ONLINE APPENDICES

A. Construction of Neighborhood Characteristics

This appendix provides definitions and sources for covariates used throughout the paper or shown in the Opportunity Atlas as neighborhood characteristics. Our source data are primarily at the tract level. We use 2010 Census tract definitions throughout. For covariates defined using 2000 tract boundaries, we use the 2010 Census Tract Relationship Files from the US Census Bureau to crosswalk 2000 tracts to 2010 tracts, weighting the 2000 tract-level covariates by the fraction of the 2000tract population that lives within the 2010 tract boundaries.

Tract-Level Characteristics:

Jobs Within 5 Miles (2015). The number of jobs within 5 miles of a tract is constructed using block-level information on the total number of jobs from the Workplace Area Characteristics (WAC) data files in the LEHD Origin-Destination Employment Statistics (LODES) provided by the Census Bureau. For each tract we compute the number of jobs within 5 miles as the total number of jobs in own and neighboring tracts whose centroids fall within a radius of 5 miles from the centroid of the tract.

Number of High Paying Jobs Within 5 Miles (2015). The number of high paying jobs within 5 miles of a tract is constructed using block-level information on the number of jobs with earnings greater than $3,333 per month from the Workplace Area Characteristics (WAC) data files in the LEHD Origin-Destination Employment Statistics (LODES) provided by the Census Bureau. For each tract we compute the number of high paying jobs within 5 miles as the number of high paying jobs in own and neighboring tracts whose centroids fall within a radius of 5 miles from the centroid of the tract.

Job Growth (2004-2013). The measure of job growth at the tract level shown in the Opportunity Atlas is constructed using block-level information on the total number of jobs from 2004 to 2013 from the Workplace Area Characteristics (WAC) data files in the LEHD Origin-Destination Employment Statistics (LODES) provided by the Census Bureau. We compute job growth in each tract as the average annualized growth rate from 2004 to 2013.

Job Density (2013). The measure of job density at the tract level shown in the Opportunity Atlas is constructed combining block-level information on total number of jobs in 2013 from the Workplace Area Characteristics (WAC) data files in the LEHD Origin-Destination Employment Statistics (LODES) provided by the Census Bureau and tract-level information on land area in square miles from the 2010 Census Gazetteer Files. We compute job density as the number of jobs per square mile in each tract.

Employment Rate (2000). The rate of employment is constructed using tract-level data on labor market measures from tables NP043E and NP043C of the Census long form SF3a dataset obtained from the National Historical Geographic Information System (NHGIS) database. We construct the rate of employment in 2000 for each tract as the total employed population (the sum of employed females and employed males) divided by the total population 16 years and over.

Poverty Rate (1990, 2000, 2006-2010, 2011-2015). The poverty share variable is constructed as the share of individuals below the federal poverty line in each tract. For the measure in 1990 we use table NP117 from the 1990 Census form SFT3, for the measure in 2000 we use table NP087B from the 2000 Census long form SF3a, and for the measures for 2006-2010 and 2011-2015 we use table C17002 from the American Community Survey in relevant years, all obtained from the NHGIS database.

Single Parent Share (1990, 2000, 2006-2010). We define the share of single parents in each tract as the number of households with female head (and no husband present) or male head (and no wife

present) with own children under 18 years old present divided by the total number of households with own children present. We use table NP19 of the 1990 Census form SFT3 for the measure in 1990, tables NP018E and NP018G of the 2000 Census SF1a form for the measure in 2000, and table B11003 of the 2006-2010 American Community Survey for the measure in 2010. All obtained from the NHGIS database.

Racial Shares (2000, 2010). Racial shares are calculated from the Census long form SF1a, tables NP008A and NP004E, taken from NHGIS database. All races (except Hispanic) exclude Hispanics and Latinos.

Share Foreign Born (2010). The share foreign born variable that is shown in the Opportunity Atlas is constructed as the number of foreign born residents in the 2010 Census divided by the sum of native and foreign born residents (long form SF3a, table NP021A) obtained from the NHGIS database.

Share with Short Commute to Work and Mean Commute Time (2000, 2006-2010). The share of workers with a short commute to work and mean commute time are constructed using tract-level data from table NP031B of the 2000 Decennial Census or tract-level data from table B08303 of the the 2006-2010 American Community Survey, both obtained from the NHGIS database. Fraction with a short to commute to work is computed by taking the share of people who commute less than 15 minutes to work over all workers 16 years and over who did not work at home. Mean commute time is constructed using the share of workers commuting to work in specific bins ($<$ 5 minutes, 5-9 minutes, 10-14 minutes, etc.), imputing the mean time commuted in a given bin (i.e. for 5-9 minutes, imputing mean commute time of 7 minutes), and then calculating a sum of imputed mean commute times within each bin weighted by the share commuting.

Kid Counts (2000). The counts of kids by race and gender used throughout the paper and shown in the Opportunity Atlas are constructed for kids under 18 using tract-level data from tables NP012F and NPCT012H of the 2000 Decennial Census using the NHGIS database.

Census Return Rate (2010). The Census return rate variable used in Figure V and shown in the Opportunity Atlas is obtained from tract-level data from the Census 2016 Planning Database. It is calculated as the number of 2010 Census mail forms completed and returned over the number of valid occupied housing units where a Census form was expected to be delivered for mail return to Census.

Mean Household Income (2000). The measure of mean household income used in Figure V is constructed using tract-level data from table NP052A of the 2000 Decennial Census found in the NHGIS database.

Median Household Income (1990, 2012-2016). The measure of median household income shown in the Opportunity Atlas is constructed using tract-level data from table NP80A of the 1990 Decennial Census and table B19013 of the American Community Survey (2012-2016) found in the NHGIS database.

High School Graduate Wage Growth (2005-2014). The measure of high school graduate wage growth is constructed using data from the 2005-2009 and 2010-2014 American Community Survey provided by NHGIS database. High school graduate wages at the tract level are computed by dividing the average high school graduate annual earnings by the product of overall average weekly hours worked and 52. High school graduate wage growth is then computed as the difference in logarithms between high school graduate wages in 2010-2014 and school graduate wages in 2005-2009.

Share College Graduate (2000, 2006-2010). The share college graduate variable shown in the Opportunity Atlas is constructed using tract-level data from table NP037C of the 2000 Census long form SF3a or tract-level data from table B15002 of the 2006-2010 American Community Survey (both obtained from the NHGIS database), and is calculated as the number of people aged 25 or

older who have a bachelor's degree, master's degree, professional school degree, or doctorate degree, divided by the total number of people aged 25 or older in a tract.

Population Density (2000, 2010). The population density variable used in Figure VIIIc and shown in the Opportunity Atlas is calculated as the total tract-level population in the Census obtained from NHGIS database (long form SF1a, table H7V) divided by tract land area in square miles from the 2010 Census Gazetteer Files.

Median Two-Bedroom Rent (2011-2015). The median two-bedroom rent variable that is used in Figure XIII and shown in the Opportunity Atlas is constructed from tract-level ACS data (2011-2015) and is defined as the median gross rent for renter-occupied housing units with two bedrooms that pay cash rent (table AD79).

Characteristics at Other Levels of Geography:

Job Growth (1990-2010, 2004-2013). The measure of job growth at the CZ or MSA level that we use in Figure VI and Online Appendix Figure III is constructed as the percentage change in employment between 1990 and 2010 in each CZ/MSA using county-level data from the Local Area Unemployment Statistics (LAUS) released by the Bureau of Labor Statistics. The measure of job growth at the county and CZ level that we use in the Opportunity Atlas is constructed as the average annualized growth rate in employment between 2004 and 2013 in each CZ using county level data from the Local Area Unemployment Statistics (LAUS) released by the Bureau of Labor Statistics.

Opportunity Zones. The list of tracts in Qualified Opportunity Zones shown in Online Appendix Figure V was downloaded from the Community Development Financial Institutions Fund.

Wharton Land Use Regulation Index (2008). The Wharton Land Use Regulation Index is constructed using city-level data from Gyourko et al. (2008). The cities in the original dataset are crosswalked to 247 commuting zones (representing 87% of the US population).

3rd Grade Math Score. Data for 3rd grade test scores are downloaded from the Stanford Education Data Archive and measured at the district level. We create a crosswalk from districts to tracts by weighting by the proportion of land area that a given school district covers in a tract.

High School Catchment Areas. We match tracts to high school catchment areas across the U.S. using data on the intersection of census tracts with high school catchment areas in 2017 provided by Peter Bergman. These data come from Maponics (2017). Tracts are not perfectly nested within catchment areas; we create an approximate crosswalk by assigning tracts to the school catchment area that contains the majority of their land area. In a few cases where school catchment areas overlap (e.g. a whole tract belongs to two different school catchment areas) we assign the tract to the largest of the catchment areas that contain it. The results of our variance decomposition analysis are very similar if we alternatively assign these tracts to the smallest catchment area or simply don't use these tracts in the analysis. Shape-files of Mecklenburg County high school catchment areas in 2002 and 2017 come from the Charlotte-Mecklenburg Schools (CMS) education agency. The shape-files for the 2002 Mecklenburg County boundaries were generously provided by David Deming.

Other Measures of Opportunity. We compare our Opportunity Atlas measures with existing indices of economic opportunity. We obtain data for the Kirwan Child Opportunity Index at the metropolitan area level constructed by the Kirwan Institute and the Institute for Child, Youth and Family Policy (ICYFP) from diversitydatakids.org, and we obtain data for the Area Deprivation Index at the block level constructed by the University of Wisconsin School of Medicine and Public Health. Area Deprivation Index.

B. Estimating Causal Effects of Neighborhoods: Methodology

In this appendix, we document the sample, variable construction, and empirical specifications used for the quasi-experimental analysis in Section V.B.

Sample and Variable Construction. Our core sample and data construction is the same as that described in Section II, but expands in two directions that increase our ability to observe moves at younger ages. First, we extend our analysis to include the 1978-1991 cohorts. Second, we focus on income ranks measured at age 24 (as in Chetty and Hendren (2018a)), in addition to marriage at age 30 and incarceration (measured as in Section III), in order to make the measures comparable across cohorts.[66]

Using the location of each child's parents in each year in our sample, we form a sample of one-time movers. These are defined as children whose parents move across tracts exactly once when the children are age 28 or below.[67] We define the year of the move as the tax year in which the parents report living in a different tract relative to the previous year. In cases where we do not observe sequential years of location information (e.g. we do not observe 1990-93 and 1996-97), we assign the year of move as the midpoint between the two nearest years in which different addresses are reported (e.g. if we see a new location in 1994 relative to 1989, we assign the year of move to be 1992.5). In cases where this leads to a non-integer year of move, we randomly select the nearest year for the move. We then define the child's age at the time of the move as the year of the move minus the child's cohort.

Following Chetty and Hendren (2018a), we make three additional sample restrictions. First, we restrict to moves between origins and destinations that have at least 20 observations used to calculate $\bar{y}_{po}$ and $\bar{y}_{pd}$. As shown in Online Appendix A of Chetty and Hendren (2018a) imposing such sample restrictions limits the impact of attenuation bias from sampling error in the $\bar{y}_{pc}$ estimates. Second, we require that we are able to observe the parents for at least two years after the move in order to enter the sample (e.g. for a child born in 1991 we only consider moves through 2013, since s/he is observed until 2015). Third, we require families to move at least 25 miles; moves less than 25 miles suffer from more severe measurement error, as we discuss in more detail below. Appendix Table IV presents summary statistics for the one-time movers sample and the complementary exposure-weighted sample.

For each subgroup of the analysis, g (e.g. g could represent black males, white females, etc), we use the complementary sample of children (who never move or who move more than one time) to provide an estimate of the average outcomes of children in group g who grew up in each tract. Using this sample, we restrict to those in group g and construct exposure-weighted outcomes, $\bar{y}_{pgl}$, for each parental income p, demographic group g, and location l. To do so, we regress children's outcomes on a linear term in transformed parental income rank (based on the national non-parametric relationship), weighting by the number of years below age 23 in which the parents are observed in the tract. We let $\bar{y}_{pgl}$ denote the predicted value from this regression for a child at parental income rank p.

Empirical Specification. Using the sample of one-time movers, we consider the outcomes of child i with parental income rank p_i who moved at age m_i from origin tract, o, to destination tract, d. Weuse a specification analogous to the approach in Chetty and Hendren (2018a). Let $\bar{y}_{pgl}$ denote

[66] Some variables are only defined for a subset of these cohorts. Marriage at age 30 cannot be observed past the 1985 cohort. Because individual income is only well defined starting in 2005, our age 24 individual income measure is missing for cohorts 1978-1980. Finally, we require incarceration to be measured after age 23, and therefore omit cohorts 1987 and later for that outcome.

[67] When constructing the sample, we observe location up to age 30. But, as discussed below, we follow Chetty and Hendren (2018a) and require that we observe the parents in the destination for at least two years. Therefore, the oldest age of move for the children is 28.

the exposure-weighted outcome of y_i for children who grew up in tract l with parental income rank $p = p_i$, where we will substitute $l \in \{o, d\}$ to denote origin tract and destination tract, respectively. Let $\Delta_{odpg} = \bar{y}_{pgd} - \bar{y}_{pgo}$ denote the difference in the income rank of exposure-weighted residents in the destination versus origin for children with parental income rank p. We then run three primary specifications. Our "extended specification" is:

$$y_i = \sum_{m=2}^{28} I(m_i = m) \left[\alpha_m + \phi_m \bar{y}_{pgo} + \zeta_m p_i + b_m \Delta_{odpg}\right] + \varepsilon_i$$

where the parameters $\{\alpha_m, \phi_m, \zeta_m\}$ are age-at-move-specific intercepts, controls for the average exposure-weighted outcome in the origin, and parental income rank, respectively. The key parameters of interest are the b_m coefficients, which capture how children's outcomes vary with the age at which they move to an area with higher or lower predicted earnings. Our "parametric specification" is:

$$\begin{aligned} y_i &= \sum_{m=2}^{28} I(m_i = m) \left[\alpha_m + \phi_m \bar{y}_{pgo} + \zeta_m p_i\right] + I(m_i \leq 23)(\gamma' + \gamma m_i)\Delta_{odpg} \\ &\quad + I(m_i > 23)(\rho' + \rho m_i)\Delta_{odpg} + \varepsilon_i \end{aligned}$$

which differs from the extended specification in that it does not interact age-at-move with the difference in tract predicted outcome measures Δ_{odpg}. One can interpret the coefficients ρ and γ as the slope of the b_m coefficients above and below age 23, respectively. Our "parsimonious specification" is:

$$\begin{aligned} y_i &= \sum_{m=2}^{28} I(m_i = m) \left[\alpha_m + \zeta_m p_i\right] + \phi'_m \bar{y}_{pgo} + I(m_i \leq 23)(\gamma' + \gamma m_i)\Delta_{odpg} \\ &\quad + I(m_i > 23)(\rho' + \rho m_i)\Delta_{odpg} + \varepsilon_i \end{aligned}$$

which further removes the interaction between age-at-move and origin tract predicted outcomes. In all specifications, we address classical measurement error in $\bar{y}_{pgo}$ and Δ_{odpg} using a split-sample instrumental variables approach. We randomly split those in the complementary sample into two groups, requiring that siblings are included in the same group to ensure independence of the samples, and instrument for $\bar{y}_{pgo}$ and Δ_{odpg} measured in one group using the same variables as measured in the second group.

Distance Restriction. In all movers regressions, we include only moves with 25 miles or more between the origin and destination tracts (as measured using the latitude and longitude of the tract centroid). We do so in order to avoid relatively large mismeasurement of $\bar{y}_{pgo}$ and Δ_{odpg} due to mismeasurement of the origin location (since it is in fact the destination from a prior, unobserved move). While this issue arises whenever we do not observe an individual from birth (which is for most cohorts), this issue is most severe for short-distance moves, where many of the single moves that we observe are in fact a return to an original tract of residence (or a very similar tract to the final destination).

In order to assess origin mismeasurement quantitatively, we focus on the later cohorts of children, for whom we can recreate the missing data problem in earlier cohorts by artificially restricting to later ages. Specifically, we focus on cohorts 1986-1991 and use data on location from age 11 onwards (this is the first age at which we observe location for the 1978 cohort). Among those children classified as one-time movers in this truncated sample, we then examine location before

age 11. Denote by o and d the origin and destination tracts for the one-time move after age 11. Denote by o' the origin of the pre-age-11 move. We then classify individuals based on the distance of the post-age-11 move.

This analysis yields several findings about the difference between children making post-age-11 moves that are greater than vs. less than 25 miles. (We refer to these two groups as "short-" and "long-distance" movers, respectively, for this section.) While short- and long-distance movers have similar probabilities of moving before age 11, short-distance movers are disproportionately likely to move to tracts d which are very similar to o'. The signal correlation between $\bar{y}_{pgo'}$ and $\bar{y}_{pgd}$ is higher for short-distance movers than for long-distance movers, and tract o' is more likely to lie within 5 miles of tract d for the former group.

The relationship between $\bar{y}_{pgo'}$ and $\bar{y}_{pgd}$ is particularly pronounced for children with single parents, for whom short-distance moves may in fact simply reflect children being claimed in different years by two separated parents living in different neighborhoods in the same city. (This is far less of a worry for long-distance movers.) This suggests that children of married parents would not suffer from the same measurement issues, even for short-distance moves. To verify this, in Appendix Table III we rerun the specification in Column 1 of Table IV, splitting children by married vs. unmarried parents. For children of married parents, in Columns 3 and 6, the key coefficient on the interaction between move quality and age-at-move (below age 23) is -0.022 (0.002) for short-distance movers, which is similar to the coefficient of -0.030 (0.002) for long-distance movers. In contrast, short- and long-distance movers look very different for children of unmarried parents in Columns 1 and 4, and 2 and 6, respectively. Based on this evidence, we restrict our analysis in the main text to those who move more than 25 miles.

Table I
Summary Statistics for Primary Analysis Sample (1978-1983 Birth Cohorts)

	Pooled (1)	Male (2)	Female (3)
A. Parental Characteristics			
Median Parent Household Income ($)	56,730	56,890	56,560
Mean Parent Household Income Percentile Rank	50.5	50.6	50.5
SD of Parent Household Income Percentile Rank	28.8	28.8	28.8
Father Present in Household?	78.9%	79.7%	78.2%
Mother Present in Household?	89.7%	89.2%	90.3%
Both Parents Present in Household?	68.7%	68.9%	68.5%
B. Income and Employment Outcomes in Adulthood			
Median Household Income ($)	42,360	41,250	43,590
Mean Household Income Percentile Rank	50.2	48.9	51.6
SD Household Income Percentile Rank	28.9	29.2	28.4
Median Individual Income ($)	29,440	35,120	24,390
Mean Individual Income Percentile Rank	50.2	53.9	46.4
SD of Individual Income Percentile Rank	28.9	29.7	27.4
Household Income in the Top Quintile?	20.2%	19.0%	21.6%
Individual Income in the Top Quintile?	20.2%	25.3%	14.9%
Household Income in the Top 1%?	1.0%	0.9%	1.2%
Individual Income in the Top 1%?	1.0%	1.4%	0.7%
Employed (Individual Income > 0)?	76.5%	77.8%	75.1%
C. Other Outcomes on Full Population			
Married?	45.1%	42.6%	47.8%
Incarcerated on April 1, 2010?	1.5%	2.7%	0.3%
Had a Child as a Teenager?			19.7%
Mean Spouse Individual Income Percentile Rank	62.4	53.5	71.2
SD of Spouse Individual Income Percentile Rank	26.5	27.4	22.3
Lives in Low Poverty Tract?	47.9%	47.4%	48.5%
Stays in Childhood CZ in Adulthood?	66.0%	66.4%	65.5%
Stays in Childhood Tract in Adulthood?	20.5%	22.7%	18.3%
Lives with Parents in Adulthood?	15.0%	16.7%	13.3%
Mean Household Income Rank | Stays in Childhood CZ	47.9	46.6	49.2
SD Household Income Rank | Stays in Childhood CZ	28.0	28.3	27.5
Mean Individual Income Rank | Stays in Childhood CZ	48.8	52.0	45.5
SD Individual Income Rank | Stays in Childhood CZ	27.9	29.1	26.1
D. ACS Outcomes			
Employed?	84.8%	88.6%	81.0%
Hours Worked Per Week	31.9	35.7	28.1
SD of Hours Worked Per Week	18.8	18.4	18.4
Median Hourly Wages ($)	18.2	19.3	17.2
Mean Hourly Wage Percentile Rank	50.2	52.3	48.0
SD of Mean Wage Percentile Rank	28.9	29.0	28.6
Graduated from High School?	86.2%	83.7%	88.6%
Earned Some College Credits?	69.5%	63.8%	75.1%
Graduated with 2-Year College Degree?	46.3%	40.5%	51.9%
Graduated with 4-Year College Degree?	36.4%	31.6%	41.1%
Has Post-Graduate Degree?	13.3%	10.6%	16.0%
Receives Public Assistance?	2.3%	1.4%	3.2%
Mean Household Income Rank | Child of U.S. Native Parents	53.2	52.0	54.4
SD of Household Income Rank | Child of U.S. Native Parents	28.4	28.7	28.0
Mean Individual Income Rank | Child of U.S. Native Parents	52.0	56.4	47.4
SD of Individual Income Rank | Child of U.S. Native Parents	28.4	29.0	27.1
Mean Household Income Rank | Child of Immigrant Parents	53.0	51.1	55.1
SD of Household Income Rank | Child of Immigrant Parents	29.0	29.4	28.5
Mean Individual Income Rank | Child of Immigrant Parents	54.1	56.4	51.7
SD of Individual Income Rank | Child of Immigrant Parents	29.6	30.2	28.7
Fraction Not Suppressed in Tract Collapse	0.9998	0.9996	0.9995
Number of Obs in Full Population	20,500,000	10,400,000	10,000,000
Fraction of Total	100.0%	51.0%	49.0%
Number of Obs in ACS Work Sample	1,409,000	696,000	713,000
Number of Obs in ACS Full Sample	3,979,000	1,979,000	2,000,000

Notes: This table presents summary statistics for children in our primary analysis sample. All values in this and all subsequent tables and figures have been rounded to four significant digits as part of the disclosure avoidance protocol. Counts are rounded in the following manner: numbers between 10,000 and 99,999 are rounded to the nearest 500; between 100,000 and 9,999,999 to the nearest 1,000 and above 10,000,000 to the nearest 10,000. Sources for this and all subsequent tables and figures: authors calculations based on Census 2000 and 2010, tax returns, and American Community Surveys 2005-2015. See Section II for definitions of variables. See Online Appendix Table I for analogous summary statistics by race and ethnicity.

Table II

Variance Decomposition for Tract-Level Estimates of Upward Mobility

	All Races (1)	White (2)	Black (3)	Hispanic (4)	Asian (5)	American Indian and Alaska Native (6)
A. Household Income, for Children of Parents at the 25th Percentile						
Mean	40.46	45.06	31.99	42.85	57.38	30.76
Total SD	6.50	6.09	3.82	4.16	6.81	6.34
Noise SD	1.95	2.80	1.90	2.29	3.73	2.70
Reliability	0.91	0.79	0.75	0.70	0.70	0.82
Signal SD	6.20	5.41	3.31	3.47	5.70	5.73
	($6686)	($6126)	($3435)	($3813)	($8243)	($5872)
Within County Signal SD	4.65	3.52	2.35	2.28	3.71	2.29
	($5002)	($3967)	($2439)	($2500)	($5348)	($2369)
B. Share Incarcerated, for Sons of Parents at the 25th Percentile						
Mean	4.81	2.99	11.27	3.35	0.52	5.45
Total SD	4.11	3.19	5.45	2.90	2.51	4.34
Noise SD	2.52	2.60	3.60	2.05	2.30	2.88
Reliability	0.62	0.34	0.56	0.50	0.16	0.56
Signal SD	3.24	1.85	4.09	2.05	1.00	3.25
Within County Signal SD	2.46	1.47	2.38	1.30	0.81	1.31
C. Household Income, for Children of Parents at the 75th Percentile						
Mean	58.31	60.57	43.40	53.76	65.22	44.79
Total SD	5.64	4.62	5.94	5.96	6.93	10.29
Noise SD	2.05	2.15	4.18	4.51	4.31	5.84
Reliability	0.87	0.78	0.51	0.43	0.61	0.68
Signal SD	5.25	4.09	4.22	3.90	5.43	8.47
	($7768)	($6373)	($4672)	($5173)	($9405)	($9644)
Within County Signal SD	4.20	2.80	3.26	3.09	3.98	2.32
	($6205)	($4368)	($3599)	($4096)	($6895)	($2609)

Notes: This table reports estimates of variance components of predicted children's adult outcomes conditional on parent income at the 25th and 75th percentiles (see Figure 2 for more detail). Panel A and C analyzes upward mobility for children with parent incomes at the 25th and 75th percentiles, respectively. The total SD is simply the national tract-level standard deviation of upward mobility estimates, weighted by the number of qualifying children in each tract. The noise SD is the square-root of the average squared standard error; the signal SD is the square root of the difference between the total variance and noise variance. Reliability is the ratio of signal variance to total variance. In parentheses we report the dollar values corresponding to the standard deviations listed in the row above. Column 1 reports these statistics for upward mobility estimates including all children; Columns 2 through 6 report the same statistics for upward mobility estimates including only children from a specific race (where all groups other than Hispanic include only non-Hispanics). Panel B replicates Panel A using upward mobility estimates for male incarceration, measured as living in group quarters on April 1, 2010, in the 2010 Decennial Census.

Table III

Correlations Between Tract-Level Estimates of Children's Outcomes

A. Mean Household Income Ranks: Correlation Across Racial Groups and Parental Income Levels

	Parents at 25th Percentile					
	White	Black	Hispanic	Asian	American Indian & Alaska Natives	Parents at 75th Pctile, Same Race
	(1)	(2)	(3)	(4)	(5)	(6)
White	1	0.573	0.580	0.523	0.636	0.604
Black		1	0.546	0.357	0.436	0.454
Hispanic			1	0.374	0.602	0.353
Asian				1	0.267	0.465
American Indian & Alaska Natives					1	0.357

B. Correlations Across Outcomes

	Parents at 25th Percentile						
	Household Income Rank	Individual Income Rank	Employment Rate	Incarceration Rate	Fraction w/ Teen Birth	Fraction Married	Household Income Rank (Parent p = 75)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Household Income Rank (Parent p = 25)	1	0.858	0.346	-0.276	-0.480	0.608	0.547
Individual Income Rank		1	0.512	-0.253	-0.418	0.311	0.478
Employment Rate			1	-0.114	-0.071	0.040	0.141
Incarceration Rate				1	0.182	-0.198	-0.154
Fraction with Teen Birth					1	-0.273	-0.350
Fraction Married						1	0.253
Household Income Rank (Parent p = 75)							1

Notes: This table presents correlations between tract-level estimates of various child outcomes conditional on parent income at the 25th percentile (Columns 1- 5) or the 75th percentile (Column 6). Panel A presents correlations between household income rank conditional on parent income at the 25th percentile across different racial groups. These correlations are "signal" correlations (see notes to Figure V for details) and are estimated from variation across tracts within CZs. Panel B presents correlations between seven different tract-level outcomes including all subgroups of children. Six of the outcomes are conditional on parent income at the 25th percentile: household income rank, individual income rank, an indicator for positive earnings (employment), an indicator for incarceration on April 1, 2010 (see Figure I for more details), an indicator for claiming a child born when the child is between 13 and 19 years old (teen birth, defined for women only), and an indicator for filing taxes as a married couple in 2015. The last outcome is household income rank conditional on parent income at the 75th percentile. These correlations control for race (see notes of Figure V for details) and CZ fixed effects, and are adjusted for attenuation due to noise infused in the estimates.

Table IV
Quasi-Experimental Estimates of Tract-Level Exposure Effects

	Baseline	No Age Interactions	Married at 30	Incarcerated	Family FEs
	(1)	(2)	(3)	(4)	(5)
Age <= 23	-0.027	-0.026	-0.027	-0.025	-0.021
	(0.001)	(0.001)	(0.001)	(0.005)	(0.002)
Age > 23	-0.008	-0.004	0.003	0.010	-0.004
	(0.009)	(0.008)	(0.009)	(0.033)	(0.009)
Num. of Obs.	2,814,000	2,814,000	1,614,000	1,484,000	2,814,000

Notes: This table reports estimates of annual childhood tract level exposure effects on children's household income ranks at age 24 (Columns 1, 2 and 5), marriage (Column 3), and incarceration (Column 4). Standard errors are shown in parentheses. Each column reports estimates from a split-sample IV regression of a child's household income rank at age 24 on the difference between parent income-specific predicted income ranks in the destination vs. the origin, interacted with the age of the child at the time of the move (m). Column 1 reports estimates from equation (9) using all children in the primary analysis sample of one-time movers. We permit separate linear interactions for age m≤23 and m>23. The estimates can be interpreted as the impact of delaying by one year moving to a tract which has a 1 percentile point higher predicted income rank, essentially a linear fit to the coefficients in Figure XI above and below age 23. Column 2 estimates exposure effects omitting the interaction terms between age and predicted ranks in the origin tract that were included in column 1. Columns 3 and 4 replicate column 1 using marriage rates at 30 and incarceration rates respectively (rather than household income ranks) to measure both the child's outcome (dependent variable) and the predictions (independent variables). Column 5 adds family fixed effects to the specification in column 1; here we identify exposure effects from families of one-time movers with two or more children of different ages at the time of move.

Table V
Quasi-Experimental Estimates of Tract-Level Exposure Effects: Placebo Tests

	Income Rank at 24 (1)	Married at 30 (2)	Incarceration (3)
Mean Income Rank at 24	-0.026	0.003	-0.001
	(0.002)	(0.004)	(0.001)
Frac. Married at 30	-0.002	-0.025	0.000
	(0.001)	(0.002)	(0.000)
Incarceration Rate	-0.017	-0.019	-0.036
	(0.009)	(0.023)	(0.005)
Num. of Obs.	2,222,000	1,614,000	1,481,000

Notes: This table reports estimates of annual childhood exposure effects when using predictions for multiple outcomes simultaneously. Standard errors are shown in parentheses. Each column reports estimates of annual childhood exposure effects based on children's predicted income ranks at age 24, the marriage rates at age 30, and incarceration rates on April 1, 2010. The estimates in each column can be interpreted as the impact on a given individual outcome of delaying by one year moving to a tract which has a 1 percentile or 1 pp higher predicted value of each of the regressors. Column 1 uses child income rank at age 24 as the outcome, while columns 2 and 3 use marriage at 30 and incarceration as the outcome variables, respectively.

Table VI
Quasi-Experimental Estimates of Tract-Level Causal Exposure Effects: Heterogeneity Analysis

	Baseline (1)	Good and Bad Moves (2)	Large Moves (3)	Observed Components of Opportunity (4)	Unobserved Components of Opportunity (5)
Age <= 23	-0.027		-0.046	-0.020	-0.025
	(0.001)		(0.017)	(0.001)	(0.003)
Age <= 23, Good Moves		-0.031			
		(0.002)			
Age <= 23, Bad Moves		-0.027			
		(0.002)			
Observations	2,814,000	2,814,000	22,500	2,692,000	2,692,000

Notes: This table reports estimates of annual childhood exposure effects on children's family income ranks at age 24 for different subgroups of one-time movers. See notes to Table IV for more details on these specifications. Standard errors are shown in parentheses. Column 1 replicates Column 1 from Table IV as a reference. Column 2 reports exposure effects separately for one-time movers who move to tracts with higher vs. lower predicted income ranks using a specification that allows the effects to vary for these two groups. Column 3 restricts to the subgroup of one-time movers who move either from the top to bottom or bottom to top decile of the within-CZ rankings of upward mobility estimates. In Column 4, we replace mean observed income ranks on the right hand side of the regression with ranks predicted based on the following neighborhood characteristics: the total number of jobs within 5 miles, the total number of high paying jobs within 5 miles, local unemployment rates, local poverty rates, local high school test scores, the fraction attending college locally, the fraction completing high school locally, the median two-bedroom rent in the tract, the share of area residents who are owner-occupiers, the local share of single-parent families, and area population density. In Column 5, we instead use the residuals from this regression (the "unobservable" component of incomes) as the regressor.

Online Appendix Table Ia
Summary Statistics for Primary Analysis Sample, by Race and Ethnicity (1978-1983 Birth Cohorts)

	White			Black			Hispanic		
	Pooled	Male	Female	Pooled	Male	Female	Pooled	Male	Female
	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
A. Parental Characteristics									
Median Parent Household Income	71,470	71,510	71,430	29,600	29,910	29,300	33,470	33,400	33,540
Mean Parent Household Income Percentile Rank	58.4	58.4	58.3	33.1	33.4	32.8	36.5	36.4	36.6
SD of Mean Parent Household Income Percentile Rank	27.1	27.0	27.1	24.4	24.5	24.2	25.4	25.4	25.5
Father Presence	86.2%	86.8%	85.5%	49.6%	50.7%	48.4%	73.7%	74.8%	72.7%
Mother Presence	93.4%	92.9%	93.9%	83.0%	82.3%	83.6%	83.5%	82.5%	84.4%
Two Parent Family	79.6%	79.7%	79.5%	32.5%	33.0%	32.0%	57.2%	57.3%	57.2%
B. Income and Employment Outcomes in Adulthood									
Median Household Income ($)	53,920	52,120	55,970	20,740	17,780	22,820	35,250	35,310	35,190
Mean Household Income Percentile Rank	55.8	54.7	57.0	34.9	32.7	37.0	45.7	44.7	46.8
SD of Mean Household Income Percentile Rank	28.3	28.5	28.1	23.2	24.3	21.9	26.1	26.5	25.6
Median Individual Income ($)	33,760	40,830	26,730	19,630	18,270	20,510	27,220	32,280	23,060
Mean Individual Income Percentile Rank	53.4	58.6	48.0	42.1	40.9	43.3	48.2	51.7	44.6
SD of Mean Individual Income Percentile Rank	28.7	28.7	27.8	25.9	27.7	23.9	27.1	28.3	25.4
P(Child Household Income in Q5)	25.3%	23.8%	26.9%	5.5%	5.5%	5.6%	12.6%	11.6%	13.5%
P(Child Individual Income in Q5)	23.3%	29.7%	16.5%	10.7%	11.9%	9.5%	15.7%	20.4%	10.9%
P(Child Household Income in p100)	1.3%	1.1%	1.4%	0.1%	0.1%	0.1%	0.3%	0.3%	0.4%
P(Child Individual Income in p100)	1.3%	1.7%	0.8%	0.2%	0.3%	0.2%	0.4%	0.5%	0.3%
Employment Measured in Tax Data	78.6%	81.7%	75.4%	76.2%	71.0%	81.2%	76.9%	77.8%	76.1%
C. Other Outcomes on Full Population									
Marriage Rate	54.7%	51.5%	58.1%	16.3%	16.9%	15.8%	37.3%	35.0%	39.7%
Incarceration Rate	0.9%	1.5%	0.2%	5.1%	10.3%	0.6%	1.5%	2.9%	0.2%
Teen Birth Rate			13.5%			41.3%			29.3%
Spouse Individual Income Percentile Rank	63.2	54.2	72.2	57.4	52.8	62.6	58.2	48.5	67.6
SD of Spouse Individual Income Percentile Rank	26.3	27.3	21.8	25.5	26.2	23.6	26.5	26.8	22.6
Fraction Living in Low Pov. Neighborhood	54.6%	53.9%	55.2%	27.7%	27.4%	27.9%	36.3%	35.6%	37.1%
Fraction Living in Childhood CZ in adulthood	63.2%	63.9%	62.5%	71.7%	71.1%	72.3%	75.0%	75.1%	74.9%
Fraction Living in Childhood Tract in adulthood	19.2%	21.1%	17.1%	22.6%	25.5%	19.8%	24.2%	26.4%	22.0%
Fraction Living with Parents in adulthood	11.6%	13.1%	10.1%	21.0%	23.9%	18.6%	23.0%	24.8%	21.2%
Mean HH Income Rank for Children who stay in CZ	52.8	51.7	54.0	33.0	30.9	34.9	44.9	43.9	45.9
SD of Mean HH Income Rank for Children who stay in CZ	28.1	28.2	27.9	21.6	22.8	20.3	25.4	25.9	24.9
Mean Indiv. Income Rank for Children who stay in CZ	51.3	55.8	46.6	40.8	39.6	41.9	48.0	51.1	44.9
SD of Mean Indiv. Income Rank for Children who stay in CZ	28.0	28.5	26.7	24.9	26.8	22.8	26.5	27.9	24.7
D. ACS Outcomes									
Employment in the ACS	86.6%	91.5%	81.6%	75.1%	70.1%	79.6%	81.5%	85.5%	77.8%
Hours Worked Per Week	32.98	37.67	28.34	26.01	24.88	27.05	29.72	33.02	26.60
SD of Hours Worked Per Week	18.51	17.43	18.38	19.63	20.89	18.34	18.88	18.80	18.43
Median Wages ($/hr)	18.89	19.76	17.71	14.71	14.72	14.57	16.19	16.90	15.69
Mean Wage Percentile Rank	51.5	53.8	49.0	41.2	41.5	40.9	45.6	47.1	44.1
SD of Mean Wage Percentile Rank	28.8	28.8	28.5	27.4	27.8	27.1	27.9	28.3	27.3
Fraction with HS Degree	88.7%	86.7%	90.8%	78.0%	73.0%	82.6%	76.9%	73.4%	80.3%
Fraction with Some 4-Year College Credits	72.7%	67.4%	78.0%	56.7%	47.2%	65.5%	56.4%	50.3%	62.1%
Fraction with Community College Degree	50.4%	44.5%	56.2%	29.0%	21.6%	35.7%	30.2%	25.3%	34.9%
Fraction with 4-Year College Degree	40.1%	35.0%	45.0%	21.0%	15.4%	26.0%	21.3%	17.4%	25.0%
Fraction with Grad Degree	14.6%	11.7%	17.4%	8.0%	4.9%	10.8%	7.0%	5.2%	8.7%
Fraction Receiving Public Assistance	1.9%	1.3%	2.5%	4.6%	2.0%	6.9%	3.1%	1.5%	4.5%
Mean Household Income Rank for Natives	57.0	56.0	58.1	35.5	33.5	37.5	47.0	46.0	47.9
SD of Mean Household Income Rank for Natives	27.8	27.9	27.6	23.2	24.4	21.9	26.8	27.1	26.4
Mean Individual Income Rank for Natives	54.2	59.6	48.6	42.9	41.9	43.8	48.5	52.5	44.8
SD of Mean Individual Income Rank for Natives	28.3	28.1	27.5	25.8	27.7	23.8	27.4	28.4	25.8
Mean Household Income Rank for Immigrants	58.5	56.8	60.4	44.9	42.2	47.5	48.3	47.0	49.6
SD of Mean Household Income Rank for Immigrants	29.4	29.8	28.8	26.5	27.5	25.2	26.0	26.5	25.4
Mean Individual Income Rank for Immigrants	56.8	60.5	52.9	51.1	49.5	52.5	50.8	53.9	47.6
SD of Mean Individual Income Rank for Immigrants	30.2	30.2	29.7	28.2	29.6	26.7	27.1	28.2	25.5
Fraction Not Suppressed in Tract Collapse	0.9987	0.9981	0.9980	0.9585	0.9541	0.9579	0.9420	0.9253	0.9236
Number of Obs in Full Population	13,000,000	6,639,000	6,360,000	2,640,000	1,294,000	1,346,000	2,517,000	1,262,000	1,255,000
Fraction of Total	0.6356	0.3246	0.3110	0.1291	0.0633	0.0658	0.1231	0.0617	0.0614
Number of Obs in ACS Work Sample	1,033,000	514,000	519,000	139,000	66,500	73,000	148,000	72,000	76,000
Number of Obs in ACS Full Sample	2,855,000	1,429,000	1,426,000	433,000	207,000	226,000	443,000	220,000	224,000

Notes: This table replicates Table I, presenting summary statistics by race and gender for children in our primary analysis sample. All racial groups except Hispanics exclude individuals of Hispanic ethnicity.

Online Appendix Table Ib
Summary Statistics for Primary Analysis Sample, by Race and Ethnicity (1978-1983 Birth Cohorts)

	Asian			American Indian and Alaska Native		
	Pooled	Male	Female	Pooled	Male	Female
	(1)	(2)	(3)	(4)	(5)	(6)
A. Parental Characteristics						
Median Parent Household Income	53,350	52,680	54,040	36,710	36,820	36,610
Mean Parent Household Income Percentile Rank	49.4	49.1	49.8	38.2	38.3	38.1
SD of Mean Parent Household Income Percentile Rank	30.7	30.7	30.7	25.7	25.8	25.7
Father Presence	88.5%	88.6%	88.3%	71.1%	72.2%	70.1%
Mother Presence	92.1%	91.8%	92.5%	88.5%	87.8%	89.1%
Two Parent Family	80.6%	80.4%	80.8%	59.6%	60.0%	59.2%
B. Income and Employment Outcomes in Adulthood						
Median Household Income ($)	63,850	56,660	72,050	23,490	22,320	24,550
Mean Household Income Percentile Rank	60.7	57.6	64.0	37.8	36.7	38.8
SD of Mean Household Income Percentile Rank	29.6	30.0	28.8	26.2	26.3	26.0
Median Individual Income ($)	43,790	45,640	41,860	17,440	20,370	15,270
Mean Individual Income Percentile Rank	60.4	61.6	59.1	40.4	43.0	37.7
SD of Mean Individual Income Percentile Rank	30.4	30.4	30.3	26.6	28.3	24.5
P(Child Household Income in Q5)	34.6%	30.4%	38.9%	8.6%	8.0%	9.3%
P(Child Individual Income in Q5)	35.8%	37.5%	33.9%	10.6%	13.8%	7.2%
P(Child Household Income in p100)	3.1%	2.5%	3.8%	0.3%	0.2%	0.3%
P(Child Individual Income in p100)	3.0%	3.6%	2.4%	0.3%	0.4%	0.2%
Employment Measured in Tax Data	79.6%	80.5%	78.6%	70.3%	70.5%	70.0%
C. Other Outcomes on Full Population						
Marriage Rate	50.0%	45.4%	54.7%	32.3%	30.2%	34.3%
Incarceration Rate	0.3%	0.5%	0.0%	2.9%	5.0%	0.8%
Teen Birth Rate			6.8%			31.4%
Spouse Individual Income Percentile Rank	67.4	58.8	75.4	55.6	47.4	63.8
SD of Spouse Individual Income Percentile Rank	28.4	30.1	24.0	25.5	25.3	22.9
Fraction Living in Low Pov. Neighborhood	60.7%	59.3%	62.1%	29.2%	29.2%	29.2%
Fraction Living in Childhood CZ in adulthood	66.5%	69.2%	63.8%	65.7%	66.3%	65.2%
Fraction Living in Childhood Tract in adulthood	22.4%	26.3%	18.4%	27.1%	29.0%	25.2%
Fraction Living with Parents in adulthood	27.1%	31.8%	22.4%	20.3%	22.7%	18.0%
Mean HH Income Rank for Children who stay in CZ	57.7	54.6	61.1	36.9	36.1	37.7
SD of Mean HH Income Rank for Children who stay in CZ	29.3	29.5	28.7	25.3	25.6	25.1
Mean Individual Income Rank for Children who stay in CZ	58.5	59.0	58.0	40.0	42.5	37.5
SD of Mean Individual Income Rank for Children who stay in CZ	29.8	30.1	29.5	26.0	27.7	23.8
D. ACS Outcomes						
Employment in the ACS	88.2%	90.5%	85.9%	73.6%	77.0%	70.2%
Hours Worked Per Week	34.14	36.31	31.95	24.99	27.15	22.84
SD of Hours Worked Per Week	17.96	17.46	18.19	20.03	20.63	19.16
Median Wages ($/hr)	23.96	23.54	24.43	13.96	14.71	13.26
Mean Wage Percentile Rank	61.2	60.7	61.8	39.3	41.2	37.2
SD of Mean Wage Percentile Rank	29.9	30.1	29.6	27.0	28.0	25.6
Fraction with HS Degree	91.4%	90.1%	92.8%	77.3%	74.5%	80.1%
Fraction with Some 4-Year College Credits	84.6%	81.6%	87.7%	51.2%	44.2%	58.2%
Fraction with Community College Degree	67.3%	62.4%	72.3%	22.8%	18.4%	27.2%
Fraction with 4-Year College Degree	58.9%	53.9%	64.1%	14.6%	12.0%	17.3%
Fraction with Grad Degree	23.4%	19.9%	26.9%	4.2%	3.2%	5.2%
Fraction Receiving Public Assistance	1.1%	1.0%	1.3%	4.8%	2.6%	7.0%
Mean Household Income Rank for Natives	58.2	55.8	60.4	38.5	37.5	39.5
SD of Mean Household Income Rank for Natives	28.8	29.2	28.3	26.2	26.4	25.9
Mean Individual Income Rank for Natives	57.5	60.5	54.8	41.0	43.6	38.3
SD of Mean Individual Income Rank for Natives	29.4	29.4	29.1	26.4	28.0	24.4
Mean Household Income Rank for Immigrants	63.3	60.1	66.7	42.2	40.9	43.6
SD of Mean Household Income Rank for Immigrants	29.3	29.9	28.3	28.0	28.7	27.2
Mean Individual Income Rank for Immigrants	63.1	63.9	62.2	44.6	46.4	42.5
SD of Mean Individual Income Rank for Immigrants	30.2	30.2	30.1	28.4	29.7	26.7
Fraction Not Suppressed in Tract Collapse	0.7781	0.7290	0.7069	0.4897	0.4426	0.4591
Number of Obs in Full Population	673,000	344,000	330,000	134,000	68,000	66,000
Fraction of Total	0.0329	0.0168	0.0161	0.0066	0.0033	0.0032
Number of Obs in ACS Work Sample	46,000	23,000	23,000	12,000	6,100	6,100
Number of Obs in ACS Full Sample	128,000	65,000	63,000	31,000	15,500	15,500

Notes: This table replicates Table I, presenting summary statistics by race and gender for children in our primary analysis sample. All racial groups except Hispanics exclude individuals of Hispanic ethnicity.

Online Appendix Table II

Explanatory Power of Historical Mobility Estimates vs. Tract-Level Covariates: OLS Regression Estimates

	Dep Var: Upward Mobility for 1989 Cohort		
	(1)	(2)	(3)
Share of Variance by Specification			
Upward Mobility for 1979 Cohort	X	X	X
Share Single Parent (1990)		X	X
Share in Poverty (1990)		X	X
Share Single Parent (2010)			X
Share in Poverty (2010)			X
Adjusted R-squared	49.04%	60.19%	63.48%

Notes: This table presents the adjusted R-squared from regressions of upward mobility for the 1989 birth cohort (the mean child household income rank at age 26 given parents at the 25th percentile of income distribution) on upward mobility for the 1979 birth cohort and tract level characteristics measured in various years. We correct for sampling and noise-infusion error by rescaling the adjusted R-squared by the reliability ratio – the ratio of the signal variance to total variance of upward mobility for the 1989 cohort.

Online Appendix Table III
Quasi-Experimental Exposure Effect Estimates by Distance of Move and Marital Status

	Moves <= 25 miles			Moves > 25 miles		
	Single Dad (1)	Single Mom (2)	Two Parent (3)	Single Dad (4)	Single Mom (5)	Two Parent (6)
Age <= 23	-0.006	-0.007	-0.022	-0.027	-0.022	-0.030
	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)
Observations	931,000	1,705,000	2,329,000	287,000	417,000	898,000

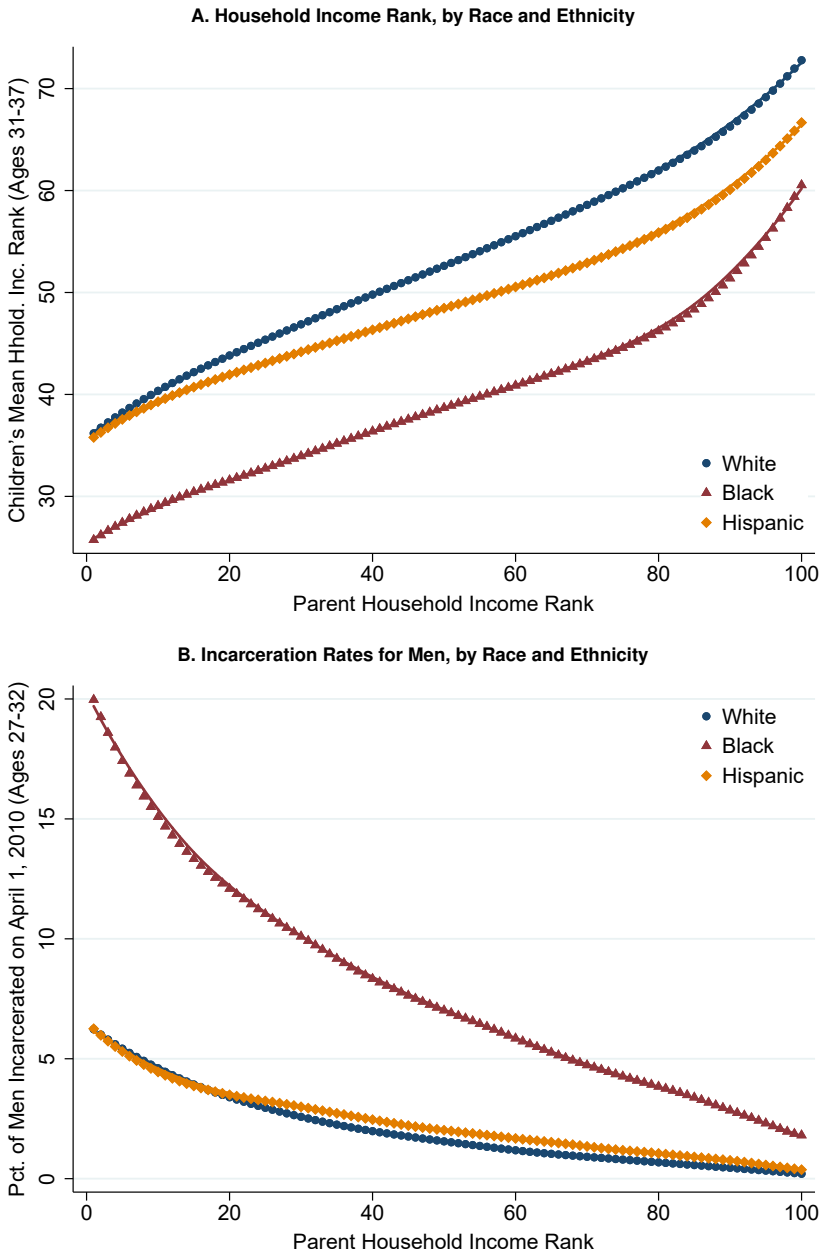
Notes: This table reports estimates of annual childhood tract-level exposure effects on children's family income ranks at age 24 for different subgroups of one-time movers. Columns 1-3 show exposure effects for moves between tracts that are less than 25 miles apart; columns 4-6 show estimates for moves between tracts that are more than 25 miles apart. Columns 1 and 4 restrict to movers with a single invariant claimer (in the tax records) who is male, columns 2 and 5 restrict to movers with a single invariant claimer who is female, and columns 3 and 6 restrict to movers with two invariant claimers who are married in every available tax year. See notes to Table IV for details on these specifications.

Online Appendix Table IV
Summary Statistics for Tract Movers Analysis Samples

		1-time Movers	Non 1-time Movers (0 & 2+ Movers)
Parent Family Income Rank	Mean	56.9	48.6
	Std. Dev.	29.2	28.7
	Num. of Obs.	3,100,000	42,000,000
Child Individual Income Rank at 24	Mean	51.5	49.5
	Std. Dev.	29.1	28.8
	Num. of Obs.	2,400,000	34,000,000
Child Household Income Rank at 24	Mean	51.8	49.6
	Std. Dev.	29.1	28.8
	Num. of Obs.	3,100,000	42,000,000
Child Incarcerated in 2010	Mean	0.9%	1.4%
	Std. Dev.	9.4%	11.8%
	Num. of Obs.	2,500,000	33,000,000
Child Married at 30	Mean	42.6%	38.1%
	Std. Dev.	49.4%	48.6%
	Num. of Obs.	1,800,000	22,000,000

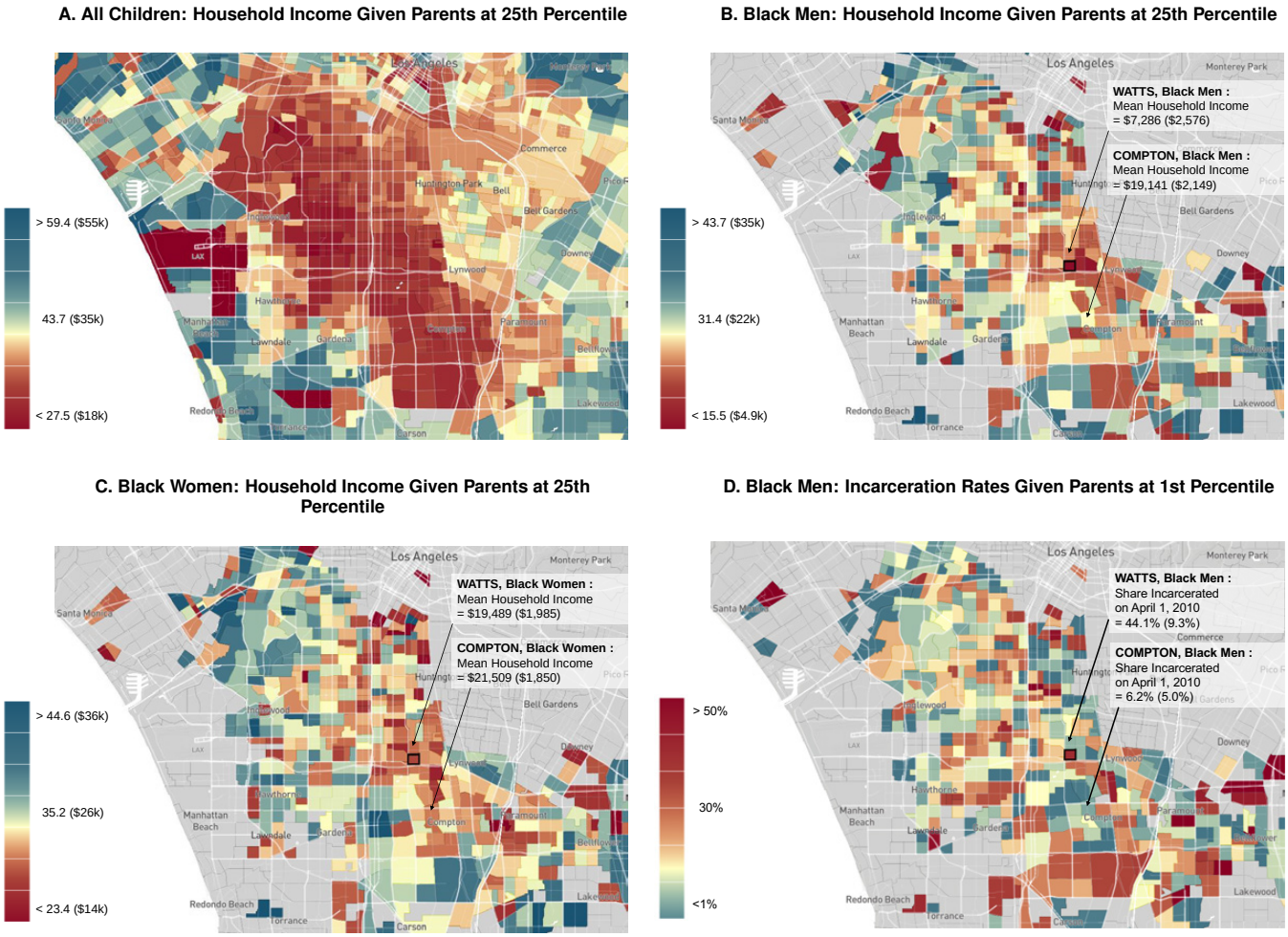
Notes: This table presents summary statistics for the samples used in our analyses of tract-level exposure effects. The full analysis sample extends the core sample described in Section III by including additional cohorts up until 1991 in order to observe moves at younger ages. Column (1) reports summary statistics for children whose parents moved across tracts exactly once throughout our sample window (1989-2015), are observed in their destination for at least two years, and moved at least 25 miles (based on their tract centroids). Column (2) reports summary statistics for children whose parents do not move across tracts throughout our sample window and for children whose parents move more than once across tracts. Parent family income is the average pre-tax household income from 1994-2000 measured as AGI. Child individual income is defined as the sum of individual W-2 wage earnings and half of household self-employment income. Incarceration is based on the individual's group home status in the 2010 US population census. Marital status is defined based on the marital status listed on 1040 forms for tax filers; non-filers are coded as single. See Section III for further details on variable and sample definitions.

FIGURE I: Children's Outcomes vs. Parental Income Rank



Notes: This figure plots the relationship between children's outcomes in adulthood and the income of their parents for non-Hispanic black children, non-Hispanic white children, and Hispanic children in our primary analysis sample (1978-83 birth cohorts). Panel A plots children's mean household income ranks in adulthood vs. their parents' income percentile. In each series, each point represents the mean income rank of children with parents in a single income percentile. Child income is the mean of 2014-2015 household income (when the child is between 31-37 years old), while parent income is mean household income from 1994-1995 and 1998-2000. Children are assigned percentile ranks relative to all other children in their birth cohort, while parents are ranked relative to all parents with children in the same birth cohort. Panel B replicates Panel A, replacing the outcome with an indicator for being incarcerated on April 1, 2010, as recorded on the 2010 Decennial Census Short Form, and focusing solely on male children. Incarceration is defined living in a federal detention center, federal prison, state prison, local jail, residential correctional facility, military jail, or juvenile correctional facility. For each series, we plot curves showing the lowess fit (with a bandwidth of 0.3) that we use as our estimate of the conditional expectation function $f_{rg}(p)$ discussed in Section III.

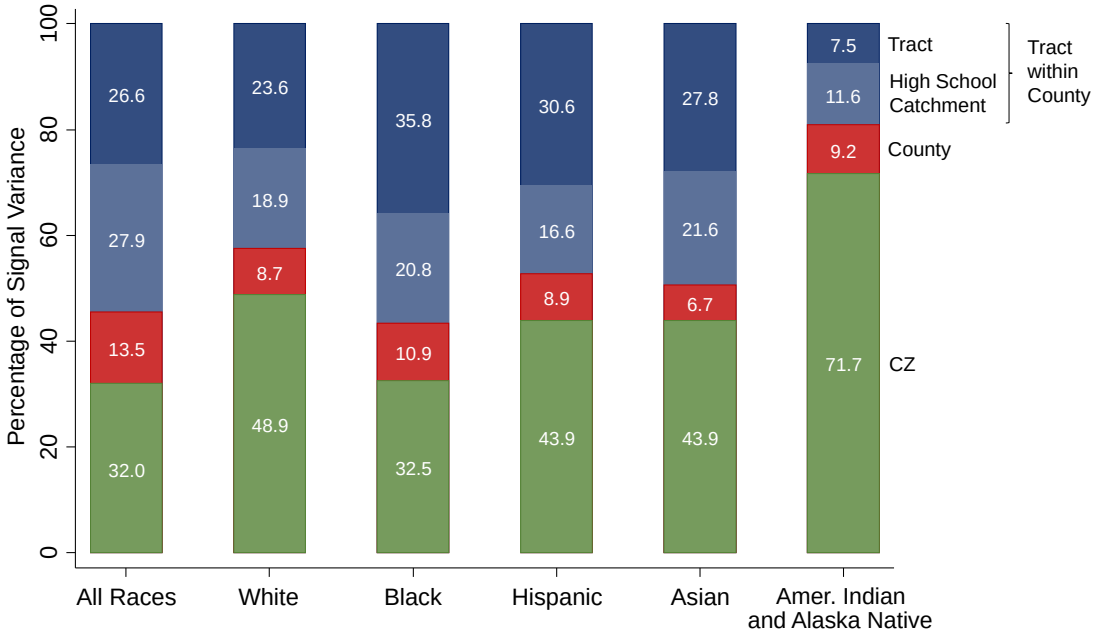
FIGURE II: Children's Outcomes in Adulthood, by Census Tract in Los Angeles



These maps must be printed in color to be interpretable.

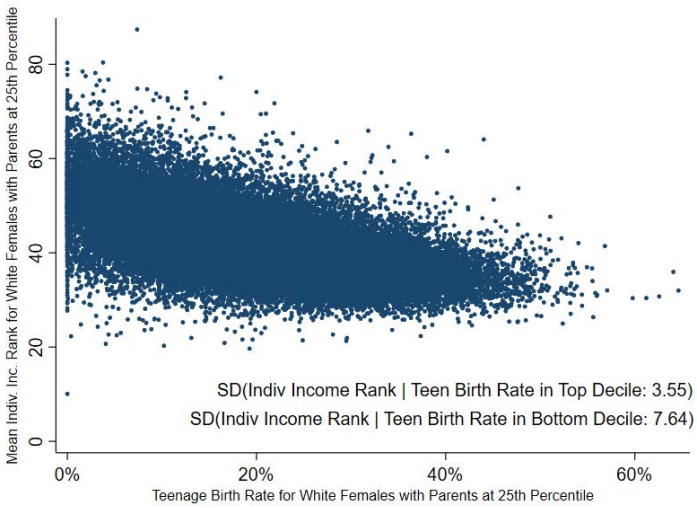
Notes: These maps display mean outcomes in adulthood of children who grew up in the Los Angeles metro area, by the tract in which they grew up. Panel A plots our estimates of mean household income ranks for children whose parents were at the 25th percentile of the national household income distribution (an income of approximately $27,000) using our primary analysis sample (1978-83 birth cohorts), which we hereafter refer to as "upward mobility." Upward mobility is estimated separately in each tract using linear regressions of children's income ranks on a tract-invariant transformation of parent income rank $f_{rg}(p)$ that is estimated at the national race-by-gender level using a lowess fit, as shown in Figure I. We weight each child by the number of years they lived in each tract before the age of 23 when estimating these regressions. Finally, we add independent Gaussian noise to the resulting tract-level estimates to protect privacy; the standard deviation of this noise is typically less than one-tenth of the standard error due to sampling variation. To facilitate interpretation, we report both mean income ranks and, in parentheses, the dollar values corresponding to those ranks based on the income distribution of children in 2015 in the legend. Panels B and C replicate Panel A, limiting the sample to non-Hispanic black male and female children, respectively. Panel D replicates Panel B for black men with parents at the 1st percentile, using an indicator for being incarcerated on April 1, 2010 as the outcome. In each panel, we report point estimates and standard errors (in parentheses) for selected tracts. The standard errors reported include the noise added to protect privacy. Tracts shown in gray are areas with no estimate due to insufficient data (fewer than 20 observations in the race-by-gender cell). See notes to Figure I for definitions of income and incarceration.

FIGURE III: Geographic Decomposition of Variance in Upward Mobility



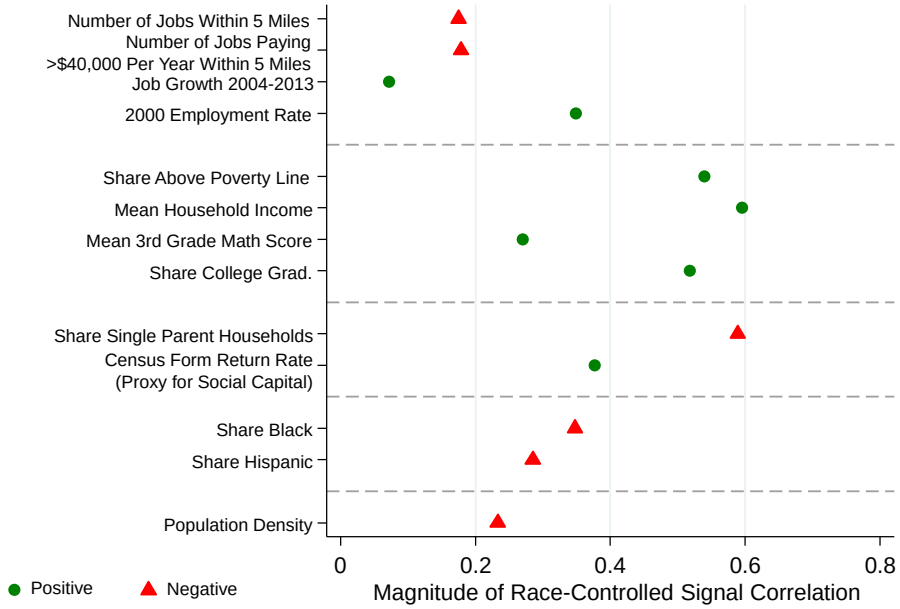
Notes: This figure presents a geographical variance decomposition of the tract-level estimates of upward mobility (children's mean household income ranks given parents at the 25th percentile), which are constructed as described in the notes to Figure II. We estimate the share of variance explained by each level of geography as the adjusted R-squared in a regression of the tract-level estimates on fixed effects for different levels of nested geographies, weighted by the number of children in each tract whose parents earn less than the national median income. We correct for sampling and noise-infusion error by rescaling the adjusted R-squared by the reliability ratio – the ratio of the signal variance to total variance of the tract-level estimates reported in Table II. We plot the share of signal variance explained by CZ fixed effects, county fixed effects, high school catchment area fixed effects, and the residual (attributed to tract-within-school catchment area). Tracts are not perfectly nested within catchment areas; we create an approximate crosswalk by assigning tracts to the school catchment area that contains the majority of their land area, as discussed in Online Appendix A.

FIGURE IV: Upward Mobility vs. Teenage Birth Rates for White Women



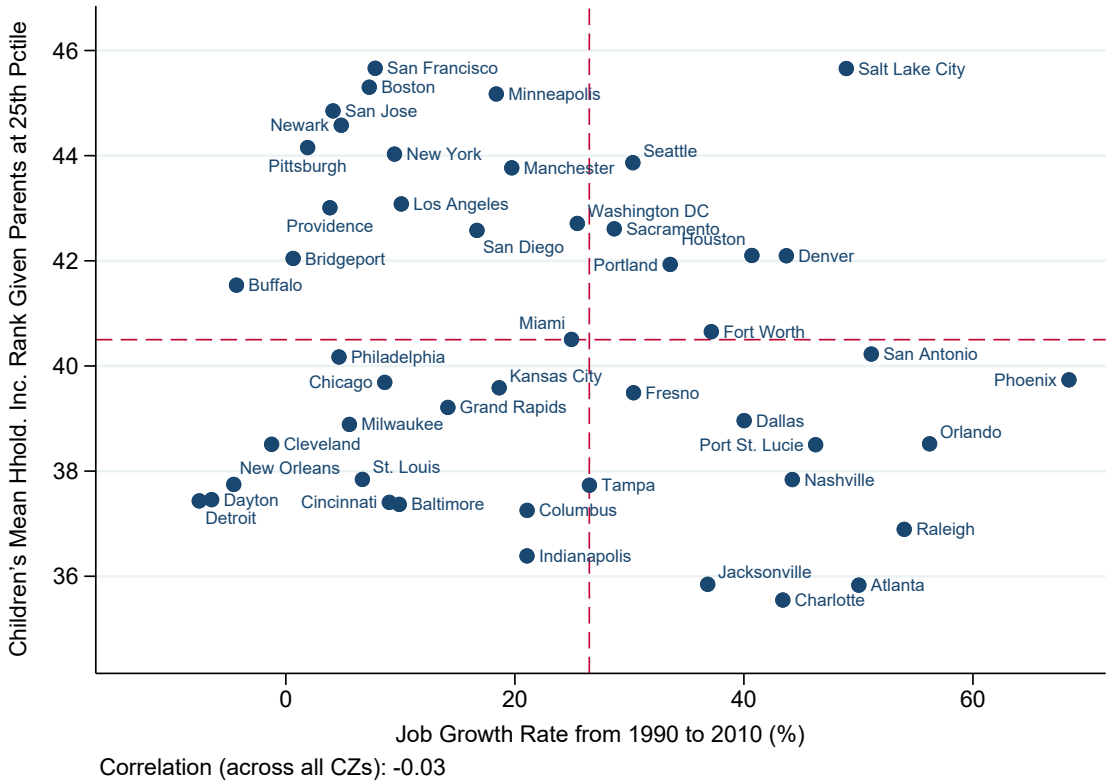
Notes: This figure presents scatter plots of mean individual income ranks vs. the teenage birth rate for white women with parents at the 25th percentile, by Census tract. Mean individual ranks are estimated as described in the notes to Figure II. Teenage birth is an indicator for ever claiming a dependent on a tax return who was born while the claimer was between ages 13 and 19. We limit the sample to tracts in which there are at least 100 observations for white women and bottom-code tracts with negative teenage birth rates to zero (negative values arise due to the addition of noise to the estimates). The standard deviations of mean income ranks reported conditional on having teenage birth rates in the bottom or top decile of the distribution are weighted by the number of white women in each tract whose parents earn less than the national median. We omit one tract in Canton, Michigan for scaling purposes; the x and y coordinates for this tract are (90%, 65.35).

FIGURE V: Tract-Level Correlations Between Neighborhood Characteristics and Upward Mobility



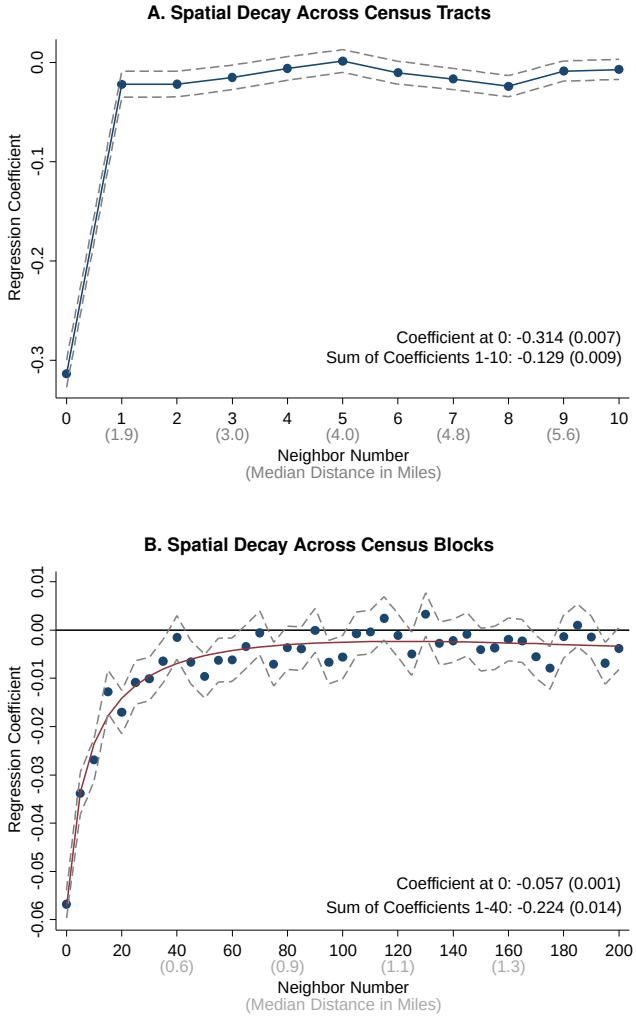
Notes: This figure plots univariate, race-controlled correlations between various tract-level characteristics and our estimates of upward mobility in each tract (children's mean household income ranks given parents at the 25th percentile, constructed as described in the notes to Figure II). The correlations are weighted by the number of children in each tract whose parents earn less than the national median income and are estimated using tract-within-CZ variation by demeaning all variables by CZ prior to estimating the correlations. We control for race when estimating each correlation coefficient by first estimating five separate correlations for each race (non-Hispanic Asians, non-Hispanic Blacks, non-Hispanic whites, American Indians, and Hispanics) and then taking a mean of the five correlations, weighting each of the five groups by its national population share in the 2000 Decennial Census. We estimate "signal" correlations that adjust for attenuation due to sampling error and noise infusion in our upward mobility estimates by rescaling the raw correlations by the square root of the reliability ratio, which is one minus the ratio of the noise variance (estimated as the mean standard error squared) to the total within-CZ variance of the upward mobility estimates. Red triangles denote negative correlations, while green circles denote positive correlations. See Online Appendix A for definitions of each of the characteristics.

FIGURE VI: Upward Mobility vs. Job Growth in the 50 Largest CZs



Notes: This figure presents a scatter plot of upward mobility in each CZ vs. the rate of job growth between 1990 and 2010 in the 50 largest CZs based on their populations in 2000. Upward mobility is constructed as described in the notes to Figure II. Job growth rates are defined as the percentage change in employment in each CZ using data from the Local Area Unemployment Statistics from the Bureau of Labor Statistics. We omit Las Vegas and Austin from the figure for scaling purposes as they have exceptionally high growth rates; the x and y coordinates for these CZs are: Las Vegas (107.7, 38.9) and Austin (87.9, 40.3). We also report the population-weighted correlation across all CZs (not just the top 50 CZs) as a reference.

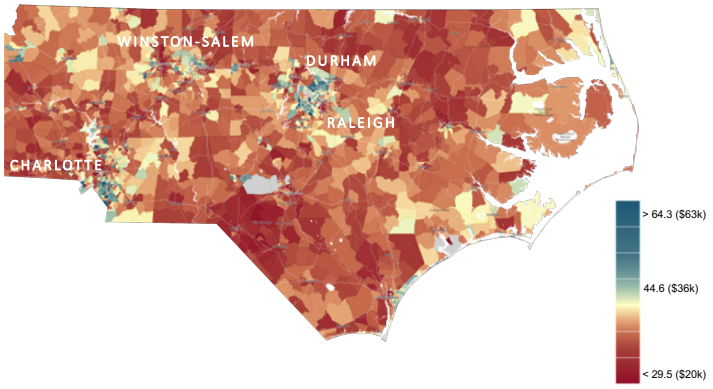
FIGURE VII: Spatial Decay of Correlation Between Upward Mobility for Whites and Poverty Rates



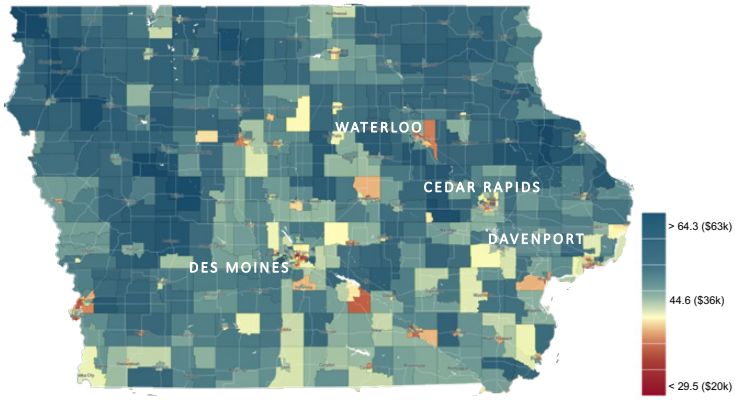
Notes: This figure plots the spatial decay of the relationship between upward mobility for whites and poverty rates at two different levels of geography: Census tracts (Panel A) and Census blocks (Panel B). Upward mobility refers to children's mean household income ranks given parents at the 25th percentile, constructed as described in the notes to Figure II. Tract-level poverty rates are obtained from the publicly available 2000 Decennial Census. Block-level poverty rates are estimated using tax records as the share of families whose total income (wages, social security income, dividends, interest income, and schedule E gains or losses) falls below the poverty line in 2010. To construct Panel A, we first standardize both the upward mobility and poverty rate measures, weighting by the number of children whose parents earn less than the national median. We then regress upward mobility on poverty rates in the same tract and the ten nearest neighbors (defined by the minimum cardinal distance between centroids) and plot the coefficients. To construct Panel B, we regress the household income rank of white children whose parents are between the 20th and 30th percentiles of the income distribution on block-level poverty rates for their own block and the 200 nearest blocks, binned into groups of 5. 95% confidence intervals for the estimates are shown by the dashed lines. In both panels, we also report the median distance between the own-tract (or block) and neighboring tracts (or blocks) in each of the bins as a reference.

FIGURE VIII: Heterogeneity in the Relationship between Upward Mobility and Population Density

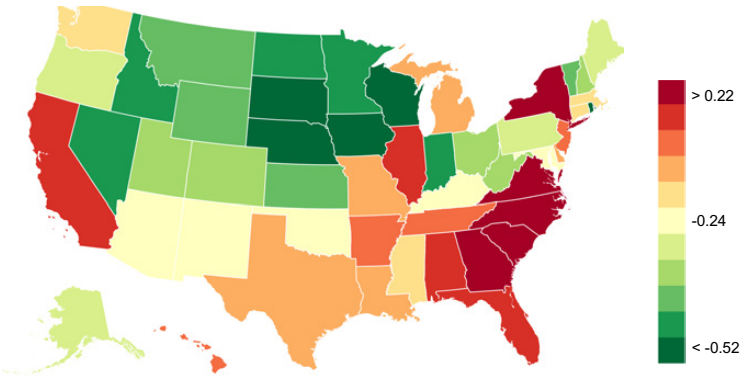
A. Mean Household Income Rank of White Children with Parents at 25th Percentile, North Carolina



B. Mean Household Income Rank of White Children with Parents at 25th Percentile, Iowa



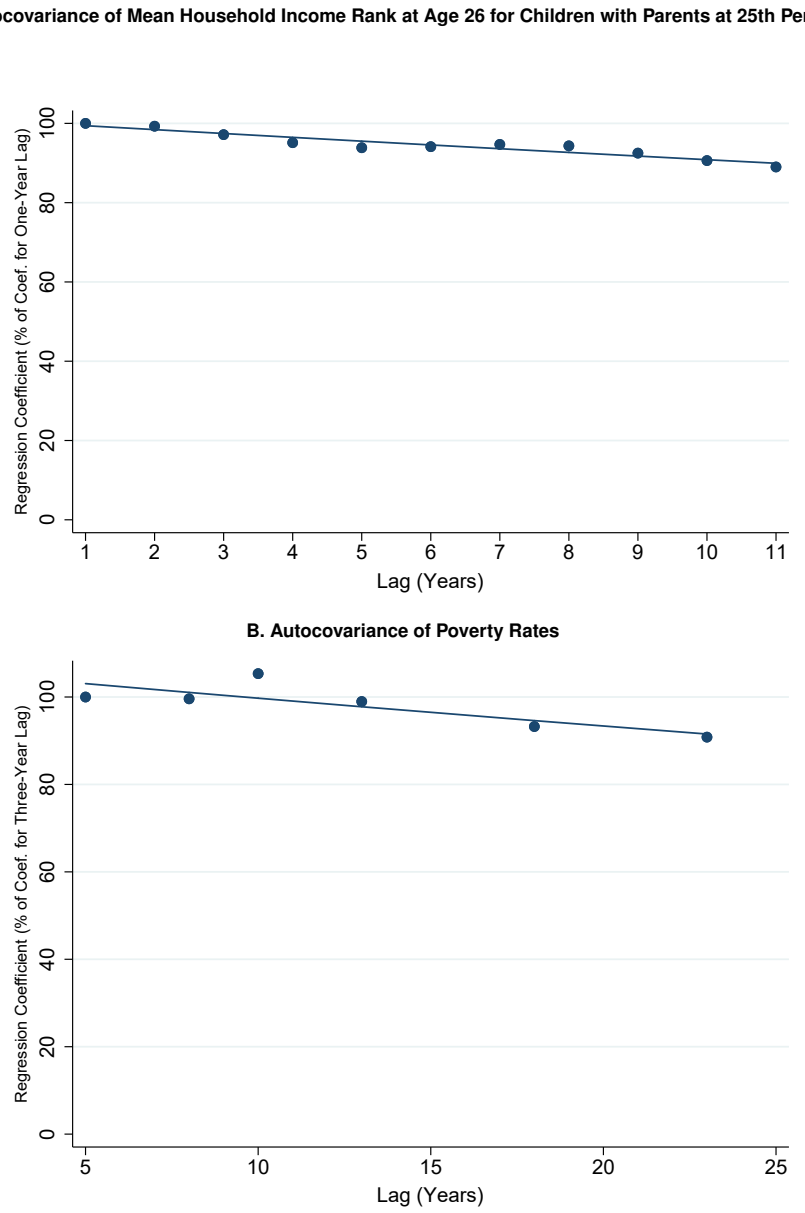
C. Correlations between Population Density and Upward Mobility for White Children, by State



These maps must be printed in color to be interpretable

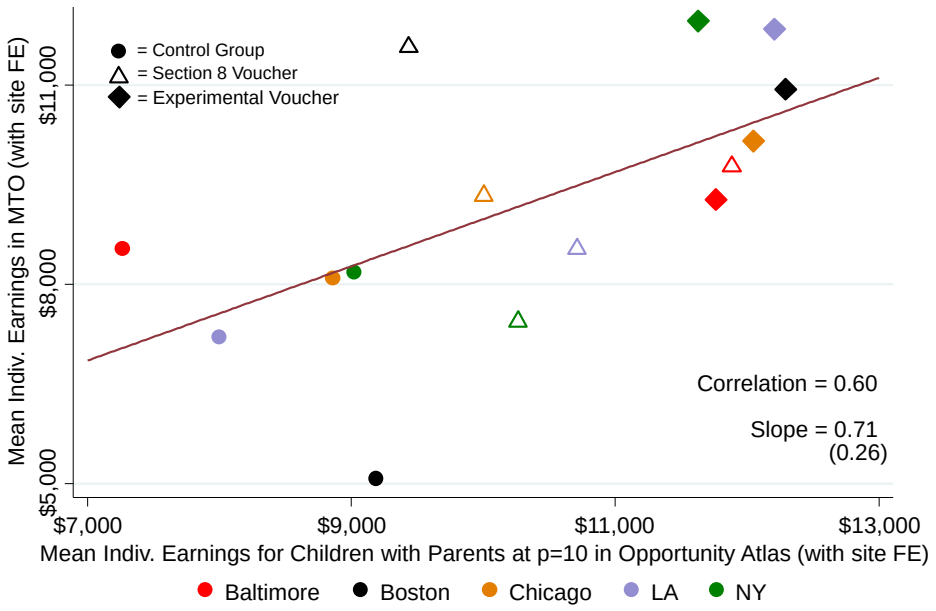
Notes: This figure analyzes the relationship between upward mobility (constructed as described in the notes to Figure II) and population density across the U.S. Panels A and B replicate Figure IIa, for white children in North Carolina (Panel A) and Iowa (Panel B). Panel C shows the signal correlation between upward mobility for white children and population density (measured using the 2000 Decennial Census) within each state, weighted by the number of children in each tract whose parents earn less than the national median. We estimate "signal" correlations that adjust for attenuation due to sampling error and noise infusion in our upward mobility estimates by rescaling the raw correlations by the square root of the reliability ratio, which is one minus the ratio of the noise variance (estimated as the mean standard error squared) to the total variance of the upward mobility estimates.

FIGURE IX: Changes in Tract-Level Outcomes and Characteristics Over Time



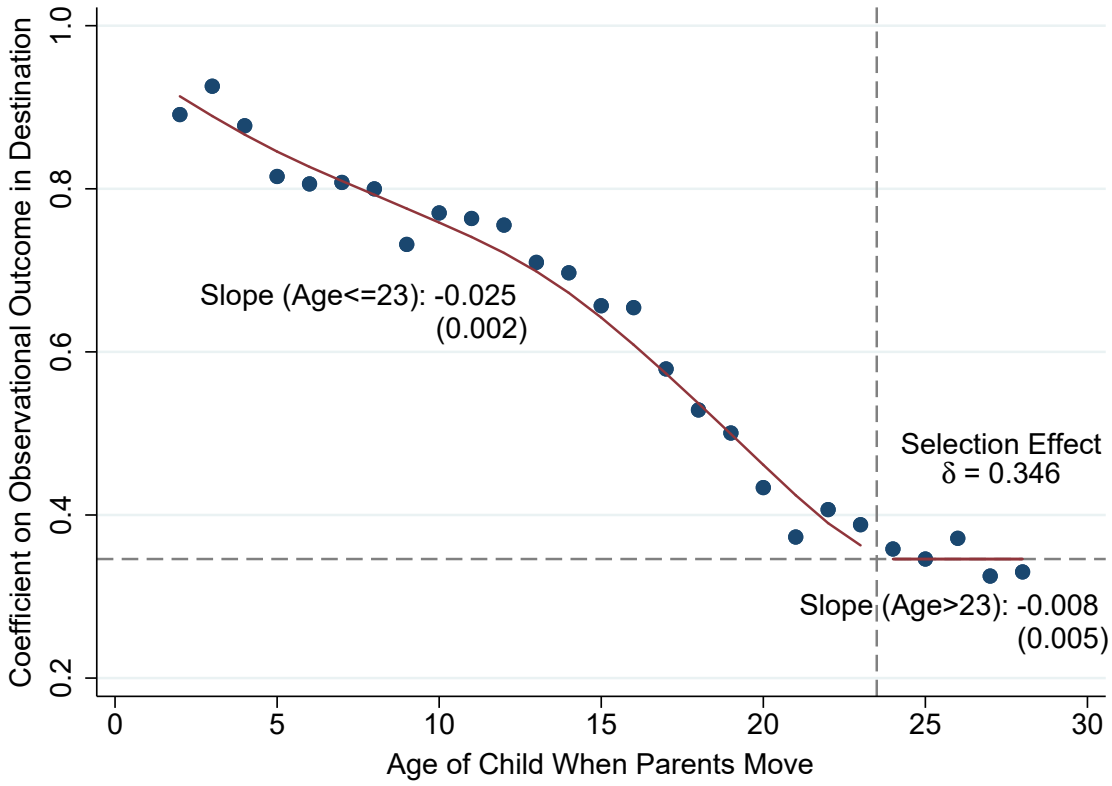
Notes: This figure examines how upward mobility and neighborhood characteristics change over time. Panel A shows the rate of decay in one's ability to forecast future cohorts' outcomes using historical data. It plots the coefficients from regressions of tract-level estimates of upward mobility for a given cohort t (constructed as described in the notes to Figure II) on estimates of upward mobility from a different birth cohort $t \pm x$, varying x from 1 to 11. We normalize the estimates by the coefficient of the regression with the one year lag/lead so that the estimates that are plotted can be interpreted as the percentage decay in the forecast coefficient. We extend our primary analysis sample to children born in the 1978-89 birth cohorts and measure children's incomes at age 26 in this figure in order to estimate as many lags as possible. To maximize precision, we use all available cohorts to estimate each covariance; for instance, the covariance at a lag of 1 is estimated using 11 pairs of cohorts. Panel B plots the autocovariance of tract-level poverty rates using publicly available data from the 1990, and 2000 Decennial Census and ACS data collected between 2006 and 2010 and between 2011 and 2015, which we pool to obtain an estimate for 2008 and 2013, respectively. This figure is constructed in the same way as Panel A, estimating the relationship between poverty rates at lags and leads of 5, 8, 10, 13, 18, and 23 years. See Online Appendix A for definition of poverty rates.

FIGURE X: Experimental Estimates of Earnings from Moving to Opportunity Experiment vs. Observational Estimates from Opportunity Atlas



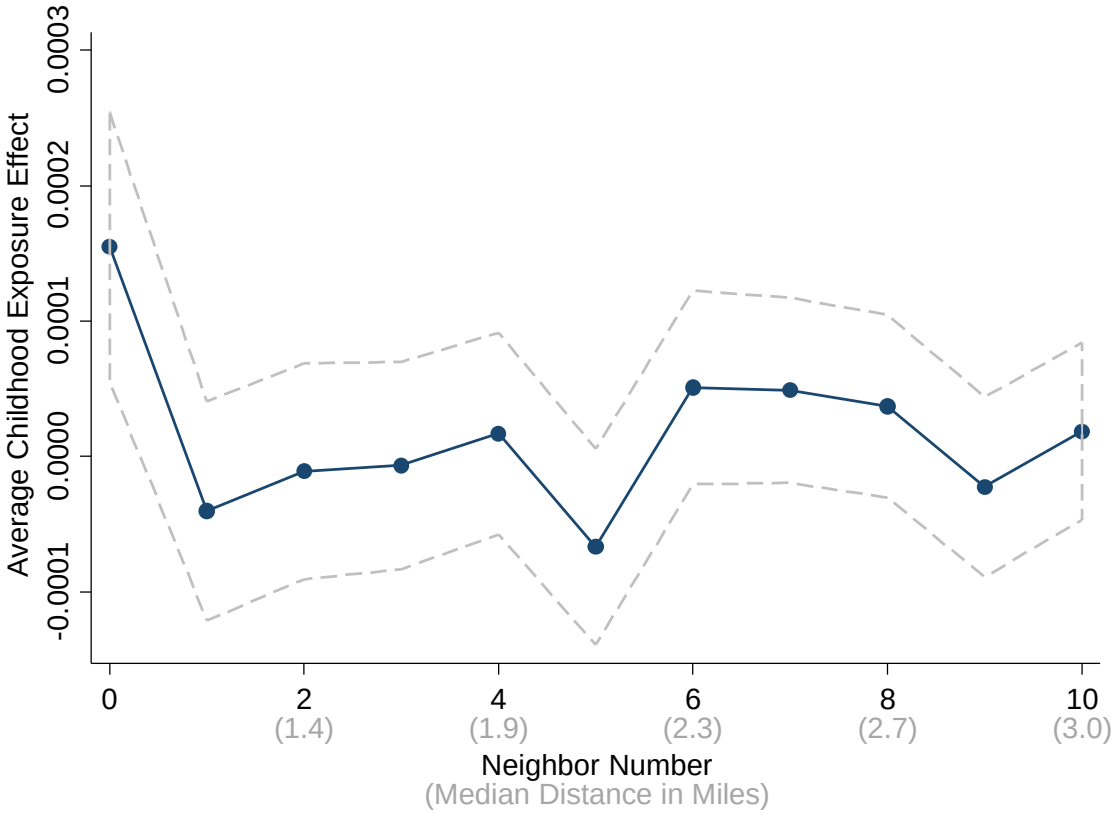
Notes: This figure plots estimates of children's earnings in adulthood from the Moving to Opportunity (MTO) experiment vs. children's mean observed earnings in adulthood in the Opportunity Atlas. The y-axis plots fifteen MTO estimates of earnings outcomes for children who were younger than 13 at the time of the experiment, for each of the five cities (sites) where MTO was conducted and for each of the three treatment arms (Control group, Section 8 Voucher group, and Experimental Voucher group). To construct the values, we start from the ITT estimates reported in Chetty, Hendren, and Katz (2016, Online Appendix Table 7, Panel B). We then construct implied treatment-on-the-treated (TOT) values for the Section 8 and Experimental groups as the mean observed earnings for the control group in the relevant site plus the site-specific ITT estimate for each treatment arm divided by the voucher takeup rate in that arm. To eliminate non-experimental variation across sites, we demean each set of estimates within site, and then add the mean income value observed for those in the MTO control group in Chicago (thereby normalizing estimates to observed earnings levels in Chicago). The x-axis plots observational estimates from the Opportunity Atlas of children's mean earnings in adulthood conditional on having low-income parents for the neighborhoods corresponding to those where children in each of the MTO groups grew up. To construct these estimates, we first identify these neighborhoods by mapping the neighborhood names listed in Online Appendix Table 1c of Chetty, Hendren, and Katz (2016) to Census tracts. We then take a population-weighted mean of children's predicted individual income ranks in adulthood across the relevant Census tracts, conditional on having parents at the 10th percentile of the income distribution (approximately the average income of parents in the MTO sample). Finally, we translate these mean ranks to dollar values at age 26 (the average age at which children's earnings were measured in the MTO sample) using a crosswalk from ranks to dollars in 2015. As with the MTO estimates, we demean children's incomes within site and add back the estimate for the mean over the set of tracts we use for the control group in Chicago. The best-fit line and slope estimates are based on an unweighted regression of the MTO estimates on the Opportunity Atlas estimates. The figure reports both the regression coefficient (with standard error in parentheses) and the corresponding correlation coefficient.

FIGURE XI: Childhood Exposure Effects: Quasi-Experimental Estimates Using Movers



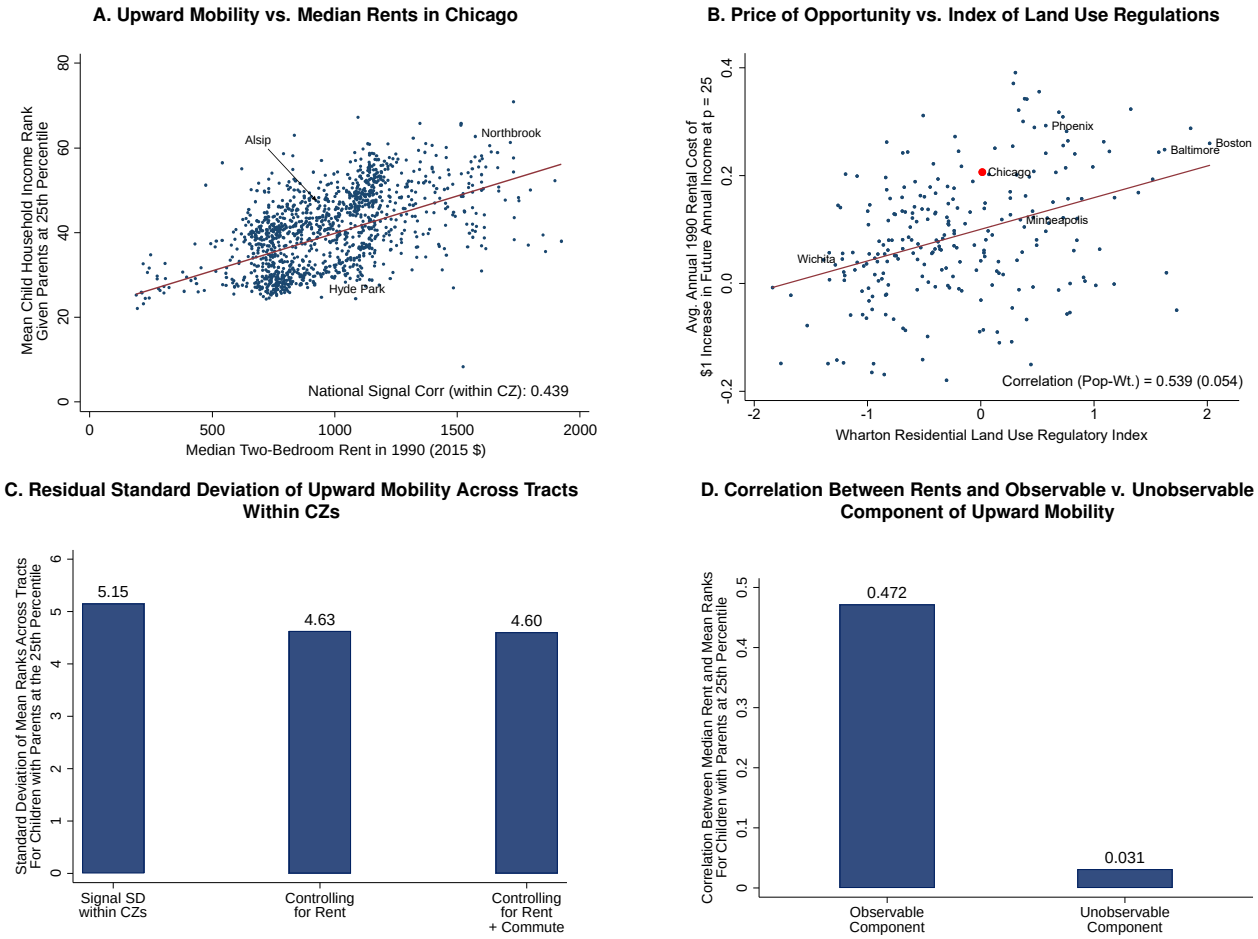
Notes: This figure plots the effect of moving to a tract where children have one percentile point higher household income ranks in adulthood, by the age at which children move. To construct the figure, we first estimate mean observed outcomes in each tract following the methodology described in Figure II, except that we (1) pool data from the 1978-91 birth cohorts and measure income at age 24 and (2) exclude all children who move exactly once between 1989-2015. We extend our primary sample to the 1978-91 birth cohorts for this analysis in order to observe moves at earlier ages and exclude one-time movers to avoid having the same observations on the left- and right-hand side of the regression specifications we use in what follows. We then take the set of children who move exactly once between two tracts that are at least 25 miles apart, and regress their household income ranks at age 24 on the difference in the observational predictions between their destination and origin tracts (at the relevant parental income percentile) interacted with indicators for their ages at move as well as the other controls specified in equation (8). The figure plots the resulting regression coefficients (b_m) vs. children's ages at move (m), along with a lowess fit to these points below age 23. We also report linear slopes and standard errors using unweighted OLS regressions of b_m on m, separately for moves at or below age 23 and above age 23. The parameter δ – defined as the mean value of the age-of-move-specific coefficients for moves older than age 23 – represents a selection effect because moves after age 24 cannot affect income measured at age 24. The dashed horizontal line shows the value of the selection effect δ; the identification assumption underlying the analysis is that the selection effect δ does not vary with the child's age at move m. Under this assumption, the magnitude of the slope for moves below age 23 represents an estimate of the average annual causal childhood exposure effect.

FIGURE XII: Predictive Power of Poverty Rates in Actual Destination vs. Neighboring Tracts



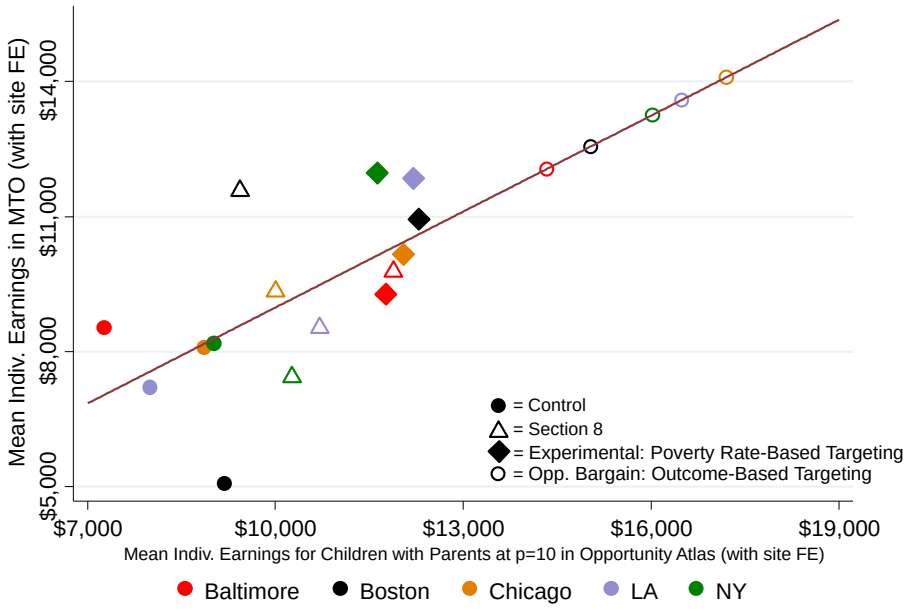
Notes: This figure plots coefficients from a regression that identifies childhood exposure effects using a specification analogous to that in Column 2 of Table IV, which is estimated on the sample of one-time movers who moved at least 25 miles. In the specification in Table IV, we regress children's household income ranks at age 24 on the difference in the observational predictions between their destination and origin tracts linearly interacted with their age at move (below age 23) and other controls specified in equation (9). Here, we replace the observational predictions on the right hand side with the poverty rates in the origin and destination tracts. We also include symmetric interactions between age at move and poverty rates in the ten tracts that are closest to the actual origin and destination tracts, respectively. We plot the eleven coefficients on the interactions between the destination-origin difference in poverty rates and age at move (for moves below age 23). These coefficients can be interpreted as the causal childhood exposure effect of moving to a tract that is x neighbors away from a tract has 1 SD higher poverty rates. Dashed lines show 95% confidence intervals for the point estimates. We also report the median distance between the own-tract and neighboring tracts in each of the bins as a reference.

FIGURE XIII: The Price of Opportunity



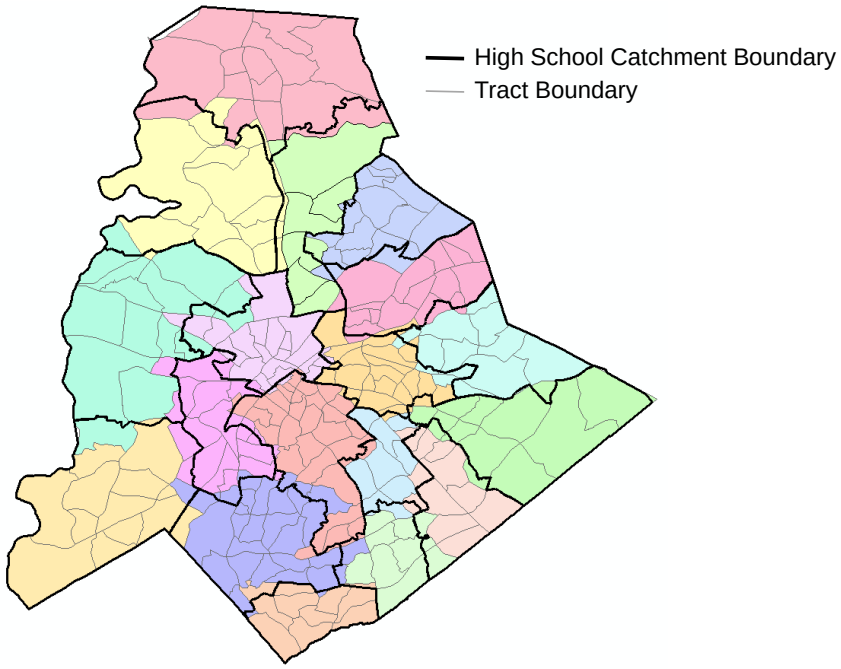
Notes: This figure assesses the relationship between our tract-level estimates of upward mobility (constructed as described in the notes to Figure II) and tract-level median rents (measured in the 1990 American Community Survey as the median rent in a tract for a two-bedroom apartment and inflated to 2015 dollars). Panel A presents a scatter plot of upward mobility vs. median rent, by tract in the Chicago CZ. We also report the signal correlation between upward mobility and rent within CZs nationally. This and all subsequent correlations and standard deviations that follow are weighted by the number of children with below-median income parents. This signal correlation is estimated by first demeaning both variables within CZs and then adjusting for attenuation due to sampling error and noise infusion in our upward mobility estimates by rescaling the raw correlations by the square root of the reliability ratio, which is the ratio of the noise variance to the total within-CZ variance of the upward mobility estimates. Panel B presents a scatter plot of the CZ-specific price of opportunity vs. the Wharton Residential Land Use Regulation index (WRLURI). To calculate the CZ-specific price of opportunity, we first regress median annual rents on upward mobility across tracts within a CZ, weighting as specified above. We then inflate this regression coefficient by the reliability of our upward mobility estimates (0.9) to adjust for noise. Finally, we map the estimates in ranks to dollars as above to obtain an estimate that can be interpreted as the average annual rental cost of a $1 increase in future annual income for children with parents at the 25th percentile. The WRLURI is obtained from Gyourko, Saiz, and Summers (2007, Wharton Land Regulation Data File) and is available for 247 CZs; we limit our sample to these CZs in Panel B. Honolulu is excluded from Panel B because it is an extreme outlier (0.41, 2.30). In Panel C, we report the signal root-mean-squared-error (RMSE) – i.e., the residual standard deviation – from a tract-level regression of our upward mobility estimates on CZ fixed effects alone (first bar); median rents and CZ fixed effects (second bar); and median rents, mean commuting times (measured in the 2000 ACS), and CZ fixed effects (third bar). The signal RMSE is computed by taking the raw RMSE from these regressions and multiplying by the square root of the reliability of the estimates across tracts within CZs. Panel D reports tract-level within-CZ correlations between median rents and the observable and unobservable components of our upward mobility estimates.We define the observable component as the predicted value from a national regression of upward mobility on the set of tract-level characteristics used in Figure V. We define the unobservable component as the residuals from the same regression. We adjust for noise in the unobservable component by reporting a signal correlation.

FIGURE XIV: Predicted Impacts of Moving to "Opportunity Bargain" Areas in MTO Cities



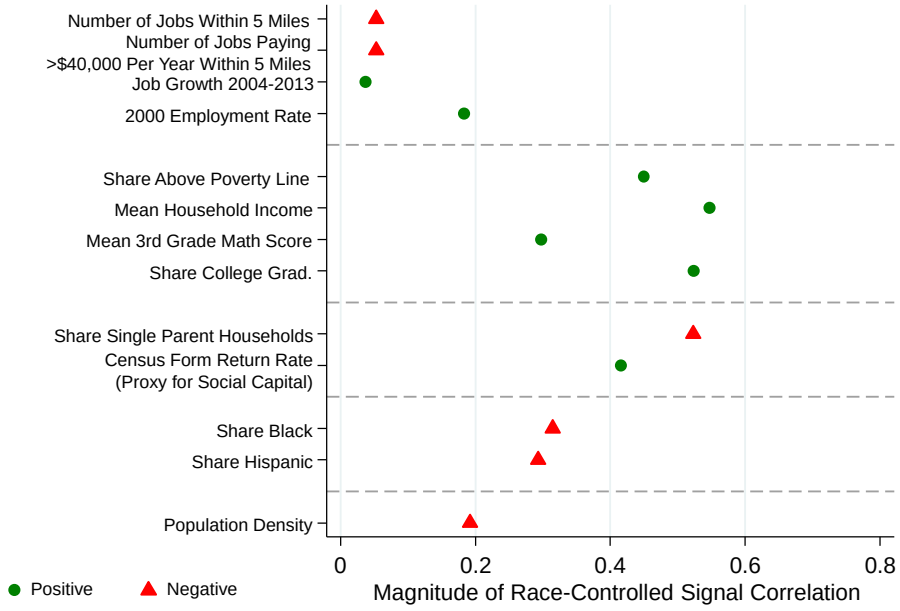
Notes: This figure replicates Figure X, adding five additional points (open circles) that show the predicted outcomes of children who grow up in "opportunity bargain" tracts in each of the five MTO cities. We define opportunity bargain areas in two steps. First, we count the number of tracts that would have been available to experimental voucher holders in the MTO experiment based on the official requirement that the poverty rate should be less than 10% in the 1990 census, which we denote by N_c. In the second step, we rank tracts within each city in descending order based on their mean observed individual income ranks conditional on having parents at the 10th percentile in the Opportunity Atlas data. We then take the N_c highest ranking tracts from the second step that satisfy the following two criteria: (1) median rent in 2000 (based on publicly available 2000 Decennial Census data) is less than or equal to the 90th percentile of the distribution of rents across the tracts where experimental or Section 8 voucher recipients moved in the same city and (2) the commute time using public transportation (as of May 29, 2018 at 8:00 AM, obtained from Google Maps) from the MTO control group tracts is less or equal to the 90th percentile of the distribution of commute times from the control locations to the tracts where experimental or Section 8 voucher recipients moved in the same city. Tracts where control group members and voucher recipients lived are identified by mapping the neighborhood names listed in Online Appendix Table 1c of Chetty, Hendren, and Katz (2016) to Census tracts. Once we have identified the set of opportunity bargain tracts in each city, we compute a population-weighted mean of children's predicted individual income ranks in adulthood across the relevant Census tracts, conditional on having parents at the 10th percentile of the income distribution. We then translate these mean ranks to dollar values at age 26 using a crosswalk from ranks to dollars in 2015 to obtain the five values plotted on the x-axis. The values on the y-axis are predicted values corresponding to these x values using the linear fit estimated in Figure X based on the 15 points from the MTO experimental data.

ONLINE APPENDIX FIGURE I: School Catchment Zone Boundaries in Mecklenburg County, NC



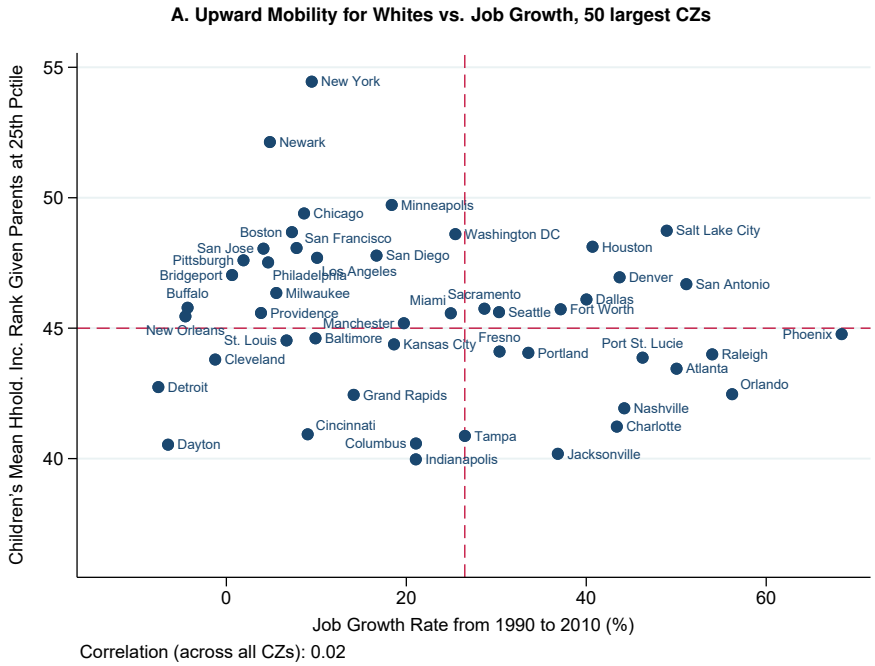
Notes: This figure presents a map of exact high school catchment areas (bold lines) in Mecklenburg County, North Carolina overlayed on tract boundaries (thin lines).

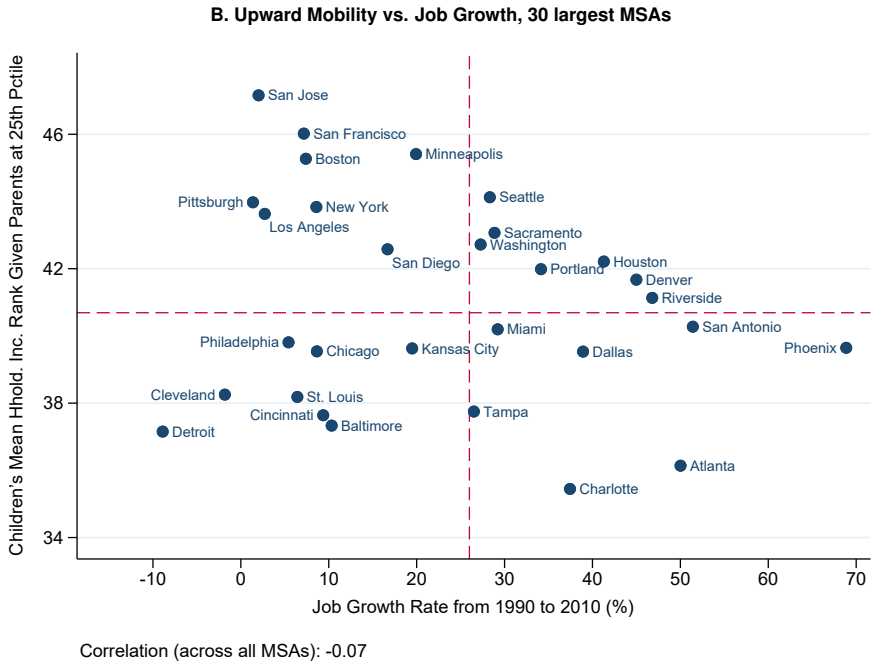
ONLINE APPENDIX FIGURE II: Tract-Level Correlations Between Neighborhood Characteristics and Children's Outcomes Given Parents at the 75th Percentile



Notes: This figure replicates Figure V using children's mean household income ranks given parents at the 75th percentile, instead of the 25th percentile. See notes to Figure V for details.

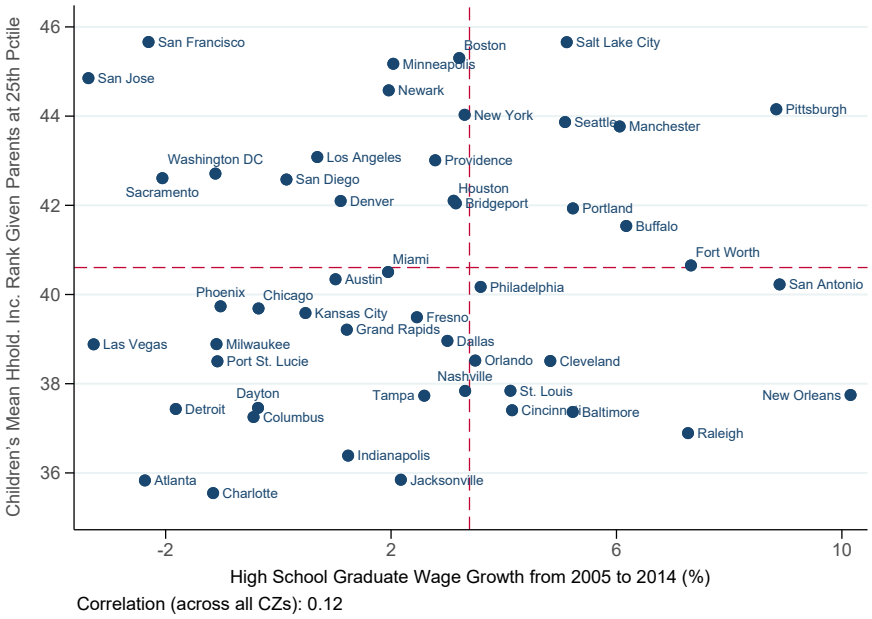
ONLINE APPENDIX FIGURE III: Upward Mobility vs. Job Growth





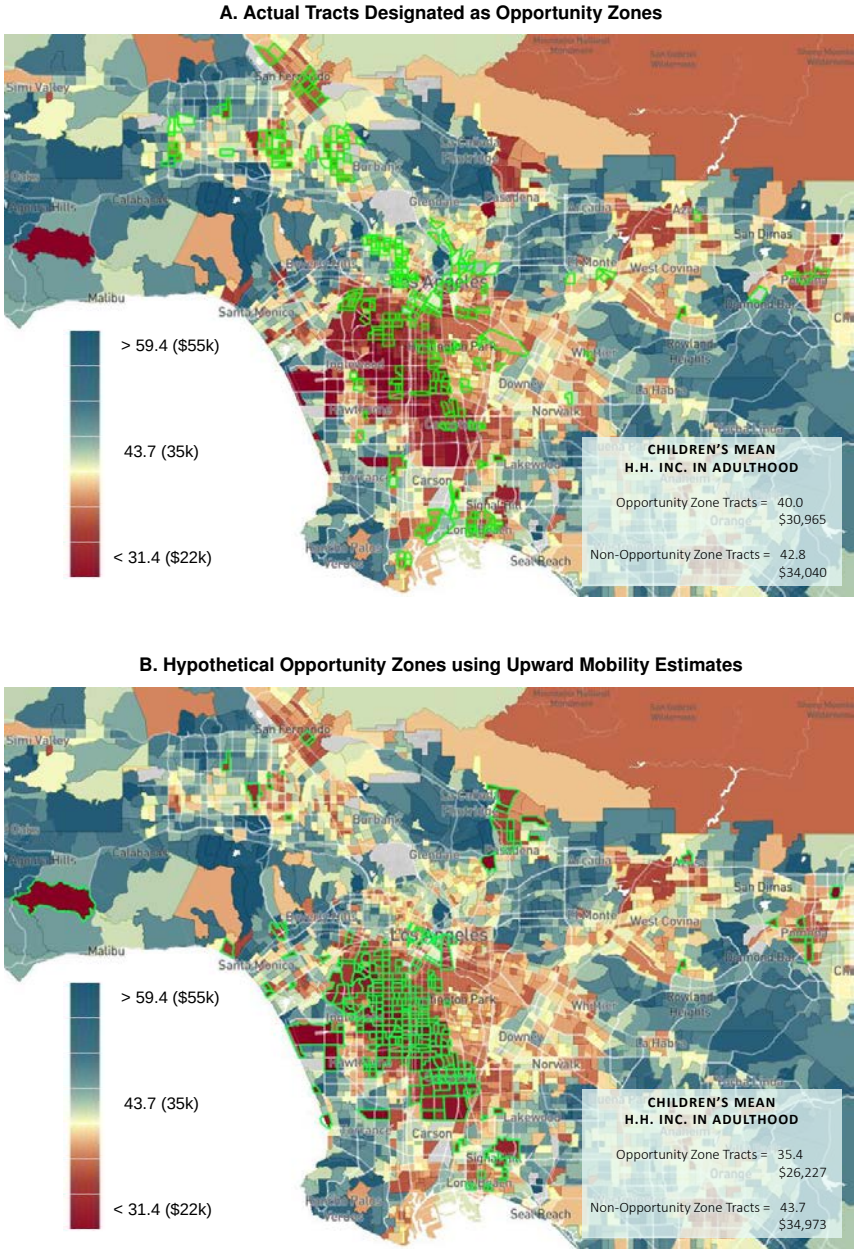
Notes: Panel A replicates Figure VI using upward mobility for whites on the y-axis. Panel B replicates Figure VI for the 30 largest metropolitan statistical areas instead of the 50 largest commuting zones. See notes to Figure VI for details.

ONLINE APPENDIX FIGURE IV: Upward Mobility vs. Wage Growth for High School Graduates



Notes: This figure replicates Figure VI, changing the x variable to log wage growth for high school graduates in each CZ between 2005 and 2014. Wage growth is measured using high school graduate annual earnings and weekly hours worked variables from the American Community Survey. See notes to Figure VI for details.

ONLINE APPENDIX FIGURE V: Targeting Opportunity Zones in Los Angeles

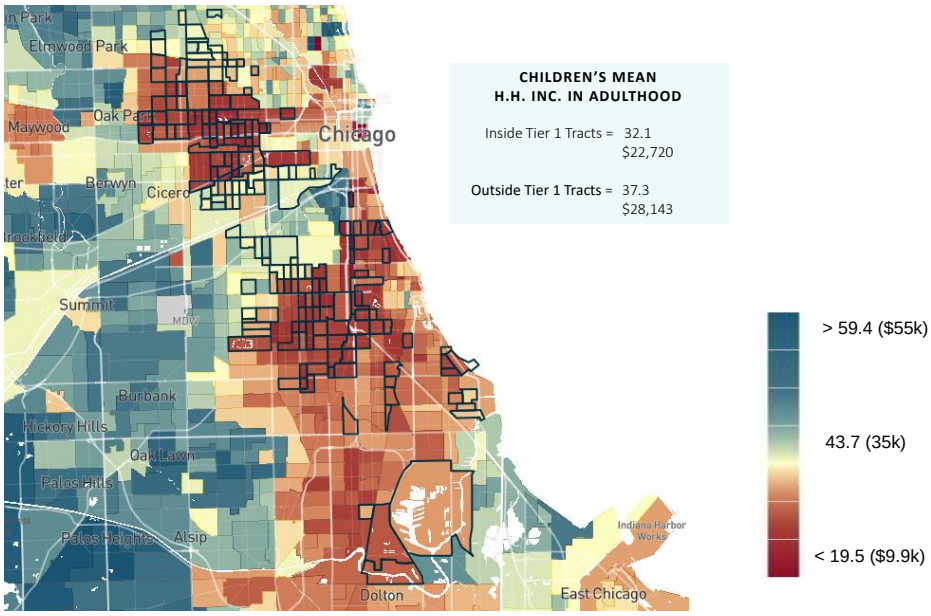


These maps must be printed in color to be interpretable.

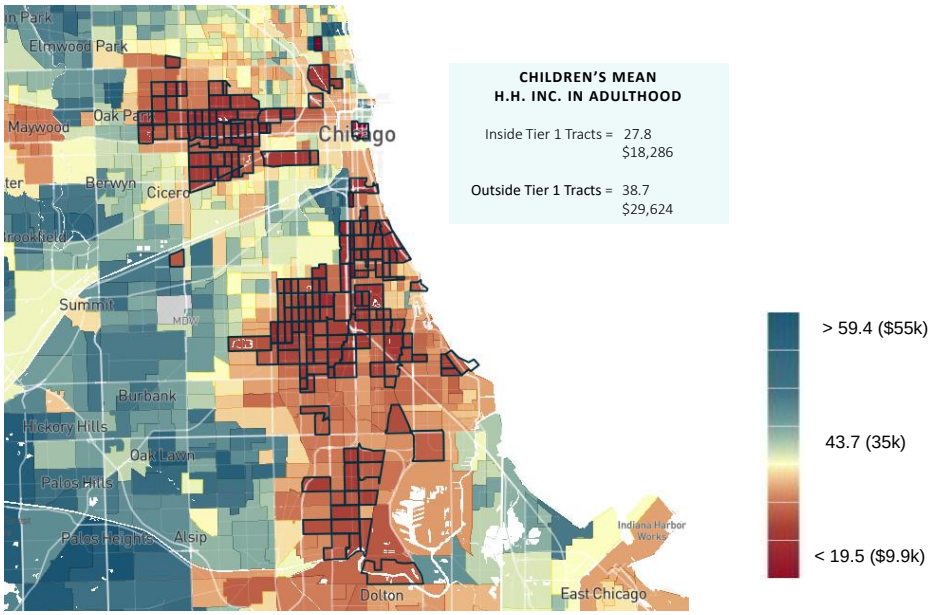
Notes: These maps replicate Figure IIa, plotting children's mean household income ranks given parents at the 25th percentile in Los Angeles. In Panel A, we outline in green borders the tracts that have been designated as Opportunity Zones in Los Angeles. Opportunity Zones are a federal incentive included in the Tax Cuts and Jobs Act to spur investment and improve economic opportunity in low-opportunity neighborhoods. State governments designated qualified areas to receive a host of tax benefits based on poverty and income. In Panel B, we consider a hypothetical alternative targeting strategy, designating the same number of zones in Panel A, but choosing the tracts with the lowest rates of upward mobility in Los Angeles county. In each case, we also report the mean household income rank in adulthood (and the corresponding dollar value) of children with parents at the 25th percentile for areas designated as Opportunity Zones vs. those that are not.

ONLINE APPENDIX FIGURE VI: Targeting Selective High School Admissions in Chicago

A. Actual Tracts Granted Tier 1 Preferential Admission Status



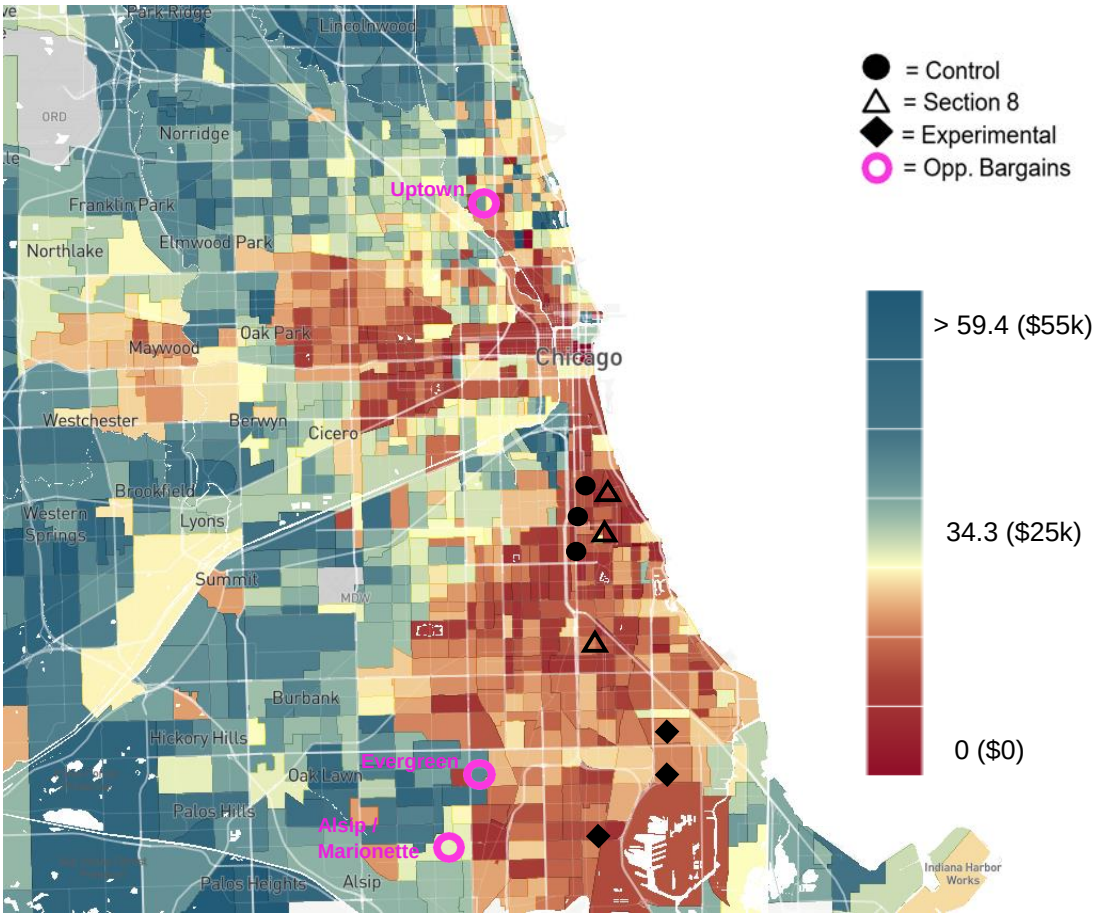
B. Hypothetical Tier 1 Tracts using Upward Mobility Estimates



These maps must be printed in color to be interpretable.

Notes: These maps replicate Figure IIa, plotting children's mean household income ranks given parents at the 25th percentile in Chicago. In Panel A, we outline in black borders the tracts that have been designated as Chicago Exam School Tier 1 tracts. The Chicago Public School tier-based admission system was created to give students from underserved areas greater access to selective schools. Chicago tracts are placed in one of four tracts, where Tier 1 tracts are the most underserved. In Panel B, we consider a hypothetical alternative targeting strategy, designating the same number of zones in Panel A, but choosing the tracts with the lowest rates of upward mobility in Cook County. In each case, we also report the mean household income rank in adulthood (and the corresponding dollar value) of children with parents at the 25th percentile for areas designated as Tier 1 tracts vs. those that are not.

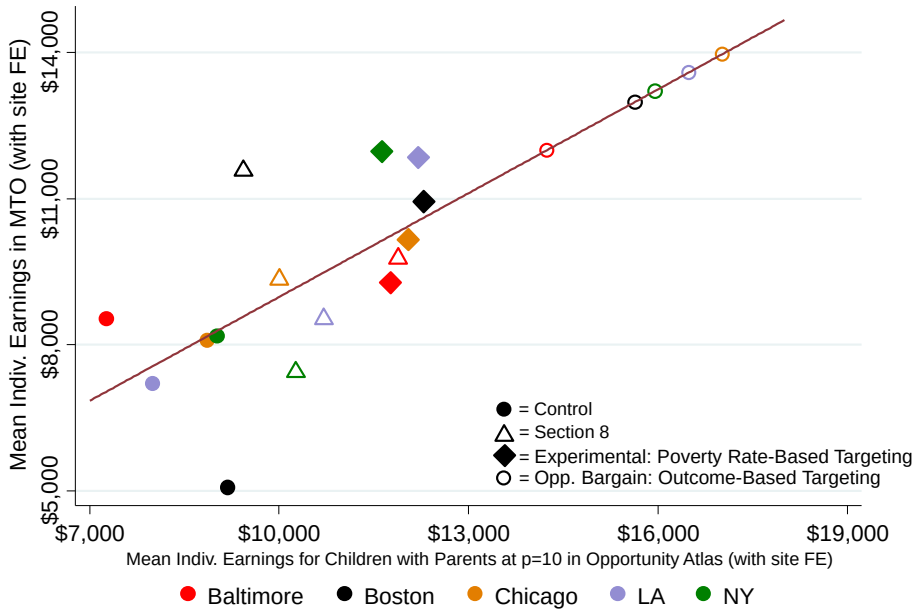
ONLINE APPENDIX FIGURE VII: Most Common Neighborhoods for MTO Participants vs. Opportunity Bargain Tracts in Chicago



This map must be printed in color to be interpretable.

Notes: This map replicates Figure IIa for tracts in Chicago instead of Los Angeles, plotting children's mean household income ranks given parents at the 1st percentile. We mark the most common neighborhoods where families in each of the three treatment arms of MTO lived on the map, using the list in Online Appendix Table 1c of Chetty, Hendren, and Katz (2016). We also mark selected "opportunity bargain" neighborhoods in Chicago, which are identified as described in the notes to Figure XIV.

ONLINE APPENDIX FIGURE VIII: Predicted Impacts of Moving to "Opportunity Bargain" Areas with High Minority Shares in MTO Cities



Notes: This figure replicates Figure XIV, except adding one additional criterion that an "opportunity bargain" must satisfy: the fraction of residents in a tract who do not self-identify as non-Hispanic white alone must be at least 20%, as measured in the 2000 Decennial Census. See notes to Figure XIV for details.