Trends in Absolute Income Mobility in North America and Europe

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Abstract: We compute rates of absolute upward income mobility for seven countries in Europe and North America for a range of birth cohorts from 1940 to 1985. Rates and trends in upward mobility varied dramatically across countries during this period. Some countries, such as Norway and Finland, saw sustained rates of upward mobility near 70% for cohorts born from the 1960s through the mid 1980s. Other countries, like the US and Canada, had mobility rates around 50% for recent cohorts. The UK and Denmark both started with high rates of upward mobility but have seen rates decline dramatically in recent years. Decomposition analyses suggest that high rates of relative mobility in Scandinavian countries did not contribute to their higher rates of absolute mobility. The primary driver was a more equal income distribution between cohorts, with the within-cohort distribution and overall rate of economic growth as secondary contributors.

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The hope that standards of living rise from one generation to the next is widely shared across the world. That children should grow up to have better lives than their parents is famously referred to as the “American Dream” in the United States. Yet the extent to which this goal is realized is not well known. Recent research has shown that in the United States, upward absolute income mobility – the likelihood of children growing up to have higher 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 cohort (Chetty et al. 2017). Have other countries experienced similar declines?

The United States is unusual among developed countries along a number of dimensions that impact absolute mobility, including its low levels of relative social mobility (Corak 2006), its high levels of inequality in market income (Piketty et al. 2017), and its comparatively underdeveloped welfare state (Esping-Andersen 2013). On these dimensions, some countries arguably are more distant from the U.S. than others, with Nordic countries seeing substantial differences on all three counts, while Canada and particularly the UK exhibit greater similarities. To what extent are these differences in relative mobility, income inequality and welfare state policies manifest in divergent absolute mobility trends?

In this paper we present trends in absolute income mobility for a selection of North American and European countries: Canada, the United States, the United Kingdom, Norway, Sweden, Denmark, and Finland. We show that both levels and trends in absolute mobility varied substantially across these countries in the late 20th century. The United States appears to have been unusual in both the magnitude of its mobility decline and (to a lesser extent) the low upward mobility rate that currently pertains. Other countries, most notably Norway and Finland, have had both higher and more stable rates of upward mobility in recent generations. Norway in particular maintained a steady upward mobility rate of roughly 75% from the 1964 to 1983 cohorts. We also validate the “copula and marginals” approach used in recent research on absolute income mobility (Chetty et al. 2017; Berman 2018), showing that this provides an accurate approximation of absolute mobility in three countries where both linked records and marginal distributions are available.
Decomposition analysis shows that the differences between high- and low-mobility countries stem largely from differences in economic growth rates and the level of income inequality, as opposed to differences in relative income mobility. While Scandinavian countries have had much higher rates of relative mobility than the US, these largely net themselves out: for every child that grows up to occupy a higher rung on the income ladder than her parents, another child finds himself further down. Trends in absolute mobility are driven much more by the marginal distributions than by the associations between children and parents (Berman 2018, Bukodi et al. 2019). The low rates of the upward mobility in the US, compared to some Scandinavian countries, appear to be due primarily to its unequal income distribution, both across and within cohorts. Low rates of mobility in Canada and Denmark (pre-tax only) are due primarily to slow economic growth in recent years and the unequal distribution of income across, but not within, cohorts.

**Prior Research**

Most previous research on intergenerational income mobility has focused on relative mobility – the correlation between the ranks of parents and children in their respective income distributions (see reviews in Jäntti and Jenkins 2015; Torche 2015). But there are important reasons to consider income mobility in absolute terms as well. Empirically, trends in absolute and relative mobility can diverge substantially: while relative mobility in the United States has been fairly stable for cohorts born after 1971, absolute mobility has declined considerably (Chetty et al. 2014; Chetty et al. 2017). Studying relative mobility alone thus presents an incomplete picture. Moreover, a large share of the population conceptualizes inequality in absolute terms (Ravallion 2018). In lab experiments, 40-60% of students think of inequality in absolute amounts (Amiel and Cowell 1999). Assuming that comparisons to parents operate similarly to other reference groups, this suggests that absolute mobility comes closer to how many people already think about their own trajectories.

Absolute mobility also has a much clearer normative interpretation than relative mobility. Relative mobility is zero-sum: any movement one person makes up the rank distribution must coincide with someone else’s movement down. This means that it may not always be the case that higher levels of relative mobility are better, particularly given that people feel losses more strongly than
equivalently sized gains (Kahneman and Tversky 1979). Absolute mobility, in contrast, is straightforward: the more people whose living standards go up, the better.

A large literature has assessed cross-country differences in relative income mobility (Smeeding, Erikson and Jäntti 2014; Corak 2004). There are clear differences in relative mobility rates across developed countries, with countries like the U.S., the U.K., and Italy having intergenerational earnings elasticities roughly three times as large as those in Denmark, Norway, and Sweden (Corak 2016). Particularly large differences have been found in the extent of downward relative mobility from the top (Corak et al. 2014; Jäntti et al. 2006). The Nordic countries are typically found to have higher rates of downward mobility from the top than the U.K., which in turn has higher rates than the U.S. (Jäntti et al. 2006). Canada appears to have higher rates of downward mobility than both the US and Sweden (Corak et al. 2014).

Cross-country differences in relative income mobility notwithstanding, recent research on absolute income mobility has emphasized the importance of the marginal income distributions in determining the overall mobility rate. Using data from the World Inequality Database and various rank-rank correlations, Berman (2018) argues that movement in the marginals alone is sufficient to estimate trends in absolute mobility. While promising, these results have not yet been compared to a full analysis using comprehensive intergenerational administrative and survey data. Chetty et al. (2017) similarly show that changes to the marginal distributions—specifically growing income inequality—were the primary driver of declining absolute mobility rates in the US. Chetty et al. also note that absolute mobility for recent cohorts in the US, where parental and children’s income distributions overlap substantially, could vary widely depending on the copula. But Berman shows that among copulas that have been empirically observed in developed countries in recent decades, none would have altered the US rates of absolute mobility by more than a few percentage points.

Research on absolute mobility in terms of social class or occupation supports the contention that changes to marginal distributions are the primary determinant of absolute mobility rates. These are referred to as “structural mobility,” as opposed to changes in relative mobility between classes (Torche 2015; Erikson and Goldthorpe 1992). The finding that marginal distributions are central for analyses of absolute class mobility has been extended to cross-country comparisons. Bukodi et
al. (2019) present recent evidence that “country differences in relative rates [of class mobility] play only a very limited part in accounting for country differences in absolute rates, confirming that the latter are primarily determined by class structural change."

This paper seeks both to directly estimate rates of absolute upward income mobility in a range of countries using administrative and survey data, and to determine whether any cross-country differences are driven more by marginal distributions or relative mobility rates.

Data and Methods

Because the type, time period, format, and quality of data differ substantially across countries, the data and methods that we use differ somewhat from country to country. Detailed descriptions of the exact data, methods, and specifications used in each country are provided in Appendix 1. The approaches that we use fall into two main categories. For countries that have register data available that directly links children to parents and tracks incomes over time – Canada, Norway, Sweden, Denmark, and Finland – we measure absolute mobility directly. We simply compute the household incomes of children and their parents at age 30, adjust for inflation using the country’s consumer price index, and calculate the fraction of children whose incomes exceed their parents’.

For the US and the UK, where linked register data is not available but historical income distributions are, we use the “copula and marginals” approach introduced by Chetty et al. (2017). This involves computing a copula, or parent-child income rank transition matrix, for a subset of the data where linked income information is available for parents and children. The marginal income distributions for parents and children in a given birth cohort are then plugged into this copula and overall absolute income mobility is computed. This approach does not determine the upward mobility of any individual child, but it does provide an accurate estimate of the upward mobility rate in total or by percentile, as we show below using data from countries where both linked data and the copula and marginals are available.

With both approaches, we compute a main 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 measure parent age using the father in Norway; the head of household (father if available, mother if not) in Sweden, Denmark, and Finland; and the parent earning higher income in Canada, the UK, and the US. We do not normalize by family size in the main specification, but do in robustness checks shown in Appendix 2. Because many countries do not have post-tax income for the full period under study, our primary specification uses pre-tax, post-transfer income. For the countries where disposable income is available we present trends in upward mobility rates in Appendix 2. Further robustness checks presented in Appendix 2 including measuring income at age 40 rather than age 30 and comparing the individual incomes of fathers and sons.

Figure 1 maps the countries that we include in our study, indicating the approach to calculating mobility we take in each case. To our knowledge, these are the only countries in which high quality data on both historical income distributions and relative income mobility exist for a substantial number of birth cohorts. Historical income data is available that would allow computation of mobility rates for Japan for the 1970 cohort, however there is not linked data that would create a copula, and the marginal income distributions for parents and children in that cohort are sufficiently overlapping that knowing the copula is necessary. It may also be possible to calculate income mobility in Germany using the SOEP survey, however the sample size is substantially smaller. Many other countries are currently creating datasets, through longitudinal surveys and/or linked administrative records, that will allow this sort of analysis in the future. These include Australia (see 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 2 presents trends in absolute income mobility by birth cohort for the countries included in the study. Because of data limitations, not all countries have estimates in all years. The US goes back to the 1940 birth cohort, while most European countries begin in the 1960s. Data for Canada only exists for the 1976-84 birth cohorts. For ease of comparison, we show results starting in 1960, the first year for which non-US data is available.
A few takeaways stand out in Figure 2. First, there is substantial variation across the seven 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%. The UK, Finland, and Sweden all have recent values above 65%, a rate unknown in the United States for cohorts born after the 1950s. Only Canada and for very recent cohorts Denmark have upward mobility rates comparable to those in the United States.

A second pattern in Figure 2 is the different mobility trends that countries have seen over the years. The United States is not alone in seeing mobility declines for recent cohorts: both the UK and Denmark have seen drops of 10% or more from their peak mobility rates, as shown in Figure 3. However the mobility declines in the UK and Denmark date roughly to the onset of the Great Recession (the 1977 cohort turned 30 and had their adult incomes measured in 2007) while the US decline began much earlier.
Figure 3. Changes in upward mobility rates since the 1967 birth cohort

In both figures the case of Denmark stands out in contrast to the rest of Scandinavia. Part of this appears to be due to the income definition used—if disposable income, after taxes and transfers, is used instead of pre-tax, post-transfer income, its trend is much higher and steadier (see Appendix 2.1). Because disposable income data is not available for all countries, we use pre-tax income for Figure 2 even though disposable income is a more accurate measure of living standards. The large difference between Danish trends before and after taxes, which does not hold for the other three countries where this comparison is possible, suggests that tax policy may have a particularly large impact on Danish living standards.

Beyond the inclusion of taxes and transfers, we conducted several robustness checks, which are shown in Appendix 2. These include using individual rather than family income, adjusting for changing family size, and measuring income at age 40 rather than age 30. Not all checks were possible to conduct in all countries, but in the countries where they are available they show relatively little departure from the trends in Figures 2-4.
Validation of copula and marginals approach

Recent research (Chetty et al. 2017; Berman 2018) has 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 is also the approach we take in our estimation of upward mobility rates for the US and the UK. While compelling, this logic has not yet been tested through a direct comparison of the “copula and marginals” approach and the linked parent child data approach. We conduct such a comparison here. For three of the countries in our sample, Sweden, Finland, and Norway, we were able to calculate the upward mobility rate directly from the linked data while also producing copulas and marginal distributions. Comparing estimates constructed from the copulas and marginal distributions to those calculated directly from linked records allows us to validate the copula and marginals approach.

Because of the smaller population of the Scandinavian countries, we could not always produce a full 100 by 100 copula for each birth cohort separately. For Norway, we produced one copula for the 1964-1968 cohorts and one for the 1979-1983 cohorts. For Sweden, we also produced two copulas, one for the 1968-1970 birth cohorts and one for the 1980-1982 cohorts (the latter matches the birth cohorts for which the US copula used in Chetty et al. 2017 was constructed). For Finland, we used the 1985 copula for the entire series. Note that this comparison of Sweden links children to their spouses at age 30 rather than age 35 as done in the main series shown in Figures 2 and 3.

Following the procedure described in Chetty et al. 2017, when using the copula and marginals approach we calculate the upward mobility rate for a given cohort by first comparing the average incomes in every combination 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. We then take the average of upward mobility across all combinations of parent and child cells weighting by the probability from the copula that children with parents in the parent cell grew up to have incomes in the child cell.
Figure 4 shows results comparing the copula and marginals and linked records approaches for Norway, Sweden, and Finland. For Norway and Sweden, our preferred approach uses the copula that is closest to each birth cohort. However we also present results using each of the copulas for the entire sample. For Finland, we use the 1985 copula for the entire period.

Figure 4. Copula and marginals estimates compared to linked records estimates of upward mobility in Norway (A), Sweden (B), and Finland (C).

The results largely confirm that the copula and marginals approach is an effective approximation of the true, linked record approach to estimating absolute income mobility. Across all cohorts in all three countries, the copula and marginals estimates are always within 1.5 percentage points of the true value, even though upward mobility rates varied by approximately 10 percentage points in Sweden, 6 percentage points in Norway, and 4 percentage points in Finland during this period. By far the largest deviations were in Finland for the cohorts most distant from the measured copula. In Norway and Sweden, where we have copulas covering both the early and late cohorts, the copula and marginals estimates were always within 0.7 percentage points. These results suggest that the choice of copula may be one of the largest sources of sensitivity in these estimates. But even with the largest distances between copula and birth cohort, the estimates are never more than 1.5 percentage points off in any of the countries. This is well within the range of
empirical copulas documented by Berman (2018), and quite small in comparison to the overall temporal variation in upward mobility for our sample.

Another source of imprecision is that when computing the upward mobility of each percentile cell we simply compare the mean incomes for parents and children, and assign all children in that cell to be upwardly or downwardly mobile based on those mean values when there may actually be a split in some cases. It should be possible to evaluate the likelihood of this split by comparing the incomes in adjacent cells.

Despite some imprecision, we believe that on the whole the comparison of results from the two approaches provides strong validation that the copula and marginals approach is an effective way to estimate absolute mobility levels when linked panel data is unavailable. However, one caveat is that the data used for these comparisons were all drawn from the same source, whereas our analyses of the US and the UK combine different sources for the marginal distribution of parents, the copula, and the marginal distribution of children.

**What drives the differences in upward mobility?**

Why have countries like Norway and Finland maintained high levels of absolute mobility, while countries as diverse as Denmark, 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. 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 quantities: 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 in each of the parent and child generations (that is, the level of inequality among 30-year-old children and parents, which we operationalize as the ratio of income at each percentile to mean income). To determine the source of the differences in mobility rates between high and low mobility countries, we run simulations substituting each of these quantities in the low-mobility
countries with the equivalent quantity in Norway. We further divide ratio of mean child to mean parent income into two quantities: the overall growth rate of real GDP per capita, and the ratio of mean in-sample income to GDP per capita. We use GDP per capita values in constant local currency units sourced from the World Bank national accounts data (World Bank 2019). In Appendix 3, we show that the cumulative substitution of all five quantities exactly accounts for the difference between mobility rates in any two countries. In Appendix 4 we present both individual and cumulative substitutions for Finland and Sweden, with broadly similar results.

We first consider differences in the copula, which captures variation in the rate of relative mobility. It is well known that rates of relative income mobility are much higher in Scandinavia than in the United States (Corak 2006; Corak, Lindquist, and Mazumder 2014; Jantti et al. 2006). This is clearly shown in Figure 5, which compares copulas for cohorts born in the early 1980s in the United States and Sweden. Cells colored blue are those with higher density in the US, while cells colored red have a higher density in Sweden. The cells on the diagonal, particularly those in the top and bottom corners, are the areas more represented among US children, indicating that US children are more likely to have income ranks comparable to those of their parents. In the extreme top right corner, a full 9.7% of US children born to parents in the top 1% of the income distribution remained in the top 1% as adults, compared to just 3.8% of Swedish children with parents in the top 1%. Cells in the bottom right and top left of the matrix, representing children who grow up to be much better or worse off than their parents, are more heavily filled in Sweden. In total, US children were almost 30% more likely than their Swedish counterparts to end up within 10 percentiles of their parents’ rank. Results for Norway and Finland are similar: US children were about 25% more likely than children in Norway and 20% more likely than children in Finland to end up within 10 percentiles of their parents. However, both Canada and Denmark had rates of relative mobility comparable to Norway, Sweden, and Finland, which did not prevent them from having upward mobility rates comparable to the United States (Canadian children were only 8% more likely than Norwegian children to be within 10 percentiles of their parents, and Danish children only 6%).
To determine whether rates of relative mobility are an important driver of differences in absolute mobility across countries, we run a set of simulations replacing the US, Canadian, and Danish copulas with that from Norway. As shown in the first, red, columns of Figure 6, 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 very comparable to that of Norway, but even in the United States there is no difference—in fact, the more egalitarian Norwegian copula actually lowers the mobility rate slightly.

**Figure 5.** Difference in relative mobility, US and Sweden, 1980-82 birth cohorts
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 6 explore three components of the child marginal distribution. The second, blue, column for each country considers a scenario where each country experienced the Norwegian GDP growth rate from 1983-2013. Real GDP per capita in Norway grew by 1.86% a year during this period, compared to GDP growth of 1.79% annually in the US, 1.50% in Canada, and 1.49% in Denmark. This scenario is implemented by multiplying the income at each 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 in the United States, but would close about a third of the gap for Denmark and about a quarter of the gap for Canada.

**Figure 6.** Counterfactual simulations comparing low mobility countries to Norway.

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**Scenario**

- Alt. copula
- Alt. GDP growth
- Alt. within sample dist.
- Alt. sample/GDP ratio

<table>
<thead>
<tr>
<th>Country</th>
<th>US</th>
<th>Canada</th>
<th>Denmark</th>
</tr>
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<tbody>
<tr>
<td>Fraction of gap closed</td>
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The third, green, 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 mean child income in the country of interest. This “within-cohort inequality” scenario is constructed by taking the ratio of income at each percentile to overall mean income in the child cohort in Norway and multiplying that by the overall mean income among children 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 roughly 40% of the mobility gap with Norway, while in Denmark it closes just 1% of the gap.

The final, purple, column considers a “between-cohort inequality” scenario, where the ratio of mean child income to GDP from Norway is applied to each of the low-mobility countries. We interpret this primarily as a measure of inequality between different age groups, capturing whether or not 30-year-olds as a whole are taking home a smaller share of GDP. It also could capture data completeness problems, for instance if the total income captured by the sample is less than the full GDP. This is known to be an issue in the US Current Population Survey, which tends to underreport top-end incomes (Bollinger et al. 2014). Additionally, in the case of Denmark, as noted above, some of the difference may be due to differences in tax policy or tax accounting. As shown in Appendix Figure A2.1 the upward mobility rate calculated with disposable income for Denmark has remained steady at roughly 70%, a rate comparable to the other Scandinavian countries (using disposable income for the US and Canada does not appreciably alter their absolute mobility rates).

For all three countries, the cross-cohort inequality scenario closes more than half of the gap with Norway, and in Denmark it closes about 75% of the gap. Thus the biggest source of difference has to do with increasing inequality across cohorts: today’s 30-year-olds as a whole take home a smaller share of national income in low-mobility countries than in high-mobility ones (alternately, it may be that the data is less complete in our low-mobility countries). For the US, 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 Scandinavia. For Denmark, low GDP growth accounts for the remainder. For Canada it is some of each.
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, in both current levels and trends over time. The US pattern of sharply declining upward mobility in recent decades is by no means a universal trend. Some countries, most notably Norway and Finland, have had high and steady rates of upward mobility for cohorts born as far back as the mid-1960s. Other countries, most notably Denmark and the UK, maintained high mobility rates much longer than the US, but have seen declining mobility for cohorts that experienced the brunt of the Great Recession.

For all of the countries except the US and the UK, we calculated mobility rates by directly comparing linked parent and child data. Our estimates thus represent a ground truth against which other methods of inferring absolute mobility can be evaluated. For three of the countries in our sample, Norway, Sweden, and Finland, we have shown that mobility rates calculated with the “copula and marginals” approach introduced by Chetty et al. (2017) very closely track those calculated directly from linked records, suggesting that the copula and marginals approach is in fact an accurate approximation of absolute income mobility.

Another recent attempt to calculate rates of absolute mobility without linked data comes from Berman (2018), who relaxes several of the assumptions in Chetty et al. (2017) to estimate upward mobility rates for a range of countries using marginal distributions for the entire population alone. For the years and countries in which our estimates overlap, the levels match Berman’s well in the US, Canada, Finland, Norway, and Sweden, but less well in the UK and Denmark. But where we find stable mobility rates in several of the countries, Berman reports declining upward mobility across all countries over the course of the late 20th Century, although much of the decline he reports occurs before our sample period begins. The discrepancy for the UK appears to be due to our use of the income distribution for 30-year-olds only where Berman uses the income distribution for adults of all ages (see Appendix 1). Other possible sources of the discrepancy could be due to differing definitions of families, or to differences in the data sources.
What drives the differences in absolute mobility across countries? Through decomposition analyses, we have shown that the higher relative mobility of Scandinavian countries contributes very little to their high absolute mobility rates. Compared to the United States, their success in upward 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 lifetime of our most recent cohorts. But Norway, Sweden, and Finland were much more efficient in translating that growth in 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 societies fail to live up to that promise, they are often beset with frustration and instability (Friedman 2005). In this paper we have shown that developed nations vary dramatically in the extent to which they live up to that promise, and 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 their citizens. Encouragingly, there exist several examples of countries that have managed exactly that.
References


Corak, Miles. 2016. Inequality from Generation to Generation: The United States in Comparison.


https://data.worldbank.org/indicator/NY.GDP.PCAP.KN
Appendix 1. Details on methods for each country
To be compiled.

Appendix 2. Robustness checks
We conduct a range of checks on the robustness of our results. These include using post-tax rather than pre-tax income, measuring income at age 40 rather than age 30, comparing individual incomes of fathers and sons, and normalizing income by the number of adults in the family. We present these results here. Data limitations prevent us from running all specifications in all countries.

2.1 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, the US, the UK, Denmark, and Sweden 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 A2.1. Mobility measured using disposable income is similar to that with gross income in Sweden, the US, and Canada, 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.
2.2 Age of income measurement. A common concern in studies of income mobility is that results might be sensitive to the age at which income is measured. If incomes are measured before the age at which people have reached their full earnings potential, results might be misleading. In the case of absolute income mobility, this might be especially concerning if age-earnings profiles have changed over time, for instance if people in later cohorts are spending longer in school and thus not reaching peak earning potential until their 30s or later.

To determine whether this is affecting our results, we also constructed absolute mobility series measuring income at age 40 for Canada, Finland, Norway, Sweden, the UK, and the US. Results are presented in Figure A2.2. For the most part, results at age 40 are similar to those using income measured at age 30, though levels are perhaps slightly higher (note that the cohorts covered are 10 years older than for age 30). This suggests that the effect of lifecycle bias on our results is fairly small.
However, some patterns—that the dip in Swedish mobility rates that was present among cohorts born in the early 1960s when incomes were measured at age 30 is present for cohorts born in the 1950s when incomes are measured at age 40, and that the UK likewise shows a sharp decline for the most recent cohorts even when measured at 40—suggest that period effects may be strongly influencing our mobility estimates. These dips correspond to the early 1990s recession in Sweden and the Great Recession in the UK respectively. If this is true then future work may want to average incomes over a longer period of years, not because of lifecycle bias but because estimates at one point in time may be overly sensitive to fluctuations in the state of the economy.

### Estimates of upward mobility by cohort and country, gross income at age 40

![Graph showing estimates of upward mobility by cohort and country, gross income at age 40](image)

**Country**
- Canada
- Finland
- Norway
- Sweden
- UK
- US

**2.3 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 the US, the UK, Canada, Norway, Sweden, and Denmark.

Results are presented in Figure A2.3. 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.
2.4 Adjusting for number of adults. As another robustness check related to changes in family structure, 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. In the US, the UK, and Canada, results normalizing by number of adults show similar trends to our main specification but much higher upward mobility rates, particularly in Canada where the normalized mobility rate is roughly 70% compared to 56% in the raw mobility rate. In the US for the most recent cohorts the normalized rates are 5-10 percentage points higher than the raw rates. The drop in mobility after the Great Recession is also more visible in the US in this specification. [Other countries coming this fall].

![Graph showing estimates of upward mobility by cohort and country, family income normalized by number of adults](image-url)
Appendix 3. Cumulative Decomposition of 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 that.

Figure 6 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 A3.1 presents the cumulative decomposition exercise comparing the three low-mobility countries to Norway. Like Figure 6 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.
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 Appendix 2).

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.

**Figure A3.1.** Cumulative decomposition of sources of difference in absolute mobility between low-mobility countries and Norway.
Appendix 4. Mobility Decompositions Compared to Sweden and Finland

In the main text and Appendix 3 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.

Figures A4.1 and A4.2 show the individual and cumulative 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 in turn means that the role of GDP growth in accounting for the differences is smaller than for Norway, while the role of within-cohort inequality in the US and Canada and cross-cohort inequality for all three countries is more important.
Figure A4.1. Individual decomposition exercise comparing with Sweden
Figure A4.2. Cumulative decomposition exercise compared to Sweden

Figures A4.3 and A4.4 repeat the decomposition exercise with Finland as the comparison case. The results are similar to those using Sweden as the comparator.
Figure A4.3. Individual decomposition exercise comparing with Finland
Figure A4.4. Cumulative decomposition exercise compared to Finland