Income Inequality and Later Life Health: Estimating Life-Course Treatment Effects

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Short Abstract
I propose mechanisms through which exposure to income inequality early in life might be functionally related to later-life health. The model builds on theory and empirical evidence that suggests that inequality experienced in critical parts of life might matter. The empirical implementation of this approach demands much data. I the required data. I use Panel Study of Income Dynamics (PSID) data. The PSID is a longitudinal survey that follows individuals for up to 49 years. I construct and map to individual PSID respondents measures of income inequality experienced every year over each person's whole lifetime. I examine the correlation between outcomes and lifetime exposure to inequality and to inequality experienced during theoretically critical periods. Finally, I examine the extent to which income inequality proxies for systematic cross-state differences in other determinants of health. Early life income inequality matters – but not always in the way a casual observer might guess.

Extended abstract

I. Introduction

Much attention has been devoted to the negative correlation between income inequality and health in and across countries. This relationship has been found across a broad set of health measures that include infant mortality (Waldman, 1992; Wennemo, 1993), life expectancy (Wilkinson 1996, 2000), average age at death (Le Grand, 1987), total mortality (Kennedy et al. 1996; Lynch et al. 1998; Smith et al. 2002), cause-specific mortality (Kennedy et al. 1996a, 1996b), and self-reported health (Kennedy et al. 1998).

Despite the similar pattern of association identified in these studies, the interpretation and robustness of the relationships in all of the studies have been criticized on both technical and conceptual grounds. The primary conceptual lacuna is that no study has yet articulated a formal model of individual behavior that clearly describes the conditions under which an association should exist between individual health outcomes and societal level income inequality. Instead researchers have conjectured about plausible pathways that might link population income inequality and health of members of that population. However, these pathways are vaguely described with respect to individual behavior. Unfortunately, the large majority of the studies fail to estimate models that can distinguish between the hypotheses that have been advanced either because they lack data on individuals or because they fail to use those data to provide tests of alternative hypotheses (Wagstaff and van Doorslaer 2000).

Perhaps not surprisingly, many studies question extant empirical evidence on technical grounds. Many of these technical critiques point out that one should estimate the relationship with data on individuals followed over time (Deaton 2001; Wagstaff and van Doorslaer, 2000).

Others point out that existing cross country comparisons fail to use comparable measures of income that account for taxes, government cash and in-kind transfers, or household size (Judge, Mulligan, and Benzeval 1998).

A relatively recent set of papers uses longitudinal data with the Piketty and Saez (2003) top income share data from tax records in the US (Lillard et al. 2015) and US and Britain (Burkhauser et al. 2016) to show that people in both countries more likely report being in poor or fair health if there was more income inequality in their country during the years they were growing up (from birth through age 20). The association is robust to various sets of model specifications. But the result is also suspect because it relates self-reported health to ***national*** income inequality. The only source of variation in exposure to income inequality is time - different birth cohorts experience different levels of income inequality. The authors cannot observe or control for a large set of competing candidates that might explain the association and that likely vary over time in similar was as the observed measure they use to proxy for income inequality.

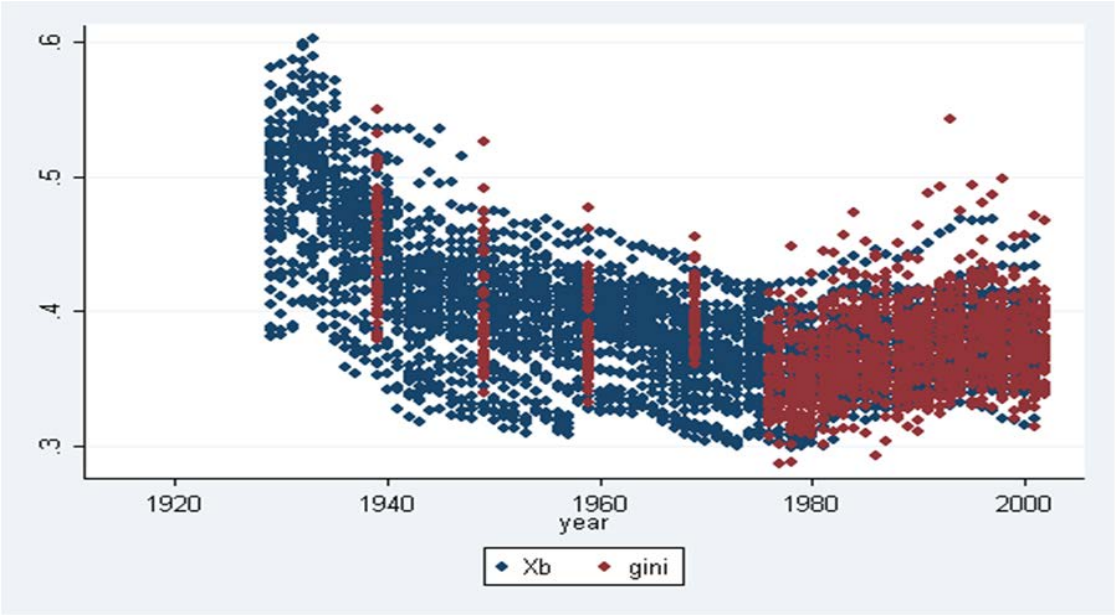
I propose mechanisms by which income inequality might theoretically be correlated with individual health. Because some of these mechanisms operate at particular points in a person's life-cycle, the hypotheses they generate can in principle be rejected and differentiated from competing hypotheses. The tests of the conjectured relationships rely on these temporal effects. To test for different associations across the life-course, I develop and exploit panel data that includes a measure of the income inequality each individual experienced in every year of life. Because these tests include one or more of the hypotheses currently circulating in this literature, they point to directions future research might profitably move.

I first frame and heuristically model how inequality might affect health. The model explicitly recognizes that health results from short- and long-run production processes. The model allows for the possibility that experienced income inequality a) directly affects health through some of the above channels described above; b) changes the availability and price of publicly financed health inputs; and c) has no effect on health production function inputs. As candidates underlying the first mechanisms, researchers have proposed that inequality affects levels of stress people experience - that then degrades an individual's health (Sapolsky et al 1997; Abbott et al. 2003) and/or that inequality leads to lower health because it increases the relative deprivation/social position a person occupies (Wilkinson 1996). The best evidence for the second mechanism is from Araujo et al. (2008) who shows that income inequality is related to how municipalities allocate resources (in favor of health inputs). The latter channel allows for the spurious correlation because income inequality happens to co-vary with a third factor that does affect health. Candidates for this mechanism are early-life disease conditions and/or omitted measures of medical technologies that developed in ways that mirror the trend in income inequality.

To estimate this model requires quite a bit of data that are not easy to find. One needs to measure each individual’s exposure to income inequality over his or her whole life course. Further one needs to measure income inequality at the theoretically correct level of geography/aggregation. One also needs data that vary over the same dimensions (time and geography) on public health inputs, disease conditions, and other factors such as changing medical technologies. Finally, to link the income inequality and these other factors to individuals, we need to observe where each person lived in every year of his or her life.

I measure state income inequality using the Gini coefficient. I estimate the Gini coefficient for each state in each year using observed state-year Ginis in the decennial Census years 1940 and later and from the CPS from 1976-2008. I then backcast to 1929 each state Gini coefficient using

Figure 1. Observed and predicted state Gini coefficient 1929-2008

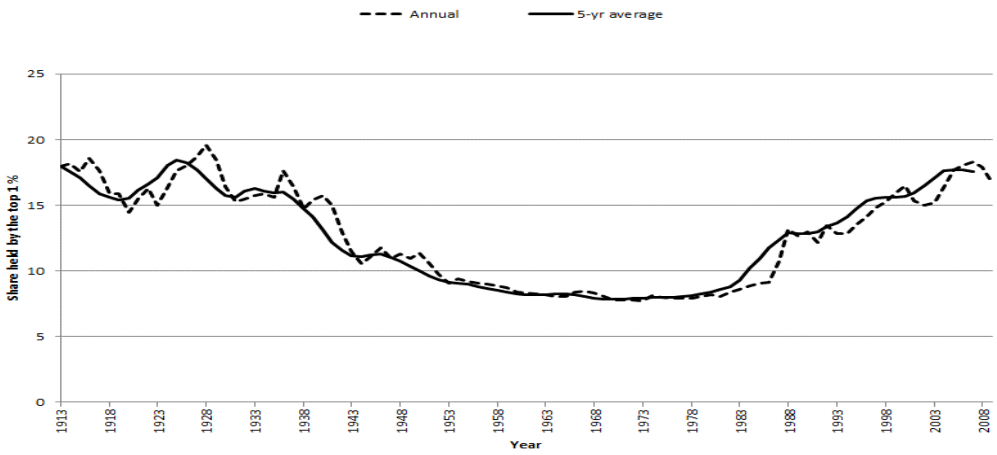


Source: author's calculations using BEA and CPS data

Bureau of Economic Analysis data on employment and earnings by industry. Figure 1 plots the resulting estimates.

The general trend in inequality matches quite well with the trends in the share of reported taxable income held by the top 1 percent of all taxpayers using the Piketty and Saez (2003) data. Figure 2 reproduces the time series in the trend in the income share of the top 1 percent of taxpayers in the US from 1913 to 2010.

Figure 2: Share of taxable income held by top 1 percent of households, 1913-2010 (source: Lillard et al. 2015)

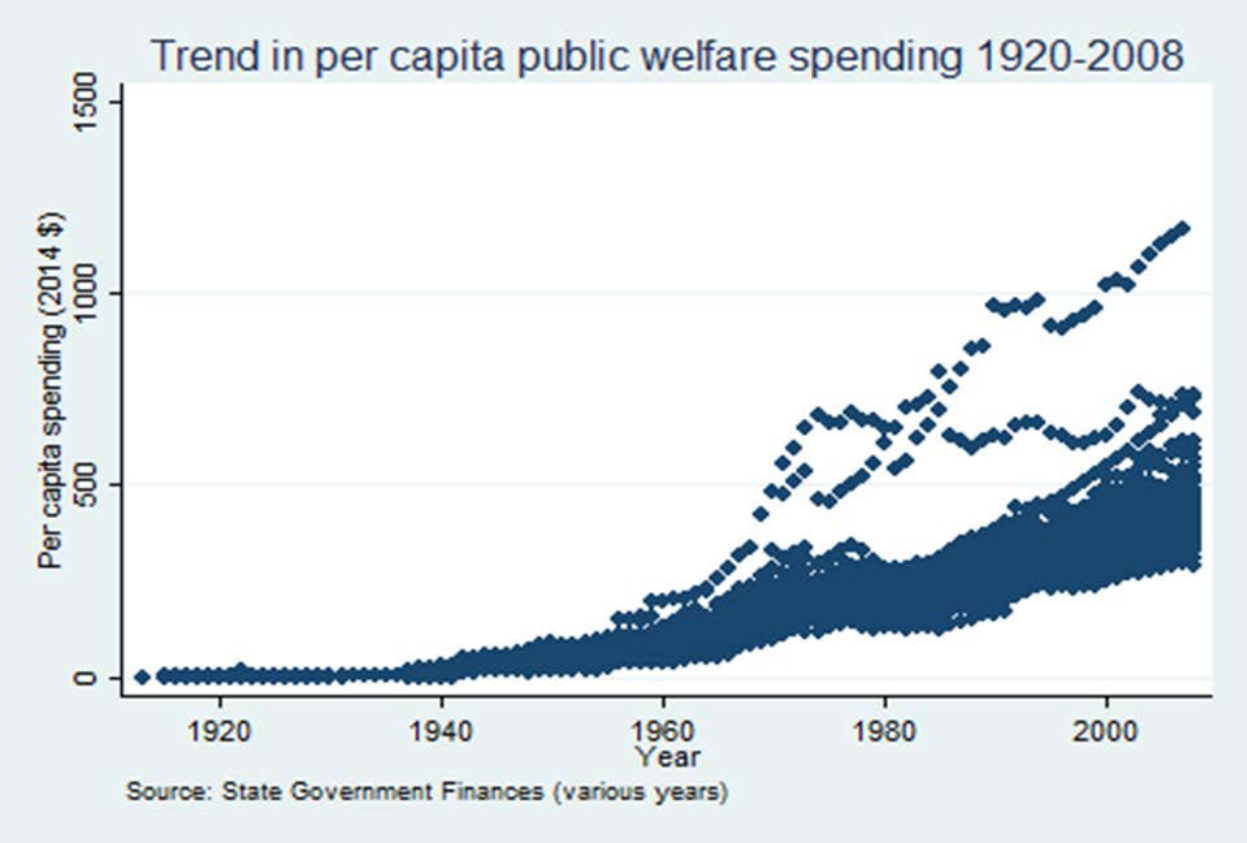


I map measures of income inequality to individual respondents to the US Panel Study of Income Dynamics (Cross-National Equivalent File version) 1970-2009. I restrict the sample to US natives born in 1929 or later who were 21 or older (in 2009). I use data on self-reported disability status and self-reported health and control for age, sex, race, household income, final education. To map state Ginis to each respondent, I impute state of residence in every year of life (Lillard & Molloy 2008). I follow Lillard et al. (2015) to map measures of state income inequality to individuals in every year of their lives and then average the inequality each person experienced his/her first 5, 10, 15, 20 years of life.

I control for state-level confounding factors in same life-cycle years. I draw data from US Census Bureau publications from 1915 to present (published under various titles such as "Financial Statistics of States."). I control for the amount a state spent each year (per capita) on "Charities" which consists of the sum of expenditures on Public safety, Corrections, Police, Education, Health, Hospitals, and Public welfare. Figure 3 plots the trend in these state-level data

from 1920-2008.

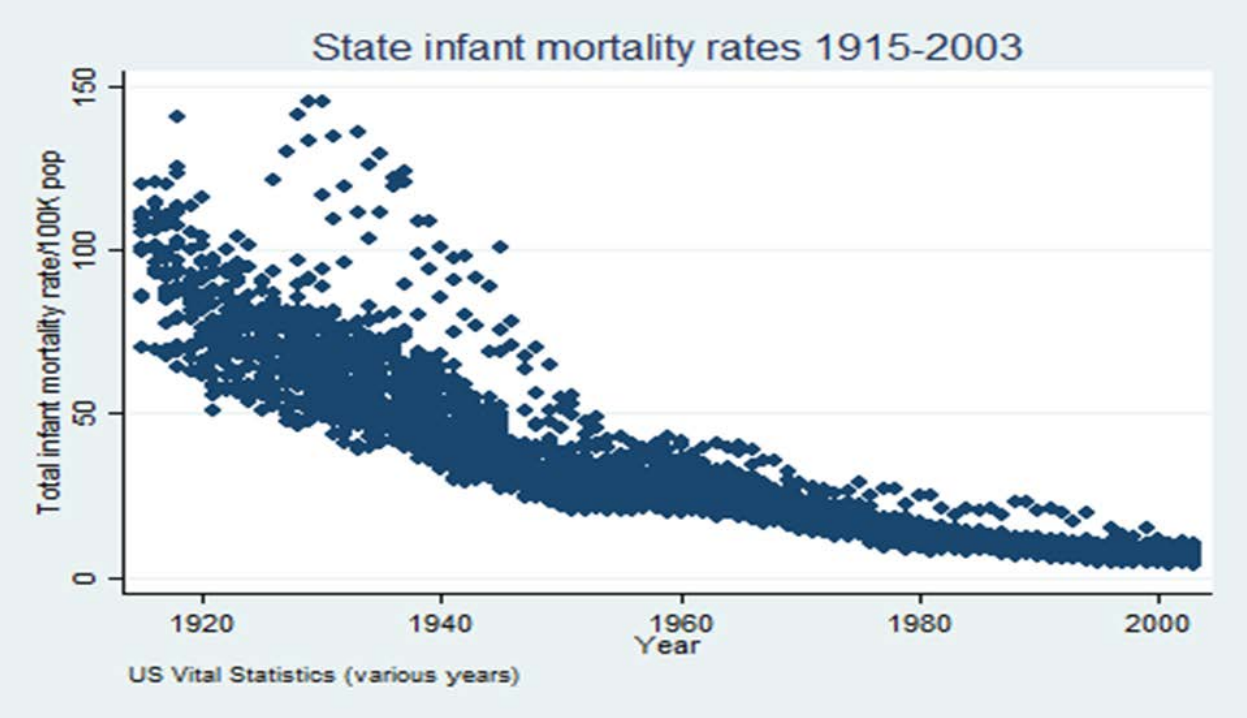
Figure 3. Trend in per capita public welfare spending 1920-2008.



To capture a summary measure of disease conditions, I also control for the state infant mortality rate in each year. Figure 4 plots the state infant mortality rate from 1915 to 2003.

Public welfare spending more or less trends monotonically upward but there is also quite a bit of variation across states over time. Similarly, the state infant mortality rate more or less trends monotonically downwards. Once again, there is substantial variation across states up through the mid-1950s (and even later). In addition to these factors, I also control for per capita income in each state in each year.

Figure 4



To estimate how inequality varies with self-reported disability and self-reported health, I fit a linear probability model (disability) and ordered probit (self-reported health) that generically takes the form:

$$\text{Prob}(Y_{it}) = f(\alpha_0 + \alpha_1 \text{ Y\_Inequality}_t + \alpha_2 X_{it} \text{ (fixed \& time-varying)} + \alpha_3 \text{ Calendar time} + \nu_{it} \quad (1)$$

Where X_{it} is a vector of demographic controls that includes fixed and time-varying factors.

Results in Table 1 show that early life inequality is associated with a higher probability that a person reports being disabled until one controls for state fixed-effects. As soon as one includes state fixed effects, there is no association between early life income inequality and the probability a person (currently) reports that he or she is disabled. Further, current income inequality is also associated with a higher probability a person reports he or she is disabled. But this association reverses when one controls for year fixed effects.

Table 1. Basic regression results

Variable	(1)	(2)	(3)	(4)	(5)	(6)
Demographics?	No	No	No	Yes	Yes	Yes
State FE?	No	No	No	Yes	Yes	Yes
Year FE?	No	No	No	No	Yes	Yes
State controls (current/past)?	No	No	No	No	No	Yes
			Probability disabled (N=257274)			
Current Gini	0.0066**		0.0054**	0.0039**	-0.0045**	-0.0032*
	(0.0007)		(0.0007)	(0.0011)	(0.0014)	(0.0015)
Early-life Gini (avg. in years age 0-4)		0.0090**	0.0088**	-0.0011	0.0012	-0.0004
		(0.0005)	(0.0005)	(0.0007)	(0.0010)	(0.0013)
R-squared	0.0021	0.0146	0.016	0.0795	0.0814	0.0818
			Probability in good health (N=164263)			
Current Gini	-0.0027		0.0173**	0.0035	0.0072	0.0039
	(0.0032)		(0.0032)	(0.0067)	(0.0076)	(0.0081)
Early-life Gini (avg. in years age 0-4)		-0.0633**	-0.0644**	-0.0074*	-0.0065	0.0029
		(0.0017)	(0.0017)	(0.0031)	(0.0038)	(0.0049)
Pseudo R-squared	0.0000	0.0222	0.0225	0.0789	0.0791	0.0792

Notes: robust standard errors clustered by person. ***, ** denote coefficients with p-value <.01 and .05. Other controls, age, age squared, race, sex, attained education,

Table 2 adds interaction terms between the state control variables and state income inequality. The addition of infant mortality in the year a person was born, and the average of state per capita income and per capita charity spending – both averaged over the years from the year a person was born until he turned five.

Results in Table 2 show that, overall, early life income inequality is unrelated to the probability that a person reports he or she is disabled and unrelated to the probability he or she is in good health. However, holding constant the state infant mortality rate in the year a person was born, a person is more likely to report he or she is disability if state income inequality was higher in his or her first five years of life. The results suggest that state income inequality is associated with a negative outcome.

By contrast, the results from the model of self-reported health suggest that, holding the covariance between state income inequality and per capita charity spending, a person is more

Table 2 Results with interaction between Gini and state controls

	Probability disabled			Probability in good health		
Variable	6	7	8	6	7	8
Current Gini	-0.0032*	-0.0039*	-0.0043***	0.0039	0.0042	0.0045
	(0.0015)	(0.0015)	(0.0015)	(0.0081)	(0.0081)	(0.0081)
Log per capita state income	0.0986**	0.1049**	0.1044***	-0.0599	-0.0654	-0.0644
	(0.0308)	(0.0308)	(0.0309)	(0.1571)	(0.1571)	(0.1574)
Per capita charity spending	0.0086	0.0084	0.0089	-0.0509**	-0.0475*	-0.0475**
	(0.0048)	(0.0048)	(0.0048)	(0.0187)	(0.0188)	(0.188)
Early life conditions (when age 0-4)						
Early-life Gini	-0.0004	-0.0022	-0.0030	0.0029	0.0037	0.0039
	(0.0013)	(0.0021)	(0.0021)	(0.0049)	(0.0081)	(0.0081)
Infant mortality in yr born	0.0003	-0.0024	-0.0029**	0.0004	0.0091	0.0099*
	(0.0002)	(0.0013)	(0.0013)	(0.0005)	(0.0047)	(0.0047)
*Early-life Gini		0.0001*	0.00078**		-0.0002	-0.0002
		(0.0000)	(0.000032)		(0.0001)	(0.0001)
Log per capita state income	-0.0185	-0.0031	0.0002	0.1371**	0.0621	0.0762
	(0.0126)	(0.0135)	(0.0135)	(0.0473)	(0.0507)	(0.0509)
Per capita charity spending	-0.0094	0.0714	0.0745	0.0018	-0.5672*	-0.5671**
	(0.0068)	(0.0526)	(0.0526)	(0.0268)	(0.1900)	(0.1904)
*Early-life Gini		-0.0024	-0.0024		0.0161**	0.0161**
		(0.0014)	(0.0014)		(0.0052)	(0.0052)
Early-life Gini standard dev.			0.0083			0.0231
			(0.0051)			(0.0187)
R-squared	0.0818	0.0823	0.0810	0.0792	0.0796	0.0791
F-stat. Gini & interactions		5.94	5.96		28.99	29.73

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likely to report being in good health later in life if state income inequality was higher in his or her first five years of life.

The results point suggest that, at best, income inequality in early life has mixed associations with self-reported disability and self-reported health. When we interact state infant mortality rate and the Gini, early life inequality is associated with a higher probability of

reporting disability later in life. The opposite is true for self-reported health. When we interact the state charity spending and the Gini, early life inequality is associated with a higher probability of reporting oneself to be in good health later in life.