertz, 2016 (social class, occupation and earnings; Sweden); Knigge, 2016; (occupation; Netherlands); Lindahl *et al.*, 2014, 2015; (education and earnings using the same data set as in this article); Long and Ferrie, 2013; (occupation; US); Modalsli, 2017; (occupation; Norway); Møllegaard and Jæger, 2015 (education and 'cultural capital'; Denmark); and Olivetti *et al.*, 2016 (earnings; US). For a survey that includes the older literature on multigenerational mobility, see Solon (2015). Recent theoretical contributions by Nybom and Stuhler (2016), Solon (2014) and Stuhler (2012) also discuss reasons for these empirical findings.

⁴ As opposed to Clark and Cummins, 2014, who use (rare) surnames to form linkages between multiple generations. They find strong wealth associations between individuals and their (surname-linked) ancestors.

⁵ A few very recent studies touch on this question. Fagereng *et al.* (2015), studying wealth transmission among 2,265 Korean-born adoptees in Norway, find that the association in wealth between adopted children and their adopting parents are not driven by gifts, *inter vivos* transfers or inheritances. However, given that the parents are between 64 and 66 years of age, there are likely very few in the children's generation that have actually received inheritances. Black *et al.* (2015), focusing on a sample of Swedish-born adoptees, and Boserup *et al.* (2016), using population-wide data for Denmark, both lack information on actual inheritances. Instead, they use the timing of death of the parent(s) to infer how the wealth transmission coefficient changes before and after the death of the parent(s). Both studies find a large increase in the wealth rank correlation after the death of parent(s), suggesting an important role for inheritances in explaining the transmission of wealth. Pfeffer and Killewald (2015), for the US, find that the parent-child wealth estimate decreases by about 11% when they add inheritances to the AR(1) model of parents' and child's wealth. The inheritances measure used is from a question in the PSID to respondents about large (above \$10,000) inheritances received (28% of the sample). Given that parents' age on average is approximately 72 when inheritances are last measured, it is likely that the majority of children have at least one living parent and, hence, that observed inheritances are very incomplete.

detailed information about inheritances hand-collected from individual inheritance tax records and thus perfectly matched to both decedents and their heirs, we make three types of estimation. First, we compute the overall importance of inherited wealth in children's wealth portfolios by relating the capitalised value of past bequests to total wealth. The second adds inheritances to the intergenerational wealth model and the third uses child wealth adjusted by subtracting capitalised bequests. This analysis adheres to the recent literature on the importance of inherited wealth in society for different economic and distributional outcomes.⁶

Because our data set contains measures of lifetime earnings and educational attainment for the first three generations, we are also able to investigate the importance of human capital for wealth transmission across generations.

We present a number of interesting findings. Our parent–child rank correlations are in the range of 0.3–0.4, which are larger than what has been found for other Scandinavian countries. Grandparent–grandchild rank correlations are in the range of 0.1–0.2, but the parent–child correlation is still almost unchanged if we control for grandparents' wealth. Bequests and gifts are found to be important, accounting for around half of the measured parent–child wealth correlation. By contrast, earnings and education together explain only approximately 25%.

1. Data and Descriptive Statistics

1.1. *Data and Variables*

The data set used in this study originates from a survey of all pupils in Malmö (the third largest city in Sweden) conducted when they attended 3rd grade in 1938. The typical child in this 'index generation' was born in 1928. Data were also collected for the parents, including survey information on the father's occupation and parental earnings from tax registers for several years. Much effort was spent on collecting the parental information, resulting in near-complete coverage (above 95%).⁷ It should be noted that the study population covers both the city of Malmö with suburbs and its rural surroundings, and this sample has been shown to be representative of the whole Swedish population at that time. For example, Lindahl *et al.* (2015) show that the distributions in education and earnings are very similar for descendants of those in the original sample compared to the population of Swedes. If we compare the cross-sectional distribution of wealth in our study population and the total Swedish population, documented by Roine and Waldenström (2009), trends appear to be roughly the same (inequality falls after the 1940s and stabilises from the 1970s onwards) but the level of inequality is clearly higher in Malmö than in the country as a whole.

⁶ A number of studies have examined the aggregate macroeconomic importance of inherited wealth (Piketty, 2011; Ohlsson *et al.*, 2014; Piketty *et al.*, 2014; Piketty and Zucman, 2015), whereas other studies investigate how inheritances affect the cross-sectional wealth distribution (Wolff and Gittleman, 2014 and Elinder *et al.*, 2016, for two recent examples).

⁷ The material was originally collected by Siver Hallgren and developed by Torsten Husén. Hallgren (1939) is the first study published using this data set. See also de Wolff and van Slijpe (1973), Palme and Sandgren (2008) and Lindahl *et al.* (2015) for a further description of the Malmö study dataset.

Information about spouses was added later, including information about dates of birth and death, earnings histories and educational attainments, all drawn from high-quality administrative registers. The result is a data set consisting of information on up to four generations of the same families, where the great-grandparents were typically born in the late nineteenth century and the great-grandchildren typically finished their education in the early twenty-first century. Because of the excellent quality of the Swedish registers, it has also been possible to add information for most of the descendants. For example, if they moved away from Malmö but stayed in Sweden, they are included in the data set.⁸

For this study, we have extended the data set by adding detailed information about personal wealth and inheritances. Our data on wealth are collected from official administrative records. For all generations, we observe tax-register wealth and, for the two first generations, we also observe wealth at death reported in estate inventory reports. Data on taxable wealth, wealth at death and inheritances for the first two generations were collected manually by the authors from tax registers stored in county archives. Because of the limited coverage of estate wealth for the second generation and inheritances received for the third generation, we do not use this information in the analysis.⁹

The definitions of assets, liabilities and net wealth are the same in principle for all generations and across the wealth tax records and the estate inventory reports. Non-financial assets include housing, urban and agricultural land and, to some degree, various kinds of valuables (consumer durables, antiquities, art etc.); financial assets include bank deposits and cash, stocks (listed and non-listed), some insurance savings and miscellaneous private claims; and liabilities include private loans (mainly mortgages) and student loans from state institutions. Some items are better covered in the estate inventory reports: for assets, the net life insurance proceeds and consumer durables, and for liabilities, funeral expenses, executor's commission, attorney fees and taxes paid (primarily, capital gains taxes).¹⁰ For the first two generations, assets are reported in tax-assessed values, which are generally (but not always) lower than current market values.¹¹ For more details on the wealth data, we refer to Appendix A.

The first generation's wealth measure is based on observed taxable wealth in 1945 and 1952; thus, it is measured around the ages of 48 and 55. Certain measurement issues warrant specific attention. For both years, wealth is bottom-coded, especially for 1952, when we only observe wealth for the wealthiest 8% of

⁸ Regarding the issue of mobility, we note that, in 1993, 38% of the third and fourth generations still lived in Malmö, an additional 31% lived elsewhere in the county where Malmö is situated, 8% lived in the county of Stockholm and the rest were quite evenly spread out in the rest of Sweden (Lindahl *et al.*, 2015).

⁹ The coverage is limited because only approximately one-third of the parents in the second generation had died at the end of our sample window.

¹⁰ A public investigation of private wealth in 1967 found that, when comparing estate inventory reports with the previous year's wealth tax returns of the deceased persons, personal assets (i.e. durables) and debts were much better covered in the estate inventory reports (SOU 1969, p. 276). See Henrekson and Waldenström (2016) for further descriptions of the Swedish inheritance taxation and the structure of estate inventory reports.

¹¹ Before World War II, tax-assessed values were generally aimed at being equal to market values but, in the post-war era, they have mostly been set with a discount: real estate was valued at 75% of market value and listed stock values have also been set at values lower than market value.

the population. For 1945, we observe all positive wealth holders, as long as positive wealth is indicated in the tax registers.¹² Hence, the left-censoring for the 1945 measure consists of those with around zero or negative wealth. We observe roughly the top 40% of the families to have positive wealth in 1945. This implies that, for most of the first-generation sample, we only use wealth in 1945. While such small coverage is problematic, it should be noted that the top tenth of the wealth distribution holds a sizeable share of total net wealth; looking at Sweden as a whole, the richest wealth decile held 83% of all wealth in 1945 and 75% in 1951 (Roine and Waldenström, 2009). In our empirical analysis, moreover, we present top decile regressions that circumvent much of the coverage problem. In subsection 2.2.1, we further examine if the different measurement issues of the first-generation wealth variable influence the results. Specifically, we impute wealth for the bottom-censored observations and use two alternative wealth measures: ‘capitalised wealth’ from a secondary source¹³ and ‘estate wealth’ (i.e. wealth at death, which is not bottom-coded). Our conclusion from these sensitivity tests is that, although there is measurement error in the wealth of the first generation, its impact appears to be quite limited and the estimates based on first-generation wealth are therefore unlikely to be severely biased.

The second generation’s wealth is based on taxable wealth observed in the administrative registers during the years 1985, 1988 and 1991 (thus measured at ages 57–63). Notable is that wealth in the first two of these years is censored from below at zero, whereas this is not the case for 1991, as different reporting routines at the tax authority after the Swedish tax reform of 1990–1. The third generation’s wealth is measured in 1999 and 2006 (thus around ages 42–49) in Statistics Sweden’s wealth register, and the fourth generation’s wealth is measured in 2006 (around age 20). Unlike the taxable wealth reported on tax returns that we use for the first two generations, the wealth-register data combine property tax data on non-financial assets with third-party (banks and financial intermediaries) reported statements on financial assets and liabilities. Note that the fourth generation is very young compared to the first three generations when we observe wealth and we, therefore, analyse their intergenerational outcomes separately from the main analysis.

Our preferred wealth measures for these four generations are constructed by averaging tax wealth (in 2010 prices) over the years available for each individual, using only non-missing years. In the estimations, we always use the sum of wealth across parents, grandparents, and great grandparents (‘family wealth’ for each ancestor generation) and individual wealth for the child generation.

¹² The lowest observed wealth amount is 900 SEK in 1945 (about 15,000 SEK today, which is equal to approximately 1,500 euro) and 2,900 SEK in 1952 (approximately 40,000 SEK or 4,000 euro).

¹³ This alternative wealth measure, ‘capitalised wealth’, divides tax-reported capital earnings (interest and dividend earnings) in 1937 (only men) and 1945 and 1952 (both men and women) by an assumed real rate of return of 3% and then averages across all three years. Capitalised wealth differs from taxable wealth by disregarding all the assets that do not yield taxable cash returns, not only most types of real estate and land, but also some financial assets, but to the extent that ownership of cash-yielding financial assets and total wealth is positively correlated, they can be expected to capture the same structures of intergenerational transmission studied here.

Estate wealth, or terminal wealth, of the deceased in the first and second generations is observed in estate inventory reports, which are filed for all individuals with wealth holdings.¹⁴ Since estate inventories are always filed individually, even though we wish to measure the joint parental wealth at death, we need to combine the value of two estates recorded at different points in time. In order to measure the joint parental estate wealth that accounts for the differential times of death and potential inter-spousal transfers from the first deceased parent to the remaining parent, we follow previous wealth mobility literature using estate wealth data (see Menchik, 1979; Wahl, 2002) and construct a specific measure, the peak midparent wealth, which is equal to $1/2[w_{\text{First deceased}} + \max(w_{\text{Second deceased}}, 0)]$.

Inheritances are the value of bequests from parents at death to their children in the second generations.¹⁵ The inheritance lot of each heir was calculated and reported by the tax authorities in inheritance tax records ('arvsskattestegar'), which were then attached to each deceased individual's estate inventory report. Because of the tax purpose, these inheritance lots were based on a close scrutiny of the probated wealth, accounting for wills if they existed and accounting for taxable *inter vivos* gifts made within 10 years of the testator's death. Note that, because of this source of inheritance information, we can observe exactly when inheritances were received. Combined with the fact that we observe this information for a very large fraction of the sample, our study makes a unique contribution to the understanding of how inheritances influence the intergenerational transmission of wealth.

Finally, we also have access to data on education for all four generations and earnings histories for the first three generations. We derive measures of years of schooling and log lifetime earnings in a similar way as in Lindahl *et al.* (2015).¹⁶ Just like for wealth, residualised earnings and years of schooling are averaged across ancestors for grandparents and for great grandparents. For more details on the education and earnings data, we refer to Appendix B.

1.2. Sample Restrictions, Sample Attrition and Descriptive Statistics

Our data set is based on 1,542 individuals in the 'index generation', which is the original population studied in the 1930s and the second generation in our multi-generational panel. Of these, 1,491 have at least one parent present in the data (1,426

¹⁴ These data were collected manually from the archives of counties all over Sweden where the individuals had died until 2001, when the Swedish tax authority took over the responsibility for storing all the country's estate inventory reports. Some of the deceased in our sample do not have estate inventory reports primarily as a result of the insignificance of their wealth, in which case only a so-called estate notification ('dödsboanmälan') was filed.

¹⁵ We do not include inheritances from others than the parents, i.e. siblings, other relatives or non-relatives. But as Elinder *et al.* (2016) show for Sweden and Wolff and Gittleman (2014) show for the US, almost two-thirds of inheritances received come from parents.

¹⁶ A few differences are that, to improve comparability with our wealth measures, we use family earnings instead of father's earnings and average years of schooling for parents. We also note that:

- (i) for the first generation, the education measure is available only for the fathers and is derived from information on occupation; and
- (ii) for four out of five years, earnings in the first generation are only available as the sum of labour earnings and capital earnings.

have both parents present). Wealth is observed for at least one parent for 1,291 individuals in the index generation and own wealth is observed for 1,356 individuals. For 1,147 of these, we observe both own and parental wealth, and this is our main analysis sample for the index generation. The main reason that we do not observe wealth for all parents is that wealth information is missing from the local tax registers for those that moved out from the county of Malmö or that were deceased before 1945.

For the third and fourth generations, we use as many observations as we can, given that they are descendants of these 1,147 individuals and that they are observed in the wealth registers (true for almost all individuals), resulting in 2,100 individuals and 3,755 individuals, respectively, in the third and fourth generations.¹⁷ Background characteristics for all four generations in our estimation samples are very similar to those in the original full samples.¹⁸ The sample for which we have access to estate wealth is slightly smaller (1,093 individuals in the first generation) and we observe inheritances given from the first generation for 809 individuals. These are the samples for which we show descriptive statistics in Tables 1 and 2.¹⁹

Table 1 reports descriptive statistics for our wealth variables for the individuals used in the estimations in this study. We present statistics for wealth for all four generations, estate wealth for generation one and two, and inheritances for generation two, in addition to the other variables used in the estimations. We show means and standard deviations (the first column), as well as various percentiles. All wealth and earnings measures are presented in thousands of SEK in 2010 prices (1 US\$ = 6.85 SEK in December 2010). Since we always use family wealth for ancestors' and individuals' wealth for descendants in our regressions, we show summary statistics separately for the second, third and fourth generation samples.

Looking first at the main wealth measures, we see that mean wealth more than doubled between the first and second generations (from 182,000 to 446,000 SEK) but grew at an even higher rate between the second and third generations (from 446,000 to 1,609,000 SEK). This is partly explained by the switch from using tax-assessed values to market values.²⁰ Because we measure the wealth of the fourth generation at a much younger age (19 on average) than for the earlier generations, they have an average wealth of only 103,000 SEK, which should be compared to the individual wealth levels for the second generation (255,000 SEK) and the third generation (705,000 SEK). It is also worth noting that wealth is more evenly distributed among the later generations than in the first, where most people have zero wealth, so the mean is driven by a smaller subset of relatively wealthy individuals. In subsequent generations, a majority of

¹⁷ If we relax this descendant requirement, meaning that we do not require that we observe wealth for grandparents, we can observe wealth for 2,579 individuals in the third generation and wealth for 4,592 individuals in the fourth generation. The estimated intergenerational rank–rank correlations are very similar for this larger sample.

¹⁸ Online Appendix Table E1 shows summary statistics for the full, unrestricted sample. Years of birth and death and years of schooling are almost identical to those reported in Table 2, and residualised earnings are close as well.

¹⁹ Summary statistics for the corresponding percentile-ranked variables, which we use in the actual estimations, are shown in the online Appendix Table E2.

²⁰ Included in the wealth measures for 1985 and 1988 is the tax value of real estate, which is 75% of market value. Because we also have separate information on real estate tax value, we can scale it up to market value and add the difference to the wealth measure. This reduces the number of zero (censored) observations by approximately 10% points, but this still does not have any influence on the main findings (see online Appendix Table E3, panel (a)).

Table 1
Summary Statistics: Wealth Distribution

	Mean (SD)	p10	p25	p50	p75	p90	Obs.
Panel (a): 2nd generation sample							
1st generation	182.3 (1,085.7)	0.0	0.0	0.0	76.1	247.4	1,147
1st generation, capitalised	56.9 (253.3)	0.0	0.0	0.0	16.5	98.7	1,147
1st generation, estate	194.8 (454.6)	0.1	24.0	72.5	193.3	445.4	1,093
2nd generation	254.9 (410.1)	-1.1	19.1	121.1	346.7	667.9	1,147
Inheritance	116.2 (203.3)	9.9	22.4	49.8	117.2	274.4	809
Panel (b): 3rd generation sample							
1st generation	185.3 (1,234.8)	0.0	0.0	0.0	57.1	256.9	2,100
1st generation, capitalised	64.6 (293.9)	0.0	0.0	0.0	12.7	101.9	2,100
1st generation, estate	203.2 (496.7)	0.0	19.6	67.4	181.3	451.3	2,012
2nd generation	445.9 (814.7)	-6.8	37.6	208.1	599.6	1,160.4	2,100
3rd generation	705.4 (2,045.8)	-162.8	-11.5	305.6	865.4	1,749.7	2,100
Panel (c): 4th generation sample							
1st generation	199.7 (1,344.0)	0.0	0.0	0.0	57.1	247.4	3,755
1st generation, capitalised	69.3 (311.9)	0.0	0.0	0.0	12.5	112.6	3,755
1st generation, estate	204.5 (498.2)	0.0	17.1	66.2	181.3	467.7	3,611
2nd generation	447.0 (816.6)	-5.3	38.1	205.7	610.9	1,177.6	3,755
3rd generation	1,608.7 (5,031.2)	-219.5	86.8	751.0	1,826.1	3,481.4	3,755
4th generation	102.6 (463.6)	-110.9	0.0	21.4	113.2	397.1	3,755

Notes. Table shows means with standard deviations and selected percentiles for the wealth variables. In panel (a) variables are individual-level for the 2nd generation and family-level for the 1st generation; in panel (b) variables are individual-level for the 3rd generation and family-level for previous generations; and in panel (c) variables are individual-level for the 4th generation and family-level for previous generations.

individuals have positive wealth.²¹ Wealth inequality appears fairly stable between the second and third generations but is much higher in the younger fourth generation.²² Unlike taxable wealth, estate wealth is not left-censored. Estate wealth is positive for

²¹ For the second, third and fourth generations, there are people with negative net wealth, whereas no cases with negative net wealth are reported for the first generation for tax-administrative reasons, as we mentioned above. To make sure that this censoring of the first-generation wealth does not affect our findings, we run sensitivity checks where we homogenise the wealth variables by censoring all of them from below at zero (see online Appendix Table E3, panel (b)).

²² Using the individual-level data, the P90/P50 ratios are 5.52 and 5.72, respectively, for the second and third generations and 18.6 for the fourth generation. Note that, because two of the three years used to calculate wealth for the second generation are censored from below at zero, it is difficult to compare the full distributions between generations.

Table 2
Summary Statistics: Covariates

	2nd generation sample		3rd generation sample		4th generation sample	
	Mean (sd)	Obs.	Mean (SD)	Obs.	Mean (SD)	Obs.
Earnings						
1st	−0.035 (0.499)	1,139	−0.035 (0.499)	2,083	−0.029 (0.509)	3,723
2nd	−0.083 (0.663)	1,142	−0.052 (0.590)	2,100	−0.057 (0.593)	3,755
3rd			−0.087 (0.720)	2,044	−0.036 (0.679)	3,741
Schooling						
1st	7.3 (1.7)	1,118	7.4 (1.7)	2,052	7.4 (1.7)	3,682
2nd	10.0 (2.9)	1,143	10.1 (2.5)	2,094	10.1 (2.6)	3,747
3rd			12.4 (2.6)	2,091	12.4 (2.3)	3,753
4th					12.7 (2.0)	1,553
Year of birth						
1st	1,897.8 (6.4)	1,147	1,897.9 (6.5)	2,100	1,898.0 (6.5)	3,755
2nd	1,927.9 (0.4)	1,147	1,921.8 (8.7)	2,100	1,920.7 (6.0)	3,755
3rd			1,956.6 (5.7)	2,100	1,956.2 (5.8)	3,755
4th					1,985.6 (8.4)	3,755
Year of death						
1st	1,973.0 (11.7)	1,146	1,972.9 (12.1)	2,098	1,972.9 (12.1)	3,752

Notes. Table shows means with standard deviations for residualised log earnings, years of schooling and years of birth and death. In the first set of columns, variables are individual-level for the 2nd generation and family-level for the 1st generation; in the second set of columns, variables are individual-level for the 3rd generation and family-level for previous generations; and in the third set of columns, variables are individual-level for the 4th generation and family-level for previous generations.

most of the individuals in the first generation (only 10% have zero or negative values). Inheritances are substantial in relation to own wealth, which represents a first indication that inheritances are likely to be an important channel for intergenerational wealth correlations.

Table 2 presents means and standard deviations for (residualised) earnings for the first three generations, year of death for the first two generations, and educational attainment and year of birth for all four generations. In the first generation, almost everyone has died, with an average age at death of 75.2. For the first generation, because wealth data are missing for many women, only around one-third of the sample is female.²³ Subsequent generations are virtually balanced in terms of gender because

²³ This is still an advantage over Lindahl *et al.* (2015), who observed earnings only for fathers in the first generation and for men in subsequent generations.

we observe wealth for almost everyone in these generations. Note that earnings and schooling are missing for a few individuals for whom we have wealth observations.

2. Wealth Transmission Across Two, Three and Four Generations

2.1. Graphical Evidence and Measurement Issues

We begin the empirical analysis by showing graphical evidence for the wealth relationship across the distribution. Figure 1 displays kernel regressions of children's wealth rank on their ancestors' wealth rank.²⁴ In each graph, the solid line shows the kernel regression estimate, grey lines along the bottom are rug plots showing the density of the data, while the dashed line indicates the best linear fit from a bivariate regression (to be discussed further below).

The association between parent and child wealth is quite well approximated by a linear specification, with the kernel almost tangent over most of the support in the parental wealth distribution. In the tails, however, there are deviations; in all parent–child graphs (*a*, *b* and *d*) there is an increase in the slope around the parental top decile group and, in panels (*b*) and (*d*), there seems to be a flat slope over the bottom decile group. Looking at the role of grandparent wealth in panels (*c*) and (*e*), the overall correlation is, as expected, smaller but otherwise very similar to that of parental wealth showing a largely linear association that becomes steeper at the top. Finally, panel (*f*) shows the regression of the fourth generation on their great grandparents. Here, the overall correlation is very flat but once again has a steeper slope at the top.²⁵ The linear intergenerational association in wealth with stronger transmission in the top decile and sometimes lower in the bottom deciles is similar to findings in previous studies, particularly the results for Denmark by Boserup *et al.* (2014) and for Sweden by Black *et al.* (2015).

We proceed to present two types of main estimation. The first is rank–rank correlations (the slope of the lines shown in the Figures), which have the advantage of allowing for observations with zero wealth and to be less sensitive to outliers and which have been used in several recent papers on intergenerational income and wealth transmission (Boserup *et al.*, 2014; Chetty *et al.*, 2014). Because of the non-linearity at the top of the distribution and the bottom censoring for first-generation wealth, we also present results from a second model, top decile regressions, in which we transform wealth into a binary variable taking the value of one for the top 10% of

²⁴ Chetty *et al.* (2014) show Figures plotting average child rank on the y-axis against parental wealth percentile. That approach corresponds to estimating a local constant kernel regression using a rectangular kernel and a bandwidth of 1. Our approach uses a more efficient local linear kernel regression with an Epanechnikov kernel, which is particularly important, given our smaller sample size. Note also that the variables have been residualised by regressing out birth cohort group dummies for both generations (see subsection 2.2), and the residuals have been rescaled to have the same range as the original percentile ranked variables.

²⁵ It should be noted that, because of the large number of observations with zero wealth in the first generation (see Table 1), there is a mass point close to the bottom of the distribution and relatively large confidence intervals in this domain, which results in a set of spikes in the rank assigned, where the spikes will be determined by the fraction of zeros (within birth cohort groups). For this reason, the lines stop at around the 25th percentile in Figures 1(*a*), (*c*) and (*f*), which calls for some caution in interpreting the patterns in the left part of the Figures.

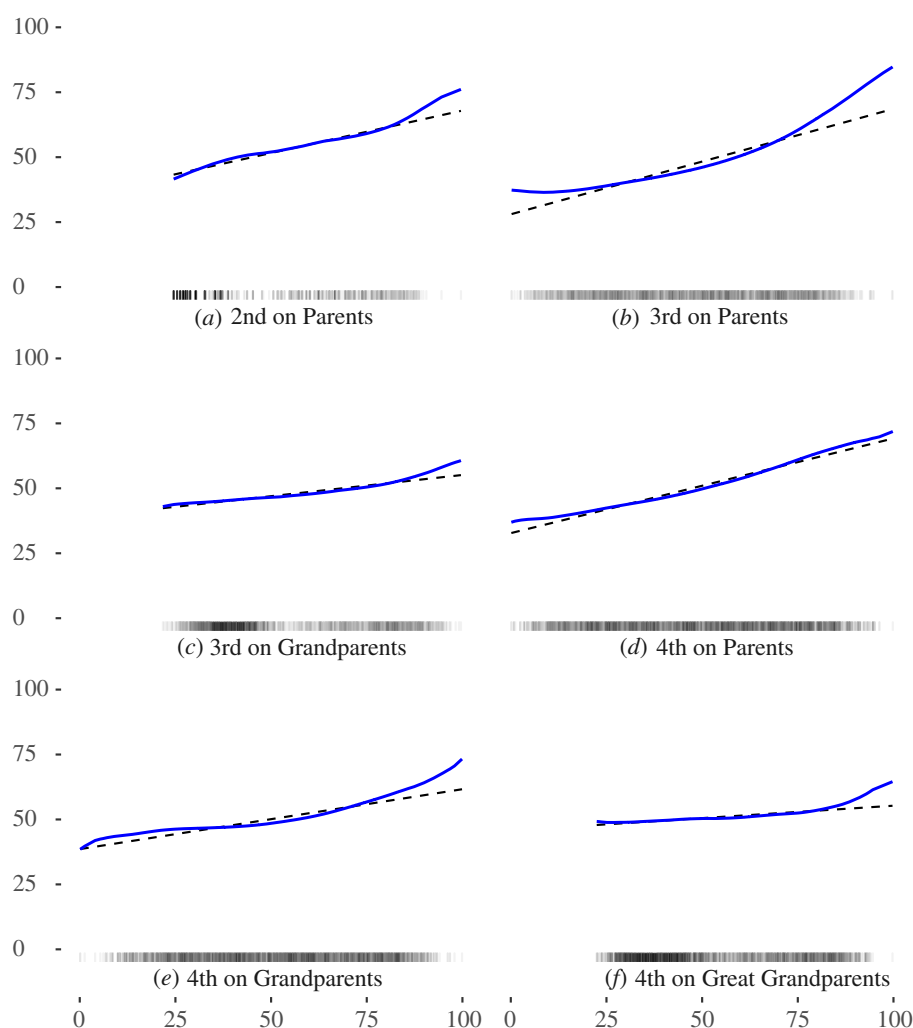


Fig. 1. *Kernel Regressions*

Notes. Solid lines show results from bivariate local linear kernel regressions using an Epanechnikov kernel and 0.12 bandwidth. The x -axis shows ancestors' wealth percentile rank and the y -axis shows descendants' wealth percentile rank. The variables have been residualised by regressing out birth cohort dummies for both generations and the residuals have been rescaled to have the same range as the original percentile ranked variables. Dashed lines show best linear fits and the vertical lines along the bottom show the distribution of observations across. Note that the lines stop at around the 25th percentile in (a), (c) and (f) because of the large number of observations with zero wealth in the first generation. Colour Figure can be viewed at wileyonlinelibrary.com.

the wealth holders in each generation. We choose the top decile²⁶ because this is where we approximately observe a steeper slope (see Figure 1) and because we have the advantage of having continuous wealth measures from two separate years at the

²⁶ Results are qualitatively similar if we use an indicator for the top 15% or for the top 5% instead – see online Appendix Table E4.

top of the wealth distribution for the first generation (hence minimising measurement error concerns when assigning observations to the top decile of the wealth distribution).

An advantage with the rank–rank and top decile regressions, compared to many alternative transformations, is that the consequences of mismeasurement of the zero wealth observations are limited as long as they are ranked correctly; this is important since 61% of the observations in the first generation have no wealth reported. If we use log wealth instead, we discard these zero-wealth families in the first generation (and also 18% of the individuals in the second generation) and would effectively estimate intergenerational associations for only approximately one-third of the sample, all located in top of the wealth distribution. If, in order to increase the sample for which we can use logarithms, we recode those with zero wealth to having some small wealth, our regression estimates are extremely sensitive to small variations in that wealth amount. An alternative that is sometimes used instead of logarithms is the inverse hyperbolic sine (IHS) transformation, which can be used in the presence of zero and negative observations (Pence, 2006). Unfortunately, the IHS transformation turns out to be sensitive to very small deviations from zero and is thus not suitable in the presence of bottom censoring (see the discussion in subsection 2.2.2). We therefore settle for estimating rank–rank correlations and top decile regressions in our main estimations. In a complementary analysis, we show results using alternative wealth measures for the first generation: estate wealth (which is not censored), and a wealth measure where we have imputed the bottom-coded observations using information on education and total earnings (including capital income).

2.2. Regression Results for the First Three Generations

Our baseline regression estimations are based on the following linear equation:

$$w_{it} = \alpha_0 + \alpha_1 w_{it-1} + \alpha_2 w_{it-2} + e_{it}, \quad (1)$$

where w_{it} is wealth of child i and w_{it-j} is wealth of the parents ($j = 1$) and the grandparents ($j = 2$). We use individual wealth for the child generation and family wealth for the parent and grandparent generations. In our main regressions, we use wealth measures scaled in percentile ranks (grouped by birth year), which means that the estimates can be interpreted as rank correlations.²⁷ All regressions include corresponding birth cohort group dummies. As mentioned above, we also estimate (1) as a linear probability model using indicators for belonging to the top wealth decile as dependent and explanatory variables. A coefficient from this regression measures the conditional probability of being in the top wealth decile, given that one's parents or grandparents were in the top wealth decile. Under perfect mobility, this probability would be 10%.

²⁷ Because of our limited sample size, it is not feasible to rank by birth cohort. Instead, we group birth cohorts so that each group has at least around 100 observations. While most such groups cover at most two or three cohorts, some groups in the tails span more cohorts (because the index generation is born in or around 1928, birth years follow a single-peaked distribution in our data set). To check if this grouping affects the results, we dropped these tail groups entirely from the analysis, and the results are mostly unchanged. We also increased group size to contain around 200 observations, and again, the results are mostly unchanged.

Table 3 presents the baseline results. Beginning with panel (a), columns (1) and (2) show two-generational rank correlations (with $\alpha_2 = 0$ in 1). A primary result is that there is a relatively strong wealth correlation: 0.30 between first and second generations and 0.39 between second and third generations. A second finding is that the wealth rank correlation appears to have increased over time and the difference is statistically significant. Columns (3) and (4) show three-generational rank correlations. Column (3) presents the rank correlation between the wealth of children and their grandparents ($\alpha_1 = 0$). The estimate is 0.17 and highly significant, which amounts to approximately 40% of the rank-rank correlation for parents and children in column (2).²⁸ Column (4) shows the results from estimating AR(2) regressions. Parents' wealth is basically unaffected by including grandparents' wealth and grandparents' wealth has a positive (0.04) but imprecisely estimated effect on a person's wealth status ($t = 1.37$).²⁹

Table 3
Wealth Regressions

	2nd generation	3rd generation		
	(1)	(2)	(3)	(4)
Panel (a): rank regressions				
Parents	0.296*** (0.033)	0.391*** (0.024)		0.382*** (0.027)
Grandparents			0.166*** (0.032)	0.041 (0.030)
R ²	0.077	0.174	0.044	0.181
N	1,147	2,100	2,100	2,100
Panel (b): top decile regressions				
Parents	0.178*** (0.041)	0.340*** (0.045)		0.323*** (0.046)
Grandparents			0.153*** (0.036)	0.061* (0.034)
R ²	0.052	0.135	0.044	0.145
N	1,147	2,100	2,100	2,100

Notes. Standard errors in parentheses are clustered on family. Dependent variable is 2nd generation tax-register wealth in column (1), and 3rd generation tax-register wealth in columns (2)–(4). Explanatory variables are tax-register wealth for parents and grandparents. In panel (a), all wealth variables have been percentile ranked within birth cohort groups. In panel (b), all wealth variables are dummy variables equal to one for individuals in the top 10% of the wealth distribution within their birth cohort group and zero otherwise. All regressions include birth cohort group dummies for all generations. *p < 0.10, **p < 0.05, ***p < 0.01.

²⁸ It should be noted that, in the main regressions (in this article and for earnings in Lindahl *et al.*, 2015), not all observations represent unbroken family lines. For example, it could be that we observe wealth for a person's father and maternal grandfather but not for their paternal grandfather. When we restrict the sample to only unbroken family lines, the grandparent–grandchild correlation is 0.136 (see online Appendix Table E5).

²⁹ Our main wealth measure for the first generation is based on data for two years, 1945 and 1952. For an alternative wealth measure 'capitalised wealth', which is the average taxed capital income in three years – 1937, 1945 and 1952 – divided by a real rate of return, we obtain very similar results (see online Appendix Table E3, panel (c)).

Panel (b)'s top decile regressions show a similar pattern as the results reported in panel (a). Persistence at the top is quite small in the second generation, with an estimate of 0.18, but relatively high in the third generation, with an estimate of 0.34, which is more than three times higher than under perfect mobility. Estimating the relationship between children and grandparents, we find that the persistence at the top is 15%, which amounts to 45% of the persistence between these children and their parents (column (2)). When we estimate the most general version of (1), we again see that parents' wealth is again unaffected by the inclusion of grandparents' wealth. However, grandparents' wealth has a positive estimated effect on a person's wealth status, which is now larger and a bit more precisely estimated ($t = 1.79$).³⁰ The coefficient estimate for grandparents in column (4) is larger, relative to the estimate for parents, in panel (b) compared to panel (a) (19% *versus* 11%). This might suggest differential non-linear associations across generations but it is also possible that measurement error in the continuous wealth measure for the first generation induces a downward bias in these estimates. Hence, we are unable to conclude convincingly that grandparents' wealth does not contain additional information explaining grandchildren's wealth, conditioning on parents' wealth.

2.2.1 Does Measurement Error in the First Generation's Wealth Matter?

The first generation's wealth in 1945 and 1952 is bottom-coded as described above. When correlating wealth across these two years, the 'raw' wealth including all the zeroes has a correlation of approximately 0.30, whereas only using the top group observed in 1952 (and in most cases in 1945 as well), the correlation is high, well above 0.9. In other words, wealth seems to be measured consistently over time and using both these years should therefore decrease the measurement error in the top decile measure significantly, which means that our top decile regression estimates are unlikely to be biased by measurement error.

The impact of measurement error due to the bottom-coding could be more important, especially for the rank–rank correlations reported in columns (1), (2) and (4) of Table 3, panel (a). One way to address this concern is to rerun the main specification from Table 3 but instead using alternative measures of first-generation wealth that are not bottom-coded: 'estate wealth', covering the whole distribution of wealth but measured at the end of life for individuals in the first generation;³¹ and 'imputed wealth', where the many bottom-coded observations in our main measure

³⁰ As expected from the Figures and the estimates shown in Table 3, there are some non-linearities, which result in larger estimates at the top of the distribution. We show elasticities and rank correlations estimates in online Appendix Table E6 (panels (d) and (e)) for the sample with positive wealth amounts (approximately one-third of the three-generation sample), where we find that child-grandparent wealth estimates (regardless of whether we control for parents' wealth) are larger than the rank correlations for the full sample in panel (a) of Table 3 but more in line with the top decile regression in panel (b). Interestingly, the elasticities and rank correlations for the smaller sample with positive wealth are similar regardless of whether we estimate elasticities or rank correlations. Hence, the selected sample – not whether we use ranks or logs – explains these results. In panels (a)–(c), we also show the sensitivity of the results when we use the IHS-transformed wealth variables: even very small variations in the bottom-coded values (making minor adjustments to everyone in the first generation with exactly zero wealth, by giving tiny amounts (10 or 1,000 Swedish kronor, equivalent to 1 or 100 euro, respectively)), can have enormous effects on the estimates.

³¹ The rank correlation between the main wealth measure and estate wealth is 0.52. Hence, these measures, although clearly related, contain a great deal of independent information.

have been imputed using family total earnings (including capital income) and years of schooling.³² Results for these measures are shown in Table 4. For estate wealth (panel (a)), there is a notably smaller grandparental estimate in the AR(2) model regression, which is likely to be because estate wealth is highly correlated with inheritance, which is not typically transferred to grandchildren.³³ The results in panel (b) show that the ‘imputed wealth’ measure generates results very similar to the baseline findings above.³⁴ Transmission of parental wealth is large and significant for both the second and third generations, though it is clearly higher in the latter case, underlining the possibility of a downward time trend in wealth mobility. Grandparental wealth is significantly positive when included on its own but statistically insignificant when parental wealth is also included. We show kernel regressions of children’s wealth rank on their parents’ and grandparents’ rank for the various measures (corresponding to Figure 1) in online Appendix Figure E1.

The second test is to impose bottom censoring on second-generation wealth at the same place (around the 60th percentile) as for first generation wealth and re-estimate the rank–rank wealth correlation between the third and second generations using a censored second generation wealth measure. The resulting estimate increases to 0.44, which suggests that the increase over time is even more pronounced. If we then impute the second-generation wealth measure and use that measure in the estimations, the estimate becomes 0.39, which is very close to the actual estimate in column (2) of Table 3.³⁵ Hence, imputation works very well, which gives credibility to our estimates involving first-generation wealth in panel (b) of Table 4.

2.2.2 Summarising and Interpreting Findings from the Three-generation Regressions

Let us briefly summarise the central results from the three-generation regressions and relate them to findings in the literature. There is a relatively strong wealth correlation: it is 0.30 between the first and second generations and 0.39 between the second and third generations. The latter estimate can be compared to recent estimates of rank correlations in wealth for Scandinavian countries and the US: it is clearly larger than the ones reported for Denmark in Boserup *et al.* (2014) and for Norway in Fagereng *et al.* (2015), slightly larger than the one reported for Sweden in Black *et al.* (2015) and very similar to the estimate reported in Pfeffer and Killewald (2015) using US survey data from the PSID. An earlier well-known study by Charles and Hurst (2003), which also used PSID data but a log-log specification, found a wealth elasticity of approximately 0.36. Because of bottom-coding of first-generation wealth, we are not able to estimate wealth elasticities connecting the second and first generations credibly. However, the wealth elasticity between the third and second generations is

³² Imputation is based on estimating a tobit regression and predicting wealth ranks for the censored observations. We perform bootstrap imputation with 1,000 draws to account for the uncertainty in the prediction step. Correlations with the main wealth measure are 0.35 for earnings and 0.20 for years of schooling.

³³ If we impute the bottom-coded wealth observations with the rank based on estate wealth, we obtain very similar results, as reported in panel (a) of Table 3 (see online Appendix Table E3, panel (d)).

³⁴ We decided not to use one of the measures as an instrument for another because estate wealth captures a different aspect of wealth, and because the imputed measure is partly determined by education and earnings, which are unlikely to be excludable in the second stage.

³⁵ See online Appendix Table E7.

Table 4
Wealth Regressions, Alternative Measures for 1st Generation

	2nd generation	3rd generation		
	(1)	(2)	(3)	(4)
Panel (a): estate wealth for 1st generation				
Parents	0.334*** (0.030)	0.389*** (0.025)		0.388*** (0.027)
Grandparents			0.144*** (0.028)	0.003 (0.026)
R ²	0.133	0.266	0.052	0.185
N	1,093	2,012	2,012	2,012
Panel (b): imputed wealth for 1st generation				
Parents	0.267*** (0.029)	0.392*** (0.024)		0.381*** (0.027)
Grandparents			0.162*** (0.028)	0.044 (0.027)
N	1,120	2,053	2,053	2,053

Notes. Standard errors in parentheses are clustered on family. Dependent variable is 2nd generation tax-register wealth in column (1) and 3rd generation tax-register wealth in columns (2)–(3). 1st generation wealth (parents in column (1), grandparents in columns (2)–(3)) is wealth at death from estate records in panel (a) and, in panel (b), the censored observations of the wealth variable have been imputed (see text for details). Note that the estimates in column (2) are not affected by the alternative wealth measures but that they deviate from the baseline estimate because of small variations in the samples. All wealth variables are percentile ranked within birth cohort groups, and all regressions include birth cohort group dummies for both generations. *p < 0.10, **p < 0.05, ***p < 0.01.

0.32 in our data ($n = 1,609$ or approximately 75% of the total sample), only somewhat lower than our wealth rank correlation of 0.39.³⁶

The wealth rank correlation has increased over time and the difference is statistically significant, which is a somewhat surprising finding, given that Lindahl *et al.* (2015), using the same data set as in this article, did not find this to be the case for schooling and earnings.³⁷ The mechanisms for wealth transmission may be different from those for schooling and earnings, and the importance of these various mechanisms may have also evolved differently over time. As we show below (Section 4), the importance of schooling and earnings in explaining wealth transmission across generations has not changed over time. Based on the analysis in the previous Sections, we do not think that measurement error at the top of the distribution or bottom-coding of the first generation wealth measure can explain this trend. However, it should still be remembered that the wealth measures are not exactly comparable across generations (see subsection 1.1) and that the sampling of the data set is such that comparisons of intergenerational estimates over time is not straightforward.³⁸

³⁶ The difference compared to our rank correlation appears to be driven entirely by sample selection, as the rank wealth correlation is 0.29 using this sample of $n = 1,609$.

³⁷ When we compare results with Lindahl *et al.* (2015), we always use the standardised coefficient estimates (Mean = 0; SD = 1) reported in that article.

³⁸ As explained in Section 1, the data set is based on the population of 6th graders attending schools in Malmö in 1938. This second generation (and their parents) is therefore representative of the population of 6th graders in Malmö at that time. However, the third generation are descendants of these individuals and hence not necessarily representative of the population of 6th graders in Malmö at that later time (they can, for instance, have relocated to other parts of Sweden, whereas immigrating families to Malmö are not represented).

Another central finding is that grandparents' wealth has a positive but imprecisely estimated effect on a person's wealth status, conditional on parental wealth. Both Boserup *et al.* (2014) for Denmark and Pfeffer and Killewald (2015) for the US are also able to estimate AR(2) models for wealth and find quite large grandparental wealth effects, conditional on parents' wealth. The conditional grandparental estimate is 72% of the unconditional estimate in Boserup *et al.* (2014) and 49% in Pfeffer and Killewald (2015), whereas in our study, it is 25% (the OLS estimates reported in panel (a) of Table 3) or 40% (the top decile regressions in panel (b)). Hence, assuming that our top decile regression is less sensitive to measurement error, our estimated conditional grandparent effect is only somewhat smaller than these studies. It should also be remembered that the parents and children are quite young in both these studies, which indicates a larger role for grandparents because grandparents are more important in the younger life of parents and grandchildren and because measuring wealth of parents in their 30s will not accurately measure their mid-life wealth. As the grandparents are relatively older (47 in Boserup *et al.*, 2014; and 62 in Pfeffer and Killewald, 2015), their wealth is better measured and will therefore capture some of this missed variation. The importance of grandparents' wealth will thus be overestimated and that of parents' wealth will be underestimated. However, we note that a 95% confidence interval around our main estimate for grandparental wealth covers the main estimate in Pfeffer and Killewald and an estimate in Boserup *et al.* for an older sample.³⁹

How do these results match those reported in Lindahl *et al.* (2015), where the AR(1) model was rejected for schooling and (marginally) for earnings? As it turns out, our results for wealth are not statistically significantly different from those for earnings, partly due to the poor precision of the estimated coefficients for grandparents in the AR(2)-model for both these outcomes.⁴⁰

Clark (2012) and Clark and Cummins (2014) propose a simple model of the evolution of wealth over time, where the parameter 'long-run intergenerational persistence in social status' is estimable using data on at least three generations (see Appendix C). If we calculate this parameter using the data in this article, we obtain an estimate equal to 0.48 for wealth, which should be compared to 0.49 for earnings and 0.71 for schooling using the estimates in Lindahl *et al.* (2015). Comparing these long-run estimates to the bivariate estimates using data on two generations, we conclude that long-run intergenerational mobility is somewhat overstated using data on only two generations for wealth.⁴¹

Alternatively, one can calculate the implied grandparent-grandchild association by taking the product of the bivariate parent-child regression coefficients for the second

³⁹ The conditional grandparental coefficient estimate decreases slightly (by 22%) in an AR(2) regression in Boserup *et al.* (2014) when they instead use an older sample (but one that suffers from potential selection issues).

⁴⁰ Estimating the grandparental wealth association in the AR(2)-model precisely enough to draw strong conclusions clearly requires more data. Note that Lindahl *et al.* (2015), in their AR(2) regressions, found standardised conditional grandparent estimates [95% CI] of 0.110 [0.054, 0.166] for years of schooling and 0.064 [−0.004, 0.132] for earnings, whereas for wealth, we find 0.041 [−0.019, 0.101] using the same generations. Hence, trivial effects can be ruled out only for schooling and large effects cannot be ruled out for any of the outcomes.

⁴¹ The average of the two-generation wealth estimates in panel (b) of Table 3 is 0.34, whereas they are 0.32 for schooling and 0.29 for earnings using the estimates reported in Lindahl *et al.* (2015).

and third generations and compare it to the coefficient from the bivariate regression of grandchildren on grandparents for the third generation. The argument is that, if the latter is larger than the former, some of the information contained in the measure for grandparents is transmitted to grandchildren, independently from the information contained in the measure for parents. Lindahl *et al.* (2015) found that the grandchild-grandparent estimate was twice as large as expected from the bivariate regression estimate for parents and children for years of schooling and approximately 50% larger for log earnings (using standardised coefficient estimates). In the present article, we see that the grandchild-grandparent estimate in panel (a) of Table 3 is 43% larger than expected from the bivariate regression estimate for parents and children ($0.296 \times 0.391 = 0.116$ compared to 0.166). Hence, the extrapolation error (Stuhler, 2012) is very similar for earnings and wealth using this data set.⁴²

Finally, and as a consequence of the prior reasoning, the parent-child wealth rank correlation is unaffected if we control for grandparents' wealth. Hence, even though grandparents' wealth is quite predictive of grandchildren's wealth, we must conclude that most of this link appears to be mediated by parents' wealth. We note that, similar to wealth in this study, Lindahl *et al.* (2015) also found that the parent-child estimates were not much affected by controlling for grandparents' outcomes (the estimate was somewhat lower for schooling but very similar for earnings). This rationale also explains why we focus on the parent-child estimates when we later turn to investigating mechanisms.

2.3. *Wealth Persistence Across Four Generations*

The long-run reach of our data set allows us to estimate wealth regression models using individuals from four consecutive generations, which appears to be a unique contribution to the literature. The fourth generation in our data set is made up of children, adolescents or young adults, making this a sample of individuals who themselves have had no or very little time to acquire wealth. Hence, because the mechanisms differ, compared to intergenerational associations using mid-life wealth for all generations, we should be careful in comparing the results here with those in the previous Sections.

Table 5 presents the results of the four-generation regressions. The parental wealth-rank correlation in column (1) of panel (a) is high, approximately 0.39, which is very similar to estimates for the third and second generations. However, columns (2) and (3) indicate a fairly strong direct association with grandparental and great grandparental wealth. In the case of grandparental wealth, this association holds even when conditioning on parents' wealth, a pattern that was not as clear for generations 1–3 in Table 3.

Splitting the fourth generation into samples below (panel (b)) and above age 18 (panel (c)), we see that the multigenerational associations appear to be driven by very young children. Since most of them have not been able to accumulate their own wealth and only a few have received inheritances, we interpret these high associations as being

⁴² Note that the extrapolation error in this approach will be overestimated in the presence of classical measurement error in the wealth variables.

Table 5
4th Generation Wealth Regressions

	(1)	(2)	(3)	(4)	(5)
Panel (a): full sample					
Parents	0.387*** (0.022)			0.350*** (0.023)	0.352*** (0.023)
Grandparents		0.222*** (0.026)		0.103*** (0.024)	0.111*** (0.025)
Great grandparents			0.104*** (0.030)		−0.005 (0.026)
R ²	0.160	0.061	0.027	0.175	0.190
N	3,755	3,755	3,755	3,755	3,755
Panel (b): age 18 and younger					
Parents	0.519*** (0.032)			0.472*** (0.033)	0.478*** (0.032)
Grandparents		0.300*** (0.039)		0.141*** (0.033)	0.143*** (0.035)
Great grandparents			0.131*** (0.042)		−0.030 (0.035)
R ²	0.297	0.118	0.054	0.331	0.360
N	1,657	1,657	1,657	1,657	1,657
Panel (c): older than 18					
Parents	0.269*** (0.027)			0.243*** (0.028)	0.250*** (0.028)
Grandparents		0.154*** (0.029)		0.073** (0.029)	0.078*** (0.029)
Great grandparents			0.066* (0.034)		−0.001 (0.031)
R ²	0.084	0.035	0.021	0.095	0.112
N	2,098	2,098	2,098	2,098	2,098

Notes. Standard errors in parentheses are clustered on family. Dependent variable is 4th generation tax-register wealth. Explanatory variables are tax-register wealth for parents, grandparents and great grandparents. All wealth variables are percentile ranked within birth cohort groups and all regressions include birth cohort group dummies for all included generations. *p < 0.10, **p < 0.05, ***p < 0.01.

driven primarily by various kinds of *inter vivos* gifts from parents and grandparents (or other relatives). As seen in column (1) of panel (b), the wealth of the fourth-generation children is very highly correlated with those of their parents and grandparents, very much in line with this reasoning.

How do the estimates in panel (c) of Table 5 compare with estimates for the three-generation sample underlying the estimates in Table 3 if we use wealth observed at a younger age for those children? As seen in online Appendix Table E8, the estimates are quite similar to the ones reported in panel (c) of Table 5 for the four-generation sample. It is notable that the estimates for grandparent's wealth in the AR(2) models are almost identical (0.080 *versus* 0.073) for the young three-generation sample (column (3) of online Appendix Table E8) and the old four-generation sample (column (4) of panel (c)), where the age distribution is quite similar in both samples.⁴³ Hence, we conclude that the difference in the results for the three and four-generation full samples is driven

⁴³ The mean (SD) age is 31.4 (5.6) in the young three-generation sample and 26.3 (5.7) in the old four-generation sample.

by the differences in age of the child generation. It is probably the case that as the children's age decreases, the role of grandparents increases, perhaps because they are able to take a more active part in their grandchildren's lives when they themselves are younger.

Additionally, as argued in Boserup *et al.* (2016), the parent–child wealth relationship is U-shaped across the life cycle, with the largest persistence when the child generation is young (driven by *inter vivos* gifts and transfers) and old (when they have accumulated capital). They find empirical support for this in Denmark, as we do for Sweden.

3. The Role of Inheritance

Having established a positive association between the mid-life wealth of parents and children and a limited role for grandparents, we now turn to an investigation of mechanisms. In this Section, we examine the role of inheritance, first by estimating the share of inherited wealth in total wealth portfolios and then by testing how important bequests are in the wealth mobility process for heirs receiving two bequests.⁴⁴ In the next Section, we examine the role of human capital and labour market productivity.

3.1. Computing the Share of Inheritances in Total Wealth

A classical way to assess the importance of bequests is to compute the aggregate inheritance share in total private wealth. In a famous controversy, Kotlikoff (1988), Kotlikoff and Summers (1981) and Modigliani (1986, 1988) presented different, and widely diverging, estimates of this share for the US. Modigliani measured inherited wealth as the sum of past inheritances, accounting only for inflation, and found the inheritance share to be 20%. On the other hand, Kotlikoff and Summers argued that one must add the capital return in the accumulation process and estimated inherited wealth to 80% of all wealth. More recently, Piketty *et al.* (2014) (PPVR henceforth) proposed a third approach using a model where inherited wealth can be both invested and consumed by heirs. Specifically, they divide inheritors into two groups, rentier-heirs, whose entire wealth is inherited, and savers, whose wealth is partly inherited and partly self-made. The sum of inherited wealth is then defined as all the rentiers' current wealth and the share of savers' wealth that is inherited.⁴⁵

In Table 6, we take these three models to our data and estimate the share of inherited wealth of the total net wealth held by the 2nd generation in 1991. In addition to actual inflation, we account for an assumed yearly real return to capital ranging from 3% to −3%, thus allowing inheritances to both grow and to shrink (when consumption exceeds saving). The Modigliani method generates an inheritance share of 46% for all

⁴⁴ In the online Appendix Table E9, we rerun all the estimations in this Section on the sample of heirs that received at least one bequest, i.e. also including heirs who have one parent who is still alive. While this expands the sample size considerably, it also means including cases where the surviving parent received the major part of the family's assets and thus understates the total amount bequeathed. The results are still very similar to our main analysis.

⁴⁵ Rentiers are defined as those whose capitalised inheritance exceeds their wealth, while savers are those whose capitalised inheritance is smaller their wealth. For an overview of these models, see Piketty and Zucman (2015).

Table 6
Inheritance Share of Total Wealth

	Modigliani	Kotlikoff-Summers	PPVR
Capitalisation rate	(1)	(2)	(3)
3%	0.460	0.891	0.489
0%	0.460	0.460	0.334
−3%	0.460	0.270	0.225
<i>N</i>	386	386	386

Notes. Table shows estimates of the share of total wealth in 1991 that is from inheritances. Sample is restricted to individuals that have received bequests from both parents. Column (1) assumes that inheritances have grown only with the rate of inflation, as in Modigliani (1986, 1988). Column (2) capitalises inheritances by a yearly rate of return, as in Kotlikoff and Summers (1981). Column (3) capitalises inheritances, adjusts for ‘rentiers’ consuming part of their inheritance (see text for details), and calculates inherited wealth as the sum of the wealth of rentier-heirs and the inherited wealth of savers, following Piketty *et al.* (2014).

return levels. By contrast, the Kotlikoff and Summers method is quite sensitive to the assumed capital return with estimates ranging from 89% when using a 3% yield to 27% when using a −3% yield. The PPVR estimates are less sensitive to the assumed yield but still vary between 49% and 23%. Despite these relatively wide estimate ranges, the models return relatively similar inheritance shares when we assume a 0% rate, between 33% and 42%, and 1%, between 38% and 57% (not shown). We can compare these levels with the estimates by Ohlsson *et al.* (2014) of the inheritance share in all of Sweden using aggregate national accounts statistics. They find a share of 43% over the 1990s and 50% in the years around 1991. Taken together, these different methods for estimating the importance of inherited wealth in total wealth indicate that inheritances are indeed sizeable, probably representing between 40% and 50% of all the wealth owned by the 2nd generation in our data set.

3.2. *The Role of Inheritance for the Intergenerational Wealth Transmission*

Next, we test whether inheritances matter for the wealth mobility process. In a first test, we rerun our baseline regressions but add inheritances as a separate variable. One challenge is how to rank the inheritances, and here, we propose two different ways to do so:

- (i) rank by year of death, capturing the relative size of the inheritance when received; and
- (ii) rank by heirs’ year of birth.⁴⁶

The results in Table 7 are consistent across ranking alternatives. The result from this first-pass test suggests that bequests matter for an individual’s wealth status. Regressing child wealth rank on inheritance rank (columns (2) and (4)) show high and

⁴⁶ A benefit of ranking inheritance by year of death is that this effectively conditions on the parents’ year of death, and hence we do not have to deal with the issue of capitalising inheritances received at different ages. The drawback is that age of death is endogenous with respect to parents’ wealth.

statistically significant correlations between 0.38 and 0.53. When adding ranked inheritance to the baseline model (columns (3) and (5)), parental wealth correlations drop to approximately 0.15, which represents a drop of 50%. This is a remarkably large reduction, suggesting that inherited wealth accounts for the majority of the measured intergenerational wealth correlation.⁴⁷ We also capitalised inheritances at either 3% or –3% and ranked them by year of birth, finding only small variations in the importance of inheritance for the wealth transmission process (see online Appendix Table E10).

A potential problem with comparing the wealth and inheritance estimates in columns (3) and (6) of Table 7 is that a higher degree of measurement error in wealth, relative to inheritance, would lead to worse attenuation bias for wealth and, hence, that we would overestimate the importance of inheritance for the intergenerational transmission of wealth. To check this, we rerun the regressions imposing bottom censoring of inheritance at the same place in the distribution as for first-generation wealth. The results are very similar (see online Appendix Table E11, panel (a)), and the drop in the estimate of parent’s wealth elasticity is again such that over 50% of the wealth association is due to inheritances. We also perform this analysis for top decile regressions (see online Appendix Table E11, panel (b)), where both wealth and inheritances equal one for the top decile of observations. We once again find a large impact of controlling for inheritances, with a decrease in the child–parent top decile wealth estimate of more than 50%.

Our second test of how inheritances influence wealth mobility uses children’s wealth adjusted for received bequests. Following the approaches of Modigliani-Kotlikoff-Summers and of PPVR as described above, we capitalise past bequests and subtract them from the observed wealth of children in 1991 and then estimate inheritance-adjusted parent-child regressions. Table 8 presents the results for different

Table 7
Inheritance Regressions

		Ranked by inheritance year		Ranked by birth year	
	(1)	(2)	(3)	(4)	(5)
Parents’ wealth	0.310*** (0.054)		0.144** (0.068)		0.149** (0.066)
Inheritance		0.379*** (0.057)	0.277*** (0.073)	0.533*** (0.073)	0.401*** (0.095)
R ²	0.113	0.144	0.181	0.116	0.153
N	386	386	386	386	386

Notes. Standard errors in parentheses are clustered on family. Dependent variable is 2nd generation tax-register wealth in 1991. Explanatory variables are tax-register wealth for parents and total inheritance received from parents. Sample is restricted to individuals that have received bequests from both parents. Parent’s and own wealth has been percentile ranked within birth cohort groups. In columns (2)–(3) inheritance has been percentile ranked within parental year of death groups, while in columns (4)–(5) inheritance has been percentile ranked within child birth cohort groups. All regressions include birth and death cohort group dummies corresponding to the included variables. *p < 0.10, **p < 0.05, ***p < 0.01.

⁴⁷ Results are similar when including children who have received only one inheritance – see online Appendix Table E9.

Table 8
Inheritance-Adjusted Regressions

	Main	3%	0%	−3%
	(1)	(2)	(3)	(4)
Panel (a): Modigliani–Kotlikoff–Summers				
Parents' wealth	0.310*** (0.054)	−0.083 (0.063)	0.045 (0.062)	0.149** (0.060)
R ²	0.113	0.036	0.040	0.052
Panel (b): PPVR, two parents bequeathing				
Parents' wealth	0.310*** (0.054)	0.061 (0.056)	0.134** (0.056)	0.188*** (0.056)
R ²	0.113	0.037	0.056	0.067
N	386	386	386	386

Notes. Standard errors in parentheses are clustered on family. Dependent variable is 2nd generation tax-register wealth in 1991. In columns (2)–(4), wealth has been adjusted by subtracting capitalised inheritances assuming a yearly rate of return of 3% (column (2)), 0% (column (3)), or −3% (column (4)). Panel (b) uses the PPVR definition of inheritance (see text for details). The sample is restricted to individuals that have received bequests from both parents. All regressions include birth cohort group dummies for both generations. *p < 0.10, **p < 0.05, ***p < 0.01.

capitalisation rates and the different approaches. Using 3% capitalisation, the coefficient of parental wealth becomes insignificantly different from zero in all cases. When using 0%, the same happens in the Modigliani–Kotlikoff–Summers case and in the PPVR method the parental coefficient becomes significant but still significantly below (a fall by 60%) the baseline unadjusted case. Thus, the intergenerational wealth association appears to collapse even when making relatively plausible assumptions about the net accumulation of past inheritances. When we assume that heirs consume more than the investment returns, as shown by a negative return rate, the correlation with parental wealth remains significant in both cases but it is still reduced by approximately half.

We also ran this regression on the sample of heirs receiving either one or two inheritances, which almost doubles the sample size but is still problematic for our purposes since it includes many cases where a surviving spouse may retain most of the parental wealth. Nonetheless, we find almost exactly the same coefficients in the different capitalisation scenarios.⁴⁸

Taken at face value, these results imply that the major part of the intergenerational correlation in wealth runs through the inheritance channel. However, if individuals anticipate the size of their future inheritance, they might adjust their savings behaviour so that a person expecting a large inheritance saves less than an individual expecting a small inheritance or no inheritance, which would bias our estimates of the correlation net of inheritance downwards, leading us to overestimate the relative importance of the inheritance channel. As discussed in Appendix D, an overestimate of the importance of the inheritance channel would also follow in the mediating variable

⁴⁸ The pattern is essentially unchanged if we use individuals who have received at least one bequest instead (see online Appendix Table E12).

approach in the presence of any unobserved mediating variable that is (positively) correlated with children's wealth and with inheritances. However, even if our estimates are lower bounds on the intergenerational wealth correlation absent inheritances, it is noteworthy that they are qualitatively similar despite using two different methods. We therefore conclude that inheritance is an important mediating channel for the intergenerational correlation in wealth.⁴⁹

4. The Role of Other Factors: Human Capital and Labour Productivity

In addition to material transfers, the intergenerational transmission of wealth may also work through human capital and labour market productivity channels, as suggested by the theoretical models of, e.g. Becker (1974) and Becker and Tomes (1979). Our data set includes measures of educational attainment and lifetime earnings for the first three generations, allowing us to address this issue. Specifically, we follow Charles and Hurst (2003) and Boserup *et al.* (2014) and include these measures for all generations used in the regressions.

Table 9 shows regression results for the second generation, corresponding directly to our inheritance analysis in the previous section. Columns (1)–(3) report baseline estimates, first from an intergenerational wealth regression and then from intergenerational earnings and schooling regressions. The estimates are similar to the correlations presented by Lindahl *et al.* (2015).⁵⁰

Human capital variables are then included as additional controls in the wealth estimations; earnings in column (4), schooling in column (5) and both earnings and schooling in column (6). These controls reduce the intergenerational wealth estimate from 0.29 to 0.21–0.23, i.e. by approximately a quarter. This result differs from Boserup *et al.* (2014), who found that their wealth correlations were not affected by including similar controls. Comparing this with the inheritance analysis above suggests a consistent picture, with the relative importance of inheritance for intergenerational wealth transmission being at least 50% and human capital-related factors representing 25%.

We have also regressed the inheritance-adjusted wealth measure used in the previous Section on the schooling and earnings measures of parents and children (see online Appendix Table E14). We then find zero rank–rank wealth correlations, which is what we would expect if inheritance played an important role in the intergenerational wealth rank correlations (which is what we find in Tables 7 and 8). Note that this is also consistent with the finding that controlling for inheritances removes those mediating channels that work through education and earnings.

⁴⁹ Some researchers, including Black *et al.* (2015) and Boserup *et al.* (2016), who are unable to observe bequests directly, have instead estimated the impact of inheritance by comparing correlations for individuals whose parents are dead with individuals whose parents are still alive. When we do this for the 2nd generation, we find a coefficient of 0.300 for those with at least one parent alive, and 0.229 for those with both parents dead, implying a smaller but still substantial role for inheritances (see online Appendix Table E13 for details). However, since these groups (that either die at an earlier or a later age) are likely to be different in many unobservable aspects, we prefer the estimates that use observed bequests.

⁵⁰ They are not identical, as samples and variable definitions differ somewhat. Note that the earnings associations here are lower than in Lindahl *et al.* (2015) because we use family earnings (instead of the father's earnings).

Table 9
Second Generation Mediating Variables Regressions

	Wealth	Earnings	Schooling	Wealth		
	(1)	(2)	(3)	(4)	(5)	(6)
Parents' wealth	0.288*** (0.034)			0.226*** (0.035)	0.228*** (0.034)	0.209*** (0.035)
Parents' earnings		0.190*** (0.030)		0.083** (0.032)		0.050 (0.033)
Parents' schooling			0.309*** (0.031)		0.048 (0.034)	0.029 (0.034)
Own earnings				0.229*** (0.030)		0.186*** (0.031)
Own schooling					0.188*** (0.032)	0.117*** (0.033)
R ²	0.072	0.048	0.104	0.142	0.122	0.154
N	1,103	1,103	1,103	1,103	1,103	1,103

Notes. Standard errors in parentheses are clustered on family. Dependent variable is 2nd generation tax-register wealth in columns (1) and (4)–(6), earnings in column (2) and schooling in column (3). Explanatory variables are parents' tax-register wealth, earnings and schooling, and own earnings and schooling. All wealth variables are percentile ranked within birth cohort groups. Earnings is percentile ranked lifetime earnings and schooling is percentile ranked years of completed schooling. All regressions include birth cohort group dummies for all included generations. *p < 0.10, **p < 0.05, ***p < 0.01.

In online Appendix Table E15, we also report third-generation mediating variable regressions on parental and grandparental variables. Only including parental variables, the child-parent wealth rank estimate decreases by 25%, which exactly confirms the results reported in Table 9. Mechanisms related to human capital and labour productivity therefore cannot explain the increase in the parent–child wealth estimate over time, as observed in Table 3. When also including grandparental variables, the child-parent wealth rank estimate is unchanged, whereas the conditional child–grandparent wealth rank correlation decreases from a positive (but statistically insignificant) estimate to an estimate very close to zero.

5. Conclusions

We estimate multigenerational wealth models using a unique data set partially compiled specifically for this study, which enables us to improve on previous studies in some dimensions. First, we analyse models with two and three generations using wealth measured in mid-life for all three generations. Second, using matched data on bequests, we are the first to measure directly the importance of this specific channel for the intergenerational transmission of wealth. Third, we present evidence on four-generational wealth transmissions, observing the wealth of great grandchildren before they have entered the labour market. In addition to these contributions, we use high-quality data on educational attainment and lifetime earnings for three generations to compare our multigenerational wealth estimates to estimates for other outcomes and to decompose multigenerational wealth transmission into a part due to education and earnings, and a part due to other factors.

Our main findings are twofold. First, we find that grandparents' wealth is associated with grandchildren's wealth but that most of the association is mediated by parents' wealth. Grandparents' wealth seems to matter for an individual's wealth status, also conditional on parents' wealth. The estimated effect is relatively small but the imprecision of the estimates makes it impossible to rule out quite sizable conditional grandparental effects.

Second, we observe a large role for inheritances in explaining intergenerational wealth transmission. The estimates indicate that direct transfers from parents (and grandparents) account for at least half of the recorded wealth persistence. These results have bearing on our understanding of the drivers of economic mobility in society as a whole. Recent survey evidence indicates that the perceived fairness of a certain level of inequality, and the extent to which interventions are called for to change it, largely depend on how this situation has come about. In particular, the extent to which economic success is inherited or self-made seems crucial (Mulligan, 1997; Arrow *et al.*, 1999; Bowles and Gintis, 2002). In other words, a possible interpretation of our results is that policy measures aimed at levelling the distribution of inherited wealth, e.g. gift and inheritance taxation, may be desirable from an equality of opportunity perspective.

Appendix A. Wealth Measures

A.1. *Wealth Measured During Life*

A.1.1. *First generation*

We measure wealth of the first generation (most born in the 1890s) at two points in time: 1945 and 1952. The observations were collected manually from the individual income and wealth tax records that are stored in the local county archives in Malmö (Malmö Stadsarkiv). Locating individuals in the income and wealth tax registers in this period is not uncomplicated, but requires parallel searches in address calendars (to get names of block and street address) and often different books containing the actual tax records.

For the 1945 observations, we use tax records (*taxeringslängder*) from 1946 showing incomes and wealth in 1945. During the period 1911–46, this information is available in the income and tax register since personal wealth was taxed jointly with income. Specifically, one hundredth of taxable net wealth was added to taxable income; if net wealth was negative, nothing was added. For reasons of discretion, an individual's net wealth was not reported directly in the tax records but for 1945 it is possible to back out taxable wealth from the reported income and deduction items (before income year 1945 tax register items were structured differently and do unfortunately not allow for this to be done). In the register, the reported item 'taxable amount' T (*taxerat belopp*) is the tax base. It equals the reported total gross income Y (*sammanräknad nettoinkomst*) less the reported 'general deductions' D (*medgivna allmänna avdrag*) plus the non-reported wealth share $\tilde{W}$ (*förmögenhetsandel*), equal to 1/100 of taxable net wealth W . Writing the taxable amount as $T = Y - D + \tilde{W}$ and using the fact that we observe the first three terms in this equation in the tax register, we can retrieve the personal taxable net wealth $W = 100(T + D - Y)$. Note that exactly this procedure is the one used by Statistics Sweden when analysing the wealth distribution for the Census of 1945 (Statistics Sweden, 1949, p. 2).

Taxable wealth in 1952 is also collected manually from the tax registers. After a wealth tax reform in 1947, however, in this year wealth was taxed separately from income and we retrieve explicitly stated net wealth amounts from wealth tax registers

(*förmögenhetstaxeringslängder*). In 1952, all households owning net assets worth at least 30,000 SEK had to hand in a wealth tax return. Approximately, 9% (329,000 out of 3.7 million) of Swedish households reported owning wealth above the taxable threshold, and in our population they were 8%.

A detail to note is that this first-generation wealth cannot take negative values because of how the tax statistics are reported. In 1945, only non-negative wealth is allowed to contribute to the total taxable amount on the tax return, and in 1952 we only observe households with wealth above a tax threshold.

A.1.2. *Second generation*

Wealth held by the second generation (mostly born in 1928) is in the form of taxable wealth observed in tax registers during the years 1985, 1988 and 1991 (thus measured at ages 57–63). Included in the wealth measure for 1985 and 1988 is the tax value of real estate, which is 75% of market value. Because we also have separate information on real estate tax value, we can scale this up to market value and add the difference to the wealth measure. This reduces the number of zero (censored) observations by around 10 percentage points. This augmented measure is used in a sensitivity analysis.

In the first two years for which we measure wealth is censored from below at zero whereas this is not the case for the last year, the reason being different reporting routines at the tax authority after the Swedish tax reform of 1990–91.

A.1.3. *Third and fourth generations*

Third (born in the 1950s) generation's wealth is measured in 1999 and 2006 (thus measured at ages 43–50), and fourth generation's wealth (born in the 1980s) is measured in 2006 (around age 20). While these wealth data also stem from the wealth tax, they differ from the wealth tax return register data used for the first two generations by being partly based on third-party reported financial asset statements of banks and brokerage firms. The data comes from Statistics Sweden's Wealth Register which covers wealth statements for all individuals, i.e. not only households filing tax returns, in Sweden between 1999 and 2007.

All assets and liabilities in the Wealth Register are in current market prices, which is a difference which means that tax-assessed property values are multiplied by a sales price ratio (computed by Statistics Sweden using data on actual sales prices and tax assessments for homes sold) and reported in market values. Wealth observations cease in 2007 due to the repeal of the Swedish wealth tax in that year.

A.2. *Wealth Measured at Death: Estate Inventory Reports*

For all deceased individuals in the first and second generations, we have collected estate wealth data. These records come from estate inventory reports (*bouppteckningar*) that the law mandates to be set up for each deceased individual with some assets.⁵¹ The reports contain information about civil status (years of marriage, remarriages), estate wealth composition (value of housing, life insurance savings), *inter vivos* gifts, wills, pre-nuptial agreements and inheritance waivers, generally for both father and mother. Up until 2001, the estate reports were filed with local courts and archived in one of Sweden's nine local county archives, and since 2001 they are filed at the tax authorities.

In order to locate a deceased individual's estate inventory report, one needs to know the date and place of death, and we have retrieved this information from the original database and from the official death register in Sweden.

⁵¹ For individuals without notable wealth, typically very young people, an estate notification (*dödsboanmälan*) is typically filed.

A.3. *Inheritances*

Inheritances are observed when parents bequeathed wealth to their children in the second generation. We do not include inheritances from others than the parents, i.e. siblings, other relatives or non-relatives. Elinder *et al.* (2016) show that almost two-thirds of inheritances in Sweden in the early 2000s come from parents.

An inheritance lot is calculated for each heir by the tax authorities and then reported in specific inheritance tax records (*arvsskattestegar*) which are filed with the local county archives until 2001 after which it is kept by the tax authorities. Typically, the tax record is also attached to each estate inventory report.

It should be noted that these inheritance lots were based on a close scrutiny of the probated wealth, accounting for wills if they existed and taxable *inter vivos* gifts made within ten years of the testator's death.

Appendix B. Earnings and Education

Lifetime earnings are calculated by taking residuals from a regression of log earnings (for left-hand side variables) or log within-family average earnings (for right-hand side variables) on a quadratic in birth year and a full set of income year dummies. For the first generation, we observe earnings in 1929, 1933, 1937, 1938 and 1942; for the second and third generations, we observe earnings in 35 different years between 1948 and 2008, restricted to observations at age 23 and older for the second generation, and 27 and older for the third generation.

Our log earnings measure is constructed as from regressing log earnings on a cubic in birth year and year indicators (done separately by generation and gender), taking the residuals which then are averaged over years. Labour income is compiled from Swedish high quality registers for all years that we use. For the first generation, we have access to income data as 5 yearly measures spanning 13 years, typically observed between ages 33 and 46. For the second and third generations, we can more or less observe lifetime earnings for most of the individuals. See Lindahl *et al.* (2015) for details.

There is no direct information on educational attainments for the first generation. However, since the 1938 survey contains detailed information on occupational status, the educational requirements for each occupation were constructed by the educational scientists who originally obtained the data. There are no education classifications available for the mothers of the index generation.

For the second to fourth generations, we have obtained data on educational attainments from the national education register. We mainly use information from 1985 for the second generation and from 2009 for the third and fourth generations. Years of schooling is constructed from educational levels available in registers for the second, third and fourth generations. With detailed information on completed level of education, we construct years of schooling as follows: seven for (old) primary school, nine for (new) compulsory schooling, 9.5 for (old) post-primary school (*realskola*), 11 for short high school, 12 for long high school, 14 for short university, 15.5 for long university, and 19 for a PhD. For more details, see Lindahl (2015).

Appendix C. Estimating the Long-run Intergenerational Persistence in Social Status

Clark (2012) and Clark and Cummins (2014) propose that intergenerational transmission of wealth is evolving as $w_{it} = x_{it} + u_{it}$ and $x_{it} = bx_{it-1} + e_{it}$. This should be interpreted as wealth mismeasuring x , the underlying 'social status', and that the true value of wealth evolves as an AR(1) between generations. Clark and Cummins (2014) label the parameter b as the long-run intergenerational persistence in social status and show that that if we estimate bivariate models between n generations we get $E[\hat{\beta}_n] = \theta b^n$ where θ is the reliability ratio of w in measuring x , and

$\hat{\beta}_n$ is from the regression $w_{it+n} = \beta_0 + \beta_n w_{it} + u_{it+n}$. Hence, we get that $E[\hat{\beta}_2] = \theta b^2 = E[\hat{\beta}_1]b$, which is a formula that can be used to derive b in the following way: divide the estimate from a regression of child's wealth on grandparents' wealth by an estimate from a regression of parent's wealth on grandparents' wealth.⁵²

As pointed out in Solon (2015), this is just an instrumental variable estimate, where grandparents' wealth is used as an instrument parent's wealth in a regression of child's wealth on parent's wealth. If the simple model by Clark and Cummins (2014) fails to hold true (Solon, 2015; lists a number of reasons for why this might be the case), this IV estimate is most likely (as argued in Lindahl *et al.* 2015) an upper bound estimate of b . To make use of the fact that we have family-linked data on three adjacent generations, we, in subsection 2.2.2 where we compare our results in Lindahl *et al.* (2015) with the results in the present article, instead divide by the average of two estimates: the estimate from a regression of child and parents wealth and the estimate from a regression of parent's and grandparents' wealth. As pointed out in Braun and Stuhler (2017) this requires the additional assumption that measurement error in wealth is constant over the first two generations.

Appendix D. Estimating Associations in the Presence of Mediating Variables

When we analyse the impact of inheritance, or bequests (B), on the intergenerational association in wealth we must acknowledge that B is a mediating variable. A common approach is to proceed by estimating regression models of the following form:⁵³

$$w_{it} = \alpha_0 + \rho_1 w_{it-1} + \varepsilon_{it}, \quad (\text{D.1})$$

$$w_{it} = \alpha'_0 + \rho_2 w_{it-1} + \phi B_{it} + v_{it}, \quad (\text{D.2})$$

$$B_{it} = \alpha''_0 + \rho_3 w_{it-1} + \mu_{it}. \quad (\text{D.3})$$

Under the strong assumption that $\text{Cov}(v_{it}, \mu_{it}) = 0$, which for example holds if B_{it} is exogenously determined conditional on w_{it-1} , we can interpret $\rho_1 - \rho_2$ as the role of inheritance (i.e. the mediating effect of inheritance) in the overall association of wealth across generations. This can be seen by inserting (D.3) into (D.2), which gives $\rho_1 = \rho_2 + \phi \rho_3$. Hence, the intergenerational association in wealth between children and parents can be decomposed into one part that is due to the direct link with parent's wealth and another part which is due to an indirect effect working through the mediating variable B_{it} .

Suppose that B is not exogenously determined – for instance, if $\text{Cov}(v_{it}, \mu_{it}) > 0$, perhaps because there is another mediating variable Z_{it} which is positively correlated with the child's wealth and also with B_{it} (conditional on parental wealth). Intuitively, by controlling for B_{it} in (D.2), we 'over-control' for B_{it} in the sense that we control not only for B_{it} but also the part of Z_{it} that is correlated with B_{it} . Hence, ϕ will be overestimated and ρ_2 , the direct channel linking parents' and child wealth, will be underestimated. It follows that $\rho_1 - \rho_2$ and the importance of B_{it} as a mediating channel will be overestimated. An example of underestimating the importance of the inheritance channel would be if inheritances are poorly measured, in relation to parent's wealth.

Note that when we investigate the importance of schooling and earnings for the intergenerational association in wealth, similar issues exists. An advantage is that we can then

⁵² Braun and Stuhler (2017) show that the Clark-model has a number of testable implications such as this one, which they use to test the model on multigenerational data for Germany.

⁵³ Alwin and Hauser (1975) lay out the general framework for decomposing total effects into direct and indirect effects. For an application, see, for example, Blanden *et al.* (2007) who analyse a number of channels underlying the intergenerational persistence in income in the UK

control for schooling and earnings in both generations, which is not possible for inheritances.

Institute for Evaluation of Labour Market and Education Policy (IFAU), Uppsala University, UCLS

University of Gothenburg, CESifo, IFAU, IZA, UCLS

Research Institute of Industrial Economics (IFN), Paris School of Economics, CEPR, IZA, UCLS and UCFS

Additional Supporting Information may be found in the online version of this article:

Appendix E. Tables and Figures.

Data S1.

References

- Adermon, A., Lindahl, M. and Palme, M. (2016). 'Dynastic human capital, inequality and intergenerational mobility', mimeo, University of Gothenburg.
- Alwin, D.F. and Hauser, R.M. (1975). 'The decomposition of effects in path analysis', *American Sociological Review*, vol. 40(1), pp. 37–47.
- Arrondel, L. and Grange, C. (2006). 'Transmission and inequality of wealth: an empirical study of wealth mobility from 1800 to 1938 in France', *Journal of Economic Inequality*, vol. 4(2), pp. 209–32.
- Arrow, K., Bowles, S. and Durlauf, S. (1999). *Meritocracy and Economic Inequality*, Princeton, NJ: Princeton University Press.
- Becker, G. (1974). 'A theory of social interactions', *Journal of Political Economy*, vol. 82(6), pp. 1063–94.
- Becker, G.S. and Tomes, N. (1979). 'An equilibrium theory of the distribution of income and intergenerational mobility', *Journal of Political Economy*, vol. 87(6), pp. 1153–89.
- Black, S. and Devereux, P. (2011). 'Recent developments in intergenerational mobility,' in (O. Ashenfelter, D. Card, eds.), *Handbook of Labor Economics*, vol. 4B, pp. 1487–541. Amsterdam: Elsevier.
- Black, S., Devereux, P., Lundborg, P. and Majlesi, K. (2015). 'Poor little rich Kids? The determinants of the intergenerational transmission of wealth', IZA Discussion Paper No. 9227.
- Blanden, J., Gregg, P. and McMillan, L. (2007). 'Accounting for intergenerational income persistence: non-cognitive skills, ability and education', *ECONOMIC JOURNAL*, vol. 117(519), pp. C43–60.
- Boserup, S.H., Kopczuk, W. and Kreiner, C.T. (2014). 'Intergenerational wealth mobility: evidence from Danish wealth records of three generations', Working Paper, University of Copenhagen.
- Boserup, S.H., Kopczuk, W. and Kreiner, C.T. (2016). 'Intergenerational wealth formation over the life cycle: evidence from Danish wealth records 1984–2013', Working Paper, University of Copenhagen.
- Bowles, S. and Gintis, H. (2002). 'The inheritance of inequality', *Journal of Economic Perspectives*, vol. 16(3), pp. 3–30.
- Braun, S.T. and Stuhler, J. (2017) 'The transmission of inequality across multiple generations: testing recent theories with evidence from Germany', *ECONOMIC JOURNAL*, <https://doi.org/10.1111/econj.12453>.
- Charles, K.K. and Hurst, E. (2003). 'The correlation of wealth across generations', *Journal of Political Economy*, vol. 111(6), pp. 1155–82.
- Chetty, R., Hendren, N., Kline, P. and Saez, E. (2014). 'Where is the land of opportunity? the geography of intergenerational mobility in the United States', *Quarterly Journal of Economics*, vol. 129(4), pp. 1553–623.
- Clark, G. (2012). 'What is the true rate of social mobility in Sweden? a surname analysis, 1700–2012', mimeo, University of California, Davis.
- Clark, G. (2014). *The Son Also Rises: Surnames and the History of Social Mobility*, Princeton, NJ: Princeton University Press.
- Clark, G. and Cummins, N. (2014). 'Intergenerational wealth mobility in England, 1958–2012: surnames and social mobility', *ECONOMIC JOURNAL*, vol. 125(582), pp. 61–85.
- Dribe, M. and Helgertz, J. (2016). 'The lasting impact of grandfathers: class, occupational status, and earnings over three generations in Sweden 1815–2011', *Journal of Economic History*, vol. 76(4), pp. 969–1000.
- Elinder, M., Erixson, O. and Waldenström, D. (2016). 'Inheritance and wealth inequality: evidence from population registers', CEPR Discussion Paper No. 11191.

- Fagereng, A., Mogstad, M. and Rønning, M. (2015). 'Why do wealthy parents have wealthy children?', mimeo. Statistics Norway.
- Haider, S. and Solon, G. (2006). 'Life-cycle variation in the association between current and lifetime earnings', *American Economic Review*, vol. 96(4), pp. 1308–20.
- Hallgren, S. (1939). *Intelligens och miljö. En experimentell undersökning av barn i tredje skolåret vid Malmö folkskolor och privata skolor*, Licentiate dissertation, Lund: Lund University.
- Henrekson, M. and Waldenström, D. (2016). 'Inheritance taxation in Sweden, 1885–2004: the role of ideology, family firms and tax avoidance', *Economic History Review*, vol. 69(4), pp. 1228–54.
- Knigge, A. (2016). 'Beyond the parental generation: the influence of grandfathers and great-grandfathers on status attainment', *Demography*, vol. 53(4), pp. 1219–44.
- Kotlikoff, L.J. (1988). 'Intergenerational transfers and savings', *Journal of Economic Perspectives*, vol. 2(2), pp. 41–58.
- Kotlikoff, L. and Summers, L. (1981). 'The role of intergenerational transfers in aggregate capital accumulation', *Journal of Political Economy*, vol. 89(4), pp. 706–32.
- Lindahl, M., Palme, M., Sandgren Massih, S. and Sjögren, A. (2014). 'A test of the Becker-Tomes model of human capital transmission using microdata on four generations', *Journal of Human Capital*, vol. 8(1), pp. 80–96.
- Lindahl, M., Palme, M., Sandgren Massih, S. and Sjögren, A. (2015). 'Long-term intergenerational persistence of human capital: an empirical analysis of four generations', *Journal of Human Resources*, vol. 50(1), pp. 1–33.
- Long, J. and Ferrie, J. (2013). 'Intergenerational occupational mobility in Great Britain and the United States since 1850', *American Economic Review*, vol. 103(4), pp. 1109–37.
- Menchik, P.L. (1979). 'Inter-generational transmission of inequality: an empirical study of wealth mobility', *Economica*, vol. 46(184), pp. 349–62.
- Modalsli, J. (2017). 'Intergenerational mobility in Norway, 1865–2011', *Scandinavian Journal of Economics*, vol. 119(1), pp. 37–71.
- Modigliani, F. (1986). 'Life cycle, individual thrift, and the wealth of nations', *American Economic Review*, vol. 76(3), pp. 297–313.
- Modigliani, F. (1988). 'The role of intergenerational transfers and life cycle savings in the accumulation of wealth', *Journal of Economic Perspectives*, vol. 2(2), pp. 15–40.
- Møllegaard, S. and Jæger, M.M. (2015). 'The effect of grandparents' economic cultural, and social capital on grandchildren's educational success', *Research in Social Stratification and Mobility*, vol. 42, pp. 11–19.
- Mulligan, C. (1997). *Parental Priorities and Economic Inequality*, Chicago, IL: University of Chicago Press.
- Nybom, M. and Stuhler, J. (2016). 'Interpreting trends in intergenerational mobility', mimeo, Universidad Carlos III de Madrid.
- Ohlsson, H., Roine, J. and Waldenström, D. (2014). 'Inherited wealth over the path of development: Sweden, 1810–2010', Working Paper, Uppsala University.
- Olivetti, C., Paserman, M. D. and Salisbury, L. (2016). 'Three-generation mobility in the United States, 1850–1940: The role of maternal and paternal grandparents', mimeo, Boston University.
- Palme, M. and Sandgren, S. (2008). 'Parental income, lifetime income, and mortality', *Journal of the European Economic Association*, vol. 6(4), pp. 890–911.
- Pence, K. M. (2006). 'The role of wealth transformations: an application to estimating the effect of tax incentives on saving', *B.E. Journal of Economic Analysis & Policy*, vol. 5(1), pp. 1–26.
- Pfeffer, F. T. and Killewald, A.A. (2015). 'How rigid is the wealth structure and why? inter- and multigenerational associations in family wealth', PSC Research Report No. 15-845.
- Piketty, T. (2011). 'On the long-run evolution of inheritance: France 1820–2050', *Quarterly Journal of Economics*, vol. 126(3), pp. 1071–131.
- Piketty, T. and Zucman, G. (2015). 'Wealth and inheritance in the long run', in (A.B. Atkinson and F. Bourguignon, eds.), *Handbook of Income Distribution*, vol. 2, pp. 1303–68, Amsterdam: Elsevier.
- Piketty, T., Postel-Vinay, G. and Rosenthal, J.-L. (2014). 'Inherited vs self-made wealth: theory & evidence from a rentier society (Paris 1872–1927)', *Explorations in Economic History*, vol. 51, pp. 21–40.
- Roine, J. and Waldenström, D. (2009). 'Wealth concentration over the path of development: Sweden, 1873–2006', *Scandinavian Journal of Economics*, vol. 111(1), pp. 151–87.
- Solon, G. (1999). 'Intergenerational mobility in the labor market', in (O. Ashenfelter and D. Card, eds.), *Handbook of Labor Economics*, vol. 3, Amsterdam: Elsevier.
- Solon, G. (2014). 'Theoretical models of inequality transmission across multiple generations', *Research in Social Stratification and Mobility*, vol. 35, pp. 13–18.
- Solon, G. (2015). 'What do we know so far about multigenerational mobility?' WP No. 21053, NBER Working Paper.
- SOU (1969). *Kapitalbeskattningen. Betänkande av Kapitalskatteberedningen*, SOU 1969:54, Norstedt, Stockholm.
- Statistics Sweden (1949). *Folkkräkningen den 31 december 1945. 3. Partiella undersökningar (totaldelssamplingen). 2. Behandlar delar av statistiken över förmögenhet*. Stockholm: Statistiska Centralbyrån.

- Stuhler, J. (2012). 'Mobility across multiple generations: the iterated regression fallacy', IZA Working Paper 7072.
- Wahl, J.B. (2002). 'From riches to riches: intergenerational transfers and the evidence from estate tax returns', *Social Science Quarterly*, vol. 84(2), pp. 278–96.
- Wolff, E.N. and Gittleman, M. (2014). 'Inheritances and the distribution of wealth or whatever happened to the great inheritance boom?', *Journal of Economic Inequality*, vol. 12(4), pp. 439–68.
- de Wolff, P. and van Slijpe, A.R.D. (1973). 'The relation between income, intelligence, education and social background', *European Economic Review*, vol. 4(3), pp. 235–64.