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The Myth of Nordic Mobility: Social Mobility Rates in Modern Denmark and Sweden

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Abstract
In this paper we estimate social mobility rates, free of measurement errors, using register data for Denmark and Sweden, 1968 to 2021. To correct for measurement error attenuation, we take ratios of the correlation of relatives at different locations in family trees, such as cousins relative to siblings. Three things emerge from these estimates. First social mobility rates in both Denmark and Sweden are much lower than conventionally estimated. Second these countries, despite their reputation for high social mobility rates, have only modestly less persistence as in modern England, or also nineteenth century England or Sweden. Finally in all the cases observed marital assortment is much stronger than conventionally estimated, and this helps explain the low rates of intergenerational mobility.

Keywords Intergenerational mobility · Social mobility · Assortative mating

JEL Classification J62 · J12 · D31 · I24

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Introduction

Nordic countries are generally regarded as among the most socially mobile in the world.[1] Take, for example, the intergenerational correlation of years of schooling, measured as the correlation of the average years of schooling of the parents with their children. For the cohort of children born in the 1980s this was 0.19 in Denmark and 0.30 in Sweden, compared to 0.47 in the UK and 0.42 in the USA (van der Weide et al. 2024, database). Intergenerational correlations of income are also lower in Nordic countries than in most other countries. On average, the intergenerational income elasticity in the Nordic countries is 0.20, compared to 0.50 in the USA, 0.47 in the UK, and 0.41 in France (Corak 2006).

This apparent high degree of social mobility led to the five Nordic countries being ranked the top five countries for social mobility in 2020 by the World Economic Forum (World Economic Forum 2020. p. 7).[2]

The paper uses register data from Denmark and Sweden on years of education to show three surprising features of social mobility in modern Scandinavia. First intergenerational social mobility rates are much lower than conventionally estimated. Second both Denmark and Sweden have nearly the same degree of status persistence as in modern England. They also show little or no increase in mobility rates compared to nineteenth century England or Sweden. Finally in all these countries and time periods marital assortment is also much stronger than conventionally estimated. The high degree of marital assortment helps explain the low rates of intergenerational mobility.

Our approach exploits administrative records in Denmark and Sweden covering both vertical and horizontal family linkages, allowing us to calculate correlations across a wide range of kinship relations: uncle to niece, father to son-in-law, brother to sister-in-law, and so on.

These observed correlations, however, as measures of the underlying correlations in educational attainment, or more general social status, are all biased downwards by measurement errors. Years of schooling, for example, is a very loose measure of true educational ability, or of social abilities in general. Extensions of compulsory years of schooling have had little or no effect, for example, on the earnings of the less academically able students who were induced to get more years of education (Clark and Nielsen 2026).

Students with the same measured years of schooling can have substantially different educational ability or social abilities depending on their exam performance, the selectivity of the institution they attended, and the selectivity of the subjects they specialized in. An MA in Physics with the highest grade from Copenhagen University implies a lot more educational ability, or social status, than an MA in Media and Communications with the lowest passing grade at Copenhagen Business School.

[1] Note, however, the recent article by Heckman and Landersø that disputes this general view for the case of Denmark (Heckman and Landersø 2022).

[2] The rankings were 1. Denmark, 2. Norway, 3. Finland, 4. Sweden, 5. Iceland. The UK was ranked 21st, and USA 27th.

Further the degree to which years of education signals underlying educational ability or general social abilities will vary across societies.

In this paper we consider how to estimate the intergenerational correlation of some general underlying social ability, x, in a world where measures of social status such as years of education, income, wealth, and occupational status, are all just imperfect indicators of x, so that $y_i = x + u_i$, and the y_i are the set of partial indicators.

The important assumption is that while the intergenerational correlation of underlying status will be biased downwards by measurement errors that bias will be the same for any partial indicator of social status across single pairs of relatives such as siblings as across multiple combinations of relatives such as brother to sister-in-law. That means that we can eliminate the measurement error in estimating intergenerational and other family correlations by dividing correlations between one set of relatives with the correlations by another, as is shown below.

Measuring True Social Mobility Rates

As noted, based on the parent-child correlation of years of education both Denmark and Sweden appear to be societies of high social mobility. The ability of completed years of education to index well underlying educational attainment or status will vary, however, across different types of society.

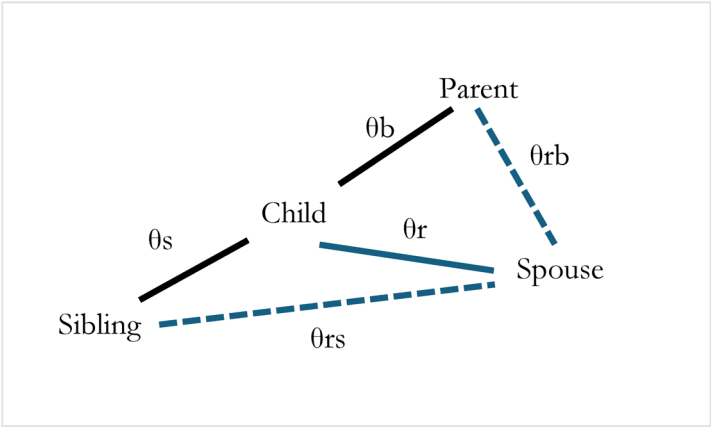
In Nordic countries, there is much greater state support for education than in most other countries. In Denmark, for example, there is no tuition payment until even the Masters degree stage, and generous support for student living expenses at age 16 and above. There is a generous supply, also, of places in degree programs. This will potentially make the correlation between years of education and actual educational attainment weaker in Denmark than in other countries, where less able students are unable to get access to tertiary education, or drop out of the educational system earlier. Thus in 2008 the completion rate for tertiary education in Denmark was 81%, compared to 56% in the USA.[3] Years of education thus potentially provide a better measure of educational attainment, or educational ability, in the USA versus Denmark, raising the observed family correlations.

Assuming all measures of social status available to researchers are imperfect indicators of underlying status, how can we get measures of social status persistence, for example, that can be compared across time in the same country, or across countries at the same time?

Figure 1 has illustrations of how such error-free estimates of the correlations that measure rates of social mobility can be obtained. In the first panel (1A) is shown the observed correlations in years of education between a child, their parent, their sibling, and their spouse. These correlations are respectively labelled $\theta b, \theta s, \theta r$, where θ is the error attenuation, and b, s, and r the underlying correlations in educational attainment between parent-child, siblings, and spouses. In Fig. 1 we assume for the moment that the error attenuation has the same proportionate effect irrespective of the genders of the relative pair, or their birth cohort.

[3] OECD (2009, p. 24).

A. In-Laws



B. Siblings versus Cousins

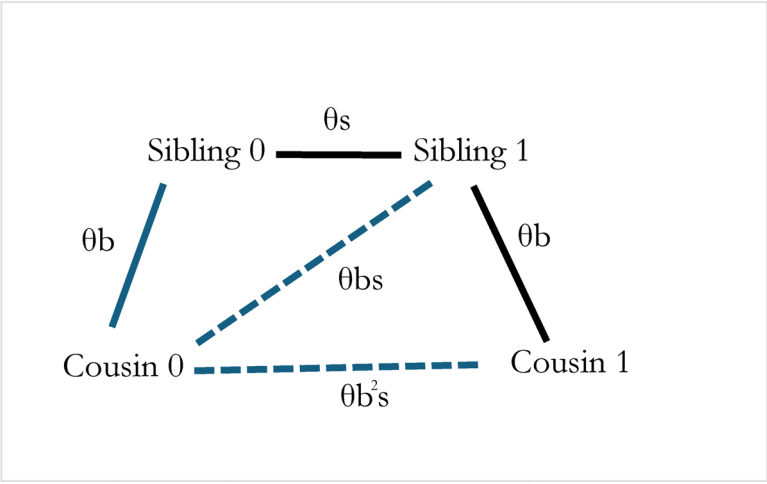


Fig. 1 Observed correlations between relatives. *Notes:* Assuming the parent-child and sibling underlying correlations are independent of gender, and also measurement error is independent of gender. All relationship labels (e.g., 'spouse', 'sibling') refer to the relatives of the focal individual, i.e., the child.

Importantly we assume in Fig. 1A that the spousal choice is made independent of the status of the parents or siblings. In that case the correlation between parent and the child-in-law will be, as shown, θbr. Though this correlation is the product of the parent-child and spousal correlations, the error attenuation only appears once. Similarly the sibling to in-law correlation, the product of the sibling correlation times the spousal correlation, is θrs. For societies such as the modern Nordic countries the assumption that assortment in marriage is based solely on the characteristics of marital partners seems entirely plausible.

If we now take the observed correlation of parent to child-in-law (θbr), and divide that by the correlation of child to their spouse (θr), then that will be b, the true under-

lying parent-child correlation. Similarly if we take the observed correlation of parent to child-in-law, and divide that by the correlation of parent to child (θb), then that will be *r*, the true underlying spousal correlation. We can also estimate s, the true sibling correlation, by dividing the sibling-spouse correlation (θrs) by the observed spousal correlation (θr).

Panel B of Fig. 1 shows another set of relatives, siblings and their children. Again assuming the outcomes of their children are independent of the outcomes for their cousins, we will find that the cousin correlation will $\theta b^2 s$. The uncle/aunt-niece/nephew correlation will be similarly θbs. Taking the ratio of the cousin correlation to the uncle/aunt-niece/nephew correlation will give us an estimate of the underlying intergenerational correlation. The ratio of the cousin correlation to the sibling correlation will give an estimate of b^2.

As Table 1 shows, we can derive further sets of relative correlations in years of education, that allow further estimates of the underlying mobility parameters b, r, and s. If, for example, we consider the relationships of a person to the spouse of their sibling in law, that would have an expected correlation of $\theta r^2 s$. The expected correlation to their aunt/uncle-in-law would be θbrs. Table 1 shows the observed correlations between 11 types of relatives using register data on completed years of education in both Sweden (from Collado et al. 2023), and from our own calculations from the population registers for Denmark. Also shown are the expected correlations for each relationship in terms of *b*, *r*, and *s*.

We assume above that the attenuation factor θ is the same for correlations across all gender combinations. Even if there is a different measurement attenuation for male-male, male-female and female-female correlations, the results will still hold. For if the attenuation factor for male-male correlations is φ, for male-female τ, and

Table 1 Years of education, correlations with relatives, Denmark and Sweden

Relationship	Expected Corr.	Sweden			Denmark		
		Ob.	Corr.	SE	Obs.	Corr.	SE
Spouse	θr	413,062	0.491	0.0012	1,869,156	0.443	0.0006
Sibling	θs	1,618,853	0.400	0.0007	2,993,118	0.374	0.0005
Parent	θb	1,595,270	0.354	0.0007	4,241,096	0.302	0.0004
Child-in-law	θbr	–	–	–	3,292,907	0.252	0.0005
Sibling in law	θrs	2,427,198	0.294	0.0006	2,545,645	0.283	0.0006
Aunt/Uncle	θbs	2,359,664	0.232	0.0006	783,564	0.232	0.0011
Cousins	$\theta b^2 s$	1,198,135	0.190	0.0009	650,723	0.191	0.0012
Sibling of Sibling in law	θrs^2	1,890,600	0.198	0.0007	1,582,569	0.192	0.0008
Spouse of Sibling in law	$\theta r^2 s$	943,108	0.231	0.0010	2,539,664	0.243	0.0006
Parent-Parent-in-law	$\theta b^2 r$	–	–	–	2,709,905	0.193	0.0006
Aunt/Uncle in law	θbrs	1,908,238	0.180	0.0007	765,909	0.183	0.0011

Sources: Danish Population Register, Collado et al. 2023, Table 3

For each relationship the table shows the number of pairs (Obs.), the correlation (Corr.), and the standard error of that correlation (SE). The reported correlation is the average correlation within each relationship-type, irrespective of gender. Standard errors are computed as $SE = \frac{1-\rho^2}{\sqrt{N-1}}$.

for female–female ω, then the average attenuation for all relative pairs if calculated separately by gender would now be, for all relationship pairs

$$\theta = \frac{1}{4}(\varphi + \omega + 2\tau)$$

Thus calculating true underlying correlations using ratios will see these disparate attenuation factors appear in the same way in numerator and denominator of each ratio employed.

Note that in Table 1 spouses are defined as individuals who are parents of a given child. There is no implication that one or both played an active role in raising the child. Siblings includes only full siblings, children who shared a father and mother.

We are also in these calculations implicitly assuming classical measurement errors. In practice many measures of social status will not have normally distributed errors. This is true even for such continuous measures as years of education or income, where the distribution will show marked clumping on particular values. For category variables, such as measures of social class, or graduating high school, attaining higher education, or earlier of literacy, the non-normality of the errors will be even more pronounced. Below we show by simulations that the ratio method will still generally work in estimating underlying social mobility rates, even in the case of highly non-normal errors.

The data in Table 1 in the Danish case looks at people born prior to 1985 so that they would overwhelmingly have completed their education. Since a criterion for inclusion was having both parents have an ID, those included here were the younger portion of the Danish population, with an average birth year of 1967.[4] We thus end up including at maximum 2.3 million individuals. Years of education has been standardized to the same mean and standard deviation by birth cohort and by gender.

The Swedish data comes from Collado et al. (2023), who use a 35 percent random sample of individuals born between 1932 and 1967 from the Swedish Population Register. In contrast, the Danish register data we use covers the full population born before 1985. Thus in Table 1, for most outcomes, despite Sweden having a population roughly double that of Denmark, we have more observations for Denmark. Following the approach in Collado et al. (2023) we define kinship based on biological links. This means that a man and woman are considered spouses if they have a child together.

Estimation Results

From Table 1 we derive Table 2, which shows the ratios of the correlations in Table 1 that reveal the implied values of *b*, *r*, and *s*, as well as the standard error of each estimate. Table 2 also shows the implied average values of each of these correlations for Denmark and Sweden.

[4] Since the register was introduced in 1968 only Danish residents still living in 1968 are guaranteed to be included.

Table 2 Implied underlying correlations, Denmark and Sweden

Relationship	Sweden			Denmark		
	b	*r*	*s*	*b*	*r*	*s*
Child-in-law	–	–	–	0.567	0.833	–
				(0.001)	(0.002)	
Aunt/Uncle	0.569	–	0.656	0.621	–	0.768
	(0.002)		(0.002)	(0.003)		(0.004)
Sibling-in-law	–	0.720	0.598	–	0.757	0.638
		(0.002)	(0.002)		(0.002)	(0.002)
Cousin	0.821	–	–	0.825	–	–
	(0.004)			(0.006)		
Sibling of Sibling-in-law	–	–	0.675	–	–	0.678
			(0.003)			(0.003)
Spouse of Sibling-in-law	–	0.799	–	–	0.859	–
		(0.004)			(0.003)	
Parent-parent-in-law	–	–	–	0.767	–	–
				(0.003)		
Aunt/Uncle-in-law	0.612	0.774	–	0.646	0.788	0.726
	(0.003)	(0.004)		(0.004)	(0.006)	(0.005)
Average	0.67	0.76	0.64	0.69	0.81	0.70

Source: Table 1

The table shows the implied values of correlations *b*, *r*, and *s* from Table 1. Standard errors in parentheses. These are calculated using the Delta method (see Appendix). The Swedish data is based on a 35% random draw of the population born between 1932 and 1967, while the Danish data covers the full population born before 1985.

Several things stand out. The first is that the average implied values of *b*, *r* and *s* are very similar for Sweden as for Denmark, typically with less than 5% of a deviation. The second is the close correlation of people matching as parents. The average underlying correlation of educational status for parents is 0.81 in Denmark and 0.76 in Sweden. Such close matching is consistent with both high observed sibling correlations, and high parent-child correlations. The third feature is the strong implied intergenerational correlation of 0.67–0.69. This is nearly double the observed intergeneration correlation in years of education for both Denmark and Sweden observed in Table 1. Finally we also observe a strong sibling correlation of 0.64–0.70, which is again nearly double the average observed correlation of 0.39.

We also estimated the parameter values using male-only kinship types to ensure our findings are the same where we restrict the relative correlations to be only those between male relatives. Restricting our analysis to male-only kinship ties yields nearly identical results, supporting the robustness of the estimates. With all gender pairings the implied intergenerational correlation averages 0.68, while looking just at correlations between male relatives the intergenerational correlation is 0.70. Similarly the sibling correlation goes from 0.67 to 0.70, and the marital correlation from 0.79 to 0.78. So the estimates are robust to gender combinations.

All this implies that for educational attainment, both Denmark and Sweden show strong familiar persistence. This is occurring despite the provision in these societies of both free education up to university level, and also stipends to cover students living expenses from high school onwards.

Note also that there is an important connection between the parental status correlation and the intergenerational correlation. If both parents contribute equally to child outcomes then the correlation between a single parent and a child will be, at maximum, $(1 + r)/2$. This implies that the intergenerational correlation between a single parent and child can only be as high as 0.8 if the parental correlation in status is at least 0.6. If the conventional measurement-attenuated correlations between parents on educational attainment, which are around 0.45, were capturing true rates of parental assortment, then intergenerational correlations would have to be much lower than observed here.

As noted above, the data on Swedish familial correlations in years of education comes from Collado et al. (2023). Collado et al., were able to identify in Sweden 141 different types of relatives in register data by linking children to each of their parents, parents to grandparents, parents to siblings, and so on through in-laws across as many as five marriages. They then estimate the correlation in years of education and income between each of these relatives. The more remote of these relatives include spouse of sibling-in-law (third degree), which involves linking seven individuals across four marriages and three sibships.

To this correlation data, Collado et al. fitted a social transmission of status model which has 20 free parameters, a combination of latent and observed status, as well as marital matching on both latent and observed status. Then using a selected set of 105 correlations, Collado et al. were able to show a strong fit of this 20-parameter model to the data for years of education.[5] That 20-parameter model, in line with the results in Table 2, shows strong assortment in parenting, and strong persistence across generations. So for a wider collection of family relations there is similar evidence of strong persistence of status as relatives become more remote.

We did also estimate r, b, and s in the same way as in Tables 1 and 2 using income as the outcome. In this case there are clear gender differences in correlations of income across relatives, so that the estimation has to be done using male relatives only. Here also a problem we run into is that even for relatives as close as cousins, the correlations in income are only 0.07 in Sweden and 0.09 in Denmark, compared to 0.19 in both countries for years of education across all cousins. This makes the estimates using the ratio of observed correlations much noisier. The average implied spousal correlation at 0.74 is similar to the education estimates. But the intergenerational and sibling correlations are estimated at only 0.55 and 0.53. These two estimates, however, are still multiple times higher than the observed intergenerational correlations of 0.19 and the observed sibling correlations of 0.20. Again there is much more persistence than the observed data would imply.

[5] The baseline model is fitted to only 105 correlations because this same model does not fit well for cousins, or for in-laws to the fourth degree or higher. (p. 1213).

Comparisons of Social Mobility Rates with Other Countries and Times

For England, Clark (2023) estimates underlying rates of social mobility over the years 1650–2021, using multiple social status indicators. These indicators are literacy at marriage (weddings 1754–1889), attaining higher education, occupational status, log house value 1999–2021, index of multiple deprivation of local neighborhood, 1999–2021, and company directorships, 1999–2021. Correlations on these outcomes are reported for siblings, parent-child, sibling once removed, grandparent-child, and first to fourth cousins, as well as first to fourth cousins once removed. These correlations are derived from a large genealogical database, *Families of England*, with 446,000 observations which tracks everyone holding a set of rarer surnames from 1600 to 2025.

From these correlations it is possible to estimate the underlying intergenerational mobility rates in England, b, for all these outcomes. Thus we can estimate intergenerational mobility using literacy at marriage 1754–1889, occupational status and higher education attainment for men born 1780–1859 and 1860–1919, and house values, index of multiple deprivation, and company directorships for men and women born 1920–1995. Just using the correlations of siblings, parent-child, sibling once removed, and cousins we get estimates of the underlying intergenerational correlation, b, and sibling correlation, s.

Table 3 reports the average underlying parent-child and sibling correlation for England in the nineteenth century, and for the modern population observed 1999–2021. The estimated intergenerational correlation is 0.80 for the nineteenth century and 0.77 for modern England. The sibling correlation is 0.79 for the nineteenth century and 0.72 for modern England.

Clark (2023) also derives for the nineteenth and twentieth centuries estimates of the underlying marital correlation, r. This comes from the ratio of the correlation of occupational status between grooms to father-in-laws to the correlation of groom to father. These correlations derive from a large set of marriage records for England 1837–2021, where in these years marriage records record the occupations of grooms, fathers, and father-in-laws. As Table 3 shows the marital correlation was estimated at 0.77 in nineteenth century England and 0.80 for the twentieth century.

Table 3 suggests that Denmark and Sweden have underlying social mobility rates that are similar, though not quite as high, as modern England, across all three dimensions of mobility. Marital assortment is as strong in the Nordic countries as in modern England, and intergenerational and sibling correlations are nearly as high.

Even more remarkable in Table 3 is that nineteenth century England had intergenerational and sibling correlations that only modestly exceed those of modern Denmark and Sweden. In contrast to the modern Nordic societies, in nineteenth century

Table 3 Comparative underlying social mobility rates, England versus Nordic

Population	Period	Marital *r*	Sibling *s*	Parent-Child *b*
England	19th c	0.77	0.79	0.80
England	Modern	0.80	0.72	0.77
Denmark	Modern	0.81	0.70	0.69
Sweden	Modern	0.76	0.64	0.67

Sources: See text, Clark (2023)

England there was minimal public provision of education. Indeed before 1871 there was no legal requirement for parents to educate their children.

Clark et al. (2014), estimates underlying social mobility rates across a variety of countries and time periods using surname status persistence as an alternative way to control for measurement errors in status indicators. In particular, this book includes a chapter measuring Swedish social mobility rates all the way from the eighteenth century to the 2000s, by looking at the overrepresentation of elite surnames from the eighteenth century in such elites as university graduates, medical doctors, and lawyers up until the present time.

It finds, for instance, that evidence on representation of elite surnames among doctors suggests that for cohorts registered as doctors 1890–1919, 1920–49, 1950–79, and 1980–2009, implied intergenerational status persistence was 0.74 throughout (Clark et al., figure 2.13). The records of Lund university students 1700–1910 similarly suggest an intergenerational status persistence of 0.78 throughout these enrollment years (Clark et al., figure 2.13). Thus the estimated educational status persistence rates in Sweden in the years before 1950 only very modestly exceed those suggested by the register data for the current generations.

Non-normal Errors

The estimates above of underlying persistence assumes a normally distributed underlying status, along with normally distributed measurement errors. For years of education and income the departure from normality in the measurement errors will not be too severe. But assuming an underlying normal distribution of social abilities, how will the methods above to correct for measurement error fare if we have measures of social status that involve measurement errors that are far from normal?

To consider this "Appendix 1" reports on a set of simulations where the marital correlation and the parent-child correlation in underlying social status are both assumed to be 0.8. But the underlying social status for each person gets translated into reported social status in a variety of ways. The first is through classical measurement error. But status is also measured as incorporating error, but then is observed as converted into a rank (such as for the Index of Multiple Deprivation in the UK). It is further measured as a person belonging to one of five social classes, or one of two social classes where the divider is at mean observed status (such a literate versus non-literate in England circa 1750), or as one of two social classes where the divider is at the upper 5% of the distribution. Finally status is observed as the exponent of the status (plus normal error), so that the distribution of observed status is log-normal.

Table 4 shows these estimates. The reporting of status as social class, or in log-normal form, often sharply lowers the observed parent-child and other correlations, as information is lost in the translation, or errors are magnified. But with these simulations, in almost all cases the estimated underlying correlation coefficients parent-child or between spouses lie within 1% of the true underlying correlations. This is true even where the observed status is just "upper" versus "lower" class, with a split around mean observed status. In only one case, where upper class is observed as the

top 5% of the distribution, do the estimated coefficients now deviate by 8% from the underlying coefficients.

The implication is that the ratio method suggested here will reliably uncover underlying social status correlations in the presence of measurement error for all commonly used status measures such as status rank, social class, or log normally distributed outcomes such as income or wealth. The only case where the method will potentially fail to correctly estimate underlying correlations would be where the status measure is membership in some small elite or underclass group.

Confirming Evidence of Limited Nordic Social Mobility

Support for the claim that societies such as Denmark and Sweden have not succeeded in increasing rates of social mobility comes if we look at the distribution of scores in the PISA (Program for International Student Assessment) measures of student reading, mathematical and science knowledge. The aim of the PISA program is to give periodic assessments of the academic achievements of a representative sample of 15-year-olds in each country.

Figure 2 shows for each OECD country in the 2018 collection of the PISA measures the average standard deviation by country of the PISA scores in Mathematics, Reading, and Science. These are graphed against average Gini coefficient for disposable income in each country for 2012–2022.

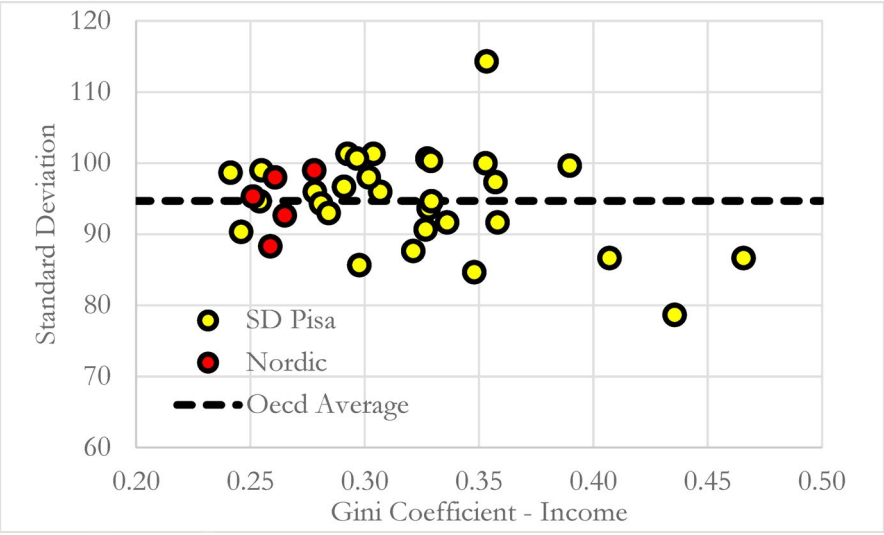


Fig. 2 Standard deviation of PISA scores 2018, by OECD country. *Source*: OECD 2019, tables 1.B1.1-6, pp. 216-21. *Notes*: The dashed line shows the OECD average standard deviation of 94.7. The Gini coefficient is that for disposable income, averaged for 2012–2022

It is very clear in the figure that Nordic countries have as high a dispersion of PISA scores as the average OECD country.[6] This is despite the fact that the low Gini in these societies means much less variation in the material home environment of students than for the average OECD country. In Nordic countries, in addition, the great majority of children attend publicly subsidized pre-school ages 1–5, where standards of care and education are not dependent on parents' income. There is a substantial recent literature that emphasizes the benefits of such pre-school is particularly strong for children from the least advantaged families, if the care is of high quality (Gormley et al. 2005, Heckman and Lochner, 2000, Waldfogel 2006). All this should compress the educational attainment differences of 15 year olds in Nordic countries. It does not. The extensive social provision of Nordic countries has not succeeded in narrowing scholastic performance gaps within each cohort.

Earlier papers, which measured the amount of PISA score variation across students that can be predicted from such factors as the father's occupational class, confirm that societies with lower income inequality, such as the Nordics, are not associated with a decline in the gap in PISA scores between upper- and lower-class families (Chmielewski 2019; Dupriez and Dumay 2006; Marks 2005).[7] It has been claimed that more equal income distributions are associated with higher average achievement across countries (Condron 2011; Thorson and Gearhart 2018). But such general performance enhancing effects will have no effect on social mobility rates.

Conclusions

All measures of social status such as years of education, income, wealth, occupational status measure true, underlying status only imperfectly. Further the degree to which these measures incorporate measurement error varies across time and place. Attempts to compare societies in terms of their degree of social mobility across time and place have often failed to take any account of the problem of measurement error.

In this paper we suggest a method of correcting for measurement errors that is based on looking not at the absolute correlation of relatives in outcomes, but at their relative correlation. Applying such methods to Denmark, Sweden and England now, as well as England in the nineteenth century, we find three things.

First, actual educational intergenerational mobility rates in modern Denmark and Sweden are much lower than conventionally measured. Also the correlation of parents and of siblings in educational attainment is again much higher than conventionally measured. If educational attainment is an index of social status in general, then modern Denmark and Sweden are very immobile societies.

Second, rates of educational mobility in Denmark and Sweden are only modestly higher than social mobility rates measured through house values, neighbor-

[6] The Nordic countries are Denmark, Finland, Iceland, Norway and Sweden.

[7] Dupriez and Dumay (2006) finds no association between income inequality and the ability to predict PISA scores using mothers educational status, and family social background. Family educational and social background predicts student PISA performance just as well in the societies with the most equal income and in those with the most unequal income.

hood quality, or company directorships in modern England. Denmark and Sweden's more generous public support of education, and compression of household income inequalities, has at best modestly reduced the importance of families in determining child educational outcomes. This point was emphasized recently in a paper on Denmark by James Heckman and Rasmus Landersø (Heckman and Landersø, 2022).

Third, and most surprising, social mobility rates in modern Denmark and Sweden are only modestly higher than social mobility rates in nineteenth century England. Despite the absence of public educational provision in England for most of the nineteenth century, educational attainment in modern Denmark and Sweden is nearly as strongly inherited as in nineteenth century England. In Sweden, where we can measure educational status inheritance back even to the eighteenth century, the strength of inheritance as measured by elite surname persistence now is as great as in the eighteenth and nineteenth centuries (Clark, 2014).

Appendix 1: True Social Mobility Rates with Different Types of Measurement Errors

Assume that for each person, x = true status, u = measurement error, $y = x+u$ = measured status. We also observe status for a person, their parent, and their spouse. The true parent-child correlation is b, and the true spousal correlation is r. But observed correlations are θb, θr. If spousal choice is dependent only on x, and is independent of the parental x, then the observed correlation in status between a parent and their child's spouse will be θbr. Can we recover the true status correlation of parent-child, or of spouses, using the ratios

$$\frac{parent\text{-}spouse\ correlation}{spousal\ correlation} = \frac{\theta \mathrm{br}}{\theta \mathrm{r}} = b$$

$$\frac{parent\text{-}spouse\ correlation}{parent\text{-}child\ correlation} = \frac{\theta \mathrm{br}}{\theta \mathrm{b}} = r$$

To test this we conduct a simulation with 1 m. random draws of underlying status for parent, child and marital partner, with a parent-child and marital correlation in underlying status of 0.8, and underying status normally distributed. But we generate different types of measurement errors. Table 4 shows the resulting estimates of b and r with different measurement types.

Classical Measurement Error

This error is assumed to be normal with the same variance as the underlying status measure. In this case the attenuation factor in measuring the underlying correlations in each case will be 0.5. As the first row in Table 4 shows the observed parent-child and spousal correlations are indeed attenuated from the true correlations by a factor of 0.5. Using the ratios of observed relative correlations in the final two columns of

the table, we see that in this case the ratios do indeed recover the true correlations of 0.8.

Status Measured as a Rank

Suppose, however, that the observed data on status is translated into a **rank** form, with rank from 0 to 100. This implies losing some of the information on status in the underlying data, as witnessed by the declining parent-child, spouse, and parent-spouse correlations. What happens to the estimated parent-child and spousal correlations with such a transformation? Row three shows the resulting estimates of r and b are both not statistically different from 0.8.

Status Measured as Social Class

Suppose social status is instead measured by assignment to one of five social classes, as is common in sociology? In this case we take class 1 as the top 5% of the observed status distribution, class 2, next 10%, class 3 next 15%, class 4 next 20% and class 5 remaining 50%. What will be estimated underlying correlations r and b if we arbitrarily just assign status scores 1,….5, to each of these social classes? Row four of the table shows an even greater decline in parent-child, spouse, and parent-spouse correlations from greater losses in status information with this five-class assignment. Yet the resulting estimates of r and b decline from 0.800 to only 0.792. This decline is also statistically significant. But the quantitative downward bias in the estimate is still only 1%.

Status Measured as Upper Versus Lower Class

A greater loss in status information comes if we just divide people at the mean into upper and lower status, as in row 5. Now we have a 0–1 status indicator centered on the mean. This reduces the observed parent-child, spouse, and parent-spouse correlations by nearly 40%. But this still yields an estimate of both the intergenerational and spousal correlations of 0.79, as opposed to the underlying value of 0.80. Even with this severely non-classical error structure, the downwards bias in the underlying estimator is still not much more than 1%.

An even more drastic loss of status information comes if we instead have a dichotomous status measure, but with the cutoff for high status being at the top 5% of the observed status distribution. This reduces the observed parent-child, spouse, and parent-spouse correlations by around 70%. The estimated underlying parent-child and spousal correlations now decline from 0.80 to 0.74, a decline of 7.5%.

Status Lognormal

The final row of Table 4 shows the case where measured status has a lognormal distribution, as in the case of income or wealth, so that $Y = e^y = XU = e^x e^u$, and y, x, and u are distributed normally. In this case even though the correlation between parent and child and spouses in x is 0.8, the correlation between parent and child and

Table 4 True and estimated correlations, varying measurement errors

Observed	Observed correlation of parent-child	Observed correlation of spouses	Observed correlation of parent-spouse	Estimated r	Estimated b
Classical Errors	0.400	0.403	0.322	0.799 (.003)	0.803 (.003)
Rank indicator	0.385	0.387	0.308	0.795 (.0031)	0.801 (.0031)
Five Social Classes	0.335	0.336	0.265	0.791 (.0036)	0.793 (.0036)
Top 50% indicator	0.262	0.263	0.208	0.788 (.0046)	0.790 (.0046)
Top 5% indicator	0.148	0.149	0.110	0.737 (.0081)	0.742 (.0081)
Log Normal Distribution	0.197	0.194	0.142	0.733 (.0063)	0.721 (.0063)

Standard error in parentheses

spouses, $X = e^x$, is 0.717 (with a standard error of .0049). The errors in this case, Y-X, are significantly non-normal. Their absolute value is much greater for high values of X than for low values, for example.

In this lognormal status measure case, as the last row of the table shows, the average estimated value using correlation ratios, is 0.727 (with standard error 0.0045). This means the estimate is not statistically significantly different from the underlying correlation of the status measure X, 0.717 (with standard error 0.0049).

Appendix 2: Computing Standard Errors Using the Delta Method

The reported standard errors in Table 2 are computed using the Delta method, a standard approach for approximating the variance of nonlinear functions of random variables. This method is particularly useful when estimating the standard errors of ratio-based estimators. Given two variables, *X* and *Y,* with means μ_X and μ_Y, and standard errors σ_X and σ_Y, respectively, the standard error of their ratio can be approximated using:

$$\sigma_{X/Y} = \frac{1}{\mu_Y}\sqrt{\sigma_X^2 + \frac{\mu_X^2}{\mu_Y^2}\sigma_Y^2}$$

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