Mirror, mirror, on the wall, who in this land is fairest of all? Revisiting the extended concentration index

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WORK IN PROGRESS!!

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Motivation

- How to measure health disparities/inequalities?

- Common practice:
  - borrow indices from income inequality literature
  - Adapt indices to the bivariate setting

  →The concentration index and its extended version

  →often used to evaluate distributional consequences of policies

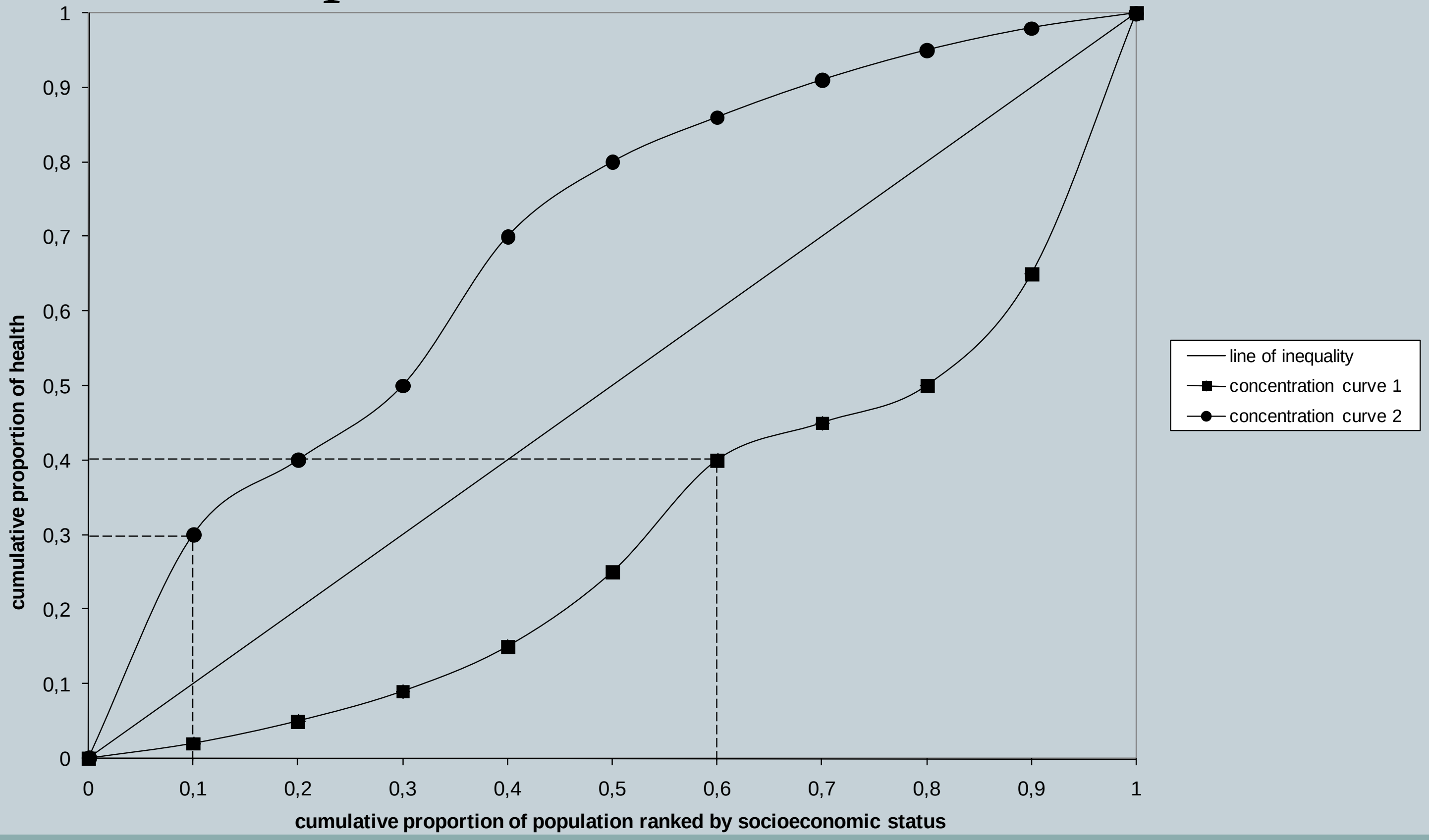
- But is this sufficient?
  - Health is really different → bounded → mirror condition
  - What is the meaning of inequality aversion in a bivariate setting?

Outline

- Motivation
- **Revisiting the concentration index**
- Revisiting the extended concentration index
- Revisiting the mirror property
- The generalized extended concentration index
- A symmetry condition
- The symmetric index
- Small-sample bias
- Empirical illustration

The concentration index revisited (I)

– Measuring association between health (*h*) and income rank (*p*Î *[0,1]*)



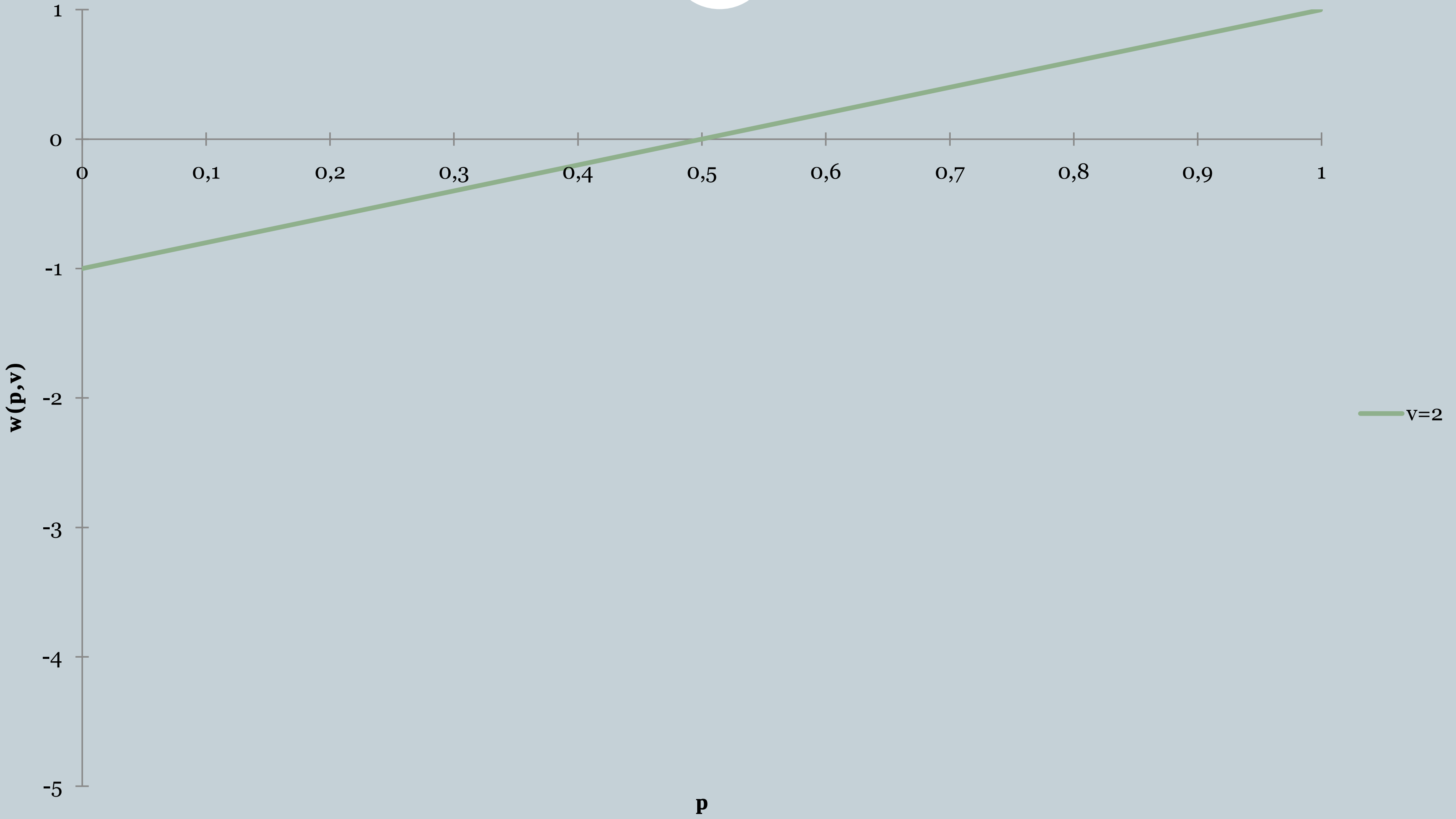
The concentration index revisited (II)

- a weighted average of health shares!

$$C(h,p) = \underbrace{\frac{1}{\bar{h}}}_{\text{normalisation function}} \int_0^1 \underbrace{(2p-1)}_{\text{weighting function}} \underbrace{h(p)}_{\text{health levels}} dp$$

- The weighting function increases linearly from *1* to -*1* and equals zero for $p=0.5$
- The concentration index lies between -*1* and *1*

The concentration index revisited (III)



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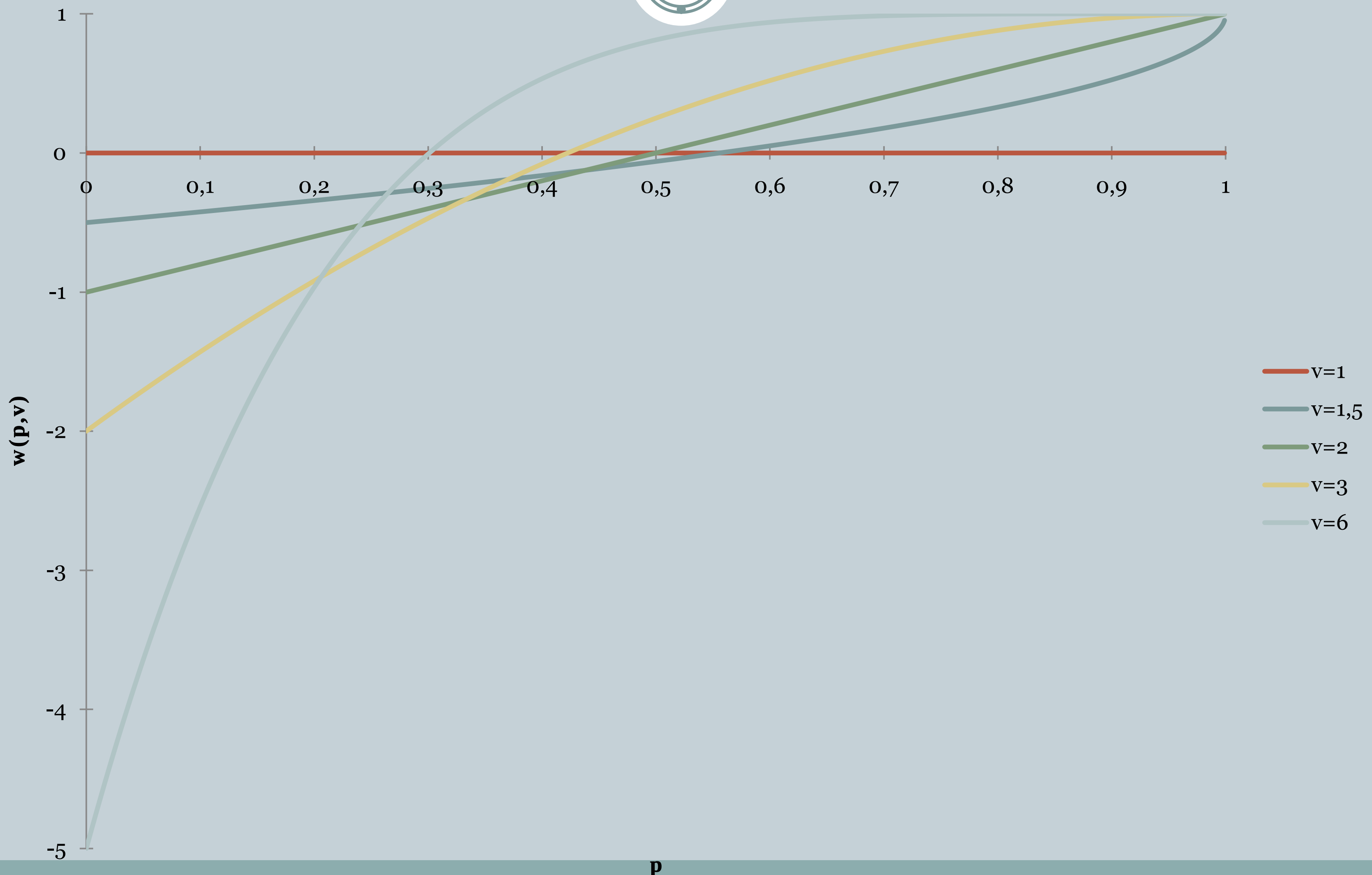
The extended concentration index revisited (I)

- Goal: augment the concentration index with a distributional parameter *v > 1* reflecting aversion to inequality (e.g. put less/more emphasis on poorest)

$$C(h,p,v)=\frac{1}{\bar{h}}\int_0^1 \underbrace{\left[1-v(1-p)^{v-1}\right]}_{\substack{\text{weighting}\\ \text{function}}} h(p)\,dp$$

- If *v=2*, we get the standard concentration index; higher values of *v* give more negative weight to the poor
- Asymmetric bounds: [*1-v, 1*]

Revisiting the extended concentration index (II)



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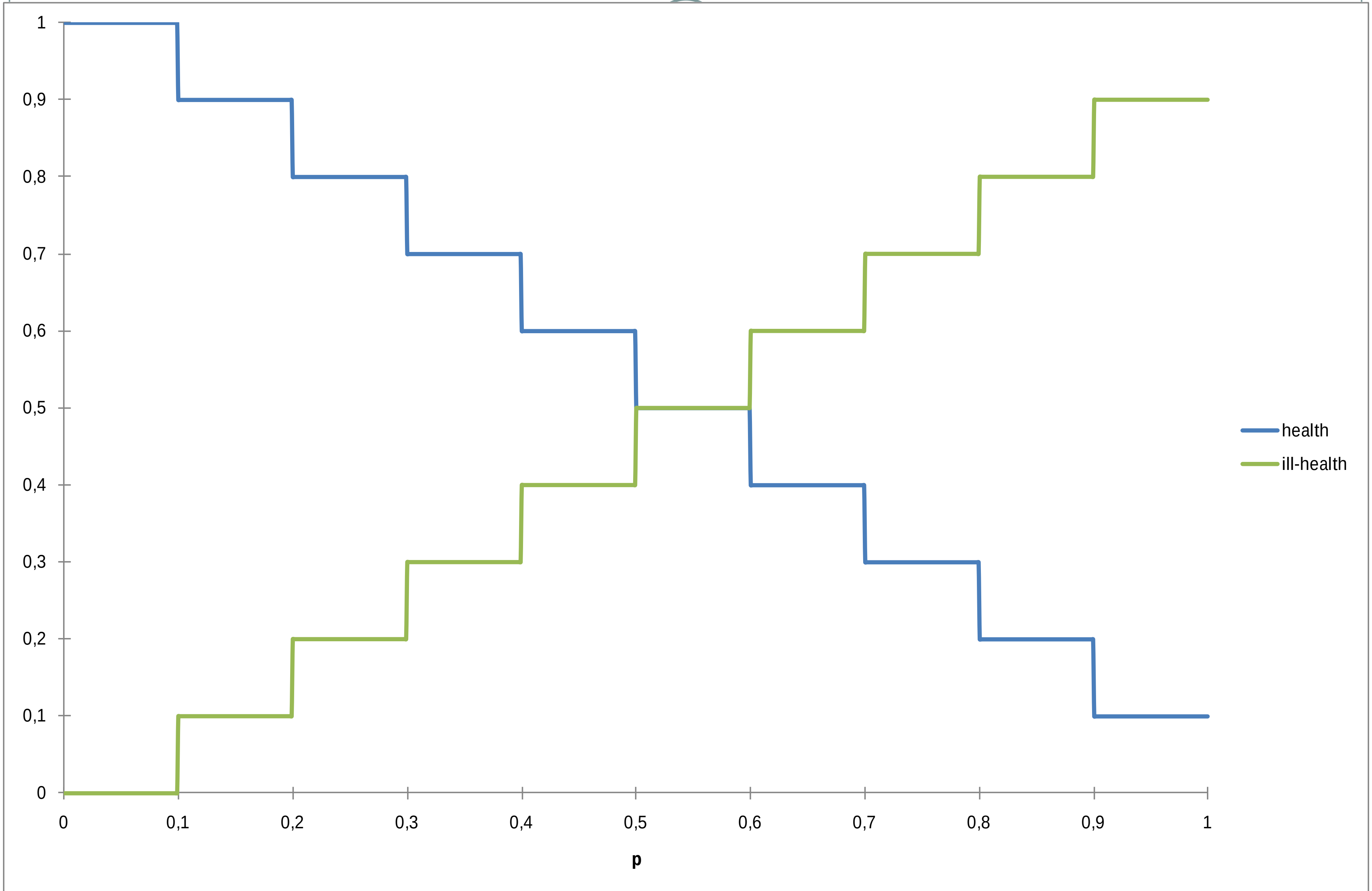
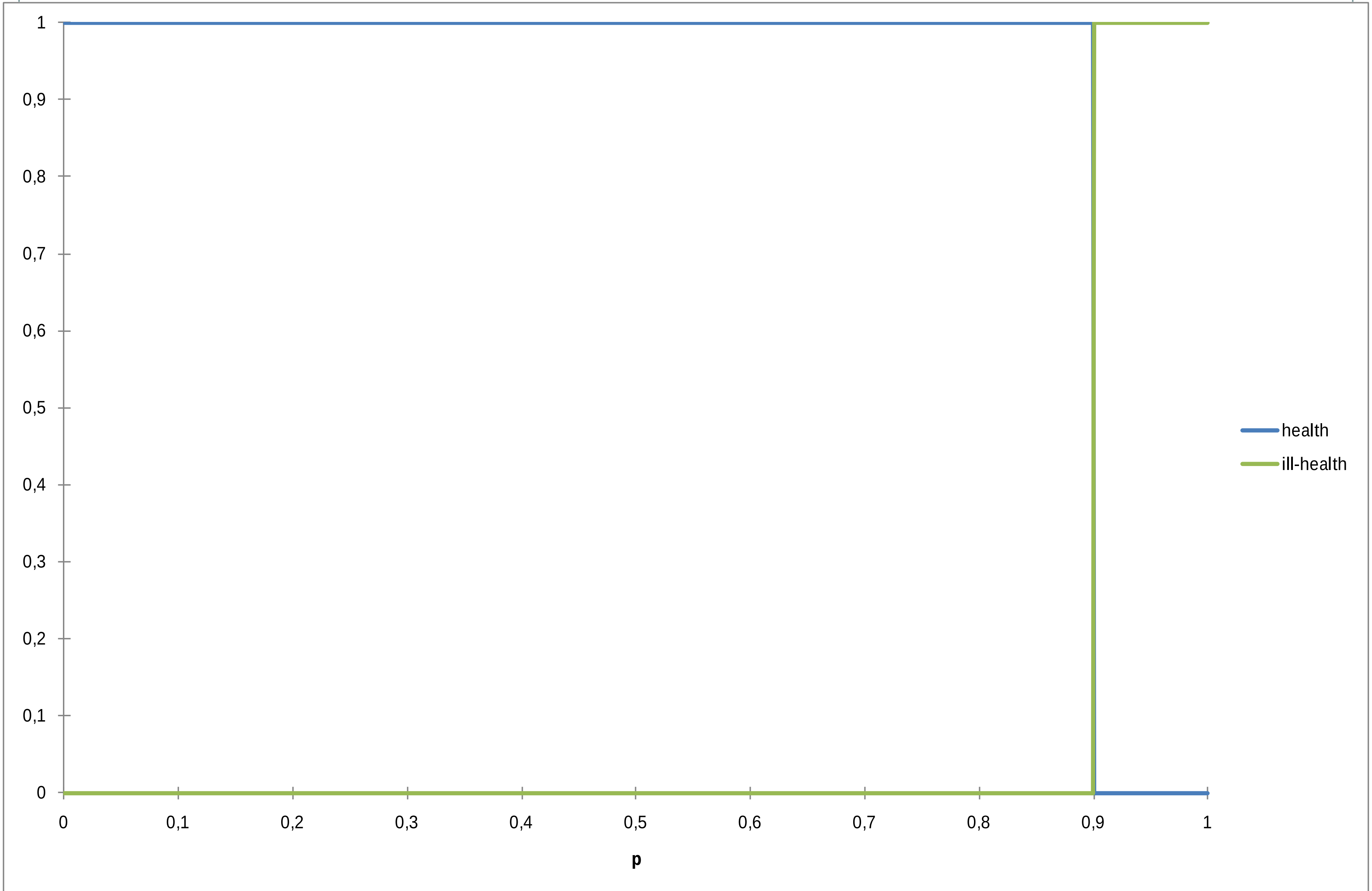
Revisiting the mirror property (I)

- Health is bounded → two points of view:
  - Positive side: focus on ‘good health’ $h(p)$
  - Negative side: focus on ‘ill health’ $s(p)=h^{max}-h(p)$
  - $h(p) \in [0,1]$
- Mirror: health inequality = ill-health inequality
- Violated by the concentration index
  - Only richest is healthy, versus everyone, except richest, is ill
  - It assumes $h^{max} = +\infty$
  - Explains ‘stylized facts’ in epidemiology

Hypothetical example



Extremer hypothethical example



Revisiting the mirror property (II)

- The violation carries over to the extended index
  - Many applications to both health and ill-health

- **First research question: Can we modify the extended concentration index such that it satisfies the mirror property?**

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The generalized concentration index

- Mirror property holds if normalization function is same for health and ill-health
- Solution: make normalization function independent of average health

$$GC(h,p,v) = \underbrace{\frac{v^{\frac{v}{v-1}}}{v-1}}_{\substack{normalization\\ function}} \int_0^1 \left[1 - v(1-p)^{v-1}\right] h(p)\,dp = \frac{v^{\frac{v}{v-1}}}{v-1}\bar{h}C(h,p,v)$$

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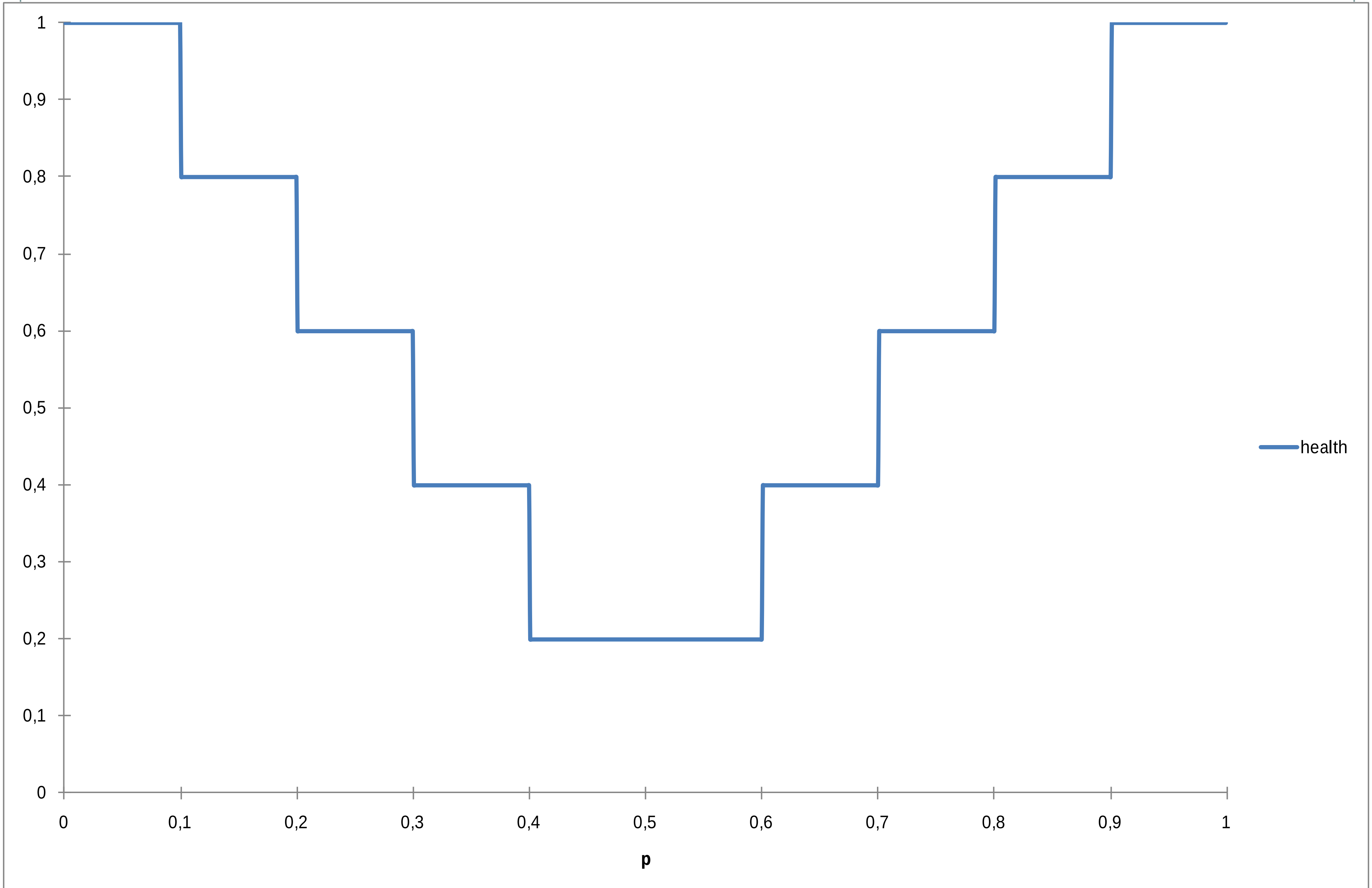
A symmetry condition

- Chances of having high or low health are symmetrically distributed over the rich and the poor

- 'Symmetric' distribution → no SES health disparities
  - Only when $v=2$, otherwise person with weight $0 \neq$ the median
  - Intuition: No systematic association between income rank and health!!

- **Second research question: can we modify the generalized extended concentration index such that it satisfies the symmetry condition?**

Hypothetical symmetric distribution



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The symmetric index (I)

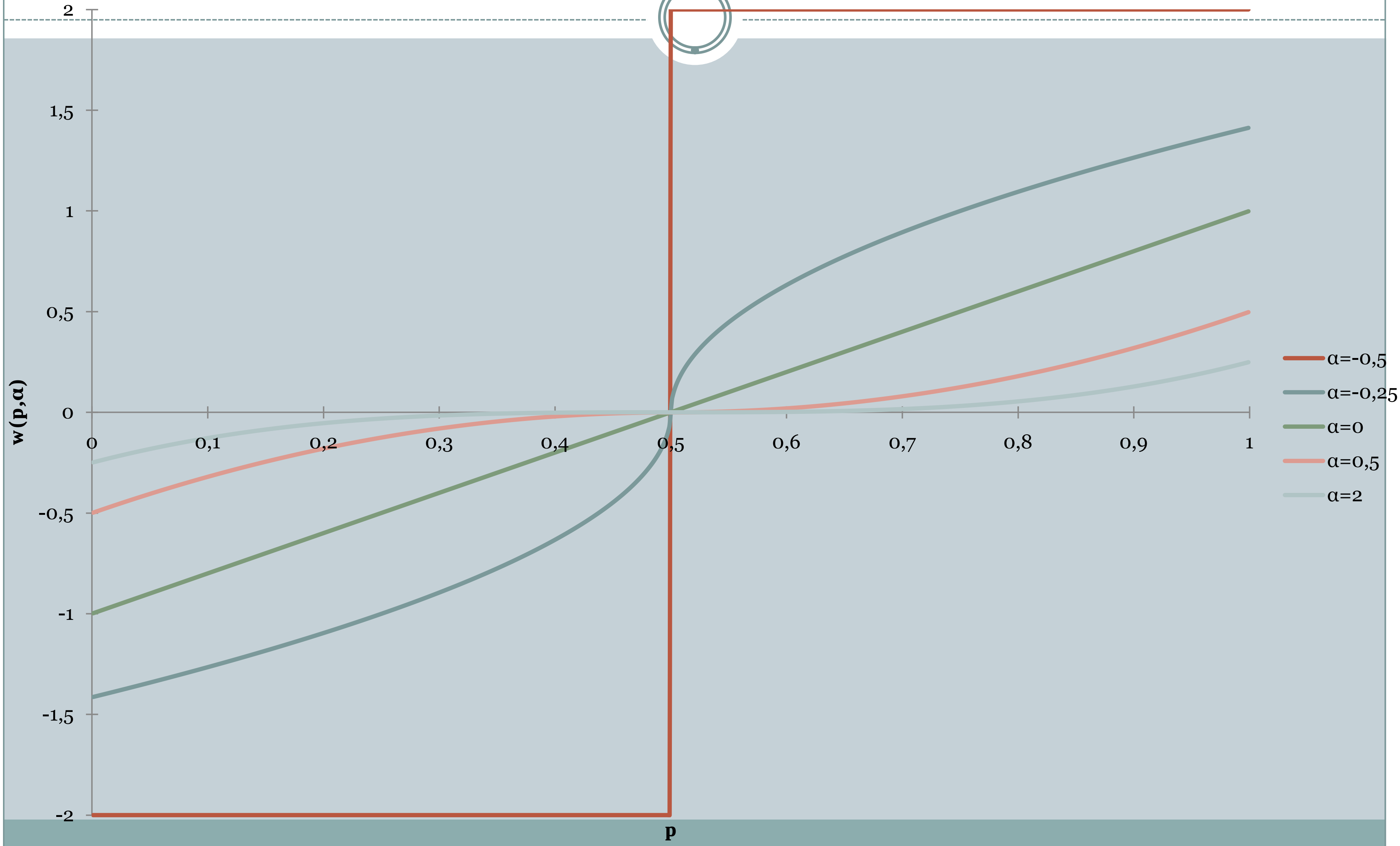
- Symmetry condition is satisfied if the weights are symmetric around the median rank 0.5
  - Explains why *v*=2 is ok

- Solution: normalization function independent of mean health (cf. mirror) and symmetric weighting function

$$S(h,p,\alpha)=\underbrace{(1+\alpha)2^{2(1+\alpha)}}_{\substack{normalization\\ function}}\int_0^1\underbrace{\left\{\left[(p-0.5)^2\right]^{\alpha}(2p-1)\right\}}_{weighting\ function}h(p)\,dp$$

- Intuition: Inequality aversion becomes ‘extremes aversion’ for higher *v*’s

The symmetric index (III)



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Small sample bias

- For relatively small values of n *or* relatively high values of v and α, the small-sample bias can be substantial
- Bias might be aggravated in case of ties in the income rank
- Our solution:
  - Very straightforward conceptually
  - Reasonably good performance in Monte Carlo simulations

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Summary of empirical results

- Demographic Health Surveys for 44 countries
  - Under 5 mortality; and its mirror 5 year survival
  - Wealth index constructed using PCA
  - Country rankings

- Summary of findings
  - Mirror and symmetry are empirically relevant
  - Small-sample bias and ties are important!

Conclusion

- How to incorporate attitudes to inequality into health inequality measurement?
- Prerequisite: mirror
- Symmetry and *not* traditional extensions → aversion to extremes matters in a bivariate setting
- Small sample bias and empirical relevance of methods