Rationality-Based Preference Aggregation

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Introduction

- Long-standing interests in group decision making
  - Households (e.g., McEloy and Horney, 1981; Chiappori, 1992; Lundberg and Pollak, 1996);
  - Committees (e.g,, Austen-Smith and Banks, 1996; Feddersen and Pesendorfer, 1998))
  - Social choice theory (e.g., Arrow, 1951; Sen, 1970), etc.
- Individual rationality is a foundational assumption in understanding group decision making.
  - Various determinants of group decision-making: outside options, information and resources controlled, rules of interaction, etc.
- We claim that the degree of individual rationality is one source of (1) the quality of group decision-making and (2) individual influence on it.

In This Paper

- Conduct large-scale panel experiments over two periods with a four-month interval
  - Over 1,300 (final sample) individuals are randomly paired to make individual and group decisions in a portfolio allocation problem
  - Collect rich individual- and collective-level data suited to applying revealed preference analysis
- Propose a nonparametric, revealed preference measure of individual power on group decision making
- Make a causal inference on the effect of individual rationality on group outcomes.

Sampling

- 1,572 students from 12 middle schools in South Korea in the baseline study (in August); 1,468 revisited in the endline study (in December)

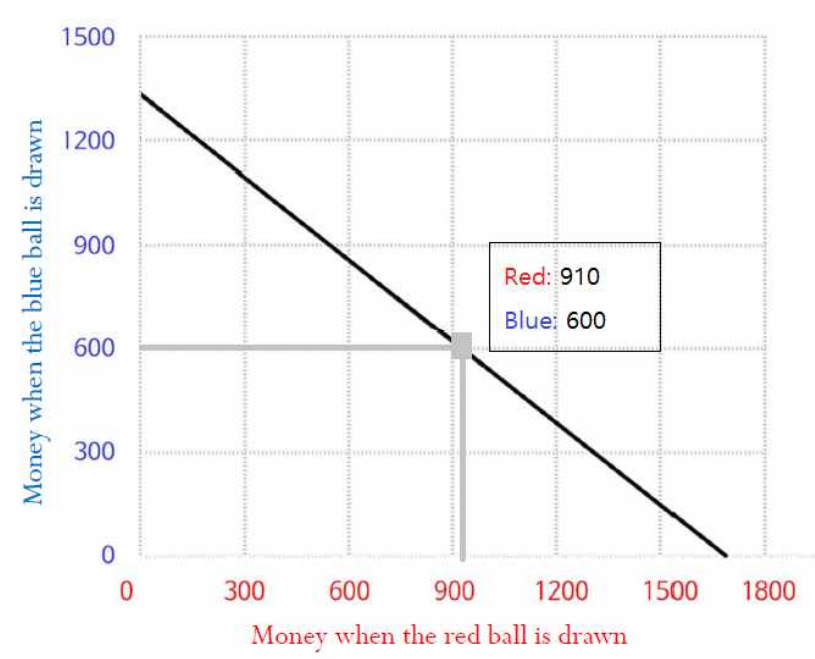
- In each study, they completed two stages of decision making under risk at the individual level and at the collective level.

  - Pairs were randomly formed within classroom for collective choices in the baseline
  - They were kept unchanged in the endline
  - Due to attrition or group mismatching, the final sample consists of 657 groups (1,314 individuals) in both studies.

- We also collected their individual characteristics (mover, height, gender, math score, etc) and friendship information.

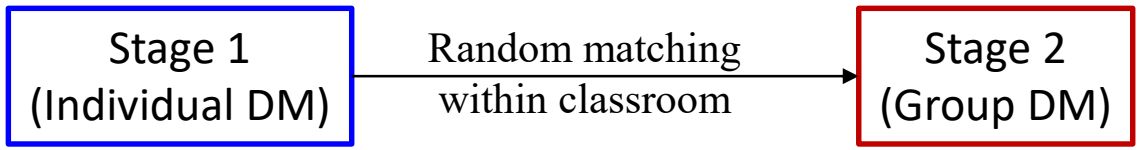
Decision Problem

- Follow Choi et al. (2007)
  - Allocate an income over two Arrow securities (associated with equally probably two states): choose (x_1, x_2) subject to $p_1 x_1 + p_2 x_2 = 1$



Experimental Procedures

- Participants: students from 12 middle schools in South Korea



- 18 rounds of individual choices with exogenous price variations
- 1 randomly selected round for payoffs

- Randomly matched students in pair sit side by side
- 1 min 30 sec of discussion
- 18 rounds of collective choices with exogenous price variations
- 1 randomly selected round for payoffs (doubled and divided equally)

- No feedback is given during the experiment, and subjects are informed only the sum of payoffs from the two stages at the end of the study.

Measuring Rationality

- Test whether each choice data are consistent with utility maximization: Generalized Axiom of Revealed Preference (GARP)

- Afriat's Critical Cost Efficiency Index (CCEI)

  - Measuring the exact amount by which each budget must be relaxed to remove all GARP violations;
  - CCEI $\in [0,1]$: the smaller it is, the more severe violation of GARP.

- Basic statistics of individual and collective CCEIs

	Baseline	Endline
Individual	0.900	0.932
	(0.133)	(0.121)
Collective	0.912	0.935
	(0.141)	(0.129)

Measuring Risk Preferences

- Simple nonparametric measure of risk tolerance (RT)
  - For each budget, the fraction of money on a cheaper asset: $\frac{x_{\text{cheaper}}}{x_1+x_2}$
  - For each individual and each group, compute the average of the fraction of money on a cheaper asset over 18 rounds
  - RT $\in [0.5, 1]$: higher (lower) degree of risk aversion when it is closer to 0.5 (1).
- Basic statistics of individual and collective RTs

	Baseline	Endline
Individual	0.678	0.702
	(0.133)	(0..153)
Collective	0.703	0.735
	(0.142)	(0.153)

Balance Test

	Case 1: Mover as Dep.Var.		Case 2: Random Assignment	
Outcome Variable	β (SE)	P-value	β (SE)	P-value
CCEI	0.038 (0.042)	0.363	0.034 (0.037)	0.364
Risk Aversion	−0.017 (0.042)	0.682	0.009 (0.038)	0.820

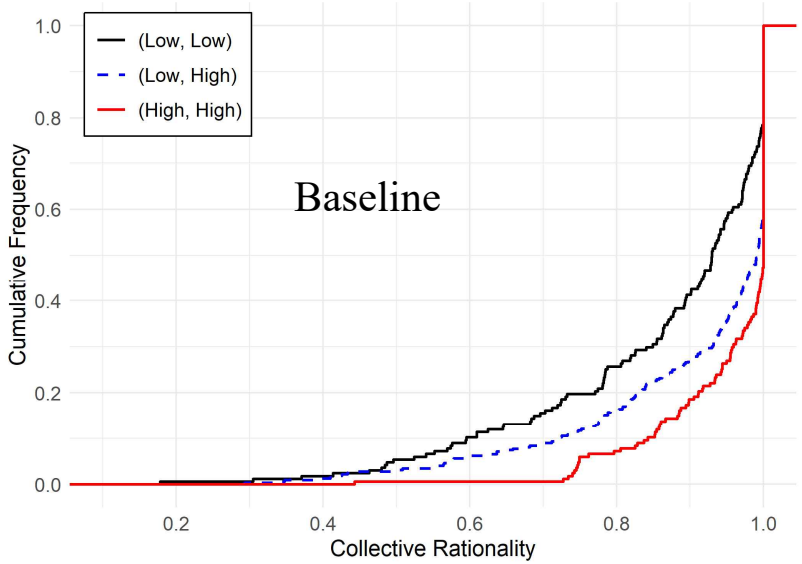
Note: This table reports regression results of each individual's outcome (CCEI or Risk Aversion) on their partner's corresponding variable. Case 1 uses the "mover" as the dependent variable, while Case 2 assigns individuals randomly within each pair. All regressions control for class fixed effects.

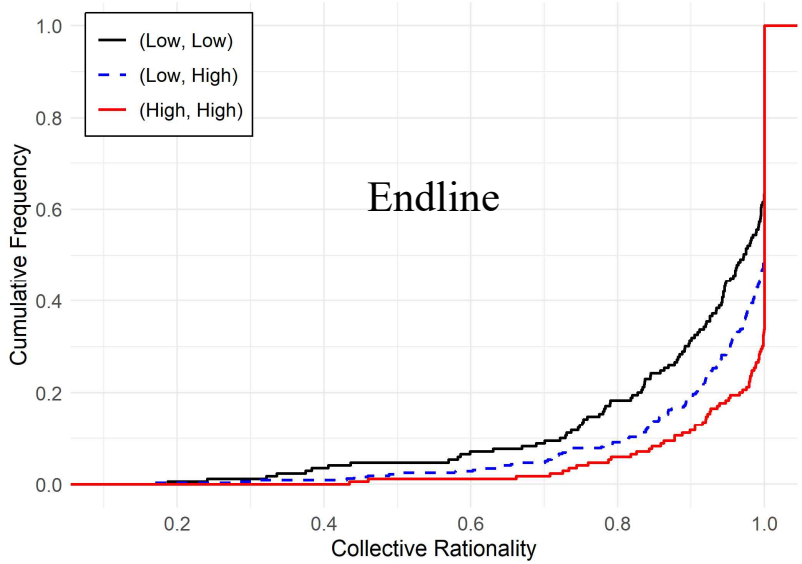
- Random group formation makes an individual's CCEI and risk aversion not correlated with those of the other in the same group.

Rationality Extension

Q1: Do more rational individuals make group decisions more rational?

- Divide subjects into two groups w.r.t. individual CCEIs
  - **High** (**Low**) group: **above** (**below**) the median of CCEI





Rationality Extension

Collective CCEI	Pooled OLS		FE Model	
	Model 1	Model 2	Model 1	Model 2
CCEI_Max	0.348***	0.314***	0.236***	0.216***
	(0.083)	(0.079)	(0.081)	(0.082)
CCEI_Distance	−0.232***	−0.206***	−0.167***	−0.151***
	(0.045)	(0.039)	(0.036)	(0.037)
Risk Tolerance_Max		0.180***		0.125**
		(0.049)		(0.060)
Risk Tolerance_Distance		−0.090**		−0.070
		(0.044)		(0.054)
Constant	0.649***	0.550***	0.714***	0.647***
	(0.083)	(0.084)	(0.080)	(0.086)
Class Fixed Effect	Yes	Yes	-	-
Individual Characteristics	Yes	Yes	-	-
School Characteristics	Yes	Yes	-	-
Friendship	Yes	Yes	Yes	Yes
Observations	1,314	1,314	1,314	1,314
R-squared	0.177	0.192	0.633	0.636

- Collective CCEI increases in CCEI of a more rational individual and decreases in the difference between CCEIs of two individuals, even after controlling for preferences.

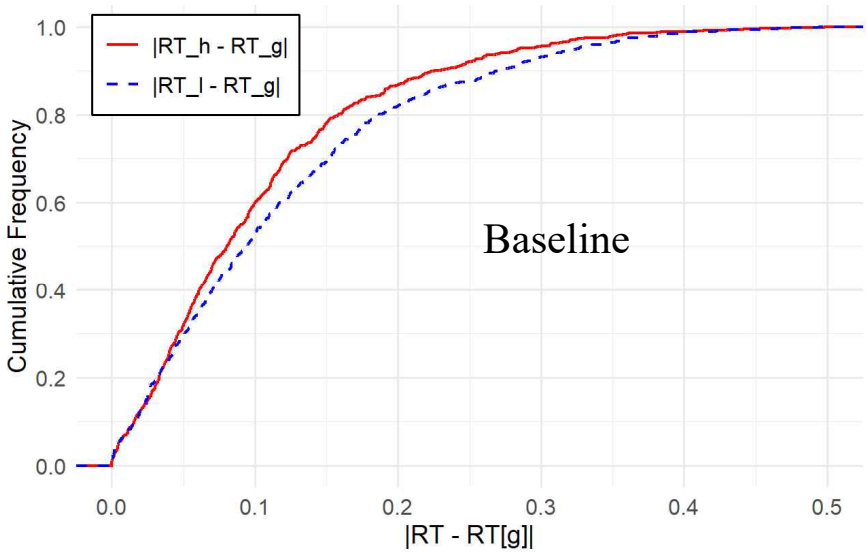
Does Preference Aggregation Depend on Rationality?

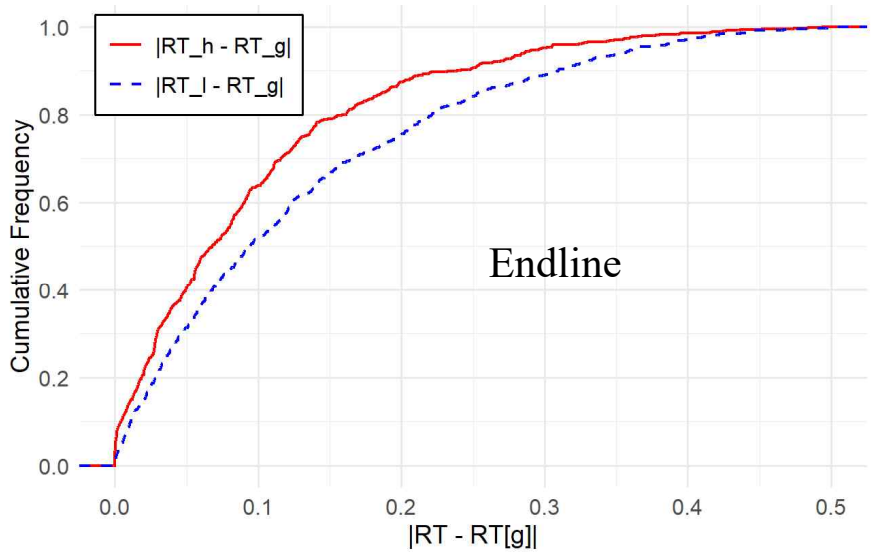
Q2: Is the preference of the group closer to that of a more rational individual?

- Individual with higher (lower) CCEI in the group: $i = h(\text{high}), l(\text{low})$
- Two approaches:
  1. Compute the distance of risk tolerance between individual i and the group
  2. Revealed preference approach of individual (bargaining) power on group decisions.

Does Preference Aggregation Depend on Rationality?

- Draw the distributions of $|RT_i - RT_g|$ for $i = h, l$.





- The preference gap between a more rational individual and the group is smaller than that between a less rational individual and the group.

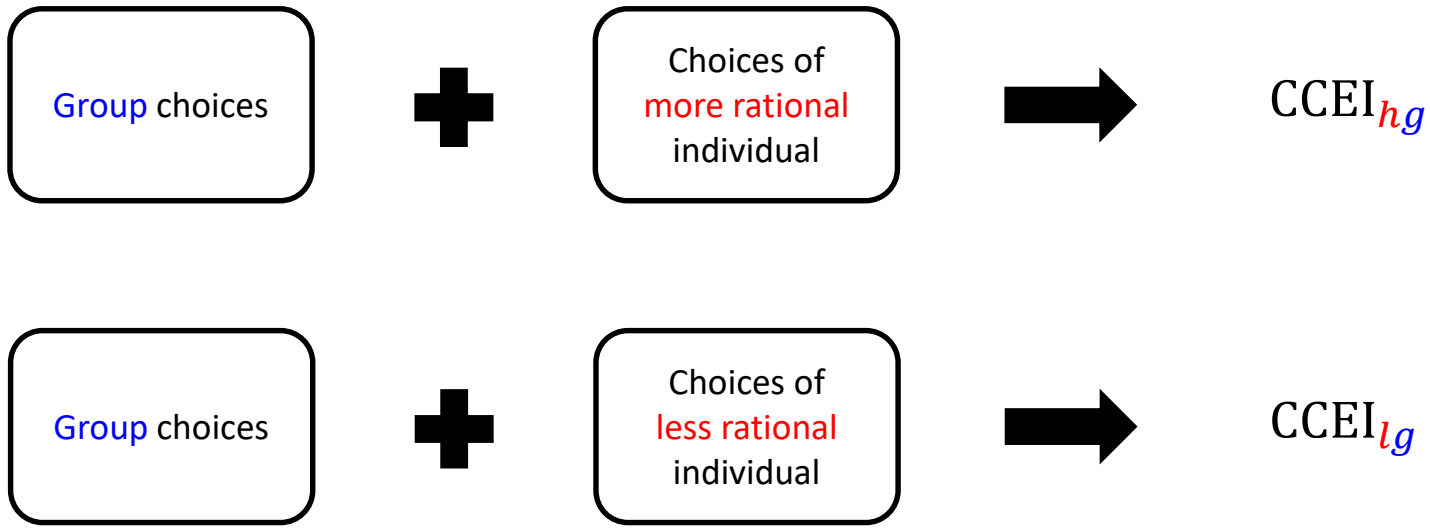
Does Preference Aggregation Depend on Rationality?

$\lvert RT_i - RT_g \rvert$	Pooled OLS			
	(1)	(2)	(3)	(4)
High_CCEI_Dummy	−0.024***	−0.014***	−0.024***	−0.014***
	(0.004)	(0.004)	(0.005)	(0.004)
Endline		0.011**		0.011**
		(0.005)		(0.005)
High × Endline		−0.020***		−0.020***
		(0.007)		(0.007)
Constant	0.131***	0.125***	0.133***	0.128***
	(0.005)	(0.004)	(0.013)	(0.013)
Class Fixed Effect	No	No	Yes	Yes
Individual Characteristics	No	No	Yes	Yes
School Characteristics	No	No	Yes	Yes
Friendship	No	No	Yes	Yes
Observations	2,628	2,628	2,628	2,628
R-squared	0.015	0.017	0.069	0.072

- Collective risk preference is closer to the individual risk preference of a more rational individual.
- This becomes stronger in the endline study.

Revealed (Bargaining) Power

- Revealed preference approach
  - how close are an individual's choices to group choices?
- An individual is said to have a larger revealed (bargaining) power if her choice data is "closer" to the data of group choices.



Revealed (Bargaining) Power

- **Revealed preference distance** between the group data and the combined data of group and more rational (less rational) individual choices, normalized by the distance between the group data and all combined data

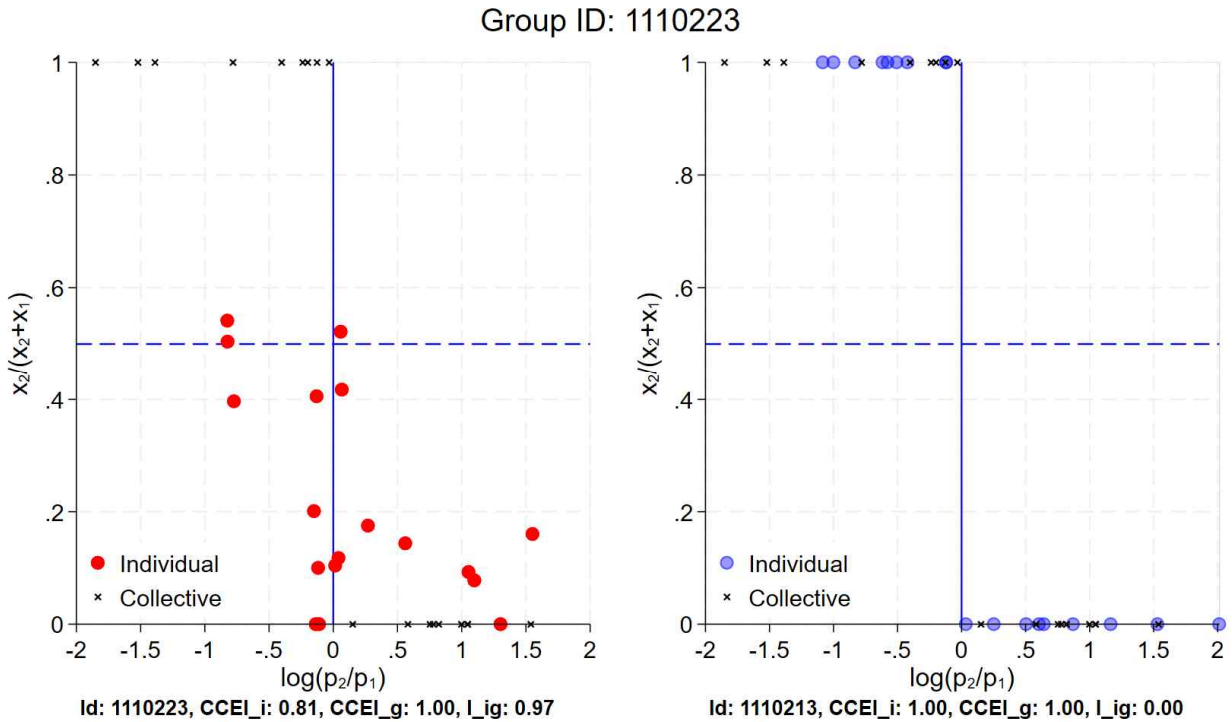
$$I_{hg} = \frac{\mathrm{CCEI}_g - \mathrm{CCEI}_{hg}}{\mathrm{CCEI}_g - \mathrm{CCEI}_{hlg}}$$ more rational individual

$$I_{lg} = \frac{\mathrm{CCEI}_g - \mathrm{CCEI}_{lg}}{\mathrm{CCEI}_g - \mathrm{CCEI}_{hlg}}$$ less rational individual

Revealed (Bargaining) Power

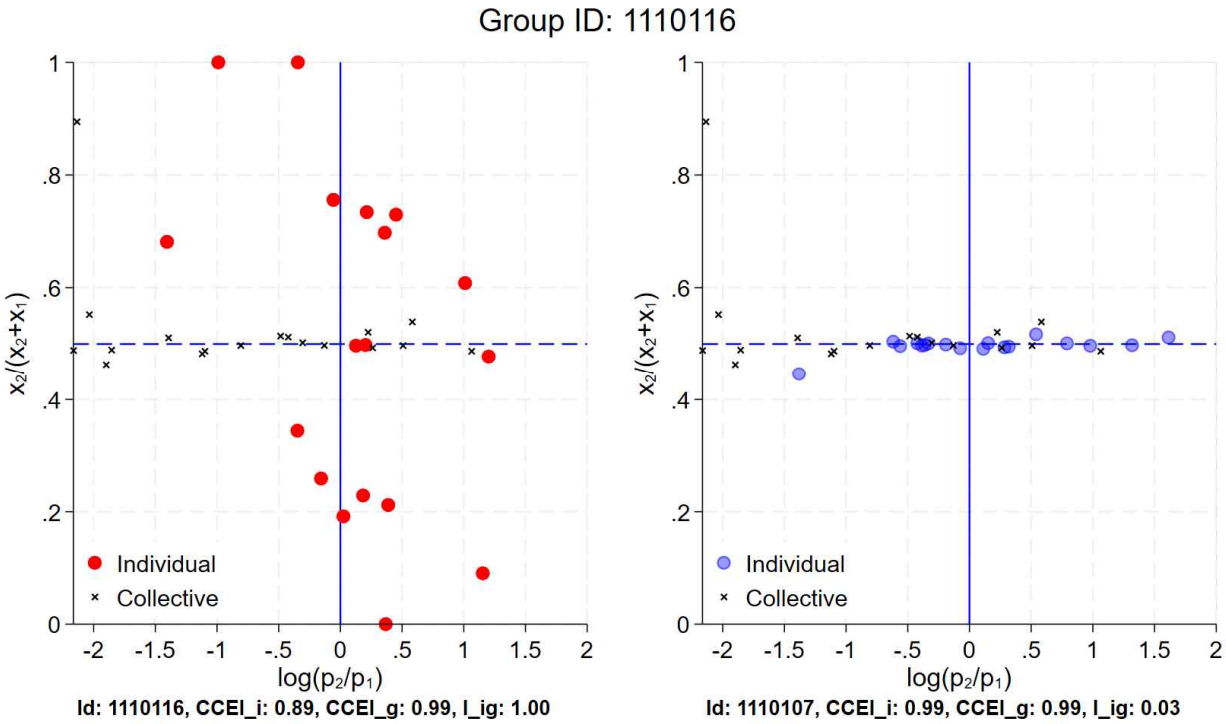
- These revealed preference distance measures, I_{hg} and I_{lg}, range between 0 and 1.
  - The closer I_{hg} is to zero, the choice data of more rational individual are consistent with the group choice data.
  - If $I_{hg} < I_{lg}$, a more rational individual is said to have a larger revealed (bargaining) power than a less rational individual.
    - 72% of the groups in the baseline data; 74% in the endline data
- These indices are not defined when
  - All three datasets have a common preference; or
  - The group data contains the most severe violation of GARP
  - About 50 pairs in each of baseline and endline samples

Selective Group 1



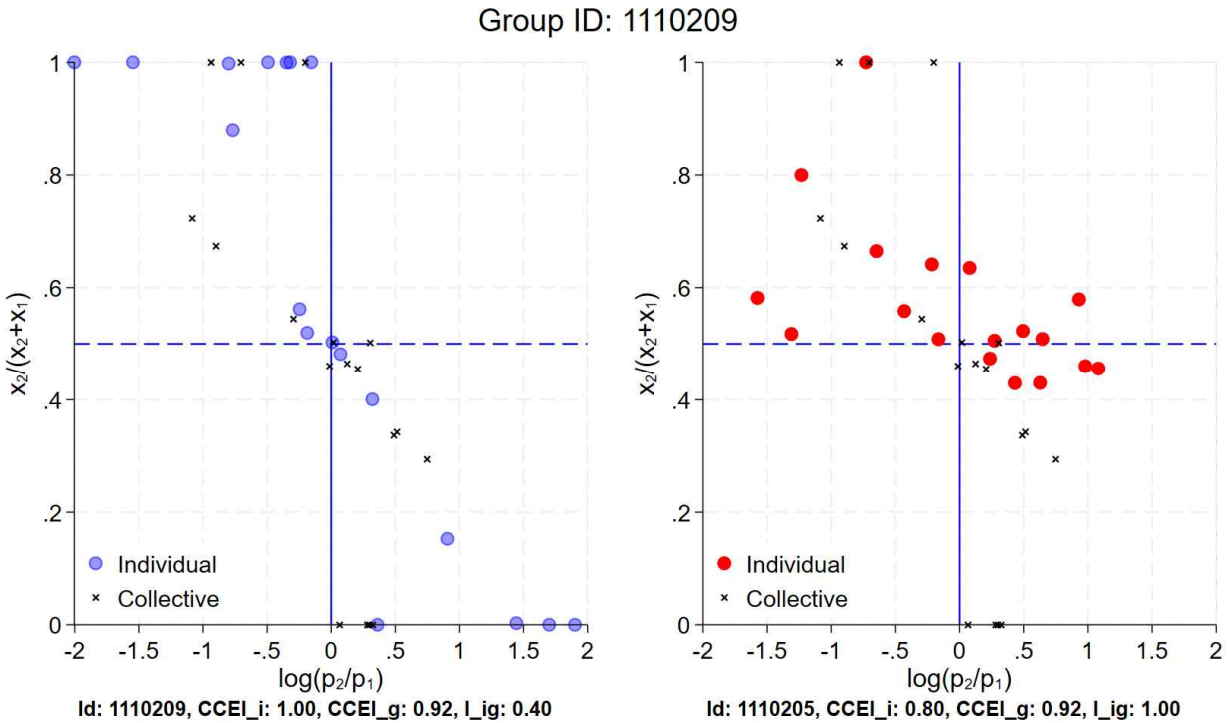
- A more rational individual (right; blue) and the group behave the same.
- $I_{hg} = 0,\ I_{lg} = 0.97$

Selective Group 2



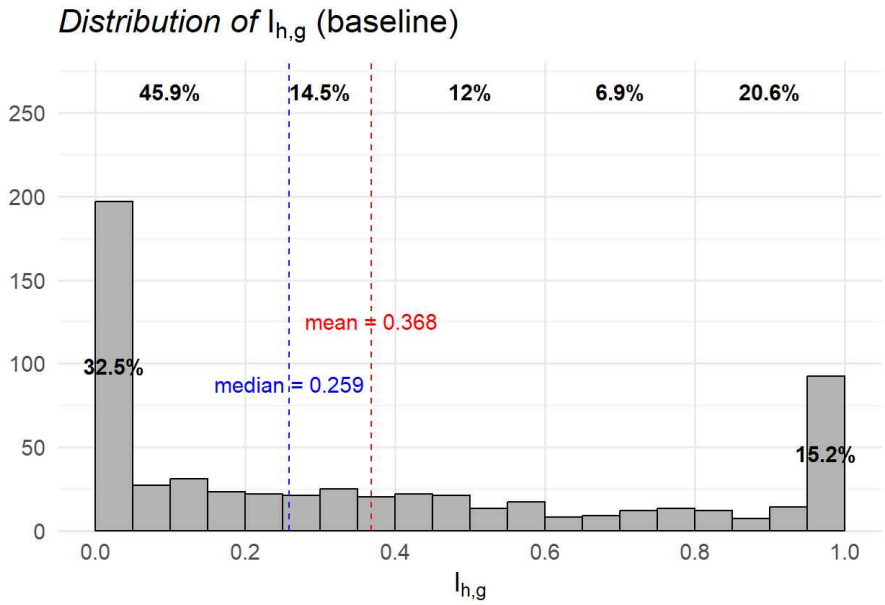
- $I_{hg} = 0.03,\ I_{lg} = 1.00$

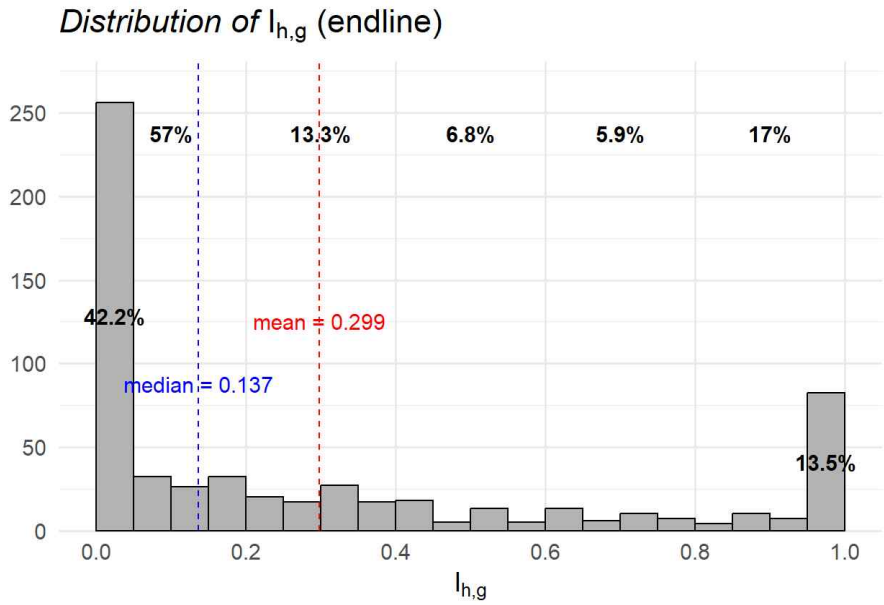
Selective Group 3



- $I_{hg} = 0.40,\ I_{lg} = 1.00$

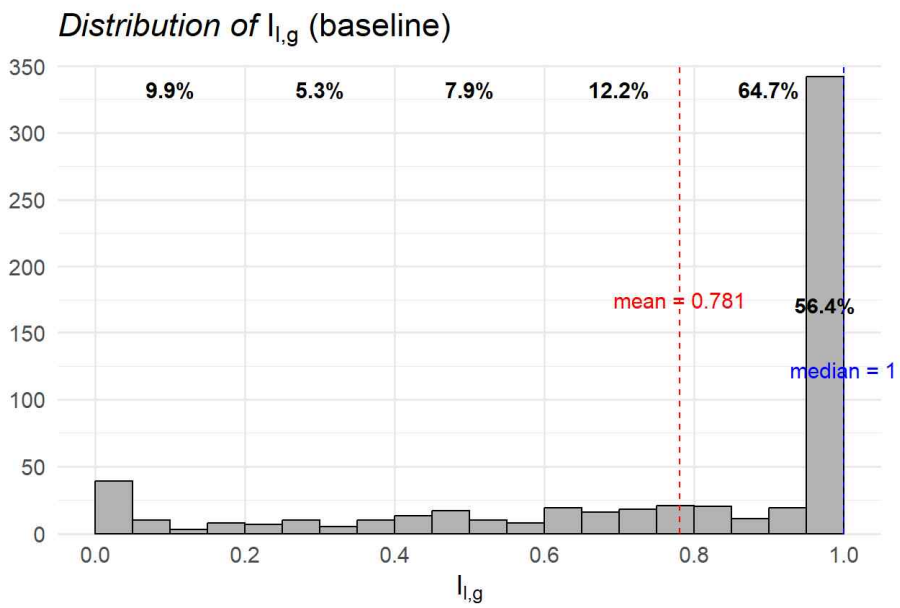
Revealed Preference Distance: **More Rational Individual**

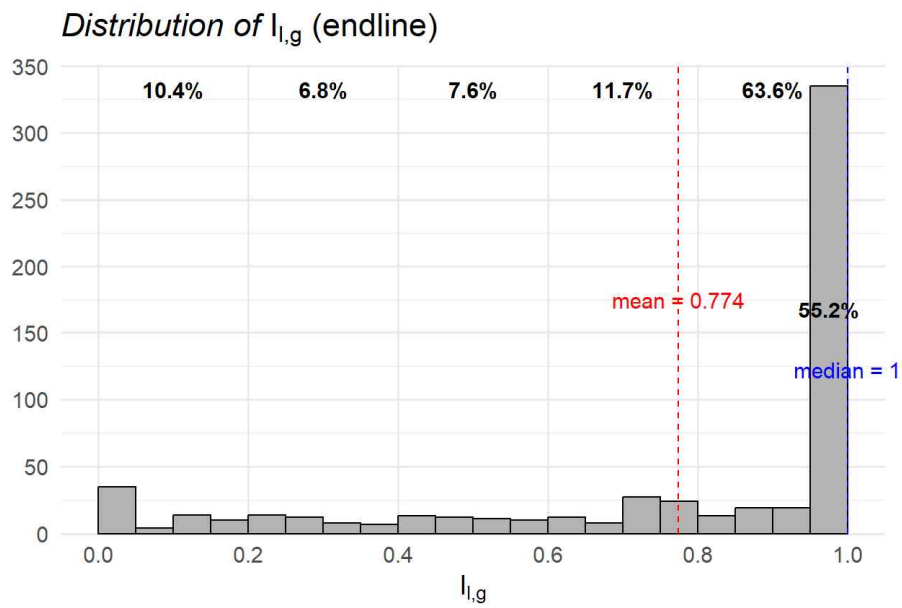




- The average of I_{hg} is 0.368 in the baseline and 0.299 in the endline.

Revealed Preference Distance: **Less Rational Individual**





- The average of I_{lg} is 0.781 in the baseline and 0.774 in the endline.

Revealed Preference Distance

I_ig	Pooled OLS					
	(1)	(2)	(3)	(4)	(5)	(6)
High_CCEI_Dummy	−0.444***	−0.413***	−0.324***	−0.444***	−0.413***	−0.318***
	(0.015)	(0.024)	(0.025)	(0.015)	(0.024)	(0.025)
Endline		−0.007	0.025		−0.007	0.028
		(0.021)	(0.019)		(0.021)	(0.020)
High × Endline		−0.062*	−0.076**		−0.062*	−0.076**
		(0.036)	(0.034)		(0.036)	(0.034)
CCEI_i			−0.651***			−0.689***
			(0.046)			(0.048)
RT_i			−0.194***			−0.210***
			(0.060)			(0.063)
Constant	0.788***	0.792***	1.461***	0.817***	0.821***	1.495***
	(0.011)	(0.014)	(0.051)	(0.037)	(0.038)	(0.062)
Class Fixed Effect	No	No	No	Yes	Yes	Yes
Individual Characteristics	No	No	No	Yes	Yes	Yes
School Characteristics	No	No	No	Yes	Yes	Yes
Friendship	No	No	No	Yes	Yes	Yes
Observations	2,426	2,426	2,426	2,426	2,426	2,426
R-squared	0.293	0.296	0.338	0.311	0.315	0.358

- Mean of a less rational individuals' I_{ig} (i.e., I_{lg}) = 0.777
  - On average, I_{hg} is 57.1% lower than I_{lg} within the same group
- This rationality-based distance becomes larger in the endline.

Conclusion

- Large-scale, panel experiments about individual and group decision-making
  - Random group formation leads to infer the effects of individual rationality on the quality of group decision-making and individual power on group decision-making.
- Provide a nonparametric, revealed preference measure of individual (bargaining) power on group decisions.
- Findings
  - The quality of group decisions increases in individual rationality and decreases in the difference in individual rationalities
  - A more rational individual has a larger revealed (bargaining) power on group decision-making.