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The Impact of Power Equality, Income, and the Environment on Human Health: Some Inter-Country Comparisons

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ABSTRACT *Economic studies on environmental degradation generally have a narrow focus on per capita income as an explanatory variable, and often fail to distinguish among the various types of environmental quality or damage. This paper addresses both problems by examining the effect of relative equality in the distribution of power on environmental outcomes, and making a clear distinction between health-related environmental outcomes and so-called 'environmental amenities,' only the latter of which should correlate strongly with income. This paper introduces a national index of power equality that is derived from related socioeconomic variables, and studies its effects on individual country achievement in addressing environmental quality and population health. This model is applied to a data set of 180 countries, as well as to subgroups of the entire country set. Employing disability-adjusted life expectancy and the population child mortality rate as two health proxies, this paper finds that power equality in most cases positively influences population health, and that power equality is in every case no worse and in some cases better than per capita income at explaining population health.*

KEY WORDS: Health, environment, power distribution, power inequality, power

Introduction

General concern over the state of our natural environment has grown significantly over the past three decades. Economists, to their credit, have helped increase the volume of research in this area substantially, seeking economic explanations for a host of environmental problems. Yet most economic studies on the environment suffer from at least one of two important weaknesses. First is the overemphasis on per capita income as a determinant of environmental outcomes, an example being the environmental Kuznets curve hypothesis (see, e.g., Grossman & Krueger, 1995; Selden & Song, 1994). While income is likely to be important, other possible explanations (e.g., education, democracy, equality) have received inadequate attention. Second, the difference between environmental outcomes directly related to human

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health and those more associated with aesthetic preferences or even non-anthropocentric motivations is frequently underemphasized.

Boyce (1994) hypothesized that greater inequality in the distribution of power would produce a greater degree of environmental degradation, and Torras & Boyce (1998) found some evidence in support. The study proposed here is an extension of the argument, but the exclusive focus is on what Martinez-Alier (1995) terms environmental 'necessities,' which are environmental outcomes that presumably have a significant impact on human health. Fortunately, it is precisely in this area where international data are most plentiful.

As done by Boyce *et al*. (1999) in their study on the US states, the author constructs an index of power equality that applies to a data set of 180 countries. Suspecting substantial heterogeneity in a country set that spans a vast income range, the author also examine the significance of the index on country sub-groups. It is found that in some instances a strong direct relationship exists between power equality and superior health outcomes. Moreover, in all the estimates power equality results no worse—and in some cases better—than per capita GDP in explaining health. To the extent that health outcomes are also linked to numerous other environmental variables that are impossible to consider here owing to insufficient data, the results should cast new doubt on the validity of the EKC hypothesis or other income-focused explanations of environmental outcomes.

Literature Review: Determinants of Environmental and Human Health Outcomes

If power equality and income influence population health, they likely do so at least in part through pollution or environmental quality as intervening variables. The majority of recent work in fact emphasizes environmental outcomes rather than the attendant health consequences. The environmental Kuznets curve hypothesis (EKC), for example, depicts a relationship between income and the environment that is quadratic, where environmental conditions worsen with income increases early in a country's development, after which, beyond a certain income level, environmental quality improves as income continues to increase (e.g., Grossman & Krueger, 1995; Selden & Song, 1994). Yet as has been demonstrated by Ekins (1997) and Shafik (1994), among others, the quadratic functional form implied by the EKC at best applies to only a subset of environmental variables, such as local atmospheric pollution and in some cases water pollution. For a variety of other variables the latter author finds monotonic changes.

A linear functional form is indeed often more realistic. Londregan & Poole (1996), for example, find that higher income levels make it more likely that a country will have a democratic political system, while Neumayer (2002) finds democratization correlated with a number of variables associated with a country's commitment to redressing environmental problems. The separate conclusions, when considered jointly, suggest a positive income–environment link.

In another study, Homer-Dixon (1995) writes of the supply of 'ingenuity' that countries can deploy to help them overcome environmental problems associated with resource scarcity and, insofar as richer countries possess more of it, also implies that wealth is conducive to environmental quality. He strikes a pessimistic note, however, foreseeing a bifurcated world in which some countries continue to supply the ingenuity necessary to countervail scarcity while others will be increasingly unable to. Also emphasizing cross-country distributional equity as a determinant of environmental degradation, Torras & Boyce (1998) and Magnani (2000) test for the separate effect of income distribution in some EKC regression equations, finding that equality in the distribution of income explains environmental outcomes at least as well, and in some cases better, than per capita income.[1]

Martinez-Alier (1995) argues that income distribution influences environmental outcomes from both the demand and the supply side. On the demand side, he distinguishes between environmental 'amenities' (e.g., pristine wilderness areas) and environmental 'necessities' (e.g., potable water) arguing that since income elasticity is higher for the former, an income redistribution would influence the demand for each of these categories of environmental goods. Since supply of environmental goods is determined by the cost of providing them, income redistribution will also alter their supply since, as Martinez-Alier (see also 1993) puts it, 'the poor sell cheap.' In other words, the fact that environmental goods are not traded in any market makes the poor undervalue them relative to other commodities more than rich people.

Here is where the distinction between environmental 'necessities' and 'amenities' is crucial.[2] While poor countries and poor people may place less relative importance on, for example, deforestation and atmospheric carbon dioxide concentration, it is not clear why the same would hold for other elements of the environment that are more directly associated with human health, such as aquatic heavy metal concentration or percentage of households with access to sanitation. Do poor people care less about their health than rich people? If not, what makes the populations in poor countries, generally speaking, less healthy?

Many have studied the relationship between income and population health, and findings have thus far been mixed. Pritchett & Summers (1996), for example, argue that more income or wealth is conducive to better health, and Carey & Judge (2001) find evidence of a 'virtuous cycle' whereby more income and better health mutually reinforce each other (since, the authors presume, better health leads to productivity increases). Rivera & Currais (1999) also find evidence of a reverse causality between health and income. In contrast, Easterlin (1995, 1999) and Shiffman (2000) find that there is at best a very weak causal link between income and health improvements despite the high correlation between the two variables. Nobody to the author's knowledge has explored an inverted-U relationship akin to the EKC, in all likelihood because there is little theoretical basis for it.[3]

Others have studied how broader socioeconomic conditions influence health outcomes, with some surprising results. For example, Eyer (1977, 1984) and Higgs (1979) find evidence of a 'pro-cyclical' movement of mortality rates with economic conditions—*viz*., mortality increases when unemployment decreases.[4] Granados (2002) and Ruhm (2000) reach similar conclusions in studying the effect of recessions on human health, finding, among other things, that economic 'good times' often paradoxically increase stress levels and lead to a reduction in social ties due to decreased leisure time. Link & Phelan (1995) and Williams (1990) also find evidence that poor health and higher disease incidence are determined by fewer social ties, higher stress levels, and lower perceived status, although they do not attempt to link the latter outcomes to income levels. In addition, Landale *et al*. (1999) argue that 'Americanization'—in the sense of higher pressure lifestyle, less leisure time, less familial and friendship ties—explains differences in infant health between newly-arrived and US-born Puerto Rican women and their infants (the former being healthier, on average).

In other studies, Marmot (2001) argues that income inequality explains population longevity better than income levels—with greater inequality resulting in lower life expectancies—and Nganda (1996) argues along similar lines for more general health outcomes including morbidity incidence. In an empirical study of the US states, Boyce *et al*. (1999) find that equality in the distribution of power is an important factor in explaining environmental outcomes, which in turn are found to influence health to a significant degree. Power equality is itself likely to be associated with some of the socioeconomic variables mentioned above, yet confirming this is beyond the scope of this paper. What is more important here is that there appear to be factors other than per capita income that explain human health outcomes.

Even though the original Boyce (1994) hypothesis on which the latter study is based addresses environmental quality and not health *per se*, it is worth discussing in some detail as it is relevant to the material that follows. The relationship between power equality and environmental quality depends on whether those enjoying greater relative power are on the whole net gainers or net losers from environmentally degrading economic activities. Although few if any *prefer* degraded environments, the fact that economic decisions frequently sully the natural environment implies the existence of net gainers—else the activities would not occur. Boyce (1994) advanced the ‘power-weighted social decision rule’ (PWSDR), which weights individual net benefits by the power accruing to each individual, to remind us of an inescapable fact so often overlooked in standard economics approaches: some individuals have significantly greater influence on social or environmental outcomes than others.[5]

The PWSDR predicts inefficiently low levels of pollution in the event that those with greater power are net losers from environmentally degrading economic activity, and inefficiently high levels if they are largely net gainers. Which is more plausible? Richer individuals are much more likely to be net beneficiaries of environmentally degrading economic activity since they gain proportionately more than the poor from the fact that they consume more and own more assets. They would only be net losers if their share of the resulting environmental externality were skewed even more unequally against them—an unrealistic scenario (see, e.g., Khan, 1997; Martinez-Alier, 1995; Torras, 2001). Richer individuals tend to be more powerful as well, since greater access to wealth grants one greater political influence. It is in this way that the impact of income distribution on environmental quality might be limited to the indirect effect it contributes by determining the distribution of power in society (Figure 1). If the richer segment of the

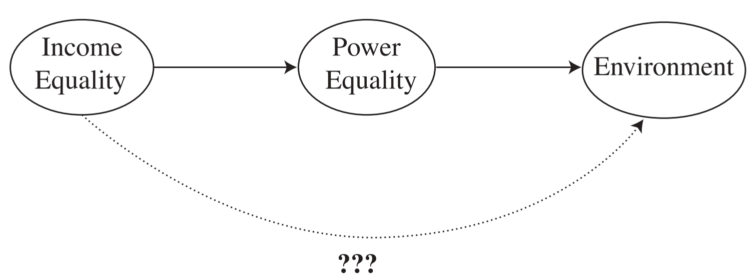

Figure 1. Inequality as a determinant of environmental quality.

population is both a net gainer from environmental degradation and has more power, the PWSDR predicts that reduced power equality will, *ceteris paribus*, lead to a lower quality natural environment.[6]

Boyce's emphasis on the role of power equality is the main motivating factor in my study. Measuring power, to say nothing of its distribution, is a difficult task because the concept itself is somewhat elusive. Power can, for example, refer to the relative economic power one possesses as a consequence of inequality in the distribution of assets. Alternatively, power can stand for the skills or capabilities that one possesses that may generate more life opportunities to enjoy.[7] As a third possibility, power can capture political influence. Individuals or groups, in other words, have greater power if they are able to make their demand (for, e.g., improvements in health infrastructure or environmental quality) effective through the political process.

This type of influence over social, environmental, and health outcomes is what Boyce has in mind in constructing the PWSDR. Yet while power undoubtedly encompasses political and civil rights and liberties as well as income distribution, equally if not more important is access to written or spoken information without which the population is far less inclined to feel empowered so as to mobilize to effect any substantive change. It is for this reason that the index developed here emphasizes information access as well, in the form of three variables to be explained in the next section: literacy rate, higher education density, and Internet density. For purposes of the analysis to follow, therefore, power stands for access—access to information and access to the political process.

A power equality index is constructed which is fashioned along the lines of Boyce *et al*. (1999), who did the same for the 50 US states. This analysis, however, differs from theirs in at least three respects. First, the data set is an international cross-section of 180 countries instead of 50 US states. Second, since the variables used to construct the equality index in the former study were 'US specific' (i.e., dealing with inter-state comparisons on issues such as tax fairness and Medicaid access), this index is based on a different array of more universal variables with, as mentioned, greater emphasis on information access. Finally, the role of income as an explanatory variable is more prominent in this study, as its influence is examined on both the environment and human health. Doing so allows a comparison of the importance of income relative to power equality.

It is hypothesized that greater equality in power distribution leads, *ceteris paribus*, to superior performance in population health. Additionally, it is expected that power equality will independently explain health better than per capita income. The latter hypothesis would mirror some of the cited conclusions (e.g., Link & Phelan, 1995; Williams, 1990) attributing health to other socioeconomic factors that merely correlate with income. Finally, while seemingly self-evident, few economists call attention to the extreme likelihood that the distribution of power correlates highly not only with income distribution but with per capita income. Simon Kuznets was among the exceptions. He states:

> One may argue that not only the welfare equivalents but also the power equivalents of the same relative income spread show a much wider range when the underlying average income is low than when it is high. (Kuznets, 1963, p. 49)

This hypothesis of Kuznets,' which has received far less attention than his earlier hypothesis of an inverted U-shaped relation between income inequality and per capita income, factors in the subsequent analysis. If the distribution of power is less equal in poorer countries, it may be misleading to consider all countries in a single group. The analysis to follow accounts for this possibility as well.

Methodology

Power Distribution

Although the distribution of power is difficult, if not impossible, to measure directly, we can obtain reasonable estimates by looking at other related variables. Six of these are considered in the present study: Gini coefficient, political rights and civil liberties, literacy rate, higher education density, Internet user density, and percentage of female representation in government. In contrast to Boyce *et al*. (1999), the Gini coefficient is represented as a component of power equality rather than as a determinant. The general observation or belief that income and power are related would support either approach, yet the author can see no reason to regard income inequality differently from other related socioeconomic variables. An inverse relationship is assumed between the Gini coefficient and power equality.

It is also assumed that poor performance in political rights or civil liberties indicates less power equality, with the opposite holding where rights and liberties are more widespread. Since power is to some degree related to information access, in turn related to education, literacy rates and higher education density are used (college degrees or equivalent per 10,000 inhabitants) as additional proxies. Both of these variables are employed because of the different connotations; literacy is a means of access to general written information but is no substitute for higher-level formal education. It is assumed that higher literacy rates and greater higher education densities reflect greater power equality.

Additionally, density of Internet access is included because a literate and educated population may still be disempowered if the technology required to access the myriad sources of information is in short supply. Again, the higher the density, the greater the equality of power distribution is assumed. Finally, higher levels of power equality are represented with a higher percentage of female representation in government, since the figure at least shows the extent to which certain positions of power are available to one-half of a given country's population.

Principal components analysis is employed to reduce existing international data for the six variables in question to a factor that serves as the key ingredient in a country's index of power equality. In addition to facilitating inter-country comparisons, derivation of such an index is sensible given the likely multicollinearity among the individual components. As we can see from the correlation matrix (Table 1), each of the constituents of power equality is significantly correlated with all others. Were we to test for the individual effect of each variable on environmental or health outcomes, low *t*-ratios would be likely, yet they may be misleading. The problem is therefore obviated by condensing the six variables into a representative index.

Environmental Quality

Per capita income and power equality are the principal regressors in this model. It is hypothesized that environmental quality conforms to the following functional form:

Table 1. Correlations among power equality co-determinants

	Gini coefficient	Political rights & civil liberties	Literacy rate	Higher education density	Internet density	Females as % of government
Gini coefficient	—					
Political rights & civil liberties	–0.229***	—				
Literacy rate	–0.362***	0.461***	—			
Higher education density	–0.406***	0.551***	0.682***	—		
Internet density	–0.424***	0.460***	0.405***	0.602***	—	
Females as % of government	–0.260***	0.345***	0.360***	0.382***	0.556***	—

***Significant at the 1% level of confidence

$$E = E(Y, \pi, Z), \tag{1}$$

where E_Y and E_π are > 0,

E represents environmental quality with a higher value signifying better quality, and the variables that will be used as measures of *E*—population access to safe water (SW) and sanitation (SNT)—are both environmental 'necessities' in the sense that they presumably influence health outcomes. Y and π stand for per capita income and power equality, and $\boldsymbol{Z}$ is a vector of other control variables.

Concerning the $\boldsymbol{Z}$ vector, three variables are included that intuition would suggest should play a role in explaining environmental outcomes: population density (PD), urbanization (URB), and manufacturing share of output (MNF). While it is expected that both PD and MNF will be negatively related to E, the case is not as clear for URB. While urbanization tends to accompany income growth (hence is potentially beneficial to the environment), urbanization *in the absence of growth* could be disastrous (Angotti, 1996; Brockerhoff & Brennan, 1998; Brown, 1989). Therefore, instead of URB, a variable is used that accounts for the interaction between income level and urbanization rate (YURB).

The equations to be estimated are as follows:

$$\text{SW} = \alpha_{12} + \beta_{12}\text{PCGDP} + \beta_{22}\text{POWER} + \delta_{12}\text{PD} + \delta_{22}\text{MNF} + \delta_{32}\text{YURB} + \mu_{12}, \tag{1a}$$

$$\text{SNT} = \alpha_{14} + \beta_{14}\text{PCGDP} + \beta_{24}\text{POWER} + \delta_{14}\text{PD} + \delta_{24}\text{MNF} + \delta_{34}\text{YURB} + \mu_{14}, \tag{1b}$$

where PCGDP and POWER obviously stand for per capita GDP and power equality. As mentioned earlier, no quadratic income term is included because, unlike the case with some other environmental variables (e.g., atmospheric emissions of particulate), all evidence supports a linear relationship between PCGDP and the dependent variables SW and SNT.

Population Health

It is immediate from the two main hypotheses that power equality and per capita GDP should be included among the explanatory variables in examining the determinants of human health. The second stage of this model also includes a role for national expenditures on health as a determinant of health outcomes, and the environmental variables from the first stage of the model.[8] The reduced form model is therefore as follows:

$$H = H(Y, \pi, E, X), \quad (2)$$

with H_Y, H_π, H_E, and $H_X > 0$.

H measures health performance, with a higher value indicating greater success, and X denotes national expenditures on health. The first two partial derivative inequalities represent the hypotheses to be tested, and there is already abundant evidence that will not be discussed here on how safe water and sanitation access are associated with human health.

As for the last partial derivative inequality ($H_X > 0$), Table 2 illustrates that health expenditures correlate well with the two measures of health achievement considered in the study: disability-adjusted life expectancy (DALE) and the rate of child mortality (CHMOR). It would therefore seem imprudent to ignore these individual effects in the model, even though the magnitude of national health expenditures is undoubtedly determined, at least in part, by per capita income and power equality. More will be discussed on this later. The equations that are estimated follow:

$$\text{DALE} = \alpha_{12} + \phi_{12}\text{EXP} + \phi_{22}\text{PCGDP} + \phi_{32}\text{POWER} + \gamma_{12}\text{SW} + \gamma_{22}\text{SNT} + \mu_{12}, \quad (2a)$$

$$\text{CHMOR} = \alpha_{14} + \phi_{14}\text{EXP} + \phi_{24}\text{PCGDP} + \phi_{34}\text{POWER} + \gamma_{14}\text{SW} + \gamma_{24}\text{SNT} + \mu_{14}, \quad (2b$$

where EXP stands for health expenditures. It is expected that all the partial derivatives will be negative when child mortality appears on the LHS, since in this case better health performance is indicated by a lower value. Finally, also for reasons noted earlier, the author tested only for the existence of a linear relationship between PCGDP and the health measures. Figure 2 summarizes the two-stage model to be tested.

Data

Statistics for per capita GDP and the Gini coefficient are taken from the World Bank (2003). Political and civil rights variables are from Freedom House (2003), which publishes separate ordinal scales for political rights and for civil liberties, each ranging from one (most free) to seven (least free). Instead of incorporating the

Table 2. Correlations among measures of health expenditures and health outcomes

	Health exp.-GDP ratio	Disability-adjusted life expectancy	Child mortality rate
Health exp.-GDP ratio	—		
Disability-adjusted life expectancy	0.510***	—	
Child mortality rate	–0.445***	–0.901***	—

***Significant at the 1% level of confidence

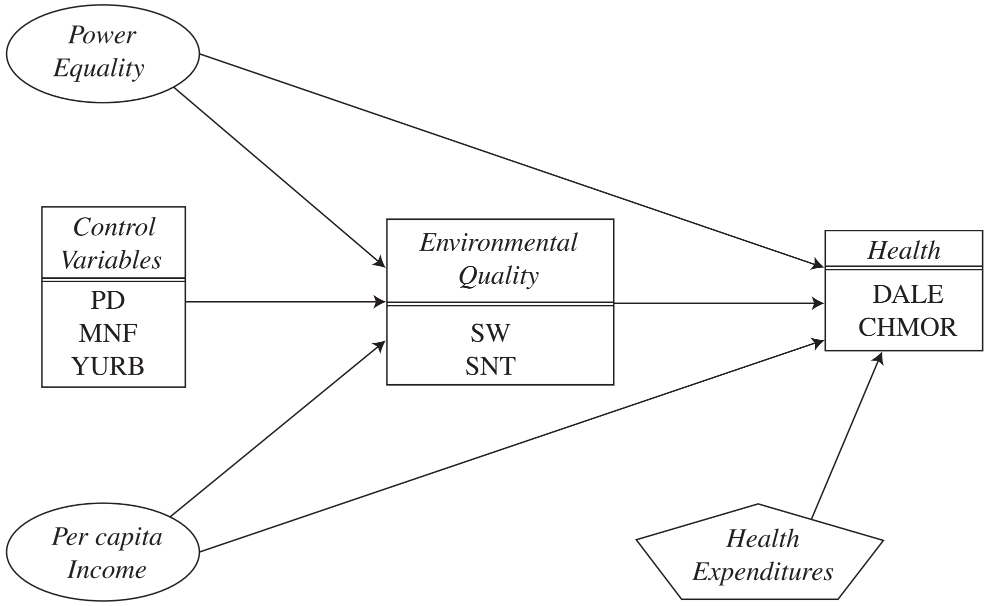

Figure 2. The model.

two indexes into the principal components analysis, fourteen minus the sum of the two measures for each country are used, making the new variable range from zero to 12. This has been done in order to have a higher number reflect greater rights and liberties rather than fewer. Literacy rates are self-explanatory and taken from the UNDP (2003). Higher education and Internet user densities are the number of inhabitants for every 10,000 in the population with a college degree and Internet access. The government in the 'percentage of government positions taken by females' variable refers to a country's Parliament or some equivalent for non-parliamentary governments. Data for these variables are from Prescott-Allen (2001).

Country statistics for power equality are reported in Table 3, along with each country's income group classification.[9] Note certain geographical patterns; the Nordic European countries occupy five of the top six places signifying greatest power equality, while the bottom 17 are, with only one exception, Saharan or sub-Saharan African nations. While on the whole there are few major surprises, some peculiarities should be noted. It is mildly surprising, for example, that South Korea should result more equal in terms of power distribution than Italy, France or Greece: eight, 12, and 20 places ahead of them, respectively. It is a greater surprise that power equality in Uzbekistan appears greater than in countries such as India and Tunisia. There is also no obvious reason for why Armenia should have such a low ranking (106th of 180 countries), just ahead of China and far lower than other countries in its geographical vicinity, such as Georgia (49th) and Azerbaijan (73rd).

It should not be surprising that rich countries tend to be clustered near the top of the power equality rankings and the poorest countries mostly at the bottom. Countries with higher incomes in general perform better on each of the individual variables, since greater national income often leads to a more developed 'information infrastructure' (improved communication, etc.), which presumably bears favorably on the distribution of power. Yet as we can see from Figure 3, the link between the two variables is far from perfect. Luxembourg (abbreviated 'lxb' in the diagram), the country with the highest per capita income in the set, performs only

Table 3. International variations in the distribution of power

Sweden (H)	10.00	Lithuania (H)	5.17	Jamaica (M)	3.73
Finland (H)	9.39	Bahamas (H)	5.09	Chile (H)	3.71
Iceland (H)	9.06	Greece (H)	5.06	Bolivia (M)	3.71
Norway (H)	8.81	Hungary (H)	5.03	Dominican Rep. (M)	3.70
Canada (H)	8.66	Poland (H)	5.00	Namibia (M)	3.69
Denmark (H)	8.27	Grenada (M)	4.97	Macedonia (M)	3.67
Australia (H)	7.83	Croatia (H)	4.94	St Vinc/Grendns (M)	3.62
United States (H)	7.49	Malta (H)	4.90	Philippines (M)	3.58
New Zealand (H)	7.22	Uruguay (H)	4.90	Azerbaijan (L)	3.54
Netherlands (H)	7.04	Costa Rica (M)	4.83	Russia (H)	3.54
Austria (H)	6.93	Barbados (H)	4.79	St Lucia (M)	3.52
Belgium (H)	6.56	Ukraine (M)	4.61	Venezuela (M)	3.51
Germany (H)	6.43	Cyprus (H)	4.44	Peru (M)	3.46
Switzerland (H)	6.34	Romania (M)	4.32	Cape Verde (M)	3.44
South Korea (H)	6.33	Belarus (M)	4.31	Cuba (M)	3.42
United Kingdom (H)	6.29	Dominica (M)	4.26	Mexico (H)	3.39
Spain (H)	6.29	Georgia (M)	4.25	Tajikistan (L)	3.36
Japan (H)	6.12	Belize (M)	4.21	Indonesia (M)	3.35
Luxembourg (H)	5.94	Seychelles (H)	4.20	Fiji (M)	3.31
Slovak Republic (H)	5.94	St Kitts and Nevis (H)	4.17	El Salvador (M)	3.31
Ireland (H)	5.91	Panama (M)	4.15	Jordan (M)	3.29
Estonia (H)	5.86	South Africa (H)	4.10	Vietnam (L)	3.28
Italy (H)	5.74	Guyana (M)	4.05	Kuwait (H)	3.25
Portugal (H)	5.72	Ecuador (M)	4.00	Thailand (M)	3.21
Slovenia (H)	5.69	Turkmenistan (M)	3.99	Mauritius (H)	3.21
Israel (H)	5.52	Kazakhstan (M)	3.94	Yugoslavia (M)	3.20
France (H)	5.46	Moldova (L)	3.87	Botswana (M)	3.19
Czech Republic (H)	5.40	Mongolia (L)	3.87	Samoa (M)	3.19
Argentina (H)	5.34	Trinidad & Tobago (H)	3.83	Qatar (H)	3.16
Latvia (M)	5.30	Bosnia (L)	3.78	Lebanon (M)	3.14
Singapore (H)	5.23	Suriname (M)	3.75	Turkey (H)	3.09
Bulgaria (M)	5.22	Antigua & Barbuda (M)	3.74	Rwanda (L)	3.07
Sri Lanka (M)	3.02	Zimbabwe (M)	2.30	Papua New Guinea (M)	1.68
Bahrain (H)	3.01	Liberia (L)	2.29	Cambodia (L)	1.65
Uzbekistan (L)	2.97	Congo, Republic (L)	2.26	Benin (L)	1.62
São Tomé/Prncp (L)	2.97	Brazil (H)	2.25	Lesotho (L)	1.60
North Korea (M)	2.91	Algeria (M)	2.23	Equatorial Guinea (L)	1.53
Kyrgyz Rep. (M)	2.90	Myanmar (L)	2.23	Nigeria (L)	1.51
Tonga (M)	2.80	Oman (H)	2.21	Eritrea (L)	1.50
Maldives (M)	2.79	Syria (M)	2.21	Congo, DR (L)	1.46
Brunei (H)	2.78	Laos (L)	2.21	Mali (L)	1.46
Armenia (L)	2.75	Honduras (M)	2.19	Bhutan (L)	1.45
China (M)	2.73	Bangladesh (L)	2.13	Yemen (L)	1.42
Albania (M)	2.72	Paraguay (M)	2.10	Togo (L)	1.40
Tanzania (L)	2.72	Gabon (M)	2.01	Sudan (L)	1.36
Colombia (M)	2.71	Nicaragua (L)	2.00	Cameroon (L)	1.36
Libya (H)	2.70	Malawi (L)	1.97	Angola (L)	1.34
UA Emirates (H)	2.65	Swaziland (M)	1.92	Mauritania (L)	1.30
Solomon Islands (L)	2.63	Guinea-Bissau (L)	1.91	Djibouti (L)	1.29
India (L)	2.58	Haiti (L)	1.90	Somalia (L)	1.22
Malaysia (H)	2.55	Iraq (M)	1.89	Guinea (L)	1.18
Mozambique (L)	2.50	Pakistan (L)	1.87	Afghanistan (L)	1.11

Table 3. *(Continued)*

Egypt (M)	2.49	Nepal (L)	1.86	Burundi (L)	1.04
Uganda (L)	2.49	Zambia (L)	1.81	Ethiopia (L)	0.98
Vanuatu (M)	2.46	Guatemala (M)	1.81	Chad (L)	0.77
Tunisia (M)	2.44	Cote D'Ivoire (L)	1.78	Ctrl African Republic (L)	0.76
Madagascar (L)	2.42	Morocco (M)	1.73	Gambia (L)	0.61
Ghana (L)	2.42	Comoros (L)	1.72	Burkina Faso (L)	0.49
Iran (M)	2.33	Kenya (L)	1.70	Sierra Leone (L)	0.38
Saudi Arabia (H)	2.31	Senegal (L)	1.68	Niger (L)	0.00

[H]High-income country
[M]Middle-income country
[L]Low-income country

modestly in power equality, and five middle eastern countries with per capita incomes greater than $10,000—Kuwait (kwt), Qatar (qtr), United Arab Emirates (uae), Bahrain (bhr), and Saudi Arabia (sda)—have relatively low power equality. In contrast, countries such as Costa Rica (crc), Estonia (est), and Slovakia (svk) enjoy high power equality relative to their per capita income levels.

The population density, urbanization, and manufacturing share of value added statistics are obtained from the UNDP (2003), World Bank (2003), and WRI (2003), as are the numbers for safe water and sanitation access. The child mortality statistics, represented as child deaths per thousand in the population, are taken from

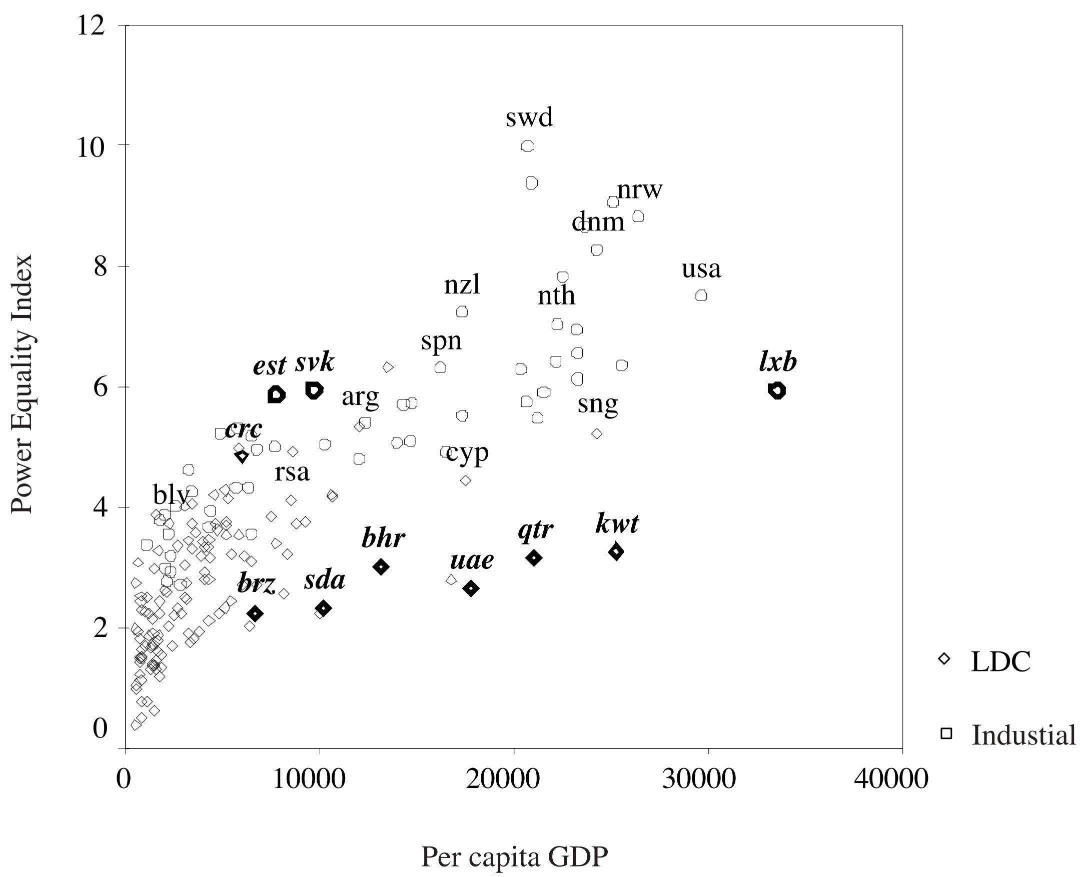

Figure 3. Power equality and per capita GDP.

Table 4. Descriptive statistics

	N	Minimum	Maximum	Mean	Standard deviation
Per capita GDP	180	458	33,505	7,022	7,491
Power equality index	180	0	10	3.4842	1.9031
Gini coefficient	112	0.195	0.629	0.3953	0.0982
Political rights and civil liberties	180	0	12	6.74	3.93
Literacy rate	178	14.7	99.8	78.36	21.623
Higher education density	157	2.60	610.6	162.838	135.028
Internet density	171	0.00	3,953	320.7854	645.1948
Females as % of government	166	0.0	42.7	11.737	8.856
Safe water, % with access	158	12	100	70.49	23.61
Sanitation, % with access	152	6	100	61.45	31.04
Population density	180	1.7	5,753	146.45	453.36
Urbanization rate	157	6	100	54.03	22.96
Manufacturing as % of GDP	129	7	70	29.75	10.62
Total health exp. As % of GDP	180	1.5	13.7	5.429	2.103
Disability-adjusted longevity	180	25.9	74.5	56.518	12.469
Child mortality rate	180	4	316	67.27	69.61

Prescott-Allen (2001). The figures for the disability-adjusted life expectancy and the ratio of health expenditures to GDP are published by the WHO (2000). Descriptive statistics for all variables are shown in Table 4.

Results

Environmental Quality

Ordinary least squares (OLS) is used to estimate all equations. The test on equation (1a) produces the result that both POWER and PCGDP are positively associated with safe water access, although the latter at only a 10% level of confidence (Table 5). MNF is also statistically significant, although its sign is contrary to what we might expect. The R^2 for the equation is 0.55. With access to sanitation (equation (1b)), in contrast, POWER is the only explanatory variable that is statistically significant, and at a confidence level of 1%. Recalling Kuznets' observation, however, it is important to compare the regression results on country sub-groups. As also seen in Table 5, equations (1a) and (1b) are tested on three equal size groups based on per capita GDP—labeled high income, middle income, and low income—and use the Chow test to determine whether any cross-group variation is statistically significant.

Not surprisingly, there is significant variability in the results when we compare across income sub-groups. The Chow test results corroborate the observed inter-country variability for both equations, as in each case the *F*-statistic leads us to reject the null hypothesis that there is no significant difference between the sub-groups. For low-income countries, neither POWER nor PCGDP seem to influence safe water access to a significant extent, while PD and YURB do (the sign for PD is somewhat counter-intuitive, however). The R^2 coefficient, at 0.32 is noticeably lower than for the entire country set. In the case of sanitation access R^2 is only 0.22, but here the coefficients for both POWER and PCGDP are statistically significant

Table 5. Determinants of environmental quality (*t*-ratios are in parentheses)

	All countries		Low income		Middle income		High income	
	Safe water	Sanitation	Safe water	Sanitation	Safe water	Sanitation	Safe water	Sanitation
Intercept	36.585***	27.437***	31.615***	33.148***	43.46***	35.10	53.092***	45.284***
Per capita GDP	1.899E-3* (1.73)	2.363E-3 (1.56)	−3.511E-4 (−0.05)	−2.336E-2** (−2.24)	1.57E-3(0.40)	4.625E-3 (0.82)	1.427E-3* (1.92)	2.64E-3** (2.62)
Power equality	3.532** (2.47)	5.960*** (3.06)	0.791 (0.30)	10.784*** (2.95)	0.626 (0.20)	5.643 (1.21)	0.670 (0.55)	3.193E-2 (0.02)
Population density	1.694E-3 (0.55)	1.736E-3 (0.41)	5.539E-2***(3.51)	8.205E-3 (0.39)	2.275E-2 (0.74)	5.228E-2 (1.17)	−3.124E-4(−0.17)	8.042E-4 (0.33)
Manufacturing value added as % of GDP	0.322** (2.18)	1.481E-3 (0.01)	−7.231E-2 (−0.41)	−0.313 (−1.36)	0.236 (0.78)	−0.566 (−1.28)	0.347 (1.47)	0.453 (1.38)
Product of urbanization rate and GDP per capita	−6.407E-6 (−0.54)	−9.717E-6 (−0.60)	2.552E-4* (1.97)	3.129E-4* (1.87)	4.948E-5 (1.20)	2.831E-5 (0.47)	−8.970E-7(−0.13)	−1.151E-5(−1.19)
Adjusted R^2	0.55	0.51	0.32	0.22	0.11	0.13	0.53	0.44
Chow Test *F*-statistic	10.74***	10.24***	—	—	—	—	—	—
N	117	117	45	45	37	37	35	35

***Significant at the 1% level of confidence
**Significant at the 5% level of confidence
*Significant at the 10% level of confidence

(at the 1% and 5% levels), while the coefficient for PD is no longer significant. Note, however, that the sign for the PCGDP coefficient implies that sanitation access declines as a poor country becomes more prosperous, contrary to what we should expect. There is no clear explanation for the outcome. It is also not evident why the results for sanitation access differ so notably from those for safe water.

The contrast between the low and middle-income country groups is striking. The R^2coefficients, for example, are noticeably lower for the middle-income countries. No doubt as a consequence, none of the regression coefficients are statistically significant for either SW or SNT. One possible explanation for the disparity is that the middle-income group is likely the most diverse of the three. The high-income group is dominated by OECD countries and the low-income group by countries from either Africa or South Asia. The middle-income group, in contrast, contains a fair mix of countries from Latin America, Europe, Asia, the Middle East, as well as a few from Africa. One may surmise that regional differences not accounted for in my model may have contributed some 'offsetting effects' rendering some coefficients insignificant.

Indeed, the high-income country group reveals a much better fit, better even than that of the low-income group according to the R^2 coefficients in both instances. Yet surprisingly, despite this, PCGDP is the only explanatory variable that is statistically significant, both in the case of SW and SNT (at 10% and 5% levels of confidence). Therefore, considering the group in aggregate leads to the possibly misleading conclusion that power equality explains our chosen environmental variables better than income. Regressions on the individual groups reveal significant differences, with both POWER and PCGDP significant determinants in low-income countries (though only for sanitation access), neither a factor in middle-income countries, and only PCGDP statistically significant in the case of high-income countries.

Population Health

Results from tests of equations (2a) and (2b) look somewhat similar to those from equations (1a) and (1b), in the sense that POWER appears to explain the dependent variables—here DALE and CHMOR—better than PCGDP (Table 6). The coefficient for POWER is in both cases statistically significant at the 1% level of confidence, while that for PCGDP is only significant for CHMOR (at the 10% level) and, more important, the sign is contrary to expectations. It is not clear whether differences among the country sub-groups are enough to explain the anomaly, since the author can imagine no general case where income gains might detract from reductions in childhood mortality.

The R^2 coefficients are higher than for equation (1)—here 0.68 and 0.64. Safe water and sanitation access also appear to be significant determinants in each case. Finally, despite the seemingly axiomatic correlation that we saw earlier between health expenditures and health outcomes, controlling for power equality and income appears to mute the effect of health expenditures. The likely explanation, as suggested earlier, is that health expenditures themselves vary in large part by income or power distribution.

As with the earlier set of regressions, running these on the country sub-groups reveals notable variability between the groups, and, as before, the Chow test verifies that the variability is meaningful. Looking first at the low-income countries, we find that both POWER and PCGDP are statistically significant. While R^2 remains reasonably high for both DALE and CHMOR, the coefficients for both SW and SNT

Table 6. Determinants of population health (*t*-ratios are in parentheses)

	All countries		Low income		Middle income		High income	
	DALE	Child mortality	DALE	Child mortality	DALE	Child mortality	DALE	Child mortality
Intercept	27.93***	228.203***	19.539***	298.47***	40.684***	122.228***	42.171***	86.22***
Health expenditure-GDP ratio	4.926E-2	1.724	0.564	–0.504	8.685E-2	0.794	0.893**	–0.919
	(0.13)	(0.77)	(1.01)	(–0.10)	(0.13)	(0.40)	(2.13)	(–0.89)
Per capita GDP	–3.663E-5	1.536E-3*	9.344E-3***	–4.399E-2**	–7.961E-4	–5.683E-3	1.909E-4	–2.331E-4
	(–0.24)	(1.67)	(4.68)	(–2.54)	(–0.68)	(–1.66)	(1.22)	(–0.60)
Power equality	2.677***	–15.464***	4.295***	–35.647***	2.704*	–9.35**	0.388	–1.322
	(4.51)	(–4.38)	(4.10)	(–3.93)	(1.87)	(–2.22)	(0.73)	(–1.01)
Safe water access	0.216***	–1.297***	4.96E-2	–0.487	0.135	–0.269	–4.098E-2	–7.723E-2
	(5.07)	(–5.11)	(0.98)	(–1.10)	(1.42)	(–0.98)	(–0.51)	(–0.39)
Sanitation access	5.548E-2*	–0.516***	–2.145E-2	–0.190	2.876E-2	–0.118	0.192***	–0.525***
	(1.68)	(–2.63)	(–0.52)	(–0.54)	(0.44)	(–0.63)	(2.89)	(–3.20)
Adjusted R^2	0.68	0.64	0.62	0.49	0.11	0.25	0.50	0.50
Chow Test F-statistic	12.56***	23.39***	—	—	—	—	—	—
N	149	149	54	54	49	49	46	46

***Significant at the 1% level of confidence
**Significant at the 5% level of confidence
*Significant at the 10% level of confidence

are no longer significant. The result may be explained by PCGDP being more highly correlated with SW and SNT at the low end of the income scale (since at the higher end many countries approach 100% access anyway). Therefore, the effect of income in the low-income group may dominate that of safe water and sanitation access. Still, this is pure conjecture that if anything calls for further study.

Again, according to the R^2 coefficients (0.11 for DALE and 0.25 for CHMOR), the middle-income group appears to offer the worst fit to the model. The only coefficient that is statistically significant here—for both DALE and CHMOR—is the one for POWER; PCGDP does not appear to be a significant determinant. Finally, in the case of the high-income group, neither POWER nor PCGDP play a role in explaining population health, even though the R^2 coefficients for both the DALE and CHMOR estimates are reasonably high (0.50 in both cases). For DALE only EXP and SNT have statistically significant coefficients, while for CHMOR only SNT does.

To sum up, even though power equality does in several cases appear to explain health outcomes, the one obvious conclusion that emerges from the analysis is that the determinants of population health in a given country may in large part depend on the income class in which the country finds itself.

Discussion and Concluding Remarks

When we examine all countries in a single group, power equality comes out positively related to health performance and explains the latter better than does per capita income—results consistent with my earlier hypotheses. When the countries are segregated according to per capita income, however, the results are mixed. Both power equality and per capita income have statistically significant coefficients when low-income countries are considered alone, while only power equality appears to be a factor in explaining population health in middle-income countries. In the case of high-income countries, neither is a factor; only expenditures on health services relative to GDP and sanitation access have statistically significant coefficients. In sum, support for this hypotheses varies depending on the income group considered, with the greatest support for the first hypothesis found within the low-income sub-group, and support for the second hypothesis indicated in the case of the middle-income group.

These findings should nevertheless cast further doubt on earlier income-based explanations of human health, since the author has found per capita GDP to be statistically insignificant for middle- and high-income countries as well as the entire country set. Even in the case of low-income countries, where per capita GDP is significant, the coefficients for power equality are as well. One likely reason for such results is that this analysis, unlike that in many related studies, emphasizes health-related environmental outcomes and the health outcomes themselves. As these results confirm, there is no compelling reason *a priori* to assume that rich countries are more concerned than poor ones about the health of their populations.

Few, of course, would dispute that per capita income correlates well with improved health. The point driven home by the results is that there is nothing *automatic* about the association; income also correlates well with many socioeconomic and political variables and higher incomes need not cause health improvements. Such improvements may just as plausibly be determined by the distribution of power—itself a product, at least in part, of information access—which is itself correlated with income. More research, however, is needed before the matter can be concluded.

Another promising area for future research is the question of the usefulness of power equality in explaining other phenomena. What effect, for example, would it have in determining economic outcomes (e.g., wages, profitability) or social or political ones (e.g., average hours worked per week, type of government or regime)? Or, equally likely, political equality may be explained *by* one or more of these variables. Another of the chief contributions of this study is the articulation of a quantitative means by which to explore some of these questions.

While recognizing that wealth and power are linked, the conception of power that is employed in this paper also relates to how informed and politically free citizens are—hence the nature of the opportunities of which they can make themselves available to. The present study goes beyond Torras & Boyce (1998) in that it includes a few variables related to information access as possible factors in defining power equality. Presumably if, through a gradual process of democratization, free information and political rights become available to more people over time, we can expect an equalization in the distribution of power. We might say the same if women in general became more empowered or also if the income spread equalized somewhat. Of course such changes require political will from certain segments of society, and whether it is likely to be forthcoming is a subject for another paper.

Finally, the focus on population health should help blunt some of the controversy over environmental policy. While there will likely remain great disagreement over the importance of environmental quality relative to other human needs, few would contend that health issues do not deserve utmost priority in policy decisions. Policy should therefore either be geared more toward addressing human health directly—by, for example, improving sanitation facilities—or indirectly—by empowering the population through literacy campaigns, education subsidies, and the like. The essential point is that GDP growth does not automatically improve health (the jury is still out on whether it detracts from it), and a more multi-faceted economic policy is more likely to deliver health improvements. If the results of this study to not produce greater misgivings over the supposed link between per capita income and health, at the very least they call out for further investigation into power equality as well as other possible non-income determinants.

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Notes

1. Torras & Boyce also include literacy and a political rights and civil liberties index on the RHS—since their main focus, unlike Magnani's is *power* equality—finding that these variables have even more explanatory power than the Gini index of inequality.
2. I intentionally avoid the term 'environmental luxuries,' which is sometimes employed in arguing why the rich care more about the environment than the poor. If anything, the relevant distinction to be made is between environmental *inferior goods*—the presence of which is implied by the upward-sloping portion of any observed EKC—and normal goods. Environmental 'amenities' may be luxury goods in some cases, but can just as often be inferior goods if other arguments in one's utility function dominate said amenity in such a way that an income increase may generate diminished demand for it. But environmental 'necessities' are almost by definition normal goods if we

assume that population health is a top priority for any individual or country independent of income level.

3. Most if not all of the environmental variables directly associated with human health—e.g., population access to safe water and sanitation—themselves do not exhibit an inverted-U function with income. Rather, they improve monotonically with income. It is reasonable to expect a similar relationship between income and health although, as already noted, a *causal* link is not axiomatic.
4. Eyer has referred to this movement as the 'Thomas effect,' after Dorothy Thomas (1925), who was among the first to document the tendency for mortality to increase during relative economic prosperity.
5. The role of power in Boyce's theory is similar to the role that Becker (1983) accords to 'influence' in determining fiscal policy.
6. I do not mean to imply that the wealthy do not care about the environment, or even that they care less about it than the poor. The contrary belief is fairly widespread—since the environment is often believed to be a luxury good, the rich are often regarded as being more conservationist than the poor, and the observation is often used to justify the environmental Kuznets curve hypothesis or the general belief that a reliable remedy for environmental problems is increasing the average income level of a population. Yet as noted by Torras & Boyce (1998) and Boyce *et al*. (1999), the view is simplistic for at least two reasons. First, the environment is not a pure public good in the sense that the rich have greater mobility than the poor and are more easily able to locate away from areas of greater pollution concentration. Second, even though the rich may care more about the environment in an absolute sense, other arguments in their utility functions may dampen the *relative* importance that they place on the environment.
7. Amartya Sen is the most well-known exponent of the 'capabilities'-based approach to assessing well-being or poverty (absence of capabilities). See, e.g., Sen (1997, 2001).
8. One might, at first glance, suspect an endogeneity problem here; intuitively we would expect nations with worse public health outcomes to invest more in public health infrastructure (i.e., improvements in safe water and sanitation access). Yet it is seldom the case in reality. Since, as my paper argues, poor health outcomes stem in large part from power inequality, there is little reason to expect that significant government funds would be diverted toward public health in a climate of such inequality. It is emphatically the case with many LDCs which are teeming with inequality and corruption. In rich countries, health problems tend to be related to 'industrial disease'—i.e., exposure to carcinogens, high stress levels and overwork, etc.—and therefore do not imply the need for increasing access to safe water and sanitation (not the least because most rich countries already enjoy almost universal access to these services).
9. As can be seen, the distribution of scores is far from uniform, and the mean score falls short of three and one-half. The reader may consult the Appendix for an explanation of how the output from the principal components analysis is converted to fit a zero to 10 range.

References

Angotti, T. (1996) Latin American urbanization and planning: inequality and unsustainability in north and south, *Latin American Perspectives,* 23, pp. 12–34.

Becker, G. (1983) A theory of competition among pressure groups for political influence, *Quarterly Journal of Economics,* 98, pp. 371–400.

Boyce, J. (1994) Inequality as a cause of environmental degradation, *Ecological Economics,* 11, pp. 169–178.

Boyce, J. *et al*. (1999) Power distribution, the environment, and public health: a state-level analysis, *Ecological Economics,* 29, pp. 127–140.

Brockerhoff, M. and Brennan, E. (1998) The poverty of cities in developing regions, *Population and Development Review,* 24, pp. 75–114.

Brown, J. (1989) Public reform for private gain? The case of investments in sanitary infrastructure: Germany, 1880–1887, *Urban Studies,* 26, pp. 2–12.

Carey, J. and Judge, D. (2001) Life span extension in humans is self-reinforcing: a general theory of longevity, *Population and Development Review,* 27, pp. 411–436.

Easterlin, R. (1995) Industrial revolution and mortality revolution: two of a kind?, *Journal of Evolutionary Economics,* 5, pp. 393–408.

Easterlin, R. (1999) How beneficent is the market? A look at the modern history of mortality, *European Review of Economic History,* 3, pp. 257–294.

Ekins, P. (1997) The Kuznets curve for the environment and economic growth: examining the evidence, *Environment and Planning A,* 29, pp. 805–830.

Eyer, J. (1977) Prosperity as a cause of death, *International Journal of Health Services,* 7, pp. 125–150.

Eyer, J. (1984) Capitalism, health, and illness, in: J.B. McKinlay (Ed.) *Issues in the Political Economy of Health Care* (New York: Tavistock).

Freedom House (2003) *Freedom in the World: Political Rights and Civil Liberties* (New York: Freedom House).

Granados, J.A.T. (2002) Mortality and economic fluctuations, PhD Thesis, New School University.

Grossman, G.M. and Krueger, A.B. (1995) Economic growth and the environment, *Quarterly Journal of Economics,* 110, pp. 353–377.

Higgs, R. (1979) Cycles and trends of mortality in 18 large American cities, 1871–1900, *Explorations in Economic History,* 16, pp. 381–408.

Homer-Dixon, T. (1995) The ingenuity gap: can poor countries adapt to resource scarcity? *Population and Development Review,* 21, pp. 587–612.

Khan, H.A. (1997) Ecology, inequality, and poverty: the case of bangladesh, *Asian Development Review,* 15, pp. 164–179.

Kuznets, S. (1963) Quantitative aspects of the economic growth of nations, *Economic Development and Cultural Change,* 11, pp. 1–80.

Landale, N. *et al.* (1999) Does americanization have adverse effects on health? Stress, health habits, and infant health outcomes among Puerto Ricans, *Social Forces,* 78, pp. 613–641.

Link, B. and J. Phelan (1995) Social conditions as fundamental causes of disease, *Journal of Health and Social Behavior,* 1995(Extra Issue), pp. 80–94.

Londregan, J. and K. Poole (1996) Does high income promote democracy?, *World Politics,* 49, pp. 1–30.

Magnani, E. (2000) The environmental kuznets curve, environmental protection policy and income distribution, *Ecological Economics,* 32, pp. 431–443.

Marmot, M. (2001) Income inequality, social environment, and inequalities in health, *Journal of Policy Analysis and Management,* 20, pp. 156–159.

Martinez-Alier, J. (1993) Distributional obstacles to international environmental policy: the failures at rio and prospects after rio, *Environmental Values,* 2, pp. 97–124.

Martinez-Alier, J. (1995) Distributional issues in ecological economics, *Review of Social Economy,* 53, pp. 511–528.

Neumayer, E. (2002) Do democracies exhibit stronger international environmental commitment? A cross-country analysis, *Journal of Peace Research,* 39, pp. 139–164.

Nganda, B. (1996) The role of markets in the worsening epidemiological environment, *Environment and Development Economics,* 1, pp. 371–375.

Prescott-Allen, R. (2001) *The Wellbeing of Nations: A Country-by-Country Index of Quality of Life and the Environment* (Washington, Covelo & London: Island Press).

Pritchett, L. and L. Summers (1996) Wealthier is healthier, *Journal of Human Resources* 31, pp. 841–868.

Rivera, B. and L. Currais (1999) Economic growth and health: direct impact or reverse causation?, *Applied Economics Letters,* 6, pp. 761–764.

Ruhm, C.J. (2000) Are recessions good for your health?, *Quarterly Journal of Economics* 115, pp. 617–650.

Selden, T. and Song, D. (1994) Environmental quality and development: is there a kuznets curve for air pollution emissions?, *Journal of Environmental Economics and Management,* 27, pp. 147–162.

Sen., A. (1997) Editorial: human capital and human capability, *World Development,* 25, pp. 1959–1961.

Sen, A. (2001) Economic development and capability expansion in historical perspective, *Pacific Economic Review,* 6, pp. 179–191.

Shafik, N. (1994) Economic development and environmental quality: an econometric analysis, *Oxford Economic Papers,* 46, pp. 757–773.

Shiffman, J. (2000) Can poor countries surmount high maternal mortality?, *Studies in Family Planning,* 31, pp. 274–289.

Thomas, D. (1925) *Social Aspects of the Business Cycle* (London, Routledge).

Torras, M. (2001) Welfare accounting and the environment: reassessing brazilian economic growth, 1965–1993, *Development and Change,* 32, pp. 205–229.

Torras, M. and J.K. Boyce (1998) Income, inequality, and pollution: A reassessment of the environmental kuznets curve, *Ecological Economics,* 25, pp. 147–160.

UNDP (2003) *Human Development Report* (New York and Oxford: Oxford University Press).

Williams, D. (1990) Socioeconomic differentials in health: a review and redirection, *Social Psychology Quarterly,* 53, pp. 81–99.

World Bank (2003) *World Development Indicators* CD-Rom (Washington, DC: World Bank).

WHO (2000) *World Health Report* (Geneva: World Health Organization).

WRI (2003) *World Resources 2002–03* (Washington, DC: World Resources Institute).

Appendix: Calculation of Power Equality Index

(1) As earlier noted, the author extracted from a data set of 180 countries the principal component associated with the six variables: (a) Gini coefficient, (b) political rights and civil liberties, (c) literacy rate, (d) higher education density, (e) Internet user density, and (f) percent female representation in government.

(2) The author possesses 180 observations for none of the above variables (see Table 4). For the missing values the author estimates numbers by regressing the actual observations in each case on variables that are likely determinants. The equation the author uses is:

$$PE_i = \alpha_i + \zeta_{1i}PCGDP + \zeta_{2i}HDI + \zeta_{3i}RD + \in_i, \qquad i = 1...6$$

where PE is the power equality variable in question, HDI is the human development index (UNDP, 2003), and RD a regional dummy. The author follows the procedure in the interest of calculating a power equality index for all countries in the data set; in no other cases does the author extrapolate missing values for other variables. As is clear from the study results, the sample size does not approach 180 for any of the regressions owing precisely to missing observations.

(3) The principal components analysis generates an array of factors with a mean of zero and standard deviation one. To facilitate interpretation somewhat, I transformed all the factors so that they would correspond to a zero-to-10 scale (10 indicating greatest equality). The transformation formula was as follows:

$$I_i = (F_i - F_{min}) \times [10 / (F_{max} - F_{min})],$$

where F is the country i's factor, and I is its power equality index. F_{min} is the factor with the lowest value of the 180 (Niger's, –1.83081), and F_{max} is the highest value factor (Sweden's, 3.42378).