Temporal Issues in Research on the Effect of Economic Inequality on Health

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Introduction

Since Wilkinson (1992) first claimed that economic inequality was the principal cause of health differences between wealthy nations, a large literature has developed investigating the impact of the distribution of income on health. Studies have been both cross-national, as well as within nations and have included a range of health outcomes. At times the debate has been unusually heated, on both sides of the issue. Although some of the passion is probably due to strong feelings regarding differing ideas of the "good" society, they are heightened by the lack of empirical results of sufficient quality to provide conclusive evidence on either side. Evidence from one scholar can, with seemingly little difficulty, be refuted by another. Rather pessimistically, Clarkwest and Jencks (2003:5) conclude that "there is no realistic prospect of getting better data that will settle this debate any time soon. Most observers will therefore continue to base their judgments on their prior beliefs."

The empirical tide seemed to have turned against the inequality hypothesis somewhat in recent years (Lynch, et al. 2004a; Lynch, et al. 2004b), though supportive results do continue to be found (Backlund et al. 2006; Subramanian & Kawachi 2006). One major criticism of the empirical work on inequality and mortality is that it has generally taken a cross-sectional approach (Lynch et al. 2004a; Mellor & Milyo 2001). This is problematic for several reasons. Among them are problems of unobserved heterogeneity and the fact the empirical specifications bear little clear correspondence to the theoretical underpinnings. Large methodological advances have been made, but they will not be sufficient to resolve differences in empirical findings without theoretical developments than can better guide empirical decision-making.

Several researchers have called for greater attention to the temporal dimensions of links between inequality and health (Blakely et al. 2000; Lynch et al. 2004a; Mellor & Milyo 2003; Subramanian & Kawachi 2003), including increased incorporation of a life course perspective (Lynch et al. 2003). The empirical reaction to those calls has, however, been somewhat less than overwhelming. In this paper I review literature related to temporal dimensions of the tie between income inequality and health and argue both for the importance of theory that more clearly specifies the likely temporal links between inequality and health and for empirical research that takes such theory seriously. I then present two empirical illustrations with state-level data from the U.S.: one incorporating a an infrastructure investment theoretical perspective on the relationship between inequality and change in longevity and a second with a life course perspective based on a critical period hypothesis (Ben-Shlomo & Kuh 2002).

Theory

Researchers have proposed various mechanisms by which inequality might affect health. Broadly following Lynch et al (2000)—though using slightly different terminology—I categorize them as individual, psychosocial, and socio-political. Individual-level effects reflect only the impact of the personal consumption power. They act purely by way of the diminishing marginal effect of income. Psychosocial mechanisms refer to the class of explanations based on the negative effects of social comparisons (Wilkinson 1997; Wilkinson & Pickett 2006). While social comparisons will occur in any hierarchical society, Wilkinson and his colleagues assert that more extreme inequality exacerbates the harmfulness of such comparisons. The comparisons may raise individuals' stress levels, which can have both direct effects on health and also indirect effects through stress-induced behavior (Lynch et al. 2000).

Empirical work has found that inequality at the state level is often more closely related to health outcomes than is inequality at the local level (Subramanian & Kawachi 2004). This has contributed to the emergence of socio-political explanations for the inequality/health connection (Lynch et al. 2000), since health and welfare policy is more often set at the state level than by municipalities. These theories claim that greater inequality reduces public investment in infrastructure that improves public health (Kawachi, et al. 1997). This reduction can either result from political power being more concentrated among individuals at the top of the income distribution (individuals who presumably have less personal incentive to support public health programs), or because inequality lessens social cohesion and, in turn, diminishes general public willingness to invest in resources that improve public health.

But these theories seldom make explicit what sorts of time lags we might expect between exposure to inequality and observed health outcomes. Thus empirical researchers are left to make their own interpretation regarding the temporal implications of a given theory (e.g., Mellor & Milyo 2003). A handful of studies have included time lags in their specifications. The evidence from them has been mixed. Blakely, et al. (2000) compared the associations between self-reported health in the mid-to-late 1990s and income inequality zero to fifteen years previous. They conclude that the strongest relationship tended to be with inequality around 1980 rather than with contemporaneous inequality. But, over such a short period, the intertemporal correlations of inequality levels within jurisdictions are high. And given that the inequality measures used by Blakely and his colleagues were calculated using CPS samples—which are much smaller than the Census samples typically used—the differences between years are likely to include quite a bit of noise. Overall, there is no strong evidence that lagged inequality helps predict health outcomes over and above what is predicted by contemporary inequality levels. (Mellor & Milyo 2003; Subramanian & Kawachi 2006).

That said, the specifications used in those studies provide little reason to expect to observe a substantial impact. As noted above, the within-state correlations of inequality are high, at least over short periods, so the lags introduce little new information. In addition, the quality of the new information will be degraded by high levels of residential mobility in the United States. Since many individuals whose outcomes are being measured within a given state have not always lived in that state, measures of state level inequality in past years do not accurately describe the inequality experience of residents in later ones. This measurement error will cause the estimated effects to be attenuated.

Rather than use measures from earlier periods, Mellor and Milyo (2001) use a first differences (change on change) specification that they assert will pick up lag effects. Why they would make such a claim, one is left to wonder. By construction, the change in inequality and change in health are being measured within the same period. So unless we have some reason to believe that all of the inequality change occurs at the beginning of the period and the health change occurs at then end, then the two changes must be assumed to be occurring simultaneously.

In general, the previous empirical work that considers lagged effects models those lags with little firm theoretical guidance. On the other hand, theoretical perspectives of the inequality-health connection have not provided much explicit discussion of what we should expect the length of time between exposure to inequality and emergence out outcome to look like. That window contains two components (Blakely et al. 2000):

1) The lag between inequality and the exposure to resulting direct risk factors, and
2) The lag between exposure to risk and the observed outcomes.

For the remainder of the paper I will refer to #1 as the “distal lag” and #2 as the “latency period.” The lag times are likely to vary depending on the particular mechanism involved. Below I discuss timing considerations for the individual, psychosocial and socio-political theories, respectively.

Individual

Under the individual income explanation, the effect of a change in the distribution of income on health risk factors should occur immediately. A change in the income distribution simultaneously affects the health-related resources individuals can afford to access. The length of the latency period is less clear. An increase in the level of inequality (holding mean income constant) is likely to increase the number of people who lack the resources to obtain needed medicines. This could have an impact on functioning or mortality almost immediately. Such a distributional shift could also increase food insecurity and reduce nutrition among children. While poor nutrition may impact health in certain ways in the short run, research has also shown that early life economic conditions can also impact outcomes such as heart disease, stroke, and cancer many years later (Galobardes et al. 2004).

It may be difficult to define *the* lag time since relevant lags are likely to vary by condition and age (Lynch, et al. 2004a). How then are researchers to take any sensible approach to latency periods? Ben-Shlomo and Kuh (2002) discuss two different ways that exposure to risk factors may affect health over the life course, “accumulation of risk” and “critical periods.” “Accumulation of risk” refers to the impact of extended exposure to risk factors over one’s lifetime. It proposes that the critical risk factor is the length of exposure, rather than the particular age at which exposure occurs. If we believe that the effects of inequality are best characterized as occurring through accumulated risk, then using inequality measures at one point in time will provide a poor measure of the inequality experience of individuals and we would want measures for as much of the lifespan as possible.

A “critical period” model, by contrast, suggests that there are certain periods in individual development during which the conditions that one experiences ‘biologically program’ his or her physiology in ways that affect later health outcomes. Often, the most reasonable time to expect these periods to occur is during phases of rapid physical development such as early childhood or while in embryo (Barker 1992; Galobardes et al. 2004; Rasmussen 2001). Studies that examine the impact of early life factors on later life outcomes (e.g., Almond & Mazumder 2005; Doblhammer & Vaupel 2001; Forsdahl 1978) use theories based on a critical period approach to thinking about latency times.

Psychosocial

Whereas little to no distal lag is likely to exist under individual-level income mechanisms, the lage may be longer in psychosocial theories. Its length depends on how long it takes individuals to perceive the change in the economic structure and their place in it. If people make comparisons based on what they observe immediately around them (Eibner & Evans 2005), then this could happen fairly quickly, but it might reasonably be expected to take longer if comparisons are based on perceptions of the nation-wide economic environment (Wilkinson & Pickett 2006).

In psychosocial models, the health impacts of inequality are most often described as occurring by way of the persistent stress that it generates. For a handful of outcomes, such as homicide, the latency period may be relatively short, but for most stress-related conditions, we would expect longer lags. Those health impacts resulting from exposure to inequality would be characterized by accumulation of risk and we would want to use some sort of cumulative measure of income inequality over multiple periods of individuals' lives to capture it.

Socio-political

The distal lag may be most complex with this class of explanations. The causal versions of theses stories posit that higher inequality reduces investment in health-enhancing infrastructure. "Infrastructure" here is a broad term that could refer to any number of factors ranging from availability of medical facilities that use practices associated with high quality of care to pollution abatement laws to eligibility guidelines for Medicaid. How inequality affects "investment" will depend on the concentration of costs and benefits. The more that costs are concentrated at the top and benefits concentrated at the bottom, the more likely it is that inequality will reduce investment since it tends to concentrate political power at the top.

Political decisions that are influenced by inequality will most likely reflect inequality levels in the recent past. Changes in inequality may not produce political impacts until new public officials are elected. Subsequently it may take additional time for policy changes to take place. Under socio-political models of the relationship between inequality and health it is also important to consider the dynamic nature of the technological environment. New "technology" (again, writ broadly) is continually emerging and is clearly a major driving force behind mortality declines. Differential change in mortality across jurisdictions will largely be due to how rapidly and comprehensively new technology is adopted. Levels of inequality may impact that adoption (Lynch et al. 2000; Szreter & Woolcock 2004). That being the case, the relationship between inequality and changes in health is not necessarily dependent primarily on *changes* in inequality. Rather, inequality could cause differential change in health even if levels of inequality across jurisdictions remained constant.

As an illustration, assume that jurisdictions characterized by greater income inequality are more likely to take measures to ensure that health-enhancing innovations are accessible to citizens, whereas less equal ones do not take such measures. Under that hypothetical, in times of rapid innovation, mortality will fall more in jurisdictions where levels of inequality are lower. The differential change in health outcomes is influenced by inequality, but it does not depend on differential *change* in inequality—though that could matter also. Consequently, an empirical researcher who was interested in socio-political explanations would want to look for associations between levels of inequality and later change as well as change-on-change (Kaplan et al 1996).

Additional observations regarding temporal ties between inequality and health could no doubt be made. The point here is not to provide an exhaustive summary of the potential temporal ties between inequality and health. Rather, it is to illustrate the importance of temporality and detail some considerations in taking timing into account empirically. Past research has not been terribly successful in finding associations between inequality and health that are both large and robust. But given misspecification due to poor modeling of timing, one would hardly expect to find robust results regardless of whether or not a strong relationship did in fact exist.

In the remainder of this paper I present two empirical illustrations derived from the preceding theoretical discussion. The first corresponds to the socio-political story just described and examines how change in longevity is predicted both by change in mortality and by the level of mortality at the beginning of the period. The second addresses the "critical period" life course perspective, examining the effect of inequality at time of birth on health outcomes later in life.

Data and Methods

The analyses of the relative impacts of level and change in inequality on subsequent longevity change use data for the fifty states for the periods 1970-1980, 1980-1990, and 1990-2000. Life expectancy (in years) for non-Hispanic Whites in each state is calculated using age-specific all-cause mortality from the Compressed Mortality File. Longevity has the virtues of ease of intuitive interpretation and of being based on an age-weighting scheme that is defensible on terms independent of the age distribution of any given society.

State-level gini coefficients, mean income, ethno-racial composition, and urbanicity of the population are calculated using decennial Census data from the Integrated Public Use Microdata Series (IPUMS) (Ruggles, et al. 2004). Income level and inequality measures are based on adjusted household income, which is calculated as total household income divided by the square root of the number of household members. All measures are calculated at the aggregate level, and the multivariate analyses were run using OLS regression with heteroskedasticity robust standard errors that have been corrected for clustering by state (given multiple observations per state).

Data used in the analysis of the impact of inequality at birth on later disability are taken wholly from IPUMS. Few datasets provide information on health outcomes, state of birth, and state of current residence. The Census includes all three, though the measures of health are limited to a limited range of disability outcomes. According to data from the Survey of Income and Program Participation, the top causes of disability in adults are arthritis, coronary heart disease, bad back, and respiratory conditions (USDHHS 1995). Other causes include stiffness, mental illness, visual impairments, and stroke. The 2000 Census includes several measures of disability, of which I use four:

1) **Physical difficulty** – "whether or not the respondent has a long-lasting condition that substantially limits one or more basic physical activities, such as walking, climbing stairs, reaching, lifting, or carrying."
2) **Work disability** – "whether or not the respondent had any lasting physical or mental health condition that caused difficulty working, limited the amount or type of work they could do, or prevented them from working altogether."
3) **Personal care disability –** "whether or not the respondent had any physical or mental health condition that had lasted 6 or more months and made it difficult for them to take care of their own personal needs, such as bathing, dressing, or getting around inside the home."
4) **Sight/Hearing impairment** – "whether or not the respondent has a long-lasting condition of blindness, deafness, or a severe vision or hearing impairment."

Other Census variables capture difficulty remembering and disabilities that limit mobility. There is substantial overlap between the various disability measures and, although there is some variation in their associations with inequality, the addition of further outcome measures would not alter the conclusions.

These disabilities most often do not emerge until relatively late in life, thus it is preferable to study older adults. Focusing on older adults also allows for greater variation in levels of inequality experienced over the life course. The Census did first began collecting data on income in 1940. In order to focus on individuals who were born near 1940, I limit my sample to respondents aged 58 to 62 in the 2000 Census. Given the focus on place of birth, the sample is restricted to individuals born in the forty-eight contiguous United States. Alaska and Hawaii are excluded since they were not states in 1940 and residents of those states are not included in that year's IPUMS sample.

In the multivariate analyses, all independent variables (such as the gini coefficient) are measured at the aggregate, not the individual level, and I perform the multivariate analyses at the aggregate level, using a linear regression specification and population weights. Of course, one could obtain qualitatively equivalent results using probit or logit form with individual-level data, but the linear specification provides somewhat greater simplicity of interpretation of magnitudes. Such analyses are frequently performed on data aggregated at the country, state, or metropolitan area level. But in this case, the aggregation is slightly more complex due to the use of state-level measures at two points in individuals' lives. I therefore aggregate jointly by state of residence in 2000 and state of birth. Consequently, the regressions are of the form:

$$H_{ij} = \alpha + \beta Y_i + \gamma Y_j + \theta X_{ij} + u_i + u_j + r_{ij}$$

H_{ij} represents the average health outcomes for individuals born in state *i* who were living in state *j* in 2000. Economic characteristics (gini and mean income) of state of birth and state of residence in 2000 are represented as Y_i and Y_j, respectively. β and γ represent the vector of coefficients associated with the economic variables from each of those time periods. The Census only collected only data wage income in 1940, so the “birth year” gini and mean household income measures are based on wage income rather than total income. Since race and ethnicity are strongly correlated with both inequality and health outcomes, the regressions also control for racial and ethnic background of the members of each birth-state*current-state cell. Those controls (X_{ij}) are measures of the fraction of each cell who are Hispanic, black non-Hispanic, and other nonwhite non-Hispanic, respectively (white non-Hispanic is the omitted category).

The income and inequality measures at birth and in 2000 are measured at non-nested levels of aggregation. Consequently, I estimate the parameters using a cross-classified multilevel specification with separate random effects at the level of state of birth (u_i) and state of residence in 2000 (u_j). The final term, r_{ij}, captures cell-specific random disturbances.

Results

Effects of Inequality on Change in Longevity

Life expectancy increased during each decade between 1970 and 2000, with particularly steep improvements in the 1970s, as shown in descriptive statistics in Table1. Consistent with data reported by Lynch et al (2004b), there is no obvious relationship between the changes in White longevity and changes in income inequality, though the simple correlations in Table 2 do show a modest association between rising inequality and less longevity improvement. There is a somewhat stronger negative relationship between change in life expectancy and *levels* of inequality at the start of each period. A particularly strong negative relationship is observed between longevity improvement and initial levels of longevity, suggesting a “catch-up” tendency, where states that had lagged behind close the gap with higher longevity states. Presumably certain “low hanging fruit” for improving life expectancy is available to low longevity states that high longevity states have taken advantage of previously.

A qualitatively similar convergence pattern is observed for income inequality, where growth in inequality is greatest in states where it was initially lowest. That observation ends up being highly consequential in the multivariate results, which are shown in Table 3. All models include controls for change in ethno-racial composition and in the fraction of the population that lives in rural areas, as well as period fixed effects since it is clear that longevity improvements were more rapid in the 1970s than in subsequent decades. The second model adds region fixed effects. The results from the first two models mirror the findings of Mellor and Milyo (2001). In neither case is the change in inequality strongly associated with a change in longevity. In fact, the signs are not even consistent between the two models. Notably, we also don’t find strong effects for change in mean income, and the signs are in the “wrong” direction in both models.

As argued above, under some socio-political theoretical frameworks, we would expect change in longevity to be more strongly associated with initial inequality than with change in inequality. In addition, given the observed trends towards between-state “catch-up” or convergence, it is clear that pre-existing conditions affect change, so failure to control for them will produce biased change-on-change estimates. Model three adds measures of state characteristics at the beginning of each period. This dramatically alters the results. The signs on both of the Gini measures are negative and are highly significant ($p<0.0003$ and $p<0.023$ for the change and initial level measures, respectively). The non-negative effect of change in inequality in the first two specifications appears to be due to the fact states where inequality increased least were also states that had higher inequality to begin with, and high inequality states experienced less longevity improvement.

It is clear that it is also important to control for initial life expectancy since it is such a strong predictor of change in longevity. The addition of that control further increases both the estimated effect and statistical significance of the inequality measures. Note that higher initial income is also strongly associated with greater longevity improvement. The results suggest that wealthier and more equal states are both more likely to adopt health-enhancing technology.

The strong association between increases in inequality and less improvement in longevity is somewhat surprising. It also poses an interesting contrast with the lack of association between change in mean income and change in life expectancy.

Effect of Inequality at Birth on Disability in Late Adulthood

This section focuses on the issue of life course approaches to the study of inequality and health by examining the impact of inequality during one commonly noted critical period—birth/early childhood—on disability outcomes in later adulthood. Several partially-overlapping measures of disability are included: physical difficulty, work disability, personal care disability and sight/hearing limitations. The data are for all individuals aged 58 to 62 in the 1% sample of the 2000 Census. The fraction of respondents reporting any disability varies from 4.1% for personal care disabilities to 17.2% for the most general category, “physical difficulty” (see Table 4). There is overlap between the outcomes at the individual level, but the highest correlation between any two measures is 0.40 (with a low of 0.13), so they are not redundant.

While outcomes are measured in 2000, the independent variables include both contemporaneous measures and measures taken at time of birth. Descriptive statistics for those measures are included in Table 5. One point to note is the low fraction of the sample that is Hispanic relative to their actual proportion of the population in 2000. This results from the limitation of the sample to individuals born in the U.S.

One problem with previous analyses that have incorporated lagged inequality measures is that they ignore cross-state mobility. Those analyses of mortality within a state at a given point in time use lag measures for that same state in earlier years. But this assumes that current residents also lived in the state in earlier years. Over any relatively large time span, this is not a reasonable assumption. For example, within this sample of older adults, 41.2% lived in state other than their birth. If effects of early life conditions persist, random interstate mobility will tend to attenuate the measured effect of those conditions in later cross-sections (Buzzelli & Su 2006).

In addition, geographic mobility may not be random (Vigdor 2002). Non-random mobility presents additional problems for research on the effects of inequality (and other measures of individuals' environment). Suppose, for example, that inequality concentrates political influence at the top of the income distribution and reduces social cohesion—resulting in reduced investment in public health. This should directly harm population health outcomes. However, it will also have an opposing indirect effect. Given the low provision of health services, individuals in the jurisdiction who suffer from poor health will be relatively more likely to move out, and unhealthy individuals from other jurisdictions will be less likely to move in.

To analyze how migration may bias estimates of the relationship between income inequality and health, I divide states into "high," "medium," and "low" terciles according to their level of inequality in 2000. Table 6 examines the disability outcomes of individuals born in each of those groups of states. Data are on rates of "physical difficulty" are presented separately for movers and non-movers. Levels of disability vary substantially by the inequality levels of the state of birth, but the differences are not markedly larger among those who remain in their birth state versus those who move out. The movers have lower disability rates than the stayers within all inequality terciles, but the differences between the high and low inequality states are similar for both movers and non-movers.

There is no evidence of selective mobility out of states by their inequality tercile. Stayers do not have disproportionately high disability rates relative to leavers in low inequality states. Neither is there clear evidence of selective destination choice. What evidence there is is limited to the fact that movers to low inequality states have slightly higher rates of disability than those who move to states with medium inequality. However, the newcomers with the highest rates of disability are those who move to high inequality states. But that is most likely due to the fact that high inequality states are largely contiguous to one another and cross-state mobility is disproportionately concentrated between nearby states.

Even mobility that is relatively random with respect to inequality levels and disability nonetheless has non-trivial impacts on differences in disability across states. As shown in the bottom two lines of the table, residents of low inequality states in 2000 have higher rates of disability compared to individuals who were born in the state, while the inverse is true for states with high inequality. The difference in disability rates of those born in high versus low inequality states is 5.1 percentage points, while there is only a 3.6 percentage point difference between the 2000 residents of those two groups of states. If we assume that all of the factors that influence disability rates between high and low inequality states operate early in life, prior to any interstate mobility, then the net impact of the mobility is to artificially reduce the observed association between inequality and disability. In this case it reduces the raw differences in disability rates between the high and low terciles by thirty percent. If we relax the assumption and allow for the possibility that characteristics of high inequality states increase the disability risk of individuals who move there, then that thirty percent figure is a lower bound of the extent to which mobility artificially reduces the estimated association that we would observe looking solely at the 2000 cross-sections.

Those figures suggest that state of birth has a stronger impact on disability in later in life than does state of residence measured contemporaneously with the outcome. To examine further whether that is the case, Table 7 presents results of multilevel analyses as described in the data and methods section. Results are shown for the estimated effects of inequality and mean income—both from 2000 and 1940—on measures of disability from the 2000 Census. The first column contains results from an specification containing only inequality and mean income of the state of residence in 2000, along with the ethno-racial composition of the state of birth*state of residence cell. The results in Column 2 are from a similar regression, but with 1940 levels of inequality and mean income from individuals' state of birth rather than those of the later state of residence. For all disability measures, the estimated impact of inequality at time of birth is higher than that of inequality measured contemporaneously with the disability outcome. The point estimates are larger in all cases and, for two of the four outcomes, the estimates have p-values below 0.05.

When the two sets of measures are combined (Model 3), inequality at time of birth generally remains the stronger predictor, though the point estimates and significance levels decline compared to Model 2. Inequality birth remains a relatively reliable predictor of rates of physical difficulty ($p<.062$) and personal care disability ($p<0.003$) and the coefficients are positive in all cases. In contrast to the inequality results, mean income of individuals' birth state is not associated strongly with any of the disability measures. State income in 2000, on the other hand, is a universally strong predictor of disability, at least in terms of statistical significance.

It is not clear why disability rates would be more strongly associated with contemporary income levels than past ones, while also bearing a greater association with past inequality than with current inequality. Direction of causality is, of course, a potential concern. This seems more likely to be the case with the contemporaneous measures, which are subject both to spurious associations due to potential selective migration and reverse causality. A positive relationship between adult health and income may be due, at least partially, to the fact that poor health is likely to reduce individual earning capacity and, at the aggregate level, total economic output (Smith 1999). One of the Census' measures of disability is, of course, whether individuals have a medical condition that impedes their ability to engage in paid employment. That reverse causation may artificially inflate the estimated impact of income level on health outcomes. Such reverse causation is much less likely to be an issue when we are looking at the correlation between income levels at the time of birth and health outcomes much later in life – though it could occur indirectly through intergenerational transmission mechanisms.

Of course, the results in Table 3 must be subjected to more rigorous tests of robustness. Even if they are accurate, it is not obvious how applicable the results are to present-day inequality. If one believes that any life course effects of inequality work through prolonged exposure to risk, rather than through exposure in critical periods, then the weaker effects in later years may reflect increasing social protections that help mitigate the impacts of inequality. Even if one believes that the first years of life are a critical period for later health outcomes, the 1940 results may not be generalizable to the present for that same reason.

On the other hand, if inequality's effects are partially transmitted through public officials' willingness to invest programs that influence health outcomes, then these effects could matter *more* as the cost of health care rises. And if there are few social programs in any state, inequality cannot have a large absolute impact on differences between states. When more options are available for investing in public health, willingness to provide has a much greater effect. The effect of inequality could also be greater today because of lower levels of social capital. If the World War II era was one of greater social unity and engagement (Putnam 2001), then that may have provided a buffer to the disintegration of social ties resulting from inequality, a buffer that may be less available now.

Conclusion

Research into health impacts of economic inequality has done surprisingly little either to develop theory that is temporally specific enough to be clearly testable, nor to empirically incorporate the temporal implications of theory that has been developed. Empirical work has relied disproportionately on cross-sectional, first difference, or simple lag specifications that pay little explicit attention to the likely timing of any effects of inequality. But without strong testable (and tested) theory, results will almost certainly continue to be equivocal. In turn, scholars conclusions will tend to be disproportionately driven by prior beliefs rather than data.

The analyses in this paper illustrate preliminary attempts at theoretically-based analyses of two issues related to temporal ties between inequality and health outcomes—change in aggregate outcomes within jurisdictions over time and development of illness among individuals over the life course. The results are not presented as conclusive evidence one way or the other regarding possible impacts of the distribution of income. Rather they are suggestive of avenues that might be pursued and the extent to which temporally-sensitive specifications may produce results that differ from those obtained using the approaches that have dominated the literature thus far.

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Table 1. Descriptive Statistics -- 50 States, 10-year change analysis

	Change			Initial Levels		
Variable	**1970-1980**	**1980-1990**	**1990-2000**	**1970-1980**	**1980-1990**	**1990-2000**
Life expectancy	3.008	1.552	1.077	70.565	73.573	75.124
	(0.340)	(0.323)	(0.428)	(0.908)	(0.834)	(0.943)
Gini (*100)	-0.321	1.737	-0.213	37.615	37.294	39.031
	(1.306)	(1.238)	(0.949)	(2.979)	(2.231)	(2.551)
Mean income (log)	0.135	0.072	0.057	9.790	9.926	9.997
	(0.069)	(0.099)	(0.050)	(0.157)	(0.129)	(0.169)
% Black (non-Hispanic) (*100)	0.475	0.286	0.704	8.661	9.135	9.421
	(1.182)	(0.610)	(0.677)	(9.172)	(9.173)	(9.314)
% Hispanic (*100)	1.002	0.962	2.476	3.315	4.316	5.278
	(1.655)	(1.285)	(2.004)	(5.273)	(6.585)	(7.486)
% "Other race" (non-Hispanic) (*100)	0.951	0.809	2.011	2.585	3.535	4.344
	(0.680)	(0.728)	(1.301)	(8.441)	(8.618)	(8.626)
% Rural (*100)	-0.872	-1.240	-3.510	33.932	33.060	31.820
	(2.431)	(1.564)	(3.420)	(14.361)	(14.403)	(14.671)

Table 2. Simple Correlations -- 50 States, 10-year change analysis

	Change			*Initial Levels*		
Variable	Life Expectancy	Gini	Mean Income	Life Expectancy	Gini	Mean Income
Change						
Life expectancy	1					
Gini (*100)	-0.1665	1				
Mean income (log)	0.3285	-0.2987	1			
Levels						
Life expectancy	-0.8221	0.1179	-0.3953	1		
Gini (*100)	-0.2533	-0.4066	0.0668	0.0165	1	
Mean income (log)	-0.3141	0.2648	-0.4791	0.6238	-0.2247	1

Table 3. OLS Estimates of the Effect of Inequality on White 10-Year Life Expectancy Change

	(1)	(2)	(3)	(4)
Gini *100 (Change)	0.014	-0.025	-0.065	-0.076
(SE)	(0.024)	(0.021)	(0.021)	(0.022)
[p]	[0.577]	[0.238]	[0.003]	[0.001]
Gini *100 (initial)			-0.046	-0.055
(SE)			(0.019)	(0.019)
[p]			[0.023]	[0.006]
Log Mean Income (Change)	-0.512	-0.514	-0.250	-0.248
(SE)	(0.430)	(0.460)	(0.457)	(0.442)
[p]	[0.240]	[0.269]	[0.587]	[0.578]
Log Mean Income (Initial)			1.120	0.999
(SE)			(0.368)	(0.329)
[p]			[0.004]	[0.004]
Life Expectancy (initial)				-0.088
(SE)				(0.044)
[p]				[0.051]
Change controls	Yes	Yes	Yes	Yes
Period Fixed Effects	Yes	Yes	Yes	Yes
Region Fixed Effects	--	Yes	Yes	Yes
Initial composition controls	--	--	Yes	Yes
N	150	150	150	150

Change and initial composition controls consist of the fraction of the state population that is Hispanic, black non-Hispanic, or nonwhite/nonblack non-Hispanic, respectively, as well as for the fraction of the population residing in rural areas. Region fixed effects consist of controls for primary Census region (South, Midwest, or Northeast-- West omitted).

Table 4. Descriptive statistics and individual-level simple correlations, 58-62 year-olds

			Simple Correlation with:			
Outcome	**N**	**Mean**	*Physical Difficulty*	*Work Disability*	*Personal Care Disability*	*Sight/Hearing*
Physical Difficulty	531,132	17.2%	--			
Work Disability	531,132	16.1%	0.374	--		
Personal Care Disability	531,132	4.1%	0.404	0.250	--	
Sight/Hearing	531,132	5.4%	0.222	0.130	0.152	--

Table 5. Descriptive Statistics for the Independent Variables

Measure	Mean	St. Dev.
2000 Income Measures		
Gini (HH income) - 2000	0.397	0.024
Mean Total Income (in 1,000s)	10.42	0.11
1940 Wage Measures		
Gini - 2000	0.438	0.058
Mean Wage Income (in 1,000s)	8.80	0.39
Demographic Characteristics		
Fraction Black	0.102	0.154
Fraction other nonwhite	0.014	0.024
Fraction Hispanic	0.027	0.070

Table 6. Physical Difficulty Rates by 2000 Gini of State of Birth and Residence

	Inequality tercile		
	Low	Medium	High
1) Stayers (lived in state in both periods)	14.8%	16.4%	20.2%
2) Moved Out	14.0%	15.1%	18.8%
3) Moved In	16.0%	15.5%	17.2%
Born In State (1+2)	14.5%	15.9%	19.6%
2000 Resident (1+3)	15.3%	16.1%	18.9%

States in each category are:
Low: NH, IA, WI, UT, MN, VT, NE, IN, ND, DE, SD, ME, MD, NV, KS, OH
Medium: WA, CO, CT, WY, MI, MA, RI, NJ, ID, OR, MO, PA, IL, NC, MT, VA
High: TN, OK, SC, AZ, GA, AR, KY, FL, WV, AL, CA, TX, NY, LA, MS, NM

Table 7. Multilevel estimates of the effect of income inequality and level at birth on disability outcomes of individuals aged 58 to 62 in 2000

	(1)	(2)	(3)	
	2000	1940	2000	1940
Physical Difficulty				
Gini	0.2906	0.4173	0.0933	0.2955
(SE)	(0.153)	(0.202)	(0.102)	(0.158)
[p]	[0.057]	[0.039]	[0.363]	[0.062]
Mean Income (log)	-0.1579	0.0053	-0.1303	0.0164
(SE)	(0.028)	(0.030)	(0.019)	(0.024)
[p]	[0.000]	[0.862]	[0.000]	[0.490]
Work Disability				
Gini	0.0655	0.1843	-0.0636	0.1433
(SE)	(0.102)	(0.156)	(0.072)	(0.143)
[p]	[0.522]	[0.236]	[0.377]	[0.316]
Mean Income (log)	-0.1134	-0.0160	-0.0878	-0.0039
(SE)	(0.018)	(0.023)	(0.014)	(0.021)
[p]	[0.000]	[0.495]	[0.000]	[0.856]
Personal Care Disability				
Gini	0.0997	0.1377	0.0757	0.0979
(SE)	(0.040)	(0.048)	(0.037)	(0.033)
[p]	[0.012]	[0.004]	[0.040]	[0.003]
Mean Income (log)	-0.0260	0.0107	-0.0222	0.0104
(SE)	(0.007)	(0.007)	(0.007)	(0.005)
[p]	[0.000]	[0.135]	[0.002]	[0.028]
Sight/Hearing Impairment				
Gini	0.0610	0.0726	0.0400	0.0136
(SE)	(0.059)	(0.081)	(0.046)	(0.066)
[p]	[0.304]	[0.371]	[0.383]	[0.837]
Mean Income (log)	-0.0653	-0.0108	-0.0476	-0.0084
(SE)	(0.011)	(0.012)	(0.009)	(0.010)
[p]	[0.000]	[0.377]	[0.000]	[0.391]

Analyses also control for the racial/ethnic composition of the population: %Hispanic, %black (non-Hispanic), and %other nonwhite (non-Hispanic).