Rationality and Preference Aggregation of Group Decision under Risk

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Introduction

- In various contexts, many important decisions are made by groups.

- Individual heterogeneity exists in various dimensions:
  - Risk preference: risk assessment in environmental policy
  - Time preference: household savings and consumption decisions
  - Rationality

- It is important to understand how individual heterogeneity in a collective influences final outcomes.

Introduction: Research Questions

1. Rationality extension:

   - Do rational members make more collectively rational decisions?
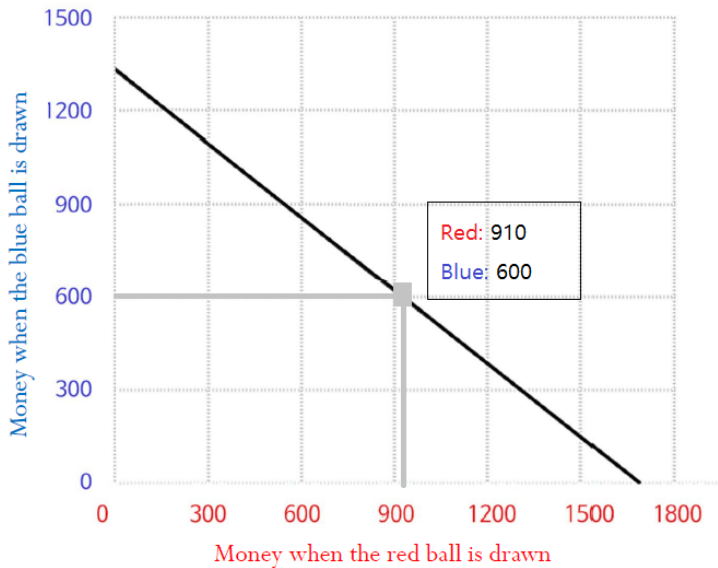
 2 Risk preference aggregation:

   - Are individual's risk preferences reflected into that of a group?

3. Efficiency and welfare:

   - How is the efficiency of group decisions related to individual's rationality and preferences?

   - How is social welfare related to individual' rationality and preferences?

Experimental Design

Screenshot

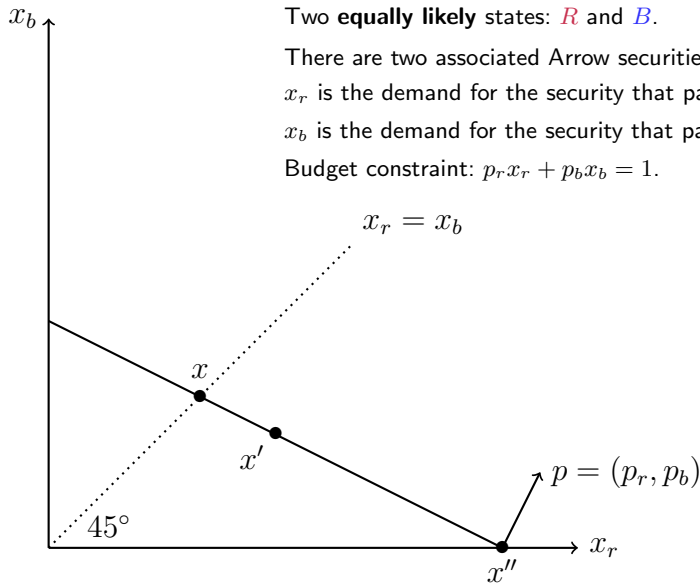# Experimental Design (Choi et al.,2007; Choi et al., 2014)

Two **equally likely** states: R and B.
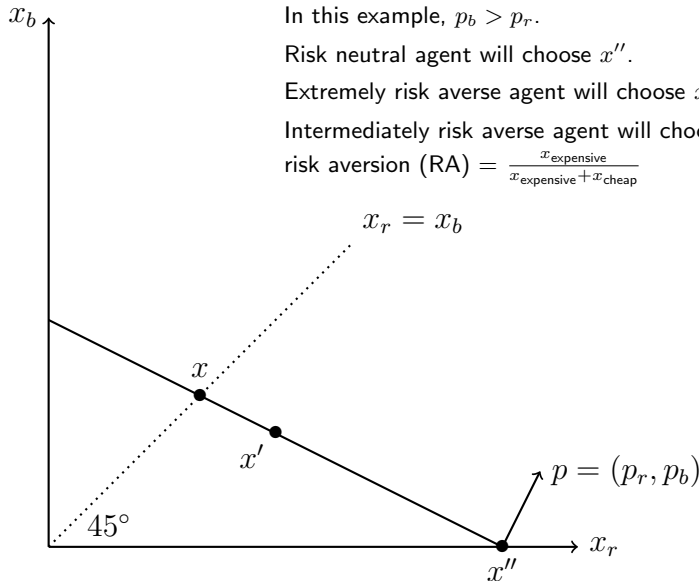
There are two associated Arrow securities.

x_r is the demand for the security that pays off in state R.

x_b is the demand for the security that pays off in state B.

Budget constraint: $p_r x_r + p_b x_b = 1$.

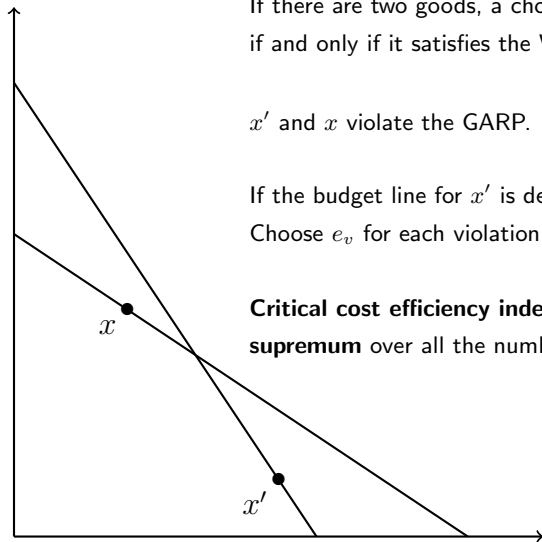# Experimental Design (Choi et al.,2007; Choi et al., 2014)

In this example, $p_b > p_r$.

Risk neutral agent will choose x''.

Extremely risk averse agent will choose x.

Intermediately risk averse agent will choose x'.

risk aversion (RA) $= \frac{x_{\text{expensive}}}{x_{\text{expensive}} + x_{\text{cheap}}}$
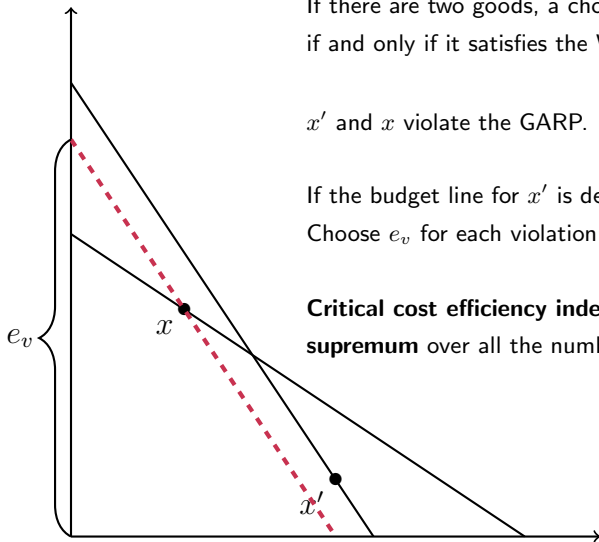
Measurement: Afriat's Efficiency Index (a.k.a. CCEI)

If there are two goods, a choice dataset satisfies the GARP if and only if it satisfies the WARP.

x' and x violate the GARP.

If the budget line for x' is deflated, the GARP is satisfied. Choose e_v for each violation v.

Critical cost efficiency index (CCEI) is defined as the **supremum** over all the numbers e_v's.
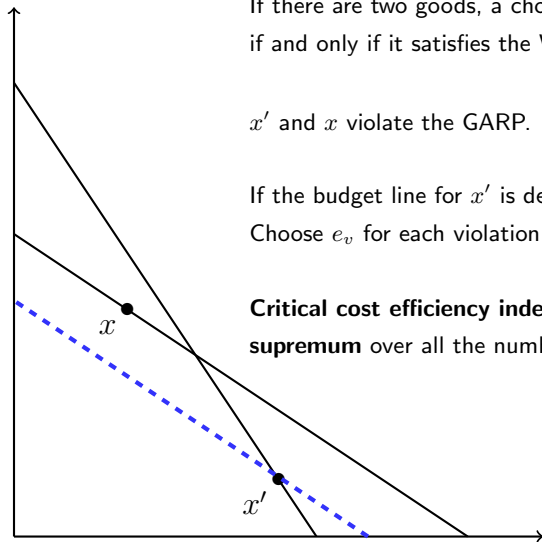
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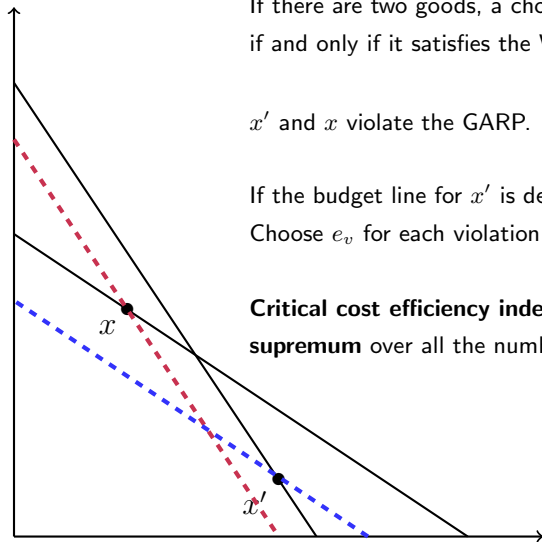
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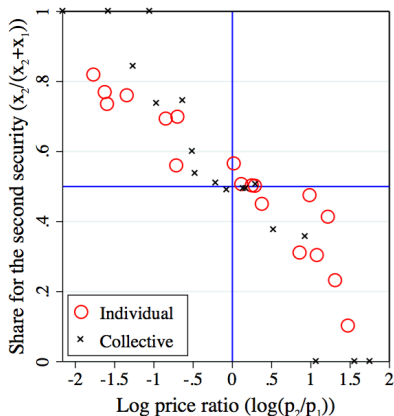
Field

Procedure and Subjects

- We conducted the experiment in 12 middle schools in Daegu.

- The number of students: 1572.

- The number of groups: 786.

- The instructions were read by an experimenter in each classroom.

- Each subject participated in two sessions: individual and group decisions.
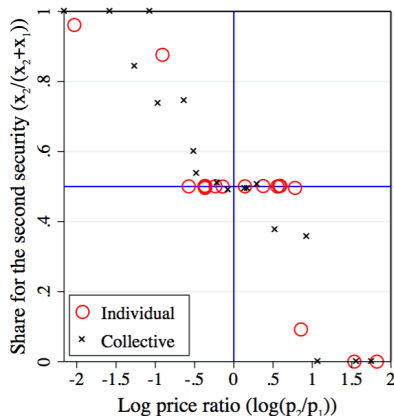
Example of Choice Data

Group ID: 284
Collective CCEI: 1.00
Risk Preference: 0.27, DAU

Individual CCEI: 1.00
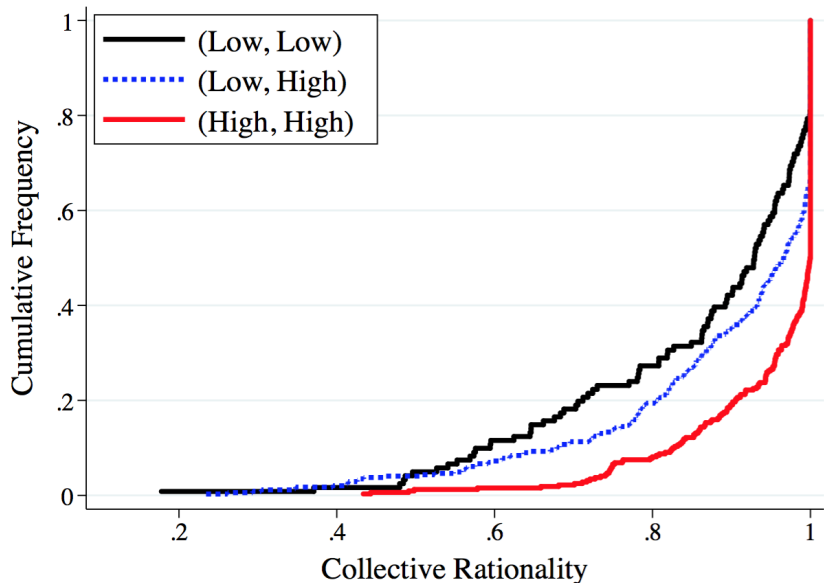Risk Preference: 0.35, EU
Id: 1410707

Individual CCEI: 1.00
Risk Preference: 0.38, DAU
Id: 1410721

Rationality Extension: Research Question

Individual Rationality $\uparrow \Rightarrow$ Collective Rationality $\uparrow$?
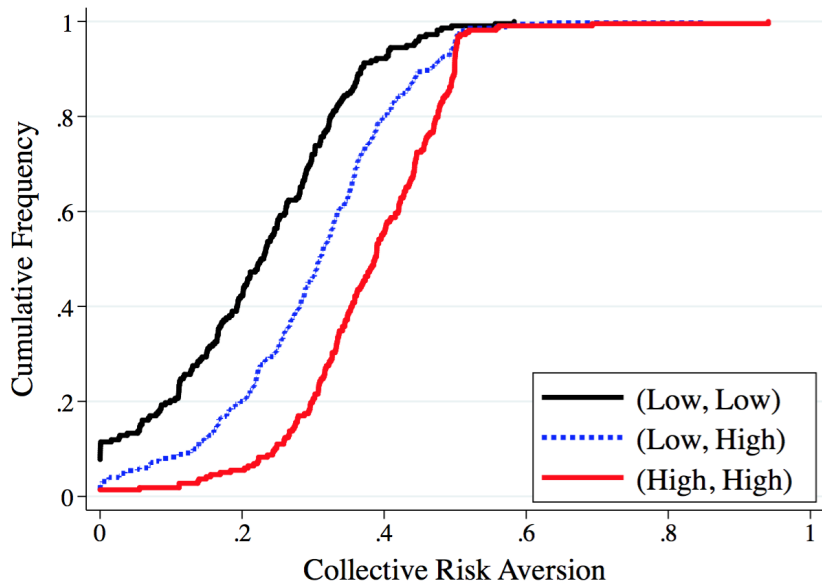
Rationality Extension: First-Order Stochastic Dominance

Risk Preference Aggregation: Research Question

Individual risk aversion $\uparrow$ $\Rightarrow$ Collective risk aversion $\uparrow$?

Preference Aggregation: FOSD by Relative Ratio
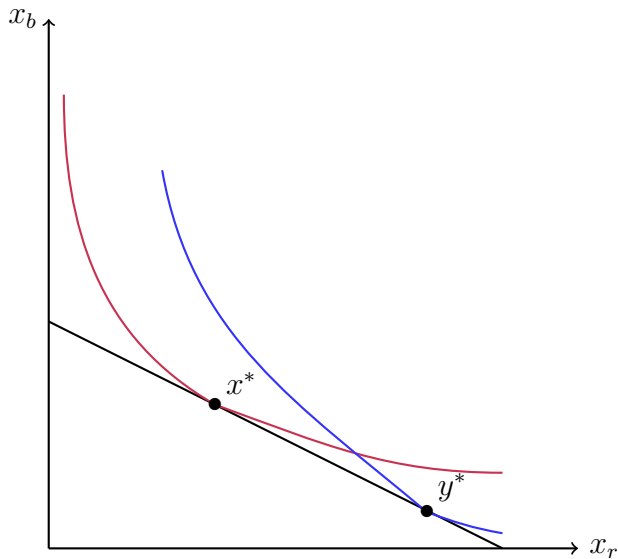
Result 3: Efficiency and Welfare

Measurement: Idea

- We analyze the **quality** of collective decisions as a function of the degrees of rationality and preference alignment.

- Idea:

  - We consider a class of utility functions over lotteries.

  - For each subject, we estimate the utility function parametrically.

  - We characterize a set of Pareto efficient choices.

  - For collective choices which are **not** Pareto efficient, we measure the degree of welfare loss.

Measurement: Utility Estimation

- We restrict our attention to a CARA utility function over outcomes.

- We consider two different types of utility function over lotteries:

  - Expected utility (EU)

  - Disappointment aversion utility (DAU).

- We estimate ρ and β simultaneously by using a combination of a bootstrapping and the non-linear least square (NLLS) methods:

  1. Find subsample of size 18 with replacement.

  2. For given subsample, estimate α and ρ by NLLS.

  3. Repeat the above for 250 times.

  4. If $0.5 \in [\alpha_{2.5}, \alpha_{97.5}]$, then set $\alpha = 0.5$ as an EU.

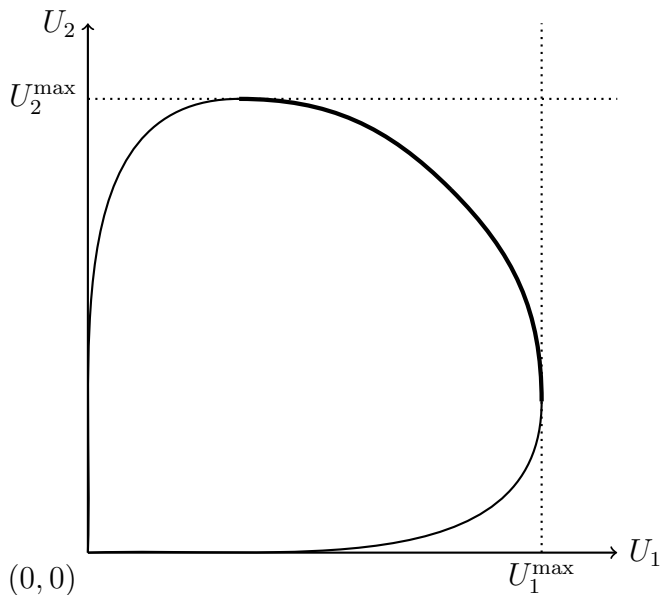 4'. Otherwise, set $\alpha = \overline{\alpha}$ as a DAU.

Measurement: Efficiency and Welfare Loss
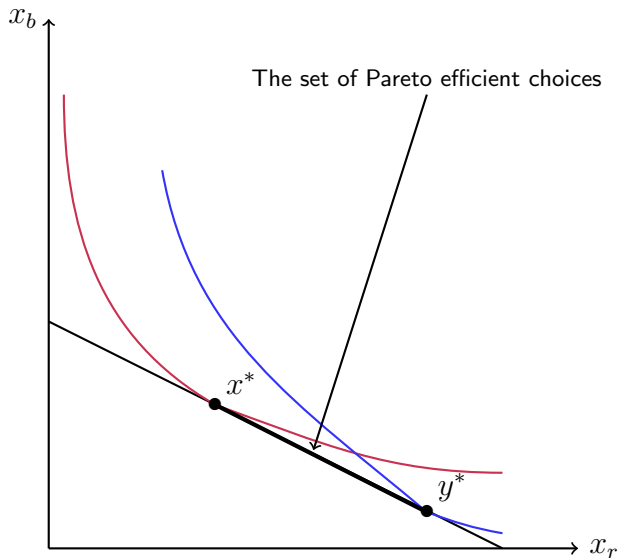
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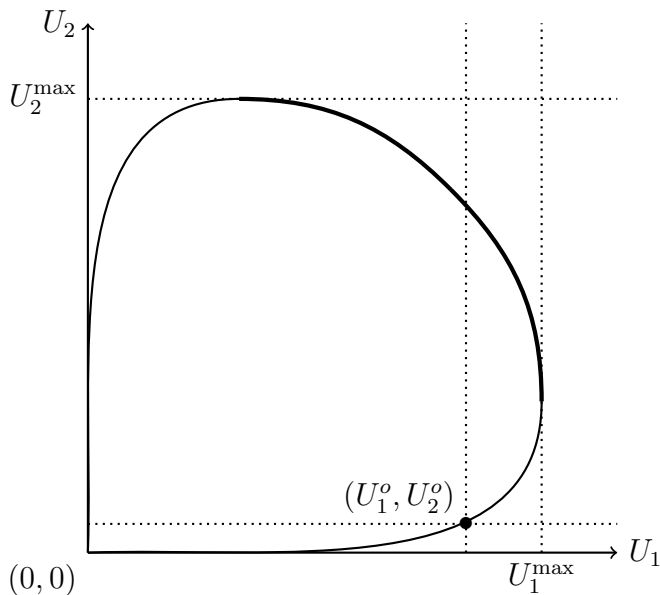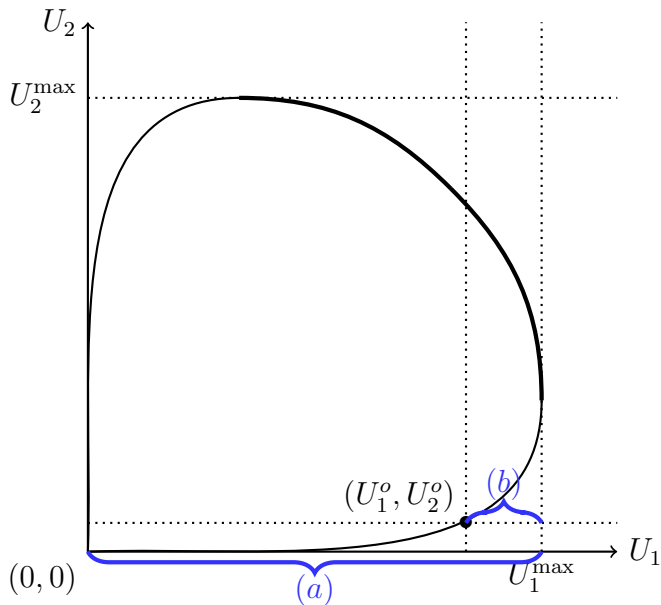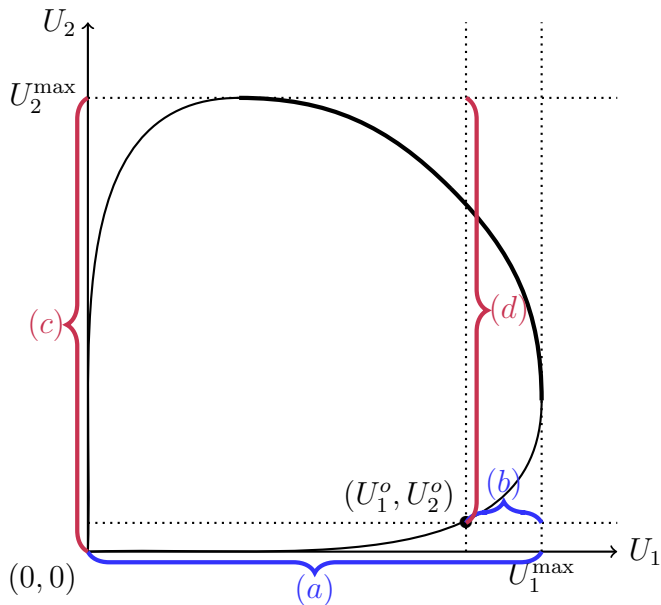
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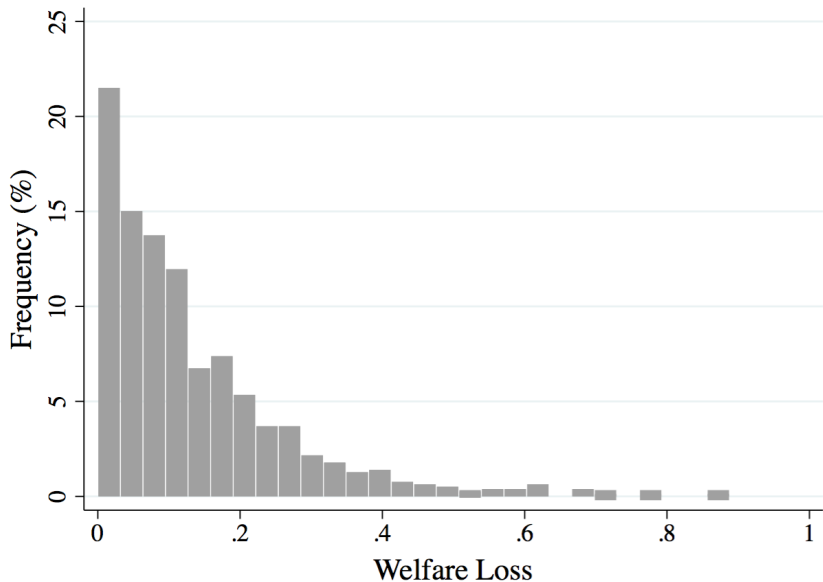
Efficiency and Welfare: Measurement

- We focus on the group choices which are not Pareto efficient (60%).

- For those choices, we measure **welfare loss** of a group as

$$\text{Welfare Loss} = \frac{1}{18} \sum_{k=1}^{18} \frac{1}{2} \sum_{i=1}^{2} \frac{U_i(x_{ikb}) - U_i(x_{ikc})}{U_i(x_{ikb}) - U_i(x_{ikw})},$$
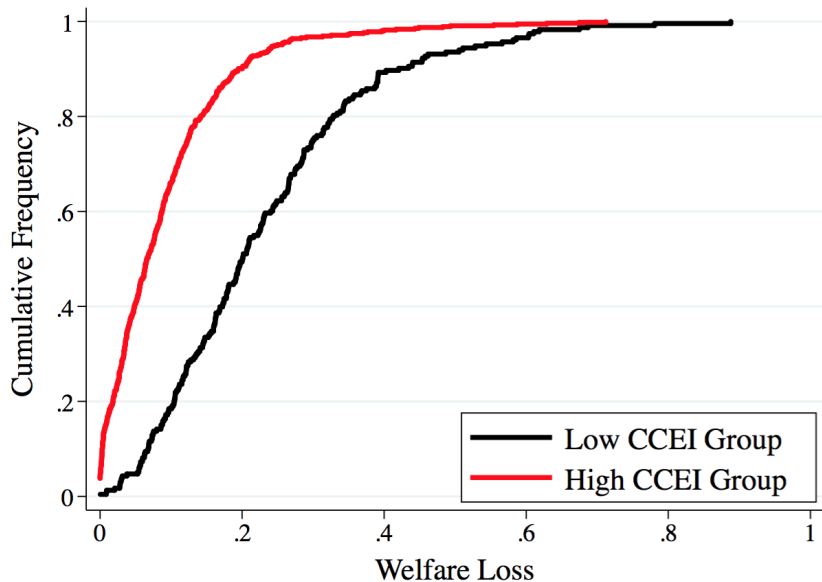
where

- x_{ikc}: group choice in k-th round

- x_{ikb}: member i's best choice in k-th round

- x_{ikw}: member i's worst choice in k-th round.

- By definition, Welfare Loss $\in [0, 1]$.

Efficiency and Welfare: Distribution of Welfare Loss

Welfare: FOSD by Group Rationality

Conclusion

- We measure rationality and risk preference in individual and group levels.

- We observe rationality extension and preference aggregation.

- We develop a measure of efficiency and utility loss of group decisions.

- We find that rational groups are more likely to make efficient decisions.

- Our main findings are robust with respect to
    - another rationality measure (Varian's efficiency index)
    - other cutoff values of CCEI (0.99 or 0.95)
    - another measure of risk preferences (risk premium).