The Changing Relationship Between Local Income and Racial Disparities in Infant Mortality

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Abstract: In this paper, I examine the differential impact of local personal income levels on infant mortality for white and non-white infants in the United States from 1962 through 2016 using county level mortality data. Non-whites have higher infant mortality rates than whites on average, but also see greater reduction in infant mortality rates associated with residence in a state with higher average non-white per capita income, as well as a state or county with higher average per capita income overall. My analysis shows the increases in average incomes in this period would be expected to be associated with about half of the observed decline in the infant mortality gap. Without the increases in average incomes, the expected gap would be twice as large. Further, without the differential impact of local personal income levels on non-white infant mortality, specifically the greater reduction of non-white infant mortality rates from higher average incomes, the expected gap would be more than three times as large. Over the full period, states with 1000 USD (in 1967 dollars; >8000 2022 USD) more in state average non-white per capita income see about 2 fewer non-white infant deaths per thousand live births. This association is strongest at the start of the study period, beginning in the early 1960s, where states with 1000 USD (in 1967 dollars) more in average non-white per capita income saw 4 fewer non-white infant deaths per thousand live births. Observing this association over rolling time windows, the relationship weakens in the mid to late 1960s. In the later periods the association shrinks to approximately 1 fewer non-white infant death per thousand live births.

Introduction

Infant mortality is both an important public health concern and an important population health measure. The racial gap in infant mortality in the United States is well known not only for Black infants but also for Native Americans, Native Hawaiians, and Pacific Islanders (Artiga et al. 2022). These gaps remain an vital area of ongoing research, particularly as Black infant mortality declines have recently stagnated (Riddell, Harper, Kaufman 2017). The relationship between economic activity and mortality - including infant mortality and the racial infant mortality gap - is an important area of study across many social science fields.

I analyze the relationships between infant mortality and average state per capita personal incomes for both whites and non-whites from 1962 to 2016 in the United States, and provide additional analysis considering overall average per capita incomes at state and county levels. I consider how these relationships between economic activity and infant mortality have changed over time for white and non-white infants.

The existing literature suggests that this is an important avenue for further analysis. Considering the racial gap in infant mortality, Collins and Thomasson considered a period leading up to and overlapping with my study period, 1920 to 1970. They studied the relationship between the racial infant mortality gap and socioeconomic factors, including income. They found that a declining share of this gap was associated with these socioeconomic measures over their study period (Collins and Thomasson, 2004).

Multiple studies focused specifically on economic activity and mortality, including infant mortality, and also found that these relationships change over time (Ruhm 2015, Orsini and Avendano 2015). However, much of this literature has focused on the period from the mid 1970s to the early 2000s. Given key policy changes in the mid 1960s – specifically the 1964 Civil Rights Act – extending additional analyses considering non-white / white disparities further back to the early 1960s contributes meaningful information. Further, the stagnation in closing the black-white infant mortality gap has been particularly noted in the 2010s and further. Therefore, extending the study period forward to 2016, as I do in this paper, contributes to a better understanding of these important modern trends. In my analysis I do find a key change in the mid 1960s, as well as observing ongoing trends through 2016.

Additionally, Lindo (2015) shows that the level of aggregation has influenced results in the literature. Specifically, Lindo notes that analyses looking at smaller spatial aggregation can produce smaller results, as they lose the impact of larger trends and spillover effects, while larger spatial aggregation, particularly at the national level, often misses important links. Further, he notes that analyses of county level mortality considering the impacts of economic activity at different levels indicate stronger relationships with state level economic conditions, but that county level economic activity does have distinct effects on mortality and is particularly worth noting for infant health (Lindo 2015). Therefore, considering the relationship of county level infant mortality with income at both the state and county level, as I do in this paper, is of particular importance. I find that county level income associations with infant mortality are attenuated but similar in patterns to state level income associations with infant mortality.

Considering income specifically is also of value. Several studies that consider economic activity using unemployment rates have found that infant mortality rates rise during booms in the economy (Ruhm 2000, 2015) and that this relationship differs for Black and white infants (Dehejia and Lleras-Muney 2004, Orsini and Avendano 2015). However, when Ruhm considers income levels as a control measure with unemployment, he finds the opposite relationship, with higher income levels being associated with lower infant mortality rates (Ruhm 2000). This suggests that income levels have a distinct relationship with mortality that differs from the relationship with unemployment rates, and therefore that examining income with regards to infant mortality, and specifically white-non-white infant mortality gaps, will provide novel contributions to our understanding of this gap. This is confirmed in my results, where I find that unlike higher employment, higher income is associated with lower infant mortality – specifically lower non-white infant mortality.

The results show that higher statewide and county average incomes are associated with lower non-white infant mortality rates but have little impact on white infant mortality rates. This overall association is strong enough that the increases in average incomes in this period would be expected to be associated with about half of the observed decline in the infant mortality gap (Appendix 1). Fixed effects estimation, including demographic controls consistent with the literature, over the period 1962 to 2016, shows that an increase of $1000 (in 1967 dollars) in state average non-white per capita income was associated with about 2 fewer non-white infant deaths per thousand live births. In comparing the changes in income relative to the difference in the impact of income, I consider the most recent 15-year window in the sample, 2002-2016. If there had been no increase in average incomes from the start, that is, if the average incomes in the 2002-2016 period had been the same as in 1962-1976 in real dollars, the expected infant mortality gap would be twice as large as the expected gap at the true incomes. However, if the non-white association with income was the same as the white association with income in this period, the expected infant mortality gap would be more than three times as large (Appendix 1). This underlies the importance of the difference in this association with income for non-white infants relative to white infants.

Similarly, I consider the white – non-white income gap in the same period. Had the income gap not been present, that is, had non-white average incomes been the same as white average incomes, the expected gap would have been close to half the size of the expected gap at the true incomes (Appendix 1). While the exact share varies over windows (Table 5) the overall relationship is relatively consistent – the income gap is associated with a share of the infant mortality gap, but not the whole piece.

The relationship between income and infant mortality changes over time. The association between higher non-white income and lower non-white infant mortality is strongest around the early 1960s and then weakens. At the start of the period, starting in the early 1960s, states with $1000 (in 1967 dollars) more in average non-white per capita income would be expected to have around 4 fewer non-white infant deaths per thousand live births. However, in the following periods the relationship falls to around 1 fewer non-white infant death. To emphasize the impact of this change in the relationship with income, had the relationship not changed, and incomes had increased as observed, the expected gap would not only have closed by 2002-2016, but would have reversed (Appendix 1). There is a slight trend in increases in the relative impact of income on non-white infant mortality after the 1990s through 2016, but these are relatively small. The weakening of this association is likely due in part to substantial declines in the level and variance of infant mortality for both white and non-white infants. Additionally, average state and county per capita incomes rose over the study period with consequent improvements in healthcare infrastructure, education, and average financial stability for families, likely reducing the impact of additional dollars of average income. There is some evidence suggesting that additional dollars of average income have less impact after a certain threshold, which is generally reached earlier by the white state population relative to the non-white population (Appendix 1).

These results are largely consistent both within and outside of the South and other regions of the U.S., and are robust with and without controls. Further, the results for white and non-white income are largely consistent in sign and in patterns over time with results with overall average incomes – rather than white and non-white average incomes – at the state and county level. This examination of the associations over time provides insight into ongoing trends in infant mortality gaps, particularly considering the stagnation and widening of the Black-white infant mortality gap (Riddell, Harper, Kaufman, 2017).

Background

The analysis contributes to the prior literature on relationships mortality and economic cycles, as well as changes in the trends and circumstances impacting nonwhite and white parents over the study period. Appendix 7 provides a table that summarizes the various papers. Christopher Ruhm (2000 and 2015) examines the relationship between economic activity during the periods 1972-1991 and 1976-2009 using state

level data. The first paper finds mortality decreases with increases in unemployment, as well as a negative relationship between income levels and mortality. The second paper finds the opposite effect of a positive relationship between unemployment and mortality in the 1970s and 1980s, no relationship later, and some negative relationships for some causes of death. Ruhm (2015) also suggests that a minimum of 15-year windows are necessary for stability of estimates. Lindo (2015) considers the level of spatial aggregation and finds in a study covering the years 1970-2006 that the level of aggregation in estimates significantly impacts the estimates. Use of state level data captures more spatial spillover of economic impacts than studies using county-level data.

Focusing on infant mortality, Dehejia and Lleras-Muney (2004) examine state data from 1975 to 1999 and find higher unemployment is associated with increases in prenatal care and reductions in neonatal and postneonatal mortality. Black mothers of higher socioeconomic status (SES) were more likely to have kids during recessions, while the opposite was true for white mothers. In these periods, there are decreases in risky behavior during pregnancy among Black mothers, which appears to be due to different selection into fertility based on education and other demographic features, in line with the finding that higher SES Black mothers were more likely to have kids during recessions, while there are increases in risky behavior among White mothers, a change which appears to be behavioral.

Orsini and Avendano (2015) find similar results for the period 1980 to 2004: Black mothers tended to be older and more educated when unemployment rates rose, and higher state unemployment at the time of conception was associated with lower Black infant mortality in 1980-1989. However, the relationship was not apparent from 1990 to 2004. Further, fewer babies were born to young mothers in periods of high unemployment. Like Dehejia and Lleras-Muney (2004), they find more prenatal care visits during periods of higher unemployment, specifically for Black mothers. In further considering this effect, Menclova (2013) examined the years 1989 to 1999 and finds higher unemployment rates were associated with better infant health specifically when Medicaid 'steps in' for disadvantaged women.

Further considering racial gaps in infant mortality, Collins and Thomasson consider how socioeconomic disparities have been associated with the racial gap in infant mortality rates over the period of 1920-1970, considering income, local urbanization, physicians per capita, and women's education. The absolute size of the gap declined over this period. They find a declining proportion of the gap is explained by their socioeconomic measures over this period. They also demonstrate that the widening gap follows with a rising gap in birth weight distribution. Further examination finds that this was unlikely to be due to white babies benefiting more from medical tech for low-birth-weight infants, but pollution exposure may have had an impact. (Collins and Thomasson, 2004).

Historical circumstances that had significant impacts on infant mortality provide context in which to consider the results of this paper, particularly major features such as the introduction of major medical technologies and their distribution (Headley, 2004) vaccine rollouts through the 1960s (Offit, 2021), the 1964 Civil Rights Act, (Almond, Chay, and Greenstone 2006, Anderson, Charles, and Rees 2020), the 1973 *Roe v. Wade* Supreme Court decision and previous state level abortion laws (Krieger et al 2015, Farin, Hoehn-Velasco, and Pesko 2021), as well as broader trends in infant mortality, income, and public health investment.

Data

I primarily consider the period from 1962-2016, with some additional data available further back. The infant mortality rate is calculated as the number of deaths during the first year per thousand live births. For white and non-white mortality and white and non-white births from 1959 through 2007, the data are drawn from the ICPSR dataset, "U.S. County-Level Natality and Mortality Data 1915-2007," (Bailey, Clay, Fishback, et al. ICPSR project 36603) The data set also includes linear interpolation of Census county white

and non-white population data.[1] To include the non-white and white infant mortality and birth data for the years 1942 to 1959, I compiled non-white and white information from the *Vital Statistics of the United States*, which was the original source of the ICPSR data for that time frame. To extend the data from 2007 to 2016, and expand the data after 1999, I added additional information from the National Center for Health Statistics (2022). The analysis focuses on the number of deaths of residents of the county, as opposed to the number of deaths occurring in the county. Information by residence was not reported until 1937, and not by white/nonwhite until 1942.

Table 1 shows large declines in infant mortality and declines in the infant mortality gap, particularly from the 1960s to the 1980s. Table 2 shows income gaps also close from the 1950s to 1980s, though there is some increase in the gap into the 1990s.

Current analyses have been done with state level average income back to 1959 and county level average income going back to 1969. Real per capita personal income data were collected from Personal Income Summary data tables from the Bureau of Economic Analysis, and subsequently adjusted for inflation based on the CPI to 1967 real dollars (McCulloch 2022). Additional income data with information by race and additional demographic details were collected from the annual Current Population Surveys (CPS) for the years 1962 through 2017. To avoid problems with small sample bias, the measures from the CPS are aggregated to the state level (Flood et al, 2021).

Table 1: White & Non-White Infant Mortality Rate Summary Statistics, 1962-2016

	White Mean	Non-White Mean	White-Non-White Gap	White N	Non-White N
All Years	8.9	15.1	6.2	95,535	69,820
SD	5.7	11.5			
1965-1974	17.8	32.6	14.8	12,132	10,486
SD	5.3	14.2			
1975-1984	11.1	19.4	8.3	26,523	23,220
SD	4.2	10.2			
1985-1994	8.2	15.0	6.8	13,555	12,078
SD	3.0	6.6			
1995-2004	6.0	11.9	5.9	14,216	7,604
SD	2.6	7.0			
2005-2014	5.5	10.1	4.5	21,999	11,389
SD	2.9	7.5			

Note: All data covers 1942-2016. Infant mortality rates by county of residence, per thousand live births. Sample selected where state level income data is available. Means weighted by population. Source: See text.

[1] A similar dataset combining "U.S. County-Level Natality and Mortality Data 1915-2007," (Bailey, Clay, Fishback, et al. ICPSR project 33603) with BLS data was used to examine cyclicality of fertility in Schaller, Fishback, and Marquadt (2019), this data builds on that dataset.

Table 2: White & Non-White State Per Capita Personal Income Summary Statistics, 1962-2016

	White Mean	Non-White Mean	White-Non-White Gap	White N	Non-White N
All data	4688.98	3671.60	1017.38	95,535	69,820
SD	898.84	1039.40			
1965-1974	3769.11	2408.77	1360.34	12,132	10,486
SD	485.69	713.52			
1975-1984	3896.02	2690.49	1205.53	26,523	23,220
SD	351.69	537.49			
1985-1994	4514.33	3323.28	1191.04	13,555	12,078
SD	490.09	647.59			
1995-2004	5337.26	4133.52	1203.75	14,216	7,604
SD	637.04	703.18			
2005-2014	5289.74	4272.08	1017.67	21,999	11,389
SD	633.80	733.71			

Note: Real state per capita personal income in 1967 dollars from CPS.
Sample selected where infant mortality data is also available. Means weighted by population.

Table 3: State Per Capita Personal Income Summary Statistics, 1942-2016

	Mean	SD	N
All data	4717.92	1520.06	195,065
1945-1954	2043.77	542.73	16,592
1955-1964	2617.12	552.55	19,029
1965-1974	3609.34	593.86	44,047
1975-1984	4161.24	523.72	57,558
1985-1994	4949.86	689.94	25,633
1995-2004	5820.98	769.22	20,322
2005-2014	6413.78	861.77	11,376

Note: All data includes years 1942-2016. Real state per capita personal income in 1967 dollars from BEA.
Sample selected where infant mortality data is also available. Means weighted by population.

Table 4: County Per Capita Personal Income summary statistics, 1969-2007

	Mean	SD	N
All data	4913.85	1471.64	137,627
1970-1979	3908.25	788.66	52,531
1980-1989	4444.46	1018.05	49,258
1990-1999	5635.05	1166.92	6,034

Note: All data includes years 1969-2007. Real state per capita personal income in 1967 dollars from BEA.
Sample selected where infant mortality data is also available. Means weighted by population.

Main Specification

The main analysis is estimated with a regression of the infant mortality rate (M_{cyr}) for race *r* in county *c* and year *y* as a function of real per capita personal income (I_{sry}) in state *s*, year *y*, and race *r* (white/ non-white), a non-white dummy variable (R_{cy}) and an interaction of the nonwhite dummy variable and per capita income ($I_{syr} * R_{cy}$). I estimate the model with vectors of year fixed effects (γ_y), capturing yearly averages for the national average, and county fixed effects (γ_c), capturing average traits of the county. The standard errors are clustered at the state and year level. In order to understand the impact of income disparities, and the sources of impacts from income, I consider mean income for the non-white and white populations in each state as the variable of interest.

To give more weight to results in counties with large population, the model is estimated with nonwhite population weights for each nonwhite observation, and white population weights for white observations. To capture changes over time in the relationships, I consider regressions with fifteen-year windows. I also plot coefficients as generated by regressions with fifteen-year rolling windows. (Additional rolling windows for five- and ten-years can be found in Appendix 6.)

I consider several demographic controls that are considered in previous literature: education, age distribution, and racial and ethnic distribution. I also consider income distribution. Specifically, I consider the share of the reproductive population (women 16-45) with education below four years of high school, the share of the sample (potential income earners 16 and older) below 18 and the share above 65, the share of the population that is Black, the share that is Hispanic, and the share of income obtained by the lowest quintile of earners, all at the state level. Shares here are converted to percentages, so share variables range from 0-100 rather than 0-1.

$$M_{cyr} = \beta_1 I_{syr} + \beta_2 R_{cy} + \beta_3 I_{syr} * R_{cy} + \beta_4 E_{syr} + \beta_4 E_{syr} * R_{cy} + \beta_5 D_{syr} + \beta_5 D_{syr} * R_{cy} + \beta_6 B_{sy} + \beta_7 H_{sy} + \beta_8 S_{syr} + \beta_9 T_{syr} + \beta_8 S_{syr} * R_{cy} + \beta_9 T_{syr} * R_{cy} + \gamma_y + \gamma_c + \varepsilon_{cyr} \quad \text{(Equation 1)}$$

E is the percentage of the reproductive population with less than four years of high school, *D* is the percentage of income held by the bottom quintile, *B* is the percentage of the population that is Black, *H* is the percentage of the population that is Hispanic, *T* is the percentage of the population that is between 15 and 18, *S* is the percentage of the population over 65.

Table 5 considers the main coefficients and analysis. Table 6 then shows the coefficients for the full set of controls.

The associations between infant mortality at the county level and state per capita income change over time, and the relationships are dramatically different for whites and nonwhites. The relationships for the entire period from 1962 to 2016 in column 1 of Table 5 show virtually no relationship between average white state income per capita and white infant mortality. This association captured by the coefficient on income, due to the inclusion of the interaction term between the non-white dummy variable and income. One might expect there may be an association of increasing economic activity with increasing mortality, consistent with previous literature, however this relationship is largely insignificant throughout. However, this is likely a result of the different measure, whereas the previous literature has largely considered unemployment, this model considers employment. A distinction found in Ruhm (2000) suggests that one would expect a different result, where considering income levels as a control in a broader model with employment showed higher income levels were associated with lower infant mortality while the opposite was true with higher employment.

The situation for non-whites appears quite different from the result for whites. The coefficient on the non-white dummy shows non-white infant mortality would have been expected 9 deaths per thousand higher than white infant mortality at zero income, though of course this is not a realistic interpretation as states with an average income of zero are not in the data. Higher incomes, however, were associated with lower nonwhite infant mortality. The coefficient is -0.0017 for the interaction of the non-white dummy with income for the whole period, which captures the difference in the relationship with income between white and non-white. The effect of non-white income on non-white infant mortality rates overall is given by the effect of the combined coefficients on income -0.0018. Thus, $1000 (1967 dollars) higher average non-white income would be associated with nearly 2 fewer non-white infant deaths per thousand live births.

The bottom of Table 5 shows the predicted non-white-white gap in infant mortality rates with white and non-white incomes at different levels based on equation 2, where *w* subscripts indicate averages for the white sample and *nw* subscripts indicate averages for the non-white sample.

$$M_{cynw} - M_{cyw} = \beta_1 I_{synw} - \beta_1 I_{syw} + \beta_2 + \beta_3 I_{synw} \quad \text{(Equation 2)}$$

The predicted gap for the whole period is 3.2 at the mean. The predicted gap is 1.4 if both groups of incomes at the white mean income, suggesting that a little more than half of the predicted gap at the actual mean incomes is associated with the white-non-white income gap.[2]

One way to think about the effect is to compare the change in the nonwhite-white gap between the periods 1965-1979 and 1995-2009 and how much of the change was associated with the rise in income per capita over time. The mean white infant mortality rate fell from 15.5 to 5.9, while the nonwhite rate fell from 28.2 to 11.5. There was therefore a decline in the infant mortality gap from 14.8 to 4.5, a decline of 10.3. White mean per capita income rose from $3827.76 to $5363.01, while non-white mean per capita income rose from $2540.27 to $4216.35. When the change in mean income is inserted in the function of coefficients from column 1 in Table 5, the predicted gap falls by 3 deaths per thousand, which is 43 percent of the actual change in means. As there is no apparent association between incomes and white infant mortality over this period, the decline is specifically driven by non-white infant mortality. This expected decline from changes in incomes is 19% of the actual observed decline in non-white infant mortality. (Appendix 1) The inference than this is that changes in income were associated with about half of the decline in the infant mortality gap and less than a quarter of the decline in non-white infant mortality.

The relationships for both whites and non-whites changed over time. During the period 1965-1979 the white income relationship with infant mortality was pro-cyclical with a coefficient of 0.0005, but this coefficient was not significant. Afterward there was a weakly significant coefficient of -0.0005 in 1980-1994, followed by a positive and insignificant coefficient of 0.0001 from 2005 to 2014. The hypothetical non-white - white gap at zero income, as observed from the coefficient on the non-white dummy, was 11 in 1965-1979 and then fell to 3.8 between 1985 and 2004 before rising to 12.7 in 2005-2014. Meanwhile, the difference in the relationship between white and non-white incomes and white and non-white infant mortality became less negative from -0.002 in 1965-1979 to a low of -0.0008 in 1980-1994 before rising in magnitude again to -0.0015 in 1995-2009. The combined coefficient became somewhat less negative from -0.0018 in the 1965-1979 period to -0.0014 in the 1995-2009 period, implying the overall impact of income for non-white infant mortality declines. There is some evidence that suggests that the impact of state average income may decline once a threshold is reached, and non-white average incomes reach that threshold later than white incomes. Considering states with high non-white incomes in 1995 (incomes comparable to or higher than overall average white incomes in the 1980s), there appears to be no effect of income at the end of the study period, and the remaining negative coefficient is driven by the states with lower non-white income. However, these higher income states are a smaller sample, so it is difficult to draw strong conclusions (Appendix 1 Table 10). Additionally, this decline in the impact of income for non-white infant mortality was associated with changes over time in the expected non-white-white gap in infant mortality. At the means, the expected gap went from 5.3 in the first period to 6.3 in the last. The expected gap if the income gap was closed went from 3.4 in the first period to 4.7 in the last.

I estimated the model with 15-year rolling windows and Figure 1 shows the changes in the income coefficient over time and the non-white*income coefficient over time as well as the combined coefficient showing the overall relationship with non-white income and non-white infant mortality. Figure 1 essentially tells the same story as shown in the results in Table 5. Higher income was associated with higher infant mortality for whites before the mid 1960s and lower infant mortality in the late 60s through the mid 80s, and

[2] See appendix 5 for nonlinear estimation with income and income squared on a base model; there are only minimal changes to magnitude of linear income effect, and little effect of income squared.

the result largely stays around zero. Higher non-white incomes had a stronger association with lower non-white infant mortality rates in the early period, specifically in the early 1960s, compared to the later periods, where the effect is still slightly negative but closer to zero, with a slight declining trend from the 1990s on. To consider the overall effect, a similar pattern emerges. The key change in this effect over time is observed here in the mid 1960s. (Figure 1)

Figure 2 then tracks the impacts of these coefficients calculated on 15 year rolling windows over time on the expected gap at different income levels, illustrating more completely the effect shown in the bottom of Table 5, with expected declines in the gap early in the overall period, with some increases from the mid 1970s to the mid 1990s and further declines afterwards. From this figure, we would expect the gap to have dropped below 5 starting after 2000 (Figure 2), and the observed gap is similar, with a gap of 4.9 infant deaths for the 2000-2015 period.

Table 5: Main Specification

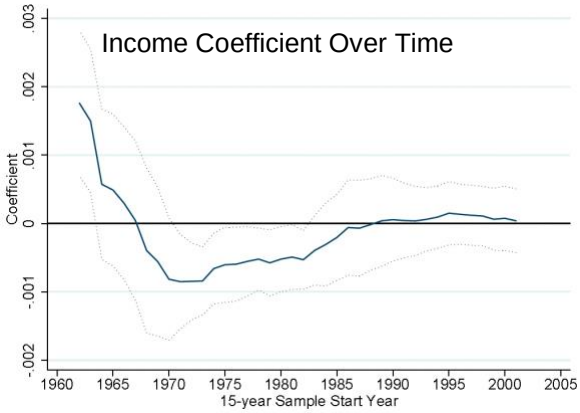
	1962-2016	1965-1979	1980-1994	1995-2009
Income	-0.0001	0.0005	-0.0005*	0.0001
	0.0002	0.0006	0.0002	0.0002
Non-White	9.3278*	11.0469*	3.8327	12.7102****
	4.6685	5.7969	2.2495	2.6968
Non-White *Income	-0.0017**	-0.0020*	-0.0008*	-0.0015***
	0.0007	0.0011	0.0004	0.0004
Non-White*Income + Income	-0.0018	-.0015	-0.0013	-0.0014
N	165,181	43,112	54,742	38,763
Gap at Means	3.2	5.3	1.9	6.3
Gap if at White mean income for both	1.4	3.4	0.4	4.7

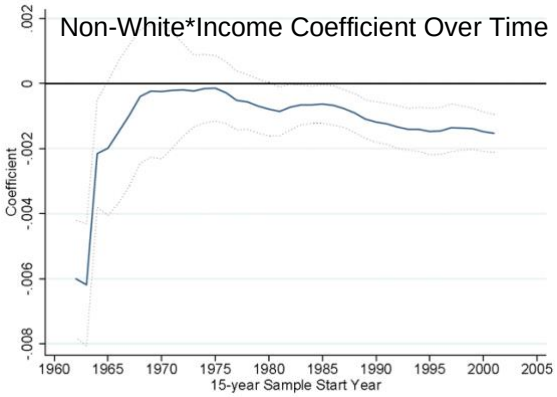
Notes: * is significant at $p \leq 0.1$ ** at 0.05, *** at 0.01, **** at 0.001. Gap at Means refers to the nonwhite-white infant mortality rate gap, calculated with equation 2. Year and county fixed effects included and a full set of state demographic controls as listed with full results in Table 6. Standard errors are clustered at state by year level.

Table 6: Results with Full Demographics

	1962-2016	1965-1979	1980-1994	1995-2009
Income	-0.0001	0.0005	-0.0005*	0.0001
	0.0002	0.0006	0.0002	0.0002
Non-White	9.3278*	11.0469*	3.8327	12.7102****
	4.6685	5.7969	2.2495	2.6968
Non-White*Income	-0.0017**	-0.0020*	-0.0008*	-0.0015***
	0.0007	0.0011	0.0004	0.0004
% reproductive population without high school education	.07344*	0.0075	0.0992**	0.1213***
	0.0379	0.0338	0.0392	0.0373
% reproductive population without high school education*Non-White	0.0506	0.2098****	-0.0549	-0.1435***
	0.0801	0.0318	0.0427	0.0470
% of Income held by bottom quintile	0.4537	2.4368**	0.1832	-0.8276**
	0.3943	0.8898	0.3639	0.3612
% of Income held by bottom quintile* Non-White	-0.4765	-5.4613****	0.2314	1.4826***
	0.5823	1.1663	0.4222	0.4605
% of population between 15 and 18	-0.2013**	0.1815*	-0.1652	-0.2169**
	0.0875	0.0918	0.1074	0.1004
% of population between 15 and 18 *Non-White	0.3416**	-0.3548*	0.2669	0.0709
	0.1687	0.1702	0.1732	0.0435
% of population > 65	-0.0216	-0.14590*	-0.1412***	0.0709
	0.0407	0.0584	0.0448	0.0435
% of population > 65* Non-White	-0.0183	-0.0145	0.2776***	0.0386
	0.0993619	0.1166	0.0859	0.0813
% of population Black	0.0567**	0.0908*	0.0484*	0.0002
	0.0275	0.0449	0.0233	0.0200
% of population Hispanic	-0.0410***	0.0131	-0.0679**	0.0092
	0.0115	0.0154	0.0258	0.0236
N	165,181	43,112	54,742	38,763

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001. Population weighting, county and year fixed effects, clustering by state and year.





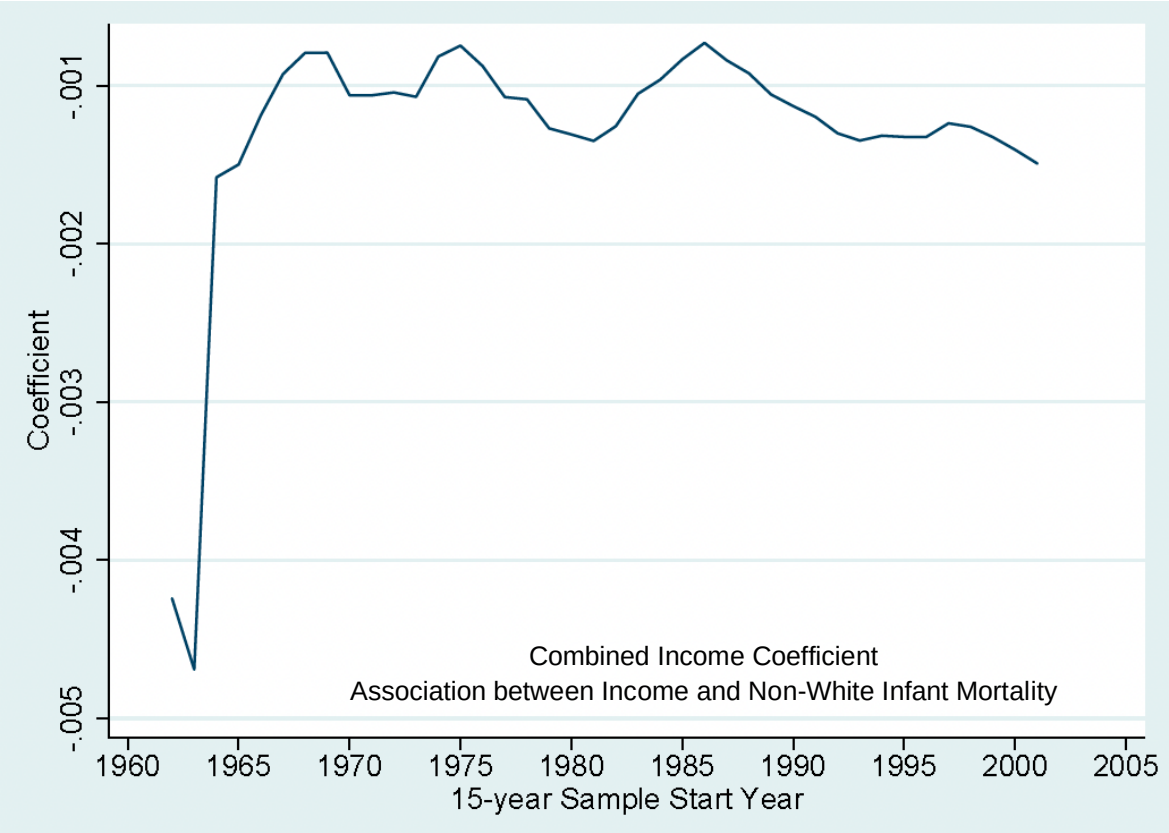


Figure 1: Coefficients from main specification. Top left, income coefficient, top right nonwhite*income coefficient. Dotted lines indicate 95% confidence intervals. Main, combined coefficient capturing the overall association of income with non-white infant mortality rates.

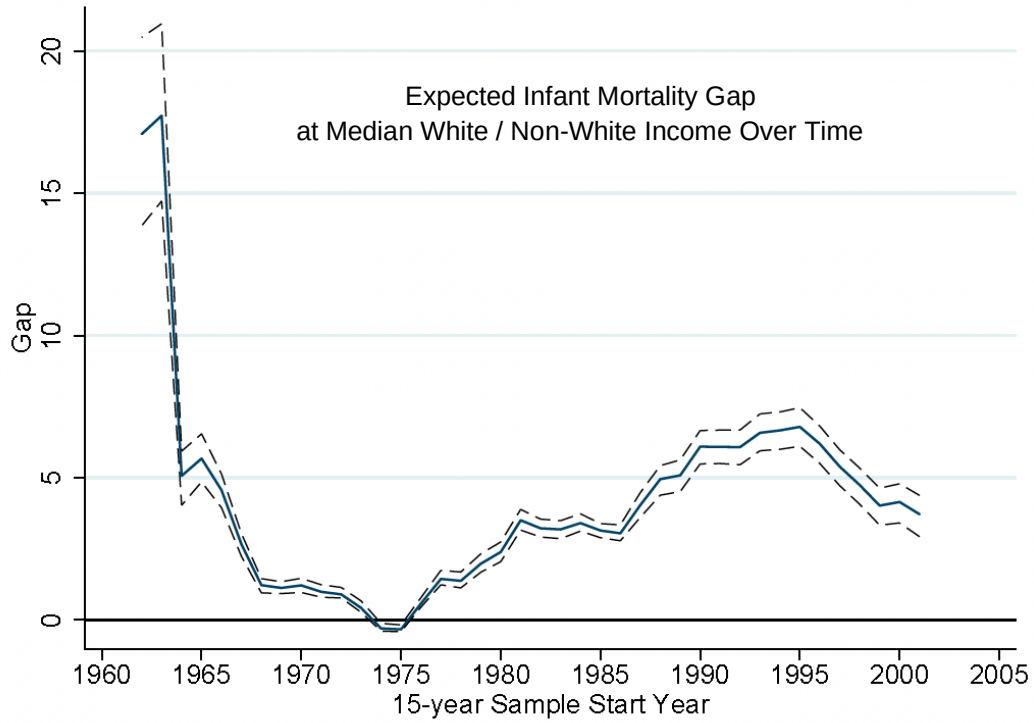


Figure 2: Predicted gap at median income. Top dashed line is 25th centile of incomes, bottom dashed line is 75th centile of incomes.

Base Case

$$M_{cyr} = \beta_1 I_{syr} + \beta_2 R_{cy} + \beta_3 I_{syr} * R_{cy} + \gamma_y + \gamma_c + \varepsilon_{cyr} \text{ (Equation 3)}$$

The associations between infant mortality at the county level and state per capita income change over time, and the relationships are dramatically different for whites and nonwhites. The coefficient of income in column 1 of table 7, covering the whole period, is 0.0000, which implies that a $1000 higher average per capita income in 1967 dollars was associated with a no difference in the white infant death rate.

The situation for non-whites was quite different. The coefficient for the nonwhite dummy in column 1 of Table 7 shows that non-white infant mortality rates would theoretically have been 18 deaths per 1000 births higher than the white infant mortality rate at zero income. Higher incomes, however, were associated with lower nonwhite infant mortality. The coefficient of the nonwhite dummy interaction with the income variable was -0.0030, which implies a $1000 higher average per capita income in 1967 dollars was associated with a non-white infant death rate that was 3 deaths per thousand live births lower, around a fifth of the average rate. This result is somewhat larger in magnitude but similar to the full specification.

The bottom of Table 7 shows the predicted non-white-white gap in infant mortality rates with non-white incomes at different levels. The predicted gap is 7.0 at the mean, and 4.8 if the income gap had closed. (Table 7) This is larger than predicted in the main specification but close to the observed gap of 6.2 for the whole period.

The relationships for both whites and non-whites changed over time. During the period 1965-1974 the white income relationship with infant mortality was 0.002. Afterward the coefficients are all negative and range from -0.0012 in 1985-1994 to -0.0004 from 2005 to 2014.

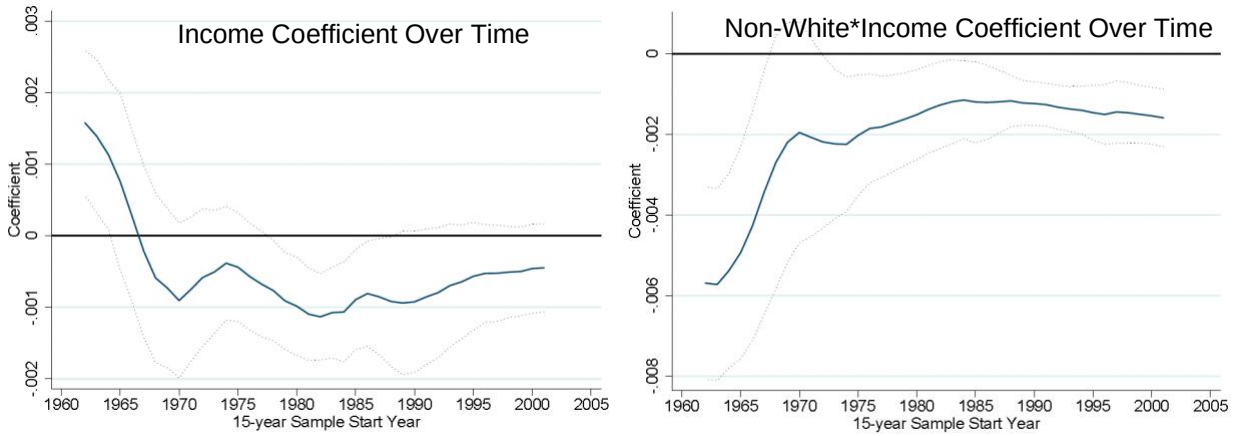
The expected non-white-white gap at zero income was highest in 1965-1974 at 29.3 and then fell to 9.4 between 1985 and 2004 before rising to 11 in 2005-2014. Meanwhile, the relationship between non-white incomes and infant mortality became less negative from -0.0054 in 1965-1974 to a low of -0.0011 in 1995-2005 before rising again to -0.0016 in 2005-2014. The combinations of the coefficients were associated with overall expected reductions over time in the non-white - white gap, predicting gap by 2005-2014 of 4.6, very close to the actual gap of 4.5. (Table 1)

Figure 3 shows these results calculated over rolling 15-year windows, which illustrates the same story over time as in Table 9 – the income coefficient for whites largely stays around 0, while the non-white income coefficient is consistently negative but decreases in magnitude after the late 60s, with slight increases in magnitude at the end of the period. The combined coefficient showing the effect of income on non-white infant mortality follows a similar pattern of being consistently negative and with a key change in the late 1960s, but with a more continuous increase further on, with some irregularities. (Figure 3) Figure 4 shows the expected infant mortality results at different income levels, tracking from above 15 and just above 5, which follows a similar pattern to the observed gaps. (Table 1)

Table 7: State Income Disaggregated by Race, Regressions with County and Year Fixed Effects for Different Time Periods, with population weighting

	1962-2016	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0000	.0020***	-.0010	-.0012***	-.0009	-.0004
	.0003	.0006	.0007	.0004	.0005	.0003
Non-White	17.9671****	29.2564****	11.8642***	9.4226****	9.4130****	11.0585****
	1.7851	3.3178	3.4698	1.9834	1.4673	1.6150
Non-White *Income	-.0030****	-.0054***	-.0020	-.0014*	-.0011**	-.0016***
	.0004	.0014	.0013	.0007	.0004	.0004
Income + Non-White*Income	-0.0030	-0.0034	-0.0030	-0.0026	-0.0020	-0.0020
N	165,350	22,618	49,743	25,633	21,639	33,266
Gap at Means	7.0	13.5	7.7	6.2	5.9	4.6
Gap if at White mean income for both	4.8	10.4	4.3	3.5	3.6	2.8

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001. Gap at X income refers to the nonwhite-white infant mortality rate gap, calculated with Equation 2. Mean average state income levels are displayed in Table 2. County and Year fixed effects. Clustering at state and year level. Population weighting is white / non-white county population.



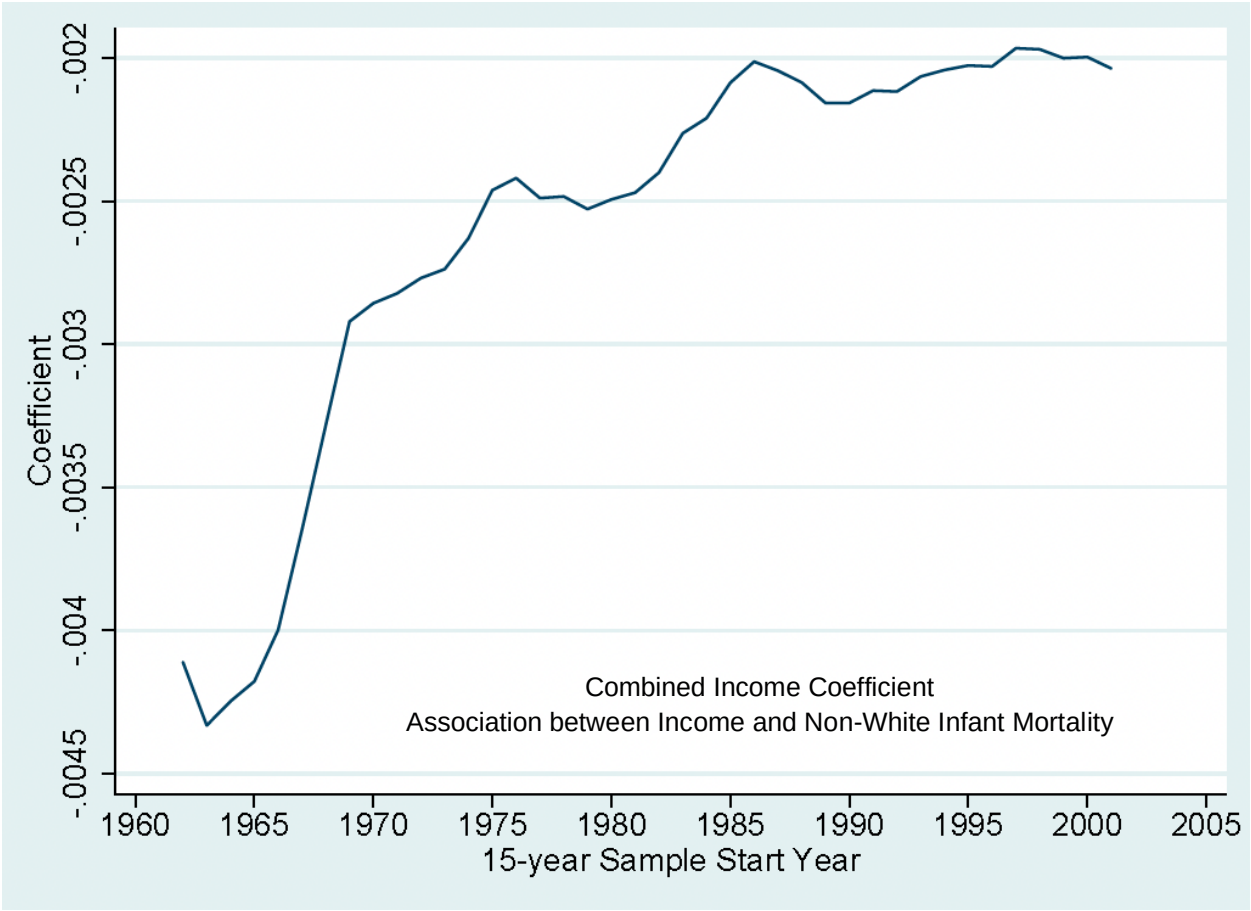


Figure 3: State income disaggregated by race. Income coefficient (left) and Non-White*Income coefficient (right) graphed over fifteen year rolling windows: with population weighting. Dotted line captures 95% confidence interval. Main, combined coefficient (Income + Non-White*Income) capturing the association of income with non-white infant mortality rates.

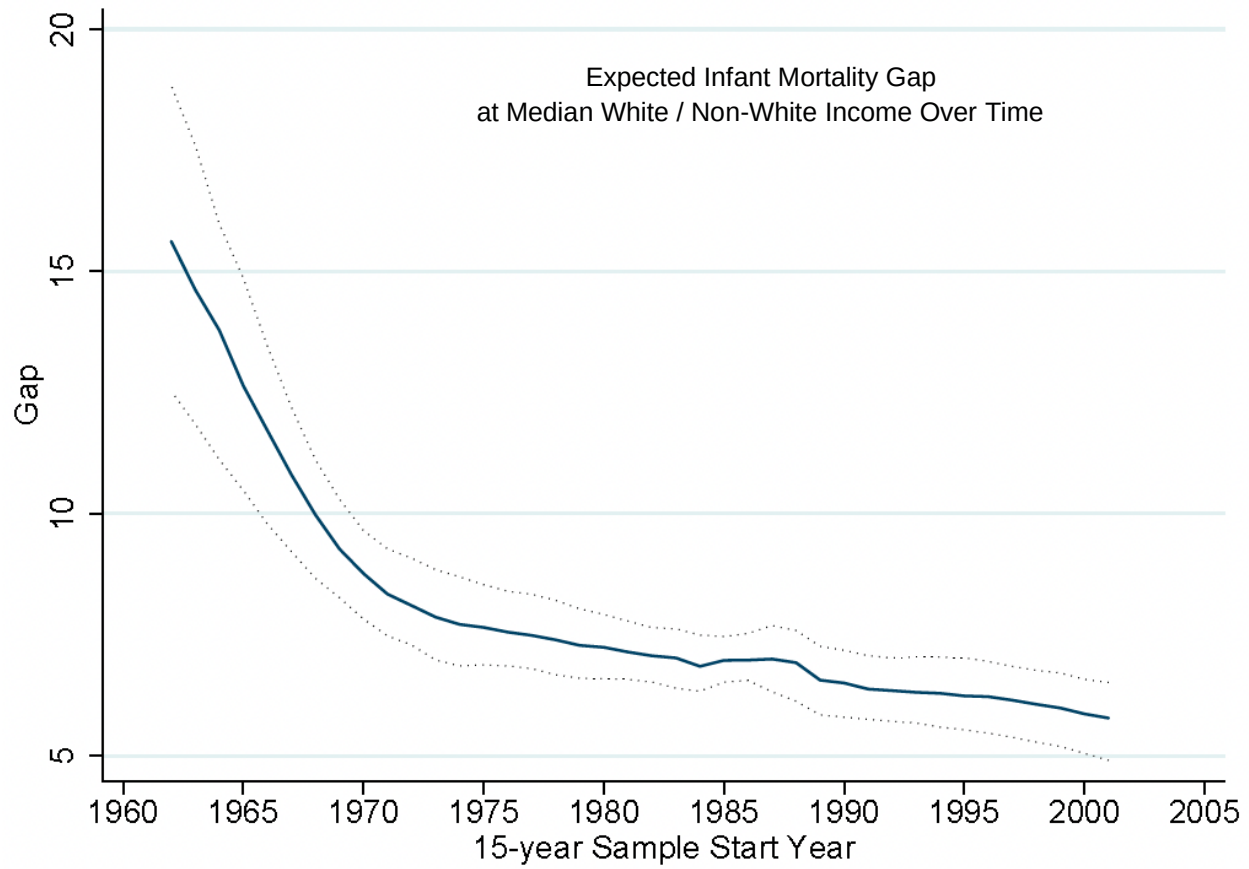


Figure 4: Expected infant mortality gap at median incomes based on coefficients calculated over fifteen year rolling windows with population weighting and income median/25th centile/75th centile from the same fifteen year rolling window. Full line captures predicted gap at median (50th centile) Top dotted line captures the predicted gap at the 25th centile of income, bottom dotted line captures the predicted gap at the 75th centile of income. Prediction is based on Equation 2.

Regional Analysis

The non-white group captured across the course of this data is of course highly diverse and varies substantially by time and region. Each of these racial and ethnic groups under the non-white category, in different times and regions, face different barriers and disparities over the study period. The South had a much stronger limits on voting and official segregation of schools, hospitals, and institutions than the rest of the country at the start of this study period, further, there is a cluster of states that have not expanded Medicaid at the end of the study period; therefore, I estimated the model for the South and outside the South. Despite the institutional differences, the results appear similar for the entire period and even in the early period of 1965-1975, when southern segregation was being challenged and struck down legally but was still strongly present in many areas. (Table 8, Table 9) Some county level effects that are persistent may be captured in county fixed effects alone, and when looking at the South alone, some effects that are year specific may be captured in year fixed effects. See appendix 3 for further analysis by different regions and a breakdown of the non-white racial demographic differences by region over time.

Table 8: State income regressions (disaggregated income) over time in the South

	1962-2016	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0004	.0009	-.0012	-.0007*	-.0005	-.0004
	.0005	.0009	.0009	.0004	.0004	.0002
Non-White	17.9739****	29.9566****	11.9308***	7.8836****	7.5892****	7.2578****
	2.3771	3.0351	2.9065	1.5553	1.4543	1.0637
Non-White *Income	-.0029****	-.0071****	-.0021**	-.0006	-.0003	-.0005*
	.0006	.0012	.0008	.0004	.0002	.0002
n	85,631	14,169	23,255	11,914	10,986	17,052

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001

Table 9: State income regressions (disaggregated income) over time outside the South

	1962-2016	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0000	.0022	-.0007	-.0018**	-.0009	-.0003
	.0003	.0012	.0015	.0007	.0006	.0005
Non-White	18.4369****	37.5649****	12.7203	11.0135**	9.2438****	13.0538***
	2.3837	6.8123	7.7342	4.2560	1.9778	2.9291
Non-White *Income	-.0032****	-.0079**	-.0021	-.0019	-.0011***	-.0021***
	.0004	.0025	.0026	.0011	.0003	.0006
n	79,719	8,449	26,488	13,719	10,653	16,214

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001

Overall Income

$$M_{cyr} = \beta_1 I_{sy} + \beta_2 R_{cy} + \beta_3 I_{sy} * R_{cy} + \gamma_y + \gamma_c + \varepsilon_{cyr}$$ (Equation 4)

This analysis examines the relationship between infant mortality and per capita income for the entire population in the state between 1959 and 2016. The associations between infant mortality at the county level and state per capita income change over time, and the relationships are dramatically different for whites and nonwhites. The coefficient of income in column 1 of table 10, covering the whole period, is 0.0005, which implies that a $1000 higher average per capita income in 1967 dollars was associated with a white infant death rate that was 0.5 deaths per thousand live births higher, only 5.6% of the average rate.

The situation for non-whites was quite different. The coefficient for the nonwhite dummy in column 1 of table 16 shows that non-white infant mortality rates would theoretically have been 21.1 deaths per 1000 live births higher than the white infant mortality rate at zero income. Higher incomes, however, were associated with lower nonwhite infant mortality. The coefficient of the nonwhite dummy interaction with the

income variable was -0.0026, leaving a combined coefficient of -0.0021 which implies a $1000 higher average per capita income in 1967 dollars was associated with a non-white infant death rate that was 2.1 deaths per thousand live births lower, 17.2% of the average rate. The bottom of Table 10 shows the predicted non-white-white gap in infant mortality rates with non-white incomes at different levels. The predicted gap is 8.9 at the mean, slightly larger but similar to those for income disaggregated by white/non-white. (Table 5)

The relationships for both whites and non-whites changed over time. During the period 1965-1974 the white income relationship with infant mortality was -0.0001. Afterward the coefficients are all positive and range from -.0001 in 1975-1984 to 0.0009 from 2005 to 2014.

The expected non-white-white gap at zero income was highest in 1965-1974 at 29.5 and then fell to 10.5 between 1985 and 2004 before rising to 15.2 in 2005-2014. Meanwhile, the non-white *incomes coefficient became less negative from -0.0047 in 1965-1974 to a low of -0.0008 in 1985-1995 before rising again to -0.0017 in 2005-2014. The combinations of the coefficients were associated with overall expected reductions over time in the non-white-white gap, predicting a gap of 4.3 in 2005-2014, similar to that actually observed. (Table 1)

Figure 5 shows these results calculated over rolling 15-year windows, which illustrates the same story over time as in Table 10 – the income coefficient for whites increases but largely stays around 0, while the non-white income coefficient is consistently negative but decreases in magnitude after the late 60s, with slight increases in magnitude at the end of the period. (Figure 5)

Table 10: State Income Regressions Over Time, with population weighting

	1959-2016	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0005*	-.0001	.0001	.0002	.0006*	.0009****
	.0002	.0008	.0006	.0003	.0003	.0002
Non-White	21.1234****	29.5287****	18.3227****	10.4870***	14.6100****	15.2103****
	1.4273	3.8983	4.0087	2.8303	2.1157	2.6262
Non-White *Income	-.0026****	-.0047***	-.0025**	-.0008	-.0015***	-.0017
	.0002	.0012	.0011	.0007	.0004	.0004
n	170,914	44,047	57,558	25,633	20,150	11,052
Nonwhite-White Gap at mean income in period	8.9	12.6	7.9	6.5	5.9	4.3

Note: * is significant at $p \leq 0.1$ ** at 0.05, *** at 0.01, **** at 0.001. Gap at X income refers to the nonwhite-white infant mortality rate gap, calculated with equation2. Mean average state income levels are displayed in Table 3. Year and county fixed effects included. Standard errors are clustered at state by year level.

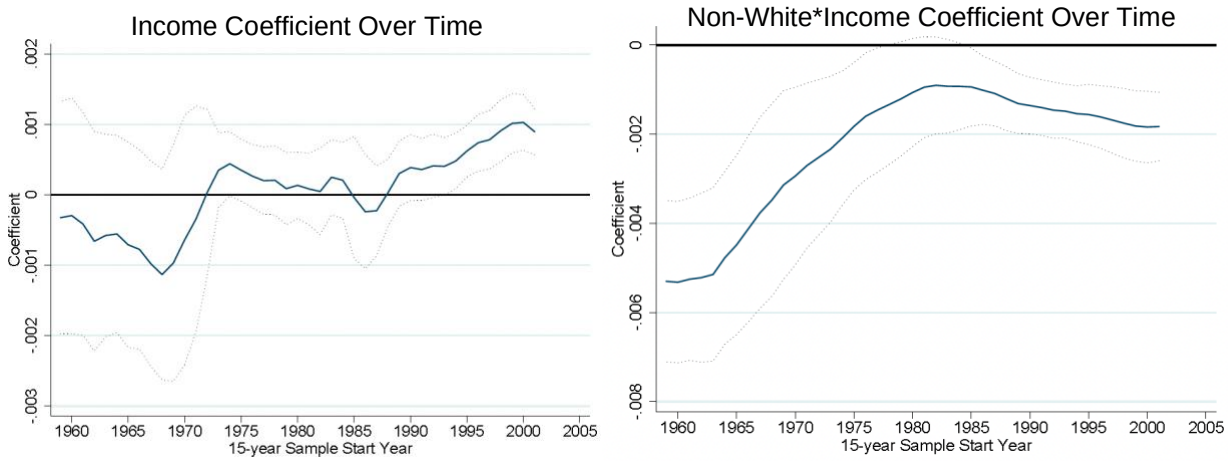


Figure 5: State level income. Income coefficient (left) and Non-White*Income coefficient (right) over fifteen-year rolling windows: with population weighting. Dotted line captures 95% confidence interval. Year and county fixed effects. 95% confidence interval based on standard errors using year and state clustering.

County Level Income

In order to assess the effects of different levels of aggregation, I consider county level average income in addition to state level average income.

$$M_{cyr} = \beta_1 I_{cy} + \beta_2 R_{cy} + \beta_3 I_{cy} * R_{cy} + \gamma_y + \gamma_c + \varepsilon_{cyr}$$ (Equation 4)

These results are largely consistent with the state level income results; In column 1 of Table 11 which represents the effect for whites, is small and positive at 0.0001 but not statistically significant. The nonwhite dummy coefficient is 13.5, while the coefficient for the nonwhite income-interaction is negative and statistically significant at -0.0012. The coefficients are closer to zero than with state level income, likely due to missing spillover effects from income in surrounding areas. (Table 10, 11) When considered over time, consistent with the patterns from state level income, the nonwhite coefficient is largest in the 1970-1979 period, the coefficient on the nonwhite dummy interacted with the income variable is greatest in the earliest period in the sample – 1970-1979, and there is some significance on the negative coefficient in the final period, 1990-1999. (Table 11) This is consistent with the coefficients graphed using the fifteen-year rolling windows, where the coefficient is most negative at the very start of the period, and moves closer to zero while staying negative, but with the confidence interval narrowing as values dip back down towards the end of the period. (Figure 6) Using the county income statistics from Table 6, the expected gap at mean income declines from 9.9 in 1970-1979 to 6.5 in 1990-1999. (Table 11) When considering state and county income together, these trends remain consistent – coefficients on the interaction terms both remain negative across time periods, and the coefficient on the state level income term is larger in magnitude in all periods except 1990-1999. (Table 12)

Table 11: County Level Income Regressions Over Time, with population weighting

	1969-2007	1970-1979	1980-1989	1990-1999
Income	.0001	.0005	.0002	.0003**
	.0001	.0004	.0002	.0001
Non-White	13.5282****	16.9108****	9.2953***	9.8420****
	1.0042	3.0457	2.1383	1.2368
Non-White *Income	-.0012****	-.0018*	-.0006	-.0006***
	.0002	.0009	.0006	.0002
n	137,627	52,531	49,258	4,722
Gap at mean income in period	7.6	9.9	6.6	6.5

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001. Gap at mean income refers to the nonwhite-white infant mortality rate gap, calculated with Equation 2. Mean average county income levels are displayed in Table 4. Includes county and year fixed effects, standard errors clustered at state and year level.

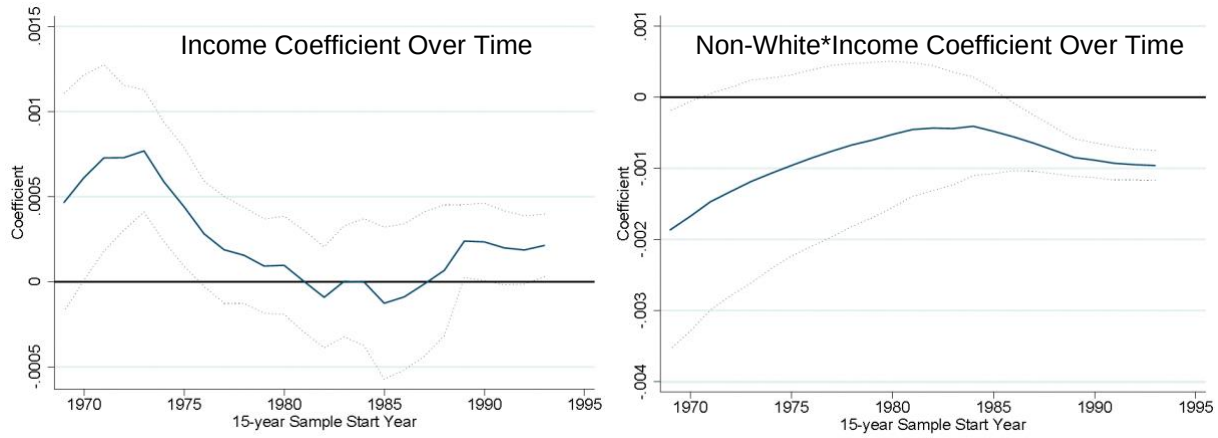


Figure 6: County level income: Income coefficient (left) and NonWhite*Income coefficient (right) graphed over fifteen year rolling windows: with population weighting. Dotted line captures 95% confidence interval. Includes county and year fixed effects, standard errors clustered at state and year level.

Table 11: County and State Level Income Regressions Over Time, with population weighting

	1969-2007	1970-1979	1980-1989	1990-1999
County Income	0.0000	0.0008**	0.0003	0.0003**
	0.0001	0.0003	0.0002	0.0001
State Income	-0.0001	-0.0018*	-0.0001	0.0001
	0.0002	0.0009	0.0003	0.0003
Non-White	15.7024****	20.2930***	12.6223***	11.1762****
	1.2693	4.6063	3.6088	2.4108
Non-White * County Income	-0.0006****	-0.0007	0.0002	-0.0005**
	0.0001	0.0005	0.0004	0.0002
Non-White * State Income	-0.0011***	-0.0020	-0.0016*	-0.0004
	0.0003	0.0012	0.0008	0.0006
n	137,627	52,531	49,258	4,722

Note: * is significant at $p \leq 0.1$ ** at 0.05, *** at 0.01, **** at 0.001. Includes county and year fixed effects, standard errors clustered at state and year level.

Discussion

In this paper, I demonstrate that higher statewide average per capita personal incomes, both disaggregated by white / non-white and overall state and county averages, are associated with reduced non-white infant mortality rates in the United States. Considering the main specification with disaggregated income and full controls, every $1000 (in 1967 dollars, >$8000 2022 dollars) in additional state average non-white per capita income, is associated with about 2 fewer non-white infant deaths per thousand live births. This is distinct from the results for white infant mortality, where additional state average white per capita income has negligible association with white infant mortality rates. This suggests that, controlling for county and year, as well as the set of state level demographic controls, non-white infants, on average, do not entirely miss out on potential health benefits of being in a higher income state, at least with regards to mortality.

The relationships between local income and infant mortality change over time. In the early 1960s for every $1000 (in 1967 dollars) higher state average non-white per capita income, there is an expected associated 4 fewer non-white infant deaths per thousand live births. However, in later periods the same difference in income is only associated with around 1 fewer non-white infant death. This level change appears to start around the mid to late 1960s, notable for the passage of the Civil Rights Act, as well as other policy and healthcare changes. I also consider results differentially in and outside the South, and across other U.S. regions, further considering different underlying demographics and policy, and find similar results by region.

Considering other potential bias from endogeneity, although it seems unlikely that infant mortality rates significantly effect average income levels, other underlying factors may impact both. Some of these factors, such as local climate or local community health, national healthcare policies and funding such as

Medicaid, or overall trends in education and medical technology, are likely to be captured by county and year fixed effects. Further, I observe changes in these relationships between the different time periods considered. In so doing, I consider specific narrow time windows where additional features of a county are more likely to be relatively constant – for example, local pollution levels are less likely to change substantially over a ten- or fifteen-year window than over a fifty-four-year window.

In trying to understand the change in these associations over time, I consider trends within my data. For instance, infant mortality declines substantially over this period, so we would expect the impact of any explanatory variable to shrink. Another factor is the increase in average state and county incomes over this period. We might expect that higher local average incomes matter up to a point, where a certain level of health benefits is achieved, and additional dollars beyond this matter less in terms of reducing infant mortality risk. This is theoretically consistent with the quadratic income results in Appendix 5, and also consistent with results considering states with higher non-white incomes in Appendix 1. Additionally, this result matches the work if Collins and Thomasson concerning the declining impact of socioeconomic disparities in the racial infant mortality gap over time through 1970 (Collins and Thomasson, 2004), at least concerning income and the decline from the mid 1960s through the end of their study period in 1970.

This paper contributes a clearer understanding of the relationship between local income, infant mortality, and specifically racial disparities in infant mortality. Higher local incomes are associated with lower non-white infant mortality, and the relationship is robust to a range of state-level controls and different income specifications. Based on the overall association between local income and non-white infant mortality, and the average rise in local incomes, these infant mortality rates would be expected to have dropped more, and gaps to have further closed, but in reality, gaps stagnate and widen in later periods. However, the association changes over time, and there is a key level change towards the mid 1960s, where higher local incomes become less associated with lower non-white infant mortality rates. The relationship particularly stagnates later, leading into the same periods as the closing of income and infant mortality gaps are stagnating. By taking an examination of these trends over time, I contribute an understanding of trends shaping the key issue of racial infant mortality disparities.

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Appendix 1: Impact over time calculations

Table A1.1: Infant Mortality, 15-year windows

	1965-1979	1980-1994	1995-2009
White Infant Mortality	15.49697	8.973171	5.886018
Nonwhite Infant Mortality	28.20602	15.8601	11.47793
White-Nonwhite Infant Mortality Gap	12.70905	6.886929	5.591912
Change in gap to 1995-2009	-7.117138	-1.295017	

Table A1.2 State Income, 15-year windows

	1965-1979	1980-1994	1995-2009
State average White Income	3827.762	4258.841	5363.013
State average Nonwhite Income	2540.268	3104.015	4216.347
Change in White Income to 1995-2009	1535.251	1104.172	
Change in Nonwhite Income to 1995-2009	1676.079	1112.332	
White-Nonwhite Income Gap	1287.494	1154.826	1146.666
Change in gap to 1995-2009	-140.828	-8.16	

Table A1.4: Income disaggregated by white-nonwhite and Infant Mortality from full controls calculation

Income coefficient	-0.0001
Race-income coefficient	-0.0017
Combined coefficient	-0.0018
Expected change in white infant mortality associated with change in white average income	-0.1535
Expected change in nonwhite infant mortality associated with change in nonwhite average income	-3.1846
Share of change in nonwhite infant mortality associated with change in nonwhite income	0.1904
Expected change in gap associated with changes in incomes	-3.0310
Share of change in gap associated with change in incomes	0.4259

Table A1.5: Infant Mortality, 10-year windows

	1965-1974	1975-1984	2005-2014
White Infant Mortality	17.8	11.1	5.5
Nonwhite Infant Mortality	32.6	19.4	10.1
White-Nonwhite Infant Mortality Gap	14.8	8.3	4.5
Change in gap to 2005-2014	10.2	3.8	

Table A1.6 State Income, 10-year windows

	1955-1964	1965-1974	2005-2014
State average income	2617.12	3609.34	6413.78
Change in income to 2005-2014	3796.67	2804.44	
State average White Income		3769.11	5289.74
State average Nonwhite Income		2408.77	4272.08
Change in White Income to 2005-2014		1520.63	
Change in Nonwhite Income to 2005-2014		1863.31	
White-Nonwhite Income Gap		1360.34	1017.67
Change in gap to 2005-2014			-342.67

Table A1.7: Income and Infant Mortality, 1965-1974 to 2005-2014

Income coefficient	0.0005
Race-income coefficient	-0.0026
Combined coefficient	-0.0021
Expected change in gap associated with change in average income	-7.2915
Share of change in gap associated with change in average income	0.7149
Expected change in nonwhite infant mortality associated with change in average income	-7.9730
Share of change in nonwhite infant mortality associated with change in incomes	0.3544

Table A1.8: Income disaggregated by white-nonwhite and Infant Mortality

Income coefficient	0.0000
Race-income coefficient	-0.0030
Combined coefficient	-0.0030
Expected change in white infant mortality associated with change in white average income	0.0000
Expected change in nonwhite infant mortality associated with change in nonwhite average income	-5.0994
Share of change in nonwhite infant mortality associated with change in nonwhite income	0.2266
Expected change in gap associated with changes in incomes	-5.0994
Share of change in gap associated with change in incomes	0.4999

Table A1.9: Impacts of Income, Coefficients, and Changes in both

	1962-2016	1962-1976	2002-2016
Expected Gap at Means	3.2	16.0	3.0
Expected Gap if no income gap	1.4	10.6	1.6
Expected Gap if same coefficient	9.0	37.6	10.0
Expected Gap if no income coefficient change			-18.9
Expected Gap if no income growth			6.0
True Gap	8.6	14.8	4.7

Table A1.10: Regressions for high- and low-income states for non-whites (measured in 1995), 2000-2014

	High Income	Low Income	All
Income	-.0004	.0001	.0001
	-.0004	.0002	.0002
Non-White	-3.7010	10.6999****	9.9706****
	4.0084	2.1417	1.8373
Income*Non-White	.0004	-.0015***	-.0015****
	.0004	.0004	.0003
Combined Coefficient	0.000	-.0014	-.0014
N	3,227	46,971	50,198

Note: 'High income' means an average income for non-whites of >$4000 (1967 dollars) in 1995. This is approximately equivalent to average white incomes in the 1980s. Regression with full controls.

Appendix 2: CPS sample

Table A2.1: State Income Summary Statistics – CPS sample

	Mean	SD	Min	Max	N
All data	3299.602	1006.943	0	11913.74	115,157
1965-1974	2899.57	896.2223	0	9025.542	23,317
1975-1984	3196.02	747.2151	704.5393	7418.686	50,589
1985-1995	3624.529	861.0544	1710.099	9265.006	26,429
1995-2005	4718.77	974.4128	1383.347	11318.71	4,588
2005-2015	4899.531	931.1278	2134.688	11471.9	3,658

Note: Real state per capita income in 1967 dollars from CPS

Table A2.2: White Income on Nonwhite Income in CPS sample

White income	.2970****	.1173
	.0843	.0003
N	111,510	110,736
State/Year Clustered SE	X	X
Year FE	X	X
County FE	X	X
Population Weighting		X

Note: * is significant at $p \leq 0.1$ ** at 0.05, *** at 0.01, **** at 0.001

Table A2.3: State Income from CPS sample

Income	.0004445	.0010945	-.0003001	.0001454
	.0007276	.0011557	.0002498	.0003002
Non-White	20.82917****	20.82857****	18.80351****	18.90957****
	4.455981	5.385129	1.683257	1.915182
Non-White*Income	-.0053782****	-.0052026****	-.0033167****	-.0032957****
	.0011965	.0013495	.0004013	.000402
N	111,617	111,616	110,837	110,836
State/Year Clustered SE	X	X	X	X
Year FE	X	X	X	X
County FE		X		X
Population Weighting			X	X

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001.

Table A2.4: State Income from CPS sample Regressions over time

	1962-2016	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0010945	.0054993	-.0011769	-.0022403**	-.0019766****	-.0002929
	.0011557	.0036206	.0011028	.0009733	.0004141	.0003628
Non-White	20.82857****	40.38693***	8.026111	-3.486751	-.7954986	10.10987****
	5.385129	9.376901	4.684618	3.070515	2.349473	1.562968
Non-White *Income	-.0052026****	-.0096574****	-.0025164*	.0010354	.0006867	-.0012203***
	.0013495	.0020827	.0013053	.0008712	.0004491	.0003342
n	111,616	22,787	50,074	25,765	3,860	2,835

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001.

Table A2.5: State Income from CPS sample, Regressions over time with population weighting

	1962-2016	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0001454	.0019256***	-.0010564	-.0012662***	-.0010369*	-.000415
	.0003002	.0005699	.0007192	.0003687	.0005272	.0004151
Non-White	18.90957****	29.11001****	11.65223***	9.332616****	8.239539****	10.78311****
	1.915182	3.300287	3.408129	1.971848	1.187893	1.887441
Non-White *Income	-.0032957****	-.0053353***	-.0019301	-.001357*	-.0009308**	-.0016045***
	.000402	.0014005	.00134	.0007043	.0002964	.0004112
n	110,836	22,618	49,743	25,633	3,846	2,835

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001

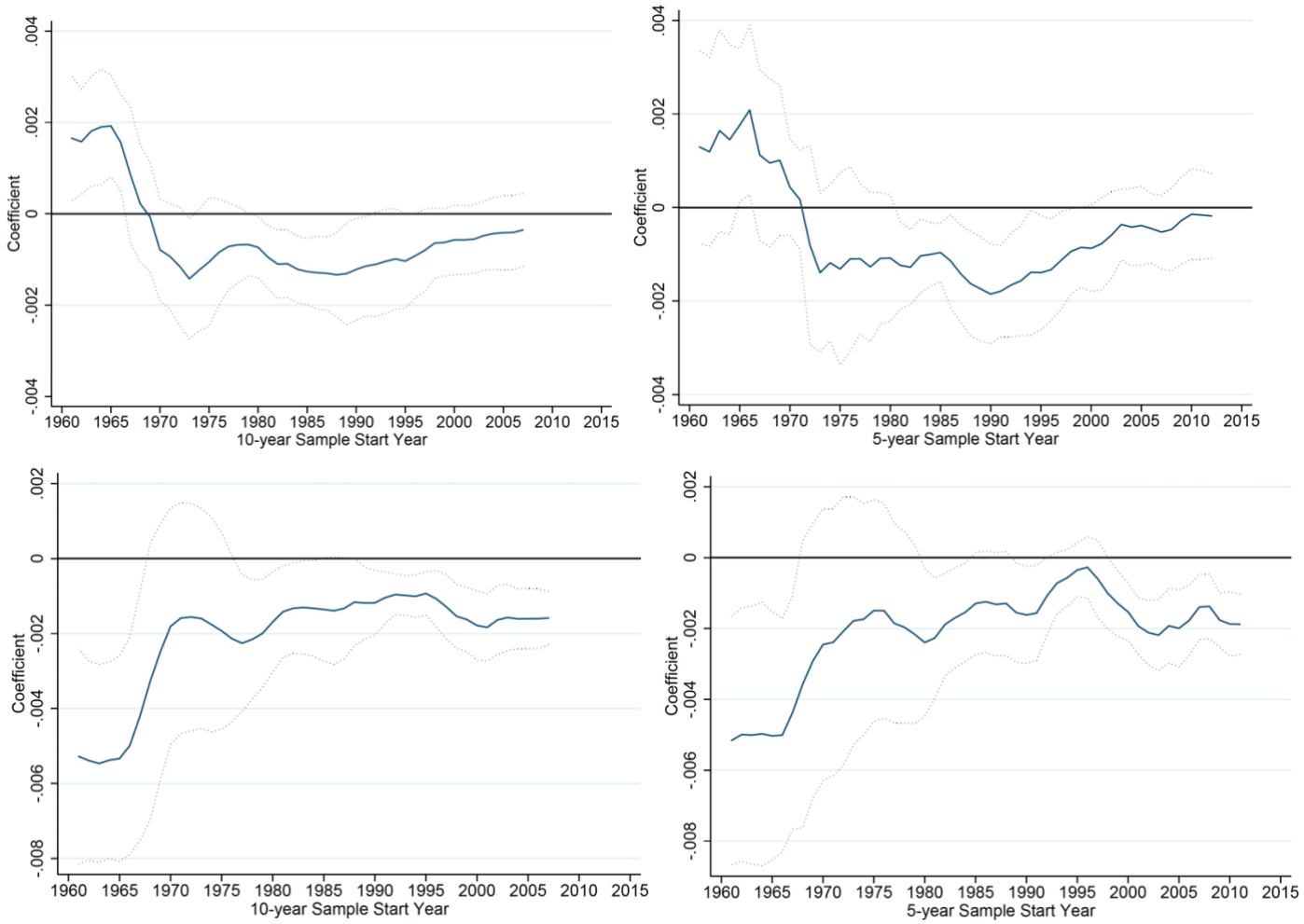
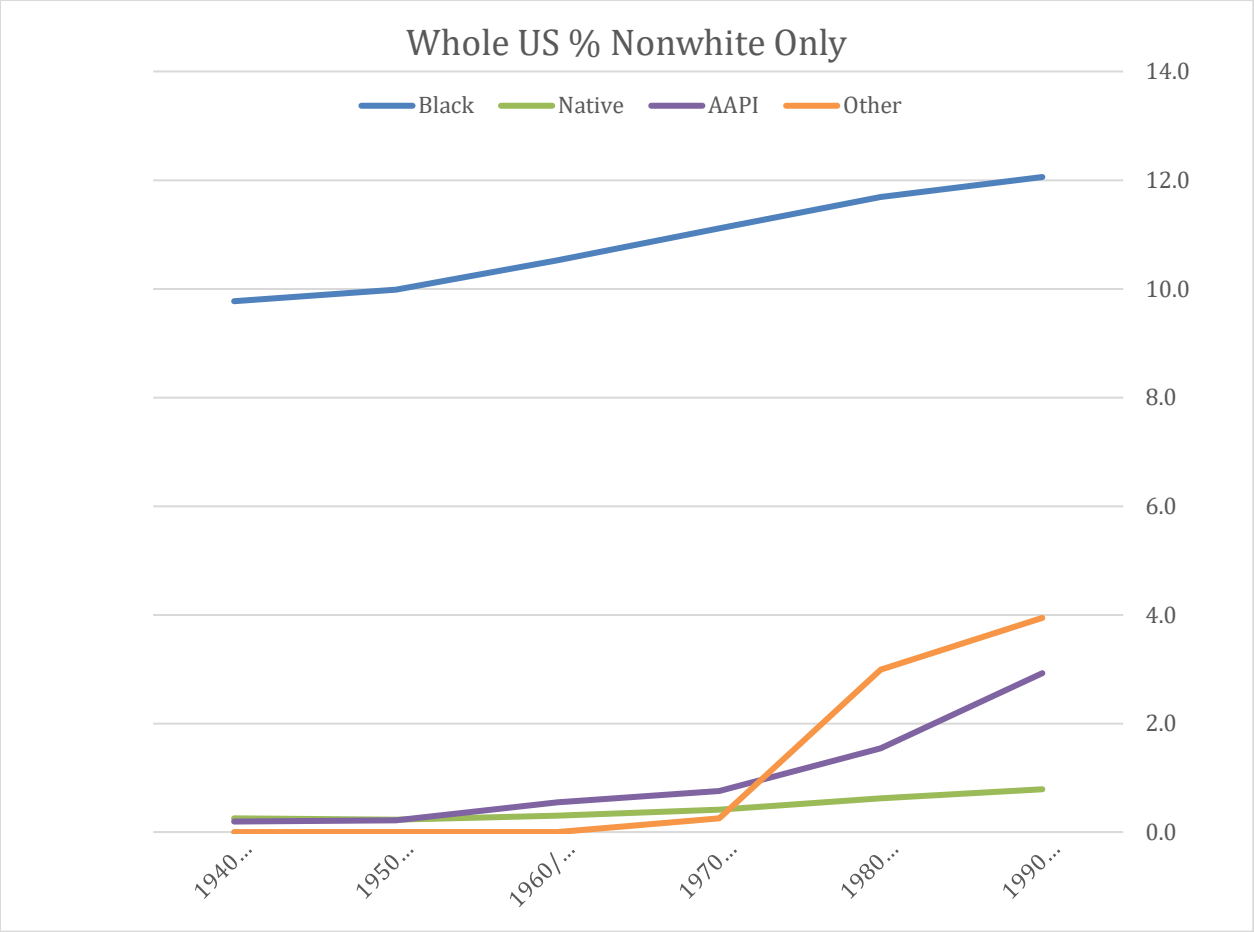
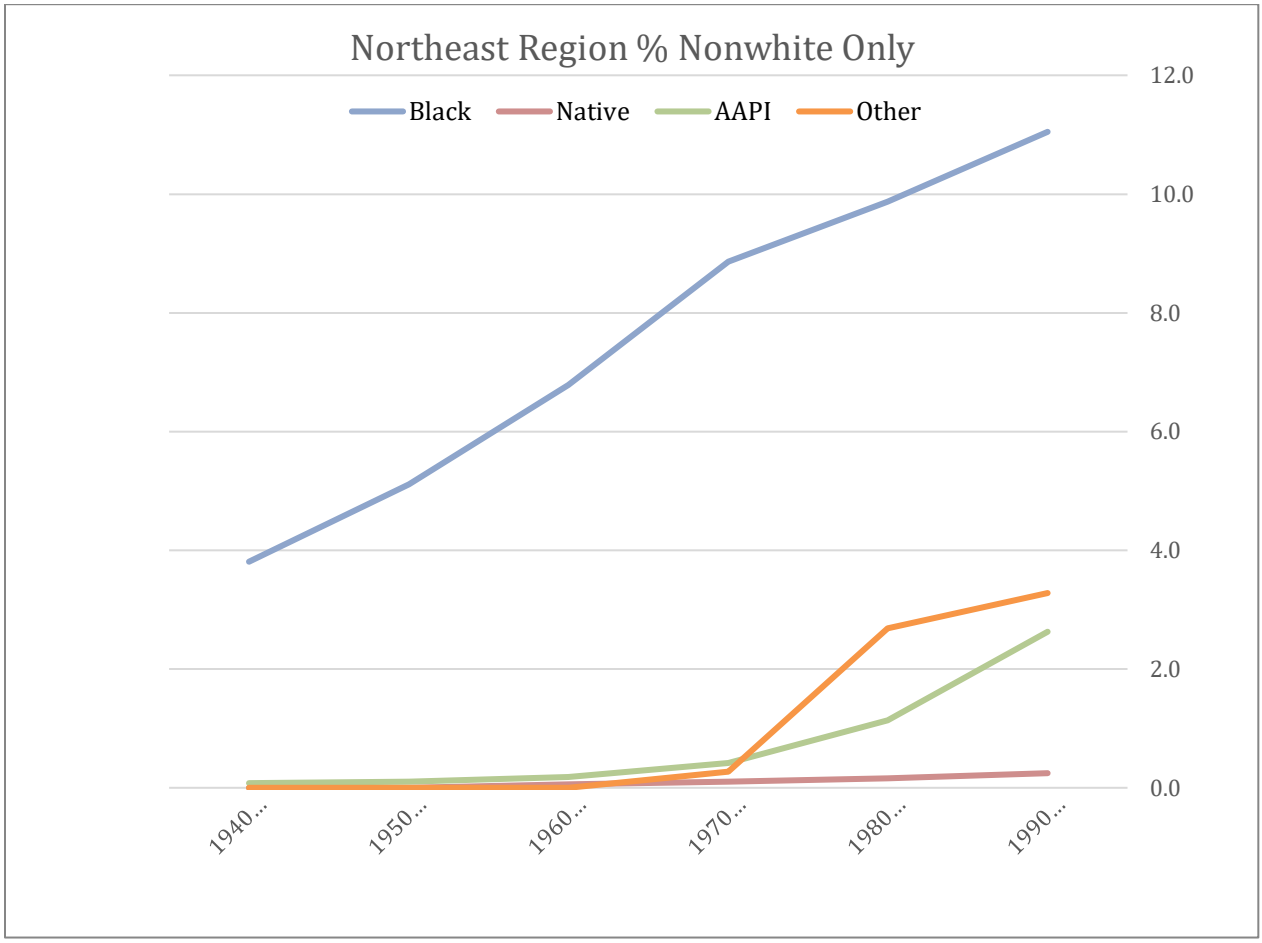


Figure A2.1: State income from CPS sample. Income coefficient (top) and NonWhite*Income coefficient (bottom) graphed over rolling windows: with population weighting. Left ten year rolling windows, right five year rolling windows. Dotted line captures 95% confidence interval.

Appendix 3: Regional Analysis




Northeast Region % Nonwhite Only
Black
Native
AAPI
Other
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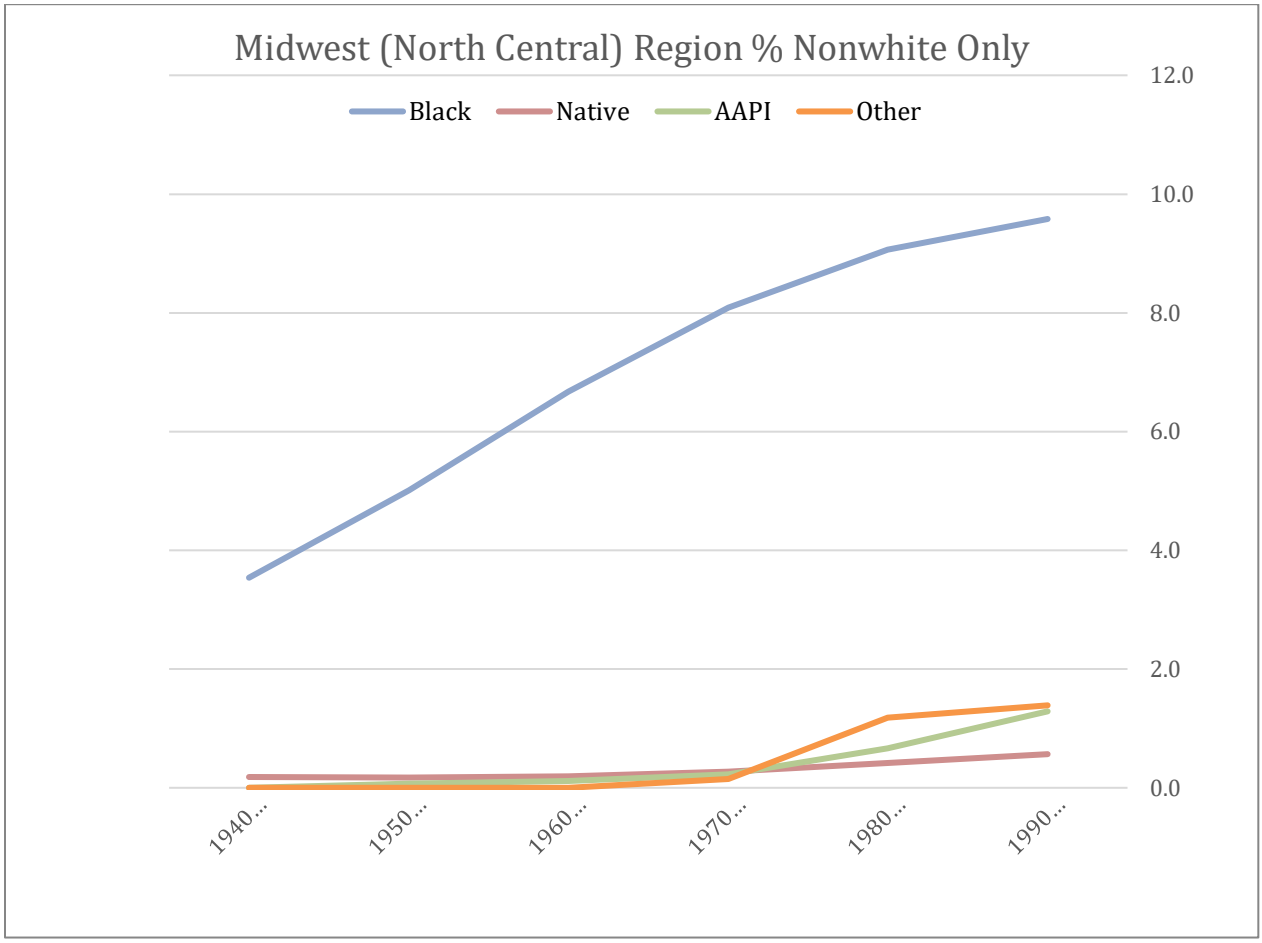
10.0
8.0
6.0
4.0
2.0
0.0
1940…
1950…
1960…
1970…
1980…
1990…


Midwest (North Central) Region % Nonwhite Only
Black
Native
AAPI
Other
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10.0
8.0
6.0
4.0
2.0
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1940…
1950…
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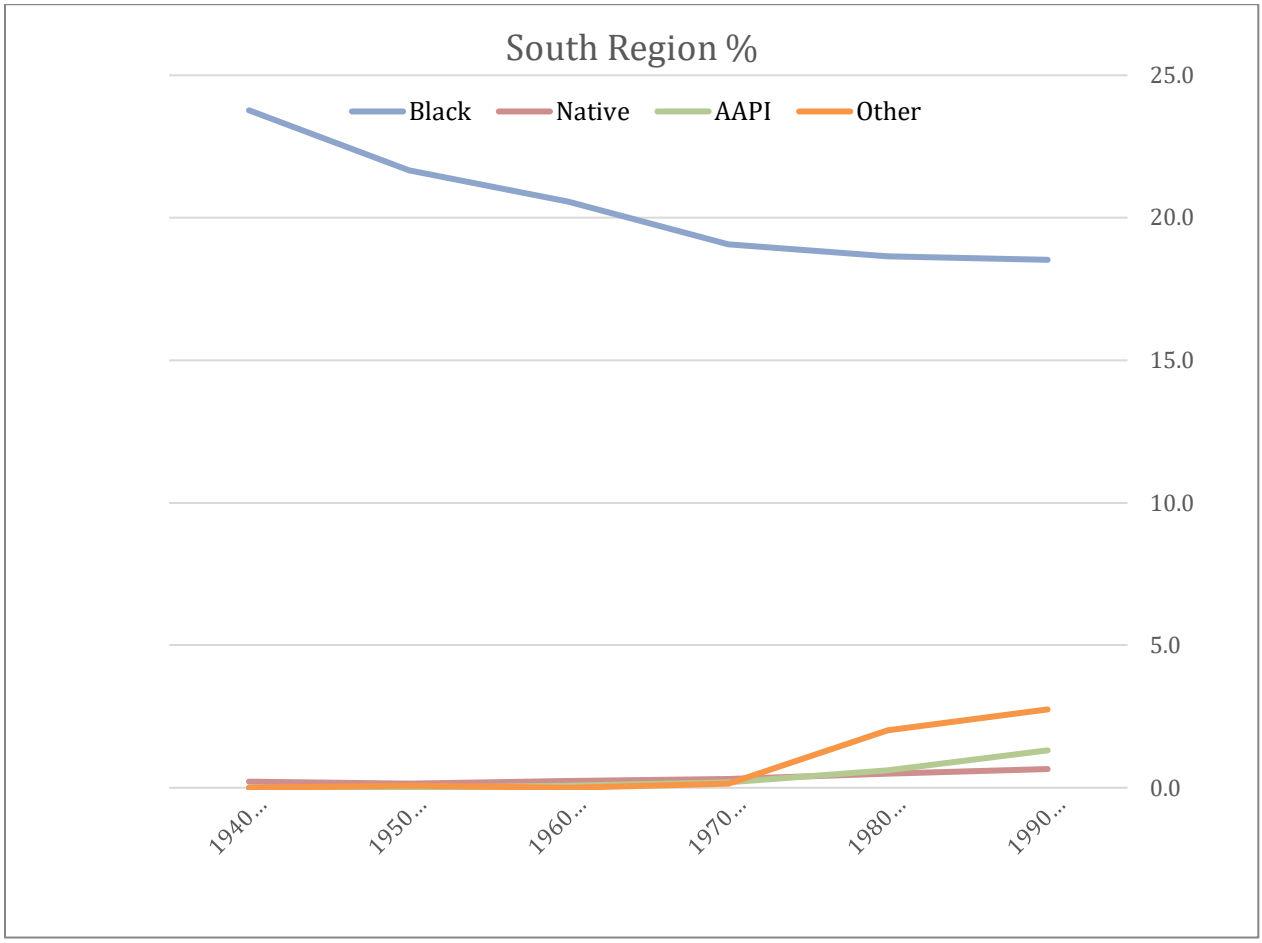
1970…
1980…
1990…


South Region %
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Native
AAPI
Other
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20.0
15.0
10.0
5.0
0.0
1940…
1950…
1960…
1970…
1980…
1990…

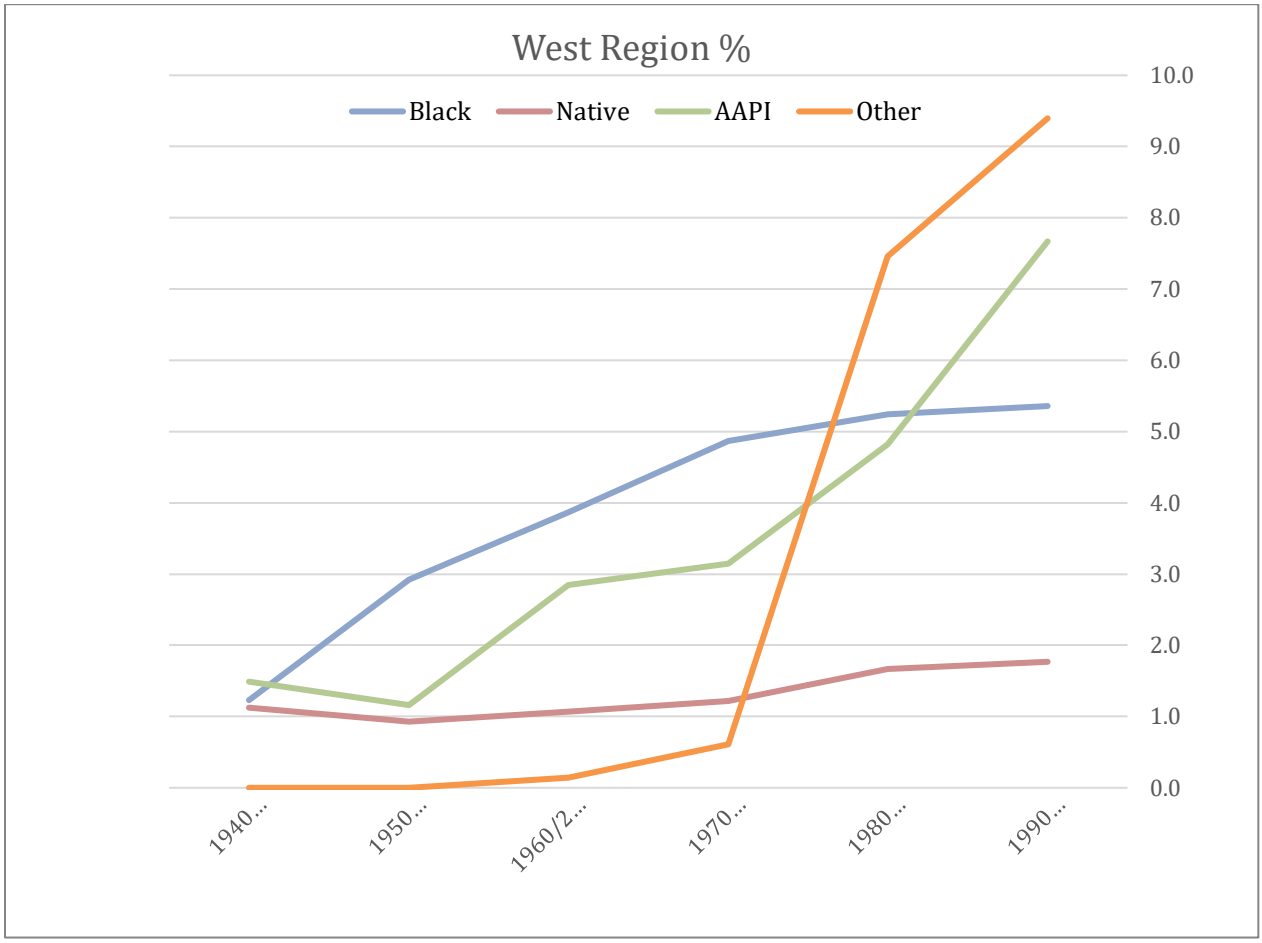

Figure A3.1: Regional race demographics over time. Source US census.

The jumps in 'other' after the 1970s may reflect an increasing Hispanic/Latine population being captured as 'other'. It's particularly notable in the West region, as is a rise in the AAPI population, which makes it important to consider the later period in the west particularly, as 'The Latina Paradox', that in spite of other disparities, Latina mothers have generally favorable birth outcomes, most notably among Mexican-born mothers (McGlade, Saha, and Dahlstrom 2004). There is also significant variation in infant and maternal disparities among AAPI communities. The South Region has the highest share of Black individuals captured in the census, and is notable for the racist Jim Crow policies covering the early decades of this study, as well as high disparities in the more modern period. For these reasons, I take a specific look at this region in comparison to the rest of the U.S.

Table A3.1: State income regressions over time in the South

	1942-2016	1945-1954	1955-1964	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0003845	-.0008389	.0032642	-.0000115	.0002558	.0000897	-.0002797	.0007171**
	.0017714	.0052493	.0050584	.0012838	.001005	.0004524	.0004879	.0002578
Non-White	29.79876****	-7.591714	16.69607*	31.65972****	15.76755****	7.593352***	8.782752***	9.976761****
	3.231353	9.628967	8.020151	3.707074	3.094493	2.215471	2.604481	1.785604
Non-White *Income	-.0053954****	.0194757**	.0015181	-.0055557****	-.0018318*	-.0000831	-.0004092	-.0008223**
	.0008741	.0077797	.0030101	.0011095	.0008668	.0004652	.0004028	.0002764
n	104,538	14,863	16,378	23,330	26,992	11,914	1,419	1,148

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001

Table A3.2: State income regressions over time outside the South

	1946-2001	1945-1954	1955-1964	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0024598**	-.007157	-.0139944	.0008855	.000559	.0001329	-.0003736	.0003259
	.0009845	.0102313	.0109502	.0008273	.0003996	.0002932	.0002739	.0002186
Non-White	31.68676****	-41.69783	30.06646**	32.62701****	21.28033**	10.07964*	14.3248***	14.97226***
	8.048823	57.0914	11.84791	6.483087	7.989007	5.001943	4.074859	4.508796
Non-White *Income	-.0067847****	.0330953	-.0053786	-.0053114**	-.0032129	-.000794	-.0015115**	-.0016769**
	.0018799	.031123	.0040857	.0019491	.0019596	.000945	.0005863	.0006656
n	77,399	1,729	2,651	20,717	30,566	13,719	2,427	1,687

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001

Interestingly, the disparities outside the south appear to show up more strongly. There may be differentials being captured by county fixed effects that are missed here. The impact of income on nonwhite infant mortality is generally larger outside the south in later periods. However the results are broadly similar.

Table A3.3: State income regressions over time in the West

	1942-2016	1945-1954	1955-1964	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0026598	.0214926*	.0091073*	-.0010827	.0000778	-.0012395	-.001075*	.0004628
	.0018252	.0097723	.0049544	.0017583	.0008738	.0007312	.0005338	.000362
Non-White	39.03985**	94.3402****	46.14104**	26.23229****	5.537919	2.649802	5.651619***	11.31091****
	13.0904	14.7154	17.88298	5.319699	3.842878	3.191455	1.554481	1.634261
Non-White *Income	-.00877**	-.0159758	-.0114536*	-.0049456***	-.0006639	-.000093	-.0005056*	-.0014144****
	.0031245	.0124533	.0052312	.0012424	.0007652	.0005822	.0002607	.0002445
n	20,484	666	895	5,165	7,506	3,419	753	609

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001

Table A3.4: State income regressions over time outside the West

	1946-2001	1945-1954	1955-1964	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0013668	.007281*	-.0131227	-.0002371	-6.41e-06	-.0000301	.0000784	.0006665**
	.0009349	.0031663	.012582	.0007752	.0006663	.0002951	.0003029	.0002163
Non-White	31.07408****	-9.323177	23.09714***	25.95948****	12.9451****	8.694855***	13.81273***	13.36607****
	3.013874	21.42693	6.509337	3.463326	2.435767	2.162688	3.124368	2.823828
Non-White *Income	-.0061334****	.0201007	-.0020838	-.0033947***	-.0009919	-.00023	-.001228**	-.0012883**
	.0007778	.0150273	.0021786	.000971	.000671	.0004482	.000539	.0004488
n	61,453	15,926	18,134	38,882	50,052	22,214	3,093	2,226

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001

Disparities in the west appear to be smaller in later periods, which may connect to the demographics of the nonwhite population in the west shifting, and lower disparities for some subsets of Latina mothers. The impact of average state income on nonwhite infant mortality appears slightly larger but mostly comparable.

Table A3.5: State income regressions over time in the Northeast

	1942-2016	1945-1954	1955-1964	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0029502	-.0156198	-.029033	.0000129	.001807**	.0010677	.0012927**	-.0007358*
	.0018858	.016299	.0149059	.0013558	.0005718	.0007881	.0005241	.0003755
Non-White	24.72827**	-104.7452*	23.91814	30.28005****	14.65973*	8.730607	12.42318	5.932579
	10.35627	50.1168	13.43356	4.661012	7.651514	7.694326	6.695465	7.827227
Non-White *Income	-.0038471*	.0602255*	-.0028791	-.0039594***	-.0014588	-.0003639	-.0011632	-.0003576
	.0019399	.0286207	.0047392	.0009806	.0017086	.0012741	.0009895	.0010512
n	12,162	316	614	3,036	4,178	2,196	819	556

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001

Table A3.6: State income regressions over time outside the Northeast

	1946-2001	1945-1954	1955-1964	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0028538**	.0074026	.0044335*	-.0001124	-.0005644	.000414	-.0003567	.0007799***
	.0013089	.0043056	.0022463	.0009461	.0006777	.0005721	.0002993	.0002157
Non-White	33.37882****	-4.409126	27.64996***	31.45087****	19.83283***	13.59035**	14.05916***	17.89896***
	2.967359	20.12522	6.928253	3.901234	4.644207	5.549837	4.303842	4.245096
Non-White *Income	-.0070133****	.0172547	-.0042294	-.0053943***	-.0029612**	-.0015185	-.001452	-.0021576**
	.0007649	.0144002	.0025146	.001227	.0012906	.0013075	.0008538	.0007231
n	169,775	16,276	18,415	41,011	53,380	23,437	3,027	2,279

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001

Table A3.7: State income regressions over time in the Midwest

	1942-2016	1945-1954	1955-1964	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0044414*	.0002056	.0031283	.0018349*	-.0016228**	-.0018538**	-.0030842	.0000265
	.0020831	.0091174	.0021427	.0008226	.0005081	.0006311	.0007145	.0004306
Non-White	40.91957****	-30.05857	3.878009	18.76915****	-4.928312	-4.948776	12.95113***	18.91608****
	9.618651	42.22839	8.377347	3.423965	3.785339	3.981066	3.013786	3.075796
Non-White *Income	-.0095056***	.0256123	.0042153	-.0012725	.0035065***	.0029133***	-.0007383	-.00196***
	.002388	.0221974	.0026836	.0009266	.0009393	.0007484	.0004969	.0005098
n	44,753	747	1,142	12,516	18,882	8,104	855	522

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001

Table A3.8: State income regressions over time outside the Midwest

	1946-2001	1945-1954	1955-1964	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0018538	.0006995	-.0186743	-.0003259	.0006748	.0002344	-.0001394	.0004638**
	.0011174	.0008747	.0145823	.0007914	.0005919	.0002036	.0002852	.0002047
Non-White	30.36333****	-13.7042	28.12524***	30.82372****	19.60226****	9.586486***	11.15565****	10.38275***
	2.948586	25.25727	6.841596	3.827273	3.41107	2.80558	2.303166	2.547962
Non-White *Income	-.0057094****	.0235599	-.0044059	-.0052052***	-.0029839**	-.0007764	-.0010755	-.0010457**
	.0007329	.0177083	.0024815	.0011839	.0009272	.0006423	.0003844	.0004058
n	37,184	15,845	17,887	31,531	38,676	17,529	2,991	2,313

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001

Appendix 4: Additional Demographic analysis

Table A4.1 Share of CPS Sample With Less Than High School Education

	Mean	SD	Min	Max	N
All data	34.77	12.49	0	78.03	136,575
1965-1974	50.75	7.83	24.74	73.08	22,787
1975-1984	36.85	6.59	21.15	53.45	50,075
1985-1994	30.38	5.93	14.25	43.10	25,767
1995-2004	23.23	3.96	14.93	33.45	20,336
2005-2014	21.99	3.95	11.65	31.00	11,376

Note: CPS data. Sample includes those 16 and up. Sample selected where infant mortality data and state level income data are also available.

Table A4.2: Share of White CPS Sample With Less Than High School Education

	Mean	SD	Min	Max	N
All data	32.24	11.55	0	72.94	76,532
1965-1974	47.70	6.81	12.14	71.72	12,217
1975-1984	34.87	6.04	9.74	51.09	26,689
1985-1994	28.74	5.70	8.56	42.80	13,622
1995-2004	21.99	4.37	9.66	32.94	13.353
2005-2014	20.99	4.39	6.90	31.95	7,456

Note: CPS data. Sample includes those 16 and up. Sample selected where infant mortality data and state level income data are also available.

Table A4.3: Share of Non-White CPS Sample With Less Than High School Education

	Mean	SD	Min	Max	N
All data	46.57	17.97	0	100	60,043
1965-1974	67.14	11.80	0	100	10,570
1975-1984	49.28	10.64	0	100	23,386
1985-1994	39.46	8.72	0	58.58	12,145
1995-2004	28.31	5.63	0	58.33	6,983
2005-2014	25.50	5.41	13.01	41.79	3,920

Note: CPS data. Sample includes those 16 and up. Sample selected where infant mortality data and state level income data are also available.

Table A4.4: Share of state income held by the bottom quintile

	Mean	SD	Min	Max	N
All data	.0038583	.0038168	0	.0444781	112,573
1965-1974	.0000648	.0002968	0	.0106331	22,967
1975-1984	.0038608	.0027094	0	.0168145	50,135
1985-1994	.0076166	.0035489	.0001618	.0243325	25,919
1995-2004	.0075275	.0043007	.0000957	.0220251	4,078
2005-2014	.0030784	.0026822	3.02e-06	.0157656	3,148

Note: CPS data. Sample includes those 16 and up.

Table A4.5: Share of state income held by the white population in the bottom quintile

	Mean	SD	Min	Max	N
All data	.0036083	.0036192	0	.0444781	60,083
1965-1974	.0000504	.0002323	0	.0109544	12,311
1975-1984	.0036689	.0026615	0	.0158079	26,719
1985-1994	.0070649	.0034454	.0001665	.0236466	13,698
1995-2004	.0068618	.0040843	.0000965	.0218102	2,220
2005-2014	.0028188	.0024385	2.02e-06	.0155193	1,895

Note: CPS data. Sample includes those 16 and up.

Table A4.6: Share of state income held by the nonwhite population in the bottom quintile

	Mean	SD	Min	Max	N
All data	.0064749	.007591	0	.23733	52,316
1965-1974	.0001535	.0007517	0	.008608	10,601
1975-1984	.0062239	.0054609	0	.0553461	23,342
1985-1994	.0132363	.0085216	0	.1249502	12,211
1995-2004	.0124193	.0105735	.0000932	.23733	1,857
2005-2014	.0048386	.0057186	1.03e-06	.048265	1,253

Note: CPS data. Sample includes those 16 and up.

Table A4.7: State Income and Education Demographics

Income	.0013201**	.0013179*	-.0003848	.0003146
	.000544	.0007392	.0002323	.000195
Non-White	24.19645****	24.39856****	20.25709****	20.40043****
	4.723589	4.84861	1.792554	1.67668
Non-White*Income	-.0045168****	-.0046558****	-.0024414****	-.0025447****
	.0010498	.0010772	.000315	.0002723
Share without high school education	.2177946****	-.0042139	.0046365	-.022911
	.0357249	.0780899	.0200462	.0177807
N	111,617	111,616	110,837	110,836
State/Year Clustered SE	X	X	X	X
Year FE	X	X	X	X
County FE		X		X
Population Weighting			X	X

Note: * is significant at $p \leq 0.1$ ** at 0.05, *** at 0.01, **** at 0.001. Share of population below a high school education overall.

Table A4.8: State Income and Education Demographics by race

Income	.0005141	.000903	-.0004806**	.0002454
	.0009541	.0010749	.0002372	.0003029
Non-White	15.08736	16.44807	10.12773	14.12615*
	14.42019	15.17212	8.786713	7.315257
Non-White*Income	-.0033324	-.0036665*	-.0012876	-.0017933**
	.0020738	.0021515	.0010377	.0008615
Share without high school education - white	.1400669	.037838	.0205263	.0346817
	.0979997	.1256558	.0207589	.033417
Nonwhite * share without high school education	.0500537	.0709985	.1103674	.059866
	.1500077	.166585	.0910372	.0800382
N	111,617	111,616	110,837	110,836
State/Year Clustered SE	X	X	X	X
Year FE	X	X	X	X
County FE		X		X
Population Weighting			X	X

Note: * is significant at $p \leq 0.1$ ** at 0.05, *** at 0.01, **** at 0.001. Share of population below a high school education by white/nonwhite.

Table A4.9: State Income and Education demographics, regressions over time without population weighting

	1962-2016	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.000903	.0029583	-.0015792	-.0014037	-.0010213*	.0005557*
	.0010749	1.38	.0016743	.0010271	.000516	.0002996
Non-White	16.44807	20.83515	-7.541566	-12.35124*	1.492239	10.72634***
	15.17212	15.74159	8.262957	5.694212	4.27295	3.228602
Non-White *Income	-.0036665*	-.0063379**	-.0011671	.001355	.0004734	-.0008874**
	.0021515	.0021561	.0014235	.0009479	.0004196	.0003521
Share without high school education - white	.037838	.1909555	-.1871845	-.1656373**	.1223336	.1357091**
	.1256558	.1963905	.1064191	.0672571	.070374	.0485987
Nonwhite * share without high school education	.0709985	.1241281	.3621628***	.2694916***	-.0126639	-.0009554
	.166585	.1884034	.102498	.0766453	.1044221	.0684775
n	111,616	22,787	50,074	25,765	3,860	2,835

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001. no population weighting, county fixed effects, clustering by state and year fixed effects.

Table A4.10: State Income and Education demographics, regressions over time with population weighting

	1962-2016	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0002454	-.0007818	-.0002945	.0005479	-.0001761	.0005194**
	.0003029	.0009193	.0005128	.0006138	.0003031	.0002198
Non-White	14.12615*	-11.12787	-7.660213	1.059453	20.92968****	12.80371***
	7.315257	11.35182	5.004028	5.176554	4.236921	3.714511
Non-White *Income	-.0017933**	.0002808	.0008168	.0001972	-.0015836***	-.0012736**
	.0008615	.0015272	.0008768	.0006046	.0004199	.0004519
Share without high school education - white	.0346817	-.1631399**	-.0026126	.100853	.2734986****	.1561134***
	.033417	.0670562	.0478304	.0593542	.0515108	.0393283
Nonwhite * share without high school education	.059866	.4228495***	.250899****	.1019034	-.2513135**	-.0144427
	.0800382	.1149951	.0418588	.0757376	.083258	.0639098
n	110,836	22,618	49,743	25,633	3,846	2,835

Note: * is significant at $p \leq 0.1$ ** at 0.05, *** at 0.01, **** at 0.001. population weighting, county fixed effects, clustering by state and year fixed effects.

Table A4.11: State Income and Education Demographics by race, disaggregated income

Income	.001178	.0007246	-.0003853	.0000777
	.0013894	.0020511	.0003348	.0003817
Non-White	13.37333	11.18127	10.37363	11.9265
	15.33142	17.89882	8.353378	8.036246
Non-White*Income	-.0039213	-.0037708	-.0019659	-.0021719
	.0026976	.0030373	.0013862	.0013098
Share without high school education - white	.1188136	-.0497448	.0049794	.00376
	.0913662	.1396208	.0206914	.0354061
Nonwhite * share without high school education	.0599779	.1255523	.0997639	.0828218
	.1555879	.1862037	.0906256	.0881902
N	111,617	111,616	110,837	110,836
State/Year Clustered SE	X	X	X	X
Year FE	X	X	X	X
County FE		X		X
Population Weighting			X	X

Note: * is significant at $p \leq 0.1$ ** at 0.05, *** at 0.01, **** at 0.001. Share of population below a high school education by white/nonwhite.

Table A4.12 State Income and Education demographics, regressions over time with population weighting, disaggregated income

	1962-2016	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	-.0001	.0007	-.0009	-.0002	.0001	.0001
	.0003	.0005	.0007	.0004	.0003	.0003
Non-White	10.7251	-14.1218	-13.2817**	5.4006	17.5806***	9.1735****
	6.7588	8.5036	4.6324	4.5091	4.0565	1.8233
Non-White *Income	-.0019*	.0010	.0022*	-.0005	-.0015**	-.0011***
	.0011	.0014	.0010	.0008	.0005	.0003
Share without high school education - white	-.0105	-.1327**	-.0255	.0981	.2043**	.0959*
	.0307	.0564	.0502	.0542	.0637	.0483
Nonwhite * share without high school education	.0912	.4526****	.3010****	.0542	-.2223**	.0214
	.0760	.0927	.0384	.0650	.0943	.0471
n	165,350	22,618	49,743	25,633	21,639	33,266

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001. population weighting, county fixed effects, clustering by state and year fixed effects.

Table A4.13: State Income and Education demographics, regressions over time without population weighting, disaggregated income

	1962-2016	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0007246	.0081716**	-.0034753**	-.0034037***	-.0018664***	.0002271
	.0020511	.0031163	.0013259	.0009193	.0005234	.0002503
Non-White	11.18127	23.68688	-23.97186**	-21.84985***	-4.94159	7.932988***
	17.89882	4.33546	7.488502	4.68094	5.054601	2.325319
Non-White *Income	-.0037708	-.0069803***	.0017311	.0031131	.0011444*	-.0007897**
	.0030373	.0020594	.0014728	.0008951	.000511	.0003259
Share without high school education - white	-.0497448	.3144852	-.3227622***	-.2665972***	.0037213	.1094054*
	.1396208	.17484	.0947263	.0815491	.0839593	.0503079
Nonwhite * share without high school education	.1255523	.1222706	.4656765****	.3423142***	.0866161	.0330277
	.1862037	.1760896	.0901911	.0835641	.1159074	.0629769
n	111,616	22,787	50,074	25,765	3,860	2,835

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001. no population weighting, county fixed effects, clustering by state and year fixed effects.

Table A4.14: State Income and Education Demographics for reproductive population

Income	0.0004*	0.0003
	0.0002	0.0003
Non-White	20.3684****	14.5198***
	1.6741	5.1999
Non-White*Income	-0.0025	-0.0018***
	0.0003	0.0006
% without high school education	0.0081	0.0614*
	0.0168	0.0317
Nonwhite * % without high school education		0.0612
		0.0723
N	110,758	110,758
State/Year Clustered SE	X	X
Year FE	X	X
County FE	X	X
Population Weighting	X	X
Education by Race		X

Reproductive population – individuals listed as female between 16 and 45

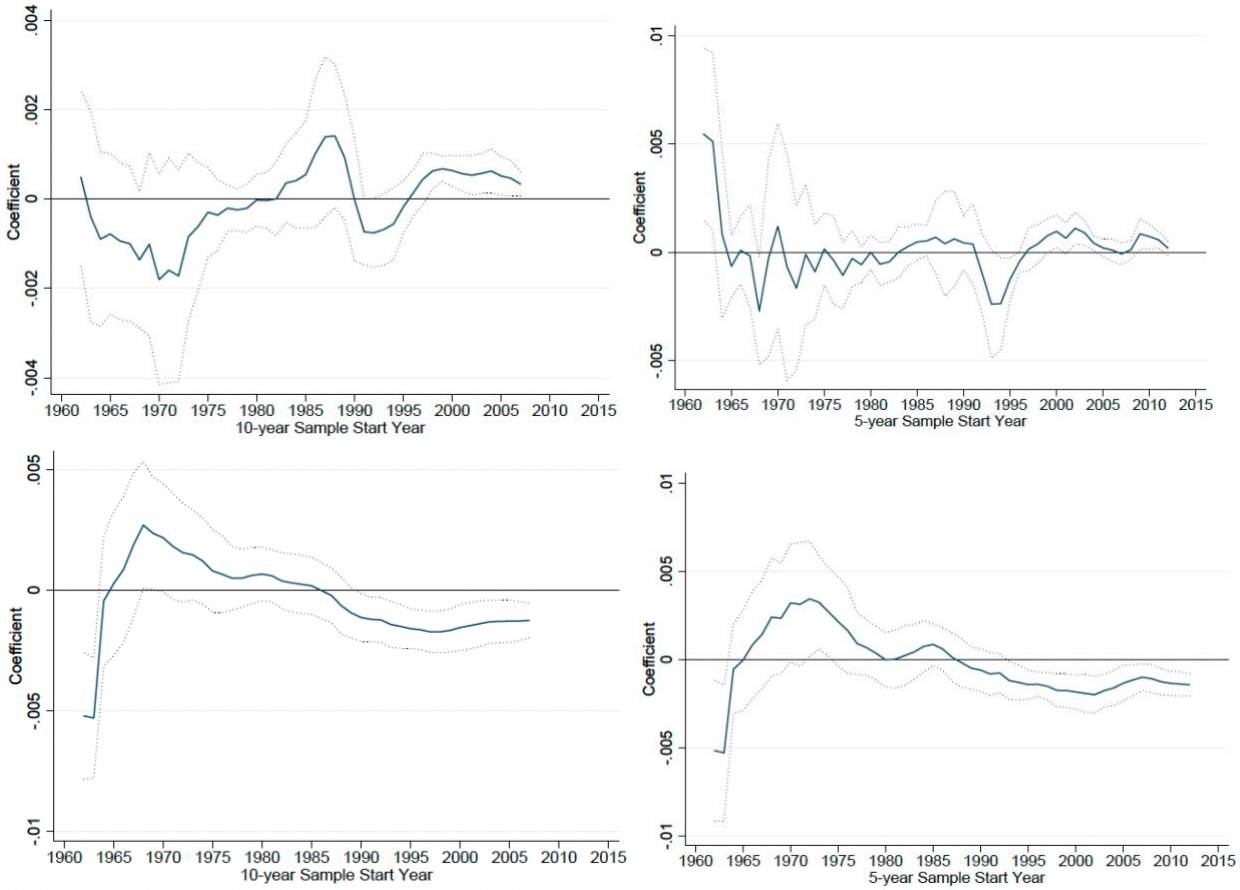

Figure A4.1: Regressions with share of population below high school education included. Income coefficients top panel, Nonwhite*Income coefficients bottom panel, ten year rolling windows left, five year rolling windows right.

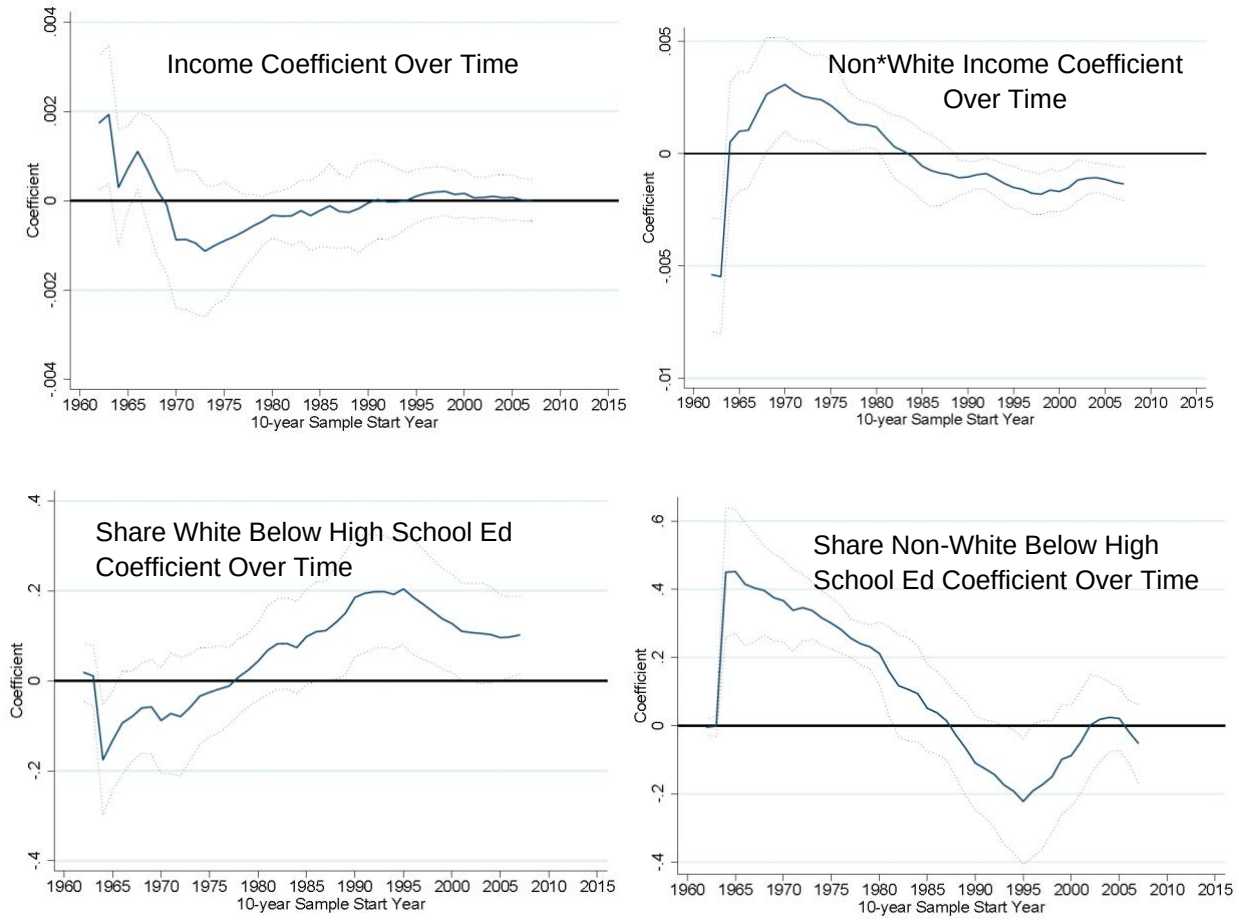

Figure A4.2: Income (White) coefficient top left, Income*Nonwhite top right, Share of white state pop below high school education bottom left, Share of non-white state pop below high school education bottom right. Disaggregated income, Education by Race, Population weighting

Table A4.15: State Income and Education Demographics for reproductive population

Income	.0009374	.0012533*	-.0004294*	.0003653*
	.000587	.0007291	.0002368	.0002056
Non-White	24.16497****	24.40216****	20.314****	20.36842****
	4.727912	4.849284	1.784299	1.674057
Non-White*Income	-.0045077****	-.0046549****	.0286879	.0080515
	.0010503	.0010771	.0003157	.0168485
Share without high school education	.2108061****	.0362251	-.0160507	-.0025382****
	.0284064	.0600058	.0286879	.0002723
N	111,533	111,532	110,759	110,758
State/Year Clustered SE	X	X	X	X
Year FE	X	X	X	X
County FE		X		X
Population Weighting			X	X

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001. Share of population below a high school education overall.

Table A4.16: State Income and Education Demographics by race for reproductive population

Income	-.0002162	.0009064	-.000506**	.0003018
	.0007811	.0009364	.0002229	.0002732
Non-White	16.76356	14.97701	11.03*	14.51978***
	10.19007	12.39574	6.303575	5.199891
Non-White*Income	-.0035529**	-.0035257*	-.001406*	-.0017885***
	.0016273	.0018876	.0007456	.0006128
Share without high school education - white	.0213919	-.0989951	.0098153	.0613966*
	.0863272	.129084	.0159584	.0317271
Nonwhite * share without high school education	.0881254	.1591085	.1354807	.0612396
	.1212554	.1630427	.0816101	.0723113
N	111,533	111,532	110,759	110,758
State/Year Clustered SE	X	X	X	X
Year FE	X	X	X	X
County FE		X		X
Population Weighting			X	X

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001. Share of population below a high school education by white/nonwhite.

Table A4.17: State Income and Education demographics for reproductive population, regressions over time without population weighting

	1962-2016	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0009064	.0038423	-.000509	-.0007271	-.0008099	.0007028*
	.0009364	.003115	.0017923	.0010404	.0004734	.0003358
Non-White	14.97701	25.39892**	8.032929	.6978425	4.653171	11.66411***
	12.39574	9.994543	5.64979	5.695429	3.201861	2.670752
Non-White *Income	-.0035257*	-.0066457***	-.0032004**	.0001225	.0003206	-.0009305**
	.0018876	.0016208	.0012971	.0010446	.0004082	.0003421
Share without high school education - white	-.0989951	.1650861	-.2703771***	-.1214636	.1499619**	.1274607**
	.129084	.1362643	.0703785	.0763078	.0486	.0478962
Nonwhite * share without high school education	.1591085	.1021843	.2883216***	.0810781	-.108993	-.0163674
	.1630427	.1364069	.0678615	.0927028	.0685538	.0558158
n	111,532	22,743	50,049	25,765	3,860	2,835

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001. no population weighting, county fixed effects, clustering by state and year fixed effects.

Table A4.18: State Income and Education Demographics by race for reproductive population, disaggregated income

Income	.000014	-.0003981	-.0004281	.0002737
	.0011142	.0017432	.0003337	.000329
Non-White	14.5926	9.263052	10.86002*	12.79922**
	10.29699	14.26286	5.907058	5.670221
Non-White*Income	-.0044948**	-.0037408	-.0020751**	-.0022106**
	.0019896	.0025792	.0009841	.0009168
Share without high school education - white	-.0204828	-.1734247	-.0032848	.0403749
	.0859828	.139337	.0226078	.0317565
Nonwhite * share without high school education	.0953704	.2069535	.1245259	.0826693
	.1220771	.1769147	.0800079	.0785922
N	111,533	111,532	110,759	110,758
State/Year Clustered SE	X	X	X	X
Year FE	X	X	X	X
County FE		X		X
Population Weighting			X	X

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001. Share of population below a high school education by white/nonwhite.

Table A4.19 State Income and Education demographics for reproductive population, regressions over time with population weighting, disaggregated income

	1962-2016	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0000	.0021****	-.0008	-.0003	.0000	-.0000
	.0003	.0005	.0007	.0003	.0003	.0003
Non-White	11.7344**	12.1517*	2.1556	12.6792****	16.7924****	10.6109****
	4.8375	5.4057	4.5570	2.4480	2.5623	1.3944
Non-White *Income	-.0020**	-.0023*	-.0003	-.0015**	-.0014***	-.0013***
	.0008	.0011	.0012	.0006	.0004	.0003
Share without high school education - white	.0260	.0503	.0041	.1255**	.1694****	.0828**
	.0287	.0314	.0490	.0392	.0349	.0327
Nonwhite * share without high school education	.0908	.1721**	.1534**	-.0936**	-.2388***	-.0003
	.0697	.0613	.0427	.0397	.0594	.0254
n	165,272	22,578	49,718	25,633	21,639	33,266

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001. population weighting, county fixed effects, clustering by state and year fixed effects. Reproductive population – individuals listed as female with ages between 16 and 45

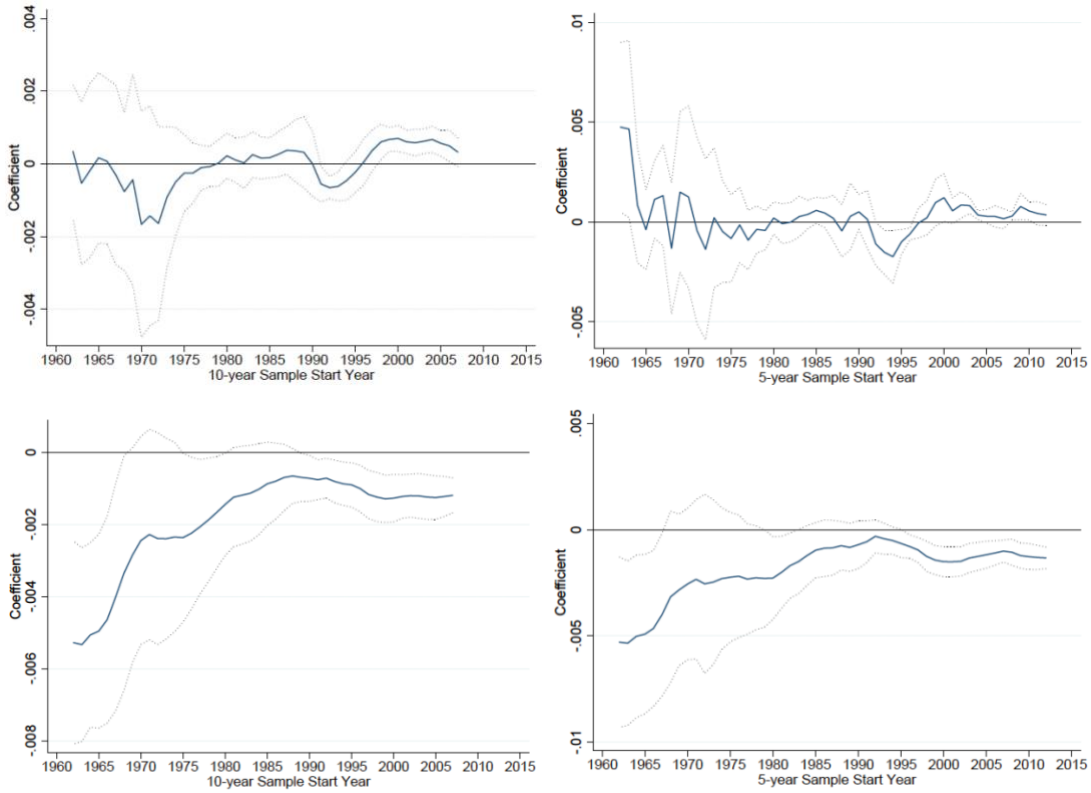

Figure A4.3: Regressions with share of income held by bottom quintile included. Income coefficients top panel, Nonwhite*Income coefficients bottom panel, ten year rolling windows left, five year rolling windows right.

Table A4.20: State Income and Income Distribution

Income	-.0000209	.0010201	-.0004035**	.0002542
	.0005324	.0006989	.0001825	.0001806
Non-White	24.28079****	24.41121****	20.27662****	20.37573****
	4.733602	4.846545	1.801647	1.679492
Non-White*Income	-.004532****	-.0046591****	-.0024412****	-.0025396****
	.0010518	.0010764	.000315	.0002725
Share of income held by the bottom quintile	-103.849	172.1111*	114.9547***	73.86809**
	80.8426	96.41395	40.68113	33.54792
N	111,617	111,616	110,837	110,836
State/Year Clustered SE	X	X	X	X
Year FE	X	X	X	X
County FE		X		X
Population Weighting			X	X

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001. Share of population below a high school education overall. Note – uses shares rather than percentages.

Table A4.21: State Income and Income Distribution by race

Income	-.0005062	.0003945	-.0004037**	.0002521
	.0004406	.0006818	.0001823	.0001824
Non-White	23.15995****	22.53151****	20.1488****	20.44867****
	4.453429	4.509013	1.986131	1.776291
Non-White*Income	-.0038802****	-.0036769****	-.0024231****	-.0025208****
	.0009907	.0009992	.0003117	.0002666
Share of income held by the bottom quintile - white	218.0595***	549.2148****	106.2844***	87.7854**
	72.8848	125.5587	32.92459	38.60072
Nonwhite * Share of income held by the bottom quintile	-322.9045****	-557.2224****	-37.15901	-64.15408
	89.87302	129.4591	51.45848	57.61947
N	111,452	111,451	110,679	110,678
State/Year Clustered SE	X	X	X	X
Year FE	X	X	X	X
County FE		X		X
Population Weighting			X	X

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001. Share of population below a high school education by white/nonwhite. Note – uses shares [0-1] rather than percentages [0-100].

Table A4.22: State Income and Income Distribution, regressions over time

	1962-2016	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0003945	.0023621	-.0011076	-.000901	-.0008723	.0006914**
	.0006818	.0022279	.0017964	.001089	.0004769	.0002896
Non-White	22.53151****	41.28027****	20.15754***	1.950527	2.936827	10.2354****
	4.509013	6.1784	5.375701	4.228096	2.990906	1.92615
Non-White *Income	-.0036769****	-.0089373****	-.0038421**	.0003312	.0003151	-.0009379***
	.0009992	.0016438	.0013292	.0009641	.0004344	.0002854
Share of income held by the bottom quintile - white	549.2148****	-835.5017	648.5784***	205.9876	14.37115	-295.7978***
	125.5587	1560.294	170.7269	128.5522	98.0595	68.34057
Nonwhite * Share of income held by the bottom quintile	-557.2224****	857.6654	-587.576**	-164.4468	-26.61805	380.3228**
	129.4591	1163.312	185.9208	120.0701	102.444	126.0325
n	111,451	22,737	50,000	25,755	3,860	2,835

Note: * is significant at $p \leq 0.1$ ** at 0.05, *** at 0.01, **** at 0.001. Note – uses shares [0-1] rather than percentages [0-100].

Table A4.23: State Income and Income Distribution, regressions over time with population weighting

	1962-2016	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0002521	.0001682	-.0002544	.0001703	-.0002304	.0005697**
	.0001824	.0011985	.0005423	.000281	.000287	.0001819
Non-White	20.44867****	31.28609	18.38106***	8.750349***	9.248732***	11.30827****
	1.776291	4.140816	4.310913	2.163579	2.136812	1.992468
Non-White *Income	-.0025208****	-.0049602***	-.0023652*	-.0008711	-.0009002**	-.0012526***
	.0002666	.0013717	.001197	.0005907	.0003134	.0003078
Share of income held by the bottom quintile - white	87.7854**	118.5015	203.7258***	-53.28312	-136.3187**	-206.4598***
	38.60072	185.1783	54.04898	51.28817	47.92775	49.43418
Nonwhite * Share of income held by the bottom quintile	-64.15408	-593.7453	-233.9197***	182.6222*	234.9067***	420.8236***
	57.61947	400.5048	67.60497	89.55136	66.5972	116.3564
n	110,678	22,573	49,669	25,623	3,846	2,835

Note: * is significant at $p \leq 0.1$ ** at 0.05, *** at 0.01, **** at 0.001. Note – uses shares [0-1] rather than percentages [0-100].

Table A4.24: State Income and Income Distribution and Education

Income	.0013987***	.0009838	-.0002409	.0002508
	.0005054	.0006845	.0001776	.0001819
Non-White	24.18685****	24.40147****	20.13795****	20.38074****
	4.722253	4.846631	1.787447	1.676856
Non-White*Income	-.004514****	-.0046564****	-.0024204****	-.0025406****
	.0010495	.0010767	.000312	.0002723
Share of income held by the bottom quintile	133.3358*	183.2575**	171.1706***	69.89525**
	69.07889	85.38488	55.91223	33.57606
Share below high school education	24.5199****	2.546759	5.993488***	-.5242978
	3.972821	7.128561	2.128217	1.66462
N	111,617	111,616	110,837	110,836
State/Year Clustered SE	X	X	X	X
Year FE	X	X	X	X
County FE		X		X
Population Weighting			X	X

Note: * is significant at $p \leq 0.1$ ** at 0.05, *** at 0.01, **** at 0.001. Share of population below a high school education overall. Note – uses shares [0-1] rather than percentages [0-100].

Table A4.25: State Income and Income Distribution and Education by race

Income	.000463	.0001375	-.0003849*	.0001633
	.0007463	.0008108	.000215	.0002676
Non-White	17.40594	19.80758	11.24601	15.01874**
	12.90983	12.41985	8.785434	7.443403
Non-White*Income	-.0028513*	-.003169**	-.001339	-.0018199**
	.001634	.0015741	.0009898	.0008295
Share of income held by the bottom quintile - white	361.799**	572.8026***	154.5347**	124.3694**
	178.1267	189.0785	69.22973	57.36633
Nonwhite * Share of income held by the bottom quintile	-461.3399**	-599.4411***	-76.61542	-97.25142
	196.2666	203.6289	69.94088	66.05564
Share below high school education - white	23.24704**	15.20793	6.200328*	6.063776
	11.03779	12.08753	3.643294	3.962173
Nonwhite * Share below high school education	-2.265931	-2.450173	8.133049	4.166364
	15.04943	15.00642	9.398982	8.384458
N	111,452	111,451	110,679	110,678
State/Year Clustered SE	X	X	X	X
Year FE	X	X	X	X
County FE		X		X
Population Weighting			X	X

Note: * is significant at $p \leq 0.1$ ** at 0.05, *** at 0.01, **** at 0.001. Share of population below a high school education by white/nonwhite. Note – uses shares [0-1] rather than percentages [0-100].

Table A4.26: State Income and Income Distribution and Education, regressions over time

	1962-2016	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0001375	.0026815	-.0018419	-.0014357	-.0010229*	.0006207*
	.0008108	.0026586	.0015876	.0010476	.0005169	.0002823
Non-White	19.80758	9.11783	-2.073013	-13.1846*	6.409572	9.209946**
	12.41985	12.34055	9.077846	5.932266	4.635668	2.830659
Non-White *Income	-.003169**	-.0048094**	-.0015027	.0013578	.0001901	-.0008333**
	.0015741	.0015641	.0015214	.0009746	.0004237	.0003028
Share of income held by the bottom quintile - white	572.8026***	-875.4398	328.7619*	-.3222642	123.3669	-227.2546***
	189.0785	1360.318	151.5215	133.749	65.49372	61.25434
Nonwhite * Share of income held by the bottom quintile	-599.4411***	505.6904	-277.5923	31.45713	-169.7904**	262.612**
	203.6289	1103.557	173.0378	132.8356	71.29131	115.0522
Share below high school education - white	15.20793	20.34377	-12.16351	-18.64151*	22.83503**	8.113091
	12.08753	17.41556	10.32126	8.554767	7.669843	4.533758
Nonwhite * Share below high school education	-2.450173	21.97266	27.69702**	28.53875***	-10.01507	2.503931
	15.00642	17.49298	10.25339	7.879259	11.15694	5.984005
n	111,451	22,737	50,000	25,755	3,860	2,835

Note: * is significant at p ≤ 0.1 ** at 0.05, *** at 0.01, **** at 0.001. Note – uses shares [0-1] rather than percentages [0-100].

Table A4.27: State Income and Income Distribution and Education, regressions over time with population weighting

	1962-2016	1965-1974	1975-1984	1985-1994	1995-2004	2005-2014
Income	.0001633	-.0006954	-.0005192	.0002665	-.0002219	.0005354**
	.0002676	.0009995	.0005547	.0004198	.0002966	.0002032
Non-White	15.01874**	-13.2854	-4.348746	-1.675525	18.5927****	11.13893***
	7.443403	11.36018	5.210664	4.660699	4.061604	2.914956
Non-White *Income	-.0018199**	.0006466	.0005307	.000237	-.0014096***	-.0011828***
	.0008295	.0015097	.0008689	.0005192	.0003858	.0003511
Share of income held by the bottom quintile - white	124.3694**	347.8061	103.6895*	-52.05738	-29.20315	-123.0773**
	57.36633	241.3014	48.97808	37.01473	22.60129	43.81402
Nonwhite * Share of income held by the bottom quintile	-97.25142	-1033.555	-137.8691**	127.4555**	73.22686**	247.1366**
	66.05564	274.6423	52.585	44.1974	27.26552	103.2084
Share below high school education - white	6.063776	-14.57974**	3.02053	3.171541	27.26552***	10.00339**
	3.962173	6.279744	4.568677	5.743265	5.43865	4.25337
Nonwhite * Share below high school education	4.166364	43.35861***	20.79945***	15.16981*	-21.86852**	.7919877
	8.384458	11.46324	4.743211	7.205191	8.012511	5.454489
n	110,678	22,573	49,669	25,623	3,846	2,835

Note: * is significant at $p \leq 0.1$ ** at 0.05, *** at 0.01, **** at 0.001. Note – uses shares [0-1] rather than percentages [0-100].

Table A4.2: State Income and Income Distribution and Education, disaggregated income by race

Income	.0019532	.001287	-.0001215	.0001036
	.0007881	.0012	.000245	.0003133
Non-White	23.40942****	21.33466****	18.84445****	18.82796****
	4.55564	5.449498	1.759332	1.96319
Non-White*Income	-.0056314****	-.0052819****	-.0032707****	-.003278****
	.0012038	.0013511	.0004078	.0004109
Share of income held by the bottom quintile	90.78005*	142.1398*	166.6212****	69.57239*
	51.68652	73.27736	45.90485	35.68007
Share below high school education	23.37806****	5.080999	7.040214****	1.274978
	4.181521	7.847056	1.999739	1.999136
N	111,617	111,616	110,837	110,836
State/Year Clustered SE	X	X	X	X
Year FE	X	X	X	X
County FE		X		X
Population Weighting			X	X

Note: * is significant at $p \leq 0.1$ ** at 0.05, *** at 0.01, **** at 0.001. Share of population below a high school education overall. Note – uses shares [0-1] rather than percentages [0-100].

Table A4.27: State Income and Income Distribution and Education by race, disaggregated income by race

Income	.0006775	-.0005989	-.0002792	.0000206
	.0009344	.0012684	.0002954	.0003228
Non-White	18.37068	15.04433	11.03007	12.58763
	12.33926	13.95546	8.77158	8.226798
Non-White*Income	-.0039722**	-.003431	-.0019009	-.0021874*
	.00195	.0021409	.001388	.0012879
Share of income held by the bottom quintile - white	324.2011**	527.4262***	140.9532**	76.26256
	157.3037	183.0552	56.745	54.18045
Nonwhite * Share of income held by the bottom quintile	-485.0771**	-622.5893***	-97.29013	-84.82848
	188.6322	214.4483	70.16068	73.21433
Share below high school education - white	19.53042**	5.425727	4.781328	2.194403
	9.566478	12.84924	3.082974	4.031233
Nonwhite * Share below high school education	-2.91256	1.588566	7.715518	6.957831
	13.92219	16.27412	9.583589	9.19993
N	111,452	111,451	110,679	110,678
State/Year Clustered SE	X	X	X	X
Year FE	X	X	X	X
County FE		X		X
Population Weighting			X	X

Note: * is significant at $p \leq 0.1$ ** at 0.05, *** at 0.01, **** at 0.001. Share of population below a high school education by white/nonwhite. Note – uses shares [0-1] rather than percentages [0-100].

Appendix 5: Quadratic Income

Table A5.1 Quadratic income disaggregated by race

Income	0.0072***	0.0096***	-0.0010	0.0017***
	0.0024	0.0029	0.0011	0.0006
Income^2	0.0000***	0.0000****	0.0000	0.0000***
	0.0000	0.0000	0.0000	0.0000
Non-White	48.3370****	51.4826****	26.4017****	30.9998****
	5.7721	6.5527	3.3669	2.6683
Non-White*Income	-0.0229****	-0.0246****	-0.0085****	-0.0103****
	0.0027	0.0030	0.0017	0.0013
Non-White*Income^2	2.67e-06****	2.91e-06****	7.70e-07***	9.41e-07****
	3.24e-07	3.59e-07	2.32e-07	1.71e-07
N	111,617	111,616	110,837	110,836
State/Year Clustered SE	X	X	X	X
Year FE	X	X	X	X
County FE		X		X
Population Weighting			X	X

Note: * is significant at $p \leq 0.1$ ** at 0.05, *** at 0.01, **** at 0.001

Table A5.2 Quadratic Income, overall income

Income	0.0091****	0.0141****	-0.0010	0.0012
	0.0026	0.0033	0.0010	0.0015
Income^2	0.0000****	0.0000****	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000
Non-White	44.6345****	45.3850****	34.6578****	34.8454****
	6.3754	6.4190	4.7714	5.2098
Non-White*Income	-0.0146****	-0.0152****	-0.0079****	-0.0080****
	0.0031	0.0031	0.0017	0.0018
Non-White*Income^2	1.18e-06***	1.24e-06****	5.00e-07****	4.91e-07***
	3.55e-07	3.61e-07	1.39e-07	1.46e-07
N	181,938	181,937	170,107	170,106
State/Year Clustered SE	X	X	X	X
Year FE	X	X	X	X
County FE		X		X
Population Weighting			X	X

Note: * is significant at $p \leq 0.1$ ** at 0.05, *** at 0.01, **** at 0.001

Appendix 6: Additional Coefficient Graphs with Rolling Windows

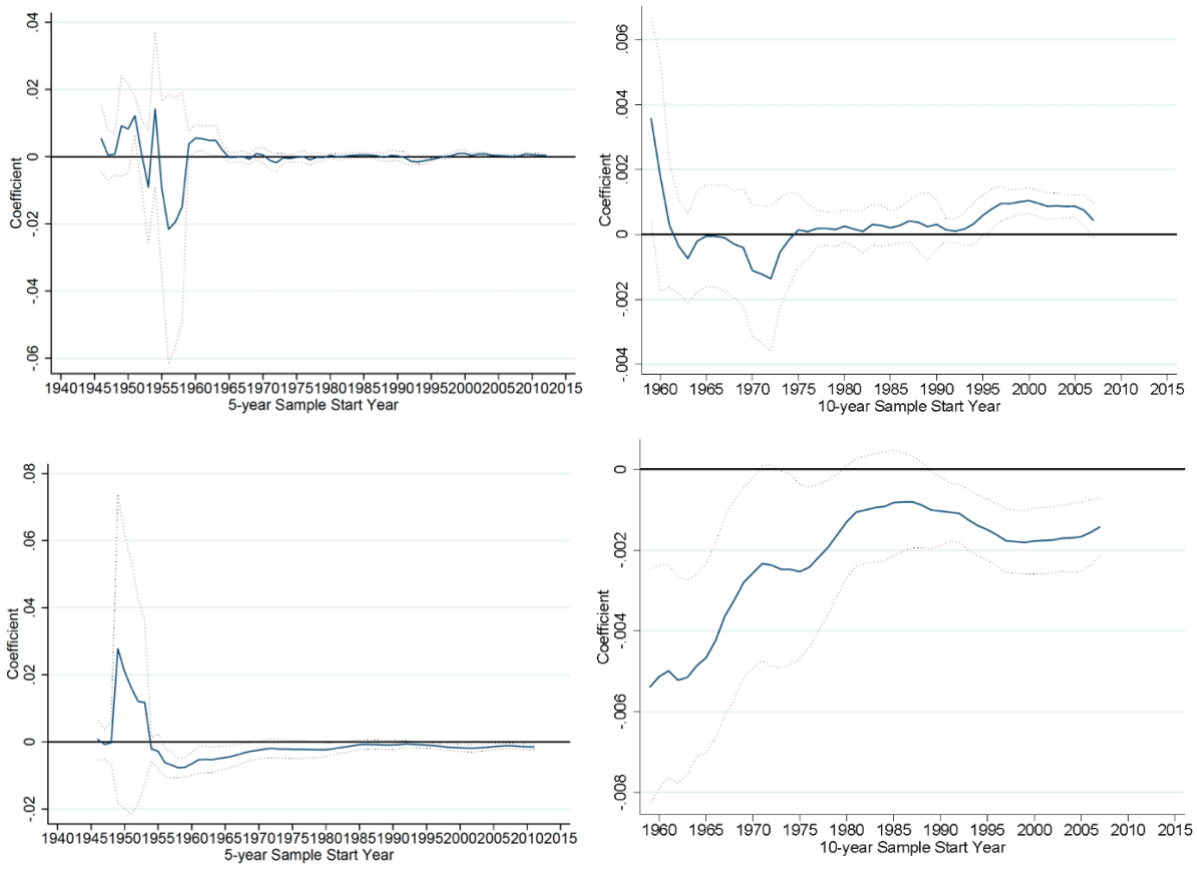

Figure A6.1: State level income. Income coefficient (top) and NonWhite*Income coefficient (bottom) graphed over five (left) and ten (right) year rolling windows: with population weighting. Dotted line captures 95% confidence interval. Year and county fixed effects. 95% confidence interval based on standard errors using year and state clustering.

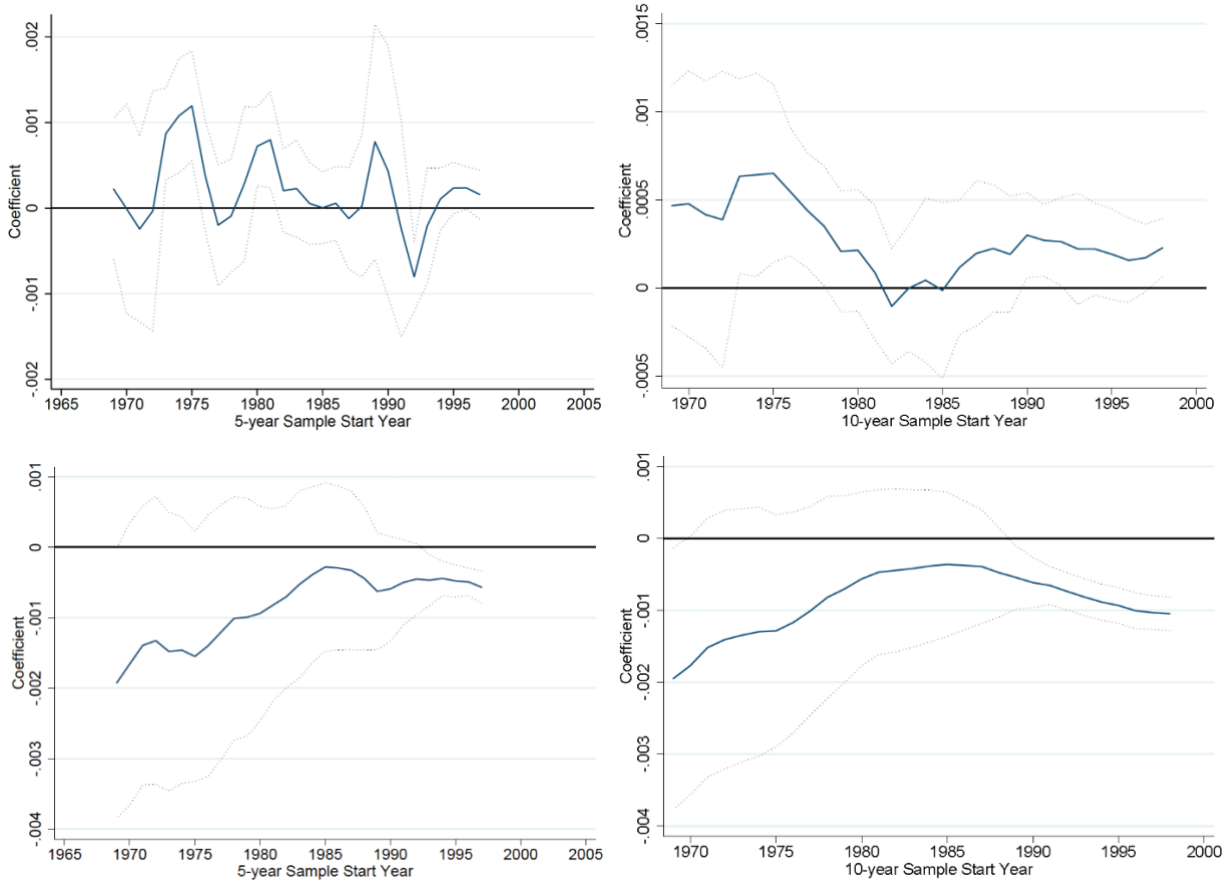

Figure A6.2: County level income: Income coefficient (top) and NonWhite*Income coefficient (bottom) graphed over five year (left) and ten year (right) rolling windows: with population weighting. Dotted line captures 95% confidence interval. County and Year fixed effects. Clustering at state and year level.

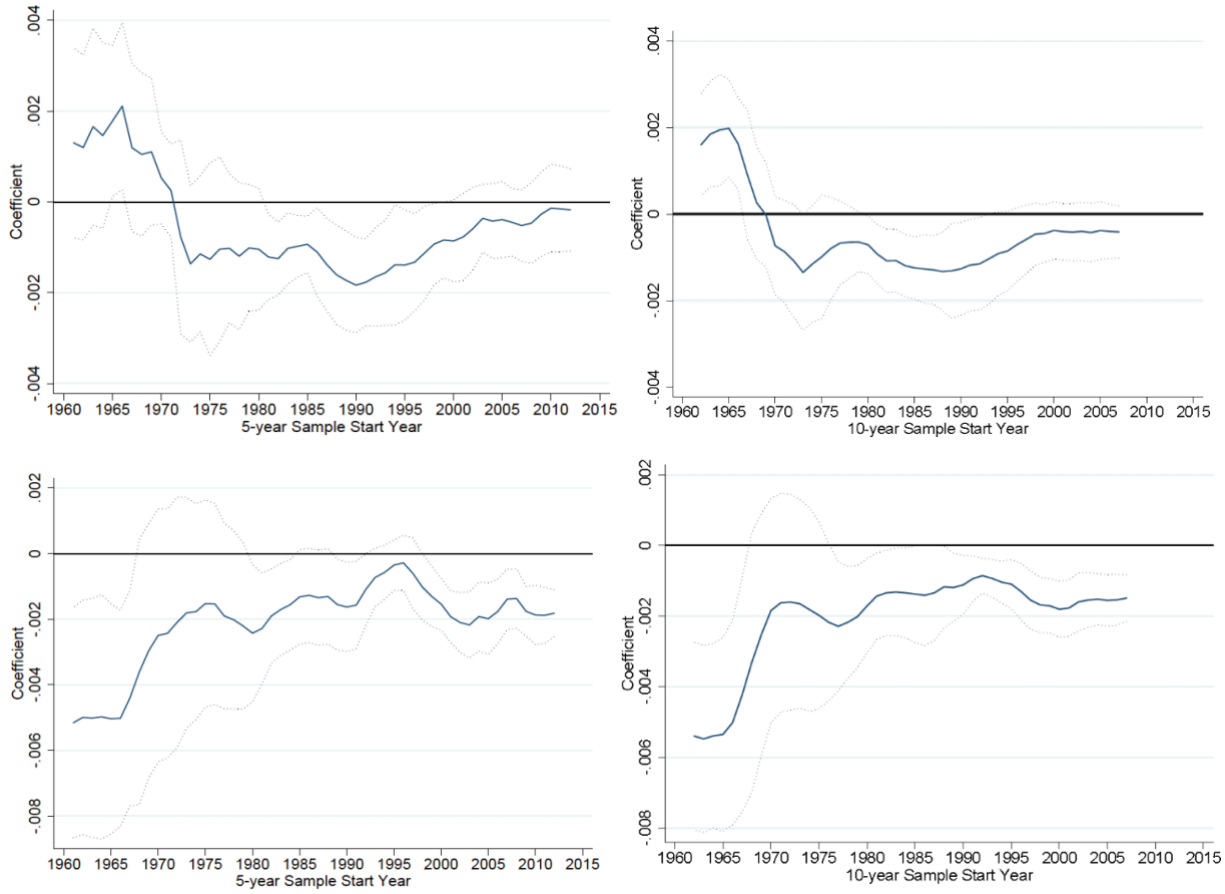

Figure A6.3: State income disaggregated by race. Income coefficient (top) and NonWhite*Income coefficient (bottom) graphed over five year (left) and ten year (right) rolling windows: with population weighting. Dotted line captures 95% confidence interval.

Appendix 7: Literature Tables

Title	Author(s)	Year	Economic Indicator	Health Outcomes	Time Period	Region	Controls & methods	Key Findings
Are Recessions Good For Your Health?	Christopher J. Ruhm	2000	Unemployment rates primarily; employment to population ratio and nonfarm payroll employment	Total mortality, Mortality by age group, Mortality by specific cause, including infant and neonatal mortality	1972-1991	U.S., 50 states and DC	% of state population with educational attainment levels, Black and Hispanic share, share of under 5 and over 65, sometimes personal incomes	Unemployment is negatively correlated with total mortality, and including infant mortality, personal income is positively related to mortality when mortality is measured in logs, negative when mortality is measured in levels
Recessions, Healthy No More?	Christopher J. Ruhm	2015	State unemployment rates; preliminary examination of home prices and per-capita incomes	Total mortality, mortality by sex and by age group, four major causes (not including infant mortality)	1976-2009	U.S.	Year fixed effects, state fixed effects, share of state population that is female, non-white, Hispanic, and 7 age groups, state year population weights. Using 20 year windows, also using time trends for the whole period	Mortality shifts from being procyclical in the 70's and 80's to having no relation overall, countercyclical relationship with some specific causes (cancer). Instability in estimates for under 15 year windows.

Aggregation and the estimated effects of economic conditions on health	Jason M Lindo	2015	Unemployment rate, employment to population ratio	Overall Mortality, Fraction of Infants with low birth weight (based on conditions in year of conception), Mortality divided by youth, working age, and elderly mortality, mortality due to cardiovascular causes, motor vehicle accidents, and suicides	1978-2006/ 2010 for mortality, 1976-1999/ 2010 for birth weight	U.S., excluding Alaska and Hawaii and Virginia	Testing by various levels of aggregation (region, state BEA econ area, BEA component econ area, county) Methods from Ruhm (2000) but excluding ed, Hispanic share controls, and Dehejia and Lleras-Muney (2004) Two way clustering by location and time	Aggregation matters, disaggregated analyses may have estimates that are smaller in magnitude, there are spillover affects from surrounding areas, which may explain why larger areas have larger estimates, more disaggregated analyses have more power and can show effects persisting where they might be lost at the larger level
Booms, Busts and Babies' Health	Rajeev Dehejia and Adriana Lleras-Muney	2004	Unemployment	Parental characteristics and behaviors, low and very low birth weight, congenital malformations, post	1975-1999	US, with more detailed examinations in CA specifically		Higher unemployment, declinding neonatal and postneonatal mortality, increased use of prenatal care. Higher SES Black mothers more likely to have kids during recessions, opposite for white mothers. Decreases in risky behavior

				neonatalmortality and neonatal mortality				among Black mothers (selection), increases among Whites (behavioral).
Why are Recessions Good for Your Health?	Douglas L. Miller, Mariane E. Page, Ann Huff Stevens, Mateusz Filipski	2009	Unemployment, including unemployment specific to demographic groups	Mortality, decomposed by age and cause, including under 1 y (infant mortality) (natural log of mortality rate)	1972-1991	U.S., follows Ruhm	Following Ruhm but further decomposing mortality, unemployment rates	"Cyclical changes in mortality among working-age individuals stem mostly from additional motor vehicle accidents. Second, decompositions by age (and by cause and age) make clear that understanding procyclical mortality requires understanding mortality patterns among the elderly. Among this group, own work behavior seems less likely to be an important mechanism. Other factors, including pollution changes and changes in the quality, quantity, and nature of health care inputs over the business cycle, form an important target for future research."
The Best of Times, the Worst of	Ann H. Stevens, Douglas L.	2015	Employment rate of own and other demographic	Mortality decomposed by age,	1978-2006	U.S.	Particularly looking at relationships	"We find three pieces of evidence in support of the hypothesis that cyclical

Times: Understanding Pro-cyclical Mortality	Miller, Marianne E. Page and Mateusz Filipski		groups	particularly looking at place of death (ie nursing homes) for elderly			between employment rates, healthcare investment, place of death (ie nursing homes) for elderly	changes in the quality of health care contribute to pro-cyclical variation in the elderly mortality rate. First, we show that, relative to other places of death, deaths occurring in nursing homes are particularly responsive to the state unemployment rate. Second, we show that mortality is more pro-cyclical in states with a higher fraction of nursing home residents. We also show that these findings are not explained by additional flows into nursing homes when the economy is strong—a possibility that would be consistent with cyclically induced increases in family caregivers' opportunity cost of time. In fact, transitions into nursing homes appear to be negatively related to the state of the economy. Finally, we show that employment levels in skilled nursing facilities show statistically significant declines when the

								unemployment rate falls, findings that are corroborated when we look at occupation data in the CPS. Taken together, our analyses suggest that the mechanisms driving pro-cyclical mortality have little to do with individual-level behavioral changes in time use over the business cycle. Instead, we provide new evidence that staffing difficulties among relatively low-skilled nursing occupations may be an important focus for efforts to improve the quality of health care. In addition, our findings help to resolve the tension in the literature between studies based on aggregate data (generally at the state level), which document a negative relationship between mortality and unemployment, and studies based on individual data, which find that job loss reduces individuals' health."

Macro-Economic Conditions and Infant Health: A changing relationship for Black and White infants in the United States	Chlara Orsini, Mauricio Avendano	2015	State unemployment rate at time of conception	Infant mortality, birthweight, cause of death, prenatal care	1980-2004	U.S.		Relationships differ between Blacks and Whites and differ by cause of death, relationships change over time Black mothers tend to be older, more educated when unemployment rates rise, relationship changes over the periods - stronger relationship in 1980-89, where higher state unemployment at the time of conception is associated with lower Black Infant mortality, but relationship is not apparent in 1990-2004. Fewer babies born to young mothers in periods of high unemployment. More prenatal care visits for Black parents during periods of higher unemployment
Short- and long-term effects of unemployment on fertility	Janet Currie, Hannes Schwandt	2014	Unemployment	Fertility	1975-2010	U.S.		"We analyze the effects of unemployment by following fixed cohorts of US-born women defined by their own state and year of birth. We find that a one

								percentage point increase in the unemployment rate experienced between the ages of 20 and 24 reduces the short-run fertility of women in this age range by six conceptions per 1,000 women. When these women are followed to age 40, a one percentage point increase in the unemployment rate experienced at 20 to 24 is associated with an overall loss of 14.2 conceptions. This larger long-term effect is driven largely by women who remain childless".
Economic Conditions During Pregnancy and Adverse Birth Outcomes Among Singleton Live Births in the United States, 1990-2013	Claire E Margerison-Zilko, Yu Li, Zhehui Luo	2017	State level unemployment rates during first two trimesters, Great Recession (during and after)	Preterm birth, low birth weight	1990-2013	U.S.		'Each 1-percentage-point increase in the first-trimester unemployment rate was associated with a 5% increase in odds of preterm birth, while second-trimester unemployment was associated with a 3% decrease in preterm birth odds. During the Great Recession, however, first-trimester unemployment was associated with a 16%

								increase in odds of preterm birth.'
Race and life expectancy in the USA in the Great Depression	Tim A Bruckner, Ashley M Ima, Trang T Nguyen, Andrew Noymer	2019	Great Depression	Mortality/ life expectancy	Great Depression, prior trends	US	Lee-Carter model	'In this analysis, all-race life expectancy did not grow unusually during the Great Depression. However, nonwhites did see greater-than-expected increases in life expectancy in 1930–1933.'
Association between disparities in intergenerational economic mobility and cause-specific mortality among Black and White persons in the United States	Farhad Islami, Stacey A Fedewa, Blake Thomson, Leticia Nogueira, K Robin Yabroff, Ahmedin Jemal	2021	Economic mobility gap	Mortality gaps, mortality gaps by some causes (not infant mortality)	Economic mobility from 1978-1983 birth cohorts, mortality from 2011-2018	U.S (varying county groups based on ages examined)		"n ages 30-39 years, a one percentile increase in the economic mobility gap was associated with a 6.8 % (95 % confidence interval 1.8 %-11.8 %) increase in the Black-White mortality gap among males and a 13.5 % (8.9 %-18.1 %) increase among females, based on data from 471 counties. In all ages combined, the corresponding percentages based on data from 1,572 counties were 10.2 % (7.2 %-13.2 %) among males and 14.8 % (11.4 %-18.2 %) among females, equivalent to an increase of 18.4 and 14.0 deaths per 100,000 in

								the mortality gap, respectively. Similarly, strong associations between economic mobility gap and mortality gap in all ages were found for major causes of death, notably for potentially preventable conditions, including COPD, injury/violence, and cancers of the lung, liver, and cervix."
Long Run Impacts of Childhood Access to the Safety Net	Hilary Hoynes, Diane Whitmore Schanzenbach, Douglas Almond	2016	Rollout of Food Stamp Program during childhood	Later life health and economic condition; incidence of metabolic syndrome, economic self sufficiency	Individuals born between 1956 - 1981	US	County controls (share urban, share <5 > 65, income < 3000 1959 usd, % farming land, log county population, Hospitals per capita (American Hospital Association data, goes back to 1948), gov't transfers per capita (from Bureau of Economic Analysis	Improvements in adult health, and economic outcomes for women

							Regional Economic Information System (REIS) (1959 1962, then annually beginning in 1965) and presence of a community health center	
The Effects of Unemployment on Prenatal Care Use and Infant Health	A Kutinova Menclova	2013	Unemployment	Birth outcomes, Infant health, prenatal care use	1989-1999	US		"I found the overall effects of unemployment to be beneficial but concluded that at least some of the apparent benefits are attributable to the Medicaid "safety net." In supplementary analyses stratified by socioeconomic status, Medicaid played the largest role among economically disadvantaged (single and less educated) women. Thus, unemployment seems to be good for at least some pregnancies—provided Medicaid steps in." Lower rates of early, adequate prenatal care for

								Black parents, higher rates of low and very low birthrate.

Institutional changes over time related to racial gaps

Title	Author(s)	Year	Economic Indicator	Health Outcomes	Time Period	Region	Controls & methods	Key Findings
The Federal Effort to Desegregate Southern Hospitals and the Black-White Infant Mortality Gap (Working Paper)	D. Mark Anderson, Kerwoin Kofi Charles, Daniel I Rees	2020	Access to 'desegregated' (medicare eligible) hospitals	Black-White infant mortality gap; Black in hospital births	1959 - 1973	'Deep South', with more focused analysis on Mississippi	Event study, looking at years from the first hospital certified was listed for that county, year fixed effects. Analogous diff-in-diff. Robustness check with state by year fixed effects. Consider whether later certification = greater racial animus Do work reproducing Almond et al (2006)	Figure 2 focuses on the evolution of the Black-White infant mortality gap in the Deep South. The Black and White IMRs are both trending downward during the period under study, but the Black IMR trend is steeper. In theory, the narrowing of the Black-White infant mortality gap in the Deep South could have been caused by any number of factors. There was, for instance, a sharp reduction in Black fertility immediately after the passage of the Civil Rights Act (Thompson 2019), and Black Southerners made significant economic progress throughout the 1960s (Freeman 1981;

								Donohue and Heckman 1991; Wright 1999, 2013).22 Other government interventions, including the rollout of Community Health Centers (CHCs) and the implementation of state Medicaid programs, could have also contributed to the observed trends (Goldman and Grossman 1988; Bailey and Goodman-Bacon 2015; Goodman-Bacon 2018).23 Pneumonia/influenza and diarrhea were two of the leading causes of mortality among U.S. infants during the sample period (U.S. Department of Health, Education, and Welfare 1963).30 Access to a hospital did not have impacts on black infant mortality declines, nor infant mortality by specific cause. Early/late adoption didn't have an impact.

Civil Rights, the War on Poverty, and Black-White convergence in Infant Mortality in the Rural South and Mississippi (working paper)	Douglas Almond, Kenneth Y. Chay, Michael greenstone	2006	Civil Rights Act and mandated desegregation, timing of hospital compliance "robust to adjustment for various alternative health determinants, such as maternal characteristics (e.g., age and marital status), transfer payments (including Food Stamps), Medicaid participation, and per-capita income."	Black infant mortality	Rural south, Mississippi	1955-1975	'This paper's goal is to assess whether the federally mandated integration of health care facilities caused at least part of the improvement in black infant mortality rates documented in Figure 1a. In the absence of a randomized experiment, we proceed by presenting a series of increasingly demanding tests. Specifically if there is a causal relationship, then the above historical context suggests that the data will fail to reject the following hypotheses about	Fails to reject all four hypotheses

							the decline in the black IMR after 1965: 1. It should exceed the decline in the white IMR. 2. It should disproportionately occur in the areas of the country where segregation and inadequate supply were more pervasive. 3. It should disproportionately occur among causes of death that are more responsive to access to hospitals. 4. Among the causes of death that are preventable with hospital access, it should respond quickly to integration. ‘	

The Long-Run and Intergenerational Impact of Poor Infant Health: Evidence from Cohorts Born During the Civil Rights Era (Working Paper)	Douglas Almond and Kenneth Y Chay	2006	Black women being born in early vs late 1960s (relative to the Civil Rights Movement)	Adult health risk factors of mothers, risk factors of infants (Birth Weight and APGAR score)	1979-2000	US; Alabama, MIssisisippi, New York, Pennsylvania	Controls for marital status, education status, age, born in state vs out of state	Improvements in health from being born in the late 1960s for Black mothers and their children
The Declining Contribution of Socioeconomic Disparities to the Racial Gap in Infant Mortality Rates, 1920-1970	William J Collins and Melissa A Thomasson	2004	Income, urbanization, women's education, physicians per capita; follow up with maternal characteristics, behaviors, environmental factors, and insurance coverage	Racial gap in infant mortality rates (state level infant mortality) Natural log	1920-1970	U.S., with coverage changing as states enter birth and death registration areas	Natural log infant mortality, run regressions separately by race categories, time period dummies (5 year) state dummies or dummy for south, decomposition from there	Negative but not significant coefficient on income generally for both, decreasing proportion of gap explained by socioeconomic factors. Widening gap shows with rising gap in birth weight distribution. Not likely to be due to smoking. Pollution exposure may have impacted. Not likely to be due to white babies benefiting more from medical tech for low birth weight infants.

International

Title	Author(s)	Year	Economic Indicator	Health Outcomes	Time Period	Region	Controls & methods	Key Findings
The Effects of Unemployment on Fertility: Evidence from England	Cevat Giray Aksoy	2016	Unemployment, as well as home prices	Fertility	1995-2011	England	Unemployment is subdivided by male vs female, age groups, and demographic characteristics (education, county of birth, marital status)	"The findings indicate that female unemployment tends to increase fertility, as women take advantage of the low opportunity cost of childbearing in the form of mothers' time. Male unemployment goes in the opposite direction, which implies an income effect. Returning to the questions posed at the beginning of this study, it is now possible to state that a comparison of age groups reveals that unemployment is more likely to affect the fertility of younger cohorts, rather than older ones."
The impact of economic recession on maternal and infant mortality: lessons from history	Tim Ensor, Stephanie Cooper, Lisa Davidson, Ann Fitzmaurice, Wendy J Graham	2010	Recessions and boom periods based on GDP per capita	Maternal and infant health outcomes	1936-2005	14 high and middle income countries		"The results suggest a modest but significant association between maternal and infant mortality and economic growth for early periods (1936 to 1965) but not more recent periods." - but

								variable by country
Economic Conditions and Mortality: Evidence from 200 years of data (working paper)	David M. Cutler, Wei Juang, Adriana Lleras-Muney	2016	Boom and bust based on GDP per capita	Mortality	Cohorts born in 1850, 1875, 1900, and 1925	32 countries		"We find that small, but not large, booms increase contemporary mortality. Yet booms from birth to age 25, particularly those during adolescence, lower adult mortality. A simple model can rationalize these findings if economic conditions differentially affect the level and trajectory of both good and bad inputs into health. Indeed, air pollution and alcohol consumption increase in booms. In contrast, booms in adolescence raise adult incomes and improve social relations and mental health, suggesting these mechanisms dominate in the long run."
Recessions and Mortality: a global perspective	Sebastian Doerr and Boris Hofmann	2020	Recessions (negative GDP growth)	Mortality, child mortality	1961-2018	180 countries		While average mortality rates are not statistically different during recessions in AEs, they are significantly

(working paper)								higher in EMDEs. These differences are even starker for child mortality rates, which increase dramatically in EMDEs in years when the economy contracts, but barely change in AEs (panel b). [AE = Advanced Economy EMDE = Developing Economy]