Rationality and Preference Aggregation of Group Decision under Risk

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Introduction

- Prevalence of group decision making: households, committees, firms, etc.
- Individuals are heterogeneous in various characteristics:
  - preferences
  - capabilities of making rational choices
  - ... etc
- Modelling

$$\text{group decision} = f(\text{individual characteristics})$$

Fundamental Questions

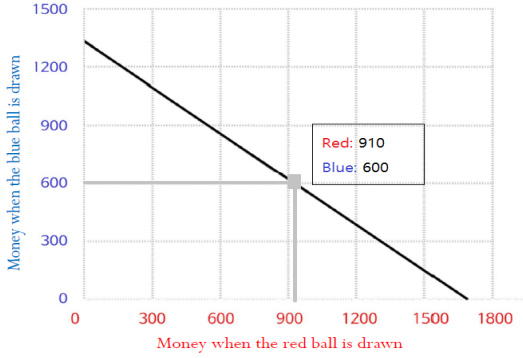
1. **Rationality extension**
   - Do rational members make more rational decisions at the collective level?
2. **Preference aggregation**
   - How are individual preferences reflected in collective preferences?
3. **Social Efficiency**
   - How do rationality extension and preference aggregation connect to social efficiency?

In This Paper

- Use a revealed preference approach and collect rich individual- and collective-level data
- Measure rationality and preferences (over risk) at both individual and collective levels in a large sample of over 1500 participants
- Report stylized findings on the three fundamental issues on group decision

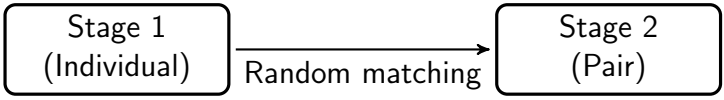
Experimental Design and Procedures

- Follow Choi et al. (2007) and Choi et al. (2014)
- Allocate an individual's income over two Arrow securities (associated with equally probable two states)



- 1,572 students from 12 middle schools in South Korea.

Experimental Design and Procedures



- 18 times of choices
- Payoff for 1 randomly selected choice
- N=1572

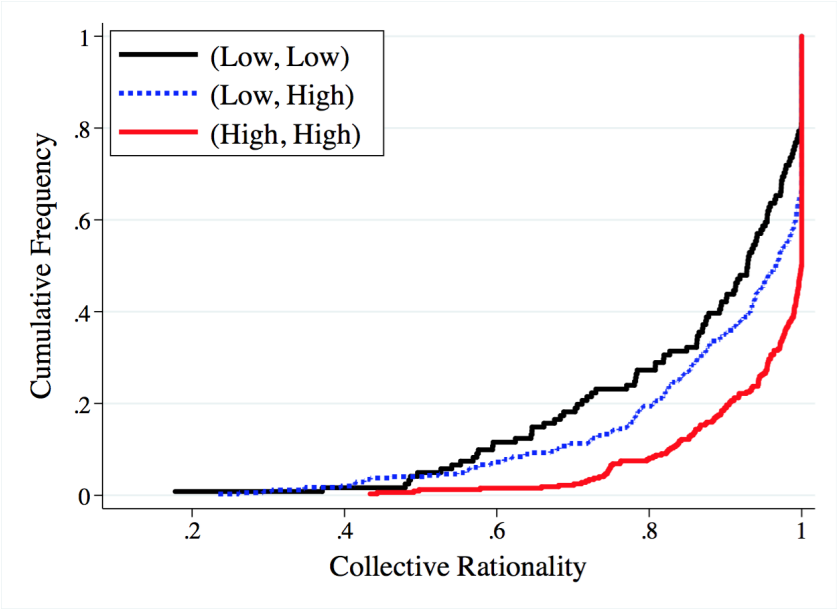
- Matched individuals sit side by side
- 1 min 30 sec of discussion time
- 18 times of choices
- Payoff for 1 randomly selected choice is doubled and divided equally
- N=786

- No feedback is given during the experiment and subjects are informed only the sum of payoff from stage 1 and 2 after all the process

Measuring Rationality

- Test whether each of individual and collective choice data are consistent with utility maximization: Generalized Axiom of Revealed Preference (GARP)
- Afriat's Critical Cost Efficiency Index (CCEI): CCEI$\in [0, 1]$, and the bigger it is, the less severe violation of GARP
- Basic statistics of individual and collective CCEIs:
  - individual average: 0.897 [0.136]
  - collective average: 0.910 [0.141]
  - p-value: 0.032

Rationality Extension



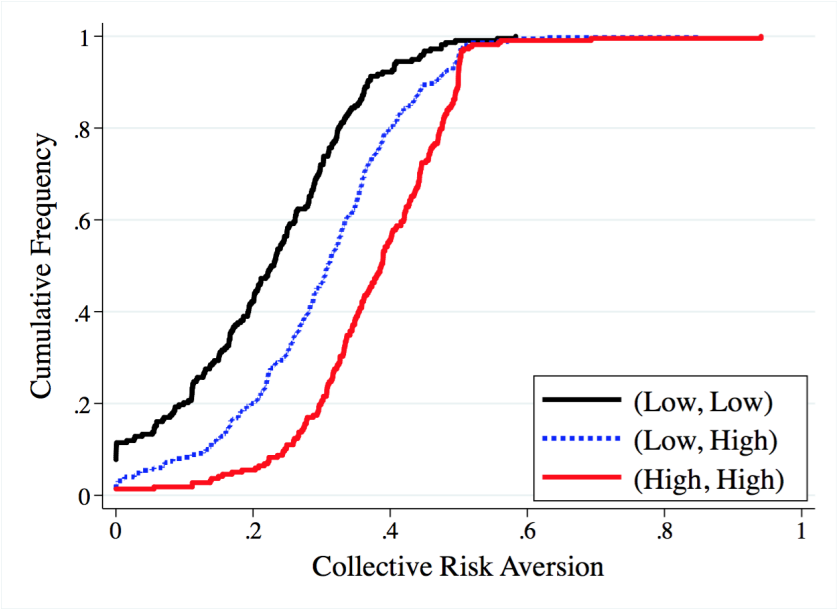
Rationality Extension: Regression Analysis

Collective CCEI	**Coefficient**	
	Model 1	Model 2
CCEI_Max	0.368^{***}	0.302^{***}
	(0.083)	(0.089)
CCEI_Distance	-0.277^{***}	-0.233^{***}
	(0.056)	(0.058)
Math_Score_Max		0.012^{**}
		(0.005)
Math_Distance		-0.010^{**}
		(0.005)
Constant	0.582^{***}	0.664^{***}
	(0.077)	(0.084)
Class Fixed Effect	Yes	Yes
Individual Characteristics	No	Yes
School Characteristics	No	Yes
Friendship	No	Yes
Observations	786	786
R-squared	0.200	0.235

Preference Aggregation: Risk Aversion

- Risk aversion (RA) measure: RA $= \frac{x_{\text{expensive}}}{x_{\text{expensive}}+x_{\text{cheap}}} \in [0, 0.5]$.
- The larger ratio is, the higher risk aversion.
- Basic statistics of individual and collective risk aversion:
  - Average individual RA: 0.324 [0.132]
  - Average collective RA: 0.298 [0.139]

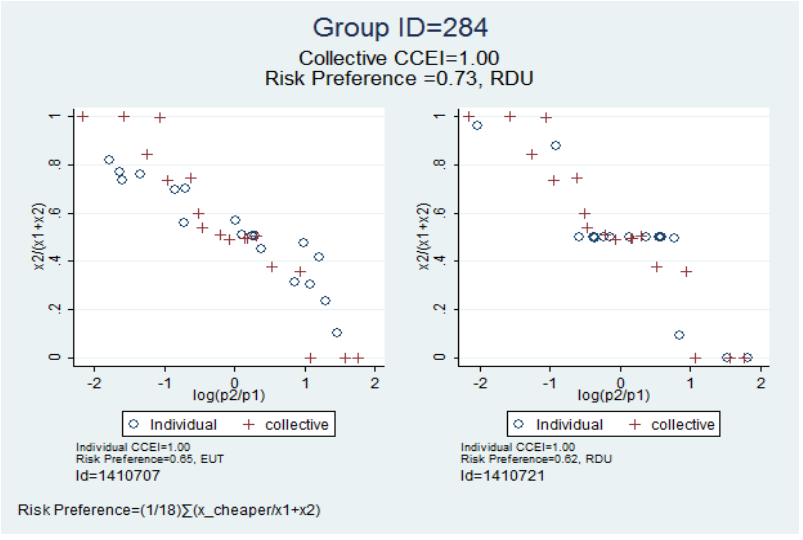
Preference Aggregation



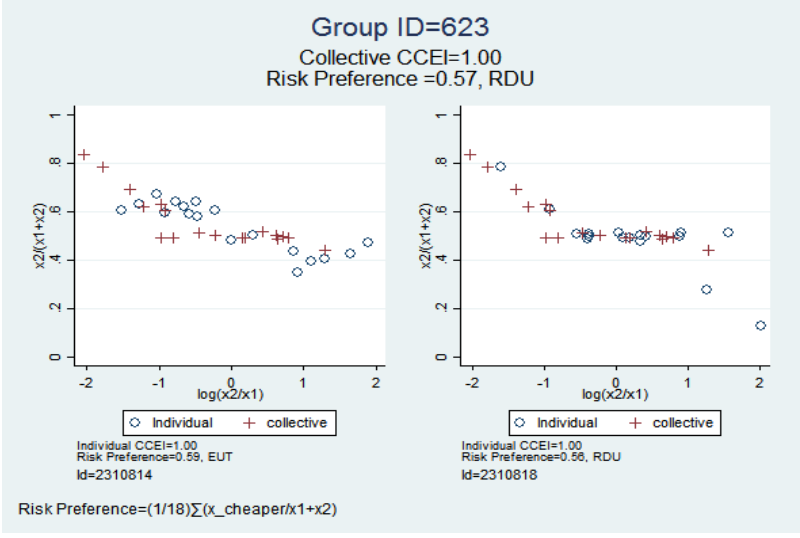
Preference Aggregation: Regression Analysis

Collective Risk Aversion	**Coefficient**	
	Model 1	Model 2
Risk_Aversion_Max	0.792^{***}	0.759^{***}
	(0.066)	(0.073)
Risk_Aversion_Distance	-0.421^{***}	-0.434^{***}
	(0.053)	(0.062)
Math_Score_Max		0.000
		(0.005)
Math_Distance		0.005
		(0.004)
Constant	0.004	-0.175^{**}
	(0.027)	(0.077)
Class Fixed Effect	Yes	Yes
Individual Characteristics	No	Yes
School Characteristics	No	Yes
Friendship	No	Yes
Observations	786	786
R-squared	0.372	0.382

Example of Individual & Collective Demand Curve



Example of Individual & Collective Demand Curve



Preference Type: EUT and RDU

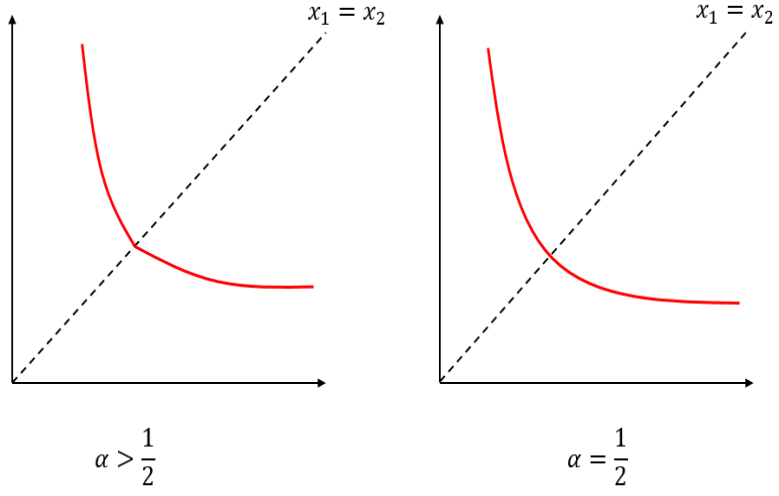


Figure: Indifference Curve: RDU (left) and EUT (right)

Aggregation of Preference Types

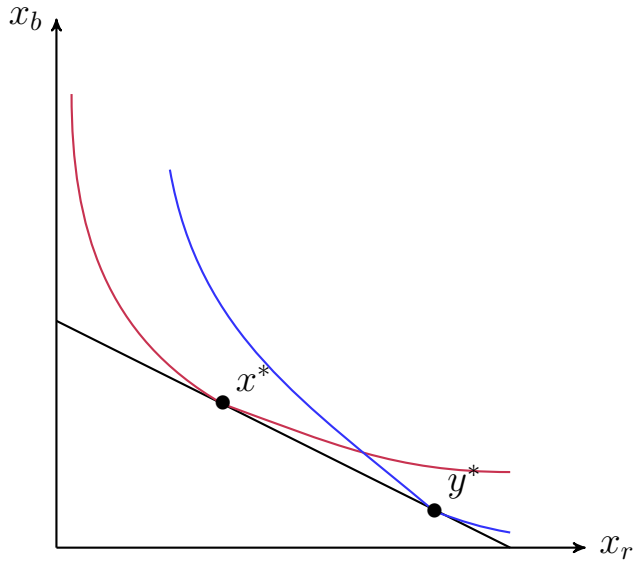
- $U(x_{min}, x_{max}) = \alpha u(x_{min}) + (1-\alpha)u(x_{max})$
- If $\alpha = \frac{1}{2}$, **Expected Utility Form (EUT)**.
- If $\alpha > \frac{1}{2}$, disappointment aversion; $\alpha < \frac{1}{2}$, elation loving. **Rank Dependent Utility (RDU) / Disappointment Aversion Model**

Individual		Both EUT	EUT & RDU	Both RDU	Total
Collective	EUT	74.5(117)	59.1(52)	50.0(7)	68.0(176)
	RDU	25.5(40)	40.1(36)	50.0(7)	32.1(83)
	Total	100(157)	100(88)	100(14)	100(259)

EUT is defined as 0.5$\in$ 95% CI of α, N for each case in parenthesis

Only includes pairs with both individuals' and collective CCEI>=0.9

Measurement: Efficiency and Welfare Loss



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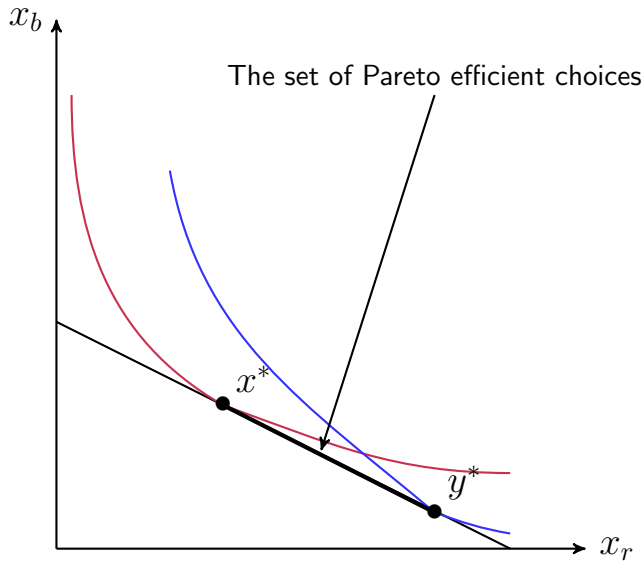

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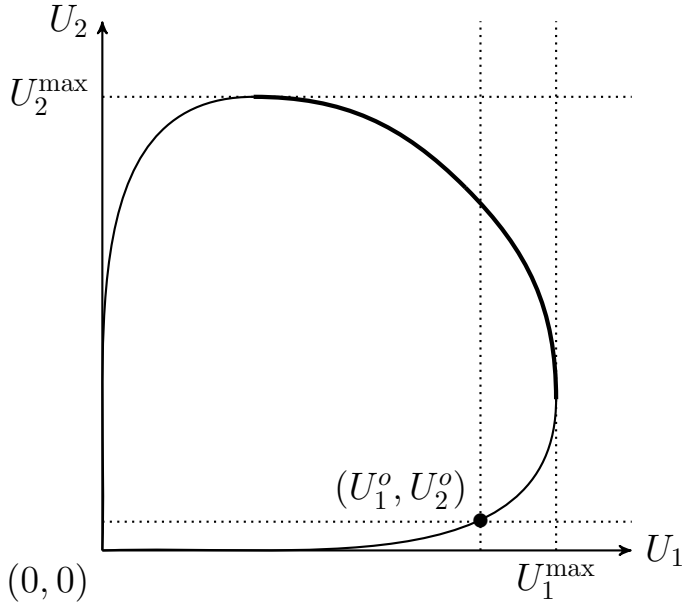

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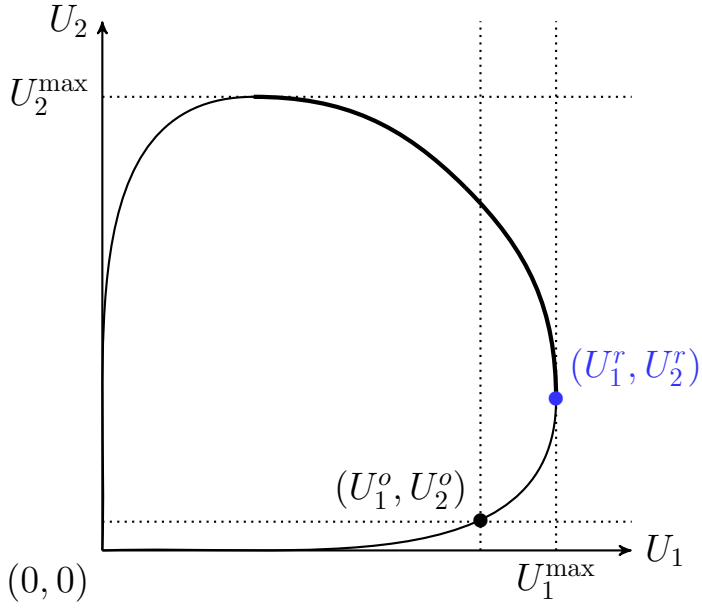

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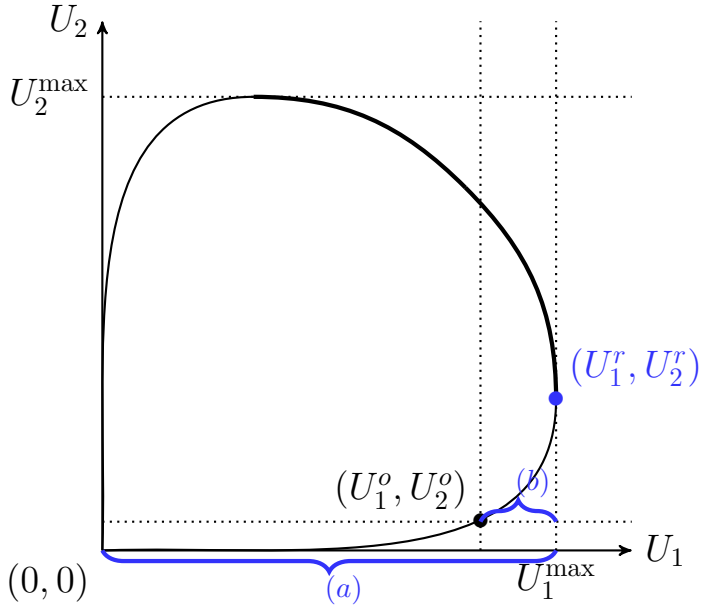
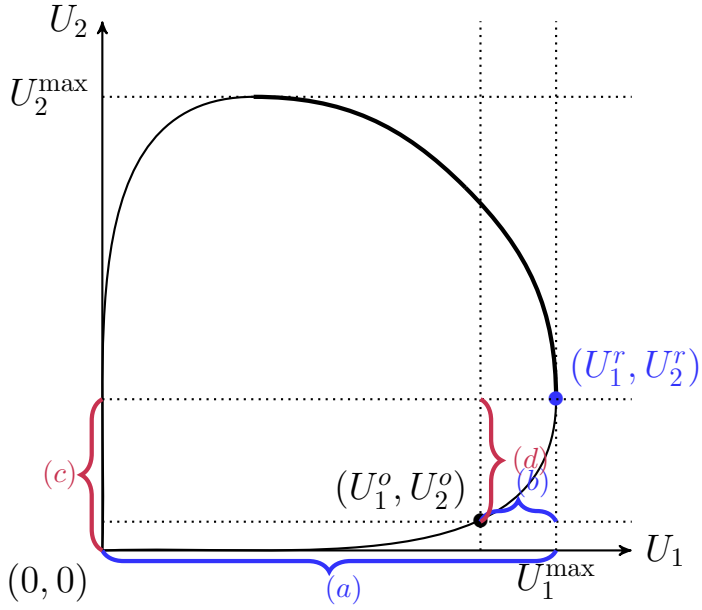


Measurement: Efficiency and Welfare Loss



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

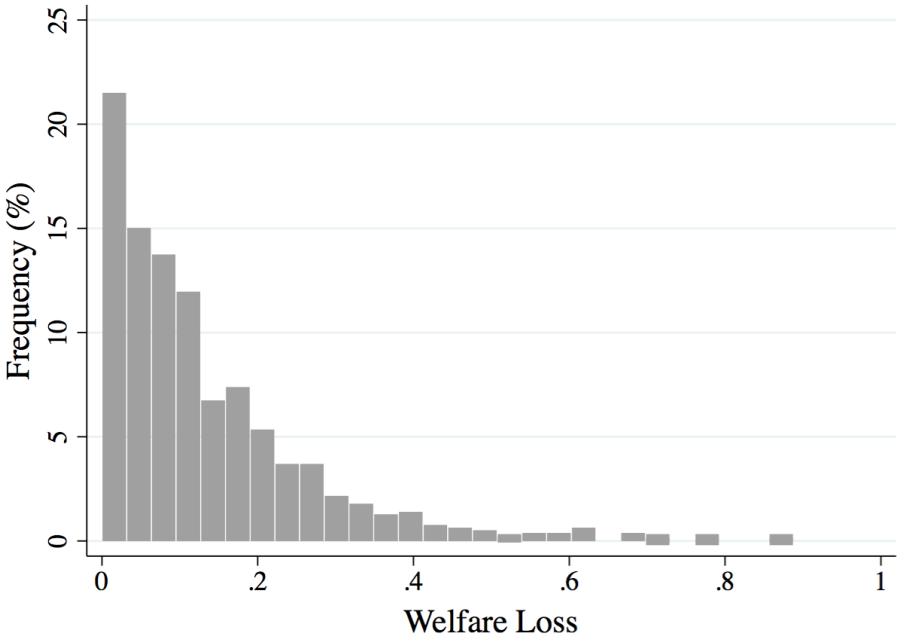
$$\text{Welfare Loss} = \frac{1}{18}\sum_{k=1}^{18}\frac{1}{2}\sum_{i=1}^{2}\frac{U_i(x_{kr}) - U_i(x_{kc})}{U_i(x_{kr}) - U_i(x_{kw})},$$

  where

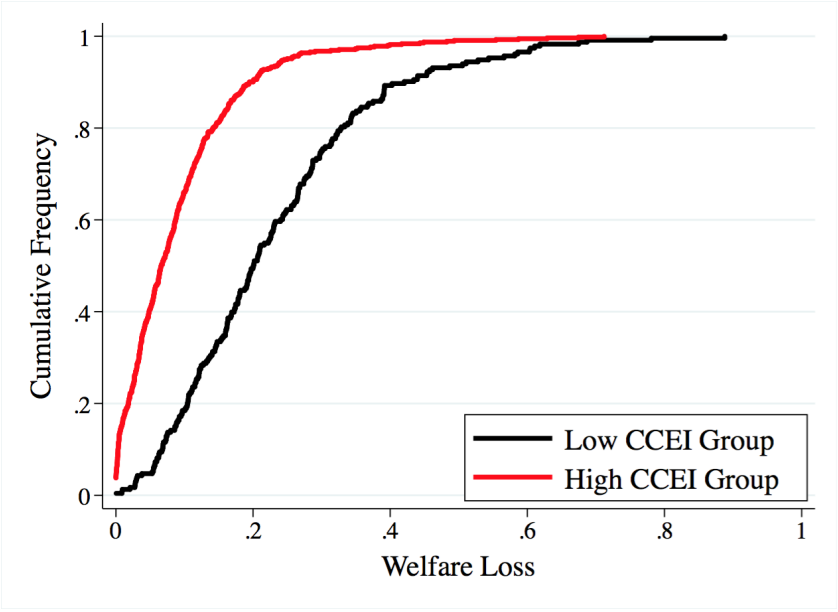
  - x_{kc}: group's choice in k-th round
  - x_{kr}: group's reference choice in k-th round
  - x_{kw}: group's worst choice in k-th round.

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

Efficiency and Welfare: Distribution of Welfare Loss



Welfare Loss and Group Rationality



Welfare Loss: Rationality Extension and Preference Aggregation

Group Inefficiency	**Coefficient**			
	Model 1	Model 2	Model 3	Model 4
CCEI_Group	-0.571^{***}	-0.503^{***}	-0.527^{***}	-0.414^{***}
	(0.042)	(0.039)	(0.043)	(0.078)
CCEI_Max		-0.296^{***}	-0.242^{***}	-0.692
		(0.045)	(0.051)	(0.671)
CCEI_Distance		0.165^{***}	0.178^{***}	0.289
		(0.042)	(0.052)	(0.257)
Risk_Aversion_Max		-0.009	0.023	-0.024
		(0.056)	(0.063)	(0.089)
Risk_Aversion_Distance		-0.057^{*}	-0.073^{*}	-0.123^{*}
		(0.031)	(0.040)	(0.066)
Math_Score_Max			0.002	0.008
			(0.005)	(0.007)
Math_Distance			-0.004	-0.010
			(0.003)	(0.006)
Constant	0.651^{***}	0.866^{***}	0.807^{***}	1.154^{*}
	(0.038)	(0.048)	(0.061)	(0.653)
Class Fixed Effect	Yes	Yes	Yes	Yes
Individual Characteristics	No	No	Yes	Yes
School Characteristics	No	No	Yes	Yes
Friendship	No	No	Yes	Yes
Observations	786	786	786	274
R-squared	0.442	0.487	0.497	0.436

Conclusion

- Revealed preference approach for rationality extension and preference aggregation
- Evidence for rationality extension
- Preference aggregation: EUT individuals more likely to be EUT in collective choices
- Welfare loss and rationality extension / preference aggregation
  - Rational groups are more likely to make efficient decisions.
  - Preference-aligned individuals need not make efficient decisions.