WORKING PAPER

Re-Examining the Evidence of an Ecological Association Between Income Inequality and Health

Jennifer M. Mellor
Department of Economics
The College of William and Mary

and

Jeffrey Milyo
Department of Economics
Tufts University

Discussion Paper 99-22
Department of Economics
Tufts University

Department of Economics
Tufts University
Medford, MA 02155
(617) 627-3560

Re-Examining the Evidence of an Ecological Association
Between Income Inequality and Health

Jennifer M. Mellor
Department of Economics
The College of William and Mary
Williamsburg, VA 23187-8795
(757) 221-2852
jmmell@facstaff.wm.edu

and

Jeffrey Milyo
Department of Economics
Tufts University
Medford, MA 02155
(617) 627-3662
jmilyo@tufts.edu

July 1999

Abstract:

Several recent studies have reported a robust association between income inequality and aggregate health outcomes across countries and across U.S. states. However, most of these studies examine only a single cross-section of data and employ few (or even no) control variables. We examine the relation between income inequality and aggregate health outcomes across thirty countries over a four decade span and across 48 U.S. states over five decades. We find little support for claims that there exists a robust association between income inequality and aggregate health outcomes across either countries or states.

Re-Examining the Evidence of an Ecological Association

Between Income Inequality and Health

Jennifer M. Mellor and Jeffrey Milyo*

1. Introduction

Is income inequality one of the most important determinants of population health? Wilkinson (1996) argues just this point: the more unequal is society, the worse is population health. The primary evidence for this claim is the repeated observation of a statistically significant association between income inequality and aggregate measures of health across countries (e.g., Waldman 1992 and Wilkinson 1992) and across U.S. states (e.g., Kaplan et al. 1996 and Kennedy et al. 1996a). Some authors have become so enamored with the notion that this statistical association is the manifestation of a causal relationship that they summarily dismiss contrary arguments and evidence (e.g., Wilkinson 1995, 1997a and 1998 and Kennedy et al. 1999). The research enterprise for these investigators now focuses on divining the nature of the causal pathways by which inequality adversely affects health (e.g., Kawachi and Kennedy, 1999).

Despite the zeal of Wilkinson, Kennedy, Kaplan and their collaborators, this "income inequality hypothesis" is, in actuality, not well supported by evidence. First, the literature reviews appearing in numerous studies and commentaries on this topic have generated a scholarly equivalent of the children's game of "telephone"; that is, successive telling has led to a somewhat embellished characterization of the evidence.[1] Our review of the existing findings (below)

---

*We are grateful for financial support from by the Robert Wood Johnson Foundation's Scholars in Health Policy Program.

[1]In addition, Mellor and Milyo (1999) point out that Wilkinson has taken some unfortunate liberties in describing prior empirical work, yet his interpretation of previous findings has become standard boilerplate for subsequent authors. In a similar vein, see the Milyo's (1999) comments on Kennedy, et al (1998a) and the response from Kennedy, et al. (1999).

demonstrates that the evidence of an association between inequality and health is more limited and mixed than is typically acknowledged. Consequently, the income inequality hypothesis, though intriguing, hardly warrants an exuberant embrace.

In Mellor and Milyo (1999), we describe several other reasons to be dubious of the existence of a causal connection between inequality and poor population health (also, see Deaton 1999, Deaton and Paxson 1999, and Smith 1999). For example, while we concur that feelings of relative deprivation may push some individuals into unhealthy or anti-social behavior, it is unclear as to why income inequality at the country or state level should be a good proxy for whether an individual is (or feels) well-treated. Further, while we also grant that political resource allocation and government regulations can alter the availability and quality of health care, there is no coherent theory of precisely how income inequality might interact with political institutions to the detriment of population health.[2] Finally, income inequality is itself the consequence of other economic and social processes, so that the association between inequality and health may be attributable to other underlying factors.[3]

The absence of a formal structural theory has not deterred proponents of the income

[2]To be sure, several authors have argued that income inequality somehow reduces social capital and social cohesion, which in turn is somehow detrimental to the health of individuals (e.g., Wilkinson 1996 and 1997b, Kawachi, et al 1997a and 1997b, Kawachi and Kennedy 1999 and Kennedy, et al 1998b). However, this amounts to a substitution of two "black box" explanations for the existing black box explanation. Occam's razor favors the latter. Further, the arguments and evidence for the income inequality-social capital connection are more dubious than those we review here.

[3]For example, the increase in income inequality in the U.S. from 1980 to 1990 has been attributed to changes in manufacturing employment, international migration and the increase in households headed by single females (Husted 1991, Levernier, et al 1995, Partridge, et al 1998 and Bernard and Jensen 1998).

inequality hypothesis from warning policy makers about the adverse health consequences of income inequality (e.g., Wilkinson 1996, Kennedy, et al. 1998b, Kawachi, et al. 1997b and Lynch, et al. 1998). These recommendations are based on the supposition that there exists a robust association between inequality and health, as well as the conviction that this association signifies a causal connection between the two.

On the latter point, it is well known that associations among statistical aggregates do not necessarily reflect causal relationships. For example, Gravelle (1996) explains that if the relationship between individual income and individual health exhibits diminishing marginal returns, then it is to be expected that measures of the variance in income (i.e., income inequality) will be associated with aggregate measures of health outcomes (also, see Rodgers 1979). Further, such a relationship between individual income and individual health is fairly well-established.[4] Consequently, the oft-observed association between income inequality and aggregate health measures may be simply an ecological fallacy.

Indeed, the results of studies employing individual level data are not entirely consistent with those that examine only aggregate data. Kennedy et al. (1998a) and Soobadeer and LeClere (1999) examine individual level data and find that controlling for individual income attenuates, though does not eliminate, the association between inequality and individual health outcomes. However, neither of these authors are able to control adequately for the relationship between income and health, since they have access only to categorical information on individual incomes. In contrast, studies that use individual level data *and* have more detailed information on income

[4]For example, Mellor and Milyo (1999) find diminishing marginal returns to income in their study of self-reported health status in the U.S., while Ecob and Smith (1999) find a similar relationship between income and mortality for residents of the British Isles.

find little evidence of an association between income inequality and individual health outcomes after controlling for individual (or household) income (Fiscella and Franks 1997 and 1999, Daly et al. 1998, Mellor and Milyo 1999, Deaton 1999, Deaton and Paxson 1999, and Leiyu, et al. 1999).

Proponents of the income inequality hypothesis are not dissuaded by these findings. They argue that income inequality is a root cause of all manner of social phenomena (Wilkinson 1996, Kaplan, et al. 1996 and Kawachi and Kennedy 1999). Therefore, controlling for the influence of individual attributes such as income and education quashes the observed association between inequality and individual health precisely because these individual attributes constitute some of the pathways by which inequality affects health (Wilkinson 1997a and 1998 and Lynch, et al. 1998).

There is yet another hitch for the income inequality hypothesis: evidence of an association between inequality and health in smaller geographic units is mixed, at best. For example, Lynch et al. (1998) do find an association between inequality and mortality across U.S. metropolitan areas, but Regidor et al. (1997) do not find any such relationship in Spain. Further, several studies employing individual level data fail to produce a robust association between inequality and individual health outcomes across either U.S. metropolitan areas, counties or census tracts (Fiscella and Franks 1997 and 1999, Mellor and Milyo 1999 and Soobader and LeClere 1999). In response to Fiscella and Franks, Wilkinson (1997a) has asserted that the relationship between income inequality and health can not be observed across small geographic units, because such units are too homogeneous. This argument has been echoed by Soobadeer and LeClere (1999) and Kennedy et al. (1998a,b). Consequently, these contrary findings have also not dissuaded proponents of the income inequality hypothesis.

We are not swayed by this logic, but for the sake of argument we take these claims at face value. In this article, we re-visit the assertion that there exists a robust statistical association between income inequality and various measures of health outcomes. In deference to the arguments made above, we examine only aggregate data and we limit our attention to inequality and health across countries and U.S. states. We describe the existing literature in Section 2, and offer our re-examination of the aggregate country and state level data in Section 3. We employ panel data to analyze changes in health and income inequality over time; in addition, we control not only for area income, but also year effects and the role of demographic variables. We find little to no support for the claim of a robust association between income inequality and aggregate health outcomes.

2. Previous Findings in Ecological Studies

What strikes us as most remarkable about the previous literature is that there have been so few attempts to demonstrate that the association between inequality and health exists in more than a single year's cross-section. It is therefore difficult to assess whether the association between inequality and aggregate health is an artifact of the particular time period examined, or of the omission of some unobserved third factor that causes both inequality and aggregate health outcomes.

Country Level Evidence

Most of the evidence of a significant relationship between income inequality and health at the country-level is shown in cross-sectional analysis using life expectancy and infant mortality as measures of health outcomes. The most commonly used measure of income inequality is the Gini coefficient; other measures include shares of income held by top 5%, the bottom 20%, or the bottom 60% of the income distribution. Judge, Mulligan and Benzeval (1998a) provide a detailed review of this literature. Here, we group previous studies into two areas: those that rely on cross sectional evidence, and those that examine the relationship between inequality and health over time.

Rodgers (1979) is one of the first published studies to report a significant relationship between income inequality and health, and unlike much of the research to follow, Rodgers does offer a justification for the inclusion of income inequality in aggregate models of health outcomes. When aggregate data is used, the effect of income inequality reflects the individual-level nonlinear relationship between income and health.[5] Using cross-sectional data for 56 countries and controlling for average income, Rodgers finds a statistically significant effect of the Gini coefficient: increases in income inequality negatively effect health by reducing life expectancy and raising infant mortality.

Several studies follow the cross-sectional analysis of Rodgers (1979) and produce similar results. For example, Flegg (1982) introduces maternal illiteracy rates and measures of the availability of nurses and physicians to Rodgers' model of infant mortality. LeGrand (1987) finds a significant relationship between mean age-at-death and income inequality in a small cross-section of 17 countries (though this results appears for only one of two regression specifications). Waldmann (1992) reports that the share of all income going to the top 5% of the income distribution has a positive and significant effect in models of infant mortality.[6] Duleep (1995)

---

[5]Steckel (1995) and Duleep (1995) also use this justification for including income inequality in models of stature and mortality.

[6]Waldmann uses data from both 1960 and 1970 in 41 countries. Due to limited availability, both years of data are available for only a portion of the total 41 countries, so this

finds a significant effect of income inequality on male mortality in most age groups. In Steckel (1995) income inequality is shown to have a negative and significant impact on height.

For the most part, the results of these cross-sectional studies support the hypothesis that income inequality has a detrimental effect on health, but there are exceptions. Pampel and Pillai (1986) do not find a significant effect of income inequality on infant morality; however their measure of income inequality is assumed constant over a 25 year period and is matched with five time periods of data on infant mortality per country.[7] In a model of life expectancy, Judge, Mulligan and Benzeval (1998) also find no significant effect of income inequality. However, the levels of the t-statistics they report (sometimes as high as 1.6 in absolute value) may be attributed to small sample size (26 observations). In addition, they do find a significant relationship between income inequality and infant mortality.

Only a few studies have used time series data to examine the effect of changes on income inequality on changes in health. Wilkinson (1992) employs several sources of data to calculate correlation coefficients between changes in income inequality and changes in life expectancy. Significant correlations are reported in three samples; however, the reported correlation coefficients do not appear to be adjusted for differences in GDP per capita across countries. In a sample of 12 European Community countries, the correlation coefficient between the change in life expectancy and the change in the portion of the population with less than half the national

---

research does not use panel data methods.

[7]The authors do find a significant effect of income inequality in models of neonatal mortality.

average disposable income is -0.73 ($p < 0.01$). In two different samples of OECD countries,[8] the correlation coefficients between the change in life expectancy and the change in the share of income received by the bottom 60% of the distribution are 0.80 ($p < 0.05$) and 0.47 ($p < 0.05$).

Judge (1995) provides several critiques of the Wilkinson (1992) analysis. For example, Judge shows that Wilkinson's results are not robust to the unit of income (family or household) and suggests that the quality of the data used by Wilkinson is insufficient to generate country-level changes.[9] In addition, Judge (1995) provides new evidence suggesting there is no significant relationship between income inequality and health using correlation coefficients for a cross section of 13 countries. Judge, Mulligan, and Benzavel (1998a) examine correlations between annual changes in income inequality and health in ten countries. Contrary to Wilkinson (1992), they find no effect significant correlation between income inequality changes and either changes in life expectancy or infant mortality.

The focus on the relationship between changes in income inequality and changes in health represents something of a methodological advance in this area. Previous cross-sectional analysis suffers from the omission of fixed country- specific factors in models of life expectancy and infant mortality. These factors may include national policies to improve health and health services delivery, persistent environmental factors, or persistent effects of epidemics and disease. By examining the relationship between changes in health and changes in inequality, factors that affect health and that are constant over time need not be included in the model, an omission that does

[8]The first is a sample of 6 countries; the second sample contains 15 countries, although here the income inequality data are based on variations in definition of income and in the income receiving unit.

[9]See the reply by Wilkinson (1995).

not result in bias. Further support for the analysis of changes over time comes from Wilkinson, who refers to this analysis as a "more demanding test" (Wilkinson 1992).

In our empirical analysis in Section 3, we examine both cross-sectional evidence and correlations between changes in income inequality and health. We also add a third component to our analysis: first-difference models of life expectancy and infant mortality. This method has the advantage of controlling for fixed country-specific factors that influence health, as well as allowing us to control for changes in other factors, a feature that simple correlation coefficients do not offer.[10]

State Level Evidence

There is some question as to the comparability of data on income distributions across countries (Le Grand 1985, Wilkinson 1996 and Deaton 1999). Consequently, the most convincing evidence for the income inequality hypothesis comes from the analysis of U.S. data. In general, studies that employ a single-cross section of state-level data do find greater income inequality to be associated with poorer state-level health outcomes. However, studies that examine changes in income inequality yield mixed results, at best.

The first study to examine the correlation between some measure of state income inequality and aggregate health outcomes for a single year is Kennedy, et al (1996a). They measure inequality by the "Robin-Hood Index" and the Gini coefficient for household income. They show that the former measure is associated with age-adjusted mortality and infant mortality,

[10]We should point out that Judge, Mulligan and Benzeval perform an OLS analysis annual of changes controlling for annual changes in income distribution and other factors. They find no significant effect of changes in income inequality; however, their sample appears to contain only 10 observations.

as well as age-adjusted mortality from heart disease, malignant neoplasms and homicide, after controlling for state poverty rates. These relationships are attenuated when state-level smoking rates are included, but only the associations for malignant neoplasms becomes insignificant. In neither specification is age-adjusted mortality from cerebrovascular disease associated with inequality. In an important correction, Kennedy, et al (1996b) show that the Gini coefficient is significantly and highly correlated with all of these dependent variables except malignant neoplasms and cerebrovascular disease, although they do not control for any other factors.

Several other studies examine state level inequality data from 1990. Kawachi and Kennedy (1997) show that nine different state-level measures of income inequality are significantly correlated with age-adjusted mortality rates across states.[11] Kaplan, et al (1996) find that share of income received by the bottom 50% of households is negatively correlated with age-adjusted mortality rates. They also examine the relationship between the 50% share of income and state rates of low-birth weight (<2,500 grams), homicide, violent crimes, disabilities, smoking, sedentary lifestyles, as well as per capita expenditures on protection and medical care. In every case, there is a significant association with inequality after controlling for median household income. Finally, Kennedy, et al (1998b) find that homicide, firearm-related violent crimes are all significantly associated with the 50% share of household income, after controlling for state poverty rates.

Less effort has been made to find an association between income inequality and health in data from other years. Kaplan, et al. (1996) report a significant correlation between the 50%

[11]Lynch, et al. (1998) perform a similar analysis across U.S. metropolitan areas, also using 1990 data.

share of household income in 1980 and age-adjusted mortality, but they do not report any other findings for that year. Mellor and Milyo (1999) show that three measures of income inequality are significantly related to the proportion of state population reporting fair or poor health status for 1995-1997, while Daly, et al. (1998) find age-adjusted mortality to be associated with seven different measures of inequality for data from both 1980 and 1990. However, these latter results do not hold up under further scrutiny. Neither Mellor and Milyo, nor Daly, et al. find consistent evidence of an association between inequality and health at the individual level (after controlling for individual attributes).

Only two studies examine changes in aggregate health outcomes as a function of changes in state level income inequality. Kaplan, et al (1996) find no significant association between changes in the 50% share of income from 1980 to 1990 and age-adjusted mortality, with or without controlling for median income. Using the same time period, Daly et al. (1998) fail to find a significant association between changes in inequality and changes in age-adjusted mortality for five of their seven different inequality measures. Consequently, the state-level evidence that is consistent with the income inequality hypothesis comes primarily from the analysis of a cross-sectional data for 1990.

3. Data and Methods

Re-examining Country Level Data

To re-examine the ecological association between income inequality and health at the country level, we use cross-sectional data for 47 countries in 1990 and time series data for 30 countries for 1960, 1970, 1980, and 1990. (Appendix 1 lists the countries in both samples.)

Because we are concerned with the impact of income inequality on health controlling for other key determinants of health, we have included country-year observations when data are available in all sample years for the following five variables: life expectancy at birth, infant mortality, the Gini coefficient, income per capita, and secondary school enrollment.[12] Descriptive statistics for these variables are reported in Table 1.

Our two dependent variables, life expectancy at birth and infant mortality (deaths per 1,000 births), represent the two health outcomes most frequently examined in the previous literature. Our measure of income inequality, the Gini coefficient, has been used in studies by Rodgers (1979), Flegg (1982), Judge (1995), and others. We use two explanatory variables in addition to income inequality. Income per capita is measured as real GDP per capita in constant dollars, base 1985, using international prices. This variable is from the Summers and Heston Penn World Tables, Version 5.6. An additional explanatory variable is the secondary school enrollment ratio. Previous research has demonstrated strong significant effects of education measures such as adult literacy on infant mortality (Flegg 1982). All data used in our country-level analysis were obtained from the Easterly (1999) data set. The income inequality data are originally from the Deininger and Squire (1996) data.

Simple correlation coefficients reveal that these data can be used to replicate some of the previous findings reported in the literature. For example, in our 47 country sample, the Pearson correlation coefficient between the Gini coefficient and infant mortality is 0.381 (significant at the 0.01 level). The correlation between income inequality and life expectancy is -0.445 (also

[12]One reason for limiting the number of explanatory variables is to increase the number of country-years in our samples.

significant at the 0.01 level). Unlike previous research, however, we do not find that changes in income inequality are significantly correlated with changes in life expectancy or infant mortality. The correlation coefficient between ten-year changes in the Gini coefficient and ten-year changes in life expectancy is 0.025 ($p > 0.8153$); the correlation between changes in the Gini and changes in infant mortality is -0.043 ($p > 0.6883$).

In Table 2, we report the results of OLS models of infant mortality and life expectancy using a cross-section of 47 countries in 1990. In a univariate regression, we find that income inequality has a significant positive effect on infant mortality, and a significant negative effect on life expectancy. These detrimental effects of income inequality on health are similar to those reported in previous studies; yet when income per capita is added to the model, the independent effect of income inequality becomes smaller in magnitude and is not statistically significant. The further inclusion of secondary school enrollment actually results in a sign change – with income inequality reducing infant mortality and increasing life expectancy – although the effects are not close to any conventional level of statistical significance.

Because of the shortcomings of cross-sectional analysis noted earlier, our preferred method of estimation is a first difference model, in which the changes in health outcomes are regressed on changes in explanatory variables, including changes in income inequality. We report these results for the country level in Table 3, and provide results from a pooled cross section for comparison. In the pooled cross section (the upper third of Table 3), income inequality has a significant and detrimental effect on both health outcomes – until income and education are added as control variables. In fact, adding education to the levels regression results in the perverse finding that income inequality has a negative and significant effect on infant mortality, and a positive and significant effect on life expectancy. In the middle and lower portions of Table 3, we present first differences models using 10 and 20 year changes respectively. Here, even without controlling for changes in income per capita or education, we find no evidence of a significant detrimental effect of income inequality on health. In one specification, (20-year changes, including income and education), we find that increases in the Gini coefficient increase life expectancy, a result that is small in magnitude, albeit significant at the 0.10 level.

Wilkinson (1995) has suggested that the Gini coefficient is not the best measure of income inequality for cross-country comparisons, so we repeat our analysis for Table 2 and Table 3 using the shares of income held by the bottom 20% and the top 20% of the income distribution (the sample is somewhat smaller due to more missing observations).[13] We find no differences in either the sign or significance of the income inequality effect in the single year cross-sectional models shown in Table 2. In our pooled cross section specification, the use of the alternative measures of income inequality produces some surprising results. For example, controlling for income (and also education) we find that an increase in the share of income held by the bottom 20% leads to an increase in infant mortality, and a reduction in life expectancy. In other models, an increase in the share of income held by the top 20% reduces infant mortality and increases life expectancy. In both cases the effect of income inequality is statistically significant. In the first differences models over 10 and 20 years, there is no evidence in support of the income inequality hypothesis using either share measure.

Sensitivity to Sample Changes

There are several reasons to examine the ecological relationship between income

[13]These results are available from the authors upon request.

inequality and health using different samples of country-year observations. First, our cross-sectional analysis of 47 countries reported no significant relationship between income inequality and health controlling for income per capita, while previous studies have found a significant relationship using income and other controls (e.g., Rodgers 1979, Waldmann 1992). Second, Wilkinson's (1992) analysis finds significant correlations between changes in income inequality and changes in life expectancy, while our analysis does not. Finally, researchers have noted that the quality of data on income distributions is not readily comparable across countries (Le Grand 1985; Deaton 1999). To address these concerns, we perform several additional analyses using country level data.

In earlier work, Rodgers (1979), Flegg (1982) and Waldmann (1982) and others reported evidence of a significant relationship between measures of income inequality and both life expectancy and infant mortality, even when controlling for income per capita and other factors. Our cross-sectional results shown in Table 1 show that when income per capita is added to models of life expectancy and infant mortality, the effect of the Gini coefficient is statistically insignificant. This discrepancy is readily explained by the difference in time periods used in earlier analysis and in our analysis. Rodgers' data are circa 1965, Flegg uses data from 1968-72, and the Waldmann data are from 1960 and 1970. When we break our data set into four cross sections by decade (1960, 1970, 1980 and 1990) we find a very intriguing result: when income per capita is held constant, the Gini coefficient has a significant detrimental effect on health in the 1970 sample only. In all other decade cross-sections, the inclusion of income per capita renders the coefficient on income inequality statistically insignificant.[14] Thus it would appear that the earlier cross-sectional findings reported by Rodgers, Flegg and Waldmann are not robust to the use of data from later time periods.

A second discrepancy between our results and earlier findings is with respect to correlations between in income inequality and changes in life expectancy. While our correlation coefficients were not statistically significant, Wilkinson (1992) reports significant correlations using a sample of 12 European countries and samples of 6 and 15 OECD countries. Since our original samples contain countries outside of Europe and the OECD, we next restrict our attention to samples similar to Wilkinson. Unfortunately, we do not have data for the same measure of income inequality used by Wilkinson, although we employ three alternatives: the Gini coefficient, and the shares of income held by the bottom 20% and top 20% of the income distribution. We use the changes in income inequality and life expectancy from 1970-80, which is close to the time period used by Wilkinson (1992). These correlation coefficients are reported in Table 5. In only one of the nine cases is the correlation coefficient significant. Consequently, the results reported in Wilkinson (1992) do not appear to be robust to changes in the measure of income equality.

As an additional check on our results, we focus on a sample of OECD countries to re-estimate our models of life expectancy and infant mortality. This exercise is warranted given that

[14]We use GDP per capita as a control variable. This increases the number of observations in our sample. We also ran univariate models with the Gini coefficient as the only explanatory variable. In each case, the Gini coefficient had the statistically significant effect of reducing life expectancy or increasing infant mortality. Finally, we ran models including the secondary school enrollment ratio as a regressor. Here again, the effect of the Gini was largely insignificant, with the exception of our 1980 sample. These results are all available from the authors.

data on income inequality may not be comparable across large numbers of countries, especially those with low incomes. In addition Wilkinson has offered many claims about the strength of the effect of income inequality in higher income countries, where he argues income per capita no longer contributes to the health of the population (Wilkinson 1996).

Twelve countries from our 30 country sample were OECD member nations in 1990.[15] We replicate our analysis using cross sectional models and first differences at 10 and 20 years; the results are shown in Appendix 2. The results for the pooled cross-sections, in the upper third of the table, show that levels of income inequality have no significant effect on levels of infant mortality or life expectancy. And although changes in income inequality have no significant effect in models of infant mortality, we find a surprising significant relationship in models of life expectancy. Income inequality consistently results in increased life expectancy among these OECD countries.

As a final check on the impact of income inequality across OECD and non-OECD countries, we add two additional variables to our models reported in Table 3: an OECD dummy variable and an interaction term (Gini coefficient * OECD dummy). These results (not reported here but available upon request) also run contrary to previous claims about the adverse role of income inequality. We find that income inequality has a negative and significant effect on levels of infant mortality, and that income inequality in OECD countries has a positive and significant effect

[15]These are Australia, Belgium, Canada, Denmark, Finland, Japan, the Netherlands, New Zealand, Norway, Sweden, the United Kingdom, and the United States. Our 30 country sample also consists of Mexico, which became a member of the OECD in 1994. Since our data do not extend beyond 1990, Mexico is excluded from the OECD subset. Mean GDP per capita in the OECD sample is 10,563 compared to a mean of 2,199 in the non-OECD sample. We are able to reject the null hypothesis that the means are equal.

on life expectancy.

Re-Examining State Level Data

It is much easier to replicate and extend previous studies at the state-level, since there is little reason to be concerned about differences in the source and quality of data across states, nor is there much variation in the number of states examined. However, because our analysis uses an extended time series, we do limit our attention to the 48 continental U.S. states. Our task is further simplified by the fact that previous cross-sectional state-level results do not appear sensitive to the particular measure of income inequality. We employ the Gini coefficient for household income, which is taken from Partridge, et al (1998) and Al-Samarrie and Miller (1967). Other state-level control variables are available from the census in the *Statistical Abstract of the United States*; descriptive statistics for both the levels and differences in our set of independent variables are listed in Table 5.

We examine nine different dependent variables; several of these have been included in one or more previous studies (death rates, infant mortality rates and low birth rates, as well as death rates from cardiovascular disease, malignant neoplasm, homicides and accidents). We also examine two other dependent variables (suicide and death rates from liver disease) that have not been included in any previous studies. The omission of these specific causes of death is surprising given that they are good indicators of self-destructive behavior. All of the data on state-level health outcomes are taken from the *Vital Statistics of the United States*; the descriptive statistics for these dependent variables are listed in Table 6.

It is important to adjust these state-level death rates for the age-composition of each states' population. We accomplish this directly by including five control variables in our regressions for the percentage of the population in different age categories (see Table 6). Previous studies tend to first adjust the dependent variable for age, then treat this modified variable as a dependent variable, although the exact procedure by which this standardization is achieved is never described in detail.

In order to demonstrate that our results are not artifacts of the omission of Alaska and Hawaii or the particular method of controlling for the age-composition of states, we first try to replicate previous findings in with our data. The most common dependent variables used in previous studies is the overall death rate, so we report our results for this variable in Table 7. We first regress death rates on only the Gini coefficient and our age controls, then we add median income as a control (columns 1 and 2). As has been found by so many previous authors, death rates are significantly associated with the Gini coefficient, even after controlling for median income.

We have repeated this analysis for all of our dependent variables. For those variables examined in previous studies, only malignant neoplasms and cardiovascular disease are not significant; this is consistent with previous findings. The two variables that have not been included in earlier studies (suicides and liver disease) are not significantly associated with the Gini coefficient.

One weakness found in previous state-level studies was the absence of controls for demographic differences (other than age) across states. Factors such as educational attainment, race and urban residency are well known correlates of individual health outcomes (e.g., Lantz, et al 1998). In fact, once we add controls for these other demographic variables, inequality is no longer significantly associated with death rates (see the last three columns in Table 7). This pattern is repeated for most of our other dependent variables, although homicide rates are an exception. This last set of findings is remarkably contrary to the frequent and recent assertions that there exists a robust association between inequality and health outcomes across states.

The other major weakness in previous empirical inquiries regarding income inequality and health was the failure to control for state-specific effects. Consequently, we estimate the effect of the Gini coefficient in ten-year differences and twenty-year differences for each similar differences in each of our dependent variables. In tables 8-10, we report the results of regressions on the levels and differences for two different specifications: the first includes controls only for age composition and decade effects, while the second also includes controls for median income, education, race and urban status, or changes in these variables.

The results in Table 8 also stand in contrast to the conventional wisdom. First, the Gini coefficient is positively and significantly related to overall death rates in only one of the four difference specifications. Further, while the Gini coefficient is positively and significantly related to infant mortality in the levels, it is not in differences. Finally, as was the case with the death rate, low-birth-weight is significantly associated with the Gini coefficeint, until demographic controls are included. Most surprisingly, the estimate on the Gini coefficient is most often negative in the differences, and significantly so for the twenty-year changes.

The results in Table 9 further undermines the income inequality hypothesis. First, in levels regressions, the Gini is always *negatively* associated with deaths from cardiovascular disease, malignant neoplasms and liver disease; the association is statistically significant in three of the six specifications. In the difference specifications, the estimated coefficient on the Gini is also consistently negative and sometimes significant. These results are particularly disturbing, since it has been argued that inequality creates stress that in turn leads to unhealthy or self-destructive lifestyles. Consequently, one would expect to see some evidence of the invidious effects of inequality in the incidence of deaths from cardiovascular or liver diseases.

Of course, the ultimate act of self-destruction is suicide; yet, the previous literature has not investigated the relationship between inequality and suicide. In Table 10, we report our findings for deaths from suicide, homicide and accidents. Suicides are always negatively correlated with inequality and, absent other controls, this association is significant in both the levels and the twenty-year changes.

Homicides are positively and significantly associated with inequality in the levels and in the twenty-year differences, but not in the ten-year differences. Nevertheless, this is the strongest evidence that we find in favor of the income inequality hypothesis. Our findings are consistent with several previous studies (e.g., Hseih and Pugh 1993 and Kennedy, et al. 1998b). However, Doyle, et al. (1999) find no association between inequality and either violent crimes or property crimes, after controlling for differences in policing across states. To the extent that policing varies over time within states, our difference estimates will not control for this omitted variable; it is also quite possible that this accounts for the different results found using twenty-year changes versus the ten-year changes.

Deaths from accidents are positively and significantly associated with inequality in the levels regression, but this association changes sign in the differences. Not only this, but the negative association between inequality and accidents is at least marginally significant in three of our four difference regressions.

In the 54 regressions reported in Tables 8-10, income inequality is significantly associated with poorer aggregate health outcomes in only 11 cases. Four of these occur for homicides, which may be attributable to our omission of controls for policing effort. In contrast, income inequality is significantly associated with better health outcomes in 15 cases. Finally, ignoring statistical significance, most of the point estimates in these tables are opposite in sign to what the income inequality hypothesis predicts.

Conclusion

Wilkinson is fond of citing the many studies that document an association between income inequality and poorer aggregate health outcomes; he argues that the sheer number of these studies is evidence of a robust relationship (e.g., Wilkinson 1995 and 1998). However, these studies are not independent observations; most examine only a single cross-section of data, and employ few (if any) control variables. Even so, this literature does not uniformly support the income inequality hypothesis.

We have investigated whether the relationship between inequality and health is indeed robust. To do this, we analyzed data from longer time periods than do previous authors; we also accounted for confounding third factors in two ways: directly, by including controls for education, etc., and indirectly, by taking differences. Overall, we find that the much ballyhooed association between income inequality and aggregate health is not robust. In fact, in many cases we find that income inequality is associated with better health outcomes. These cases occur primarily in the difference specifications with few controls variables; that is, precisely where Wilkinson has argued that the consequences of inequality for health should be most clearly revealed. To the extent that previous work was thought sufficient to make causal inferences, we look forward to a torrent of books and articles touting the salutary effects of income inequality!

Our findings are consistent with those in several recent studies using individual-level data; rather than a robust association between inequality and health, results are all over the map. But why is income inequality sometimes negatively and sometimes positively associated with better health outcomes, even significantly so?

We suspect that there is no causal relationship between individual health and income inequality across countries or states, or any other geographic unit. However, there are several reasons why income inequality might be nevertheless *associated* with better or worse health outcomes. First, income inequality is in part the result of economic growth, for at least two reasons. As the material wealth of society increases, the number of adults per household falls; this leads to an increase in household income inequality, even as greater material wealth improves health outcomes. In addition, since wages are never negative, economic growth tends to stretch the distribution of incomes over a greater range. Conversely, inequality can also be associated with poor health. For example, a decrease in the number of manufacturing jobs will shift some workers out of the labor force and lead some to accept employment at lower wages and with fewer benefits. Consequently, industrial re-structuring or other employment shocks may have detrimental effects for individual health outcomes (through the loss of insurance coverage or income), while at the same time increasing income inequality. It should be no surprise then, one can sometimes observe a significant association between inequality and aggregate health measures, regardless of the sign of that association.

Bibliography

Al-Samarrie, A. and H. P. Miller (1967). "State Differentials in Income Concentration," *American Economic Review*, 57: 175-184.

Bernard, Andrew and J. Bradford Jensen (1998). "Understanding Increasing and Decreasing Wage Inequality," manuscript (Yale University School of Management).

Daly, Mary C., Greg J. Duncan, George A. Kaplan, and John W. Lynch (1998). "Macro-to-Micro Links in the Relation between Income Inequality and Mortality," *The Millbank Quarterly*, 76(3): 315-339.

Deaton, Angus (1999). "Inequalities in Income and Inequalities in Health," *NBER Working Paper 7141*.

Deaton, Angus and Christina Paxson (1999). "Mortality, Education, Income and Inequality among American Cohorts," *NBER Working Paper 7140*.

Deininger, Klaus and Lyn Squire. (1996). "A New Data Set Measuring Income Inequality," *The World Bank Economic Review*, 10(3): 565-91.

Doyle, Joanne M., Ehsan Ahmed and Robert Horn (1999). "The Effect of Labor Markets and Income Inequality on Crime: Evidence from Panel Data," *Southern Economic Journal*, 65(4): 717-738.

Duleep, Harriet Orcutt (1995). "Mortality and Income Inequality Among Economically Developed Countries," *Social Security Bulletin,* 58: 34-50.

Easterly, William (1999). "Life During Growth," *World Bank Working Paper*.

Ecob, Russell and George Davey Smith (1999). "Income and Health: What is the Nature of the Relationship?" *Social Science and Medicine,* 48: 693-705.

Fiscella, Kevin and Peter Franks (1997). "Poverty or Income Inequality as Predictor of Mortality: Longitudanal Cohort Study," *British Medical Journal*, 314: 1724-1728.

Fiscella, Kevin and Peter Franks (1999). "Individual Income, Income Inequality, Health and Mortality: What are the Relationships?" Manuscript (University of Rochester).

Flegg, A. (1982). "Inequality of Income, Illiteracy and Medical care as Determinants of Infant Mortality In Developing Countries," *Population Studies*, 36: 441-458.

Gravelle, Hugh (1998). "How Much of the Relation Between Population Mortality and Unequal Distribution of Income is a Statistical Artefact?" *British Medical Journal*, 316: 382-385.

Husted, Thomas A. (1991). "Changes in Income Inequality from 1981 to 1987," *Review of Regional Studies*, 21(3): 249-260.

Hsieh, C. C. and M. D. Pugh (1993). "Poverty, Income Inequality and violent crime: A Meta-Analysis of Recent Aggregate Data Studies," *Criminal Justice Review*, 18: 182-202.

Judge, K. (1995). "Income Distribution and Life Expectancy: a Critical Appraisal," *British Medical Journal*, 311: 1282-1285.

Judge, Ken, Jo-Ann Mulligan and Michaela Benzeval (1998a). "Income Inequality and Population Health," *Social Science and Medicine,* 46(4-5): 567-579.

Judge, Ken, Jo-Ann Mulligan and Michaela Benzeval (1998b). "Reply to Richard Wilkinson," *Social Science and Medicine*, 47(7): 983-985.

Kaplan, George A., Elsie R. Pamuk, J. M. Lynch, Richard D. Cohen and Jennifer L. Balfour (1996). "Inequality in Income and Mortality in the United States: Analysis of Mortality and Potential Pathways," *British Medical Journal*, 312: 999-1003.

Kawachi, Ichiro and Bruce Kennedy (1999). "Income Inequality and Health: Pathways and Mechanisms," *Health Services Research*, 34(1): 215-227.

Kawachi, Ichiro and Bruce P. Kennedy (1997). "The Relationship of Income Inequality to Mortality: Does the Choice of Indicator Matter?" *Social Science and Medicine*, 45(7): 1121-1127.

Kawachi, Ichiro, Bruce P. Kennedy and Kimberly Lochner (1997a). "Long Live Community: Social Capital as Public Health," *The American Prospect*, 35(November\December): 56-59.

Kawachi, Ichiro, Bruce P. Kennedy, Kimberely Lochner and Deborah Prothrow-Stith (1997b). "Social Capital, Income Inequality and Mortality," *American Journal of Public Health*, 87(9): 1491-1498.

Kennedy, Bruce P., Ichiro Kawachi and Deborah Prothrow-Stith (1996a). "Income Distribution and Mortality: Cross-Sectional Ecological Study of the Robin-Hood Index in the United States," *British Medical Journal*, 312: 1004-1007.

Kennedy, Bruce P., Ichiro Kawachi and Deborah Prothrow-Stith (1996b). "Important Correction," *British Medical Journal*, 312: 1194.

Kennedy, Bruce P., Ichiro Kawachi, Roberta Glass and Deborah Prothrow-Stith (1998a). "Income Distribution, Socioeconomic Status and Self-Rated Health in the United States," *British Medical Journal*, 317: 917-921.

Kennedy, Bruce P., Ichiro Kawachi, Deborah Prothrow-Stith, Kimberly Lochner and Vanita Gupta (1998b). "Social Capital, Income Inequality and Firearm Violent Crimes," *Social Science and Medicine*, 47(1): 7-17.

Kennedy, Bruce P., Ichiro Kawachi, Roberta Glass and Deborah Prothrow-Stith (1999). "Income Distribution, Socioeconomic Status and Self-Rated Health in the United States: Authors' Reply," *British Medical Journal*, 318: 1417.

Lantz, Paula M., James S. House, James M. Lepkowski, David R. Williams, Richard P. Mero and Jieming Chen (1998). "Socioeconomic Factors, Health Behaviors and Mortality," *JAMA*, 279(21): 1703-1708.

Le Grand, Julian (1987). "Inequality in Health: Some International Comparisons," *European Economic Review*, 31: 182-191.

Leiyu, Shi, Barbara Starfield, Bruce Kennedy and Ichiro Kawachi (1999). "Income Inequality, Primary Care, and Health Indicators," *The Journal of Family Practice*, 48(4): 275-284.

Levernier, William, Dan S. Rickman and Mark D. Partridge (1995). "Variations in U.S. State Income Inequality," *International Regional Science Review*, 18(3): 355-378.

Lynch, John W., George A. Kaplan, Elsie R. Pamuk, Richard D. Cohen, Katherine E. Heck, Jennifer L. Balfour and Irene H. Yen (1998). "Income Inequality and Mortality in Metropolitan Areas of the United States," *American Journal of Public Health*, 88(7): 1074-1080.

Mellor, Jennifer and Jeffrey Milyo (1999). "Income Inequality and Individual Health: Evidence form the Current Population Survey," *Robert Wood Johnson Health Policy Scholars Working Paper #8*, Boston University School of Management (Boston, MA).

Milyo, Jeffrey (1999). "Income Distribution, Socioeconomic Status and Self-Rated Health: Authors' Ignored Data in Their Study," *British Medical Journal*, 318: 1417.

Pampel, Fred C. and Vijayan K. Pillai (1986). "Patterns and Determinants of Infant Mortality in Developed Nations, 1950-1975," *Demography*, 23 (4): 525-541.

Partridge, Jamie S., Mark D. Partridge and Dan S. Rickman (1998). "State Patterns in Family Income Inequality," *Contemporary Economic Policy*, 16: 277-294.

Regidor, Enrique, Pedro Navarro, Vicente Dominguez and Carmen Rodriguez (1997). "Inequalities in Income and Long Term Disability in Spain: Analysis of Recent Hypotheses Using Cross-Sectional Study Based on Individual Data," *British Medical Journal*, 315(7116): 1130-1135.

Rodgers, G.B. (1979). "Income and Inequality as Determinants of Mortality: An International Cross-Section Analysis," *Population Studies*, 33(2): 343-351.

Smith, James P. (1999). "Healthy Bodies and Thick Wallets: The Dual Relation Between Health and Economic Status," *Journal of Economic Perspectives*, 13(2): 145-166.

Soobader, Mah-Jabeen and Felicia LeClere (1999). "Aggregation and the Measurement of Income Inequality: Effects on Morbidity," *Social Science and Medicine*, 48: 733-744.

Steckel, Richard H. (1995). "Stature and Standard of Living," *Journal of Economic Literature*, 33(4):1903-1940.

Waldmann, Robert J. (1992). "Income Distribution and Infant Mortality," *The Quarterly Journal of Economics*, 107: 1283-1302.

Wennemo, I. (1993). "Infant Mortality, Public Policy and Inequality — A Comparison of 18

Industrialized Countries, 1950-1985," *Sociology of Health and Illness*, 15: 429-446.

Wilkinson, Richard G. (1998). "Letter to the Editor," *Social Science and Medicine*, 47(3): 411-412.

Wilkinson, Richard G. (1997a). "Commentary: Income Inequality Summarizes The Health Burden of Individual Relative Deprivation," *British Medical Journal*, 314: 1727-1728.

Wilkinson, Richard G. (1997b). "Comment: Income, Inequality and Social Cohesion," *American Journal of Public Health*, 87(9): 1504-1506.

Wilkinson, Richard G. (1996). *Unhealthy Societies: The Affliction of Inequality*. Routledge (London).

Wilkinson, Richard G. (1995). "Commentary: Mistaken Criticisms Ignore Overwhelming Evidence," *British Medical Journal*, 311: 1285-1287.

Wilkinson, Richard G. (1992). "Income Distribution and Life Expectancy," *British Medical Journal*, 304: 165-168.

Table 1
Country Level Analysis
Descriptive Statistics for All Variables

Variable Name	1990 Levels (N=47)	30 Countries by Decade, 1960-1990 Levels by Decades (n=120)	10-Year Difference (n=90)	20-Year Difference (n=60)
Infant deaths per 1,000 births	48.11 (38.71)	63.13 (51.25)	-15.83 (11.05)	-31.60 (20.70)
Life Expectancy at birth	64.91 (9.85)	63.57 (10.37)	2.95 (1.84)	6.34 (3.14)
Gini Coefficient	38.90 (9.25)	40.53 9.67	-2.00 (6.59)	-4.78 (7.07)
GDP per capita	5759.32 (5589.49)	5544.75 (4781.44)	1245.53 (1294.14)	2491.47 (2385.65)
Secondary school enrollment ratio	0.575 (0.286)	0.515 (0.305)	0.098 (0.081)	0.205 (0.115)

Table 2
Estimated Effect of Income Inequality on Infant Mortality and Life Expectancy at birth for 47 Countries, 1990

Explanatory Variables	Infant Deaths per 1,000 Births			Life Expectancy at Birth		
	(1)	(2)	(3)	(4)	(5)	(6)
Gini Coefficient	1.596 (2.85)	0.072 (0.13)	-0.364 (-0.99)	-0.475 (-3.42)	-0.089 (-0.67)	0.021 (0.24)
GDP per capita		-0.005 (-7.07)	-0.001 (-0.73)		0.001 (6.18)	0.0003 (1.18)
Secondary school enrollment ratio			-98.15 (-4.32)			24.93 (4.68)
R^2	0.146	0.580	0.723	0.198	0.626	0.769

Notes: T-statistics are reported in parentheses, and are based on White standard errors.

Table 3
Country Level Analysis
Estimated Effect of Income Inequality on Infant Mortality and Life Expectancy at birth
for 30 Countries by Decade, 1960-1990

	Infant deaths per 1,000 births			Life Expectancy at Birth		
Model One: Levels (n=120)	Year Controls	Plus Income	Plus Education	Year Controls	Plus Income	Plus Education
Gini coefficient	1.688 (4.46)	-0.249 (-0.71)	-0.816 (-3.45)	-0.354 (-4.54)	0.060 (0.85)	0.166 (3.55)
R^2	0.215	0.632	0.809	0.212	0.678	0.829
Model Two: 10-year changes (n=90)						
Gini coefficient	-0.090 (-0.60)	-0.019 (-0.156)	-0.044 (-0.34)	0.031 (1.37)	0.021 (1.13)	0.019 (0.93)
R^2	0.026	0.321	0.325	0.248	0.443	0.444
Model Three: 20-year changes (n=60)						
Gini coefficient	-0.090 (-0.23)	-0.189 (-0.65)	-0.250 (-0.92)	0.046 (0.88)	0.060 (1.44)	0.065 (1.65)
R^2	0.011	0.399	0.424	0.072	0.429	0.435

Notes: T-statistics are reported in parentheses, and are based on White standard errors. Year controls consist of indicators for each decade. Income is measured as GDP per capita and education is measured as the secondary school enrollment ratio.

Table 4
Country Level Analysis
Estimated Effect of Income Inequality on Infant Mortality and Life Expectancy at birth for 12 OECD Countries by Decade, 1960-1990

	Infant deaths per 1,000 births			Life Expectancy at Birth		
Model One: Levels (n=48)	Year Controls	Plus Income	Plus Education	Year Controls	Plus Income	Plus Education
Gini coefficient	-0.007	0.009	0.012	0.020	0.014	0.008
	(-0.07)	(0.10)	(0.13)	(0.62)	(0.45)	(0.26)
R^2	0.762	0.766	0.767	0.661	0.669	0.706
Model Two: 10-year changes (n=36)						
Gini coefficient	-0.033	-0.037	-0.036	0.045	0.046	0.045
	(-0.28)	(-0.32)	(0.32)	(1.86)	(1.96)	(1.86)
R^2	0.278	0.396	0.403	0.349	0.442	0.476
Model Three: 20-year changes (n=24)						
Gini coefficient	-0.081	-0.023	-0.019	0.091	0.076	0.074
	(-0.47)	(-0.17)	(-0.15)	(2.05)	(2.12)	(2.09)
R^2	0.211	0.412	0.436	0.154	0.318	0.448

Notes: T-statistics are reported in parentheses, and are based on White standard errors. Year controls consist of indicators for each decade. Income is measured as GDP per capita and education is measured as the secondary school enrollment ratio.

Table 5
Descriptive Statistics for Explanatory Variables;
48 Continental States by Decades, 1950-1990

Independent Variables	Levels by Decades (n=240)	10-Year Difference (n=192)	20-Year Difference (n=144)
Gini coefficient for family income	0.376 (0.038)	-0.001 (0.034)	-0.005 (0.044)
Median family income (constant 1992 dollars)	26,758 (7,351)	3,894 (4,934)	6,769 (6,914)
Percent w/high school education	48.3 (23.0)	14.3 (7.3)	32.3 (8.0)
Percent w/college education	11.7 (6.1)	4.1 (2.4)	7.7 (2.6)
Percent in urban area	63.7 (15.3)	3.2 (5.4)	5.8 (7.6)
Percent black	9.2 (9.9)	0.2 (1.2)	0.42 (2.4)
Percent ages 0-18 years	32.9 (5.8)	-2.2 (5.1)	-6.6 (5.6)
Percent ages 19-24 years	9.8 (2.8)	0.8 (3.3)	3.5 (3.5)
Percent ages 45-64 years	19.3 (1.7)	-0.1 (1.3)	-0.3 (1.8)
Percent ages 65 years and older	10.2 (2.4)	1.2 (0.8).	2.2 (1.2)

Table 6
Descriptive Statistics for Dependent Variables;
48 Continental States by Decades, 1950-1990

Dependent Variables	Levels by Decades (n=240)	10-Year Difference (n=192)	20-Year Difference (n=144)
Deaths per 100,000	909.4 (108.3)	-20.6 (65.6)	-51.6 (86.7)
Infant deaths per 1,000 births	19.6 (8.9)	-5.3 (3.3)	-11.7 (4.3)
Low birth-weight per 100 births	7.3 (1.2)	-0.1 (0.8)	-0.5 (1.0)
Specific causes of death per 100,000:			
Cardiovascular disease	449.4 (90.9)	-24.8 (53.0)	-54.8 (84.2)
Malignant neoplasms	161.0 (38.9)	18.0 (14.9)	37.5 (21.3)
Liver disease	10.5 (4.2)	0.6 (3.6)	1.7 (5.0)
Suicide	12.1 (3.5)	0.4 (2.2)	1.0 (2.7)
Homicide	6.3 (4.1)	0.5 (2.3)	1.8 (2.5)
Accidents	55.1 (14.9)	-6.6 (9.0)	-11.1 (11.4)

Table 7
Estimated Effect of Gini on Overall Death Rate
for 48 Continental U.S. States by Decade, 1950-1990

Number of Observations = 240	Dependent Variable is Deaths per 100,000				
Independent Variables	(1)	(2)	(3)	(4)	(5)
Gini coefficient	617.0 (5.15)	364.1 (2.35)	163.5 (0.79)	-152.1 (-0.76)	-66.6 (-0.30)
Median Income		-.0034 (-2.96)	.0003 (0.25)	-.0007 (-0.57)	0.0013 (1.03)
Percent with High School Education			-3.83 (-4.41)		-1.92 (-2.21)
Percent with College Education			-3.47 (-1.75)		-3.78 (-2.07)
Percent Black				2.91 (6.54)	2.07 (4.46)
Percent in Urban Areas				-1.02 (-3.46)	-0.76 (-2.42)
Other controls included: Year and age composition of state	Yes	Yes	Yes	Yes	Yes
R^2	.76	.77	.81	.81	.83

Notes: T-statistics are reported in parentheses, and are based on White standard errors. Year and age controls consist of indicators for each decade, percent of population under 18, between 18 and 24, between 45 and 65, and over 65 years old.

Table 8
Estimated Effect of Gini on Deaths, Infant Deaths and Low Birth-Weight for 48 Continental U.S. States by Decade, 1950-1990

	Deaths per 100,000		Infant Deaths per 1,000 Births		Low Birth-Weight per 100 Births	
Model One: Levels (n=240)	Age and Year Controls only	Plus Income and Demographic Controls	Age and Year Controls only	Plus Income and Demographic Controls	Age and Year Controls only	Plus Income and Demographic Controls
Gini coefficient	617.0 (5.15)	-66.6 (-0.30)	60.4 (8.36)	35.5 (2.55)	12.6 (5.73)	-2.9 (-1.00)
R^2	.76	.83	.90	.91	.37	.49
Model Two: 10-year changes (n=192)						
Gini coefficient	325.8 (1.42)	598.9 (2.71)	8.0 (0.64)	-5.75 (-0.48)	-2.4 (-1.12)	-2.62 (-0.97)
R^2	.56	.60	.38	.43	.52	.54
Model Three: 20-year changes (n=144)						
Gini coefficient	19.5 (0.07)	282.6 (0.89)	13.3 (1.13)	-6.5 (-0.41)	-11.4 (-3.22)	-9.6 (-1.98)
R^2	.69	.72	.37	.42	.55	.58

Notes: T-statistics are reported in parentheses, and are based on White standard errors. Low birth-weight is less than 2500 grams. Year and age controls consist of indicators for each decade, percent of population under 18, between 18 and 24, between 45 and 65, and over 65 years old. Other control variables are median family income, percent of population with a high school degree, percent with a college degree, percent living in urban areas and percent black.

Table 9
Estimated Effect of Gini on Deaths from Cardiovascular Disease, Malignant Neoplasms and Liver Disease for 48 Continental U.S. States by Decade, 1950-1990

	Cardiovascular Disease		Malignant Neoplasms		Liver Disease	
Model One: Levels (n=240)	Age and Year Controls only	Plus Income and Demographic Controls	Age and Year Controls only	Plus Income and Demographic Controls	Age and Year Controls only	Plus Income and Demographic Controls
Gini coefficient	-34.1.0 (-0.38)	-680.7 (-4.54)	-41.0 (-1.41)	-167.9 (-3.49)	-14.3 (-2.72)	5.3 (0.51)
R^2	.81	.86	.89	.91	.51	.59
Model Two: 10-year changes (n=192)						
Gini coefficient	-206.7 (-1.96)	-74.8 (-0.79)	-52.4 (-1.83)	-53.0 (-1.52)	-11.5 (-0.94)	-13.3 (-0.81)
R^2	.76	.78	.66	.70	.57	.60
Model Three: 20-year changes (n=144)						
Gini coefficient	-383.9 (-2.56)	-96.0 (-0.53)	-117.1 (-3.15)	-71.6 (-1.42)	-17.9 (-1.64)	-21.7 (-0.93)
R^2	.82	.85	.75	.77	.68	.72

Notes: T-statistics are reported in parentheses, and are based on White standard errors. Year and age controls consist of indicators for each decade, percent of population under 18, between 18 and 24, between 45 and 65, and over 65 years old. Other control variables are median family income, percent of population with a high school degree, percent with a college degree, percent living in urban areas and percent black.

Table 10
Estimated Effect of Gini on Deaths from Suicide, Homicide and Accidents for 48 Continental U.S. States by Decade, 1950-1990

	Suicide		Homicide		Accidents	
Model One: Levels (n=240)	Age and Year Controls only	Plus Income and Demographic Controls	Age and Year Controls only	Plus Income and Demographic Controls	Age and Year Controls only	Plus Income and Demographic Controls
Gini coefficient	-32.7	-1.52	90.4	54.1	41.9	68.1
	(-5.42)	(-0.16)	(14.98)	(6.92)	(1.76)	(2.09)
R^2	.21	.43	.64	.79	.48	.61
Model Two: 10-year difference (n=192)						
Gini coefficient	-8.8	-2.2	3.7	5.5	-38.9	-30.5
	(-1.41)	(-0.39)	(0.53)	(0.89)	(-2.41)	(-1.64)
R^2	.26	.28	.38	.44	.64	.65
Model Three: 20-year difference (n=144)						
Gini coefficient	-24.6	-11.5	36.0	31.5	-48.7	-39.8
	(-2.91)	(-0.98)	(4.20)	(3.75)	(-1.81)	(-1.28)
R^2	.29	.34	.52	.51	.67	.71

Notes: T-statistics are reported in parentheses, and are based on White standard errors. Year and age controls consist of indicators for each decade, percent of population under 18, between 18 and 24, between 45 and 65, and over 65 years old. Other control variables are median family income, percent of population with a high school degree, percent with a college degree, percent living in urban areas and percent black.

Appendix 1
List of Countries

Countries used in 1990 Cross-Section (n=47)

Austria	Ghana	Mexico	Senegal
Bangladesh	Guinea-Bissau	Morocco	Sri Lanka
Belgium	Honduras	Netherlands	Sweden
Bolivia	Hungary	New Zealand	Timor
Canada	India	Nicaragua	Tunisia
Chile	Indonesia	Nigeria	Uganda
China	Italy	Norway	United Kingdom
Colombia	Jamaica	Pakistan	United States
Denmark	Japan	Peru	Venezuela
Ecuador	Jordan	Phillipines	Zambia
Egypt	Kenya	Poland	Zimbabwe
Finland	Mauritius	Portugal	

Countries used in Time-Series Cross-Section (1960-1990)

Australia	Finland	Netherlands	Sweden
Bangladesh	India	New Zealand	Thailand
Belgium	Indonesia	Nigeria	Tunisia
Canada	Jamaica	Norway	United Kingdom
Chile	Japan	Pakistan	United States
Colombia	Kenya	Peru	Venezuela
Denmark	Mexico	Philippines	
Ecuador	Morocco	Sri Lanka	

Appendix 2
Correlation Coefficients
Between Changes in Life Expectancy and Changes in Income Inequality
1970-1980

Sample	Countries	Correlation between Change in Life Expectancy and Change in:		
		Gini Coefficient	Income Share of Top20%	Income Share of Bottom 20%
European Community (N=10)	Belgium, Denmark, France, Greece, Ireland, Italy, Netherlands, Portugal, Spain, United Kingdom	-0.049 (0.89)	-0.622 (0.06)	0.317 (0.37)
Small OECD (N=6)	Canada, France, Italy, Japan, Norway, United Kingdom	0.233 (0.66)	-0.555 (0.25)	-0.053 (0.92)
Large OECD (N=13)	Australia, Canada, Denmark, Finland, France, Italy, Japan, Netherlands, Norway, Spain, Sweden, United Kingdom, United States	0.385 (0.19)	-0.260 (0.39)	0.187 (0.54)

Notes: Changes were calculated over periods of 10 years. Some countries with more than two decades of level data contributed more than one observation on changes to the samples.

TUFTS UNIVERSITY
ECONOMICS DEPARTMENT

DISCUSSION PAPERS SERIES 1999

99-22 Jennifer M. MELLOR and Jeffrey MILYO; Re-Examining the Evidence of an Ecological Association Between Income Inequality and Health.

99-21 Jeffrey MILYO and Brian GRAN; The Effects of Extended Time on Exams for College Students Without Learning Disabilities: A Classroom Experiment.

99-20 Jeffrey MILYO; A Problem with Euclidean Preferences in Spatial Models of Politics.

99-19 Drusilla K. BROWN; Can Consumer Product Labels Deter Foreign Child Labor Exploitation?

99-18 Alexander M. BRILL, Kevin A. HASSETT, and Gilbert E. METCALF; Household Energy Conservation Investment and the Uninformed Consumer Hypothesis.

99-17 Yannis M. IOANNIDES and Kambon KAN; The Nature of Two-Directional Intergenerational Transfers of Money and Time: An Empirical Analysis.

99-16 Linda HARRIS DOBKINS and Yannis M. IOANNIDES; Dynamic Evolution of the U.S. City Size Distribution.

99-15 Anna M. HARDMAN and Yannis M. IOANNIDES; Residential Mobility and the Housing Market in a Two-sector Neoclassical Growth Model.

99-14 Yannis M. IOANNIDES; Why Are There Rich and Poor Countries? Symmetry Breaking in the World Economy: A Note.

99-13 Linda HARRIS DOBKINS and Yannis M. IOANNIDES; Spatial Interactions Among U.S. Cities: 1900-1990.

99-12 Yannis M. IOANNIDES; Residential Neighborhood Effects.

99-11 Yannis M. IOANNIDES; Neighborhood Interactions in Local Communities and Intergenerational Transmission of Human Capital.

99-10 Yannis M. IOANNIDES; Economic Geography and the Spatial Evolution of Wages in the United States.

99-09 Edward KUTSOATI and Dan BERNHARDT; Can Relative Performance Compensation Explain Analysts' Forecasts of Earnings?

99-08 Don FULLERTON, Inkee HONG, and Gilbert E. METCALF; A Tax on Output of the Polluting Industry is Not a Tax on Pollution: The Importance of Hitting the Target.

99-07 Marcelo BIANCONI; A Dynamic Monetary Model with Costly Foreign Currency.

99-06 Marcelo BIANCONI; The Effects of Alternative Fiscal Policies on the Intertemporal Government Budget Constraint.

99-05 Lynne PEPALL and Dan RICHARDS; The Simple Economics of "Brand-Stretching."

99-04 Drusilla K. BROWN, Alan V. DEARDORFF, and Robert M. STERN; U.S. Trade and Other Policy Options and Programs to Deter Foreign Exploitation of Child Labor.

99-03 Margaret S. MCMILLAN and William A. MASTERS; A Political Economy Model of Agricultural Taxation, R&D, and Growth in Africa.

99-02 MASTERS, William A. and Margaret S. MCMILLAN; Ethnolinguistic Diversity, Government Expenditure and Economic Growth Across Countries.

99-01 MCMILLAN, Margaret S.; Foreign Direct Investment: Leader or Follower?

Discussion Papers are available on-line at

http://www.tufts.edu/as/econ/papers/papers.html