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Article

Inequality and Trust: Testing a Mediating Relationship for Environmental Sustainability

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Abstract: Instrumental arguments linking inequality to environmental sustainability often suppose a negative relationship between inequality and social cohesion. While social cohesion is difficult to measure, there are measures of a narrower concept, social trust, and empirical studies have shown that social trust is negatively related to inequality. In this paper we test whether at least part of the observed relationship may be explained by income level, rather than income distribution. We use individual response data from the World Values Survey at the income decile level, and find evidence that income level is indeed important in explaining differences in levels of social trust, but it is insufficient to explain all of the dependence. In the sample used for the study, we find that both income level and income distribution help explain differences in social trust between countries.

Keywords: trust; inequality; social capital; social cohesion

1. Introduction

In his widely-cited book, Uslaner [1,2] provided evidence that social trust (as measured by the proportion of people within a country who say that, generally speaking, most people can be trusted) declines with rising income inequality. This is of interest for sustainability studies, because social trust, and the broader concepts of social capital or social cohesion, have been suggested or identified as a factor in achieving environmental sustainability [3–9]. While the mechanisms may be complex [10], and social trust is likely to be just one of many mediating variables [11], the thesis derives from a result with strong empirical and theoretical support, that generalized, or social, trust, is essential for overcoming collective action problems [12,13].

Uslaner supports his claim using a plot of a measure of social trust against a measure of inequality (the Gini index) for countries that do not have a Communist legacy. There is a clear downward trend to the data, but upon closer inspection it appears that the graph is dominated by two clusters of countries: a high-trust, low-inequality cluster that is mostly composed of high-income countries and another low-trust, high-inequality cluster mostly composed of low-income countries. Thus, the relationship that Uslaner observed might be due to differences in income level rather than income inequality. Furthermore, if trust depends on differences in income at the national level, then it might also depend on income level within countries. Following Heerink *et al.* [14], we wish to distinguish the "aggregation effect" arising from a nonlinear dependence of trust on income from the "political economy effect" arising from inequality *per se*.

There have now been many studies, after Uslaner's book, investigating the link between inequality and trust, but a survey by Jordahl [15] did not mention income level as a possible explanatory variable. Nevertheless, one of the studies cited in the survey, by Fischer and Torgler [16], did explore absolute *vs.* relative income, and found evidence for both an absolute and relative effect. The contribution of this paper is to attempt to disentangle the different contributions of three factors: the overall level of development, as measured by per capita GDP; absolute income within countries, as measured by income deciles (the aggregation effect); and aggregate income inequality (the political economy effect). Using income decile data and a measure of social trust it tests whether the purported effect of inequality on trust can be explained solely as a function of income, rather than income distributions.

While the aim of this paper is somewhat narrow, it investigates a result with broad implications—the link between inequality and environmental sustainability, as mediated by social trust. That such studies are needed can be seen from the active (and sometimes heated) debate over the relative income hypothesis of Wilkinson [17] in the fields of public health and epidemiology. Briefly, the hypothesis is that the negative impact of inequality on health that has been observed in international data is due to the direct influence of inequality itself, and not simply an aggregation effect as originally argued [18–20]. Some critics argue that Wilkinson and Pickett [21], the most prominent defenders of the hypothesis, inappropriately use national level data to draw conclusions about individual responses [22,23]; supporters counter that multilevel analysis produces results consistent with the hypothesis [24]. Other critics claim that the purported effect disappears when variables are added to the model [25,26], while Wilkinson and Pickett respond that the additional variables might, as the critics argue, be confounders, but might also be mediating, or pathway, variables that their theory anticipates [27]. In spite of heated debate, most academic critics do not reject Wilkinson and Pickett's underlying hypothesis that social position can influence health status, separate from purchasing power. Indeed, one of their critics presents supporting evidence of a link between social trust and health [28] using, as this paper does, decile-level data from the World Values Survey. The history of the relative income hypothesis in the health literature encourages us to examine links between income distribution and environmental impacts using a variety of approaches. This paper contributes to such an examination, although it does not make the link explicit. Rather, it tests an important mediating relationship that has been identified in the literature, between inequality and social trust.

2. Model

Following Uslaner [1,2] and Bjørnskov [29], this paper takes the answer to the survey question, "Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?" from the World Values Survey [30,31] as a measure of generalized, or social, trust. Respondents can answer either that "Most people can be trusted" or "Can't be too careful". (They can also choose not to answer the question.) The analysis in this paper uses individual response data, as Jen *et al.* [28] do in their study of social trust and self-reported health. The individual response data in the World Values Survey reports an income range for respondents. Nominally, the ranges are income deciles, suitable for a study of correlates of social trust at the income decile level. In fact, for some countries the income ranges are clearly not deciles. As discussed in the next section, the analysis uses data only for those countries that appeared to properly code income as deciles.

Each country c in our data set (which is described below) has data on income and trust at the decile level. Deciles are constructed by ordering respondents to a survey by income, from lowest to highest, and then dividing that sequence of people or households into ten equal parts, labeled by i = 1,...,10. Thus the population within each decile is 10 percent of the total population. We denote the share of total national income in each decile by $d_{c,i}$; these are the data reported in income distribution statistics. Because deciles are computed from data ordered by income, each succeeding decile receives a larger proportion of national income than the preceding decile. As a measure of social trust, $n_{c,i}$ is the number of people in decile i in country c answering "Most people can be trusted" to the social trust question, out of a total of $N_{c,i}$ respondents. The model is,

$$\ln\left(\frac{n_{c,i}}{N_{c,i}-n_{c,i}}\right) = A + \alpha \ln \bar{y}_c + \gamma I_c + \beta \ln d_{c,i}, \quad (1)$$

where I_c is an aggregate national inequality indicator—this paper uses the Gini coefficient—and $\bar{y}_c$ is national mean income. The function on the left-hand side of the equation is a logit transformation that transforms the odds ratio $n_{c,i}/(N_{c,i}-n_{c,i})$, which is nonnegative, to a variable that can take any value on the real line, from negative to positive infinity. Equation (1) can be tested as a generalized linear model (GLM) with a binomial distribution and a logit link function [32]. Moreover, it is a multi-level model, with data at two levels: national (mean income, income inequality) and decile (income share, trust).

The decile data were collected using national surveys carried out by different surveyors. Also, as shown below, dependence of trust on income decile varies from country to country. The error structure of Equation (1) may therefore vary from one country-year combination to another. The analysis assumes the following structure,

$$\ln\left(\frac{n_{c,i}}{N_{c,i}-n_{c,i}}\right) = (A + a_c) + \alpha \ln \bar{y}_c + \gamma I_c + (\beta + b_c) \ln d_{c,i} + \varepsilon_{c,i}, \quad (2)$$

where a_c, b_c, and $\varepsilon_{c,i}$ are all normally-distributed variables with zero mean. That is, the analysis assumes that country-specific intercepts and decile coefficients differ due to random, rather than systematic effects.

Equation (2) is a generalized linear mixed model (GLMM) [33]. It properly captures the binary nature of the trust data, and accounts for non-systematic differences between countries and national surveys through the error structure.

3. Methods and Data

The analysis tests Equation (2) using the R statistical software version 2.13.0 [34] using the glmer() function in the lme4 package version 0.999375–39, which estimates GLMMs. The lme4 package is the most recent version of lme, developed and maintained by Bates and colleagues [35]. Purchasing power parity-adjusted GDP at constant 2005 international dollars from the World Bank World Development Indicators [36] provides a measure of per capita income. For income deciles and Gini coefficients the analysis uses data from the World Income Inequality Database version 2c (WIID2c) [37]. Trust data are compiled from decile-level counts of people who answered "Most people can be trusted" or "Can't be too careful" to the trust question in the World Values Survey (WVS) waves 3 and 4, omitting any deciles with no responses to the trust question.

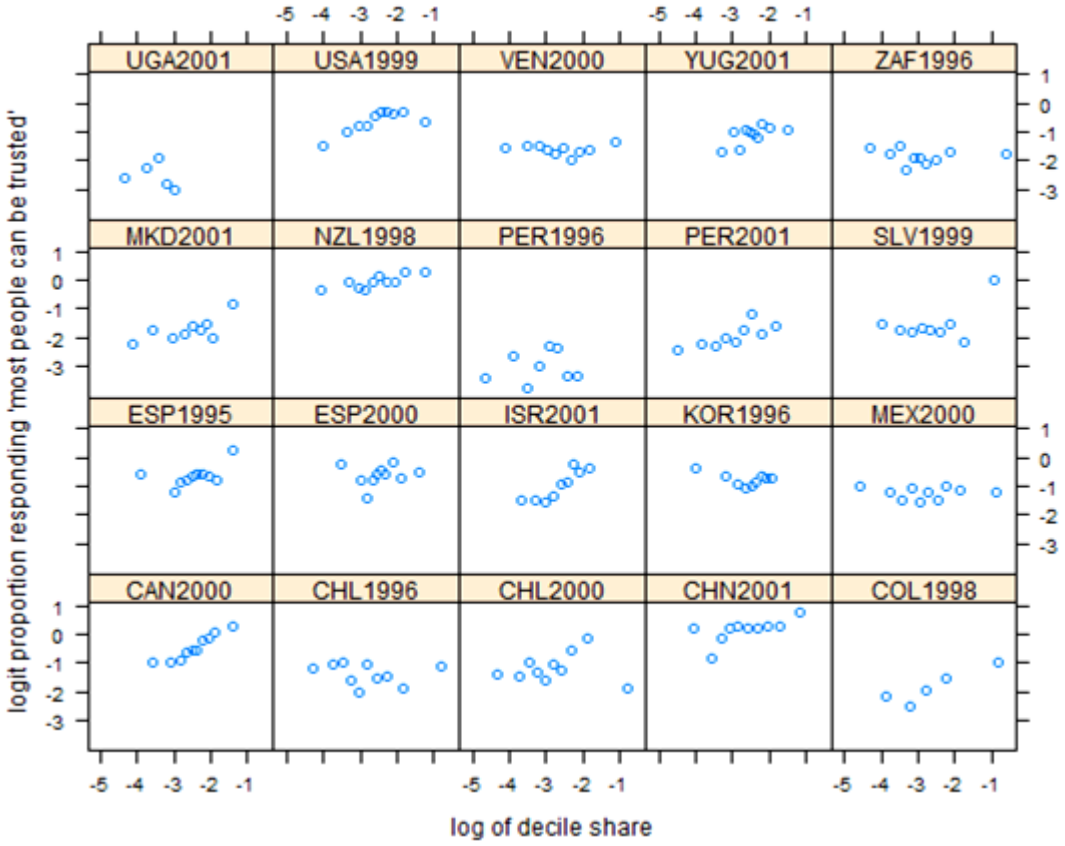
Income distribution data are notoriously challenging to work with. The WIID2c database typically has multiple surveys for each country-year combination, and Solt's Standardized World Income Inequality Dataset [38] does not include decile-level data. Wherever possible, this analysis uses data on gross income before taxes and transfers, selecting data with the highest quality score. The use of gross income best matches the question in the WVS codebook, which asks respondents to list "all wages, salaries, pensions and other incomes that come in" [31]. Distributional data for countries and years are matched to the WVS data, for country and year combinations that differ by at most two years. For example, a WVS survey was carried out in South Africa in 1996, but no inequality data were available for that year; instead, the data set contains the values for 1997. All WIID2c and WVS data in the set differed by at most one year except for New Zealand (1996 in the WIID2c database, and 1998 in the WVS database). Note that a test of Equation (2) requires records from the WIID2c database that include decile data, which is a considerably smaller set than the records reporting Gini coefficients.

The income groups in the WVS are supposed to be deciles, but some of them clearly are not. For example, the income scale for Algeria (codes 12001–12010) is in even steps of 10,000 dinar per month [31], which is implausible as a set of deciles. Also, although codes are provided for each income scale, some surveys did not report which income scale they used. The data set for this paper omits any observations that did not report the code for the income scale, and any income scales that could not plausibly represent income deciles. Even in this case, the decile ranges must, of necessity, have been computed from an income survey for a year prior to the World Values Survey, but the WVS does not report the year for which the decile ranges were calculated.

After these procedures the data set contains 183 decile-level observations, for 20 country-year combinations: Canada in 2000, Chile in 1996 and 2000, China in 2001, Colombia in 1998, Spain in 1995 and 2000, Israel in 2001, South Korea in 1996, Mexico in 2000, Macedonia in 2001, New Zealand in 1998, Peru in 1996 and 2001, El Salvador in 1999, Uganda in 2001, USA in 1999, Venezuela in 2000, Yugoslavia in 2001, and South Africa in 1996. While small, this set of countries ranges from low to high income and includes both relatively egalitarian and non-egalitarian countries.

As shown in Figure 1, while in many countries the proportion of people responding "Most people can be trusted" to the trust question tends to rise with income, in some countries the rate is nearly flat, or even negative. This variability could be due to many factors. While some of those factors may be systematic, rather than random, for this analysis the slopes are treated as random effects in a mixed model, as discussed in the previous section, and as shown in Equation (2).

Figure 1. Social trust *vs.* within-country income.



Beyond problems with data lie the general problems with social trust studies identified in the survey by Nannestad [39]: endogeneity, omitted variable bias, and bias from unobserved heterogeneity. Of these, omitted variable bias is least problematic. Indeed, the purpose of this paper is to ask whether the omission of income in previous studies might give misleading results. In turn, this study omits variables that have been considered in other studies, including cultural and religious fragmentation, because it focuses on the specific question of whether the observed dependence on income inequality (that is, relative income) may actually be due to an absolute income dependence. Unobserved heterogeneity is addressed by using a mixed model with random effects, as explained above. The endogeneity problem remains: if more equal societies are more trusting, but more trusting societies also build institutions and adopt norms that foster greater equality, then the influences pass in both directions. The data set does not have sufficient time-series data to test for endogeneity.

4. Analysis

The analysis regresses Equation (2) on the data described in the previous section with the lme4 R package. The package solves GLMM problems using an adaptive Gauss-Hermite numerical integration procedure. The accuracy of the estimation depends on the number of points at which the integrand is evaluated. The analysis uses four points; adding more points did not change the parameter estimates. This gave the results in Table 1. As seen in the table, log income is marginally non-significant (Pr = 0.07), while log decile income is highly significant (Pr < 0.001). Interestingly, the estimated parameter values are almost identical (0.26 and 0.24), suggesting that there is no overall effect of economic level separate from income variations within the country. That is, the effect of a difference in income between two people in different countries is indistinguishable from the effect of a difference in income between two people in the same country, holding income inequality constant. The Gini coefficient is significant at the 95 per cent level (Pr = 0.03).

Table 1. Parameter estimates.[a]

	Estimate	z	Pr
log $\bar{y}_c$	0.26	1.8	0.07 (.)
log $d_{c,i}$	0.24	3.5	< 0.001 (***)
Gini	−2.64	−2.1	0.03 (*)
Intercept	−1.80	−1.0	0.30

[a] Asterisks (*) indicate statistical significance: * means Pr < 0.05; ** means Pr < 0.01; and *** means Pr < 0.001.

The GLMM procedure does not provide an *R*-squared statistic. Instead, an ANOVA table comparing the model with and without the Gini coefficient tests the significance of inequality relative to a model from which it is excluded. As seen in Table 2, the addition of the Gini coefficient contributes significantly (Pr = 0.05) to the explanatory power of the model. Also, the model with the Gini coefficient has a higher log likelihood and a lower Akaike information criterion (AIC) score than the model without the Gini coefficient, which each indicate a better fit.

Table 2. ANOVA table comparing model with and without Gini coefficient.[a]

	Chi-squared	DF	Pr	Δ log likelihood	Δ AIC
Without Gini				--	--
With Gini	3.89	1	0.048 (*)	1.9	−1.9

[a] Asterisks (*) indicate statistical significance: * means Pr < 0.05; ** means Pr < 0.01; and *** means Pr < 0.001.

Coefficients in logistic models are not as intuitive as ordinary least squares (OLS) coefficients, because they lead to changes in odds ratios rather than directly to changes in the variable of interest. However, as a simple estimate, if initially the odds are even—that is, half of respondents say that they trust others, while the other half say that they do not—then dividing the change in the odds ratio by four gives the approximate change in the response rate. Thus, using the figures in Table 1, a change of 0.05 in the Gini coefficient (comparable to the difference between New Zealand and China *circa* 2000) is associated with a 13 percent decline in the odds ratio for social trust. Dividing that by four shows

that it corresponds to a 3.3 percentage point decline in the reported level of social trust relative to even odds. Similarly, a 10 percent increase in income is associated with a 0.6 percentage point rise in trust.

5. Discussion

The results presented in Tables 1 and 2 suggest that trust is affected by both income level and inequality. The logit transform of trust rises with income, but with a concave shape (that is, it has a positive coefficient that is less than one); trust also falls with rising income inequality. We therefore reject the hypothesis—for an admittedly limited data set—that the observed negative relationship between trust and income inequality is due solely to a correlation between income and inequality between countries and an aggregation effect within countries, rather than the contextual effect of living in a more or less equal country.

The coefficient of each of the explanatory variables in the regression is statistically significant (although average income is only marginally significant), but the question remains whether they are substantively significant. That is, whether over a plausible range of values the explanatory variables contribute to meaningful differences in levels of trust. The mode of the trust distribution is close to 0.3. To raise a country from a trust level of 0.3 to 0.4 requires a change in the log odds ratio of 0.44. Dividing that by 0.26 (the coefficient for log income) and exponentiating gives 5.4, meaning that a country would have to increase its income more than five-fold to gain an improvement based solely on income using the parameter estimates in Table 1. Such an increase would take over 30 years at a 5 per cent annual growth rate, and half a century at a more realistic 3 per cent annual growth rate. The required change in the Gini coefficient is −0.17, slightly more than the difference, *circa* 2000, between Spain—a relatively egalitarian country, as are most Western European countries—and Venezuela—one of the most unequal countries in the world at that time.

Either of these differences would be substantial and transformative. These figures therefore suggest that neither inequality by itself nor income growth by itself is substantively important for determining differences in levels of social trust. However, stable growth, extended over perhaps two decades, combined with an increasingly equal income distribution could, using the parameter estimates in Table 1, be associated with meaningful changes in social trust. It is doubtful, except in low-income countries, that this would then translate into improved environmental conditions, since environmental pressures would most likely rise with average income.

In general, many factors affect social trust, including the manner in which economic development and changes in income distribution come about, and there is no mechanical link between income, income distribution, and social trust. The finding that the income distribution effect is not sufficient by itself to explain large differences in social trust reinforces the need for multi-dimensional sustainability strategies: narrowing income distributions may be part of such a strategy, and for low-income countries raising incomes is also important, but they are at best proxies for complex social processes.

6. Conclusions

The results support the contention that income inequality is negatively related to social trust. Moreover, the relationship cannot be explained solely by differences in income, although rising incomes do contribute to higher levels of social trust. After accounting for income, income distribution

contributes (statistically) significantly to explaining differences in levels of social trust between countries. Our results are therefore consistent with those of Fischer and Torgler [16]. However, within the limits of the model presented in this paper, we found that only when income level and distribution both changed together was there likely to be a substantive effect on social trust.

The analysis in this paper is admittedly limited by the availability of data. Carrying out a multi-level analysis using income and trust data at the level of income deciles restricts the analysis to a relatively small data set, consisting of 183 data points (from twenty country-year combinations). The relatively small size of the data set means that we cannot explore potential endogeneity problems. Bearing this in mind, the main recommendation is that future analyses should include income as an explanatory variable, because it partly, but not fully, accounts for the observed dependence on income inequality. Furthermore, the analysis only considers income—either income level or distribution—as an explanatory factor. Other factors affect social trust, including institutions, social norms, and various types of fragmentation. Finally, it is quite possible that trust might change with income in a nonlinear way; but the data set for this paper is too small to test for such an effect. While acknowledging these limitations, this analysis supports the supposition: inequality does affect social trust.

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Conflict of Interest

The author declares no conflict of interest.

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