Hypotheses:

1. There is a separate and non-linear effect of absolute income level on individual health status.

Distinct non-linear relations in regression of health status on both income and wealth as been found in several studies. If this is a causal relation, it may be profitable for the general health status in the society to redistribute income from rich to poor. Also an effect of general economic growth.

2. There is a separate effect of income inequality.

There is a separate effect of income inequality, in addition to the non-linear effect of the level of income, on health. Additional effect of income redistributions.

$$h_{is} - \overline{h} = \alpha + \beta \left(y_{is} - \overline{y} \right) - \gamma \left(y_{is} - \overline{y} \right)^2 - \theta \upsilon_s,$$

where i is sub-index for individual s is for country, h is heath, y is income, υ_s is income inequality measured by country income variance.

Averaging over all individuals in a country

$$h_s - \overline{h} = \alpha + \beta \left(y_s - \overline{y} \right) - \gamma \left(y_s - \overline{y} \right)^2 - \left(\gamma + \theta \right) \upsilon_s.$$

Allows for diminishing effect of country mean income level.

Both γ and θ are identified. Possible to test for separate effect from income inequality.

Limitations:

- The derivative with respect to mean income is $\beta - 2\gamma \left(y_s - \overline{y} \right)$. Since γ is positive, this implies that mean income becomes less important as income increases and income inequality, even if the direct effect (θ) is zero, becomes more important.
- Restrictive functional form and implies that health, at a certain level, will decrease with income level.

Binary specification

$$h_{is} = a + b \ln y_{is} + d\omega_s + \epsilon_{is},$$

ω_s is the variance of log incomes. If the individual ends up below a threshold level he/she dies.

Probability of dying:

$$p_{is} = p\left(death \mid y_{is}, \omega_s\right) = \Phi\left(\frac{c - a - b \ln y_{is} - d\omega_s}{\sigma}\right)$$

Extending with $b\mu_s$, we get

$$h_{is} = a + b\mu_s + d\omega_s + b\left(\ln y_{is} - \mu_s\right) + \epsilon_{is},$$

For an aggregate economy:

$$p_s = p\left(death \mid \mu_s, \omega_s\right) = \Phi\left(\frac{c - a - b\mu_s - d\omega_s}{\sigma\sqrt{1 + b^2\omega_s/\sigma^2}}\right).$$

The separate effect of income inequality is identified from aggregate data. Setting $d = 0$ it can be seen from differentiating with respect to income inequality and mean income that there is a diminishing effect of both these variables on mortality in absence of a direct effect of income inequality.

Empirical results

Cross-country Analysis

Severe measurement problems. Refers to Atkinson and Brandolini (2001) who compares Deininger and Squire (1996) with LIS data. Sweden is for example ranked as very unequal in DS but most equal in LIS.

Wilkinson (1992, 1994, 1996) bold, but apparently not very careful studies. Shows a cross country relation between income inequality an life expectancy.

Judge, Mulligan and Benzeval (1997) most convincing study according to Deaton. Negative but insignificant effect of the Gini coefficient on life expectancy. Infant mortality: harmful effect of poverty (10/90 percentile ratios).

Deaton also refers to studies on the relation between income inequality and other outcome variables such as criminality.

Within-Country Area Studies of Income Inequality and Health

Wolfson et al. (1999) finds a strong relation between income inequality and mortality across US states that cannot be made up by a non-linear relation to income.

Mellor and Milyo (2001) replicates the previous relation between income inequality and mortality. Shows that inclusion of controls for education level, urbanization and race eliminates the relation. Also shown in various studies by Deaton himself. Next question: what makes up the relation between race and mortality in the US. No unambiguous answer on that.

Gertham and Johannesson (2003):

Uses Swedish data from the ULF surveys. Rotating panel. Interviews the same people every eight year. The pool all surveys together and obtains 43,898 individuals. Tax register data on incomes matched on.

Cox proportional hazard model on survival. Dependent variable: number of years from survey to death. Right hand censoring of people who are alive in December 31, 1996.

Independent variables: Measure of individual disposable income, income difference to the mean income in the municipality, a measure of the difference between the individual's income and average income in the municipality, a measure of the Gini coefficient in the municipality calculated in the sample (varies between 0.12 and 0.51), measure of individual initial health status obtained from the survey interviews (controls for feedback effect).

Tests the absolute income hypothesis (including non-linear effect in income), relative income hypothesis and a separate effect of income inequality.

Results: Support for the absolute income hypothesis (including non-linearity in incomes); not for the relative income hypothesis, nor a separate effect of income inequality.

Effects on health during childhood - observed correlation through intergenerational income correlation.

Differences in health status comes from differences in treatment during very early childhood. Correlation in income over generations. No direct effect (in the current generation) of income redistributions.

Case, Lubotsky and Paxton (2002) "Economic Status and Health in Childhood: The Origins of the Gradient" American Economic Review, 92, 1308-1334.

The probability that a child is in poor health:

$$P(H \mid X) = P(H \mid C = 0, X)\, P(C = 0 \mid X) + P(H \mid C = 1, X)\, P(C = 1 \mid X)$$

C - 1 if the child suffers from chronic conditions, 0 otherwise.
H - 1 if the child suffers from bad health, 0 otherwise.

Decomposition:

$$\begin{aligned}\frac{\partial P(H)}{\partial \ln y} &= \frac{\partial P(H \mid C=0)}{\partial \ln y} + \\ &\left[\frac{\partial P(H \mid C=1)}{\partial \ln y} - \frac{\partial P(H \mid C=0)}{\partial \ln y}\right] P(C=1) + \\ &\left[P(H \mid C=1) - P(H \mid C=0)\right] \frac{\partial P(C=1)}{\partial \ln y}\end{aligned}$$

Three components:

1. The marginal effect of income on bad health given that the child does not suffer from a chronic condition.
2. The additional impact of income if the child suffers from a chronic condition. "Severity effect".
3. The effect of income on poor health that works through the greater probability that poorer children obtain a chronic condition. "Prevalence effect".

Two different LPM models:

$$\begin{aligned}C &= \alpha_0 + \alpha_1 \ln y + X\delta^C + \varepsilon^C \\ H &= \beta_0 + \beta_1 \left(\ln y - \overline{\ln y}\right) + \beta_2 C + \beta_3 \left(\ln y - \overline{\ln y}\right) C + X\delta^H + \varepsilon^H\end{aligned}$$

Key parameters:
$\alpha_1 = \frac{\partial P(C=1)}{\partial \ln y}$.
$\beta_3 = \left[\frac{\partial P(H|C=1)}{\partial \ln y} - \frac{\partial P(H|C=0)}{\partial \ln y}\right]$
$\alpha_1\beta_2$ = Prevalence effect.
β_2- shows which chronic condition that have the most severe impact.

Results:
α_1 only positive for hay fever and sinusitis (brat diseases!).
β_3 negative throughout. Larger for older children.

Decomposition: The effect on health goes primarily through the severity effect.

Section 5: Understanding the gradient.

1. Health at birth: In general a significant relation between income and health at birth. However, adding controls for health at birth does not alter the original relation.

2. Parental health as a determinant of children's health: Separate analysis. 1. Large effect of parental health on child health. 2. Mother's health most important. 3. Does not account for the entire effect of the previous analysis although the gradients become smaller.

3. Genetic ties: Interactions with indicators on adopted children. No effect of interactions could not be rejected.

4. Health and health insurance: Investment in children's health can go through health care and access to health insurance. Not supported in the empirical analysis since interactions with access to health insurance insignificant.

5. Children's health and maternal labor supply: Parents of children with chronic conditions may work and earn less, which may make up for the observed relation. However, not supported in the empirical analysis.

6. Parent and child health-related behavior: Indicators for different behavioral differences (e.g. does the child have a regular bedtime). Some indicators are significant. Make up for some of the income relation.