Trends in Absolute Income Mobility in North America and Europe

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Dynamics of Inequality Across the Lifecourse: structures and process

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Abstract

We compute rates of absolute upward income mobility for the 1960-1987 birth cohorts in eight countries in North America and Europe. Rates and trends in absolute mobility varied dramatically across countries during this period: the US and Canada saw upward mobility rates near 50% for recent cohorts, while countries like Norway and Finland saw sustained rates above 70%. Decomposition analysis suggests that differences in the marginal income distributions, especially the amount of cross-cohort income inequality, were the primary driver of differing mobility rates across countries. We also demonstrate that absolute mobility rates can be accurately estimated without linked parent-child data.

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Introduction

The hope that standards of living rise from one generation to the next is widely shared across the world. In the United States, this goal is often considered part of the "American Dream." Yet the extent to which different countries realize this goal is not well known. Recent research has shown that in the United States, upward absolute income mobility—the likelihood that children grow up to have higher real incomes than their parents—has declined substantially over the last fifty years. Roughly 90% of US children born in 1940 grew up to earn more than their parents at age 30, compared to just 50% of the 1984 birth cohort (Chetty et al. 2017). But the United States is unusual among high-income countries along a number of dimensions that may impact absolute mobility, including its low levels of relative social mobility (Corak 2006), its high levels of inequality in market income (Piketty, Saez, and Zucman 2018), and its comparatively underdeveloped welfare state (Esping-Andersen 1990). This raises the question: do trends in absolute income mobility in other countries mirror those in the United States, or is this an area in which the US is exceptional?

In this paper we present trends in absolute income mobility for a selection of North American and European countries: Canada, Denmark, Finland, the Netherlands, Norway, Sweden, the United Kingdom, and the United States. In doing so, we make three contributions to the literature on intergenerational income mobility. First, we show that both levels and trends in absolute mobility varied substantially across these countries for cohorts born in the late 20th century. The United States appears to have been unusual but not unique in both the magnitude of its mobility decline and the low upward mobility rate that currently pertains. Some countries, most notably Norway and Finland, have had both higher and more stable rates of upward mobility in recent generations, with Norway in particular maintaining a steady upward mobility rate of roughly 75% for the 1964–1983 birth cohorts. Other countries, such as the UK and the Netherlands, have had similarly high rates of mobility but with fluctuations, especially in recent years, that appear to reflect variation in macroeconomic conditions. Varying specifications highlight the importance of national economic institutions and demographic trends—most notably declining marriage and cohabitation rates—in shaping absolute income mobility.

Second, we provide direct validation of an increasingly common method to estimate absolute mobility rates by combining separate datasets on the marginal income distributions of parents and children and the parent-child income rank transition matrix, or copula. This "copula and marginals" approximation is emerging as the most widely used method of calculating absolute income mobility (e.g. Berman 2018; Bönke, Harnack, and Luthen 2019; Chetty et al. 2017). This approach does not require linked parent-child records, which makes it possible to calculate absolute mobility in the absence of high quality panel data. But it has not yet been directly tested through comparison to linked data. We conduct such a test here in five countries where both types of data exist, and show that the copula and marginals approach provides an accurate approximation of the true absolute mobility rate.

Third, we use decomposition analysis to show that cross-national differences in absolute mobility for recent cohorts stem largely from differences in levels of income inequality and economic growth rates, as opposed to differences in the likelihood of children moving up or

down in relative terms. While Scandinavian countries have had higher rates of relative mobility than the US, these largely net themselves out: anytime one child moves up the income ladder, other children necessarily move down. Patterns of absolute mobility are determined much more by marginal income distributions than by rank associations between children and parents (Berman 2018; Bukodi, Paskov, and Nolan 2019). In the case of the United States, low mobility rates exist not because the US economy has grown more slowly than the economies of other high-income countries, but because the US is less efficient at translating economic growth into higher standards of living for its populace.

Prior Research

Scholars of intergenerational mobility distinguish between absolute mobility, which compares the raw outcomes of children and parents—in this case their inflation-adjusted income—and relative mobility, which compares their rank or relative position in their respective distributions, adjusting for population-wide changes such as economic growth. Most previous research on intergenerational income mobility has focused on relative mobility: the association between the adult incomes of parents and children, often operationalized using the intergenerational elasticity of income or the correlation between the income rank of children and that of parents (Jäntti and Jenkins 2015; Torche 2015). A large literature has compared relative mobility rates across countries, generally finding that it is high in the Nordic countries and Canada, midrange in countries like Germany and Japan, and low in countries like Italy, the UK, and the US (Bratberg et al. 2017; Corak 2016; Smeeding, Erikson, and Jäntti 2011).

Very recently a number of researchers have turned to absolute income mobility, motivated by the high salience of absolute comparisons among laypeople (Amiel and Cowell 1999; Ravallion 2018) and its straightforward normative interpretation: while one person's upward mobility in relative terms necessarily comes at the expense of someone else's downward mobility, upward mobility in absolute terms does not. Individual studies have estimated absolute mobility rates for recent cohorts of roughly 50% in the US (Chetty et al. 2017), 53% in Canada (Ostrovsky 2017), 70% in Germany (Bönke et al. 2019; Stockhausen 2018), and 77% in Sweden (Liss, Korpi, and Wennberg 2019).[15]

While no prior study has compared upward mobility rates across developed countries using comprehensive intergenerational administrative and survey data, Berman (2018) approximates mobility rates from countries' marginal income distributions alone. His findings suggest that upward mobility declined over the second half of the 20th Century in 10 high-income countries, and confirm that absolute mobility is determined largely by the marginal income distributions of parents and children, echoing findings for social class (Bukodi et al. 2019; Erikson and

[15] Note that the usage of the terms "absolute mobility" or "absolute income mobility" in this paper and the literature described here is distinct from their usage by Chetty et al. (2014), who use the term "absolute mobility" to refer to the expected adult income rank of a child born to parents at the 25th income percentile. That measure would capture a particular aspect of relative mobility in our terminology, since it is based on rank position rather than dollar earnings.

Goldthorpe 1992; Torche 2015). These are promising initial results that call for a fuller analysis using richer, inter-generationally linked administrative data.

There are reasons to expect that the countries in our sample might vary in their mobility trends. Although all have market economies, they differ substantially in their economic institutions—for instance, their union coverage rates and use of sectoral bargaining—and recent macroeconomic histories, in ways that might impact absolute mobility. One such potential driver is the extent to which countries exhibit cross-cohort inequalities. Esping-Anderson famously distinguished between English-speaking "liberal", Scandinavian "social democratic," and continental European "conservative" welfare states, which take very different approaches to managing the risks created by markets. Chauvel (2010; Chauvel and Schroder 2014) shows that conservative welfare states, which offer strong protections but tie many of them to employment, can have the effect of creating cross-cohort inequality, advantaging cohorts who come of age in a strong economy and are able to begin their careers in high-quality first jobs.

Liberal welfare states, most notably that of the US, have also seen cross-cohort inequalities increase. Guvenen et al. (2017) show declining median lifetime incomes for US men in the 1967-83 birth cohorts, which they attribute to income differences in the early years in the labor market. Concomitantly to these income pressures, marriage and family formation have been delayed (Ruggles 2015). Social democratic welfare states offer both a wider array of public goods and protections against adverse life events that are not tied to employment status (DiPrete 2002). In such countries younger cohorts could be expected to see similar income growth relative to prior generations.

Macroeconomic trends also differ across our sample countries. Sweden, for instance, suffered a major recession in the early 1990s, but was less impacted by the Global Financial Crisis which began in 2007 (Domeij and Flodén 2010). Other countries in our sample—notably the US, the UK, Denmark, and the Netherlands—were more impacted by the Financial Crisis, while Norway, Finland, and Canada have had somewhat calmer recent macroeconomic histories (Eurostat 2020). The US saw a much larger increase in income inequality than any other country in our sample over the last four decades, which was a major driver of its declining absolute income mobility (Alvaredo et al. 2017; Chetty et al. 2017).

The remainder of this paper makes three contributions to the literature described here. First, we present a comparative analysis of trends in absolute income mobility across eight high-income countries using high quality administrative and survey data that require minimal assumptions for the computation of income mobility rates. We use a range of specifications to isolate the role of the various demographic, economic, and institutional differences across these eight countries. Second, we provide the first direct validation of the "copula and marginals" approximation that is rapidly becoming a standard approach for estimating absolute mobility in the presence of data limitations (Berman 2018; Bönke et al. 2019; Chetty et al. 2017). Third, we identify drivers of variation in mobility rates across countries, specifically noting the importance of cross-national differences in income inequality, especially the share of total national income going to young adults.

Data and Methods

Because the type, time period, format, and quality of data differ across the countries in our sample, the data and methods that we use vary somewhat from country to country. A high-level comparison of the specifications used across all eight countries is provided in Appendix 1, and detailed descriptions of the exact data, methods, and specifications used in each country are provided in Appendix 2. The approaches that we use fall into two main categories. For countries where register data that link children to parents and track incomes over time are available—Canada, Denmark, Finland, the Netherlands, Norway, and Sweden—we calculate absolute mobility directly. We measure the household incomes of children and their parents when each is age 30. We then adjust for inflation using each country's consumer price index,[16] and compute the fraction of children whose incomes exceed their parents'. This is the most straightforward way to measure absolute mobility, requiring minimal assumptions or statistical approximations.

For the US and the UK, where linked register data are not available, we use the "copula and marginals" approach introduced by Chetty et al. (2017). This involves constructing a copula, or parent-child income rank transition matrix, for the subset of the data where linked income information is available for parents and children. Following Chetty et al., we use a 100 x 100 percentile cell copula. We then create marginal income distributions for parents and children in each birth cohort, again using percentile cells. We calculate the overall absolute mobility rate for a given cohort by first comparing the mean incomes in every pair of child and parent percentile cells and determining whether the children in that child cell had higher incomes than the parents in that parent cell. Next, we take the average of upward mobility across all parent and child cell pairs, weighting by the probability from the copula that children with parents in that parent cell grew up to have incomes placing them in that child cell. This approach does not determine whether any individual child out-earned his or her parents, but it does provide an accurate estimation of the upward mobility rate in total, as we show below using data from countries where both linked data and copulas and marginals are available.

With both approaches, we compute an initial specification that compares the family incomes of children (self plus spouse or cohabiting partner) at age 30 with those of their parents at the same age. We compute a second specification measuring income at age 40, to account for the possibility that incomes have not yet peaked by age 30 and to reduce the impact of noise from measuring income in one year only. We measure parent age using the father in Norway; the father if available and the mother if no father is present in Denmark, Finland, the Netherlands, and Sweden; and the parent earning the higher income in Canada, the UK, and the US. We limit our sample to children born in the country everywhere except Canada, where children are

[16] The proper way to measure inflation has long been debated (Abraham, Greenlees, and Moulton 1998; Boskin et al. 1997). Challenges include how to account for consumers' substitution of goods due to changes in price, how to quantify the benefits of technological advances, and how to create one summary index that is valid for people with a range of income levels and purchasing habits (Jaravel 2019). While a perfect price index is impossible, governments must construct some measure of changes in the price level for the purposes of macroeconomic policymaking. Those are the measures that we use here. It is possible that our results may be sensitive to the use of alternative price indexes, and scholars working in specific countries where multiple price indexes exist may wish to replicate our analysis using alternative price indexes. Such an analysis for all eight countries is beyond the scope of this paper.

included if they lived in Canada between ages 16–19; Finland, where they are included if they lived in the country in the year their parents turned 30; and the UK, where children are included if they were present in the country at age 30. Because all of the children in a given cohort were by definition born in the same year, their incomes are measured in the same year as one another, 30 (40) years later. But since parents vary in the age at which they have children, parent incomes for a given cohort are not always measured in the same year as one another.

The measurement of incomes in one year only means that there will be noise in our results, but because absolute mobility is evaluated by comparing income levels rather than calculating a correlation this should not introduce a systematic bias. Additionally, by age 30 income ranks have largely stabilized (Chetty, Hendren, Kline, and Saez 2014), but earnings have not typically peaked (Murphy and Welch 1990). We measure income at age 30 in our initial specification as it is the age where family formation and (early) child-rearing is likely to make inter-generational reproduction the most salient. Moreover, the age 30 results allow for comparability with Chetty et al. (2017) and maximize the length of our time trends. Our second specification, where income is measured at age 40 rather than age 30, provides a second year of income measurement closer to typical peak earnings and to more settled family and child-rearing patterns.

We do not normalize by family size in the main specification, but do so in an alternative specification shown in Appendix 3. We also include a specification that compares the individual incomes of fathers and sons. Because many countries do not have disposable (post-tax) income data available for the full period under study, our primary specification uses pre-tax income from wages, self-employment, and social insurance programs such as unemployment and social security.[17] For countries where post-tax disposable income is available, we present trends in upward mobility rates using that measure in Appendix 3.[18]

To our knowledge, our sample contains virtually all of the countries in which high quality data on both historical income distributions and relative income mobility currently exist for a substantial number of birth cohorts. Similar data exist for Germany, and have been used to estimate trends in absolute income mobility there (Bönke et al. 2019; Stockhausen 2018). Historical income data are available that would allow computation of mobility rates for Japan for the 1970 birth cohort, but there is not linked data to create a copula, and the marginal income distributions for parents and children in that cohort are sufficiently overlapping that knowing the copula is necessary for precise estimation. Similarly, historical data on income distributions by age exist for France (Garbinti, Goupille-Lebret, and Piketty 2018), but linked parent-child records do not. Many other countries are currently creating datasets, through longitudinal surveys or linked administrative records, that will allow this sort of analysis in the future. These

[17] Data constraints require us to deviate from this exact income definition in certain countries. As described in Appendices 1 and 2, in Finland and the United States we include capital income as well as labor and transfer income, while we include income from social transfer programs beyond unemployment and social security in Canada, the Netherlands, the UK, and the US.

[18] One possible concern in both our pre- and post-tax results is that individuals in countries with high tax rates might engage in fiscal manipulation of income, choosing to take compensation in non-wage or deferred form. Because the countries in our sample vary in their tax rates, this may affect comparisons of income levels across different countries. For it to impact our estimates of absolute mobility, the prevalence of such strategies would have to change from the parent to child generations within a single country, as might happen following a major tax reform.

include Australia (Deutscher 2018), New Zealand (Laws, Gemmell, and Creedy 2014), and Singapore (Yip 2012). However, the great length of time necessary for a direct comparison—roughly 30 years between children and parents to directly calculate absolute mobility for one cohort, and longer to establish any sort of trend across cohorts—means that such datasets are not yet usable for the analysis we conduct here.

Results

Trends in Absolute Income Mobility

Figure 1 presents trends in absolute mobility in pre-tax, post-transfer income by birth cohort for the countries included in this study. Because of data limitations, not all countries have estimates for all cohorts. The US series goes back to the 1940 birth cohort, while most European countries begin in the 1960s. Data for Canada only exist for the 1976–85 birth cohorts, and for the Netherlands we focus on the 1973–84 cohorts. For ease of comparison, we show results starting in 1960, the first year for which non-US data are available.

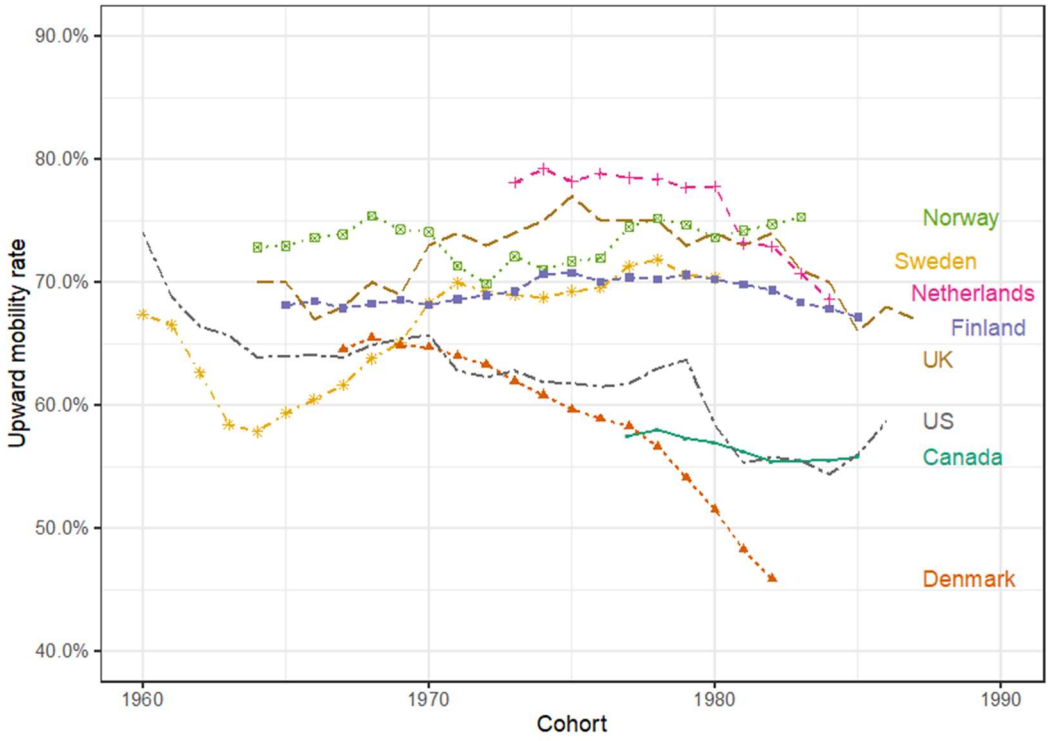

Figure 1. Estimates of Upward Absolute Income Mobility by Country and Birth Cohort

Notes: The upward mobility rate is calculated as the percentage of children in each birth cohort whose pre-tax, post-transfer family income at age 30, adjusted for inflation, was higher than their parents' family income at age 30. Incomes are measured using a combination of register and survey data in each country, as described in Appendix 2.

A few takeaways stand out in Figure 1. First, there is substantial variation across the eight countries in the rates of upward mobility experienced by recent cohorts. At the top end, recent cohorts of Norwegians have experienced upward mobility rates of roughly 75%, while cohorts born before 1980 in the Netherlands saw upward mobility rates approaching 80%. Finland, Sweden, and the UK all have recent values over 65%, well above recent US levels. Only Canada and Denmark have recent upward mobility rates comparable to those in the United States.

A second pattern in Figure 1 is the different mobility trends that countries have seen over time. The United States is not alone in seeing mobility declines for recent cohorts: Denmark, the Netherlands, and the UK have all seen drops of 10 percentage points or more from their peak upward mobility rates. However, the bulk of the mobility decline in these countries dates roughly to the onset of the Global Financial Crisis (the 1977 cohort turned 30 and had their adult incomes measured in 2007), while the US decline began much earlier. In very recent years upward mobility in the US has increased slightly, perhaps capturing the relatively strong economy in the years between the Global Financial Crisis and the Coronavirus pandemic.

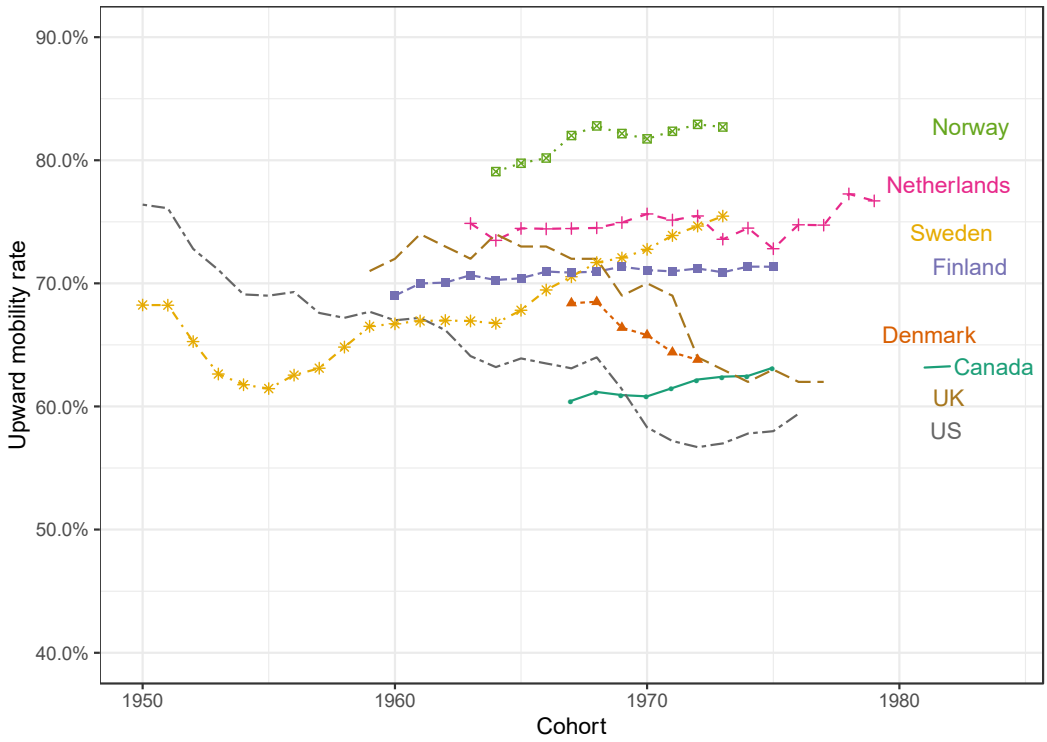

Figure 2. Estimates of Upward Absolute Income Mobility by Country and Birth Cohort, Income Measured at Age 40

Notes: The upward mobility rate is calculated as the percentage of children in each birth cohort whose pre-tax, post-transfer family income at age 40, adjusted for inflation, was higher than their parents' family income at age 40. Incomes are measured using a combination of register and survey data in each country, as described in Appendix 2.

As discussed above, one potential concern with this analysis is that we measure incomes at age 30. If recent cohorts are reaching their peak earning years later than earlier cohorts did, this may create an appearance of lower upward mobility that is driven by changes in the age-income profile rather than lower lifetime or peak earnings among children. Alternately, the fact that we measure income in one year only may create noise in our results, though as discussed above it should not bias them systematically. To address these possibilities, Figure 2 presents results with income measured at age 40. Note that because of the later age of income measurement, the cohorts for which we have age-40 data are shifted roughly 10 years earlier than those where we observe income at age 30.

For countries and cohorts where mobility data at both age 30 and 40 are available, trends in upward absolute income mobility measured at age 40 were broadly similar to those measured at age 30, with a few notable differences. In Sweden and Norway, upward mobility rates measured at age 40 were 5-10 percentage points higher than mobility rates for the same cohorts at age 30, while in the US, the UK, and the Netherlands mobility rates were 5–15 points lower when measured at age 40. In Denmark and Finland mobility rates were similar at both ages. Some of the difference between mobility rates at age 30 and age 40, particularly in Sweden and the UK, appears to be due to different cohorts being impacted by the same macroeconomic shocks at different ages. In Sweden, for instance, there is a drop in age-40 mobility rates for the 1953–56 cohorts that parallels that in age-30 mobility rates for the 1963–1966 cohorts. In both cases, the adult incomes of children were measured in the early 1990s, during a major recession. This suggests that the business cycle, and period effects in general, may have a large impact on rates of absolute mobility. Such an impact is consistent with the importance of marginal income distributions for absolute mobility, but differs markedly from the impact on relative mobility rates, which have been found to be fairly stable from year to year (Chetty, Hendren, Kline, Saez, et al. 2014; Lee and Solon 2009; but see Harding and Munk 2020).

In Figure 1, and to a lesser extent Figure 2, the case of Denmark is particularly striking in contrast to the other Nordic countries: after a very sharp decline over the previous five cohorts, upward absolute mobility at age 30 for the 1982 birth cohort was below 50%, the lowest of any country in our sample. Upward mobility at age 40 for the 1972 cohort was 64%, seven percentage points lower than Finland and more than 10 percentage points below Sweden and Norway. This difference appears to be in part a consequence of the Global Financial Crisis, which hit Denmark substantially harder than other Scandinavian countries. The overall unemployment rate for Danes aged 25–54 more than doubled from 3.2% of the active population in 2006 to 6.7% in 2010, compared to changes for the same population from 6.1% to 6.8% in Finland, 2.9% to 3.0% in Norway, and 5.3% to 6.7% in Sweden (Eurostat 2020). This unemployment shock was felt most strongly by young adults (Pihl and Breck 2012), as is the case in many recessions (Hoynes, Miller, and Schaller 2012). The disproportionate effect on young adults may be one reason why the impact of the Financial Crisis appears larger in the age-30 than age-40 results.

The Danish trends also reflect our use of pre-tax income in our primary specification. If we look instead at results using post-tax disposable income (Appendix Figure A3.1), which is generally agreed to offer a better measure of true living standards, we see a decline in age-30 upward mobility of just 5 percentage points following the Financial Crisis, from 72% for the

1977 cohort to 67% for the 1982 cohort. Measured using disposable income, then, absolute mobility in Denmark for recent cohorts is much higher than in the US or Canada, and substantially closer to Sweden, the other Scandinavian country where disposable income is available. This substantial difference between market and disposable income is consistent with findings from Landersø and Heckman (2017), who show that pre-tax relative mobility is similar in Denmark and the US, but post-tax relative mobility is much greater in Denmark. Among the other countries where disposable income is available, upward mobility in post-tax income is roughly 10 percentage points higher than in pre-tax income in Sweden, 5 percentage points higher in the UK and the US, and 2 percentage points higher in Canada. Trends over time in these four countries are similar for both pre- and post-tax measures.

On the whole, then, it appears that pre-tax absolute mobility in Denmark suffered a large decline due to the particularly large impact of the Global Financial Crisis on Danish young adults, but the impact was lessened somewhat by the structure of the Danish tax and welfare state. These patterns are consistent with the Danish policy of labor market "flexicurity," which combines low barriers to employment separations with educational and social insurance programs (Andersen 2019).

Beyond the measurement of income at age 40 and the inclusion of taxes, we conduct two alternative specifications to explore the impact of changing family composition and labor force participation by gender on our results. These are shown in Appendix 3. First, we analyze mobility after normalizing income by the number of adults in each family. In practice this means dividing total income by two for couples, while leaving income for singles unchanged. This specification accounts for the possibility that changing total incomes may be due to changing family structures, rather than changes in the earnings patterns of individuals. There has been a secular decline in marriage among countries in our sample over the past several decades (Lesthaeghe 2010; Ruggles 2015). If members of younger cohorts are remaining single at higher rates than older cohorts, their total family incomes may be lower simply because there are fewer adults in the household (c.f. Bloome 2014; Western, Bloome, and Percheski 2008). As shown in Figure A3.2, in all countries and cohorts where this normalization is possible upward mobility using the normalized income measure is 8–17 percentage points higher than baseline. This suggests that changes in family structure have resulted in lower family incomes for recent cohorts than would pertain if family structures had remained as they were for these cohorts' parents.

Second, we conduct an analysis comparing the individual incomes of fathers and sons rather than total family income. This comparison isolates the mobility patterns that are due to earnings trends among men alone from those that are due to changes in labor force participation or earnings among women. Results are shown in Figure A3.3. In Canada, Denmark, Norway, Sweden, and the UK, upward mobility rates for sons compared to fathers are similar to those using total family income, although the dips in mobility associated with the early 1990s recession in Sweden and the Global Financial Crisis in the UK are steeper when looking at father-son mobility. In the Netherlands and the US, upward mobility rates for sons alone are consistently 10–20 percentage points lower than those using total family income. In the Netherlands, this likely reflects the massive increase in female labor force participation since the 1970s, by far the largest in the OECD (Olivetti and Petrongolo 2017). In the US it may

reflect the faster than average decline in male labor force participation over this same period (Krause and Sawhill 2017) or the partial closing of the gender earnings gap (Blau and Kahn 2017).

Taken together, our various alternate specifications broadly conform to the baseline results in terms of the relative position of the different countries and trends over time. But the variation across specifications highlights important differences between countries in terms of political economy, age, and gender. The results using incomes at age 40 suggest that changes from parents to children in the age-earnings profile may be largest in Norway and Sweden, while results using post-tax disposable income highlight the importance of the tax code as a means of increasing mobility in Denmark and Sweden, but not Canada, the US, or the UK. Results using normalized family income highlight the role of changing family structure—in particular the growing share of young adults who are not married or cohabiting—in reducing family incomes across our sample countries. Results using the individual incomes of fathers and sons suggest that different labor force participation and earnings trends by gender may be especially impactful on mobility patterns in the Netherlands and the United States.

In online Appendix 4 we present a detailed comparison of our results with those of Berman (2018). The upward mobility rates we calculate for recent cohorts roughly align with Berman's estimates in most countries, but differ in the UK and Denmark by as much as 10 to 15 percentage points. Additionally, we find stability in absolute mobility rates over time in several countries where Berman reports downward trends. Where differences exist, they appear to be due to differences in the data used rather than differences in methods—specifically, the fact that we measure incomes for 30-year-old parents and children directly, while Berman uses income data for the entire population. Because younger workers tend to be more affected by changes to the macroeconomic climate than older workers (Hoynes et al. 2012), and because incomes of parents may differ systematically from incomes of non-parents of similar age, trends in the full income distribution are in some cases not an accurate proxy for trends in the earnings of young adults.

Validation of the Copula and Marginals Approach

Chetty et al. (2017) proposed that overall rates of absolute mobility can be accurately calculated without linked panel data, by combining data on the marginal income distributions of children and parents with the copula, or parent-child rank transition matrix. This approach draws on Sklar's Theorem (Sklar 1959), which showed that any multivariate distribution can be expressed in terms of marginal distributions and a copula. Because of its much lower data requirements and its ability to incorporate data from multiple sources, the "copula and marginals" approach is becoming widely used in studies of absolute income mobility (e.g. Berman 2018; Bönke et al. 2019).

While the logic behind this approach is compelling, it has never been validated through a direct comparison of absolute mobility rates calculated using the copula and marginals approach and those using the true, linked records approach on the same data. We conduct such a comparison here. For five of the countries in our sample—Canada, Denmark, Finland, Norway, and Sweden—we can both calculate the upward mobility rate directly from linked data and produce copulas and marginal distributions. By comparing estimates constructed

using the copula and marginals to those constructed from linked data we are able to determine whether the former is a reasonable approximation of the latter.

For each country, we produce a copula for the most recent birth cohort in the data. In Norway and Sweden we combine multiple birth cohorts to increase the observation counts within each percentile cell. This parallels the methodology of Chetty et al. (2017), who used a copula constructed from the 1980–82 birth cohorts for the entire analysis. We then combine the copula constructed from the most recent cohort with marginal distributions for each cohort individually to estimate absolute mobility for that particular cohort, as described in the Data and Methods section above.

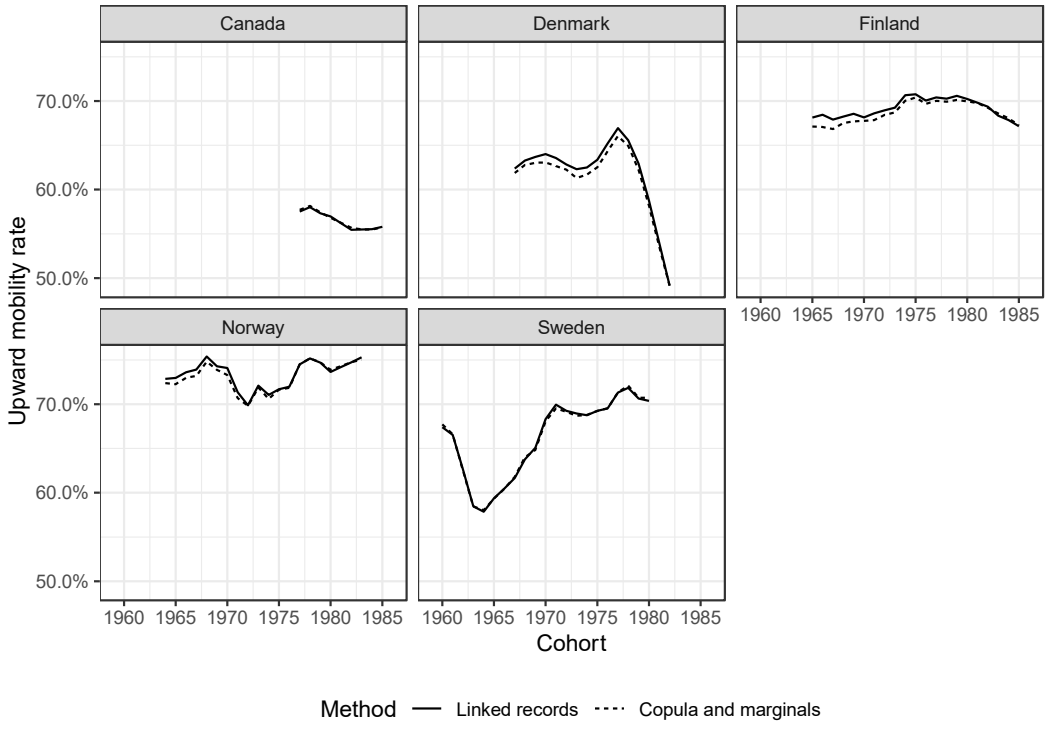

Figure 3. Validation of the "Copula and Marginals" Approach for Estimating Absolute Income Mobility

Notes: This figure compares estimates of absolute income mobility using linked records with those using the "copula and marginals" approach introduced by Chetty et al. (2017) for the five countries in our sample where both methods are possible. Copula and marginals estimates are constructed by computing child and parent marginal income distributions at age 30 for each birth cohort in each country, and combining them with the parent-child income rank transition matrix constructed based on linked parent-child records for the most recent available cohort in each country. Linked records estimates are computed as in the baseline results except for Denmark, where non-age matched records are used (see Appendix 2.2), resulting in a mobility trend for Denmark that differs somewhat from that shown in Figure 1. Across all countries and birth cohorts, estimates with the two methods match within 1.4 percentage points.

Figure 3 compares upward mobility rates calculated using the copula and marginals and linked records approaches in each country. The results largely confirm that the copula and marginals approach is an effective approximation of the true, linked record method of estimating absolute income mobility. Across all cohorts in all five countries, the copula and

marginals estimates are always within 1.4 percentage points of the true value, even though upward mobility rates varied by approximately 18 percentage points in Denmark, 14 percentage points in Sweden, 6 percentage points in Norway, and 4 percentage points in Finland over our sample period. The largest deviations from the true value, especially in Finland, Norway, and to a lesser extent Denmark, occur for the cohorts most removed from those in the copula, but across all cohorts the differences between the two methods are always small relative to the overall trends. This exercise suggests that the copula and marginals approach is an effective way to estimate rates of absolute mobility when linked panel data are unavailable.

What Explains Variation in Upward Mobility?

Why have countries like Norway and Finland maintained high levels of upward absolute mobility in recent years, while countries as diverse as Denmark (in pre-tax income), Canada, and the United States have seen much lower rates? To answer this question, we conduct a series of counterfactual exercises to decompose the differences between high- and low-mobility countries for cohorts born in the early 1980s. Here we present results comparing the low mobility countries of Canada, Denmark, and the US to Norway, which had the highest rate of upward mobility in our sample.

Using the copula and marginals approach, the absolute mobility rate of a given cohort in a given country can be fully accounted for by four components: the copula, the ratio of mean income in the child generation to mean income in the parent generation, and the shape of the income distribution (that is, the level of inequality) in a) the parent and b) the child generations (Liss et al. 2019; Van Kerm 2004).

To determine the source of differences in mobility rates between high- and low-mobility countries, we run simulations for the 1983 birth cohort in which we substitute each of these components from our low mobility countries with the equivalent component from Norway. For greater interpretability, we further decompose the ratio of mean child to mean parent income into two subcomponents: the overall growth rate of real Gross Domestic Product (GDP) per capita from 1983–2013 and the ratio of growth in mean income from parents to children in our sample to growth in GDP—that is, the extent to which incomes for 30-year-olds kept up with GDP growth during this period. We use GDP per capita values in constant local currency units sourced from the World Bank national accounts data (World Bank 2019). In Appendix 5, we show that the cumulative substitution of all five of these components—the copula, GDP growth rate, sample income growth to GDP growth ratio, inequality among parents, and inequality among children—perfectly accounts for the difference between mobility rates in any two countries.

We first consider differences in the rate of relative mobility, operationalized here using the parent-child rank transmission information contained in the copula. It is well known that rates of relative income mobility are much higher in Scandinavia than in the United States (Bratberg et al. 2017; Corak 2006; Smeeding et al. 2011). In our sample, 25.4% of US children born in the early 1980s ended up within 10 percentile ranks of their parents, compared to 20.1% of Norwegian children. US children were thus 26% more likely than their Norwegian counterparts to grow up to occupy a position in the income distribution similar to that of their parents.

To determine whether rates of relative mobility are an important driver of differences in absolute mobility across countries, we run simulations replacing the US, Canadian, and Danish copulas with that from Norway. As shown in the first column of Figure 4, doing this hardly alters rates of absolute mobility at all. This is perhaps unsurprising in the cases of Canada and Denmark, which have relative mobility rates comparable to Norway's, but even in the United States there is no difference—in fact, the higher relative mobility of the Norwegian copula actually lowers the absolute mobility rate slightly, conforming to the result that absolute and relative mobility are inversely correlated when other variables are held constant (Berman 2018).

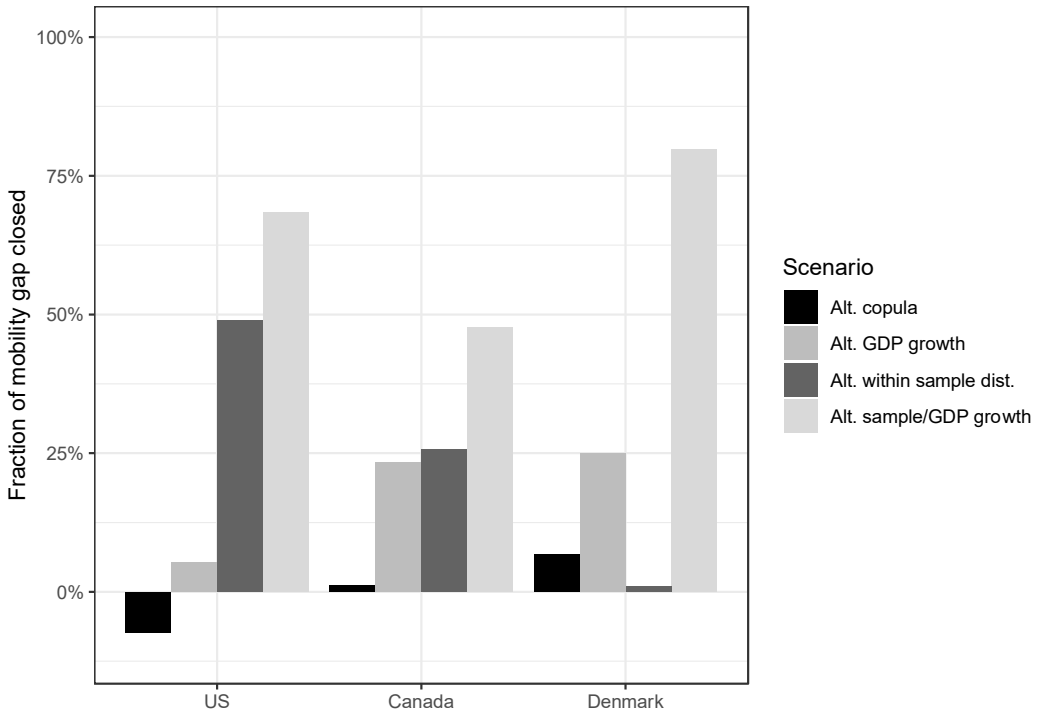

Figure 4. Decomposition of Cross-Country Differences in Absolute Mobility

Notes: This figure shows results from counterfactual simulations decomposing the difference in upward mobility rates between three low-mobility countries and Norway for the 1983 birth cohort (1982 in Denmark). As shown in Figure 1, upward mobility in Norway for the 1983 birth cohort was roughly 20 percentage points higher than for the same cohort in the US and Canada, or for the 1982 cohort in Denmark (the most recent available). To determine the source of this difference, upward mobility is calculated using the "copula and marginals" decomposition approach. Simulations are run replacing the copula, GDP growth rate, within-sample income distribution, and ratio of mean sample income growth from parents to children to GDP growth of each low-mobility country with those of Norway. Bars indicate the fraction of the total gap with Norway that is closed in each simulation.

If differences in relative mobility do not account for national variation in upward absolute mobility, the variation must be due to features of the marginal distributions. The remaining columns of Figure 4 explore three aspects of the child marginal income distribution. The second column for each country considers a scenario where that country experienced the Norwegian GDP growth rate from 1983-2013. Real GDP per capita grew by 1.86% a year during this

period in Norway, compared to growth of 1.80% annually in the US, 1.50% in Canada, and 1.49% in Denmark. This scenario is implemented by multiplying the income for every percentile of the child distribution in each low mobility country by the ratio of total Norwegian GDP growth from 1983–2013 to total country GDP growth over that same period. It thus simulates a scenario where GDP grew more quickly during the children's lives but was distributed exactly as in reality. As shown in the figure, faster GDP growth would not make much difference for the United States, but would close about a quarter of the gap for Canada and Denmark.

The third column considers a scenario where the total size of the economy stays the same but the income distribution among 30-year-old children in Norway is applied to the country of interest. This "within-cohort inequality" scenario is constructed by taking the ratio of income at each child percentile to overall mean child income in Norway and multiplying that by the mean child income in the country of interest. As with GDP, the importance of within-cohort inequality varies substantially across the three countries considered. In the US, this scenario closes almost half of the mobility gap with Norway, while in Denmark it closes just 1% of the gap.

The final column considers a "between-cohort inequality" scenario, where the ratio of growth in mean income from parents to children in our sample to GDP growth in Norway is applied to observed GDP growth in each of the low-mobility countries. We interpret this primarily as a measure of changing inequality between age groups, capturing the extent to which mean incomes for 30-year-olds kept up with GDP. It could also reflect measurement error if the total fraction of GDP captured by our data sources changed over time. Such a change could be due to increasing non-response rates in survey data (for a discussion of this issue in the US context, see Bollinger et al. 2019), or due to changes in the composition of income that affect the percentage of GDP subject to taxation and thus inclusion in register data.[19]

For all three countries, the between-cohort inequality scenario accounts for the single largest proportion of the gap with Norway, and for Denmark it accounts for roughly 75%. Thus the biggest source of difference has to do with increasing inequality across cohorts: mean incomes for 30-year-olds did a much better job of keeping pace with overall economic growth in high-mobility countries than in low-mobility ones. For example, for the 1983 cohort in the US, the growth rate from mean parent income to mean child income in our sample was only 71% of the GDP growth rate over the same period, while in Norway the sample income grew 95% as fast as GDP. In the United States, the remainder of the gap is accounted for by within-cohort inequality: the richest 30-year-olds take home a much larger share of their cohort's total income than in Norway. For Denmark, low GDP growth accounts for the remainder. For Canada it is some of each. Results comparing the low mobility countries to Sweden and Finland are presented in online Appendix 6 and are similar to those for Norway.

[19] Note that to the extent that results for the "between-cohort inequality" scenario are driven by increases in nonresponse bias rather than truly growing inequality across cohorts, the child income distribution used in the "within-cohort inequality" scenario will likely understate the true level of within-cohort inequality, since nonresponse tends to be concentrated at the extremes (Bollinger et al. 2019). Thus the amount of the mobility gap attributable to within- and between-cohort inequality combined is likely to be similar to what we report, although the allocation between the two scenarios might be affected by measurement error.

Discussion

In this paper we have directly calculated absolute income mobility rates for a selection of countries in North America and Europe. We have shown that there is a substantial amount of variation in upward mobility across countries, both in current levels and in trends over time. The US pattern of declining upward mobility in recent decades is by no means a universal trend. Some countries, most notably Finland and Norway, have had high and steady rates of upward mobility for cohorts born as far back as the mid-1960s. Other countries, notably Denmark (in pre-tax income only), the Netherlands, and the UK, maintained high mobility rates longer than the US, but have seen declining mobility for cohorts that experienced the brunt of the Global Financial Crisis. The exact mobility patterns for each country vary across our specifications in ways that reflect cross-national differences in demographic trends, economic institutions, and macroeconomic environment.

For all of the countries except the US and the UK, we calculated mobility rates by directly comparing linked parent and child income data. Our estimates thus represent a ground truth against which other methods of inferring absolute mobility can be evaluated. For five of the countries in our sample—Canada, Denmark, Finland, Norway, and Sweden—we have shown that mobility rates calculated with the "copula and marginals" approach introduced by Chetty et al. (2017) closely track those calculated directly from linked records, suggesting that the copula and marginals approach is in fact an accurate approximation of true absolute income mobility. This is promising for a range of popular applications that frequently cannot be validated directly, such as microsimulations and synthetic panels (Bourguignon and Spadaro 2006; Deaton 1985).

Through decomposition analyses, we have shown that the high relative mobility of Scandinavian countries contributes little to their high absolute mobility rates. Compared to the United States, their greater upward absolute mobility is due not to faster economic growth, but to their more egalitarian income distributions, both across and within cohorts. US GDP grew almost as fast as Norway's, and faster than Sweden's, during the lifetimes of our most recent cohorts. But Norway, Sweden, and Finland were much more efficient in translating that growth in total production into increased standards of living for their residents. Low pre-tax mobility in Denmark, on the other hand, is due to slower GDP growth than its neighbors and especially to the divergence between overall GDP growth and growth in the incomes being earned by 30-year-olds. Canada falls somewhere in the middle.

The idea that living standards should rise from one generation to the next is a core implicit promise of the market economy. When countries fall short of that promise, they are often beset with frustration and instability (Friedman 2005). In this paper we have shown that high-income countries vary dramatically in the extent to which they live up to that promise, and have explored some of the drivers of that variation. Our findings highlight the contingent nature of absolute income mobility. To achieve and sustain high rates of upward mobility, countries need economic institutions capable of both encouraging strong economic growth and distributing that growth to all of their citizens. Encouragingly, there exist several examples of countries that have managed exactly that.

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Appendix

Appendix 1. Specification Parameters Compared Across Countries

To facilitate meaningful comparisons between the countries in our sample, we match our specifications across countries as possible across countries. However, the substantial variation from country to country in both the data sources and the data structures used prevents us from implementing the exact same specification in every country. Tables A1.1 and A1.2 provide the parameters used in the baseline specification for in each country. Details on the exact specifications, data, and methods used for each country's analysis are provided in Appendix 2.

Table A1.1 indicates the method of absolute mobility calculation and the birth cohorts included in each country's analysis, as well as the income sources that are included. In every country labor income (wages and self-employment) and unemployment/social insurance income are included. Capital income is not available in the register data we use for Norway, Sweden, and the Netherlands, or the survey data we use in the UK. For maximum comparability, we thus exclude capital income from our primary specification in Canada and the Netherlands as well. In Finland and the US, our data do not distinguish capital from labor income, so we include both in the analysis. Similarly, in Canada, the Netherlands, the UK, and the US, data on income from government transfers include social transfer programs in addition to unemployment and social security.

Table A1.1. Method, Cohorts Included, and Income Sources Included by Country

Country	Method	Start Cohort	End Cohort	Income sources included			
				Labor / Self-employment	Capital	Unemployment / Social Security	Social Transfers
Canada	Linked records (population)	1977	1984	X		X	X
Denmark	Linked records (population)	1967	1982	X		X	
Finland	Linked records (population)	1965	1985	X	X	X	
Netherlands	Linked records (sample)	1973	1984	X		X	X
Norway	Linked records (population)	1964	1983	X		X	
Sweden	Linked records (population)	1960	1984	X		X	
UK	Copula and marginals	1964	1986	X		X	X
US	Copula and marginals	1940	1984	X	X	X	X

Table A1.2 describes the way child and parent families are defined, the way parent age is determined, and the sample of children included in the analysis for each country. The approach in each country is largely determined by the structure of that country's register data. In some

countries, such as Denmark and Norway, children are linked to their biological parents, whether or not they live in the same household. In other countries, such as Canada and Sweden, children are linked to the parents with whom they live at a particular point in time.

Because parents may not be born in the same year as one another, determining the year in which parent income should be measured to compare to the child's income at age 30 is not entirely straightforward. We use the father's age alone in Norway; the father's age if the father is present and the mother's age if there is no father present in Denmark, Finland, and Sweden; and the parent whose age results in the higher total family income in Canada, the UK, and the US.

Table A1.2. Family Definition, Parent Age Definition, and Child Sample by Country

Country	Parent Family Definition	Parent Age Definition	Child Family Definition	Child Sample
Canada	Parent with whom the child lived at age 16-19 + spouse	Parent whose age results in higher total income	Child + spouse (statuatory or common law marriage)	Children in country at age 16-19
Denmark	Biological parents	Father if present, mother if no father present	Child + spouse/cohabiting partner	Children born in country
Finland	Biological parent with higher income at age 30 + spouse/cohabiting partner	Father if present, mother if no father present	Child + all cohabitants	Children in country when parents aged 30
Netherlands	Biological father (if alive, mother if not) + spouse/cohabiting partner	Father if present, mother if no father present	Child + spouse/cohabiting partner	Children born in country, alive, and residing there in 1995
Norway	Biological parents	Father	Child + spouse/cohabiting partner	Children born in country
Sweden	Parents with whom the child lived when head of household aged 30	Father if present, mother if no father present	Child + spouse or co-parent (childless cohabiting partners excluded)	Children born in country
UK	Head + spouse	Parent whose age results in higher total income	Child + spouse/cohabiting partner	Children in country at age 30
US	Head + spouse	Parent whose age results in higher total income	Child + spouse	Children born in country

In all countries, grown children are linked in the register data to a spouse if they are legally married. In most countries, they are also linked to a partner with whom they cohabit even if they are not legally married, but this is not universal: in Sweden, for instance, a link is only possible when two people are legally married or parents of the same child.

Many of the countries in our sample have had relatively high levels of immigration in recent years. Among our sample countries in 2019, foreign-born residents made up 21.3% of the population in Canada, 12.5% in Denmark, 6.9% in Finland, 13.4% in the Netherlands, 18.2% in Norway, 20.0% in Sweden, 14.1% in the UK, and 15.4% in the United States (United Nations Department of Economic and Social Affairs 2019). Where possible, we restrict our sample to children who were born in the country being analyzed. However, in Canada, Finland, and the UK we are not able to impose this restriction. In Canada our sample consists of all children who lived in the country between ages 16–19. In Finland it consists of all children who lived there when their parents were age 30, while in the UK it consists of all children who lived there when they themselves were 30 years old.

Appendix 2. Detailed Methodology by Country

A2.1: Canada

Intergenerational Income Database (IID)

The IID is a linked administrative database composed of two main components. The first component is the Family File (FF) in which children who were aged 16 to 19 in 1982, 1984, 1986, 1991, 1996 and 2001 were matched with their parents. The calendar years in which the children were 16 to 19 (i.e., 1982, 1984, etc.) are known as *IID cohort years* or *IID cohorts*. The birth years of children in the IID range from 1963 (19 in 1982) to 1985 (16 in 2001).

Table A2.1.1 shows the structure of FF and several hypothetical examples. Each observation in the Family File is uniquely identified by the child's case number. Different children, however, can have the same parent or both parents.

Table A2.1.1 Intergenerational Income Database Family File Structure, Canada

Observation	Child's case number	Mother's case number	Father's case number
1	A's case number	A's mother's case number	A's father's case number
2	B's case number	… (no mother present)	B's father's case number
3	C's case number	C's mother's case number	… (no father present)
…	…	…	…

Notes: This table presents hypothetical examples of file structure in the Canadian Intergenerational Income Database.

An important concept in the IID is the "link year." This is the year in which children were linked to their parents. For most children, the link year is the same as the cohort year. However, in order to improve the IID coverage and reduce the scope of a sample selection, establishing the link between children and their parents was attempted in several subsequent years. For example, most children from the 1982 cohort were linked to their parents using 1982 administrative data. For children who could not be linked to their parents in 1982, an attempt was made to link them in 1983, 1984, 1985 or 1986. The link year in this case is the year between 1982 and 1987 in which the first successful link was established.

The family structure in the Family File represents the family structure in the link year. There is no information on whether the mother and the father are biological parents. Stepparents are deemed to be parents.

The second main component of the IID is the annual T1 files (information from individual tax returns).[20] For the 1982, 1984 and 1986 cohorts, T1 files are available from 1978 to 2014.[21] For the 1991, 1996 and 2001 cohorts, T1 files are available from 1981 to 2014. Each T1 file contains unique individual identifies (case numbers), so that each individual in the Family File—a parent or a child—can be linked to his or her tax return records in year *t* if they filed a tax return in that year. Not all variables are available for all years; changes in the variables' availability primarily reflect changes in the tax code.

[20] The Canadian T1 form is roughly similar to the 1040 IRS form in the United States.
[21] At the time of writing.

Weights

Certain criteria have to be satisfied for a child 16 to 19 to be selected into the IID: the child had to have a Social Insurance Number, live with his or her parents, and the parents had to file a tax return at least once during the 5-year linkage window. In each cohort, only about two thirds of all children 16 to 19 satisfy all three criteria; therefore, the size of an IID cohort is about two thirds of the total population of 16- to 19-year-olds. A set of weights was developed by Statistics Canada methodologists to account for underreporting of income among low-income individuals and to make the IID representative of the population. The weights are used in all computations related to absolute mobility rates.

Family unit

The family unit in the IID consists of only parents and their children. This definition is consistent with the Census data definition of the "census family." Note that a census family is different from a household since a household may include other relatives living at the same address (same household). Household information is not available in the IID and only census families can be identified.

As mentioned above, children's parents are either biological parents or stepparents with whom children lived during the link year. Children's own marital status and their spouses (if they are married or in common-law relationship) can be identified from the T1 files.

Total family income

The total family income is the combined income of the spouses. If children have both parents present in the Family File, the total income of parents is computed as the parents' combined income in the year when one of the parents was 30. If the parents reached age 30 in different years (e.g., father was 30 in 1982 and mother was 30 in 1984) and their family income can be computed for both years, the higher family income is retained for further computations. If both parents we identified in the Family File, but only one parent filed a tax return when he or she was 30, the income of the other spouse is coded as zero. If only one parent is present in the Family File, that parent's income at age 30 is the parental family income at age 30 used in the computations.

The family income of children is the combine income of children and their spouses in the year in which the child was 30. If the child was not married at the age of 30, the child's family income is his or her own income in that year.

The definition of the total income before tax used in the computations is the same as the definition of total income used by the Canada Revenue Agency (Canada Revenue Agency 2020). From this total income, we subtract net capital gains/losses, investment income, dividend income, and net rental income for our primary specification, to maximize comparability with other countries in our sample. We include capital income in the post-tax income analysis shown in Figure A3.1.

Inflation factor

All dollar amounts are converted to 2015 constant dollars using the all-items Consumer Price Index; see Statistics Canada, Table 18-10-0005-01: CPI, all-items, Canada, 2002=100, 2005 basket (formerly CANSIM, Table 326-0021).

Main sample structure and caveats

The structure of the IID creates some inconsistency across cohorts with respect to the age at which parents had their children. The inconsistency stems from two constraints imposed by the structure of the IID. The first constraint is imposed by the earliest year in which parents' income is available. For the cohorts born between 1963 and 1970, the first year in which parents' income could be observed at age 30—or any age for that matter—is 1978 (first T1 file). This means that parents' income could be observed only for parents born after 1948.

The second constraint is related to the age at which parents could reasonably have their children. Parents born after 1948 would have to be 15 or younger to have children in 1963. This essentially excludes the 1963 birth cohort from the analysis. Even for children born in 1970, the age range at which their parents could have them is 19 to 22 assuming that one wishes to exclude those who became parents before reaching 19. (The upper bound is determined by the 1948 cut-off.)

For all cohorts born in 1972 or later, the first year in which the incomes of their parents could be observed is 1981, which means that only children whose parents were born in 1951 or later can be included in the analysis. An important point here is that, as we move along the cohort spectrum toward more recent cohorts, the age range at which parents could have their children widens. For children born in 1985, the last cohort that can in observed at age 30 (in 2015), the age at which their parents could have their children is 19 to 34. Hence, whereas we can observe only 30-year-old parents of the 1970 birth cohort who had their children when they were between 19 and 22 years of age, we can observe 30-year-old parents of the 1985 birth cohort who were 19 to 34 when they had their children.

To mitigate the effects of this cross-cohort inconsistency, only children born between 1977 and 1985 are included in the analysis. The age range at which their parents could have them and other related information is shown in Table A2.1.2.

Table A2.1.2 Details of Main Sample, Canada

Children's birth cohort	Parent's birth cohort	Parents' age when child is born	Years parents' income is observed	Year child's income is observed
1977	1951-1958	19 to 26	1981-1988	2007
1978	1951-1959	19 to 27	1981-1989	2008
1979	1951-1960	19 to 28	1981-1990	2009
1980	1951-1961	19 to 29	1981-1991	2010
1982	1951-1963	19 to 31	1981-1993	2012
1983	1951-1964	19 to 32	1981-1994	2013
1984	1951-1965	19 to 33	1981-1995	2014
1985	1951-1966	19 to 34	1981-1996	2015

Notes: Parents' and children's family income is observed at age 30.

Robustness: restricted sample

One way to gauge the impact of the problem described above is to restrict the sample for all cohorts to only those children who were born when their parents were between 19 and 26 years old. This restriction is not likely to completely eliminate the cross-cohort inconsistency because the fertility age increases across cohorts and an increasingly large number of parents who were

over 26 when their children were born may be excluded from the analysis, but it is an informative robustness check. Results using disposable income for the main and restricted sample are presented in Table A2.1.3. They match closely for early cohorts, and are 1–2 percentage points lower than those in the main sample for cohorts born after 1980.

Table A2.1.3 Comparison of Main and Restricted Samples, Canada, 1977–1984 Cohorts

Children's birth cohort	Absolute mobility main sample	Absolute mobility restricted sample
1977	0.575	0.575
1978	0.580	0.583
1979	0.579	0.587
1980	0.575	0.585
1982	0.565	0.586
1983	0.568	0.593
1984	0.571	0.600

Notes: Absolute mobility is measured using disposable income. The restricted sample is limited in all cohorts to children who were born to parents between 19 and 26 years old, the age range available in the main sample for the 1977 birth cohort.

A2.2: Denmark

Data and Sample Selection

The sample we use is the Danish non-immigrant population, born between 1967 and 1982. We require that the individual's income is observed at least once between ages 30–35, and that they successfully be linked to a parent whose income is also observed between ages 30–35. Because income data are only available from 1980 on, this limits the completeness of our sample. The total number of observations is 737,452, 70.31% of the overall Danish non-immigrant population born between 1967 and 1982. The distribution of in-sample cases by cohorts are shown in Figure A2.2.1. Most of the missing cases are due to missing parent income.

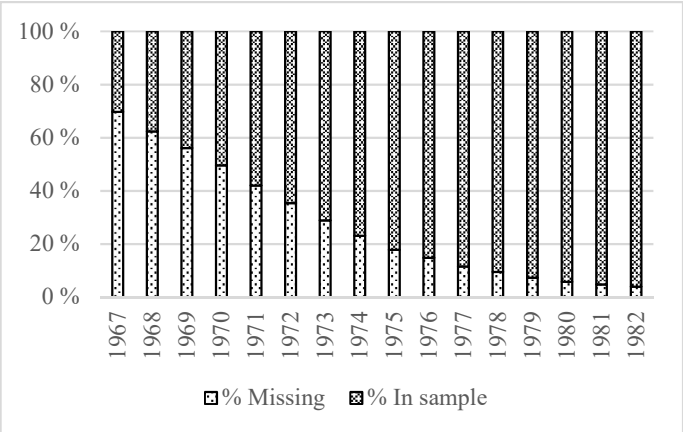

Figure A2.2.1 Percentage of In-Sample Cases by Cohort

Notes: This figure shows the percentage of the total Danish non-immigrant population in each birth cohort that is included in our sample. Observations are excluded if either child or parent income was not observed between ages 30 and 35.

Income measure

We measure two types of income: pre-tax labor income and post-tax disposable income. Pre-tax labor income is the sum of personal earnings, unemployment benefits and sick payments. Disposable income is the sum of labor income, the imputed rent value of housing property, transfer income (social benefits), and capital income, less all taxes and interest payments. We deflate all income measures with the Danish CPI (reference year is 2012).

Income age

Our baseline individual incomes are drawn from the year in which the individual is age 30. When the incomes are not available at age 30, we substitute them with non-missing income between the age of 31 to age 35. 99.8% of children in this study have their own income at their age 30. Meanwhile, as shown in Figure A2.2.2, the parents' average income-age decreases at a rate from 33.79 for the 1967 birth cohort to 30.71 years old for the 1982 cohort.

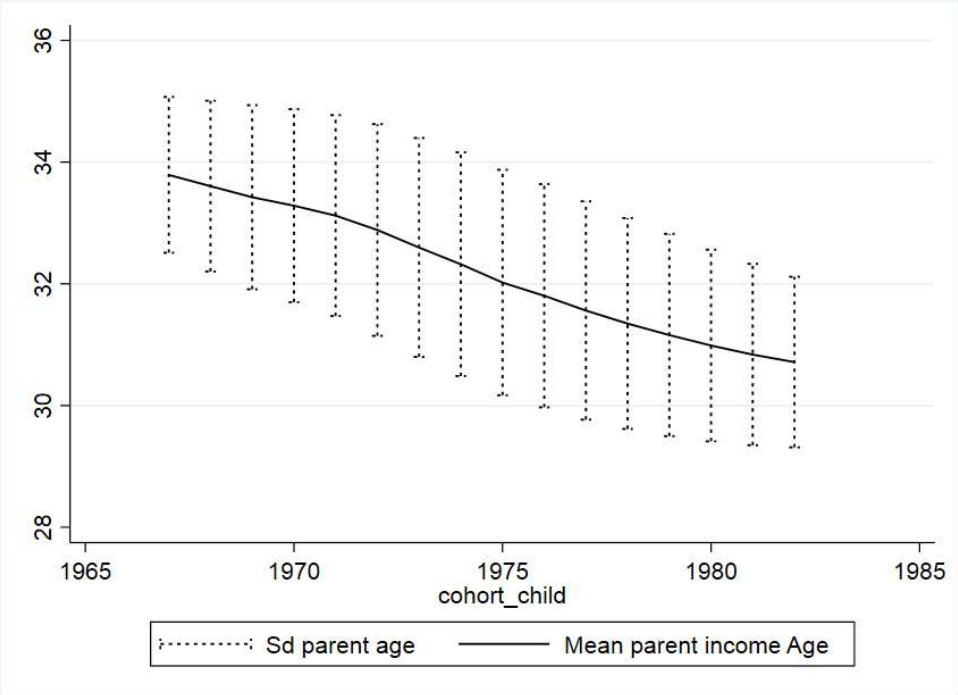

Figure A2.2.2. Mean Age at which Parent Income is Measured by Child Birth Cohort, Denmark

Notes: Because Danish income data is only available from 1980 on, we measure parent income at ages greater than 30 for some cohorts. This figure presents the mean age at which parent income is measured by child birth cohort.

Income definition: Family income and individual income

Parent family income is the sum of a father's income at age 30 and mother's income in the same calendar year. Parents are defined as children's biological parents. When father's income is not available within the age window of this study (between 30 to 35 years old), we replaced parent family income by the sum of mother's income at age 30 (or between the age 31 to 35) and father's income in the same calendar year.

Children's family income is the sum of the child's income at age 30 and their partner's income in the same calendar year as measured for child's income. A partner refers to either the married or registered spouse, or a cohabiting partner. Cohabiting partners are identified as adults living at the same address as the grown child who are not their parents or dependents.
Children's individual income is their own income at age 30 (or between age 31 and 35). Parent individual income is the father's income at their age 30 or between 31 and 35.

Non-Age-Matched and Age-Matched Absolute Mobility

Absolute family income mobility refers to the percentage of children whose family income exceeds their parent's family income in each cohort. Absolute individual income mobility indicates the percentage of children whose individual income is higher than their father's income.

We calculate both family and individual income mobility with two different comparison standards: age-matched and non-age-matched. As noted above, the parent income age varies between 30 and 35 across cohorts, whereas children's income is primarily measured at age 30. This means that some of the income mobility calculations are in effect a comparison between child and parent's incomes at different age. For example, when a parent family income is measured at father's age 35 and child's family income is drawn from child's age 30, the absolute family income mobility for this case is calculated from the comparison between child's family income at age 30 and parent family income at father's age 35. If individuals on average earn more at age 35 than age 30, upward mobility in this case may be underestimated not because the child's family income is actually smaller than their parents' family income, but because of the comparison between different ages (e.g., family income at 30 years old for the child vs. family income at 35 years old of parent). To adjust for this possible error, in our preferred specification we calculate income mobility by matching the children's income age to their parents' income age. In this specification, if parent income is measure at father's age 34, then we also measure the child's income at age 34 instead of age 30. We term this way of calculating income mobility the "age-matched" income mobility.

For certain decomposition and comparative analyses we report family and individual income mobility using the non-age matched sample. Non-age matched income mobility is the mobility measured using child's family or individual income at age 30 with parent family or individual income at the age closest to 30 that is available in the data. This non-age matched sample is used in Figures 2 and 3 of the main text and Figure A2.3 in Appendix 2.

Upward mobility trends: Family Income Mobility

Figure A2.2.3 shows upward absolute income mobility in total and disposable income by cohort and age match. The age-matched measure, which is our preferred specification, shows upward mobility rates roughly 5 percentage points higher than the non-age-matched measure for the first half of the sample period, and roughly 5 percentage points lower in the second half. Mobility rates calculated with pre-tax total income show a sharp decline for cohorts born after roughly 2007, while those calculated using post-tax disposable income show a smaller decline.

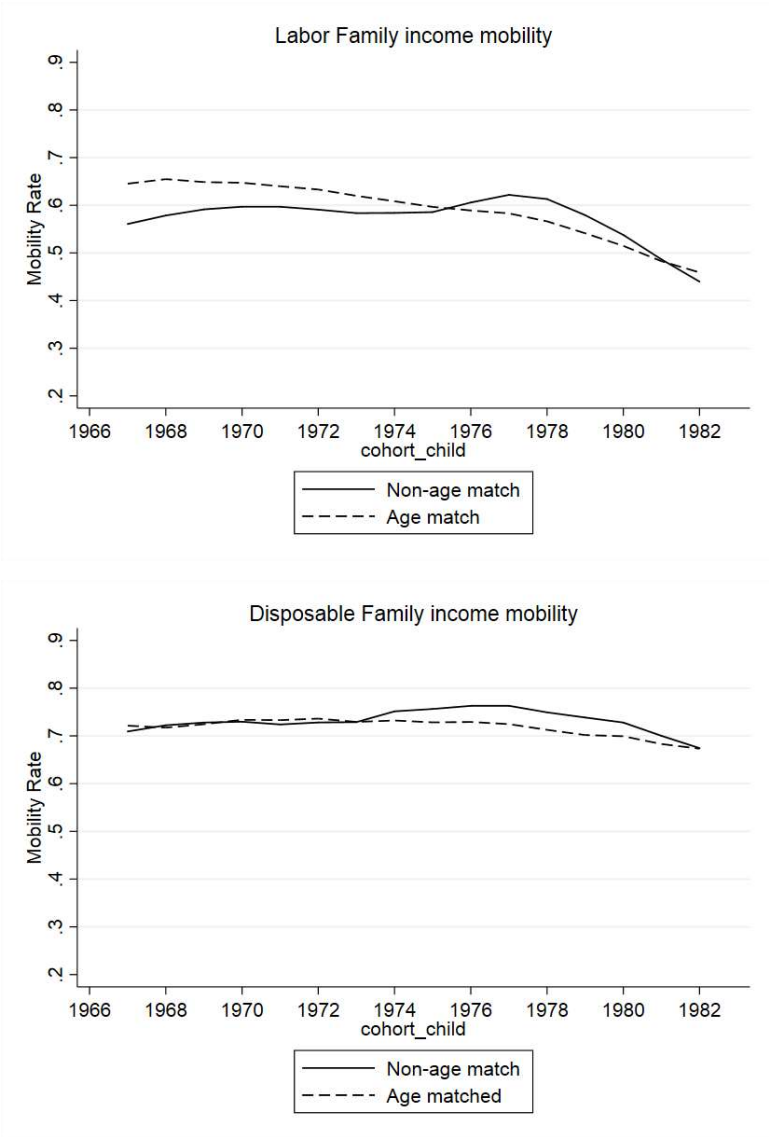

Figure A2.2.3. Upward Absolute Income Mobility by Income Definition and Age Match, Denmark.

Notes: As described in the Appendix text, as a result of sample limitations the average age at which parent income is measured in Denmark is higher for earlier than later cohorts. To address this possible source of bias, in our preferred specification we match the age at which child and parent income is measured. In this specification, both children and parent incomes are on average measured at ages greater than 30 in early cohorts, and ages closer to 30 in later cohorts.

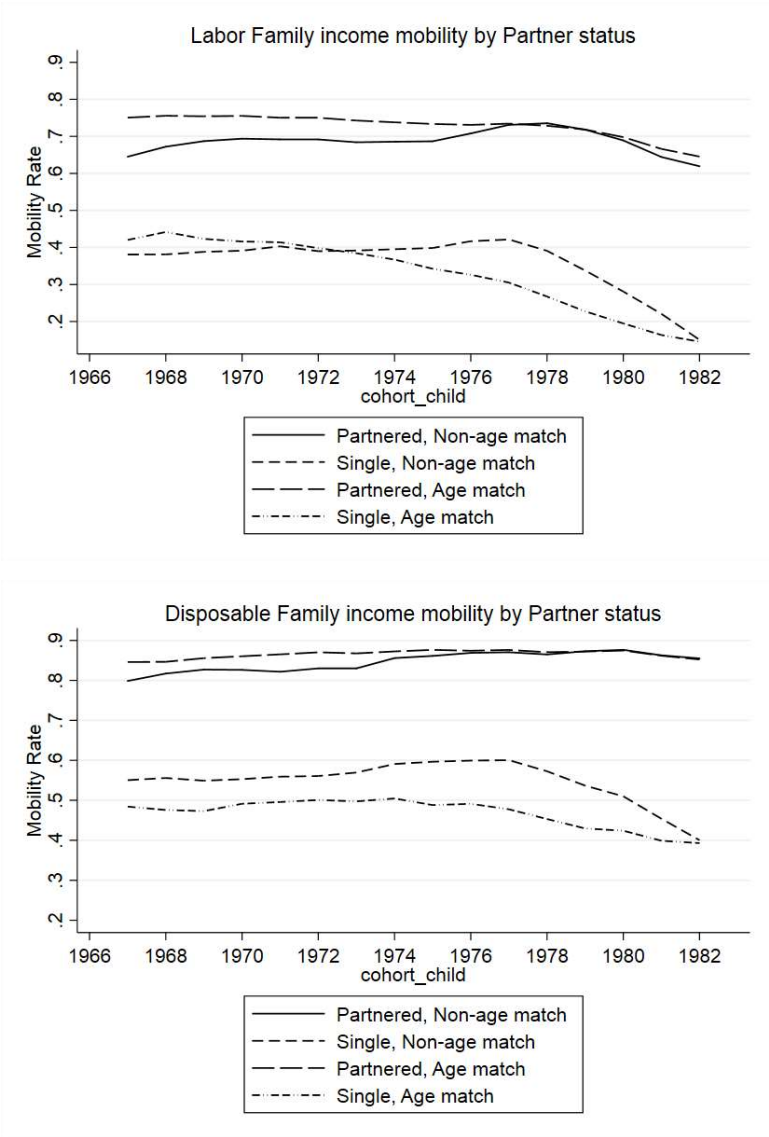

Figure A2.2.4. Upward Absolute Income Mobility by Partner Status, Income Definition, and Age Match, Denmark.

Notes: Not all children in our sample were partnered by the age at which their income was measured, meaning that in our primary specification their individual income was compared against the sum of their parents' incomes. This figure shows that estimated upward mobility was much higher for children who were partnered than for single children.

The decreasing upward mobility of total family income attenuates when we narrow the focus to children with a partner. As shown in Figure A2.2.4, upward mobility in both total and disposable income is relatively stable across cohorts for children who are partnered, while upward mobility for single children is much lower and shows a much sharper decrease for recent cohorts

Comments

There are a couple of points that should be noted. First, Danish income data is only available from 1980. This restricts the available study cases which in turn restricts available observations. Restriction of available cases may cause selection issues particularly for the early cohorts. More than half of children born 1967, 1968 and 1969 are not included in our final sample mainly due to missing of both of father's and mother's income. Missing parental income is the case for all parents born before 1945.

To get a sense of the potential bias, we measure the upward mobility trend with income at age 40. By measuring income at age 40 for both of children (with their partners) and parents, we can include about 10% to 15% more observations for the early cohorts from 1967 to 1972 (see Table A2.2.1). We show the results in Figure A2.2.5. The overall trend of upward income mobility persists for all different income measures, though the absolute rate of upward mobility is higher in age 40 income than when using earlier income ages. This indicates that the missing cases in the early cohorts may to a lesser degree influence the overall trend of upward mobility demonstrated in this report. Figure A2.2.5 shows that while the upward rate itself changes according to the income age; the overall trend pattern is similar across different income ages.

Table A2.2.1 Comparison Between Age 30–35 and Age 40 Samples, 1967–72 Birth Cohorts, Denmark

Birth	Age 30–35 Sample		Age 40 Sample		Total
Cohort	Count	Percent	Count	Percent	Population
1967	23,540	30.3%	34,820	44.8%	77,665
1968	27,033	37.7%	38,014	52.9%	71,798
1969	30,256	43.9%	40,530	58.8%	68,979
1970	34,810	50.4%	44,541	64.4%	69,110
1971	42,005	57.9%	51,590	71.2%	72,507
1972	47,083	64.6%	54,830	75.2%	72,923

Notes: This table presents the fraction of Danish non-immigrant children born in the 1967–1972 who are included in our main age 30–35 and supplementary age 40 samples.

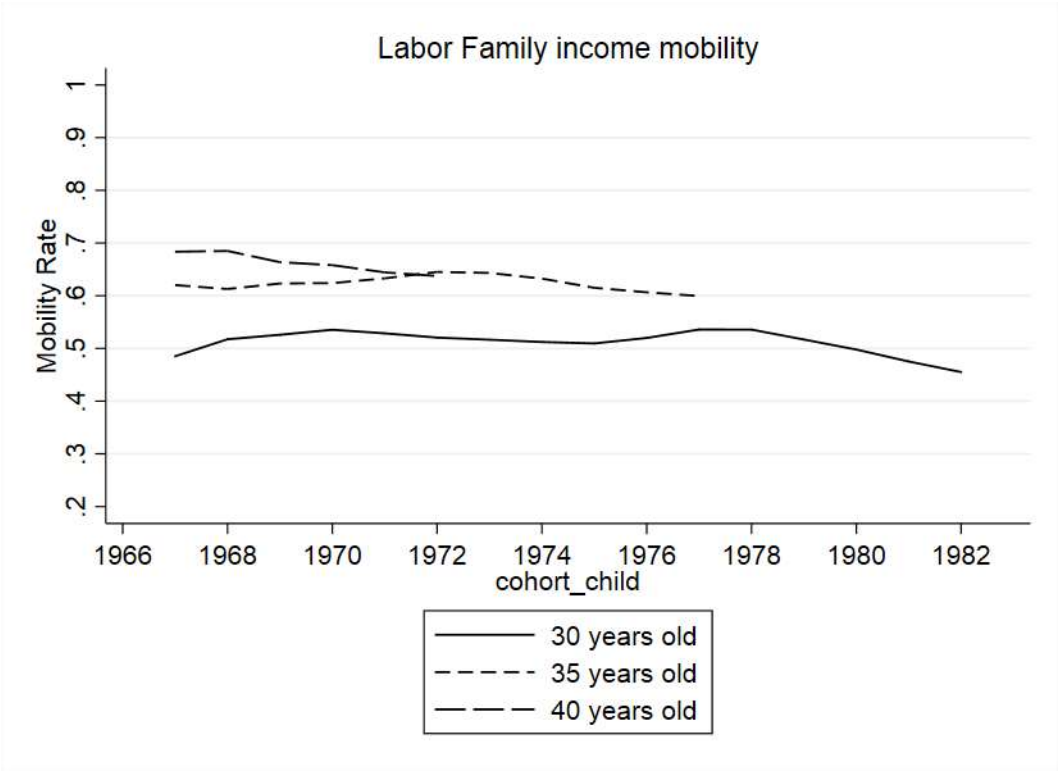

Figure A2.2.5. Upward Absolute Income Mobility by Age at which Income is Measured, Denmark.

Notes: This figure plots upward income mobility in family pre-tax income measured at age 30, 35, and 40 for the 1967–1972 birth cohorts. Note that this sample differs slightly from that used in Figure A2.2.3 in that here we only include observations where income was observed at exactly age 30, exactly age 35, or exactly age 40. In Figure A2.2.3 and in the main text we include observations where income was observed between ages 30–35, choosing the age closest to 30 when multiple years were observed.

A2.3: Finland

The Finnish sample is derived from total-population register-based longitudinal data provided by Statistics Finland. These data include annually updated information between 1987 and 2015, and are complemented with information from censuses from 1975 and 1985. In these data, all individuals residing in Finland (including immigrants, although their number is low) on the last day of each aforementioned calendar year are observed. Subjects are linked to their parents with the help of personal identification numbers. Data collection information along with quality descriptions are available from Statistics Finland.

Information on income was obtained from the Finnish Tax Administration database based on tax files of the National Board of Inland Revenue. The income variable incorporates the annual sum of all forms of income that are subject to state taxation. This includes wages, capital income, and taxable income transfers such as unemployment benefits. Some income transfers, such as social assistance and housing allowance, are not subject to tax, however, and are thus not included in the measure.

With the available data structure, it is possible to observe information on both personal and parental incomes for child cohorts born between 1965 and 1984. Income is measured at the same age for both parents and children, for most of the cohorts at the age of 30. For the oldest cohorts, however, data availability does not enable observing incomes exactly at this age; for these cohorts, the closest possible age to 30 has been used (mean age of income measurement for the oldest cohort is 32.6 years of age). From cohorts born in 1971 onward we are able to observe both parental and personal incomes for 85 to 91 per cent of the total population. For the cohort born in 1970, this fraction is 82 per cent, and it declines for older cohorts so that for the oldest cohort born in 1965, these data allow observing both parental and personal income for 63 per cent of the population. Altogether 838,290 individuals are analyzed.

Parental income is defined as the combination of the income of the head of household and their spouse. This includes all cohabiting couples, both married and non-married. Both biological and adoptive parents are included. If parents were not living together at the time of measuring parental income, the parent (and his/her spouse) with higher income was included in the analysis. When identifying age 30 for the income measurement, the age of the head of household (father if present, mother if not) was used. Child's income is measured as household income. This measure includes the total income of everyone residing in the household. Conducted sensitivity analyses indicated this measure to be very similar to that of combining the incomes of the head of household and their spouse. Income measures were adjusted for inflation using an index provided by Statistics Finland.

A2.4: The Netherlands

The Netherlands has register data available that directly links children to parents and tracks incomes over time, hence we are able to measure absolute mobility directly. However, while parent-child links are established since 1966, *population-wide* register data on income is only available since 2003. Therefore, for parental income we still rely on register data, but only among a random *sample* of the Dutch population, as described below. We compute the household incomes of children and their parents at age 30, adjust for inflation using the Dutch consumer price index with 2015 as baseline year, and calculate the fraction of children whose incomes exceed their parents'.

Data construction and representativeness

The sample of children consists of the non-immigrant population of Dutch individuals born between 1973 and 1984 (inclusive): 2,077,136 children in total ("GBAPERSOONTAB"). Children are then matched to their parents using personal identifiers ("KINDOUDERTAB"). We use the population-wide income register 2003-2017 to measure income of the children around age 30 ("INTEGRAAL PERSONEN/HUISHOUDENS INKOMEN"). To measure income of the parents around age 30, we use the sample income register ("IPO") which is available for 1981, 1985 and annually from 1989. Given the restriction that we require observations on both children's and parent's income, our final cohort sizes are as shown in Table A2.4.1.

Table A2.4.1. Number of Observations by Birth Cohort, the Netherlands

Birth year	Observations
1973	2,857
1974	3,229
1975	3,712
1976	4,088
1977	4,398
1978	4,910
1979	5,175
1980	5,622
1981	5,914
1982	5,626
1983	5,722
1984	5,763

Notes: This table provides the number of observations for each birth cohort in the Netherlands data.

To assess the representativeness of our sample compared with the population of children born in the same birth year, we compare the mean taxable income of our sample to the mean taxable income of all children in the same cohorts (see Table A2.4.2). We distinguish between (i) children in our sample, (ii) those for whom we do not observe parental income (i.e. due to random sample of the parental income register), (iii) those for whom we do not observe the child's income (e.g. due to child death or emigration before age 30), and (iv) those for whom we have neither parental nor child's income around age 30.

Table A2.4.2. Mean birth year and median taxable income by status (observed, not observed), 1973-1984 Birth Cohorts, the Netherlands

Category	Birth year	Taxable income in 2014
Analysis sample	1979.21	€ 25,312
Parental income not observed	1978.36	€ 25,732
Child income not observed	1978.75	€ 19,185
Neither parent nor child income observed	1979.08	€ 22,537

Notes: This table compares the mean birth year and median taxable income in our sample with those of other subsets of 1973–1984 birth cohorts in the Netherlands, to assess the representativeness of the linked sample.

From Table A2.4.2 it becomes clear that our analysis sample is very similar in terms of birth year and taxable income to the children for whom parental income is not observed. In fact, the reported difference is not statistically significant. Hence, while we lose a significant proportion of children in the relevant cohorts due to the sample nature of our data on parental income, the fact that the characteristics of our observed children are very similar to the population of children from the same cohorts is reassuring. It seems safe to say, therefore, that we observe a fairly representative sample of the population of children born between 1973 and 1984. Note that the average taxable income for those where child income is not observed around age 30 is substantially lower. This is partly due to the fact that for most of these individuals income is not observable, and that income is observed only for a selected subset of individuals (e.g. those who emigrated and returned to the Netherlands by 2014). As the group of individuals for which child income is not observed only makes up 0.19 percent of the entire 1973–1984 birth cohort, excluding these individuals from the estimation sample is not likely to be problematic.

Income source and measurement

We use "gross income", measured as the sum of labor income, social employee insurances (UI, DI), and social benefits (old age benefits, survivor benefits and welfare), minus the income insurance premiums, as our income measure. Gross income only measures personal income, and therefore does not include income items that cannot easily be assigned to one individual in a couple, like capital income and child allowances. We sum the two gross personal incomes for a couple to derive a measure of the couple's gross income. Net (pos-tax) income is available in the data, yet major changes in the computation of net income in 2001 and 2011 render the absolute values of net income incomparable across children and parents. We therefore report estimates for gross income only. While gross income measures for parent income and child income are both register-based, the exact source differs.

Parent income: Parent income is obtained from the IPO ("InkomensPanelOnderzoek") in 1981, 1985 and 1989-1999 annually. The IPO 1981 was a 3.3% sample of all Dutch addresses and samples all household members (~170,000 households). IPO 1985 includes all 1981-sampled households that were still living on the same address in 1985; but additionally samples a large refreshment sample (~180,000 households). Starting from 1989, a core sample of ~75,000 households was selected from the 1985 sample, and is longitudinally followed-up annually since then.

Parent income is paternal income at age 30 (or closest age in interval 25–35) plus their partner's income in the same year.[22] We convert Dutch guilders into Euros by using an exchange rate of 2.20371. A partner refers to either the married or registered spouse, or a cohabiting partner. In case the father is not present, we take maternal income at age 30 (or closest age in interval 25–35). In about 4.5% of the cases one of the individuals in the household was not the biological parent of the child, but our results are robust to excluding these observations (see Table A2.4.11 below). We measure parent age using the head of household (father if available, mother if not) in a similar fashion as done for the analyses for Sweden, Denmark, and Finland.

Children's income: Children's income is obtained from population-wide income registers ("IPI/IPATAB" and "IHI/IHATAB") from 2003 to 2017. We select the child's income both at age 30 (or closest age in interval 25–35), and at age X around 30, where X is age at which parental income was defined.

Descriptive statistics

Table A2.4.3 provides descriptive statistics of the exact age at which income is measured. When using income at age 30, in practice we use income measured at age 30, or the closest age in the range 25–35. This could lead to slight differences in the average age at which we measure income for parents and children. Indeed, columns 2 and 3 of Table A2.4.3 ("Age non-matched") suggest that the mean age of parents at which income is measured is slightly higher than that of their children, especially in the older birth cohorts. This is because income for parents was only available for the years 1981, 1985 and from 1989 annually, when these parents were already relatively old.

Table A2.4.3. Comparison of Ages at which Income is Measured by Birth Cohort, Parents and Children, the Netherlands

	Age non-matched		Age matched
Birth cohort	Age at which income measured, parent	Age at which income measured, child	Age at which income measured (parent and child)
1973	32.89	30.15	33.30
1974	32.71	30.10	33.00
1975	32.43	30.05	32.63
1976	32.09	30.03	32.25
1977	31.82	30.01	31.91
1978	31.44	29.99	31.52
1979	31.12	30.00	31.21
1980	30.81	30.02	30.90
1981	30.51	30.06	30.61
1982	30.27	30.07	30.38
1983	30.04	30.03	29.89
1984	29.88	30.00	29.45

Notes: Parent's age is defined as father's age if the father is present and mother's age if the father is not present.

[22] For children, we use the variable "persink" in the population-wide income register. For parents, this "persink" is not available directly in the sample income register IPO, and instead we sum the variables *ybln, ydin, ywuo, yfrl, ywvu, ywac, yzwu, yaou, yplu, yaow, yaw, yabi, yasu* and *yale*, and substract *pwvg, pipb,* and *pwvw* in IPO 1981, 1985 and from 1989 onwards. We checked the accuracy of our approximation of the "persink" variable in the year 2000, the only year in which all income measures are available, and the correlation is >0.98. Results are available upon request.

This can also be observed from Figure A2.4.1; the distribution of parental age at which income is measured shifts to the left for later cohorts. For this reason, our preferred results are those in which we do not specifically focus on age 30, but rather use the income of the child at the same age for which we observe parental income (see column 4 ("Age matched") of Table 1.4.3. for the average age per cohort).

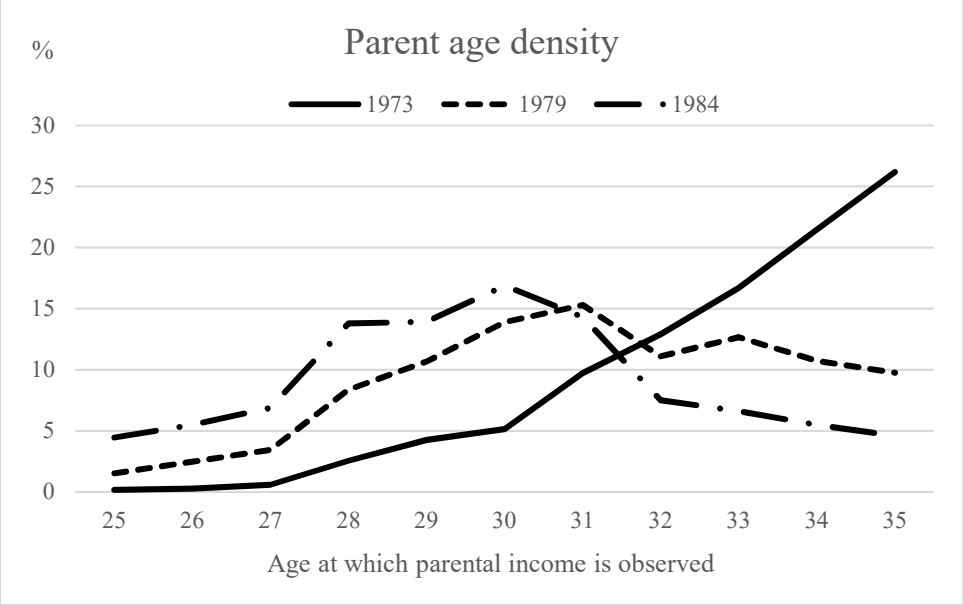

Figure A2.4.1. Age at which Parent Income is Measured by Birth Cohort, the Netherlands.

Notes: As described in the Appendix text, as a result of sample limitations the average age at which parent income is measured in the Netherlands varies by birth cohort. Specifically, as shown here, for the earliest cohorts parent income is measured at higher ages.

Table A2.4.4. Median Gross Income and Average Number of Adults per Family by Birth Cohort, Parents and Children, the Netherlands

Birth cohort	Gross income around age 30 (median), parent	Number of adults in family around age 30, parents	Gross income around age 30 (median), child	Number of adults in family around age 30, child
1973	€ 38,506	1.91	€ 61,000	1.78
1974	€ 37,588	1.91	€ 62,267	1.78
1975	€ 37,079	1.90	€ 59,996	1.76
1976	€ 36,703	1.92	€ 60,661	1.75
1977	€ 36,455	1.92	€ 60,722	1.74
1978	€ 36,313	1.92	€ 60,093	1.73
1979	€ 35,922	1.93	€ 59,712	1.73
1980	€ 35,482	1.93	€ 58,886	1.73
1981	€ 36,501	1.94	€ 56,721	1.71
1982	€ 36,237	1.93	€ 56,156	1.70
1983	€ 35,961	1.92	€ 53,331	1.69
1984	€ 35,452	1.92	€ 52,100	1.67

Notes: Parent's age refers to father's age when the father is present and mother's age when the father is not present.

Table A2.4.4 shows that median gross income among parents is pretty stable over the child's birth cohorts, and around €22,000 lower than the gross incomes of their children in real terms.

The number of adults in the family around age 30 is slightly higher for parents than for their children, which likely reflects the tendency for more recent cohorts to partner at a later age.

Finally, Table A2.4.5 provides the mean and median age at which parents had children over the birth cohorts for children. The mean age increased monotonically over birth cohorts from around 24 to close to 30 over 12 birth cohorts in our sample. Again, this is related to the availability of parental income data, which is limited to certain years.

Table A2.4.5. Mean and Median Age at which Parents had Children, the Netherlands

Birth cohort	Mean age at childbirth	Median age at childbirth
1973	23.99	24
1974	24.67	25
1975	25.27	26
1976	25.85	26
1977	26.36	27
1978	26.84	27
1979	27.32	27
1980	27.81	28
1981	28.25	28
1982	28.62	29
1983	29.16	29
1984	29.62	30

Notes: Parent age refers to father's age when the father is present and mother's age when the father is not present.

Main results

Table A2.4.6 presents our main results regarding absolute income mobility at age 30 in the Netherlands for the cohorts 1973–1984. The absolute family income mobility refers to the percentage of children whose family income exceeds their parent's family income in each cohort. In the second column we present the age matched results, and in the third column we present the age non-matched (i.e. child age closest to age 30) results.

Table A2.4.6. Absolute Income Mobility by Birth Cohort for Gross Income at Age 30 in the Age Matched and Age non-Matched Samples, the Netherlands

Birth year	Absolute income mobility Age matched	Absolute income mobility Age non-matched
1973	0.7811	0.7102
1974	0.7920	0.7076
1975	0.7820	0.6959
1976	0.7885	0.7221
1977	0.7850	0.7385
1978	0.7838	0.7525
1979	0.7770	0.7517
1980	0.7780	0.7563
1981	0.7320	0.7190
1982	0.7292	0.7058
1983	0.7069	0.6859
1984	0.6859	0.6781

Notes: Figure 1 in the main text presents these results for the age matched sample.

Absolute income mobility was relatively high and stable for the cohorts 1973–1980, in the range of 0.78. This implies that for these cohorts about 78% of children earned more than their parents at age 30. The age non-matched results show a fairly similar pattern but are somewhat

smaller than the age non-matched results. After 1980, we observe a sharp drop in absolute income mobility of almost 10 percentage points, to an absolute income mobility of 0.69 in 1984. This sharp drop is likely to be caused by the impact of the financial crisis 2008–2010, the effects of which were beginning to be felt around 2010, which is exactly when the 1980 cohort turned 30 years old. Still, even for the cohort 1984 – who turned 30 in 2014, the peak year of the unemployment rate – the absolute income mobility rate still is around 0.69.

Table A2.4.7 presents the same results, but now at age 40. Given the later age, here we observe cohorts only until 1979, but not later cohorts. The absolute income mobility rate is slightly lower than at age 30, but again relatively high and stable. The cohorts after 1980 did not yet turn 40, such that we cannot observe whether the drop in absolute income mobility at age 30 for cohorts after 1980 persisted at age 40.

Table A2.4.7. Absolute Income Mobility by Birth Cohort for Gross Income at Age 40 in the Age Matched and Age non -Matched Samples, the Netherlands

Birth year	Absolute income mobility Age-matched	Absolute income mobility Age non-matched
1963	0.7487	0.7000
1964	0.7349	0.6936
1965	0.7447	0.6782
1966	0.7443	0.7196
1967	0.7446	0.7310
1968	0.7451	0.7468
1969	0.7494	0.7490
1970	0.7564	0.7552
1971	0.7514	0.7495
1972	0.7548	0.7524
1973	0.7359	0.7327
1974	0.7449	0.7356
1975	0.7282	0.7173
1976	0.7476	0.7337
1977	0.7473	0.7414
1978	0.7727	0.7453
1979	0.7670	0.7363

Notes: Figure A2.2 presents results for the age matched sample.

Robustness and Heterogeneity

In addition to our primary specification, we conduct several analyses of robustness and heterogeneity. Here we report results for the age matched and age non-matched samples. For certain analyses we reproduce the age matched results presented here alongside results for other countries in Appendix 2.

Standardization: Table A2.4.8 presents our first robustness check, dividing family income by the number of adults present in the household. Since the average number of adults is slightly smaller in the children sample compared with the parents sample, the absolute income mobility rate increases in both the age non-matched and the age-matched sample. The main patterns (relatively high and stable income mobility for cohorts 1973–1980 and a drop afterwards) however hold up when adjusting for differences in household size between parents and children.

Table A2.4.8. Absolute Income Mobility by Birth Cohort for Standardized Gross Income at Age 30 in the Age Matched and Age non-Matched Samples, the Netherlands

Birth year	Absolute income mobility Age matched	Absolute income mobility Age non-matched
1973	0.8435	0.7917
1974	0.8555	0.8108
1975	0.8553	0.7982
1976	0.8647	0.8261
1977	0.8707	0.8370
1978	0.8744	0.8546
1979	0.8735	0.8558
1980	0.8749	0.8618
1981	0.8418	0.8429
1982	0.8303	0.8215
1983	0.8117	0.8039
1984	0.8058	0.7972

Notes: Figure A2.3 presents results for the age matched sample.

Median income ratio: An alternative measure for income mobility is the median of the income ratio, where the income ratio is defined as

$$\frac{y_{i,c}^{child}(a)}{y_{i,c}^{parent}(a)},$$

for individual *i* in cohort *c* at age *a*. Table A2.4.9 presents the results in the age non-matched and age-matched samples. The median ratio over these cohorts is around 1.3–1.6, implying that the median child earns 1.3–1.6 times as much as their parents at age 30. Again, a similar pattern shows up over cohorts with slightly increasing but relatively mobility for the cohorts up to 1980, and decreasing median ratio's after 1980.

Table A2.4.9. Median Income Ratio by Birth Cohort for Gross Income at Age 30 in the Age Matched and Age non -Matched Samples, the Netherlands

Birth year	Median income ratio Age matched	Median income ratio Age non-matched
1973	1.5404	1.3631
1974	1.5787	1.3510
1975	1.5933	1.3424
1976	1.6069	1.3961
1977	1.6189	1.4761
1978	1.6242	1.5235
1979	1.6101	1.5538
1980	1.6056	1.5686
1981	1.4946	1.4532
1982	1.4689	1.4147
1983	1.3969	1.3560
1984	1.3685	1.3422

Notes: The median income ratio is computed as the median of the ratio of child to parent income for all parent-child pairs.

Father-son mobility: Yet an alternative way of looking at income mobility is by focusing on fathers and sons only, and studying personal gross income rather than family income (Table A2.4.10). The overall mobility rate among fathers and sons is lower compared with studying household income. It is not immediately clear why this rate is lower, but one possible explanation could be the strong increase in female labor force participation after 1980 (Olivetti and Petrongolo 2017; Tijdens 2006), which made the traditional "male as breadwinner" family less common and clearly has influenced the high family income mobility rate in Tables A2.4.6–A2.4.9. Still, also here we observe a relatively stable income mobility rate up until around cohort 1980 and a drop afterwards.

Table A2.4.10. Absolute Income Mobility at Age 30 for Fathers and Sons Only in the Age Matched and Age non -Matched Samples, the Netherlands

Birth year	Absolute income mobility Age matched	Absolute income mobility Age non-matched
1973	0.6376	0.4926
1974	0.6194	0.4616
1975	0.6474	0.4864
1976	0.6300	0.5073
1977	0.6381	0.5460
1978	0.6267	0.5803
1979	0.6028	0.5842
1980	0.6228	0.5875
1981	0.6022	0.5907
1982	0.5923	0.5775
1983	0.5765	0.5690
1984	0.5764	0.5823

Notes: Figure A2.4 presents results for the age matched sample.

Excluding irregular observations: As a final sense of robustness, we exclude observations (i) for whom one of the parents is not the biological parent (i.e. about 4.5% of the sample); and (ii) for whom gross income is above €200,000 at age 30 (i.e. less than 1% of the sample). Table A2.4.11 presents the results, and shows that both of these sensitivity tests do not alter any of our results or conclusions.

Table A2.4.11. Absolute Income Mobility at Age 30, Excluding non-Biological Children (Columns 2–3) and Top Incomes Above € 200,000 (Columns 4–5), the Netherlands

Birth cohort	Excluding non-biological children		Excluding top incomes	
	Absolute income mobility Age matched	Absolute income mobility Age non-matched	Absolute income mobility Age matched	Absolute income mobility Age non-matched
1973	0.7889	0.7195	0.7794	0.7095
1974	0.8002	0.7150	0.7893	0.7046
1975	0.7869	0.7014	0.7815	0.6953
1976	0.7938	0.7274	0.7864	0.7195
1977	0.7907	0.7417	0.7835	0.7378
1978	0.7880	0.7560	0.7827	0.7511
1979	0.7801	0.7557	0.7764	0.7508
1980	0.7823	0.7599	0.7778	0.7559
1981	0.7360	0.7224	0.7314	0.7182
1982	0.7343	0.7114	0.7285	0.7044
1983	0.7120	0.6893	0.7042	0.6834
1984	0.6926	0.6825	0.6837	0.6758

Notes: Robustness analysis.

Heterogeneity by sex and partner status: Table A2.4.12 presents the absolute income mobility rates by gender of the child separately. The income mobility rate (based on household income) for daughters and sons is fairly comparable.

Table A2.4.12. Absolute Income Mobility at Age 30 by Gender, the Netherlands

Birth cohort	Men		Women	
	Absolute income mobility Age matched	Absolute income mobility Age non-matched	Absolute income mobility Age matched	Absolute income mobility Age non-matched
1973	0.7803	0.7055	0.7818	0.7147
1974	0.7786	0.6824	0.8052	0.7340
1975	0.7960	0.6924	0.7681	0.6994
1976	0.7887	0.7085	0.7882	0.7359
1977	0.7802	0.7347	0.7897	0.7424
1978	0.7881	0.7471	0.7797	0.7581
1979	0.7660	0.7430	0.7878	0.7607
1980	0.7771	0.7516	0.7789	0.7611
1981	0.7265	0.6983	0.7373	0.7405
1982	0.7149	0.6887	0.7425	0.7232
1983	0.6865	0.6662	0.7260	0.7060
1984	0.6646	0.6611	0.7059	0.6952

Notes: Absolute income mobility is measured using household income, but analyzed separately by gender.

In Table A2.4.13 we present the results stratified by single children and children with a partner. As expected, the income mobility rates are much larger among children living in a couple compared with children who are single. Note that early-cohort singles may be different from later-cohort singles; whereas the latter are much younger and still about to find a partner, the former may have explicitly chosen to remain single (e.g. as they prefer to focus on pursuing a career and making a lot of money, etc.).

Table A2.4.13. Absolute Income Mobility at Age 30 by Child Partner Status, the Netherlands

Birth cohort	Single children		Children with a partner	
	Absolute income mobility Age matched	Absolute income mobility Age non-matched	Absolute income mobility Age matched	Absolute income mobility Age non-matched
1973	0.5717	0.3801	0.8530	0.8305
1974	0.5992	0.3458	0.8595	0.8436
1975	0.5790	0.3498	0.8601	0.8369
1976	0.5775	0.3908	0.8730	0.8665
1977	0.5488	0.4024	0.8749	0.8735
1978	0.5432	0.4194	0.8775	0.8941
1979	0.5124	0.4063	0.8765	0.8975
1980	0.5010	0.4370	0.8851	0.8937
1981	0.4501	0.3855	0.8627	0.8904
1982	0.4654	0.3904	0.8464	0.8612
1983	0.4669	0.3624	0.8140	0.8487
1984	0.4223	0.3611	0.8099	0.8473

Notes: Household income is the income of the child alone for single children and the child plus partner for children with a partner.

A2.5: Norway

The data source is full population data from Statistics Norway. Children may be matched to parents using personal identifiers. Incomes are based on "pensionable income:" pre-tax wages and taxable social insurance transfers (such as unemployment and sickness benefits). This data series is available from 1967, when the National Insurance Act was adopted.

The income data is individual-based, and family incomes were computed as follows. Child family income at age *a* is the sum of own income and spouse income in the current year, where the spouse is identified by an id based on address (including but not limited to married couples). This link is only available from 1987. Parent family income at age *a* is calculated as the sum of father income at age *a* and mother income in the same calendar year. Fathers and mothers are identified by links to the child identifier. Incomes were deflated using Statistics Norway's Consumer Price Index.

Absolute mobility for child cohort *c* is computed as

$$\frac{1}{N_c}\sum_{i=1}^{N_c} 1\{y_{i,c}^{chil}\ (a) \geq y_{i,c}^{parent}(a)\},$$

where N_c is cohort size and $y(a)$ is income at age *a* as defined above. In the main analysis $a = 30$. As a sensitivity check, rates at $a = 40$ were calculated as well.

The full sample of children includes the non-immigrant population of Norwegians born 1964-1983, 1,092,027 individuals in total. The last available income data in our data is 2013. Because income is only available from 1967, for the 1964 birth cohort only fathers who were 27 or younger at childbirth (i.e., 30 in 1967 or later) will be included in the sample of parent-child incomes. Choosing 1964 as the starting year was a trade-off between sample selection and series length. Figure A2.5.1 below plots match rates for $a = 30$ (top) and $a = 40$ (bottom). Using $a = 30$, only a very small fraction of non-matches is due to missing id link, and the fraction with missing father income at age 30 decreases significantly from the 1964 to the 1983 cohort. Using $a = 40$ improves the match rate but limits the observation period.

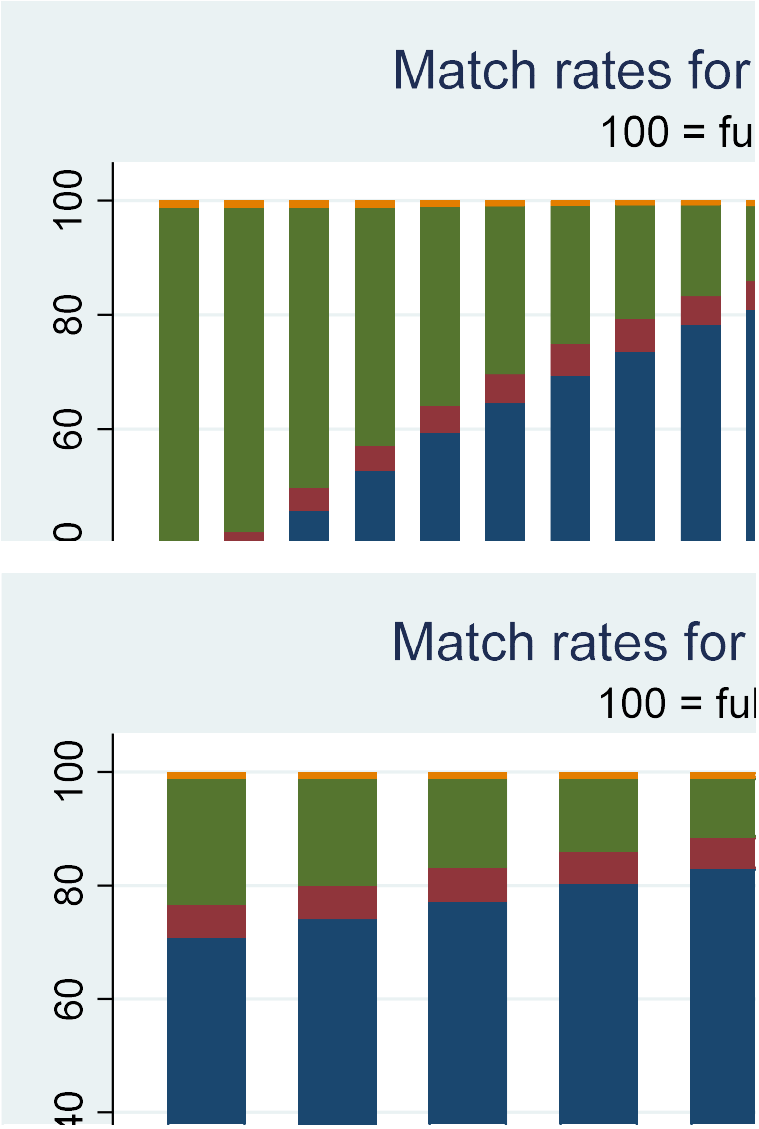

Figure A2.5.1. Parent-Child Match Rates by Child Birth Cohort, Incomes Measured at Age 30 (top) and Age 40 (Bottom), Norway

Notes: Income data is available from 1967, which limits the match rates at age 30 for cohorts born in the 1960s.

A2.6: Sweden

Our main sample is based on the full population of Swedish non-immigrants, born 1960–1984. We observe about 100,000 individuals per cohort, which is essentially the full population. We use household identifiers in the Swedish censuses from 1960, 1970, 1975, 1980, 1985, and 1990 to link the individuals of the main sample to their cohabiting parents. We define the child's parents in the year the head of the household (father if present, mother if not) was 30 years old or, if information from this year is missing, the census year in which the head of the household was *closest* to age 30. Families are identified based on cohabitation, where cohabitants/spouses are identified based on address and family status (i.e. not only marital status or biological link to the child). Thus, married as well as non-married parent couples are identified.

We then use register data from 1990–2014 to identify the households and potential spouses of the individuals in the main (child) sample. This measure is slightly different from the one above, being based on a family identifier that links those who are either married or have children together. Thus, in the child generation we will not identify unmarried partners without joint children as belonging to the same family and therefore potentially underestimate the family incomes of those households. Importantly, however, both these definitions are constant over cohorts within each generation. As shown in Figure A2.6.1, we still end up with a level difference in the share of couples (i.e. two-parent households; married or cohabiting) between the child and parental generations. This difference partly reflects a real trend in terms of a postponement of family formation and a decrease in marriage rates, but is also due to mechanical reasons.

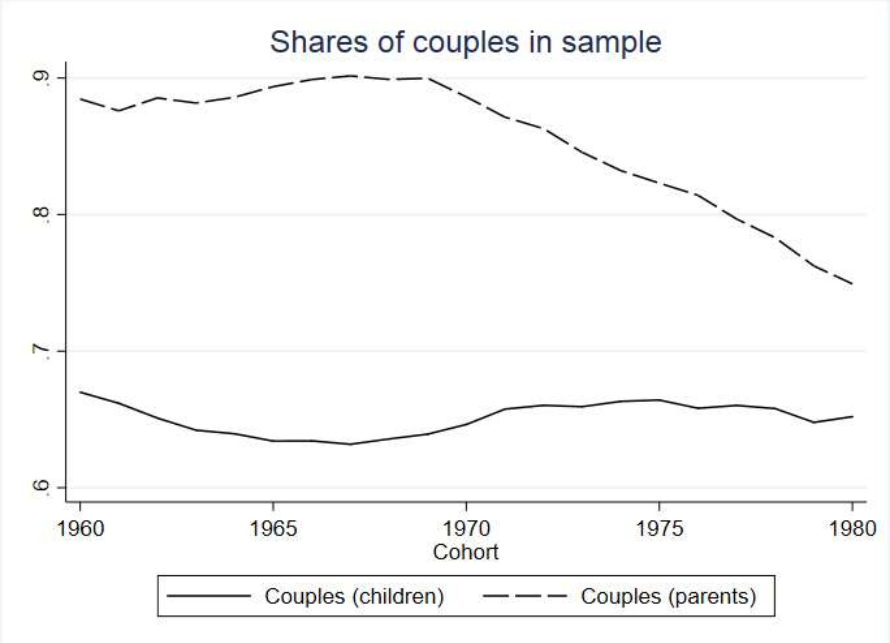

Figure A2.6.1. Share of Couples in Gross Income Sample by Child Birth Cohort, Parents and Children, Sweden

Notes: Parent couples are identified at age 30 (or closest observed age) based on address and family status. Child couples are identified at age 35 only if they are married or have a child together.

The first mechanical reason is that the parental household of the child can only be identified once the child is born, while the households of the child generation are almost always identified at age 30, irrespective of whether they will have a partner or own children in the future, and thus includes more singles. Second, as explained above, unmarried partners without children are identified as singles in the child generation. For this reason, we identify spouses in the child generation at age 35 rather than age 30. As shown in Figure A2.6.2, by age 35 most people in the child generation have married and formed families. This choice decreases the mechanical differences in two-earner households between the two generations.

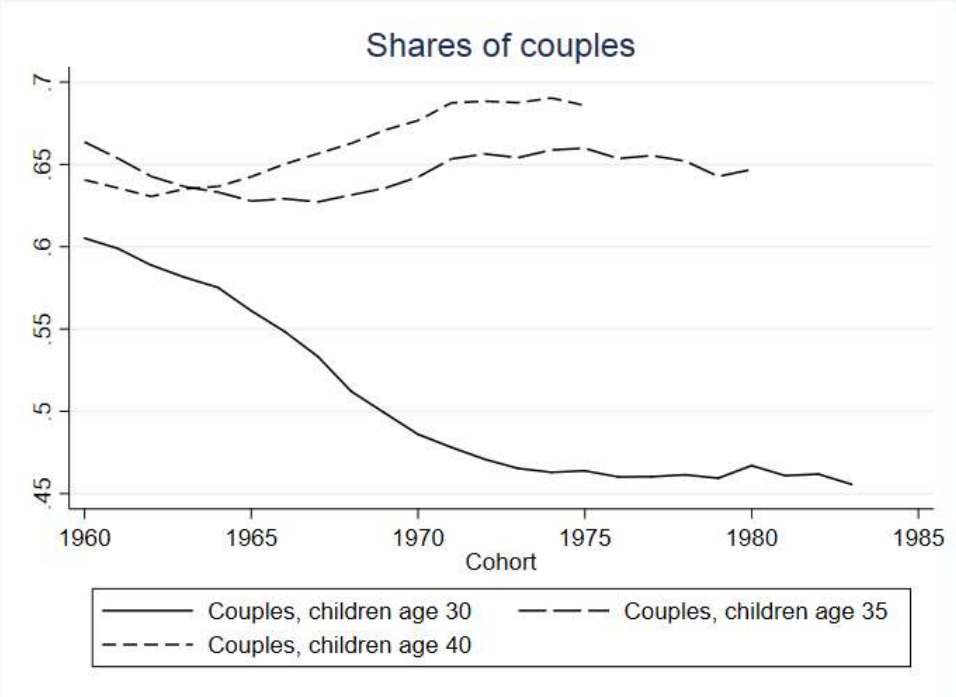

Figure A2.6.2. Share of Couples in Child Gross Income Sample Identified at Child Ages 30, 35, and 40, Sweden

Notes: Children are identified as members of a couple if they are married or have a child together. Because many Swedish children in recent birth cohorts have formed families between the ages of 30 and 35, the couple match rate is much higher when identified at age 35 than at age 30. In our main analysis we identify child couples at age 35, then sum the age 30 incomes of both members to calculate child family income.

We use two income measures. Our main income measure is gross annual family earnings at age 30, stemming from population-wide tax declaration files. This measure covers gross labor income, business income, and unemployment benefits, and is available for the years 1968, 1971, 1973, 1976, 1979, 1980, 1982, and every year 1985–2013. To construct family gross earnings, we take the gross individual earnings of the child in the year the child was 30 years old, and then add the gross earnings of the child's spouse from the same calendar year, if a spouse is identified. To construct parental family income, we follow the same procedure, summing up the parents' gross individual earnings in the year the head of the household was 30 years old, or if this is a gap/missing year (e.g. 1974 or 1978), in the year closest to age 30.

We exclude those for which we cannot observe the incomes of the household head in any of the ages 25–35. We construct this measure for the (child) cohorts born 1960–1983.

We also have access to individualized disposable income for the years 1975, 1979, 1982, 1985, and 1990–2014, also based on tax data. This measure covers all incomes and transfers net of taxes. We use these in the exact same way as above, enabling us to create measures of family disposable income for both generations of the (child) cohorts born 1965–1984. All incomes are deflated using the CPI. Absolute mobility is the cohort mean of an indicator for whether the child's income surpasses the parental income at the same age.

Given the restrictions above, we are able to match the children in the censuses to a parental household for about 99 percent of the population and observe their incomes at age 30 for about 90 percent of the population. These fractions are also fairly constant over time. The fraction for which we also observe parental incomes at around age 30 is between 80 and 90 percent, and this fraction increases slightly over cohorts, especially for the earliest cohorts. This is a consequence of the fact that we require parental incomes to be observed at around age 30 and the first year of income data is 1968 (or 1975 for disposable income). However, from cohorts born around 1970 and onwards (or somewhat later for disposable income), there is not much of a trend in the fraction for which we observe parental incomes at around age 30.

A2.7. The United Kingdom

Method

We follow the "copula and marginals" method as described by Chetty et al. (2017), calculating absolute income mobility for each cohort by comparing the average incomes in each pair of quantile cells from the child and parent marginal income distributions and assigning an upward mobility rate of 1 to those cells if the child income is greater than the parent income. We then compute the overall absolute mobility rate by taking the mean across all pairs of cells weighted by the probability in the copula that a child born to parents in the parent cell would end up in the child cell as an adult.

Data

We use three surveys for this analysis: the Family Expenditure Survey (FES) and the Family Resources Survey (FRS) provide information on marginal earnings distributions, and the British Cohort Study (BCS) provides data for the copula.

Family Resources Survey: The FRS was a continuous representative household survey, starting from 1993–94, that covers questions on a wide range of topics relating to their financial circumstances including receipt of Social Security benefits, housing costs, assets and savings. We use the FRS from 1994 onwards, i.e. the year from when incomes are reported, to construct the children's sample.

Households are included in our sample if the head of household is on average 30 years old (28–32 years) and if they reported any income. We consider the person with the highest individual income as the head of the household. The head of the household is male in 58 percent of households (inclusive of single-person households). As the FRS began in 1994, the earliest birth cohort of children is 1964 (1994 - 30). Similarly, as the latest survey is from 2017, the last birth cohort is 1987 (2017 - 30). We have about 46,000 households satisfying these restrictions.

Individual income is the sum of labor earnings, self-employment earnings, pensions and other benefits and transfers. We sum individual income among partners (spouse, cohabiting and civil partners) to create the gross combined income, and across all members of the family to create the family income. Net income is defined as gross income less taxes.[23] We only include households whose family income was positive.[24] We also conduct specifications that normalize the household income with the square root of family size, and the spousal income with the number of partners in the household, as robustness checks.

Family Expenditure Survey: The FES is an annual representative household survey designed to determine the basket of goods and services for the consumer price index. The survey is digitally available from 1968 and provides detailed individual level information on all members of the household, including their year of birth, their relation to other members and their labor earnings. We use the FES to construct the marginal income distribution of parents, as we have earnings records from as early as 1968. The FES was converted to another survey after 2000 – we only use the years between 1968–2000.

As with the children's sample, parent's households are only included if the head of the household was 30 years old on average (28–32 years), and if they reported any income. In

[23] Net incomes are only available from 1996 onwards.
[24] About 160 households that satisfied the age restriction reported no or zero family income.

addition, to qualify as a *parent*, the household must include a child born between 1964–1987. We use the birth cohort of the child to match the children to their statistical parents. Our sample size, after the restrictions, is about 26,000 fathers.

Incomes and corresponding normalizations are the same as defined for the FRS.

British Cohort Study: The BCS sampled all children born in a particular week in 1970 and collected data at several points in childhood and periodically through the age 50 survey in 2020. Parental incomes were collected at age 16 of the child (average age of father's was 39 years), and the adult gross earnings of the child are available from the 2000 sweep at age 30. In total, we have income information for about 3,900 parent-child pairs.

An issue with the BCS is that it provides banded net income for parents. We use the FES to impute gross median income of parents for each band reported in the BCS. We use our imputed income information along with the reported income data for children to construct our copula. As the sample size is limited, our copula is a 10x10 bi-stochastic matrix.

A2.8. The United States

To estimate absolute income mobility in the United States, we follow the "copula and marginals" approach introduced by Chetty et al. (2017). Like they do, we use a copula constructed from IRS tax records for the 1980–82 US birth cohorts, as presented in Chetty et al. (2014). However, for maximum comparability to the other countries in our sample, we use pre-tax, post-transfer income as our baseline, which is not a specification constructed by Chetty et al. Because the Current Population Survey does not capture all transfer income, we estimate the marginal income distribution for children from Columbia Historical Supplemental Poverty Measure (SPM) dataset (Wimer et al. 2017). This data augments the Current Population Survey with estimates of income from cash or near-cash transfers, including the Supplemental Nutrition Assistance Program, the National School Lunch Program, the Low-income Home Energy Assistance Program, the Special Supplemental Nutrition Program for Women, Infant, and Children, Federal Economic Stimulus and Economic Recovery payments, the Earned Income Tax Credit, the Aid for Families with Dependent Children and Temporary Assistance for Needy Families programs, Social Security. Note that we continue to use the Decennial Census for parent incomes, which has less complete information on transfer incomes but extends further back in time.

Note that our baseline estimates of upward mobility are approximately 5 percentage points higher than those in Chetty et al. 2017. We believe this is due to our more complete data on child transfer incomes. As shown in Figure A2.8.1, if we measure both parent and child incomes using the Historical SPM dataset, our estimates are comparable or even slightly higher than in our baseline. This suggests that the more limited information on parent transfer incomes is not biasing our results upward.

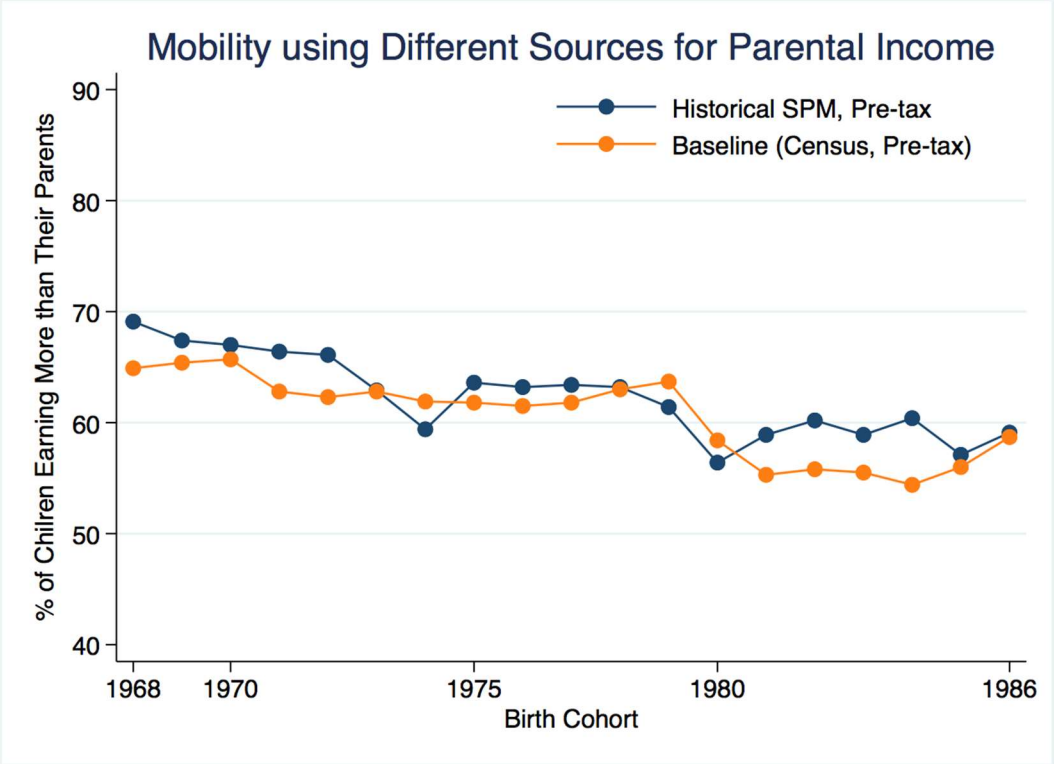

Figure A2.8.1. Absolute Income Mobility by Cohort, Parent Incomes Measured Using the Historical SPM and Decennial Census, United States

Notes: As discussed in the Appendix text, we measure child incomes using the Historical SPM dataset (Wimer et al. 2017), which captures income from transfers more completely than the Current Population Survey used by Chetty et al. (2017). However, we still use the Decennial Census, which does not include as much information on transfers, to measure parent incomes. To confirm that the lack of parent transfer income does not upwardly bias our results, this figure compares our baseline results to those using parent income including transfers for the subset of cohorts where both parents and children can be measured in the Historical SPM dataset.

For our estimates of upward mobility using disposable income, shown in Figure A2.1, we use the Historical SPM dataset for both parent and child incomes. This limits our sample to cohorts born in 1968 or later, but is necessary because the Decennial Census does include information on post-tax income.

Appendix 3. Alternate Specifications

In addition to our primary specification shown in the main text, we conduct a range of alternate specifications to explore the sensitivity and heterogeneity of our results. These include using post-tax rather than pre-tax income, measuring income at age 40 rather than age 30; normalizing income by the number of adults in the family; and comparing individual incomes of fathers and sons. We present these results here. Data limitations prevent us from running all specifications in all countries.

Post-tax income

Our primary specification uses income before taxes but after transfers, as this is the definition available most consistently across countries in the data. However, for Canada, Denmark, Sweden, the UK, and the US we are able to construct series using post-tax, post-transfer disposable income for a subset of birth cohorts. This income definition is perhaps the closest to measuring true standards of living. Results are shown in Figure A3.1. Mobility measured using disposable income is similar to that with gross income in Canada, Sweden, the UK, and the US, though the upward mobility rate in Sweden is higher for recent cohorts when measured using disposable rather than pretax income. For Denmark, the trend in upward mobility is quite different when measured using disposable income from the trend measured using pre-tax income. Specifically, the marked decrease in mobility rates for the later cohorts disappears when measured using disposable income. This is due to a much smaller decline in post-tax compared to pre-tax incomes among recent cohorts. The real pre-tax median income of 30-year-olds in Denmark dropped by 20% from 2007 to 2012, while the post-tax median fell by just 7%. This suggests that the Danish tax system lessened the blow of the Recession for young adults, which would otherwise have been quite severe.

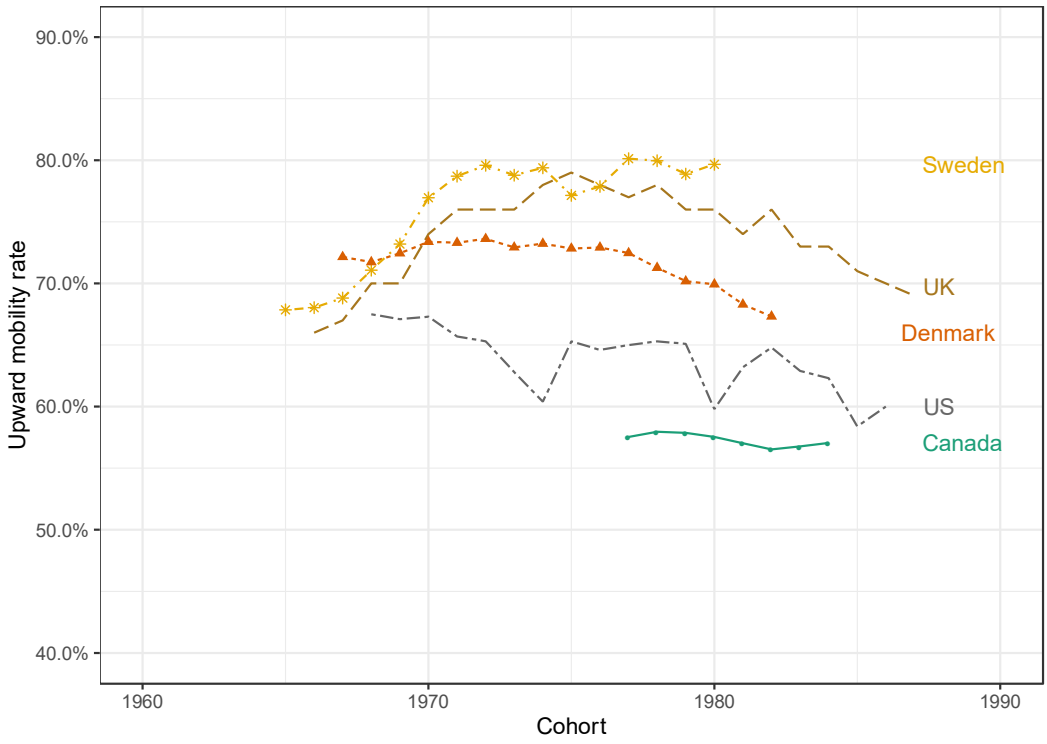

Figure A3.1. Estimates of Upward Mobility by Country and Birth Cohort, Disposable (Post-Tax, Post-Transfer) Income

Notes: The upward mobility rate is calculated as the percentage of children in each birth cohort whose post-tax, post-transfer disposable family income at age 30, adjusted for inflation, was higher than their parents' family income at age 30. Incomes are measured using a combination of register and survey data in each country, as described in Appendix 2.

Adjusting for number of adults

To examine the importance of changes to family structure for absolute mobility, we run a specification where we divide family income by the number of adults present. This should address the rise in single parent families, which might decrease estimated mobility rates, and the rise in dual earner families, which might increase them. Results for this specification are shown in Figure A3.2. For most of the countries in the sample, trends are similar to those in baseline specification but levels are 8–17 percentage points higher. Exceptions include Norway, where there is more of a positive trend over time using the normalized income measure, and the Netherlands, where mobility using normalized income shows an upward rather than flat trend for the 1973–1980 cohorts.

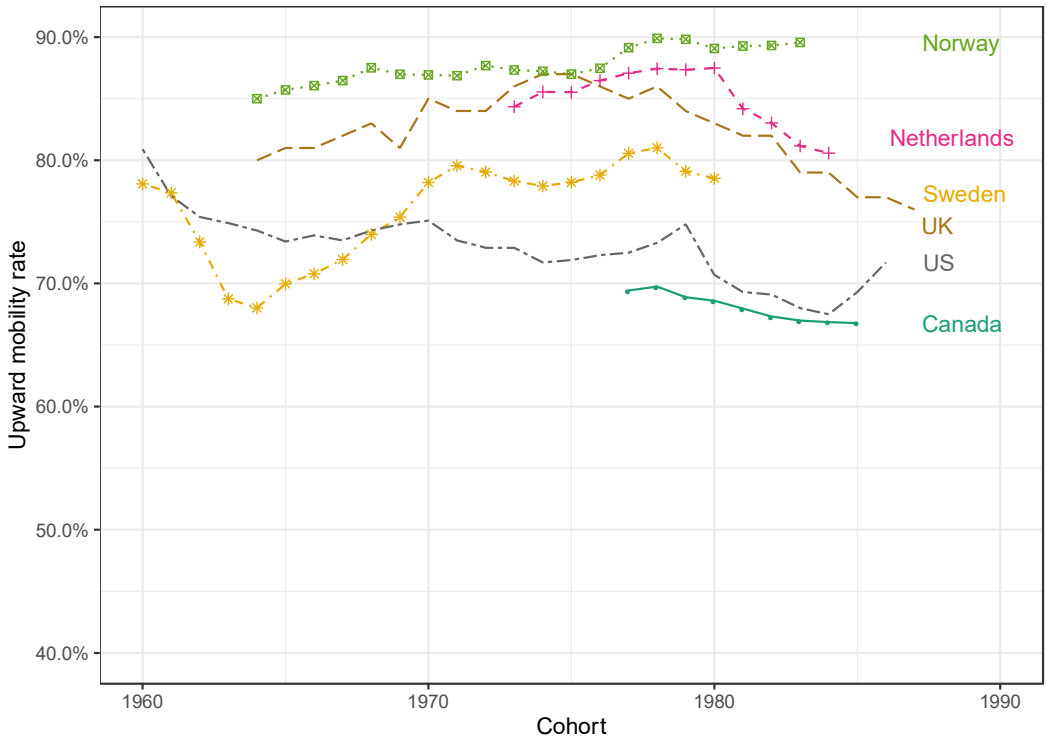

Figure A3.2. Estimates of Upward Mobility by Country and Birth Cohort, Income Normalized by Number of Adults Per Family

Notes: The upward mobility rate is calculated as the percentage of children in each birth cohort whose pre-tax, post-transfer family income-per-adult at age 30, adjusted for inflation, was higher than their parents' family income-per-adult at age 30. Incomes are measured using a combination of register and survey data in each country, as described in Appendix 2. Results for Denmark are for the non-age-matched sample, as described in Appendix 2.2.

Individual income of fathers and sons

In many of the countries in our study, family structure and labor force participation have changed substantially over the last 40 years (Western, Bloome, and Percheski 2008). Determining the best way to account for this is challenging: what does it mean for mobility that there are now more earners, or more children, or fewer children in a family? However, as one form of robustness check we estimate the individual income mobility of fathers and sons. This gets around changing family structure and labor force participation, though it opens up the problem of trajectories being different for men and women, which is true in the US in recent years. This comparison is available in Canada, Denmark, the Netherlands, Norway, Sweden, the UK, and the US.

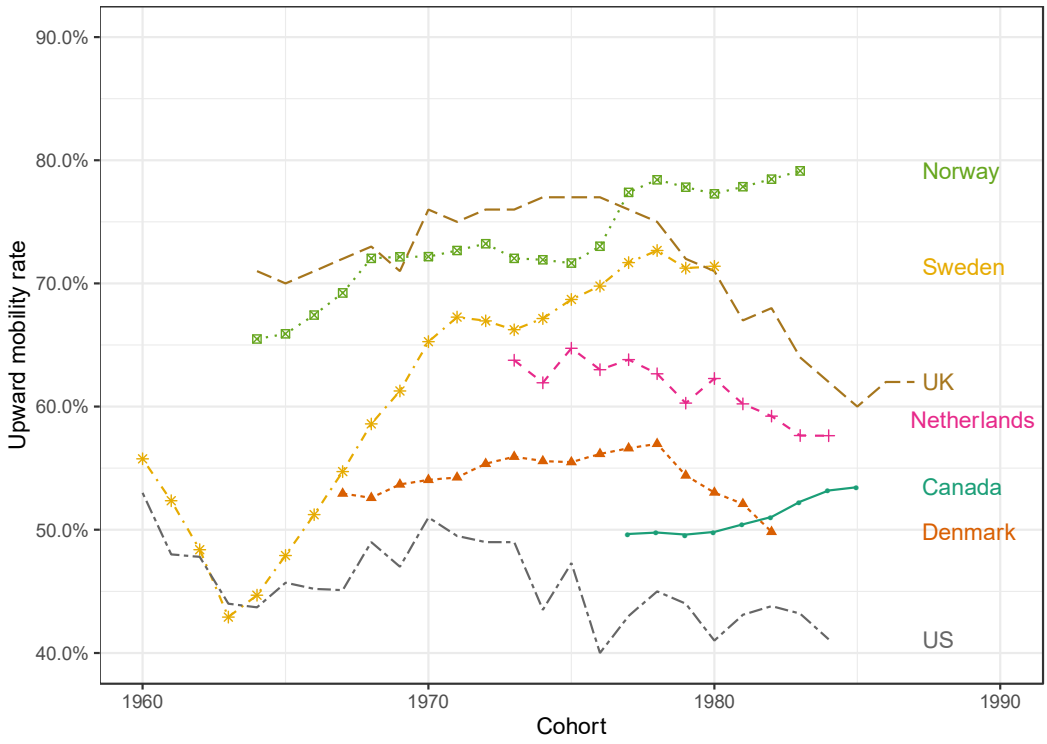

Figure A3.3. Estimates of Upward Mobility by Country and Birth Cohort, Individual Incomes of Fathers and Sons

Notes: The upward mobility rate is calculated as the percentage of sons in each birth cohort whose pre-tax, post-transfer individual income at age 30, adjusted for inflation, was higher than their fathers' individual income at age 30. Incomes are measured using a combination of register and survey data in each country, as described in Appendix 1.

Results are presented in Figure A3.3. For the most part the levels and trends are similar, though for Denmark the levels are much lower early in the period, which indicates that having dual-earning couples might be an important part of upward mobility for that country. For Canada there is a bit of an increasing trend in the upward mobility of sons in recent cohorts, though it is difficult to tell for sure given the small number of cohorts available. For Sweden the dip in mobility rates among sons born in the early 1960s (whose adult incomes were measured in the 1990s recession) is much deeper than in the family income analysis, as is the drop in the UK among sons born in the 1980s. In the US and the Netherlands, mobility rates for sons compared to fathers are much lower than those constructed using family income. This result in the Netherlands is likely due to the very large increase in female labor force participation in recent decades, from roughly 30 percent in the 1970s to roughly 70 percent in the 2010s (Olivetti and Petrongolo 2017). In the US, this result may be due to the combination of rising female labor force participation (which grew from 50 percent to 60 percent during this time), falling labor force participation among men, or growth in the earnings of women relative to men.

Appendix 4. Comparison of current analysis with Berman 2018

In a recent paper, Berman (2018) presents estimates of trends in upward absolute income mobility in several countries calculated solely from historical marginal income distributions for the full population. Here we present a detailed comparison of our results with Berman's and identify potential sources of differences where they exist. Figure A4.1 overlays our baseline upward mobility estimates with Berman's for the countries and periods where the samples overlap. There are two main differences between the estimates. First, in certain countries—most notably the UK and Denmark, as well as Sweden for cohorts born in the 1960s—there are substantial differences in estimated levels of upward mobility, with our estimates being as many as 15 percentage points higher or lower than Berman's. Second, for some of the countries in the sample, most notably Finland, Norway, Sweden, and the UK, our trend differs from Berman's.

We believe that the main source of the discrepancies between our results and Berman's, where they arise, is the use of different data for the marginal income distributions. Specifically, we use data on incomes of 30-year-olds only while Berman uses distributions for the full population of each country. Because economic trends sometimes have different impacts on people of different ages (Hoynes, Miller, and Schaller 2012), the income distribution of the full population is not always an accurate proxy for the incomes of a specific birth cohort. Additionally, when constructing the income distributions for parents, we include only those adults who had children, which may be a selected subset of the population with systematically different income patterns from adults of similar age who did not have children. As we show below, the difference between our results and Berman's for the United Kingdom—the country with the single largest discrepancy—can be fully accounted for by the difference in the marginal distributions we use rather than the difference in methodology.

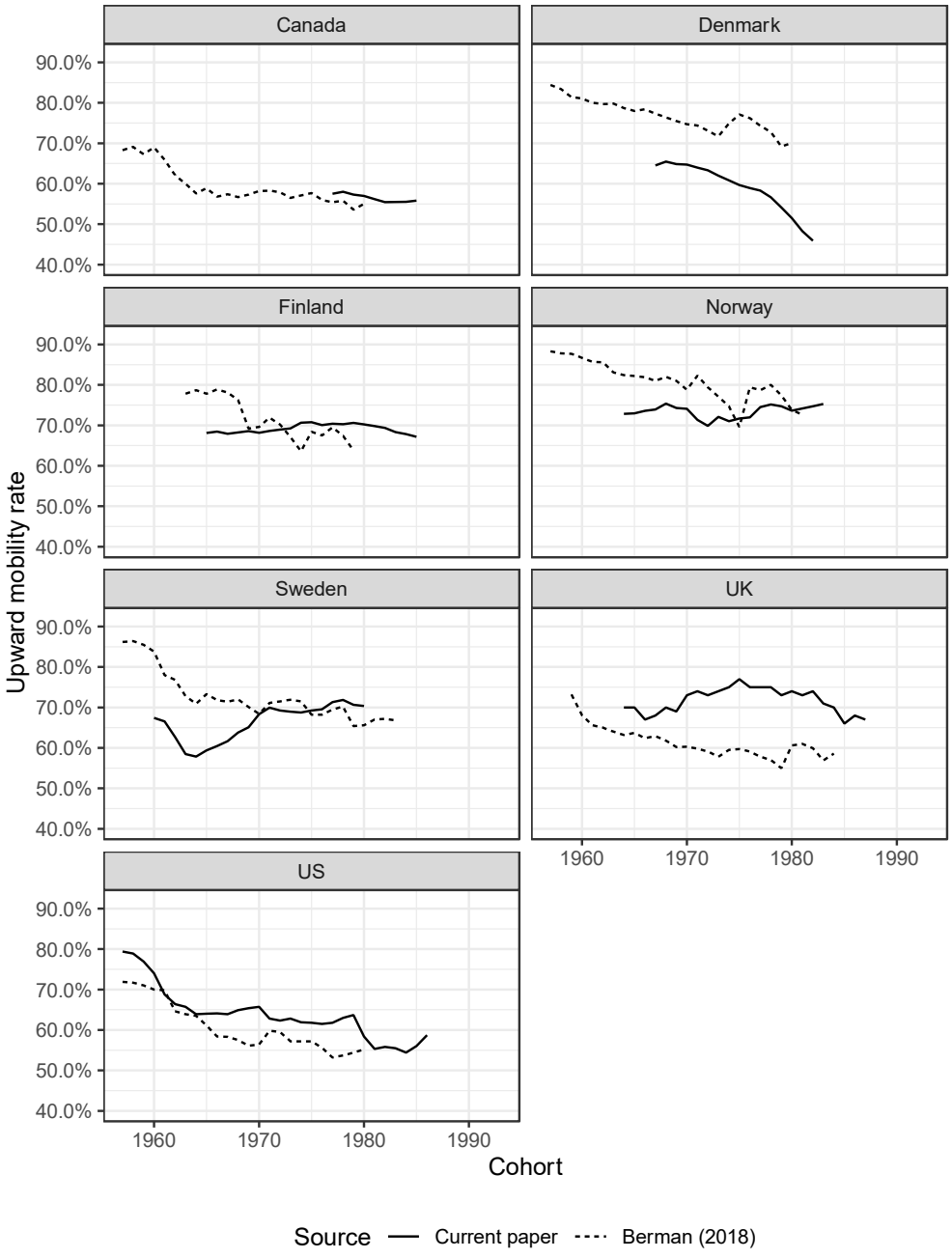

Figure A4.1. Comparison of Baseline Absolute Income Mobility Estimates with those of Berman (2018)

Notes: This figure compares the current paper's estimates of absolute upward income mobility with those of Berman (2018) for the countries and cohorts where the samples overlap. Berman's estimates are constructed using full-population marginal income distributions, as opposed to the linked parent-child age 30 samples used here. In many cases the results are remarkably consistent, but in some instances they differ substantially, likely because of the greater specificity of our income measures.

Detailed Comparison of Results for the United Kingdom

Berman (2018) presents a cross-country analysis of absolute income mobility, simplifying the methodology in Chetty et al. (2017) further by introducing two changes. First, he uses the method of generalized Pareto curve interpolation (Blanchet, Fournier, and Piketty 2017) to derive the marginal income distributions using two points—the mean and some measure of inequality, which in their case is the top 10 percent share of incomes. In addition, he assumes that the joint parent-child incomes follow the bivariate log-normal distribution.[25] Second, he shows that the rank correlation is a sufficient statistic to capture the details in relative mobility. Both these changes make it even easier to compute absolute mobility, and he demonstrates this by estimating it for several countries, including the UK. However, these results do not conform with our findings.

The reason for this discrepancy, as we show, is Berman's use of a more aggregated dataset that does not fully capture the changes to household level income and inequalities for 30-year-olds. His marginal income distributions are constructed using pre-tax national income for adults from the World Inequality Database (WID). As the WID does not report estimates at the micro-level, there is no cohort-level information. As a result, these marginal income distributions can only be attributed to specific years, and he compares these distributions across every 30 years. In contrast, we rely on survey data focusing on specific cohorts of interest. We can observe individual and household incomes within a narrow age-band, in our case age 30. And, because we can observe relationships within each cross-section, we can match parents and children using the birth cohort of the child. This accounts for the changing age of fertility across the years. Importantly, the high-quality surveys that inform our analysis are the same ones used by the UK government to understand changes in household income and inequalities.

[25] Chetty et al. (2017) argue that incomes cannot be well-approximated by such a distribution, but Berman shows that this assumption leads to a maximum of 10 percentage point difference between his estimates and that of Chetty et al. (2017).

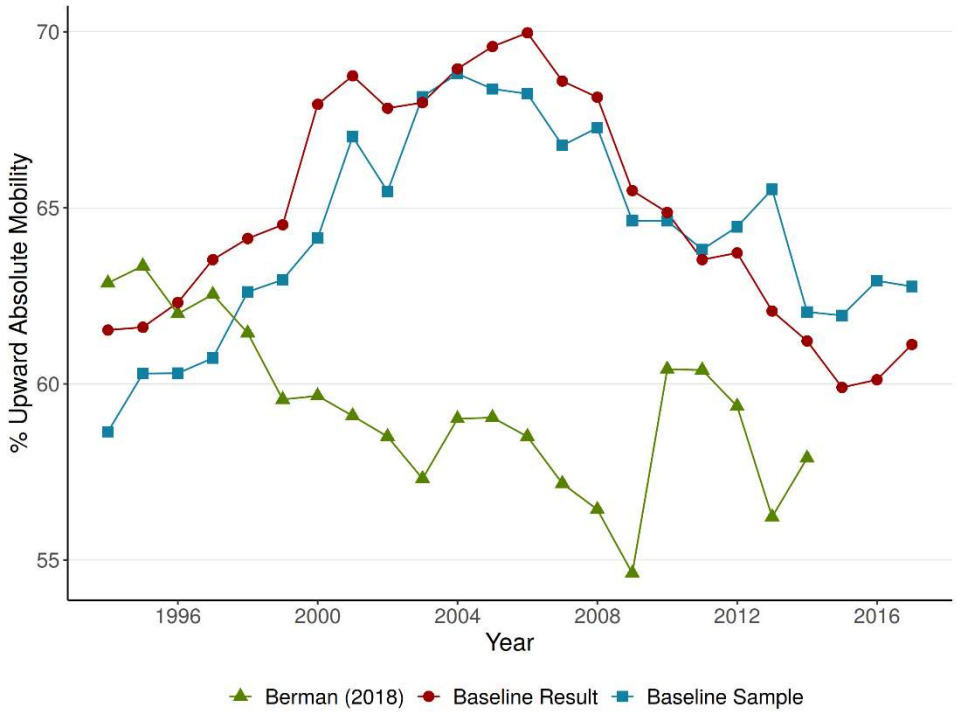

Figure A4.2. Comparison of Baseline Estimates of Absolute Mobility in the United Kingdom

Notes: This figure explore the sources of the difference between our estimates of absolute income mobility in the United Kingdom and those of Berman (2018). The difference between the baseline results of the present paper (red circles) and those of Berman (green triangles) is substantial. However, if we apply Berman's method to our more detailed income distribution data (blue squares) the results match quite closely. This both confirms the power of Berman's approximation method and highlights the importance of having accurate and specific data on the income distributions of parents and children. In this case, income trends for young adults in the UK during this period diverged from those for the overall population.

In Figure A4.2 we present the absolute mobility estimates reported in Berman (2018)[26] in green, along with our baseline estimates in red and estimates using our baseline sample and his method in blue. Our baseline results diverge both in terms of the trend and the level. Berman finds that absolute income mobility in the UK declined consistently between 1994 and 2009. On the other hand, we find that absolute income mobility among 30-year-olds in the UK grew between 1994 and 2005, after which it began to fall. Compared to his estimates, our baseline results are about 10 percentage points higher in 2004 and 3 percentage points higher in 2014.

To probe the sources of this difference, we first show that when both methods are applied to the survey data that we use, they generate approximately the same level of absolute income mobility. To be precise, we calculate the average real weekly income and the Gini coefficient of income for each year in our sample, and then interpolate to generate the full distribution. Following Berman (2018), we assume that the rank correlation for the UK is 0.3. Together, these two components provide the estimates of absolute income mobility shown in blue in Figure A4.2. The baseline results and the comparison with Berman's method produce very

[26] Berman (2018) presents results from 1989-2014, which correspond to the 1969-1984 birth cohorts using the terminology of the present paper. As we do not have estimates between 1989-1993, we only report his findings from 1994.

similar estimates (not significantly different). In other words, the methodology produced by Berman (2018) matches up well with the established methodology of Chetty et al. (2017). This implies that the differences in our estimates is due to the data used.

Second, we show why using survey data is more appropriate in this regard. To understand how using aggregate national statistics that do not refer to specific age groups can skew the results, in Figure A4.3 we compare the level of inequality between three sources: the top 10 percent income share from the WID, the Gini coefficient in our sample of 30-year-olds, and the Gini coefficient for the entire population of Great Britain published by Cribb, Norris Keiller, and Waters (2018), which we use as a benchmark. Strictly speaking, the top 10 percent income share and the Gini coefficient are not directly comparable but they are both measures of inequality and used for the same end in the method proposed by Berman (2018).

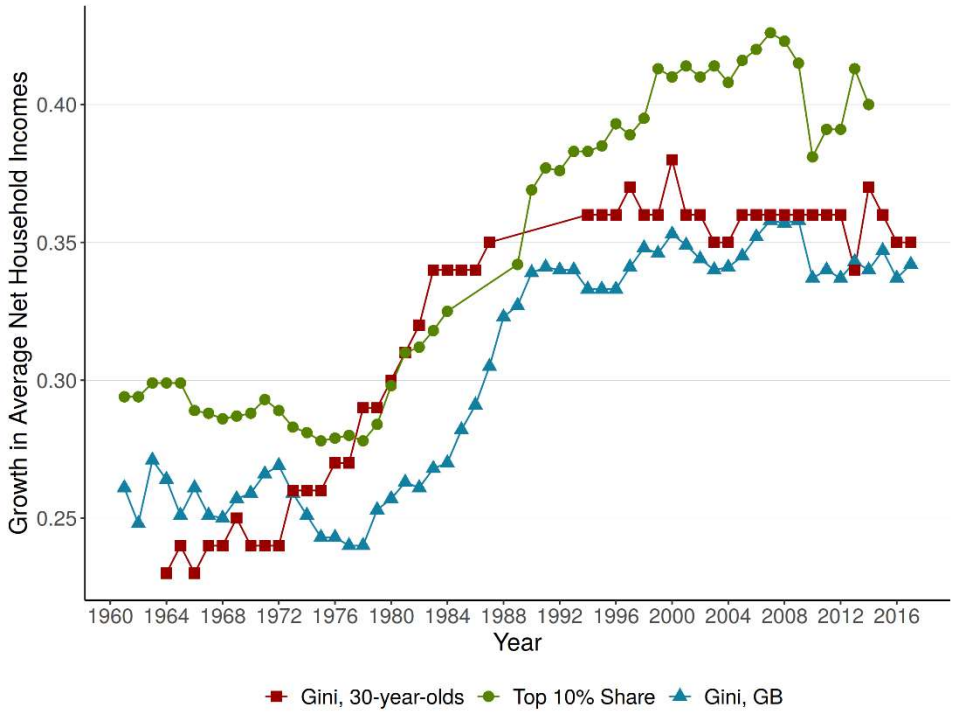

Figure A4.3. Three Measures of Inequality in the United Kingdom, 1961-2017

Notes: Gini, 30-year-olds, show the baseline estimates of Gini computed on gross household income, where at least one adult member is 30 years old. Gini, GB shows the Gini coefficient for equivalized household net income in Great Britain reported by Cribb, Norris Keiller, and Waters (2018). Top 10% share is estimated on pre-tax national income for adults as reported by Berman (2018).

The Gini coefficients for 30-year-olds and for the entire population are similar for the most part. The difference between the two remain within 0.02 points of each other for 22 of the 47 years reported here. In addition, the major difference is experienced in the 1980s for the parent sample: 30-year-olds experienced a faster growth in inequality in the 1980s compared to GB as a whole. On the other hand, the top 10 percent income share is much higher than the Gini coefficient. This would not be a problem in and of itself, but there is a much larger difference with the benchmark for the sample of children (after 1994) compared to the sample of parents

(prior to 1988). These discrepancies in the inequality experienced among children and parents help explain why Berman (2018) finds much lower levels compared to our results.

The final issue is to compare the growth in income across the sample. We use the average income reported for parents and children in Berman (2018) to construct a series from 1977-2014. We do this to compare his results with the reported growth in mean real equivalized household disposable income of individuals by the Office of National Statistics (Webber and O'Neill 2019), which we consider as the benchmark. As a comparison, we also plot the growth rate in unequivalized household income from our baseline sample for the same period. These comparisons are illustrated in Figure A4.4.

Once again, we find that the growth rate in incomes (although using different definitions) are very similar in trend between the benchmark and our baseline sample. The main difference is that the sample of 30-year-olds experience slightly lower levels of growth over time. On the other hand, the growth rate reported in WID (Berman, 2018) is much lower than the benchmark and this difference increases with time. What this means is that the children in the WID sample experienced much less growth in the mid-1990s than the benchmark, but they also suffered from a lower decline after the Great Recession. As a result, not only is absolute income mobility lower in levels, the trend is also different. Without the sharp rise in incomes in the 1990s, Berman (2018) does not find increasing absolute mobility during that era, and instead finds that absolute mobility consistently declined.

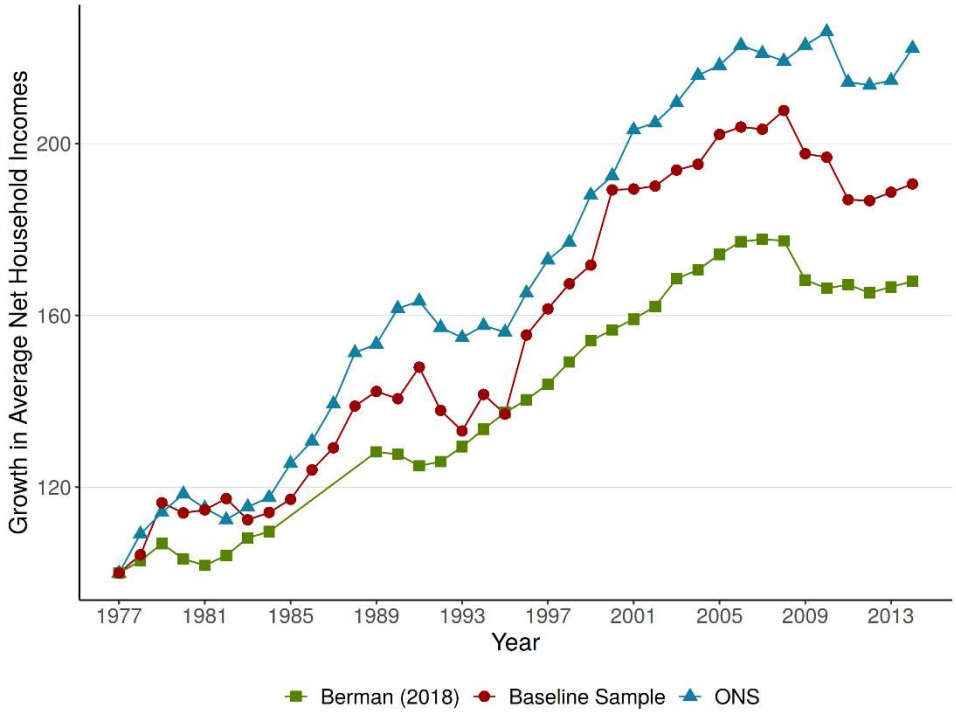

Figure A4.4. Income Growth in the United Kingdom, 1977-2014

Notes: Trends in average net household incomes are presented as a percentage of the 1977 value of each series, which is set to 100. Berman (2018) uses the pre-tax national income for all adults, equivalized using an equal split. We consider the unequivalized pre-tax income for 30-year-olds.

Appendix 5. Cumulative Decomposition of Cross-National Differences in Absolute Mobility Rates

The differences in absolute mobility between any two countries (or any two cohorts in one country) can be fully accounted for by four quantities: The amount of inequality among children, operationalized as the ratio of income at each percentile to child mean income; the amount of inequality among parents, operationalized in the same way; the ratio of mean child to mean parent income; and the copula. To increase interpretability, we further decompose the ratio of mean child to mean parent income into two parts: the national rate of GDP growth over the first 30 years of the children's lives and the difference between the ratio of GDP to mean sample income for parents and that for children. The latter quantity captures two concepts: differences across countries in the fraction of GDP earned by 30-year-olds (the amount of inter-cohort inequality), and differences in measurement error if the total income captured by our data sources is less than a country's GDP.

Figure 4 of the main text shows simulations in which four of the quantities described above (everything except the within-sample income distribution for parents) are individually varied. Here, we present a complementary set of simulations in which we cumulatively change each of the five quantities. This demonstrates that the five quantities together exactly account for the difference in absolute mobility.

Figure A5.1 presents the cumulative decomposition exercise comparing the three low-mobility countries to Norway. Like Figure 4 in the main text, it shows how the sources of low mobility rates differ between the US, Canada, and Denmark, even though their overall rates are similar. In the case of the United States, within- and across-cohort inequality are more than sufficient to fully account for the difference in upward mobility compared to Norway. The US copula and US parent income distribution actually serve to increase upward mobility. In the case of the copula, this conforms with Berman's (2018) finding that, holding marginal distributions constant, higher relative mobility is associated with lower absolute mobility. In the case of the parent income distribution, the higher level of inequality among US parents compared to Norwegian ones means that low-income US parents have lower incomes relative to GDP than Norwegian ones. Holding child incomes constant, this results in more upward mobility.

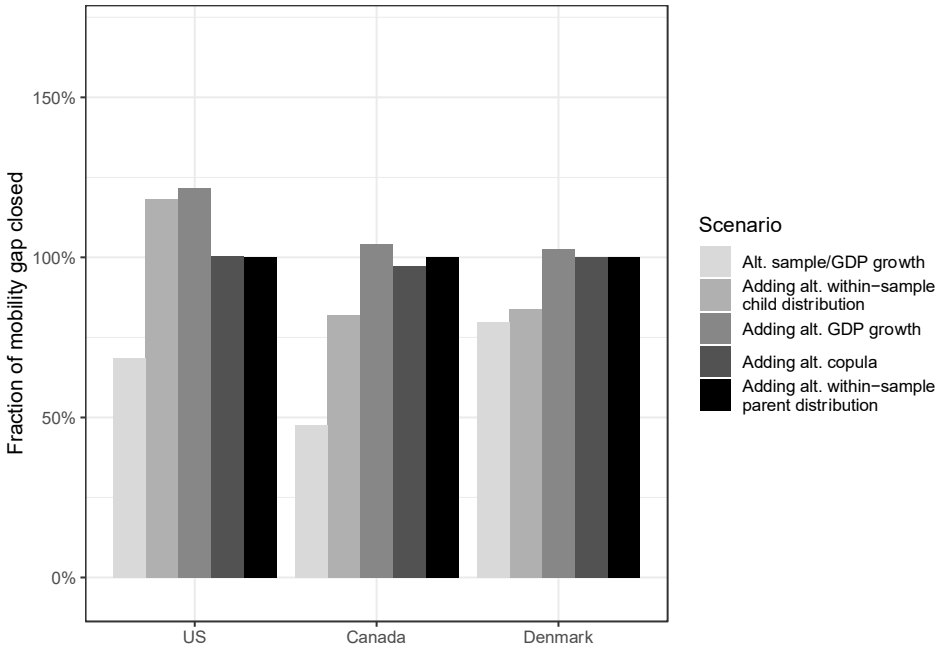

Figure A5.1. Cumulative Decomposition of Sources of Difference in Absolute Mobility Between Low-Mobility Countries and Norway, 1983 Birth Cohort

Notes: Results are for the baseline specification, estimated using the copula and marginals approach.

As in the main text, the low Danish mobility rate with pre-tax income is almost fully accounted for by the combination of the low income to GDP ratio among children and slower GDP growth. As mentioned in the main text, this result should be treated with some caution given that post-tax mobility, which is more central to individuals' lived experiences, is much higher for Denmark (see Figure A3.1).

Canada falls somewhere between the US and Denmark, with its low mobility rate accounted for by all three of the sample mean income to GDP ratio (inter-cohort inequality), the within-sample income distribution (intra-cohort inequality) and slower GDP growth. In both Canada and Denmark the copula and parent income distributions have little impact on the overall rate of absolute income mobility.

Appendix 6. Mobility Decompositions Compared to Sweden and Finland

In the main text and Figure 51 we perform decomposition exercises to determine the source of the differences in mobility between the three low-mobility countries and Norway. We chose Norway because it had the highest and most stable rates of upward mobility during our sample period. However, two other Scandinavian countries, Sweden and Finland, also had high and stable rates of upward mobility during this time. Here we replicate our decomposition exercises using Sweden and Finland as comparison cases.

Figure A6.1 shows the individual (top) and cumulative (bottom) decomposition exercises with Sweden as the comparator. The main difference compared to the simulations with Norway as the comparator is that Sweden experienced lower rates of GDP growth than Norway during the 30 years to 2013 (just 1.67% annually compared to 2% in Norway). This means that the role of GDP growth in accounting for the differences is smaller than for Norway, while the role of within-cohort and cross-cohort inequality is more important.

Figure A6.2 repeats the decomposition exercise with Finland as the comparison case. Like Sweden, Finland saw lower rates of GDP growth than Norway during our sample period. Here, the most striking result is the importance of within-cohort in equality for explaining the difference with the US, which is more important than the sample to GDP ratio.

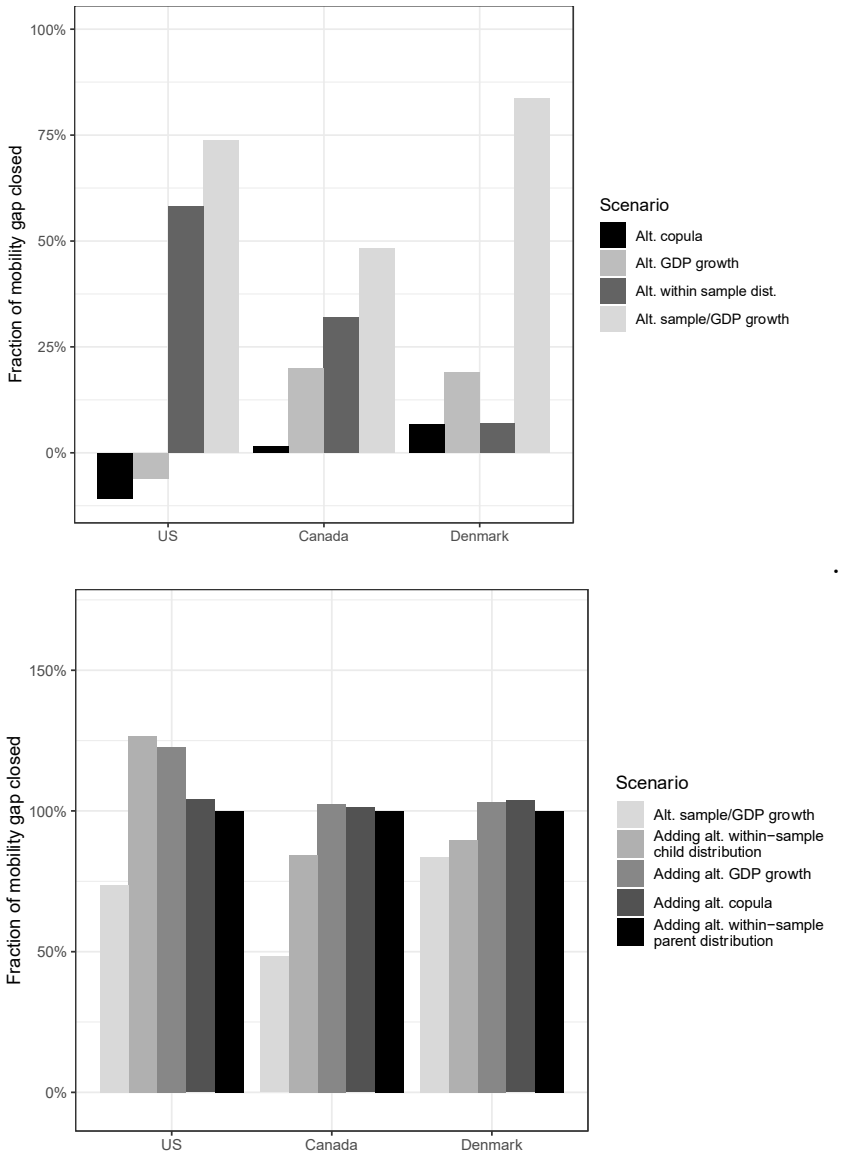

Figure A6.1. Individual (Top) and Cumulative (Bottom) Decomposition of Sources of Difference in Absolute Mobility Between Low-Mobility Countries and Sweden

Notes: Results are for the baseline specification, estimated using the copula and marginals approach. Due to data constraints results for Sweden are for the 1980 birth cohort, those for Denmark are for the 1982 birth cohort, and those for Canada and the US are for the 1983 birth cohort.

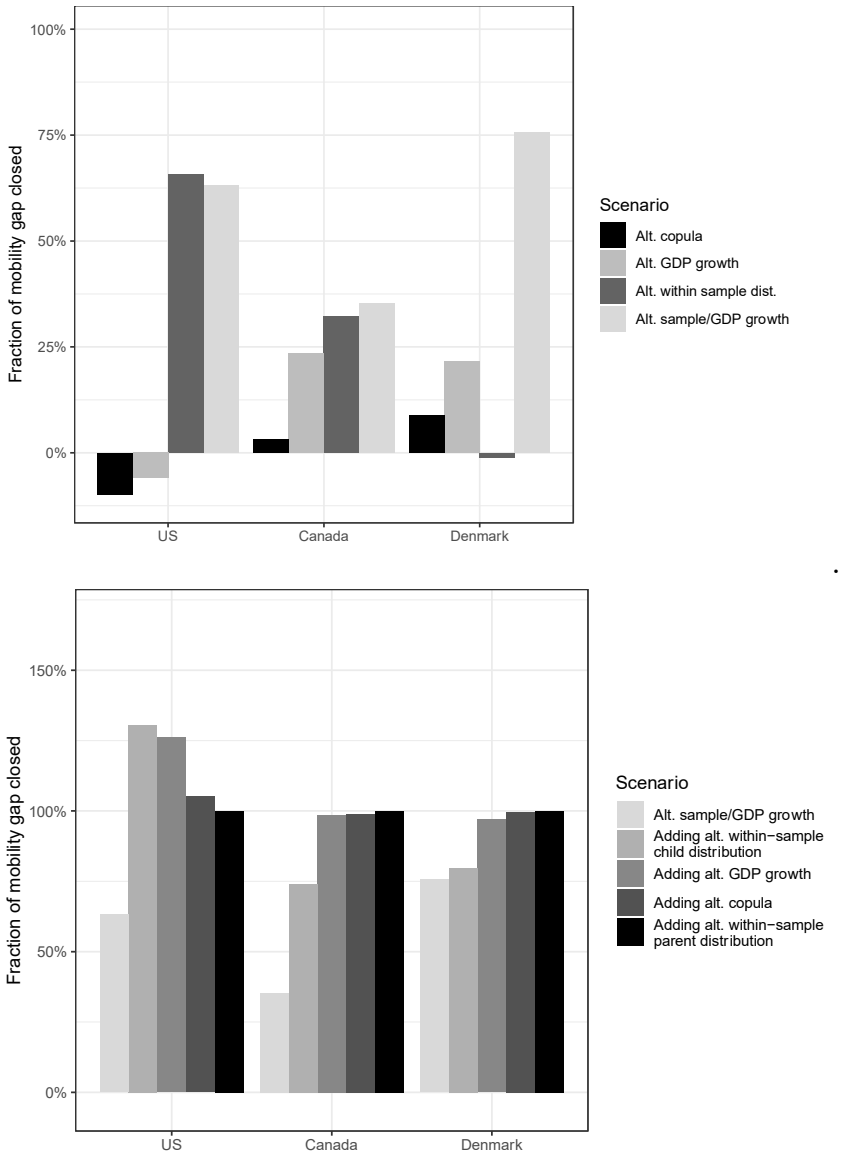

Figure A6.2. Individual (Top) and Cumulative (Bottom) Decomposition of Sources of Difference in Absolute Mobility Between Low-Mobility Countries and Finland

Notes: Results are for the baseline specification, estimated using the copula and marginals approach. Due to data constraints results for Denmark are for the 1982 birth cohort and those for Canada, Finland, and the US are for the 1983 birth cohort.

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