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The fading American dream: Trends in absolute income mobility since 1940

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We estimated rates of "absolute income mobility"—the fraction of children who earn more than their parents—by combining data from U.S. Census and Current Population Survey cross sections with panel data from de-identified tax records. We found that rates of absolute mobility have fallen from approximately 90% for children born in 1940 to 50% for children born in the 1980s. Increasing GDP growth rates alone cannot restore absolute mobility to the rates experienced by children born in the 1940s. However, distributing current GDP growth more equally across income groups as in the 1940 birth cohort would reverse more than 70% of the decline in mobility. These results imply that reviving the "American dream" of high rates of absolute mobility would require economic growth that is shared more broadly across the income distribution.

One of the defining features of the "American dream" is the aspiration that children have a higher standard of living than their parents (*1*). When children are asked to assess their economic progress, they frequently compare their own standard of living to that of their parents (*2*, *3*). Such measures of "absolute income mobility"—the fraction of children earning or consuming more than their parents—are also often the focus of policy-makers when judging the degree of economic opportunity in the United States (*4*).

Despite longstanding interest in the topic, empirical evidence concerning absolute income mobility remains scarce, mainly because of the lack of large, high-quality panel data sets linking children to their parents in the United States (*5*). Some studies have used panel surveys such as the Panel Study of Income Dynamics to measure the level of absolute income mobility for recent U.S. cohorts (*6*–*9*). These studies have produced conflicting results because estimates of absolute mobility using available panel income data sets are sensitive to econometric assumptions and sample specification (*5*). Moreover, to the best of our knowledge, there is no evidence on trends in absolute income mobility, although prior work has documented declining absolute mobility in terms of occupational status (*10*) and educational attainment (*11*).

Here, we developed a new method of estimating rates of absolute mobility that can be implemented with existing data sets covering the 1940 to 1984 birth cohorts. Our approach combines two inputs: (i) marginal income distributions for parents and children, and (ii) the copula of the parent and child income distribution, defined as the joint distribution of parent and child income ranks.

We used cross-sectional data from the decennial U.S. Census and Current Population Surveys (CPS) to estimate marginal income distributions for children in the 1940 to 1984 birth cohorts and their parents. The census data sets cover between 1% and 5% of the U.S. population, yielding samples of 20,000 to 35,000 families per cohort, whereas the CPS samples include approximately 1500 to 3000 people per cohort. In our baseline analysis, we measured income in pretax dollars at the household level when parents and children were about 30 years old, which we refer to as the amount of income "earned" by parents and children for convenience. We adjusted for inflation using the Consumer Price Index Research Series (CPI-U-RS). Finally, we ensured that our results are robust to a variety of alternative specification choices, such as using different inflation adjustments, adjusting for taxes and transfers, measuring income at later ages, and measuring income at the individual rather than family level.

We estimated the fraction of children who earn more than their parents in each birth cohort by combining the marginal income distributions with the copula in each cohort. For children born in or after 1980, we followed Chetty *et al.* (*12*) and directly estimated the joint distribution of parent and child ranks, using information from de-identified federal income tax returns covering more than 10 million parent-child pairs. For cohorts born before 1980, such population-level panel data are not available. We addressed this missing data problem in two ways. First, we

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determined estimates of absolute mobility under the assumption that the copula remained stable across all birth cohorts, a benchmark motivated by evidence of copula stability (i.e., stable relative mobility) since the 1970s (*13–15*). Because we have no evidence that the copula was in fact stable prior to 1970, we additionally constructed upper and lower bounds on absolute mobility for each birth cohort by using linear programming methods to search over all plausible copulas (*16*). Our key technical result is that these bounds are very tight for the 1940 to 1950 birth cohorts, allowing us to obtain a reliable time series on rates of absolute mobility despite the lack of historical panel data.

Using this methodology, we found that rates of absolute upward income mobility in the United States have fallen sharply since 1940. Under the benchmark of copula stability, the fraction of children earning more than their parents fell from 92% in the 1940 birth cohort to 50% in the 1984 birth cohort. Relaxing the copula stability assumption for earlier cohorts, we found that the rate of absolute mobility for the 1940 birth cohort is bounded between 84% and 98% across all plausible copulas, well above the rates observed for recent cohorts. Thus, the key piece of missing data that has hampered direct measurement of absolute mobility—the lack of historical panel data linking parents and children—turns out to be inessential for characterizing trends in mobility.

Why have rates of upward income mobility fallen so sharply over the past half century? There have been two important macroeconomic trends that have affected the incomes of children born in the 1980s relative to those born in the 1940s: lower Gross Domestic Product (GDP) growth rates and greater inequality in the distribution of growth (*17*). We considered two counterfactual scenarios to assess the relative contribution of these two factors.

First, we considered a "higher GDP growth" scenario, in which children in the 1980 cohort experience GDP growth from birth to age 30 that is comparable to what was experienced by the 1940 cohort, but GDP is distributed in proportion to GDP shares by income percentile in 2010. In this scenario, absolute mobility rises to 62%. Second, we considered a "more broadly shared growth" scenario, in which the actual GDP in 2010 is allocated across income percentiles as it was in the 1940 cohort. In this scenario, the rate of absolute mobility rises to 80%. Together, these simulations show that increasing GDP growth without changing the current distribution of growth would have modest effects on rates of absolute mobility. Under the current distribution of GDP, we would need real GDP growth rates above 6% per year to return to the rates of absolute mobility seen in the 1940s. Intuitively, because a large fraction of GDP goes to a small number of high income earners today, higher GDP growth does not substantially increase the number of children who earn more than their parents. Hence, reviving the "American dream" of high rates of absolute mobility would require more broadly shared economic growth rather than just higher GDP growth rates.

Methods and data

Let y_{ic}^{k} denote the income of child i in birth cohort c, and let y_{ic}^{p} denote the income of his or her parents. In our baseline analysis, we measure income as pretax family income (summing income across spouses) at age 30. We measure incomes in 2014 dollars, adjusting for inflation using the CPI-U-RS. In sensitivity analyses (discussed below), we consider several variants of this income concept: using alternative price deflators, measuring income at age 40, measuring income after taxes and transfers, and adjusting for family size.

We define the rate of absolute mobility in cohort c, A_c, as the fraction of children in cohort c that earn weakly more than their parents:

$$A_c = \frac{1}{N_c}\sum_i 1\left\{y_{ic}^{k} \geq y_{ic}^{p}\right\} \tag{1}$$

where N_c is the number of children in the cohort.

We estimate A_c by decomposing the joint distribution of parent and child income into the marginal distributions of parent and child income and the joint distribution of the ranks (the copula). Let r_{ic}^{k} denote the percentile rank of child i in the income distribution for children in birth cohort c. Similarly, let r_{ic}^{p} denote the percentile rank of child i's parent in the income distribution of parents who have children in cohort c. The joint distribution of parent and child ranks for cohort c is given by $C_c(r^k, r^p)$, the probability density function of observing a child with income rank r^k and parent income rank r^p. Let $Q_c^k(r)$ and $Q_c^p(r)$ denote the rth quantile of the child and parent income distributions (measured in dollars), respectively. $Q_c^k(r)$ and $Q_c^p(r)$ summarize the marginal distributions of parent and child incomes. With this notation, we can write absolute mobility as

$$A_c = \int 1\left\{Q_c^k\left(r^k\right) \geq Q_c^p\left(r^p\right)\right\} C_c\left(r^k, r^p\right) dr^k dr^p \tag{2}$$

Intuitively, a child with rank r^k earns weakly more than her parent with rank r^p if the r^kth quantile of the child's income distribution is weakly higher than the r^pth quantile of the parent's income distribution; that is, $Q_c^k\left(r^k\right) \geq Q_c^p\left(r^p\right)$. The copula, $C_c(r^k, r^p)$, measures the probability that each pair of ranks (r^k, r^p) occurs. Absolute mobility is the fraction of cas-

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es where $Q_c^k\left(r^k\right) \geq Q_c^p\left(r^p\right)$, integrating over the copula.

Equation 2 shows that absolute mobility can be calculated by estimating (i) the marginal income distribution for children (which yields Q_c^k), (ii) the marginal income distributions for parents (which yields Q_c^p), and (iii) the copula, $C_c(r^k, r^p)$. We next describe how we estimate these three distributions; see the supplementary materials for details.

Children's marginal income distributions

We obtained marginal income distributions at age 30 for children in the 1940 to 1984 birth cohorts directly from the CPS March 1970 to March 2014 samples. The sample of children includes U.S.-born members of the 1940 to 1984 birth cohorts who, at age 30, were present in the U.S. and not institutionalized. We exclude immigrants in order to have a consistent sample in which we observe both parents' and children's incomes (*18*, *19*). We compute family income as the sum of spouses' personal pretax income.

Parents' marginal income distributions

Estimating the income distributions of parents at age 30 who have children in a given birth cohort is more complicated because of the lack of historical panel data. We construct parents' income distributions for children in each of the 1940 to 1984 birth cohorts by pooling data from census cross sections between 1940 and 2000, using the 1% IPUMS samples (*20*). We restrict our attention to individuals who have children between the ages of 16 and 45. To cover all parents via decennial censuses, we estimate parents' incomes when the highest earner is between the ages of 25 and 35, a symmetric window around age 30.

For example, we estimate the income distribution of parents of children in the 1970 birth cohort as follows. First, we use the 1970 census and select parents between the ages of 25 and 35 who have a child less than 1 year old in 1970. Next, we turn to the 1980 census and select parents between the ages of 26 and 35 who have 10-year-old children (i.e., individuals who had a child in 1970 when they were between the ages of 16 and 25). Third, to identify parents between ages 35 and 45 who had children less than 1 year old in 1970, we turn to the 1960 census and select all individuals aged 25 to 35. We give this group a weight equal to the fraction of individuals in the 1970 census between the ages of 35 and 45 who had a child less than 1 year old in 1970. This approach assumes that the income distribution of those who have children after age 35 is representative of the income distribution of the general population. Such an assumption is unavoidable, as one cannot identify parents who will have children in the future in cross-sectional data. Fortunately, this assumption turns out to be inconsequential in practice because most children are born before their parents are 35. In the supplementary materials, we show that restricting attention to parents who have children between the ages of 25 and 35, thereby avoiding this assumption entirely, yields very similar results.

We estimate income distributions for parents with children in each of the other birth cohorts from 1940 to 1984 using an analogous approach. Summary statistics on parents' and children's incomes by birth cohort are reported in table S1.

Copula

For children born in the 1980s, we estimate a nonparametric copula—a 100 × 100 matrix giving the probability of each child and parent rank pair (r^k, r^p)—exactly as in Chetty *et al.* (*12*). The sample includes all children born in 1980, 1981, and 1982 who are linked to parents according to dependent claiming on tax forms.

For both parents and children, we define family income in the tax records in a manner that is as similar as possible to the measures in the CPS and census. For those who file tax returns, we define income as adjusted gross income (AGI) plus the nontaxable portion of two types of income distributed by the U.S. Social Security Administration: Supplemental Security Income and Social Security Disability Income. For nonfilers, we measure income using third-party information returns, defining income as the sum of the W-2 wage earnings, Supplemental Security Income, Social Security Disability Income, and unemployment insurance income. If individuals do not file a tax return and have no information returns filed on their behalf, taxable income is coded as zero.

Following (*12*), we measure children's incomes as mean income in 2011 and 2012, when children in the 1980 to 1982 birth cohorts are between the ages of 30 and 32. We measure parents' incomes as mean taxable income between 1996 and 2000, the first 5 years in which population tax records are available. Parents are between the ages of 30 and 60 when we measure their incomes because we limit the sample to parents who have children between the ages of 15 and 40 during 1980–1982. Chetty *et al.* (*12*) showed that the distribution of income ranks is stable between the ages of 30 and 60. Because of this rank stability, this approach provides an accurate estimate of the copula that one would obtain if one could observe income ranks at age 30 for all parents.

We exclude parents with zero or negative income when constructing the copula because parents with no earnings typically do not file a tax return and hence cannot be linked to their children on the basis of dependent claiming. This does not pose a problem for measuring absolute mobility because children whose parents have zero income always earn at least as much as their parents. We calculate the frac-

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tion of parents with zero income in each cohort based on census data and include these individuals when computing average rates of absolute mobility, assigning the group of children whose parents have zero income an absolute mobility rate of 100%.

We define children's percentile ranks r_{ic}^{k} based on their incomes relative to other children in their birth cohort. We include children with zero income when constructing these ranks by defining their ranks as the fraction of children with zero income divided by 2; for instance, if 10% of children have zero income, all children with zero income would be assigned a percentile rank of 5. Likewise, parents are assigned percentile ranks based on their incomes relative to other parents (among those with positive income). The copula is then estimated as a 100 × 100 matrix that gives the joint probability of each child and parent rank pair (r^k, r^p).

For children born before 1980, we lack the panel data necessary to estimate the copula. Chetty *et al.* (*15*) used a 0.1% IRS Statistics of Income panel to show that the copula (relative mobility, measured by percentile ranks) is approximately stable from the 1971 birth cohort to the 1984 birth cohort. Motivated by this result, we begin by assuming copula stability across all cohorts since 1940, applying the copula estimated for the 1980 to 1982 cohorts to all cohorts. We then compute bounds on absolute mobility searching over alternative copulas, as there is no empirical evidence that copula stability holds going back to 1940.

The statistics we construct on absolute mobility by birth cohort, parent percentile, state, and gender can be downloaded from www.equality-of-opportunity.org.

Baseline estimates

Our baseline estimates of absolute mobility assume copula stability from 1940 to 1984 and measure family income in real pretax dollars at age 30. Figure 1A plots rates of absolute mobility by parent income percentile for the decadal birth cohorts, 1940 to 1980. Each series shows the percentage of children earning more than their parents versus their parents' income percentile, limiting the sample to parents with positive income.

In the 1940 birth cohort, nearly all children grew up to earn more than their parents, regardless of their parents' income. Naturally, rates of absolute mobility were lower at the highest parent income levels, as children have less scope to do better than their parents if their parents had very high incomes.

Rates of absolute mobility have fallen substantially since 1940, especially for families in the middle and upper class. At the 10th percentile of the parent income distribution, children born in 1940 had a 94% chance of earning more than their parents, compared with 70% for children born in 1980. At the 50th percentile, rates of absolute mobility fell from 93% for children born in 1940 to 45% for those born in 1980. And at the 90th percentile, rates of absolute mobility fell from 88% to 33% over the same period.

Figure 1B aggregates the rates of absolute mobility across parent incomes (including those with zero income) and plots average absolute mobility (A_c) for each birth cohort from 1940 to 1984. Absolute mobility declined starkly across birth cohorts: On average, 92% of children born in 1940 grew up to earn more than their parents. In contrast, only 50% of children born in 1984 grew up to earn more than their parents. The downward trend in absolute mobility was especially sharp between the 1940 and 1964 cohorts. The decline paused for children born in the late 1960s and early 1970s, whose incomes at age 30 were measured in the midst of the economic boom of the late 1990s. Absolute mobility then continued to fall steadily in the remaining birth cohorts.

Bounds under alternative copulas

We now assess the sensitivity of the estimates reported in Fig. 1 to the assumption that the copula remained stable at the values observed for the 1980 birth cohort going back to 1940. We do so by deriving bounds on the rate of absolute mobility in each birth cohort, searching over all copulas $C_c(r^k, r^p)$, defined nonparametrically by a 100 × 100 percentile-level matrix.

We restrict our attention to copulas satisfying the intuitive requirement that children from higher-income families are less likely to have lower incomes (relative to children from lower-income families). Formally, we assume that the income distribution of children with higher-income parents first-order stochastically dominates (FOSD) the income distribution of children from lower-income families:

$$\int_0^{r^k} C_c\left(r, r^p\right) dr \text{ is weakly decreasing in } r^p \text{ for all } r^k \tag{3}$$

For each birth cohort, we calculate bounds on absolute mobility by solving for the copulas $C_c(r^k, r^p)$ that minimize and maximize A_c, as defined in Eq. 2, given the empirically observed marginal distributions, $Q_c^k\left(r^k\right)$ and $Q_c^p\left(r^p\right)$. We impose two sets of constraints on this problem: (i) the FOSD requirements for each (r^k, r^p) pair in Eq. 3, and (ii) integration constraints requiring that each of the columns and rows of $C_c(r^k, r^p)$ sum to 1. This optimization problem has 100 × 100 = 10,000 arguments, which might appear to be computationally intractable. Fortunately, because the objective function in Eq. 2 and all the constraints are linear, this problem can be solved rapidly with a standard linear programming algorithm.

The results of this bounding exercise are presented in

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Fig. 2A. The series in circles reproduces the baseline estimates under the assumption of copula stability shown in Fig. 1B. The dashed lines show the upper and lower bounds on absolute mobility. The bounds are very tight in early cohorts but grow much wider for more recent cohorts. For example, for the 1940 birth cohort, the bounds on absolute mobility span only 84% to 98%. In contrast, for the 1984 birth cohort, the bounds span 14% to 88%.

The dashed vertical line in Fig. 2A demarcates the point after which the copula is known to be stable, based on the analysis of tax records in (*15*). Quite conveniently, the panel data necessary to estimate the copula happen to be available for precisely the cohorts where the bounds are least informative. For earlier cohorts, where the necessary data to estimate the copula are missing, the bounds are quite narrow and the copula therefore proves to be unimportant. The upshot of Fig. 2A is that even though we cannot identify the copula in early cohorts, we can be certain that absolute mobility has declined sharply since the 1940s.

We now consider why the bounds are tight in the 1940 and 1950 cohorts but grow wider in more recent cohorts. Figure 2B plots the marginal distribution of income for children in the 1940 birth cohort and their parents. Income grew very rapidly across all quantiles of the income distribution between 1940 and 1970. As a result, there is very little overlap between the income distributions of children born in 1940 and their parents. For example, a child born to parents at the 80th percentile of the parent income distribution needed to reach just the 14th percentile of the child income distribution to exceed his or her parents' income. In the extreme case in which the distribution of child income lies everywhere above the distribution of parent income (i.e., the poorest child earns more than the richest parent), absolute mobility would be 100%, irrespective of which children are linked to which parents. Although the 1940 parent and child income distributions are not fully separated, we show below that they are sufficiently close to this scenario to render the copula unimportant for calculating absolute mobility.

In contrast, recent cohorts experienced much less growth across most quantiles of the income distribution (*17*, *21*). Figure 2C illustrates this point by replicating Fig. 2B for the 1980 birth cohort. Because growth rates were much lower between 1980 and 2010, there is substantial overlap between parents' and children's income distributions (at age 30) for children born in 1980. Children with parents at the 80th percentile of the income distribution now need to reach the 74th percentile of their cohort's income distribution to earn more than their parents.

Figure 2D shows why the greater degree of overlap between children's and parents' income distributions in recent cohorts leads to wider bounds on absolute mobility. The curves in this figure plot the income rank a child must reach to earn more than his or her parents as a function of the parents' income percentile, separately for the 1940 and 1980 birth cohorts. For example, to earn more than parents at the 80th percentile, children need to reach the 14th percentile in the 1940 cohort and the 74th percentile in the 1980 cohort, as shown in Fig. 2, B and C.

The copula can be visualized in Fig. 2D as the distribution of mass within the (r^k, r^p) square. Absolute mobility A_c can be calculated by summing the mass in the copula that lies above the relevant curve. The empirically observed copula for the 1980 to 1982 cohorts used in our baseline analysis is shown by the shading in the figure, with darker colors representing areas with higher density. The mass is clustered around the diagonal, reflecting positive intergenerational persistence of income. Absolute mobility is 50% for the 1980 cohort because half of the mass of this copula lies above the curve plotted for the 1980 cohort.

Our bounding procedure minimizes and maximizes the amount of mass in the copula that falls above the curves in Fig. 2D, subject to the FOSD and integration constraints specified above. Because the child rank required to surpass parents is very close to the 45° line for the 1980 cohort, rates of absolute mobility are very sensitive to whether the mass in the copula lies just above or just below the diagonal. This shows why we obtain wide bounds when searching over all copulas for the 1980 cohort. In contrast, because the child rank required to earn more than parents is very low at nearly all percentiles of the parent income distribution for the 1940 cohort, all feasible copulas generate high levels of absolute mobility for that cohort.

Sensitivity and heterogeneity analysis

In this section, we first assess the sensitivity of our baseline estimates to key specification choices, such as the price deflator and definition of income. We then examine heterogeneity in trends in absolute mobility across subgroups.

Sensitivity analysis

We begin by considering alternative price deflators. Several studies have noted that the CPI-U-RS may overstate inflation by failing to account adequately for improvements in product quality and the introduction of new goods (*22*, *23*). Prior work on the measurement of trends in poverty recommends subtracting 0.8 percentage points from the annual inflation rate implied by the CPI-U-RS to account for such biases (*24*, *25*). The series in squares in Fig. 3A replicates the baseline series on absolute mobility by cohort in Fig. 1B using this adjusted price index. As expected, this adjustment increases absolute mobility in recent cohorts, as it increases real income growth rates across the distribution. However, the magnitude of the change is small: With the

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adjusted series, absolute mobility falls from 93% in 1940 to 59% in the 1984 cohort. Even subtracting 2 percentage points from the inflation rate implied by the CPI-U-RS—a conservative adjustment larger than virtually all existing estimates of the bias due to new goods—still results in a 26–percentage point decline in absolute mobility from 1940 to 1984 (fig. S2A).

We also consider a variety of other commonly used price indices: (i) the personal consumption expenditure price index (PCEPI), an index that includes a broader bundle of goods than the CPI; (ii) the producer price index (PPI), an index constructed from prices at the producer level; (iii) the GDP deflator, an index that covers all goods used domestically; and (iv) the CPI-U series that is most commonly used to measure inflation (*26*). All of these alternative indices produce time series of absolute mobility very similar to our baseline estimates (Fig. 3A and fig. S2A).

Our baseline analysis uses pretax measures of earnings rather than net income after taxes and transfers. Conceptually, it is not clear which of these income definitions provides a better measure of absolute mobility, as individuals' sense of progress might differ if they achieve upward mobility through government transfers rather than their own earnings. We assess whether the distinction matters empirically in Fig. 3B by replicating our baseline analysis using post-tax and transfer incomes. We estimate tax liabilities for parents and children using the National Bureau of Economic Research (NBER) TAXSIM model, which is available for years after 1960. Before 1960, we use data on federal marginal tax rates, adjusted for personal exemptions by marital status and number of children (*27*). We estimate the value of transfers as the sum of Aid to Families with Dependent Children, General Assistance, Supplemental Security Income, and the cash value of in-kind transfers. Accounting for taxes and transfers increases the level of absolute mobility by around 3 percentage points in all cohorts but does not affect the trend in absolute mobility appreciably. This is because taxes and transfers affect the incomes of both parents and their children and because tax and transfer changes typically affect the tails of the income distribution, where incremental changes in income have smaller effects on absolute mobility because children are either already earning more than their parents or have fallen far short of that threshold.

In our baseline analysis, we measure children's incomes at age 30. One may be concerned that children take a longer time to reach peak life-cycle earnings in more recent cohorts, which could lead to a spurious downward trend in rates of absolute mobility. Figure 3C addresses this concern by replicating our baseline analysis measuring income at age 40 for children (for the 1940 to 1974 cohorts) and at ages 35 to 45 for parents. This series continues to exhibit a sharp decline in absolute mobility across birth cohorts. The time pattern of the decline is shifted backward by approximately 10 years, consistent with measuring incomes 10 years later.

The fraction of individuals who are married at age 30 and the size of families have both fallen steadily in recent decades (*28*). One widely used approach to adjusting for changes in household size is to divide family income by the square root of the number of family members in the household (*29*). Figure 3D shows that when we divide our baseline income measures by the square root of family size, rates of absolute mobility fall from 93% in 1940 to 60% in 1984 (*30*). As an alternative approach, one can measure income at the individual rather than household level. The series in triangles in Fig. 3D compares the individual earnings of sons to their fathers, as in prior studies of intergenerational mobility (*13*). Here, we find a steeper decline in absolute mobility than in our baseline specification: The fraction of sons earning more than their fathers fell from 95% in 1940 to 41% in 1984. Together, these results show that accounting for trends in family size and the number of earners does not affect the qualitative conclusion that absolute mobility has fallen substantially.

Combining the preceding adjustments by (i) measuring income at age 30 after taxes and transfers, (ii) dividing income by the square root of family size, and (iii) subtracting 0.8 percentage points from the CPI-U-RS when adjusting for inflation continues to yield qualitatively similar results. In this specification, absolute mobility falls from 96% to 72% between the 1940 cohort and the 1984 cohort (fig. S3).

Beyond the specific factors considered above, one may be concerned that levels of absolute mobility for recent cohorts may still be understated because of increases in fringe benefits, nonmarket goods, or underreporting of income in the CPS (*31*, *32*). As an omnibus approach to assessing the potential bias from such factors, we recalculate absolute mobility for the 1984 birth cohort after increasing each child's income by various fixed dollar amounts. Adding $1000 to every child's income in 2014 would increase absolute mobility for the 1984 cohort to 51% from the baseline estimate of 50%; adding $10,000 would increase absolute mobility to only 61% (fig. S4). These calculations show that plausible adjustments to children's incomes are unlikely to change the conclusion that absolute mobility has fallen sharply from the rates of 80 to 90% experienced by children born in the 1940s and 1950s.

In our baseline analysis, we define absolute mobility using a discrete measure of whether children earn more than their parents. Using other thresholds (e.g., the fraction of children earning 20% more or less than their parents) or a more continuous definition of absolute mobility—the median ratio of child to parent income—yields very similar re-

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sults (fig. S5).

Finally, in figs. S6 to S9, we show that the results are also robust to a set of other technical issues that arise from data limitations: (i) adjusting for changes in the definition of family income across censuses; (ii) including immigrants in all years to account for missing data on immigrant status in early cohorts; (iii) using a single census to measure parents' income instead of pooling data across multiple censuses; and (iv) using data from either the census or CPS to measure the incomes of both parents and children from a single data set.

Heterogeneity analysis

Next, we examine how trends in absolute mobility vary across subgroups. We begin by examining heterogeneity across states. We define parents' states as based on where they live when we measure their incomes (between ages 25 and 35). We define children's state as their state of birth to account for the possibility that children who grow up in a given state may move elsewhere as adults. Because children's state of birth is not observed in the CPS, we use the census for both parents and children (*33*).

Figure 4 presents the results by state, showing absolute mobility by cohort for selected states (Fig. 4A; see table S2 for estimates for all states) and a map of the change in absolute mobility from 1940 to 1980 by state (Fig. 4B). Absolute mobility fell substantially in all 50 states between the 1940 and 1980 birth cohorts. Absolute mobility fell particularly sharply in the industrial Midwest, where rates of absolute mobility fell by 48 percentage points in Michigan and about 45 percentage points in Indiana, Illinois, and Ohio. The smallest declines occurred in states such as Massachusetts, New York, and Montana, where absolute mobility fell by about 35 percentage points.

Next, we examine heterogeneity by gender. When comparing children's family incomes to their parents' family incomes as in our baseline analysis, we find similar declines in absolute mobility for sons and daughters (fig. S10). However, the patterns differ by gender when we focus on individual earnings. As noted above, sons' chances of earning more than their fathers fell steeply, from 95% in 1940 to 41% in 1984, underscoring the sharp decline in the economic prospects of American men. In contrast, the fraction of daughters earning more than their fathers fell from 43% for the 1940 birth cohort to 22% in 1960, and then rose slightly to 26% in 1984. The pattern for women's individual earnings differs because of the rise in female labor force participation rates and earnings over the period we study (fig. S11).

In sum, the subgroup analysis shows that declines in absolute mobility have been a systematic, widespread phenomenon throughout the United States since 1940 (*34*).

Counterfactual scenarios

Why have rates of absolute income mobility fallen so sharply over the last half century, and what policies can restore absolute mobility to earlier levels? We used simulations to evaluate the effects of two key trends over the past half century: declining rates of GDP growth and greater inequality in the distribution of GDP (*17*, *35*).

We considered two counterfactual scenarios. The first, a "higher GDP growth" scenario, asks what would have happened to absolute mobility for the 1980 cohort if the economy had grown as quickly during their lifetimes as it did in the mid–20th century, but with GDP distributed across households as it is today. The second "more broadly shared growth" scenario asks the converse: What if total GDP grew at the rate observed in recent decades, but GDP was allocated across households as it was for the 1940 birth cohort? The first scenario expands the size of the economic pie, dividing it into the proportions by which it is divided today. The second keeps the size of the pie fixed but divides it more evenly, as in the past. We define households' income shares as a fraction of GDP rather than total labor income in order to characterize what would have happened to absolute mobility had the total output of the economy been distributed as in the past, accounting for changes in the distribution of labor income as well as changes in the share of GDP going to labor.

We calculate children's counterfactual incomes under the higher GDP growth scenario as follows. Let G_t^O denote the observed GDP per working-age family in year t, where "working-age" families are families with at least one member between the ages of 18 and 64. We first define the share of GDP that goes to children at percentile q of the 1980 cohort in 2010 as $\pi_{q,1980}^k = y_{q,1980}^k / G_{2010}^O$, where $y_{q,1980}^k$ is the qth percentile of the income distribution in 2010 for children in the 1980 cohort. We then construct a counterfactual level of GDP per working-age family in 2010, $G_{2010}^C = G_{1980}^O \times 1.025^{30}$, under the assumption that real GDP per family grew at a rate of 2.5% per year from 1980 to 2010. This 2.5% growth rate is comparable to the real growth rate per working-age family from 1940 to 1970, and is 1 percentage point per year higher than the actual annualized growth rate from 1980 to 2010 of 1.5% (*36*). Finally, we define a counterfactual marginal income distribution for children in the 1980 cohort as

$$y_{q,1980}^{k,C1} = \pi_{q,1980}^k \times G_{2010}^C \tag{4}$$

The counterfactual income for children at percentile q is given by the share of GDP going to 30-year-olds at percentile q in 2010 multiplied by the level of GDP that would have prevailed in 2010 had children in the 1980 cohort experienced GDP growth from birth to age 30 comparable to that

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experienced by children born in the 1940s.

For the "more broadly shared growth" scenario, we follow the same approach as above to calculate the share of GDP that goes to children at percentile q of the 1940 cohort in 1970, $\pi^{k}_{q,1940} = y^{k}_{q,1940} / G^{O}_{1970}$. We then apply these shares to the observed level of 2010 GDP to construct a counterfactual income distribution for the 1980 birth cohort:

$$y^{k,C2}_{q,1980} = \pi^{k}_{q,1940} \times G^{O}_{2010} \tag{5}$$

This counterfactual represents the incomes 30-year-olds would have had in 2010 if GDP in 2010 were allocated across households in the same proportions as in 1970.

After calculating the counterfactual income distributions for children in the 1980 cohort, $\left\{ y^{k,C1}_{q,1980} \right\}_{q=1}^{100}$ and $\left\{ y^{k,C2}_{q,1980} \right\}_{q=1}^{100}$, we use the same copula and parent marginal income distributions as above to compute counterfactual rates of absolute mobility by parent income percentile. Figure 5A presents the results. The top and bottom curves in the figure reproduce the empirical series for the 1940 and 1980 cohorts from Fig. 1A. The dotted and dashed series show absolute mobility rates that would have been observed for the 1980 cohort under the counterfactuals in Eqs. 4 and 5.

Under the higher-growth counterfactual, the mean rate of absolute mobility is 62%. This rate is 12 percentage points higher than the empirically observed value of 50% in 1980, but closes only 29% of the decline relative to the 92% rate of absolute mobility in the 1940 cohort. The increase in absolute mobility is especially modest, given the magnitude of the change in the aggregate economy: A growth rate of 2.5% per working-age family from 1980 to 2010 would have led to GDP of $20 trillion in 2010, $5 trillion (35%) higher than the actual level.

The more broadly shared growth scenario increases the average rate of absolute mobility to 80%, closing 71% of the gap in absolute mobility between the 1940 and 1980 cohorts. The broadly shared growth counterfactual has larger effects on absolute mobility at the bottom of the income distribution, whereas the higher-growth counterfactual has larger effects at higher income levels. Because income shares of GDP are larger for high-income individuals, higher growth rates benefit those with higher incomes the most, whereas a more equal distribution benefits those at the bottom the most.

The results in Fig. 5A imply that much of the decline in absolute mobility is due to changes in the distribution of growth rather than reductions in aggregate growth rates. In Fig. 5B, we ask what rates of GDP growth would be necessary to return to mid-century rates of absolute mobility under today's income distribution. We plot mean rates of upward mobility under real GDP per family growth rates from 1% to 10%, recalculating G^{C}_{2010} and using Eq. 4 to generate counterfactual income distributions. Achieving rates of absolute mobility above 80% under today's income distribution would require sustained real per-family growth greater than 5% per year (or total real GDP growth above 6.4%), well above the historical experience of the United States since the Second World War.

Higher GDP growth rates do not substantially increase the number of children who earn more than their parents because a large fraction of GDP goes to a small number of high income earners today. To see why absolute mobility is insensitive to the growth rate when growth is distributed unequally, consider the extreme case in which one child obtains all of the increase in GDP. In this case, higher GDP growth rates would have no effect on absolute mobility. More generally, GDP growth has larger effects on absolute mobility when growth is spread more broadly, allowing more children to achieve higher living standards than their parents. Higher GDP growth and a broader distribution of growth have a multiplicative effect on absolute mobility: Absolute mobility is highest when GDP growth rates are high and growth is spread broadly across the distribution.

In the supplementary materials, we show that similar results are obtained when using counterfactuals for the change in incomes from 1980 to 2010 based on shares of GDP growth over that period rather than counterfactuals for the level of incomes in 2010. Measuring incomes at age 40 instead of 30 also yields similar results (fig. S12).

In sum, the counterfactuals show that higher growth rates alone are insufficient to restore absolute mobility to the levels observed in mid-century America. A broader distribution of income growth is necessary to revive absolute mobility, and can itself be sufficient to reverse much of the decline since 1940 even if growth were to remain at current levels (*37*, *38*).

Conclusion

Our analysis yields two main results. First, children's prospects of earning more than their parents have faded over the past half century in the United States. The fraction of children earning more than their parents fell from approximately 90% for children born in 1940 to around 50% for children entering the labor market today. Absolute income mobility has fallen across the entire income distribution, with the largest declines for families in the middle class. These findings contrast with prior research showing that relative mobility—measured, for instance, by the correlation between parents' and children's incomes—remained stable in recent decades (*13*, *15*). The measures of absolute mobility we focus on in this study differ from relative mobility because they compare levels of earnings across genera-

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tions by bringing in data on the marginal income distributions of parents and children. Absolute mobility has fallen over time while relative mobility has remained stable because income growth has stagnated across much of the income distribution in recent decades.

Second, most of the decline in absolute mobility is driven by the more unequal distribution of economic growth in recent decades, rather than by the slowdown in GDP growth rates. In this sense, the rise in inequality and the decline in absolute mobility are closely linked. Growth is an important driver of absolute mobility, but high levels of absolute mobility require broad-based growth across the income distribution. With the current distribution of income, higher GDP growth rates alone are insufficient to restore absolute mobility to the levels experienced by children in the 1940s and 1950s. If one wants to revive the "American dream" of high rates of absolute mobility, then one must have an interest in growth that is spread more broadly across the income distribution.

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50. We use the same counterfactual GDP—applying 30 years of a 2.5% annual growth rate to GDP in 1980—even though children are 40 years old when we measure their incomes because children's incomes are still measured approximately 30 years after their parents' incomes.

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SUPPLEMENTARY MATERIALS

www.sciencemag.org/cgi/content/full/science.aal4617/DC1
Materials and Methods
Figs. S1 to S12
Tables S1 to S4
References (*41–50*)

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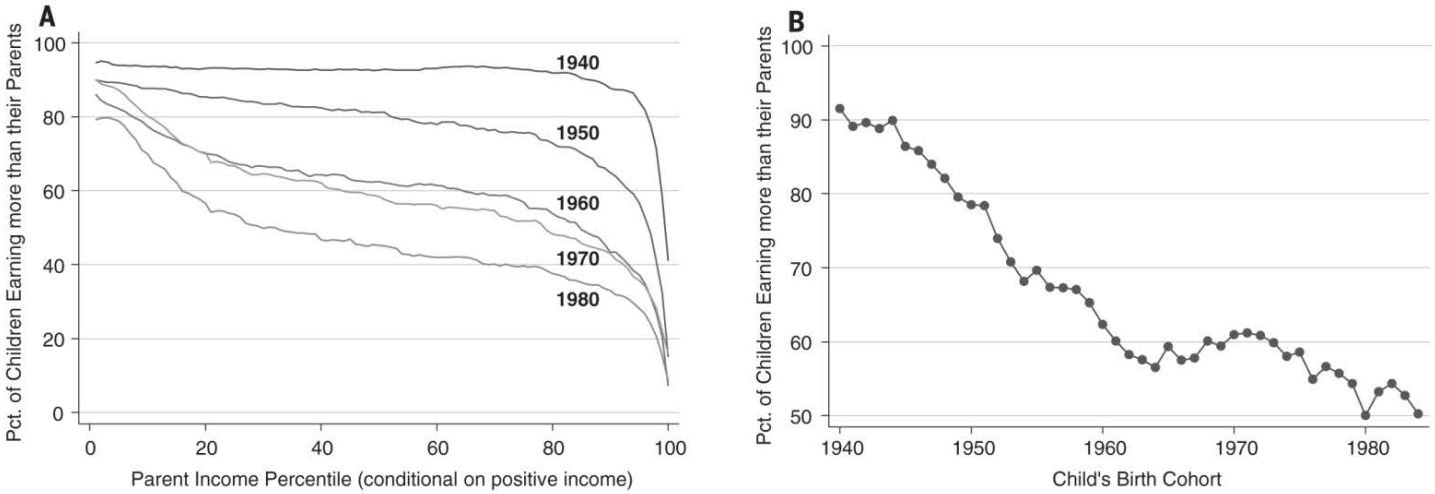

Fig. 1. Baseline estimates of absolute mobility by birth cohort. (**A** and **B**) The fraction of children earning more than their parents ("absolute mobility") by parent income percentile for selected child birth cohorts (A) and on average by child birth cohort (B). Only parents with positive income are included in (A); within this group, parent income percentiles are constructed according to their ranks in the distribution of parents' incomes within each child cohort. Parents with zero income are included in (B), defining absolute mobility as 100% for that subgroup when computing the mean rate of absolute mobility by cohort. Child income is measured at age 30 in the CPS March supplement as the sum of individual and spousal income, excluding immigrants after 1994. Parent income is measured in the census as the sum of the spouses' incomes for families in which the highest earner is between ages 25 and 35. Children's and parents' incomes are measured in real 2014 dollars using the CPI-U-RS. Absolute mobility is calculated by combining these income distributions with the copula estimated for the 1980 to 1982 cohorts in tax data by (*12*).

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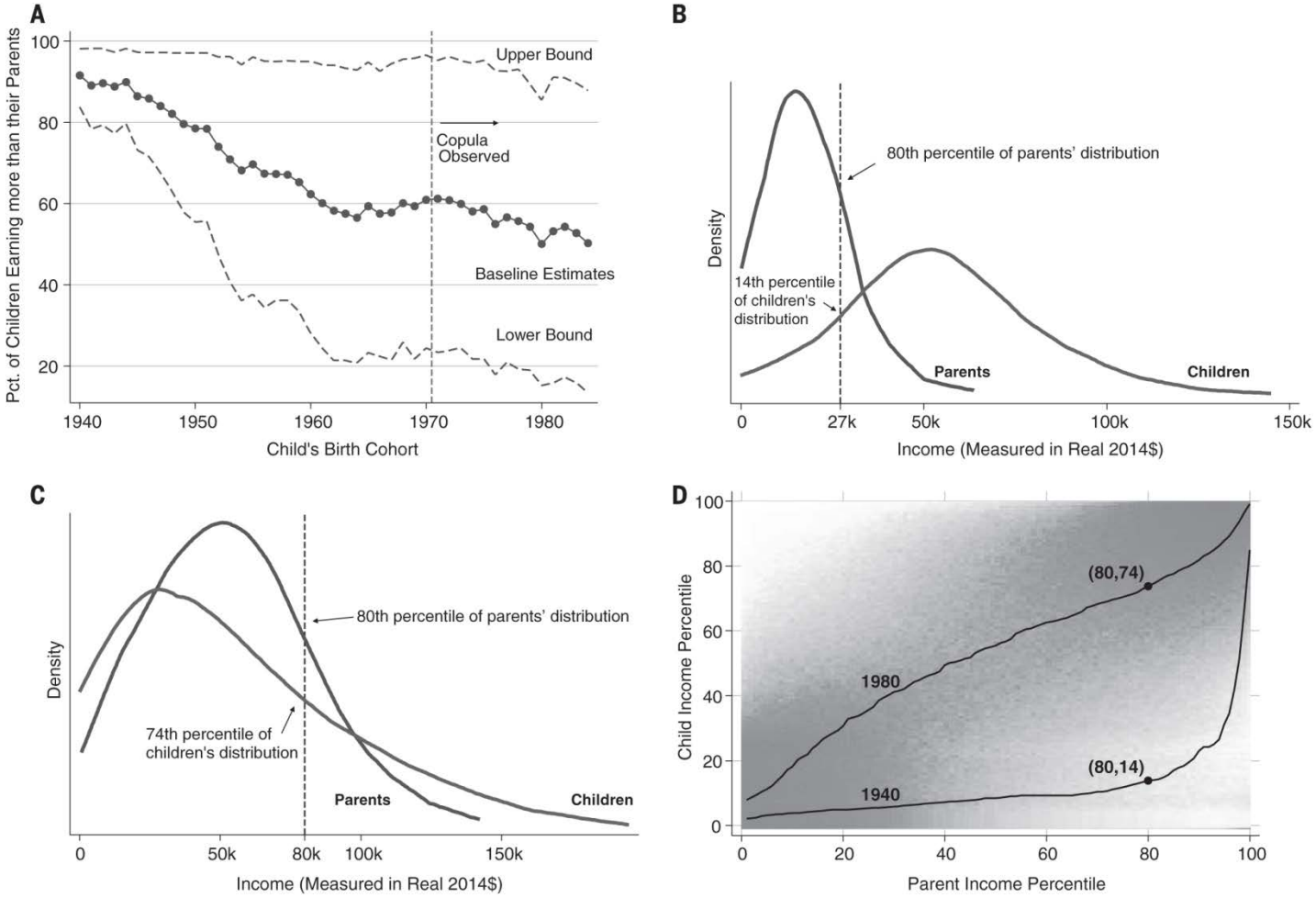

Fig. 2. Effects of copula on absolute mobility by birth cohort. (**A**) Plot of bounds on absolute mobility for each cohort over all copulas satisfying first-order stochastic dominance of child income distributions as parent income rises. The bounds are estimated separately by cohort. Solid circles replicate the baseline estimates shown in Fig. 1B, with the section to the right of the dashed vertical line corresponding to the cohorts (1971 to 1984) for which copula stability is documented in (*15*). (**B**) Plot of the marginal family income distributions of children in the 1940 birth cohort and their parents, measured at approximately age 30. Corresponding to the analysis in Fig. 1A, parents with zero income are excluded, but children with zero income are included when estimating these kernel densities. For scaling purposes, incomes above $200,000 are excluded. (**C**) Plot of analogous income distributions for children in the 1980 birth cohort and their parents. (**D**) Plot of the income percentile that a child must reach in order to earn more than his or her parents for the 1940 and 1980 cohorts, with labels corresponding to the examples shown by the dashed vertical lines in (B) and (C). Also shown is a heat map of the baseline copula for the 1980 to 1982 birth cohorts. The copula is a 100 × 100 matrix where each cell (x, y) gives the probability of a child being in income percentile y and having parents in income percentile x (conditional on parents having positive income). Darker colors represent areas with higher density in the copula.

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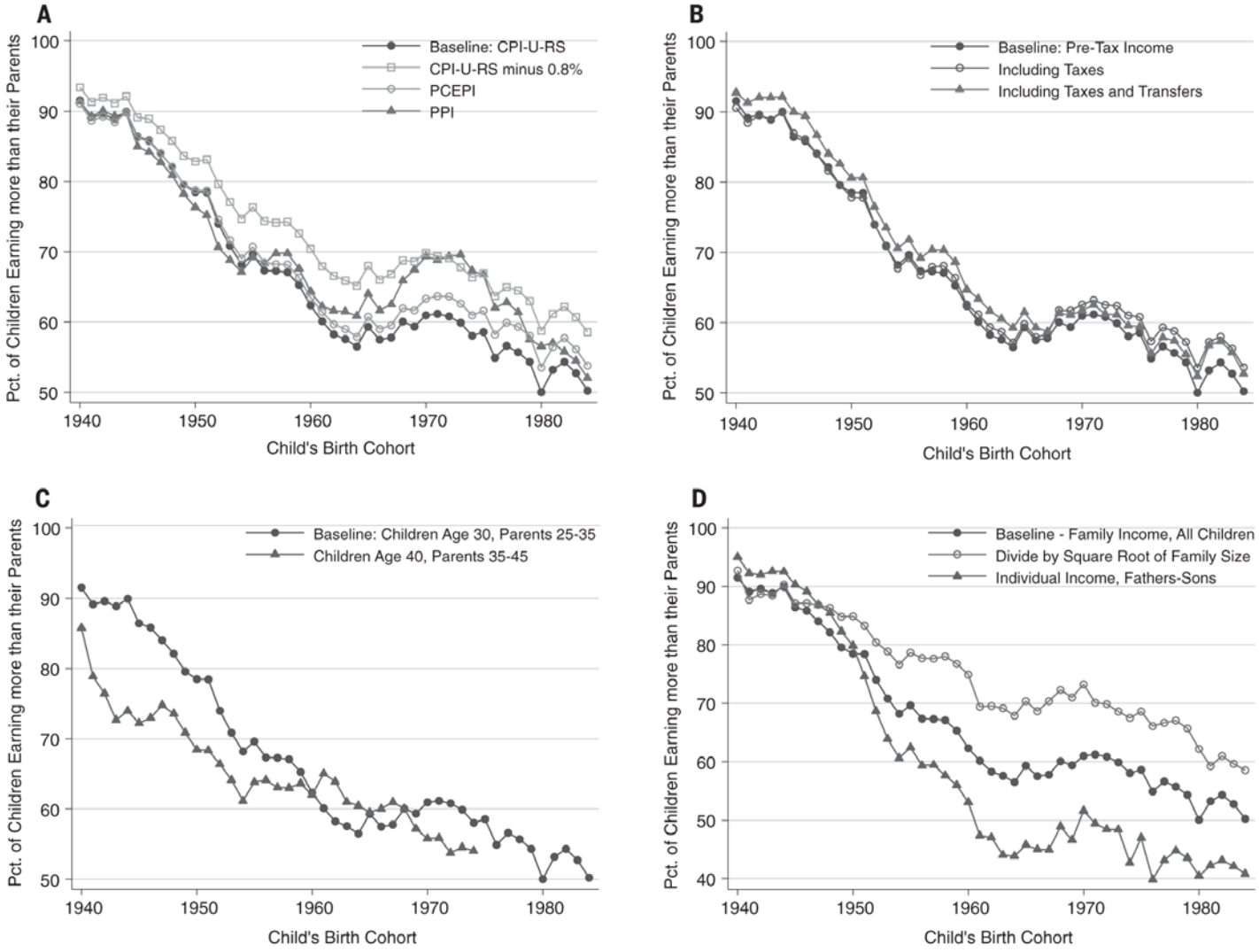

Fig. 3. Trends in absolute mobility: Sensitivity analysis. Plots show absolute mobility by child birth cohort according to a set of alternative income definitions. (**A**) Estimates that use alternative price deflators to adjust for inflation, including the PPI and the PCEPI. We also consider a price index that adjusts for bias in the CPI-U-RS due to new and higher-quality products by subtracting 0.8% from the annual inflation rate implied by the CPI-U-RS (*24*, *25*). (**B**) Estimates using income after including federal taxes and transfers. Taxes are estimated using the NBER TAXSIM model (*39*) for years since 1960 and historical marginal tax rates for years before 1960. Transfers include cash and in-kind transfers. Cash transfers are obtained from census and CPS data; in-kind transfers are obtained from calculations in (*40*) using CPS data from calendar year 1967 onward (for years before 1967, in-kind transfers are set to zero). (**C**) Plot of absolute mobility when child income is measured at age 40 and parent income is measured between ages 35 and 45. Note that the last year of income data in our sample is 2014, so absolute mobility can be measured at age 40 only until the 1974 birth cohort. (**D**) Estimates that adjust income for family size and number of earners. In the series in open circles, we divide the baseline measures of family income by the square root of family size (defined as the number of dependent children plus the number of adults) for both parents and children. In the series in triangles, we estimate the fraction of sons whose individual incomes are greater than or equal to their fathers' individual incomes. Individual income is defined in the same way as the baseline family income measure but does not include spousal income.

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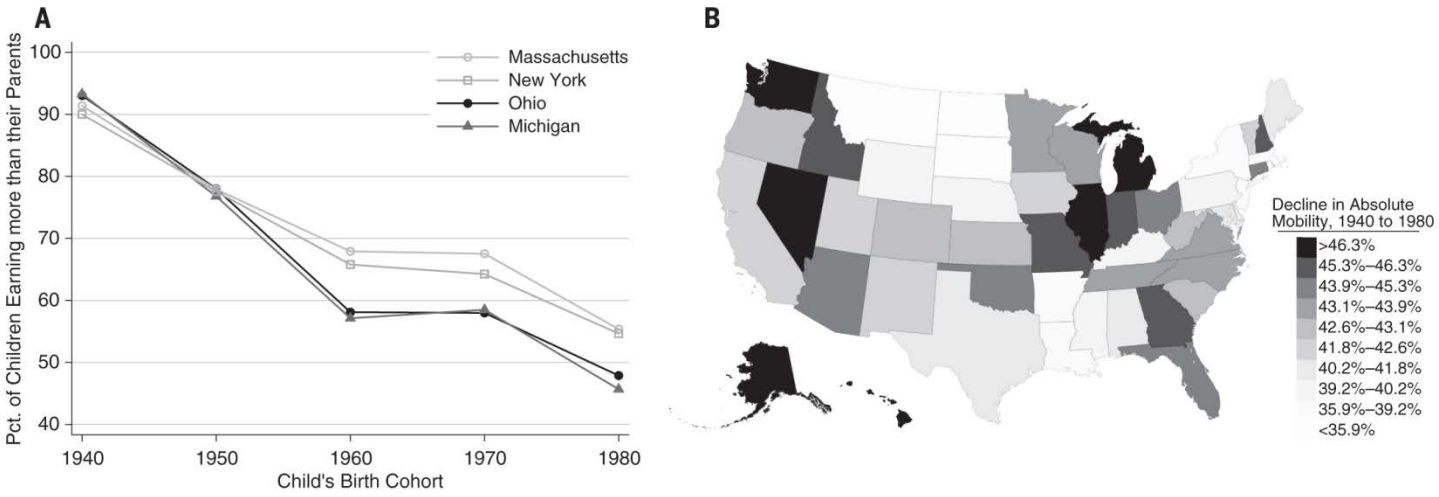

Fig. 4. Trends in absolute mobility by state. (**A**) Estimates for decadal birth cohorts for selected states; table S2 shows data by cohort for all other states. (**B**) Map of the magnitude of the decline in absolute mobility from the 1940 cohort to the 1980 cohort, with darker colors representing states with larger declines. For parents, state refers to location at the time incomes are measured (between ages 25 and 35); for children, state refers to location at birth. Because children's state of birth is not observed in the CPS, we use the census for both parents and children.

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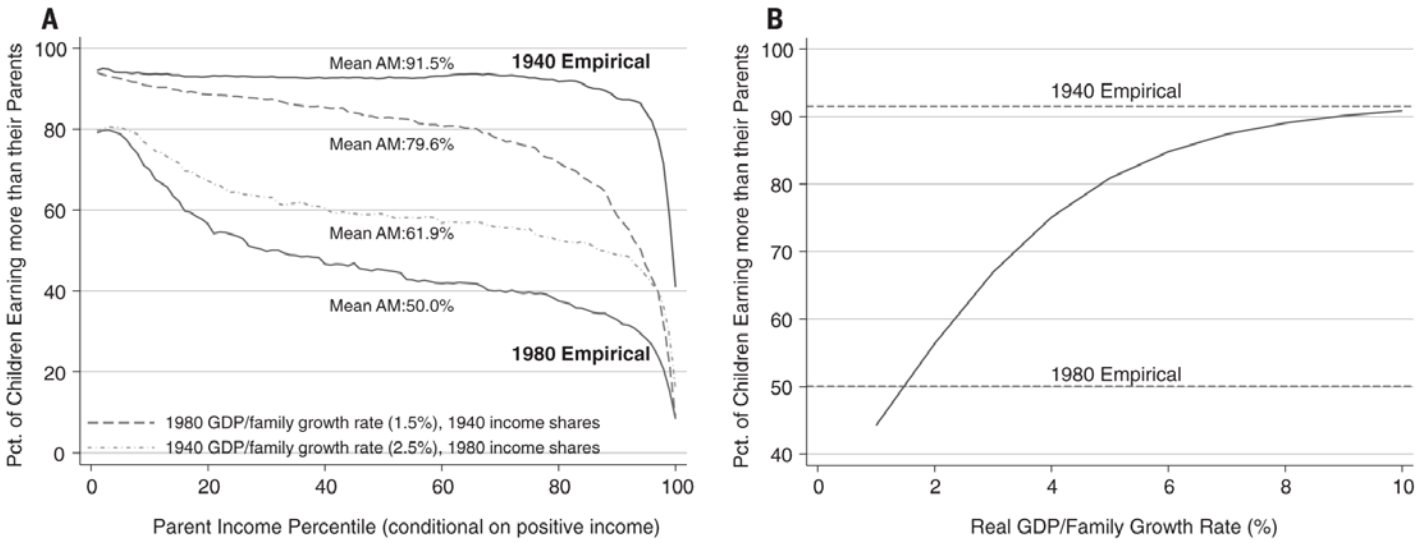

Fig. 5. Absolute mobility for the 1980 birth cohort: Counterfactual scenarios with different GDP growth rates or income distributions. (**A**) Plot of absolute mobility by parent income percentile. The solid curves replicate the baseline estimates of observed absolute mobility by parent income percentile from Fig. 1A for the 1940 and 1980 birth cohorts. The series "1940 GDP/family growth rate (2.5%), 1980 income shares" plots the rates of absolute mobility that the 1980 cohort would have experienced if GDP per working-age family had grown at 2.5% annually from 1980 to 2010 instead of the actual rate of 1.5%. The resulting higher level of GDP in 2010 is allocated to households according to the ratio of income to GDP per working family at each percentile of the family income distribution for 30-year-olds in 2010. The series "1980 GDP/family growth rate (1.5%), 1940 income shares" plots the rates of absolute mobility that the 1980 cohort would have experienced if GDP in 2010 had been allocated in the same manner across households as it was for the 1940 cohort. For each series, we also report the mean level of absolute mobility (AM), averaging across all income percentiles (including parents with zero incomes, whose children mechanically have absolute mobility of 100% and are not shown in the figure). (**B**) Plot of mean absolute mobility for the 1980 cohort if it had experienced alternative GDP growth rates. These estimates are constructed in the same way as the estimate of AM for the "1940 GDP/family growth rate (2.5%), 1980 income shares" series in (A), using growth rates ranging from 1% to 10%. The dashed horizontal lines show the actual levels of AM for the 1940 and 1980 birth cohorts.

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The fading American dream: Trends in absolute income mobility since 1940

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