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A Comparison of Intergenerational Mobility Curves in Germany, Norway, Sweden, and the US*

Espen Bratberg

University of Bergen, NO-5007 Bergen, Norway
espen.bratberg@econ.uib.no

Jonathan Davis

Harris School of Public Policy, Chicago, IL 60637, USA
jonmvdavis@gmail.com

Bhashkar Mazumder

Federal Reserve Bank of Chicago, Chicago, IL 60604, USA
bhash.mazumder@gmail.com

Martin Nybom

SOFI, SE-10691 Stockholm, Sweden
martin.nybom@sofi.su.se

Daniel D. Schnitzlein

Leibniz University Hannover, DE-30167 Hannover, Germany
schnitzlein@aoek.uni-hannover.de

Kjell Vaage

University of Bergen, NO-5007 Bergen, Norway
kjell.vaage@econ.uib.no

Abstract

We examine intergenerational mobility differences between Germany, Norway, Sweden, and the US. Using ranks, we find that the US is substantially less intergenerationally mobile than the three European countries and that the most mobile region of the US is less mobile than the least mobile regions of Norway and Sweden. Using a linear estimator of income share mobility, we find that the four countries have very similar rates of intergenerational mobility. However, when we use non-parametric versions of rank and income share mobility, we find that the US tends to experience lower upward mobility at the bottom of the income distribution than Norway and Sweden.

Keywords: Intergenerational mobility; inequality

JEL classification: *D*63; *J*62

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I. Introduction

Intergenerational mobility has risen to prominence among policymakers in many countries. In the US, President Barack Obama has described growing inequality and lack of upward mobility as the "defining challenge of our time". In the UK, intergenerational mobility is such a salient issue that the government has been tracking indicators of social mobility in recent years. The OECD is now examining social mobility as one important measure in its Measurement of Economic Performance and Social Progress program. Given the growing worldwide importance of intergenerational mobility to policymakers, one would imagine that an important priority would be to document differences in rates of intergenerational mobility across countries. Establishing a sound body of descriptive facts concerning cross-country differences in intergenerational mobility might yield fruitful insights into understanding the sources of intergenerational persistence in any given society.

Thus far, however, most existing evidence on cross-country differences in intergenerational mobility has focused on one particular measure, the intergenerational elasticity (IGE) in income.[1] For example, the oft-cited "Great Gatsby" curve plots the IGE against the Gini coefficient for a sample of countries.[2] While the IGE is a useful summary measure of relative intergenerational mobility that requires just one parameter, it has some limitations. For example, it is not informative about differences between upward and downward mobility or how mobility differs at different points in the income distribution. Also, it does not tell us anything about absolute intergenerational income mobility.

We use a new methodological approach that addresses these concerns. Specifically, we measure intergenerational mobility curves using a variant of the framework developed by Aaberge and Mogstad (2014) who analyze cross-country differences in intra-generational mobility. Aaberge and Mogstad measure mobility using the difference between two Lorenz curves: the true Lorenz curve, corresponding to the realized permanent income distribution, and a "reference" Lorenz curve, which measures the counterfactual permanent income distribution if there were no intra-generational income mobility. The difference between the curves describes the additional share of total income obtained at each percentile of the initial distribution due to income mobility over time. The use of the Lorenz curve unifies the study of economic mobility with the large body of literature on inequality

[1] An exception is Corak *et al.* (2014), who use measures of directional rank mobility.

[2] See Corak *et al.* (2014). The curve shows that countries with higher levels of inequality also have higher levels of intergenerational persistence, or lower mobility. The relationship was first shown by Corak (2006) and the expression, the Great Gatsby curve, was coined by Alan Krueger.

and social welfare (Atkinson, 1970) and offers the possibility of making normative statements about mobility.

We use the mobility curve framework to examine intergenerational mobility in Germany, Norway, Sweden, and the US. We focus on two general measures of intergenerational mobility: a measure of rank mobility and a measure of income share mobility. As we discuss in greater detail below, an analogous way to create a rank mobility curve would be to measure the mean change in ranks between parents and children at each percentile of the parental income distribution. Similarly, we could construct a mobility curve based on the change in the share of income at every percentile of the income distribution. For rank mobility, we decided to follow the highly influential work of Chetty *et al.* (2014) who estimate the mean level of the child's percentile income at every percentile of the parental income distribution rather than the change in ranks. As we show below, this formulation contains exactly the same information about rank mobility as does a curve depicting the change in ranks, but it allows us to directly compare our estimates with those of Chetty *et al.* and might also be more intuitively appealing.

Conceptually, rank mobility is purely a measure of relative positional mobility. However, it does not tell us anything about the distance between ranks in terms of economic resources, which might also be of interest. Our second measure, income share mobility, is a hybrid measure containing aspects of both absolute and relative mobility. Rather than using ranks, this measure utilizes the level of absolute income in each generation but scales it by the average income in each respective country in each generation. In addition to providing a different conceptual measure of mobility based on the level of economic resources, it also solves the problem of how to compare absolute changes in income that are measured using different currencies.

Our methodology has at least four advantages over previous studies of cross-country differences in intergenerational mobility that have relied primarily on the IGE. First, as Aaberge and Mogstad (2014) show, mobility curves are closely linked to Lorenz curves and more clearly connect the intergenerational mobility and inequality and social welfare bodies of literature. While we do not utilize this connection in this paper, we lay the ground work for future research to exploit these linkages and potentially say something normative about the right level of intergenerational mobility. Second, because mobility curves are non-parametric estimators, they reveal heterogeneity in intergenerational mobility across the initial income distribution. Third, rank-based measures allow for subgroup analysis whereas the IGE does not. We demonstrate the usefulness of this by exploring how mobility differs across regions within a country and across men and women. Finally, our income share mobility measure captures differences in absolute

mobility. To focus solely on ranks might ignore important differences in the gaps in economic resources held by families at different points of the distribution. Measures of absolute mobility might be particularly relevant to cross-country comparisons when one wants to explicitly take into account how differences in cross-sectional inequality might affect intergenerational mobility.

With respect to rank mobility, we highlight several results. First, if we focus on a summary measure of rank persistence that imposes a linear relationship, the "rank–rank slope", we find that rank mobility is quite similar in Germany, Norway, and Sweden, while the US is a clear outlier. In the US, there is generally much greater rank persistence. The intergenerational rank association is about 0.395 in the US compared to 0.245 in Germany, 0.223 in Norway, and 0.215 in Sweden. The rank mobility curves also demonstrate that the US and Germany are characterized by much less upward mobility from the bottom and that the US also has significantly less downward mobility from the top. For example, children whose parents were in the bottom five percentiles of the income distribution are expected to rise to about the 40th percentile of the income distribution in Norway and Sweden, and the 31st percentile in Germany and the US. However, as our German samples are small, we are less comfortable with the precision of the non-parametric estimates for Germany.

Our results also imply that although there is considerable heterogeneity in intergenerational rank mobility across the US, as highlighted by Chetty *et al.* (2014), it is nonetheless exceptionally rare for a US city to exhibit the degree of rank mobility in these other societies. We also directly examine heterogeneity in rank mobility by looking at subregions in each country. Comparing point estimates, we find that the most mobile region of the US is still less mobile than the least mobile regions of Germany, Norway, and Sweden. Moreover, relative to simply assuming linearity, we find that the use of non-parametric mobility curves is important in evaluating these cross-country differences in rank mobility. We see very little difference in mobility between the countries from around the 35th to the 60th percentiles but quite significant differences between the US and the Scandinavian countries at the bottom and the top of the income distribution.

Our conclusions about cross-country intergenerational mobility differences are notably different when we turn to the income share mobility measure. This measure considers the expected change in absolute income over a generation at every percentile of the income distribution. Similar to the finding of mean reversion in ranks, there is also mean reversion in absolute income. Families that start at higher percentiles in the distribution experience smaller increases in absolute income over a generation than families that start at lower percentiles. If we scale those absolute income changes by the average level of family income in each country, and if we

impose linearity on the relationship, then we find that the rate of mean reversion is nearly identical in all four countries. We find that in all of our samples, moving up 10 percentiles in the parental income distribution is associated with, on average, a reduction in the change in income over generations equal to 10 percent of the average family income level in that country.[3] However, when we allow for non-linearities, we find substantial cross-country differences at the bottom and the top of the income distribution. For example, among children who start in the bottom decile of the parental income distribution, income is expected to increase by 32 percent of average income in Germany, 40 percent of average income in the US, 46 percent of average income in Norway, and 49 percent of average income in Sweden. Corak *et al.* (2014) also found lower absolute income gains among those at the bottom of the distribution who experienced upward mobility when comparing the US with Sweden.

We show that the differing conclusions regarding cross-country differences in intergenerational mobility between the linear version of rank mobility and the linear version of income share mobility reflect the difference in concepts between the two measures. Intuitively, in a country with higher inequality, it will be much more difficult to change ranks because the ranks will be farther apart in dollar terms than in a country where the ranks are closer together.[4] Therefore, countries can experience similar rates of absolute mobility but experience very different degrees of rank mobility. Thus, when it comes to interpreting estimates of intergenerational income mobility, it is critical to choose the estimator that captures the concept of mobility that one is interested in measuring. A focus on relative mobility as measured by changes in ranks over a generation suggests that the US has significantly less intergenerational income mobility than Germany, Norway, and Sweden. However, a measure of mobility based on absolute income changes scaled to average income shows little difference across the countries. We also find that for both measures there are important non-linearities and that the broad conclusions implied by the linear estimators do not hold throughout the income distribution, highlighting the importance of using non-parametric estimators when studying intergenerational mobility. This echoes a similar point first made by Jäntti *et al.* (2006).

[3] For example, a family at the 30th percentile of the parent income distribution in our US sample would expect to experience an absolute income gain ($25,419), which would increase its ratio of income measured relative to the national average by 0.19 over a generation. A family at the 50th percentile would expect to experience an absolute income gain ($11,296), which would increase its ratio of income measured relative to the national average by 0.01. In this example, there is an 18 percentage point difference in income share mobility between two families that are 20 percentiles apart in the income distribution.

[4] In a slightly different context, Aaberge and Mogstad (2014) argue that there is an almost mechanical relationship between cross-sectional inequality and mobility measures.

While our findings are nuanced and depend on the estimator used and the concept of mobility being examined, overall our results suggest that, at least compared to the Scandinavian countries, the US might be exceptional in terms of experiencing lower upward mobility from the bottom of the distribution.[5] Such a finding naturally raises questions as to what accounts for such low upward mobility. Is this due to poverty traps? Is there something about the characteristics of families, neighborhoods, and schools in the US that causes greater persistence at the bottom of the income distribution? These remain salient issues for future studies of cross-country differences in intergenerational mobility.

The rest of the paper proceeds as follows. In Section II, we describe our measures and outline our methodological approach. In Section III, we discuss our data. In Section IV, we present our main findings. In Section V, we analyze regional differences in rank mobility. We conclude in Section VI.

II. Measures and Methods

Rank Mobility

Rank mobility focuses on one particular concept of mobility, namely positional mobility. Measures based on ranks are the basis for many recent non-parametric intergenerational mobility estimates (Bhattacharya and Mazumder, 2011; Chetty *et al.*, 2014; Corak *et al.*, 2014; Mazumder, 2014). Compared to the IGE, rank mobility measures have several advantages in addition to capturing a different concept of mobility. First, they can depict how mobility differs at different points of the income distribution. Second, when fixing ranks relative to the entire population, they can be used to compare the mobility of subgroups of the population (Mazumder, 2014). Third, rank mobility measures are relatively robust to measurement issues (Mazumder, 2015; Nybom and Stuhler, 2015).

We construct a measure of rank mobility throughout the entire income distribution based on the approach of Aaberge and Mogstad (2014). Aaberge and Mogstad construct a mobility curve by taking the difference between two Lorenz curves where one curve reflects a counterfactual state in which there is no mobility. In our context, an analogous measure of rank mobility (RM^*) is given by

$$RM^*(p) = E[P_{1i} - P_{0i} | P_{0i} = p], \qquad p = 1, 2, \ldots, 100. \tag{1}$$

[5] We also find similarly low rates of upward mobility for Germany. However, as our samples are significantly smaller, we are less confident in our ability to make strong conclusions regarding non-linearities for Germany.

In this case, we would take the expected change in percentiles at every percentile in the parent distribution. In this example, the initial percentile serves as a counterfactual distribution in which there is no mobility. An alternative representation of a rank mobility curve is the conditional expectation of the child's rank. This representation, labeled RM, is simply a 45° rotation of RM^* (i.e., just adding P_{0i} to the rank mobility measure):

$$RM(p) = E[P_{1i}|P_{0i} = p], \qquad p = 1, 2, \ldots, 100. \tag{2}$$

Taking the difference between RM and a 45° line is equivalent to the RM^* measure, which estimates the mean difference between the child's percentile and the parents' percentile. Although the two curves contain identical information, we choose to use the RM curve rather than RM^* because it is the formulation utilized by Chetty *et al.* (2014) in their highly influential work and will be more familiar to mobility researchers. Of course, if one wants to exploit the rich framework developed by Aaberge and Mogstad (2014) to consider the links between mobility and social welfare, one can easily transform the measure accordingly.

Income Share Mobility

If one is interested in the actual magnitude of income changes and how that differs at different points in the income distribution, then the rank mobility measure is not an appropriate measure as it treats all rank changes equally. For example, in our US data, moving from the 10th to the 11th percentile of the child income generation is associated with $1,313.64 in additional family income (measured in 2007 US dollars), whereas moving from the 90th to the 91st percentile is associated with $5,575.03 in additional family income. To supplement the analysis of rank mobility, we also study income share mobility. Income share mobility is defined as the difference between a child's income relative to their generation's average income and their parents' income relative to their generation's average income:

$$ISM_i = \frac{Income_{1i}}{E[Income_{1i}]} - \frac{Income_{0i}}{E[Income_{0i}]}. \tag{3}$$

As we use a balanced panel of families in each generation, this measure is equal to the change in a family's share of their generation's total income scaled by the population of the generation. Consequently, income share mobility can be thought of as the change in the share of the total pie a family receives between the two generations.[6] Here, we simply estimate the

[6] Although the income share mobility measure uses absolute income changes, it is not a true measure of absolute mobility as we scale it relative to average income. Instead, it might be viewed as a hybrid of both absolute and relative mobility.

change in the real dollar value of income at each percentile of the parental income distribution. Specifically, an income share mobility (IS) curve is given by

$$IS(p) = E\left[\frac{Income_{1i}}{E[Income_{1i}]} - \frac{Income_{0i}}{E[Income_{0i}]}\Big| P_{0i} = p\right],$$
$$p = 1, 2, \ldots, 100. \quad (4)$$

We estimate these mobility curves using a bin estimator. Specifically, we calculate the average of each mobility measure at each percentile of the parental income distribution.[7]

We often report slope coefficients from linear versions of mobility curves as summary measures of mobility. A linear mobility curve is given by the linear regression of either child rank or income share mobility on parent rank.[8]

III. Data

Our analysis uses separate datasets from Germany, Norway, Sweden, and the US. We begin by explaining our sample for the US, as the other samples were selected to be comparable to this dataset.

For the US, we use the cross-sectional and supplemental samples[9] of the National Longitudinal Survey of Youth 1979 (NLSY79) cohort. The NLSY79 is nationally representative of young people who were 14–22 years old when the survey was conducted in 1979. All young individuals in the sample were born between 1957 and 1964. We restrict the sample to families with all parents living in the household born between 1920 and 1950. Lastly, we restrict the sample to families for which we observe at least one year of total family income in both the adult and child generations.[10] In total, our sample includes 6,414 parent–child pairs.

Parents who were still living with their children were asked to report their total pre-tax family income from the previous year in the 1979, 1980, and 1981 parent interviews, covering the years when their children were 14–23 years old. Therefore, parents are 28–60 when we measure their total family income. We subtract any earnings the young individuals had during this period from the total family income measure. We use the average of

[7] Note that income share mobility measures changes in income shares as a function of parent rank in the income distribution, and consequently a 45° rotation similar to the one used for rank mobility is not appropriate.

[8] The linear regressions are estimated using our full samples, not the bin estimates used for the non-parametric mobility curves.

[9] Because we include the supplemental sample, which was designed to oversample minority and economically disadvantaged youth, we weight the estimates by the 1979 sample weights.

[10] Because of this restriction, 4,387 observations are dropped.

all of the available family income measures in this period to construct our income measure for the parent generation. For the child generation, we take the average of self-reported total pre-tax family income in 1996, 1998, 2000, 2002, 2004, 2006, and 2008 when the children were 32–52 years old.

For Sweden, we use a 35 percent population random sample drawn from administrative data. Mirroring the NLSY79, we restrict this sample to children born between 1957 and 1964 whose parents were born between 1920 and 1950. Our parent generation income measure is average pre-tax household income between 1978 and 1980. Our child generation income measure is average pre-tax household income in 1996, 1998, 2000, 2002, 2004, 2006, and 2007. In total, our Swedish sample includes 252,745 parent–child pairs.[11]

For Norway, we use Statistics Norway's full population administrative data. The sample is restricted to children born between 1957 and 1964 whose parents were born between 1920 and 1950 and were married. In total, the sample includes 328,428 parent–child pairs.[12] We measure income in the parent generation as average pre-tax family earnings in 1978, 1979, and 1980. We measure income in the child generation as average pre-tax family earnings in all years between 1996 and 2006. It should be highlighted that cohabitants are not included in the family income measure, which is a concern for the child income measure given declining marriage rates in Norway.

For Germany, we use the German Socio-Economic Panel[13] data. Unlike the other data sources, we restrict the sample to children born between 1957 and 1976 whose parents were born between 1926 and 1956. The sample includes 1,128 parent–child pairs.[14] We measure income in the parent generation as average annual pre-tax total household income between 1984 and 1986 when the children were 8–29 years old. For the child income measure, we use average annual pre-tax total household income between 2001 and 2012 in the years when the child was between 25 and 55 years old.[15] A key issue is that German sample size is only about a sixth of the

[11] Because of missing or problematic data, 16,165 observations are dropped.

[12] Because of missing or problematic data, 13,936 observations are dropped.

[13] We use SOEPv29; for more details, see http://dx.doi.org/10.5684/soep.v29.

[14] No observations in the German sample are dropped because of missing or problematic data. However, 16.22 percent of observations include at least one imputed value. There are 3.5 percent of the parent–child pairs that have annual income observations in their respective averages, whose imputed subcomponents are larger than 50 percent of the total income observation.

[15] Because of the low number of observations in the German sample, we did not impose an additional age restriction on the children here. As a test, we ran the analysis on a sample only including income observations at ages 32–54, which did not change the results presented below.

Table 1. *Summary statistics*

	Germany	Norway	Sweden	US
Observations	1,128	324,870	252,745	6,414
Parent Generation				
Family Income (2007 US$)	68,714	67,590	53,300	65,141
Father Birth Year	1939	1931	1931	1933
Mother Birth Year	1942	1934	1934	1936
Two Parents	1.00	1.00	0.87	0.85
Child Generation				
Family Income (2007 US$)	77,168	57,346	72,129	76,877
Child Birth Year	1969	1961	1961	1961
Female	0.44	0.49	0.49	0.48
Married	0.53	0.59	–	0.64

Notes: All currencies are reported in 2007 US dollars. Currencies were converted to 2007 units using GDP deflators reported by the World Bank or by their national CPI and converted to US dollars using the average 2007 exchange rate reported by the OANDA Corporation.

size of the US sample. This reduces the statistical precision of our estimates and so we refrain from drawing too strong conclusions regarding cross-country differences, particularly when we consider non-linearities based on non-parametric estimates.

Summary statistics for the four samples are shown in Table 1. We report all income measures in 2007 US dollars.

Average family income in the parent generation ranges from $53,300 in Sweden to $68,714 in Germany. In Norway and Sweden, the average father was born in 1931 and the average mother was born in 1934. In the US, parents are about two years younger. As children in all three samples were born in 1961 on average, parents in the US are about two years younger when they have children. Parents in our German sample are about eight years younger than in Norway and Sweden, and six years younger than in the US. However, children in our German sample are also eight years younger, on average, so parents in our German sample were about the same age as parents in our US sample when they had their children. Both our Norwegian and German samples are restricted to families with both parents present in the parent generation. In Sweden and the US, 87 and 85 percent of households had two parents present in the parent generation.

In the child generation, average income ranges from $57,346 in Norway to $77,168 in Germany. There are slightly more men than women in all of our samples of the child generation. Our Norwegian and Swedish samples are 49 percent female, our US sample is 48 percent female, and our German sample is 44 percent female. In our US sample, 64 percent of individuals in the child generation were married at the time of the 2002 survey. In Norway, 59 percent of children were married in 2002. In Germany, 53 percent of children were married in the first year that a valid income

Table 2. *IGE estimates*

	Germany	Norway	Sweden	US
IGE	0.314	0.194	0.231	0.432
	(0.036)	(0.002)	(0.002)	(0.014)
N	1,128	324,870	251,288	6,298

measure was reported. We do not observe marital status for children in our Swedish sample.

We present IGE estimates from a regression of log child income on log parent income for each country in order to benchmark our samples to previous estimates from the literature. These estimates are shown in Table 2. The IGE estimates vary substantially across the four countries. The IGE is 0.194 in Norway, 0.231 in Sweden, 0.314 in Germany, and 0.432 in the US.

IV. National Mobility Curves

Rank Mobility

Figure 1 presents rank mobility curves for Germany, Norway, Sweden, and the US. Separate figures for each country are shown in the Appendix. All of the mobility curves have a roughly similar shape. Rank mobility is approximately linear over most percentiles of the parental income distribution, but it curves downward at the bottom of the parental income distribution and upward at the top of the parental income distribution in some of the countries. There is a slight curvature in rank mobility in the middle of the income distribution. Children whose parents were below the median have more upward rank mobility than the linear fit predicts, and children whose parents were above the median tend to have more downward rank mobility than the linear fit predicts. For Norway and Sweden, the non-parametric rank mobility estimates curve sharply upward at the top of the parental income distribution. In all countries, the rank mobility curves appear to bend at least somewhat downward at the bottom of the parental income distribution. This suggests that in many instances there is relatively more persistence in ranks among the poorest and wealthiest families than the linear curves indicate.

The first row of Table 3 shows the slope of linear rank mobility curves for each country. Looking across countries, Germany, Norway, and Sweden have similar levels of rank mobility across the parental income distribution. The slopes of linear mobility curves, which are summary measures of rank persistence, are 0.245, 0.223, and 0.215 in Germany, Norway, and Sweden,

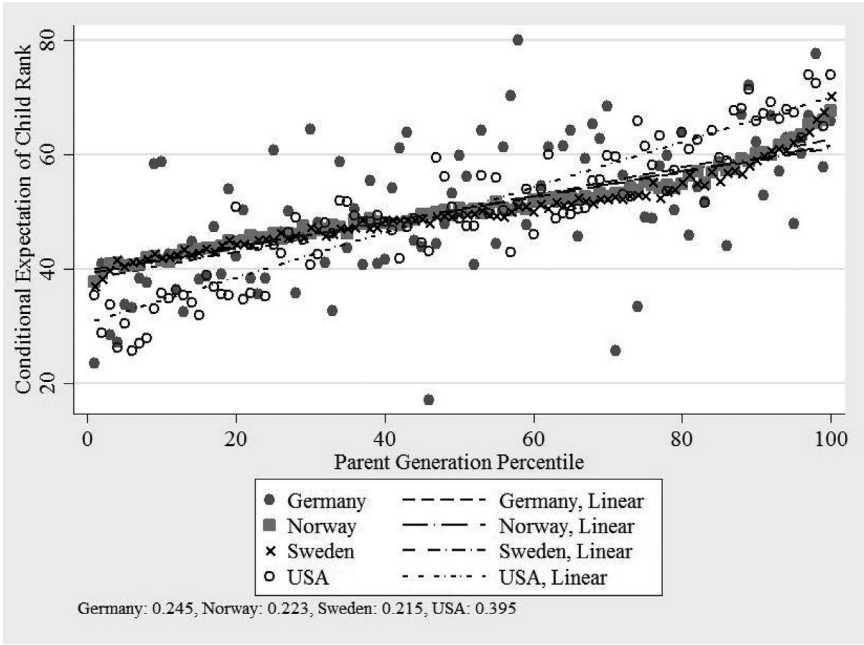


Fig. 1. Rank mobility curves

Table 3. *Rank persistence by country*

	Germany	Norway	Sweden	US
National	0.245	0.223	0.215	0.395
	(0.029)	(0.002)	(0.002)	(0.011)
With controls	0.232	0.223	0.204	0.292
	(0.029)	(0.002)	(0.002)	(0.011)
N	1,128	324,870	252,745	6,414

Notes: Ranks are determined using national income distributions in each generation. Controls include parents' age at birth and indicators for gender, parents' region, and – for all countries except Sweden – whether the child is married.

respectively.[16] This implies that each percentile increase in the parental income distribution is associated with a 0.245, 0.223, and 0.215 percentile increase in the child's rank in the income distribution in Germany, Norway, and Sweden, respectively. Put another way, the gap in ranks between a child whose parents were in the 100th percentile of the parental income distribution and a child whose parents were at the bottom of the income distribution – a gap of 99 percentiles in the parent generation – would be

[16] Boserup *et al.* (2013) estimate a rank persistence of 0.18 for Denmark.

expected to fall to just 21.5 percentiles in a single generation in Sweden. In contrast, the slope of the US linear mobility curve is 0.395. The gap in ranks between the two hypothetical children just discussed would be nearly twice as large if the two children were from the US instead of Germany, Norway, or Sweden.

This cross-country disparity in rates of rank persistence can also be scaled based on the geographic mobility estimates across US cities from Chetty *et al.* (2014). Moving from 0.25 (Germany) to 0.40 (US) is the equivalent of moving from the 20th ranked US city to the 324th ranked US city.[17] Furthermore, there are only 11 out of 384 US cities where the rank persistence is found to be less than 0.22. Simply put, it is difficult to find the rank mobility experience of Norway or Sweden anywhere in the US.

One might also wonder whether these cross-country differences are a result of demographic differences across countries. To address this, the second row of Table 3 shows the slope of the linear rank mobility curves for each country, controlling for parents' age at birth and indicators for gender, parents' region, and – for all countries except Sweden – whether or not the child is married. The inclusion of these controls has a small effect on the estimated persistence for Germany, Norway, and Sweden, but reduces the US persistence by over 25 percent, from 0.395 to 0.292. Because the impact of parental income on child marital status might be an important source of intergenerational persistence, one might worry that this is an inappropriate control. Without controlling for a child's marital status, the US rank persistence is much less affected by controls, falling only 7 percent to 0.369. This suggests that the relationship between parental income and marital status might be an important driver of the higher rank persistence in the US.

Table 4 further explores the role of demographics by showing separate rank persistence estimates for the subsample of married children, men, and women without additional controls using the ranks implied by the full population income distribution. Across countries, marital status and gender have an ambiguous association with intergenerational mobility. Compared to the full sample, rank persistence is higher among married children in Norway (0.260 versus 0.223), the same in Germany (0.245) for both groups, and lower in the US (0.344 versus 0.395). Persistence is lower for men than for women in Germany and it is roughly the same for both genders in the US, but it is slightly higher for men than for women in Norway and Sweden.

Importantly, focusing instead on the non-parametric mobility curves allows for a richer and more nuanced comparison of mobility at different

[17] This calculation uses the online version (Chetty *et al.*, 2014) of the preferred measures for commuting zones with over 100,000 people.

Table 4. *Rank persistence by subgroup*

	Germany	Norway	Sweden	US
Married children	0.245	0.260	–	0.344
	(0.037)	(0.002)	–	(0.014)
N	595	186,025	–	3,202
Men	0.198	0.229	0.234	0.395
	(0.039)	(0.002)	(0.003)	(0.160)
N	627	165,947	129,027	3,301
Women	0.293	0.220	0.196	0.396
	(0.043)	(0.002)	(0.003)	(0.016)
N	501	158,923	122,575	3,113

Notes: Ranks are determined using national income distributions in each generation.

points in the parental income distribution. Children whose parents were at the bottom percentile were expected to be in the 24th percentile in Germany, the 35th percentile in the US, and about the 37th percentile in Norway and Sweden. As is evident in Figure 1, the non-parametric estimates at any given percentile of the rank mobility curves are imprecisely estimated for the US and, especially, for Germany. Averaging over several percentiles will improve precision for these countries but we are still wary about drawing too strong conclusions, particularly for Germany. Nevertheless, we find that children whose parents were in the bottom five percentiles of the income distribution are expected to rise to about the 40th percentile of the income distribution in Norway and Sweden, and the 31st percentile in Germany and the US. In contrast, children whose parents were in the top five percentiles of the income distribution are expected to fall to the 66th percentile in Germany, Norway, and Sweden, and the 70th percentile in the US. Therefore, the gap in ranks between children of the wealthiest and poorest families is expected to fall to 26 percentiles in Norway and Sweden, to 35 percentiles in Germany, and to 39 percentiles in the US.

At other points of the parental income distribution, there are only small differences in rank mobility. Children whose parents were in the 5th decile of the income distribution are expected to be in the 49th percentile in all four countries. Children whose parents were in the 6th decile are expected to be in the 50th percentile in Sweden and the US, the 51st percentile in Norway, and the 57th percentile in Germany.

Income Share Mobility

Income share mobility considers changes in income normalized by the average income in the economy.[18] Figure 2 shows income share mobility

[18] Footnote 3 provides an actual example.

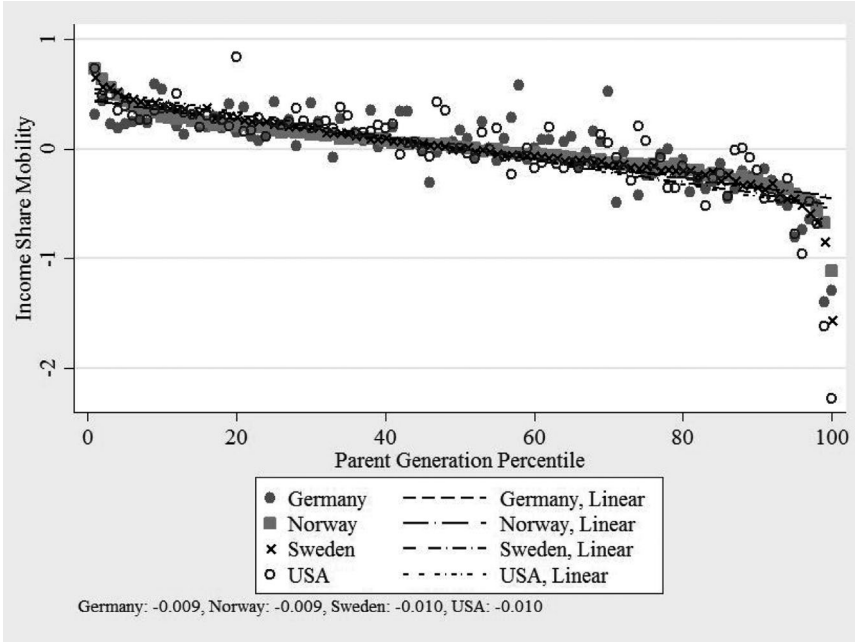


Fig. 2. Income share mobility curves

curves for the four countries in our analysis. Because we are now plotting changes in income share on the y-axis in Figure 2, we expect a downward sloping curve if there is regression towards the mean. Figure 1 was upward sloping as we presented the conditional expectation of the child's rank rather than the difference between the child and their parent's rank. This was done in order to make our analysis comparable to that of Chetty *et al.* (2014).

What is immediately evident is that the non-parametric income share mobility curves are approximately linear over most of the income distribution, as was the case with rank mobility. The slopes of all four linear income share mobility curves are approximately -0.01. More precisely, the slopes are -0.009 in Germany and Norway and -0.010 in Sweden and the US. This indicates that, in all countries, a move up 10 percentiles in the parental income distribution is associated, on average, with a reduction in the change in income over the next generation equal to about 10 percent of average income. Put another way, the income of two children whose parents were at the top and bottom of the income distribution, respectively, will converge by 100 percent of the average income in a single generation, on average.

How is it possible that large cross-country differences in rank mobility can be consistent with small differences in income share mobility? This can be reconciled by considering the differences across countries in the levels of cross-sectional inequality. Consider two countries with equal levels of average income, but where one country has significantly higher income inequality in the parent generation. A given change in absolute income over a generation would lead to higher changes in ranks in the country with smaller cross-sectional inequality than an identical change in absolute income in a country characterized by a high degree of inequality, where surpassing the next rank requires a greater income change.[19] However, the identical absolute income change would lead to an identical level of income share mobility.

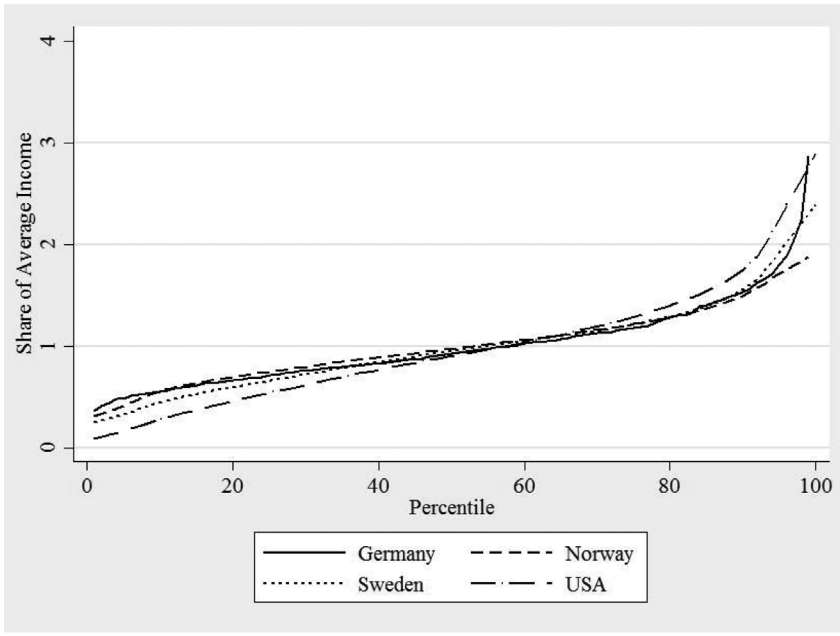
We illustrate that this is exactly the case when we compare the US to our other samples. Figures 3(a) and 3(b) show the cross-sectional income distributions in the parent and child generations of each of our samples. Incomes are measured as shares of average income in each generation within a country. In both generations, the poor in the US have relatively lower incomes and the rich have relatively higher incomes. A child whose parents were in the bottom decile of Norway's income distribution is expected to be in the 42nd percentile of the child generation's family income distribution. This is associated with an increase in earnings equal to 46 percent of the generation's average earnings. In contrast, a similar child in the US is only expected to be in the 30th percentile of their generation's family income distribution, which is associated with an earnings increase equal to 40 percent of the average income. Although the child from Norway is expected to move up nearly twice as many percentiles as the child from the US, this higher rank mobility is only associated with a 15 percent larger increase in income.

In contrast to the rank mobility curves, the income share mobility curves bend sharply downwards at the top of the income distribution. This suggests that, although children whose parents are born at the top of the income distribution persistently remain in the highest ranks of the income distribution, the small rank changes are associated with relatively large declines in their income.

The non-parametric income share mobility curves indicate some notable differences at the top and bottom of the income distribution, though again we should be cautious about drawing overly strong conclusions for Germany where our samples are especially small. The income of children whose parents were in the bottom decile of the parental income distribution is expected to increase by 32 percent of average income in Germany,

[19] As Aaberge and Mogstad (2014) emphasized, this creates an almost mechanical relationship between cross-sectional inequality and rank mobility measures.

(a)



(b)

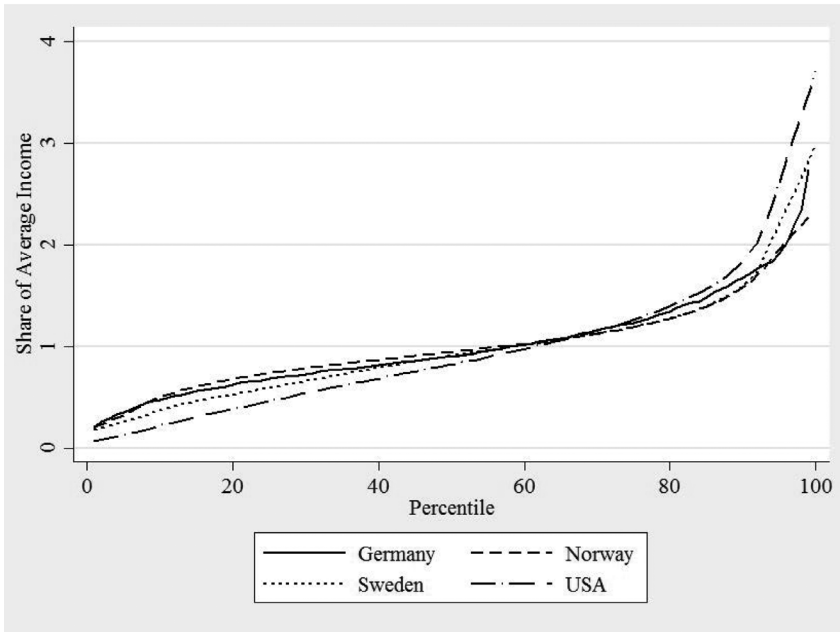


Fig. 3. (a) Parent and (b) child generation income distributions

by 40 percent of average income in the US, by 46 percent of average income in Norway, and by 49 percent of average income in Sweden. At the other end of the distribution, the income of children whose parents were in the top decile is expected to fall by 51 percent of average income in Norway, by 62 percent of average income in Sweden, by 69 percent of average income in Germany, and by 84 percent of average income in the US.

There is even more downward mobility among the very top of the distribution. Children whose parents were in the top five percentiles can expect their income to fall by 65 percent of average income relative to their parents in Norway, by 84 percent of average income in Sweden, by 92 percent of average income in Germany, and by 120 percent in the US.

These results are in some respects similar to the findings of Corak *et al.* (2014) who find significant cross-country differences between Canada, Sweden, and the US in absolute income changes at the very bottom and top of the income distributions. For example, they find that the US experiences lower absolute upward income mobility at the very bottom and greater absolute downward mobility than Canada and Sweden from the very top. However, Corak *et al.* condition their estimates on having either upward or downward mobility, and they do not scale these income changes relative to average income.

V. Regional Results

An important question is whether Germany, Norway, Sweden, and the US are reasonably comparable. The US is much larger than the other countries in terms of its population and geographical area. The US population is nearly four times the population of Germany and more than 30 and 60 times the populations of Sweden and Norway, respectively. Similarly, the area of the US is over 20 times larger than the area of Germany, Norway, or Sweden. Chetty *et al.* (2014) have shown that the overall level of rank mobility in the US conceals a considerable degree of heterogeneity across smaller geographical areas. While we have already shown that it is rare to find a city in the US with the same degree of intergenerational rank mobility as the entire nation of Norway or Sweden, it might also be useful to look at heterogeneity within all of our sample countries. Perhaps, comparing the most mobile region of the US to the most mobile regions of Germany, Norway, and Sweden is more sensible.[20]

[20] We thank Magne Mogstad for suggesting that we make this comparison.

Table 5. *Rank persistence by region*

	Germany	Norway	Sweden	US
Region 1	North	Eastern Norway	Stockholm Region	West
	0.223	0.179	0.175	0.261
	(0.043)	(0.003)	(0.006)	(0.031)
N	510	95,061	30,189	972
Region 2	South	Western Norway	Central	North Central
	0.236	0.189	0.183	0.396
	(0.040)	(0.006)	(0.006)	(0.025)
N	584	24,674	32,142	1,249
Region 3		Middle Norway	South	South
	–	0.191	0.197	0.439
	–	(0.006)	(0.003)	(0.020)
N	–	29,778	109,326	2,027
Region 4		Northern Norway	North	Northeast
	–	0.250	0.233	0.455
	–	(0.003)	(0.005)	(0.031)
N	–	137,675	44,014	866

Notes: Ranks are determined using regional income distributions in each generation. The sample is restricted to individuals who stayed in the region of their parents.

To address this issue, we examine intergenerational mobility separately for regional subdivisions of each country. For this analysis, we treat regions as if they are separate countries. We generate separate income distributions for each region and restrict the sample to children who lived in the region as children and adults. This restriction is meant to mirror the fact that the national analysis is implicitly conditional on not emigrating, as emigrants will generally not be observed in both generations and will therefore be excluded. For simplicity, we focus on summary measures of rank persistence instead of the non-parametric mobility curves.

Table 5 shows rank persistence measures for each country and for regional subdivisions of each country. Only one region of the US, the West, has comparable rank persistence as Germany, Norway, and Sweden. The slope of the linear rank mobility curve for the West in the US is 0.261. For comparison, the lowest rank mobility regions in Germany, Norway, and Sweden have a rank persistence of 0.236, 0.250, and 0.233, respectively. Therefore, the point estimate for the highest mobility region of the US still has higher rank persistence than the lowest mobility regions of the three Northern European countries. If we compare the West of the US to the most mobile regions of Norway and Sweden, then there is a fairly substantial gap, as the Western region of Norway and the Northern region of Sweden exhibit rank persistence below 0.180.

The other three regions of the US have much higher rank persistence than the West of the US or any of the other regions in the other three

countries. The North Central region's rank persistence is 0.396, the Southern region's rank persistence is 0.439, and the Northeast region's rank persistence is 0.455. Figures 4(a) and 4(b) show that the regional income distributions are similar in both the parent and child generations. In other words, regional differences in cross-sectional inequality do not appear to explain the differences in rank mobility within the US.

Overall, we find that there is a notable striking difference in rank mobility between the US and the Northern European countries that remains even when comparing the most mobile region of the US (i.e., the West) to the least mobile regions of the Northern European countries. The other regions of the US are substantially less mobile than any region in Germany, Norway, or Sweden.

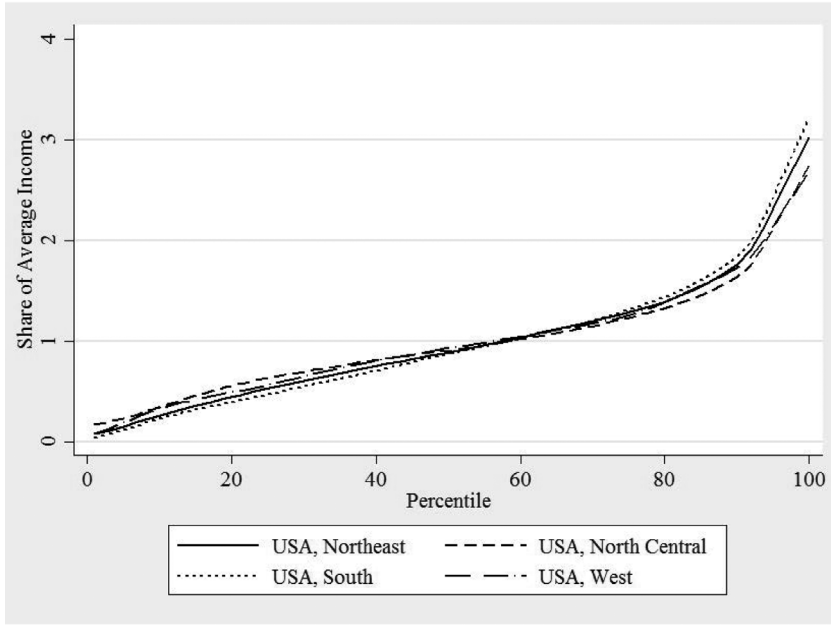
VI. Conclusion

We use comparable intergenerational samples from Germany, Norway, Sweden, and the US to construct estimates of intergenerational mobility curves for each country. Using our first measure (i.e., rank mobility), we find that the US is an outlier compared to the other three countries when we assume a linear relationship. The US has much greater intergenerational rank persistence with roughly comparable levels in the other three countries. Compared to the Scandinavian countries, the US exhibits both less upward mobility from the bottom of the distribution and less downward mobility at the top of the distribution. We also find that even the most mobile region of the US is less mobile than the least mobile regions of the Scandinavian countries. Germany also appears to experience lower upward mobility from the bottom of the distribution than the Scandinavian countries but the estimates for Germany are less precise because of smaller sample sizes. Non-parametric estimates, which relax linearity, are important as the rank mobility differences are not constant at all points of the income distribution and the countries are fairly similar in the middle of the parental income distribution.

In contrast, when we examine our second measure (i.e., income share mobility) and impose linearity, we find that rates of intergenerational mobility are very similar across countries. The difference between these results and those using rank mobility is explained by the fact that the US has much higher cross-sectional inequality than the other countries so any given change in income is associated with a smaller change in ranks.

Taken together, our findings highlight several important points. First, the cross-country differences in rank mobility are consistent with many previous studies of intergenerational mobility that focused on a different

(a)



(b)

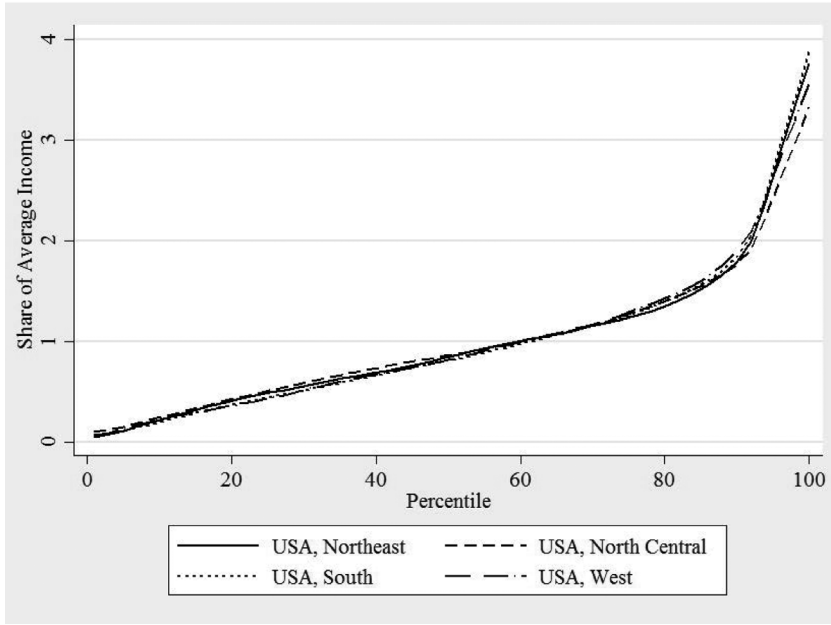


Fig. 4. (a) Parent and (b) child generation income distributions (US regions)

measure of relative mobility, the IGE.[21] Second, although there is considerable heterogeneity in rank mobility within the US as documented by Chetty *et al.* (2014), it is clear that the cross-country differences in rank mobility are robust to spatial heterogeneity in the four countries. Third, there are important non-linearities with respect to cross-country differences in rank mobility. We find that there are relatively small differences in rank mobility if we compare those who start in the middle of each country's respective income distributions. Fourth, our results with respect to income share mobility suggest that once we move to a measure of mobility that is closer to a measure of absolute mobility and we impose linearity, the countries are quite similar in their rates of intergenerational mobility. Fifth, we also find evidence of important non-linearities in income share mobility at the very bottom and top of the income distributions that can significantly affect cross-country comparisons.

Overall, we find that one must take care in drawing firm conclusions regarding cross-country differences in intergenerational mobility. The differences depend to some degree on what portion of the income distribution one is examining and, conceptually, whether one is interested in looking at relative or absolute outcomes. Nevertheless, there is fairly consistent evidence that the US has lower rates of upward mobility from the bottom of the income distribution compared to the Scandinavian countries. We also find evidence to suggest lower upward mobility from the bottom in Germany but the data are much noisier so we are hesitant to make too strong conclusions.

Future research should continue to consider these types of nuanced approaches to studying intergenerational mobility and ultimately should try to better understand the causes and consequences of mobility differences across countries.

[21] See, for example, Corak (2006) and Jantti *et al.* (2006). Schnitzlein (2015) argues that the relative ordering in mobility between the US and Germany, based on the IGE, is sensitive to the choice of how income is measured.

Appendix: Country-Specific Figures

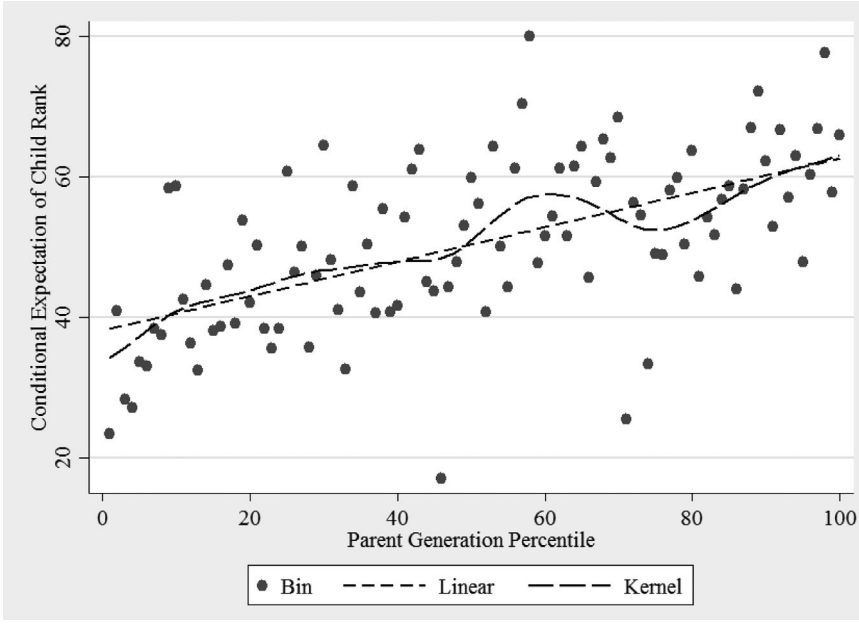


Fig. A1. Rank mobility curve: Germany

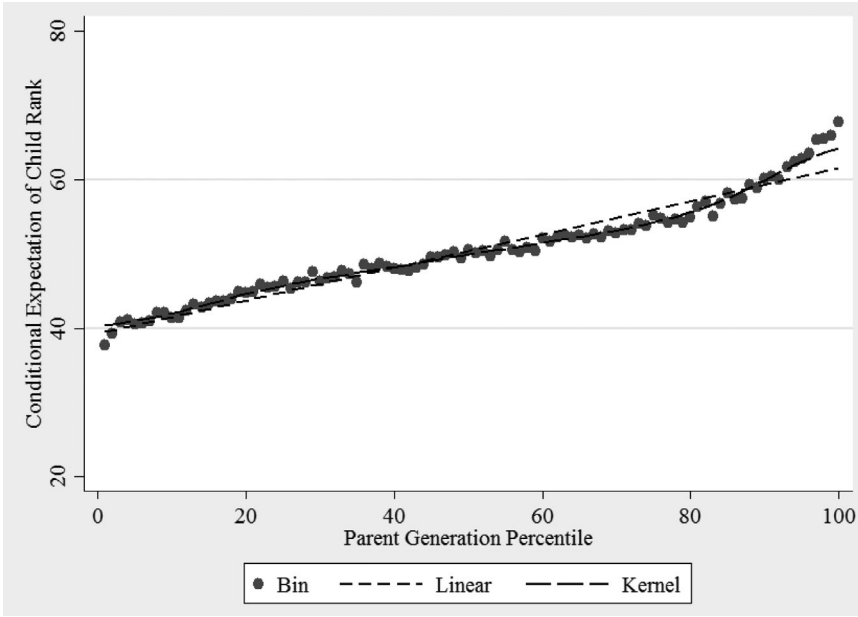


Fig. A2. Rank mobility curve: Norway

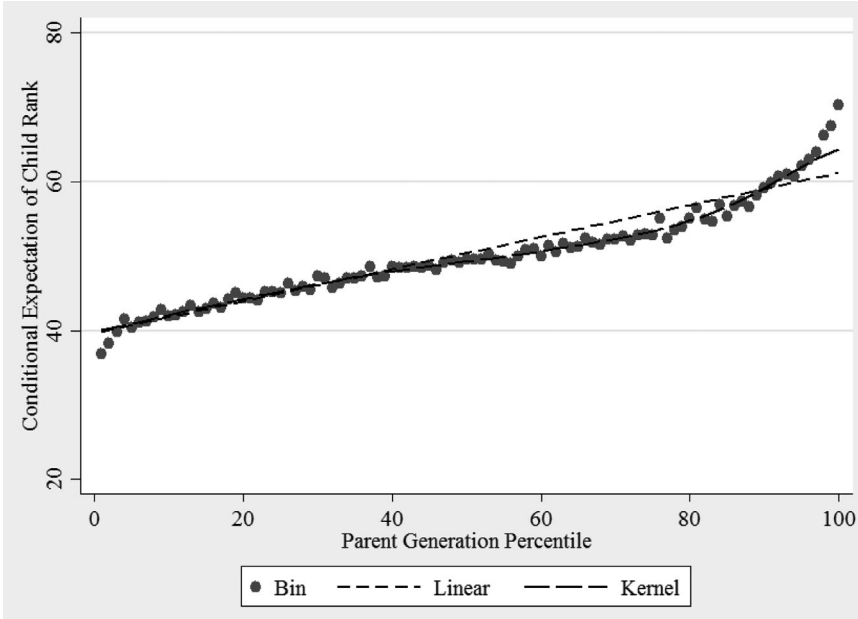


Fig. A3. Rank mobility curve: Sweden

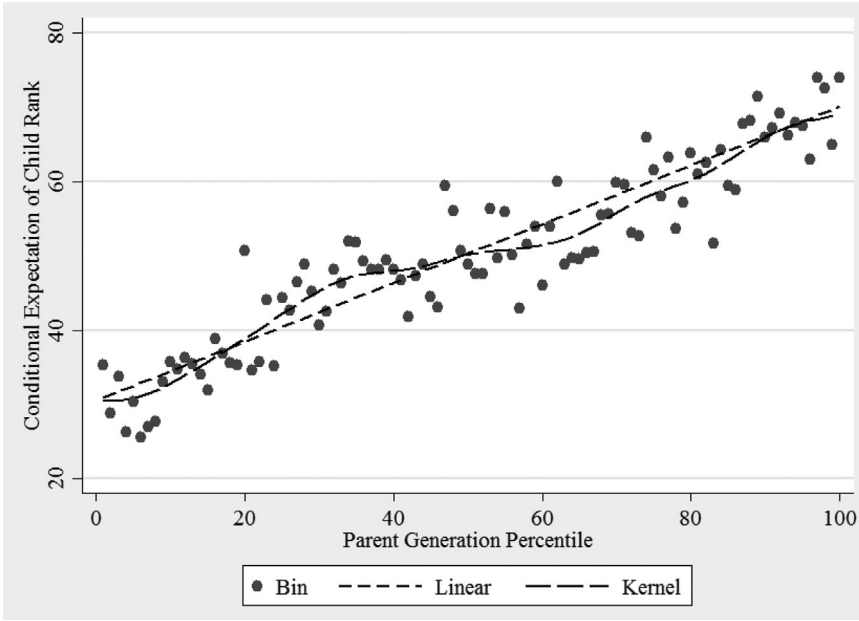


Fig. A4. Rank mobility curve: US

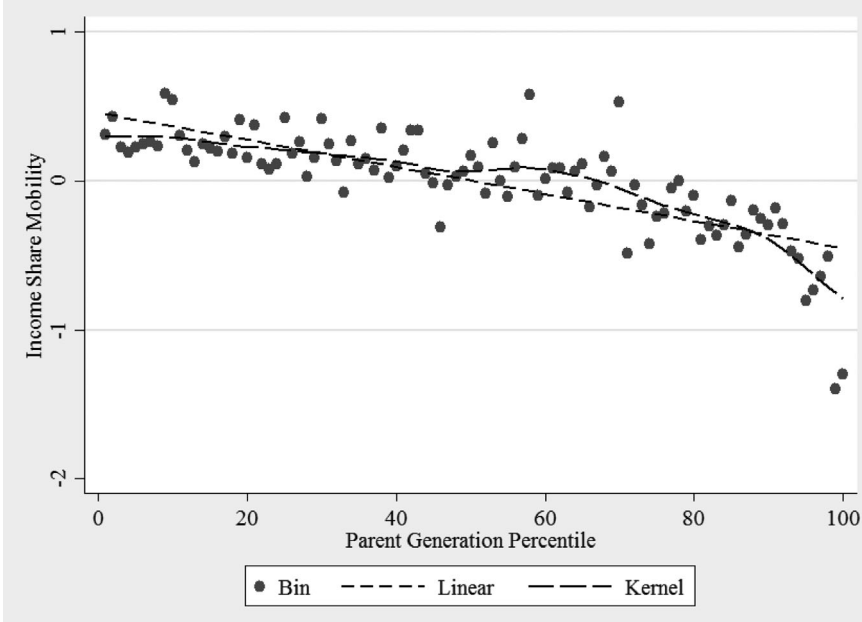


Fig. A5. Income share mobility curve: Germany

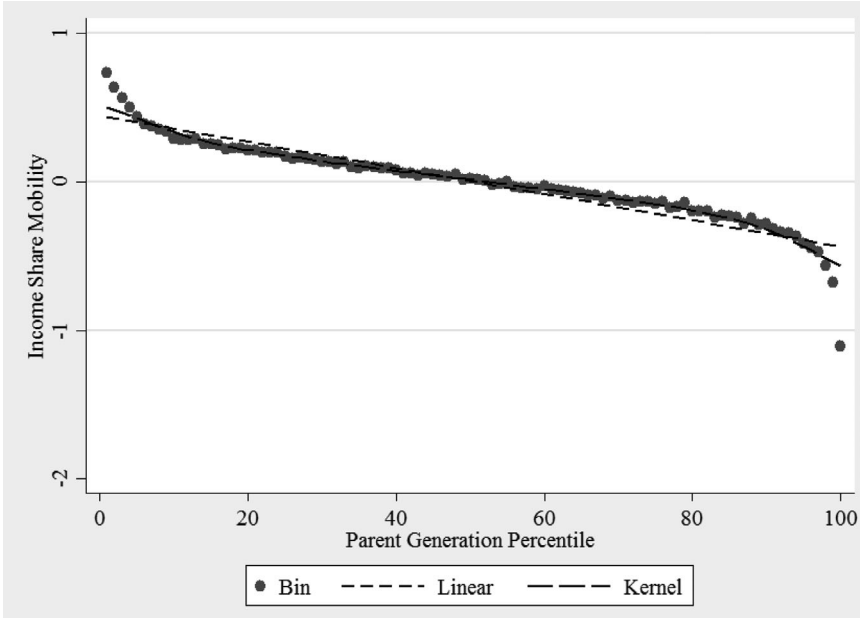


Fig. A6. Income share mobility curve: Norway

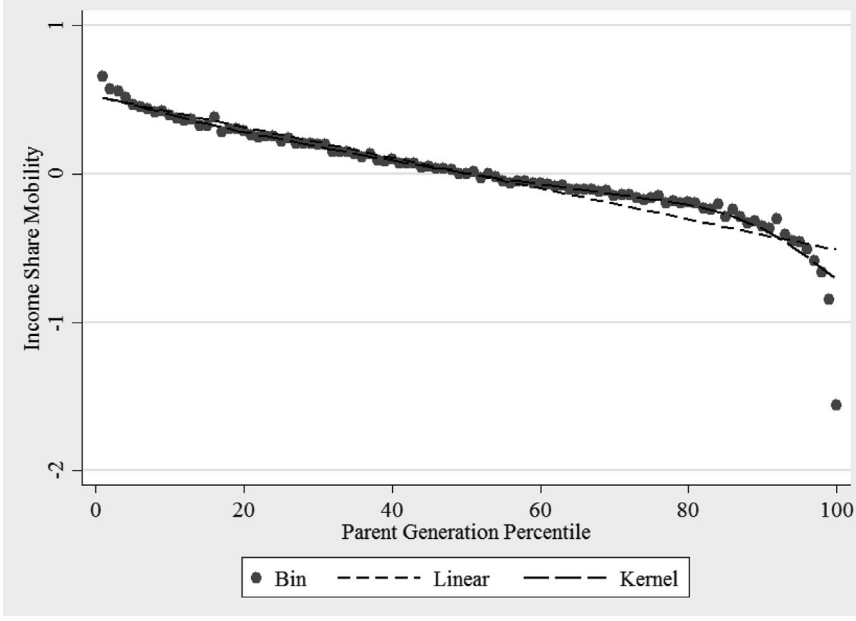


Fig. A7. Income share mobility curve: Sweden

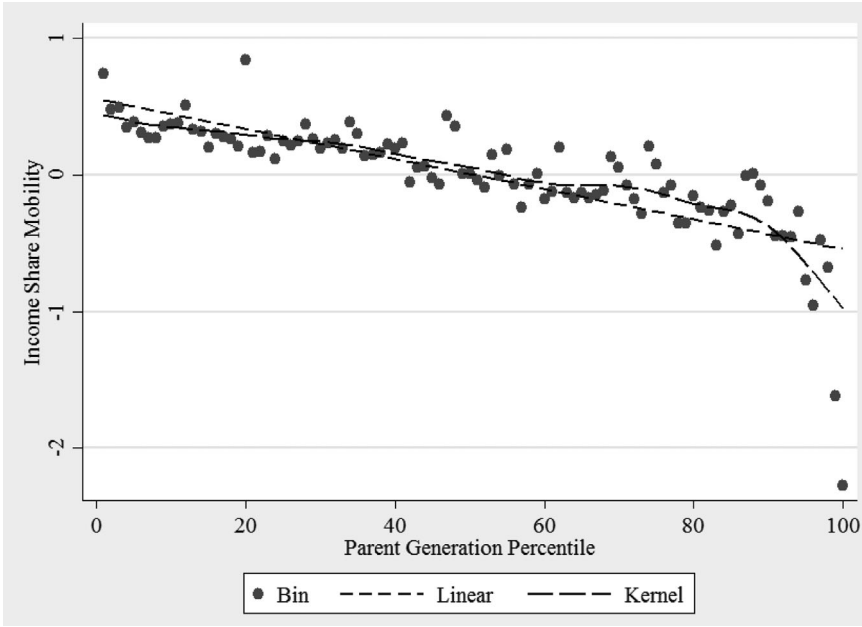


Fig. A8. Income share mobility curve: US

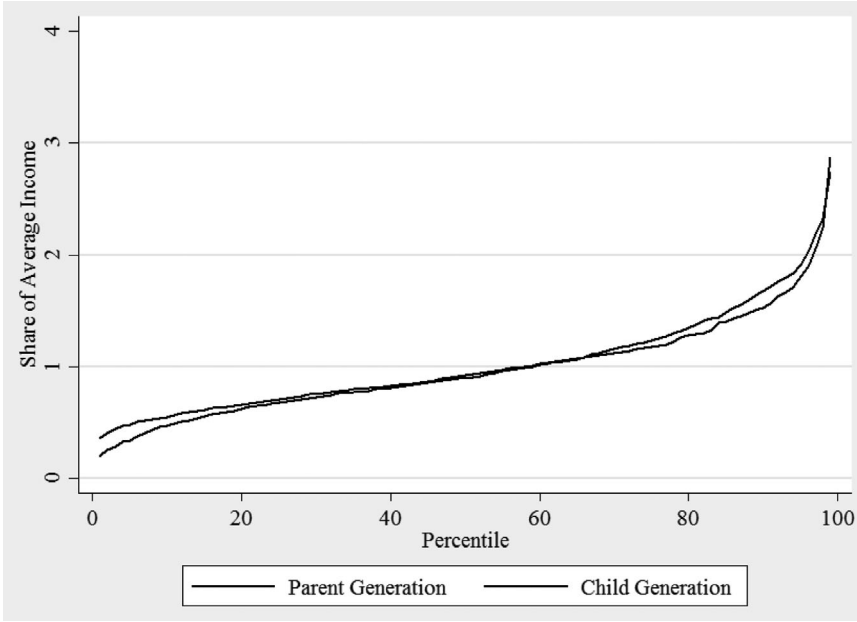


Fig. A9. Income distributions: Germany

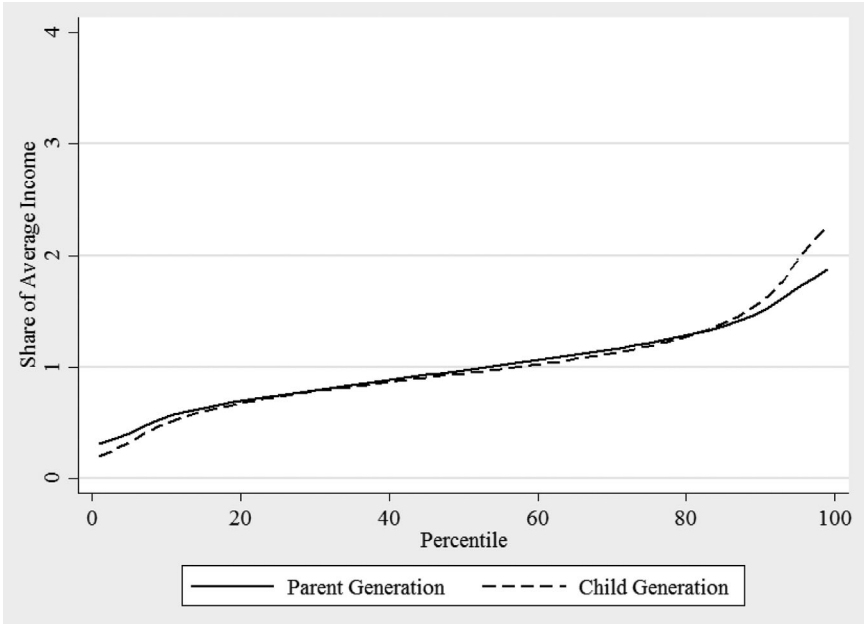


Fig. A10. Income distributions: Norway

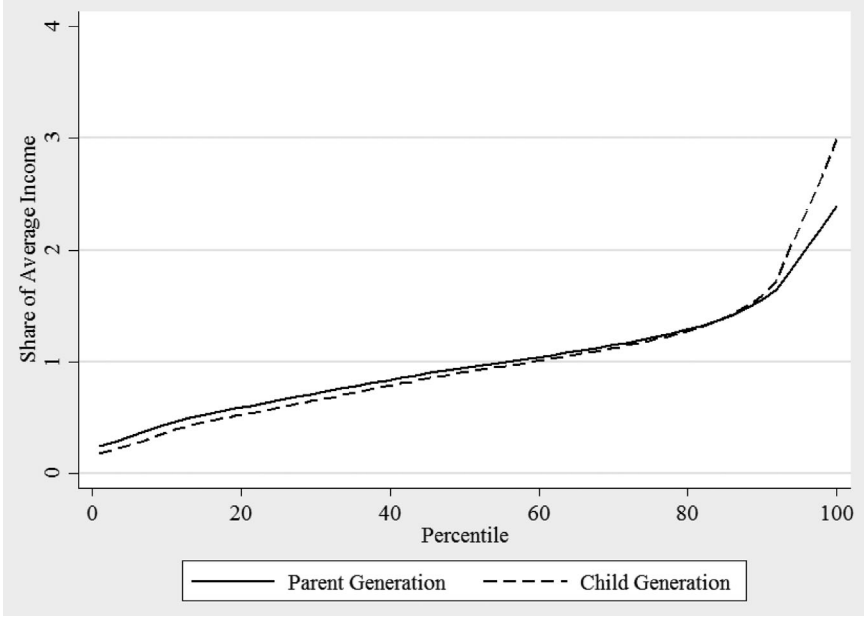


Fig. A11. Income distributions: Sweden

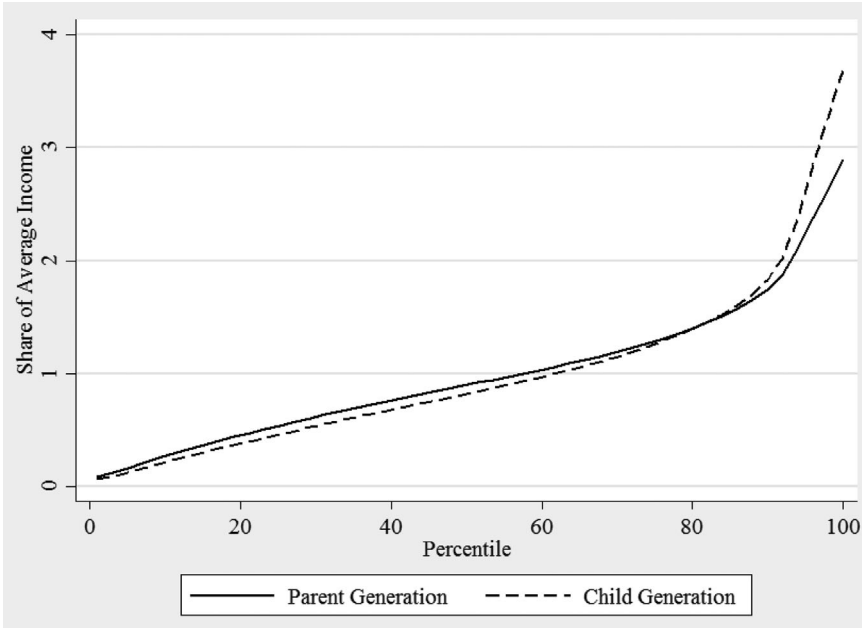


Fig. A12. Income distributions: US

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