

Rationality and Preference Aggregation of Group Decision under Risk

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Introduction

- In various contexts, many important decisions are made by groups.
- Individuals in the collective are **heterogeneous**.
 - Rationality
 - Time preference: household savings and consumption decisions
 - Risk preference: risk assessment in environmental policy-making in committees
- The expansion of democratic institutions and rapid progress in communication technology (e.g., Skype and SNS) highlight the importance of exploring the process of group decisions.

Introduction: Why Experiments?

- The laboratory experiment can be stripped of many confounding factors, and decisions can be observed in a highly **controlled environment**.
- We can directly measure rationality and risk preference without noise.

Introduction: Why Experiments?

- The laboratory experiment can be stripped of many confounding factors, and decisions can be observed in a highly **controlled environment**.
- We can directly measure rationality and risk preference without noise.
- Beyond measuring risk preference, we can investigate how risk preferences are **aggregated**.
- We measure **rationality** of both individuals and group decisions by applying the **revealed preference theory**.
- We finally analyze efficiency of group decisions.

Introduction: Research Questions

1. Rationality extension:

- If each individual's choices are consistent with a utility maximization model, do a group's choices also tend to be?

2 Risk preference aggregation:

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

3. Efficiency:

- Are a group's choices Pareto efficient? Is it maximizing social welfare?

Related Literature

1. Preference aggregation
 - If each individual's choices are consistent with a utility maximization model, do a group's choices also tend to be?
- 2 Testable implication
 - Are individual's risk preferences reflected into that of a group?
3. Intra-household bargaining
 - Are a group's choices Pareto efficient? Is it maximizing social welfare?

Experimental Design and Subjects

Experimental Design

x_b

Two equally likely states: R and B .

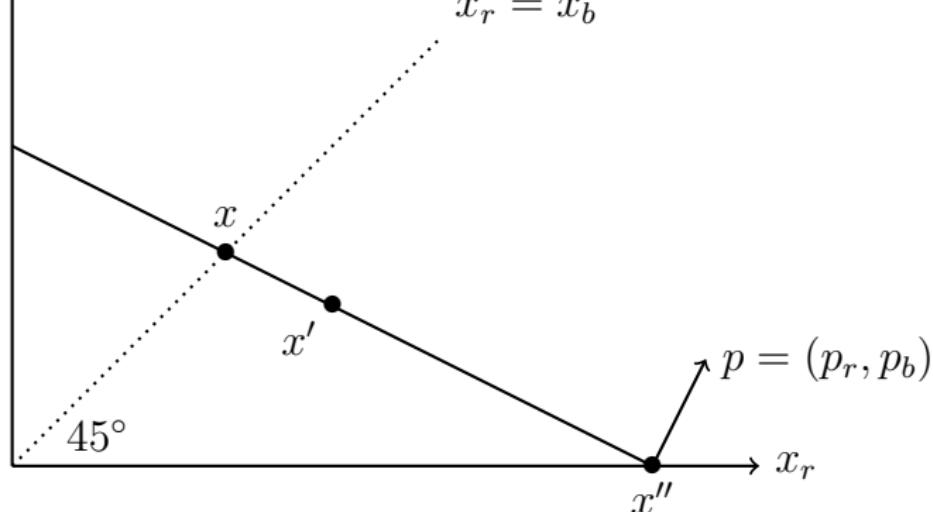
There are two associated Arrow securities.

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

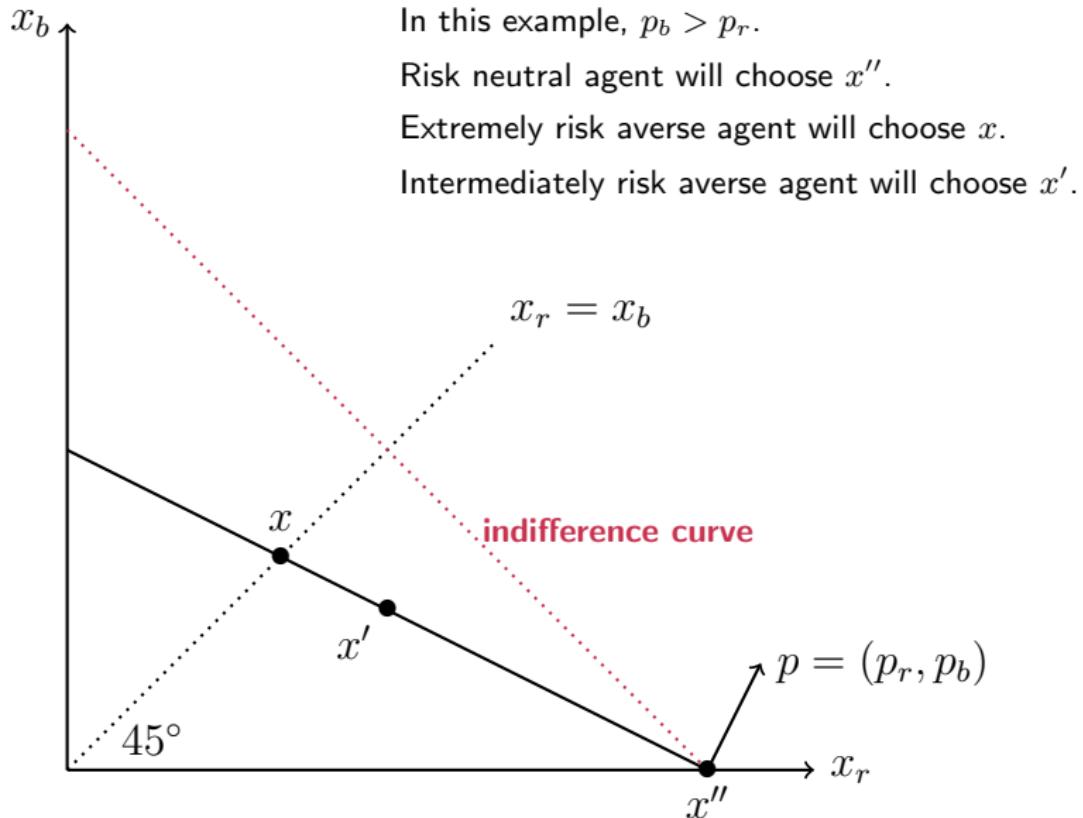
x_b is the demand for the security that pays off in state B .

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

$$x_r = x_b$$



Experimental Design



Procedure and Subjects

- We conducted the experiment in 12 middle schools in Daegu.
- The number of students:
- The instructions were read aloud by an experimenter in each classroom.
- Each subject participated in two sessions: individual and group.
- Each session consisted of 18 independent decision rounds.
- Each round started by having the computer select a budget line randomly from the set of lines that intersect at least one axis at or above 300 KRW or below 1500 KRW.

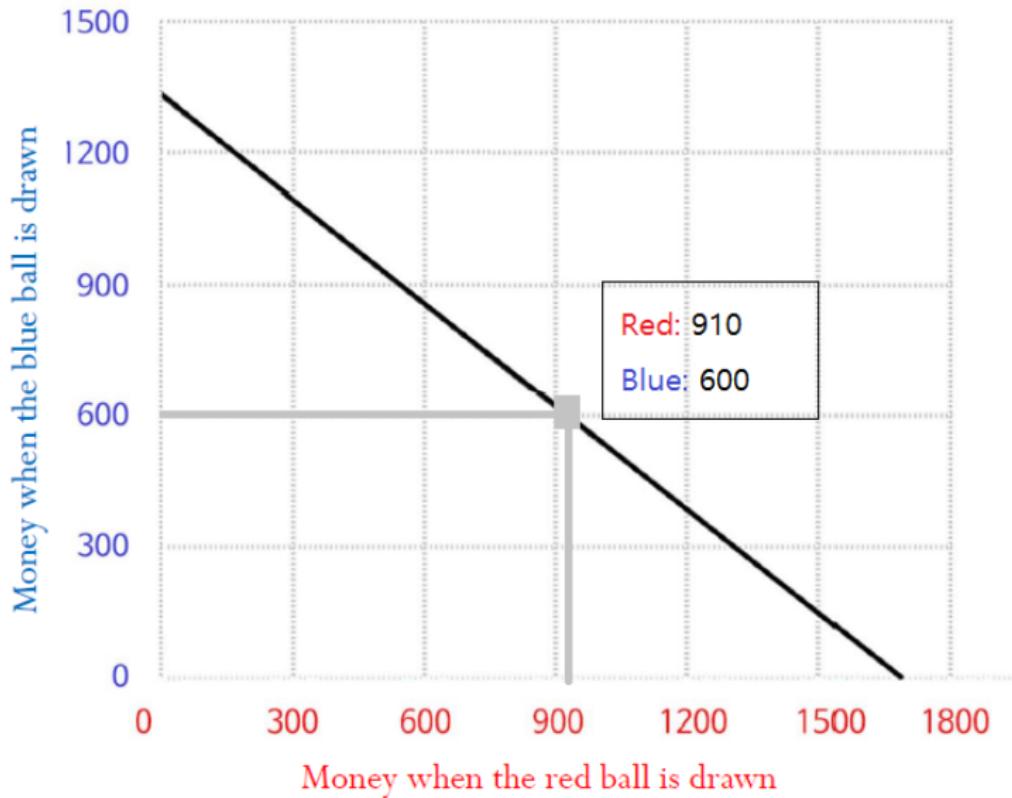
Procedure and Subjects

- At the end of each round, the computer randomly selected one of the two states (*R* and *B*).
- Subjects were not informed of the state that was actually selected at the end of each round.
- Each subject was paid for he/she earned in a randomly selected round.
- After finishing the first session, students start the second session.
- Two students in the same classroom were randomly matched.
- A student moved to the other partner's desk and shared the computer.

Experimental Design



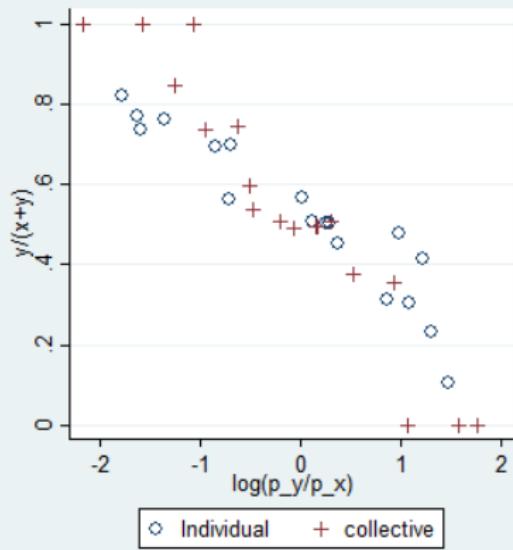
Experimental Design: Screenshot



Experimental Design: Example

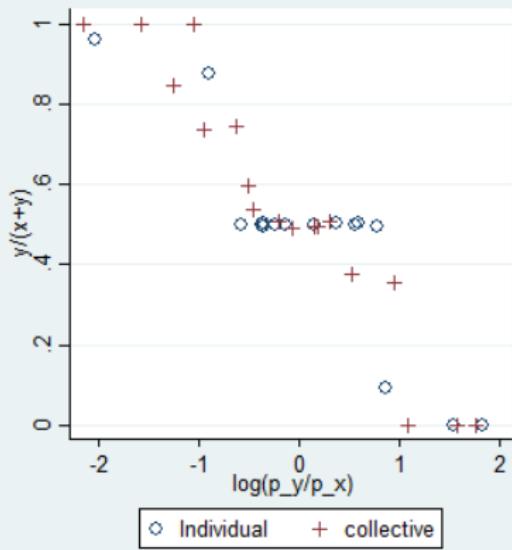
Group ID=284

Collective CCEI(Risk Pref.) = 1.00(0.73)



Individual CCEI(Risk Pref.)=1.00(0.65)

Id=1410707



Individual CCEI(Risk Pref.)=1.00(0.62)

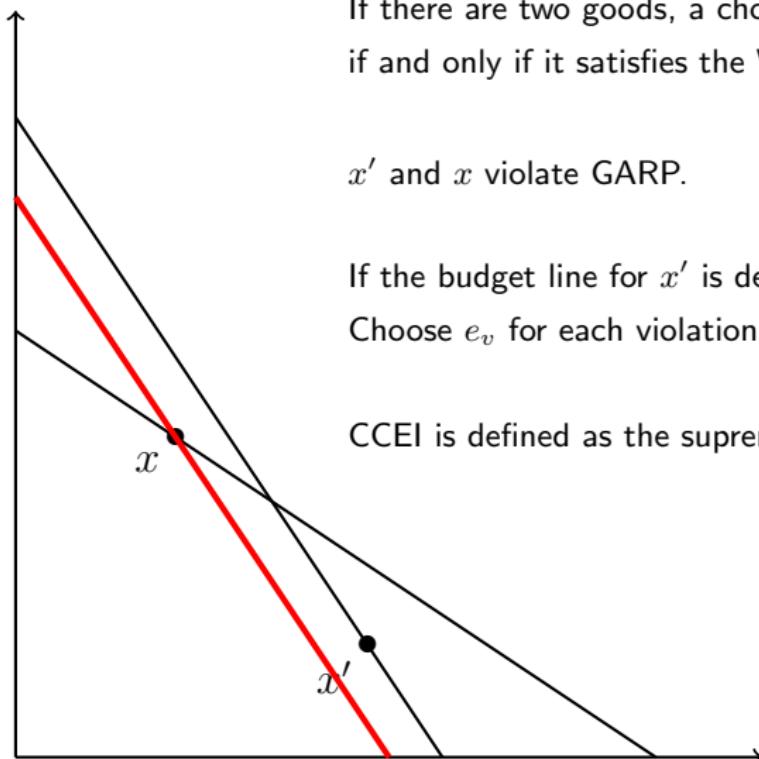
Id=1410721

Right Individual moved the seat.

Risk Pref=average(Unit of cheaper goods/sum of unit)

Result 1: Rationality Extension

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 GARP.

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

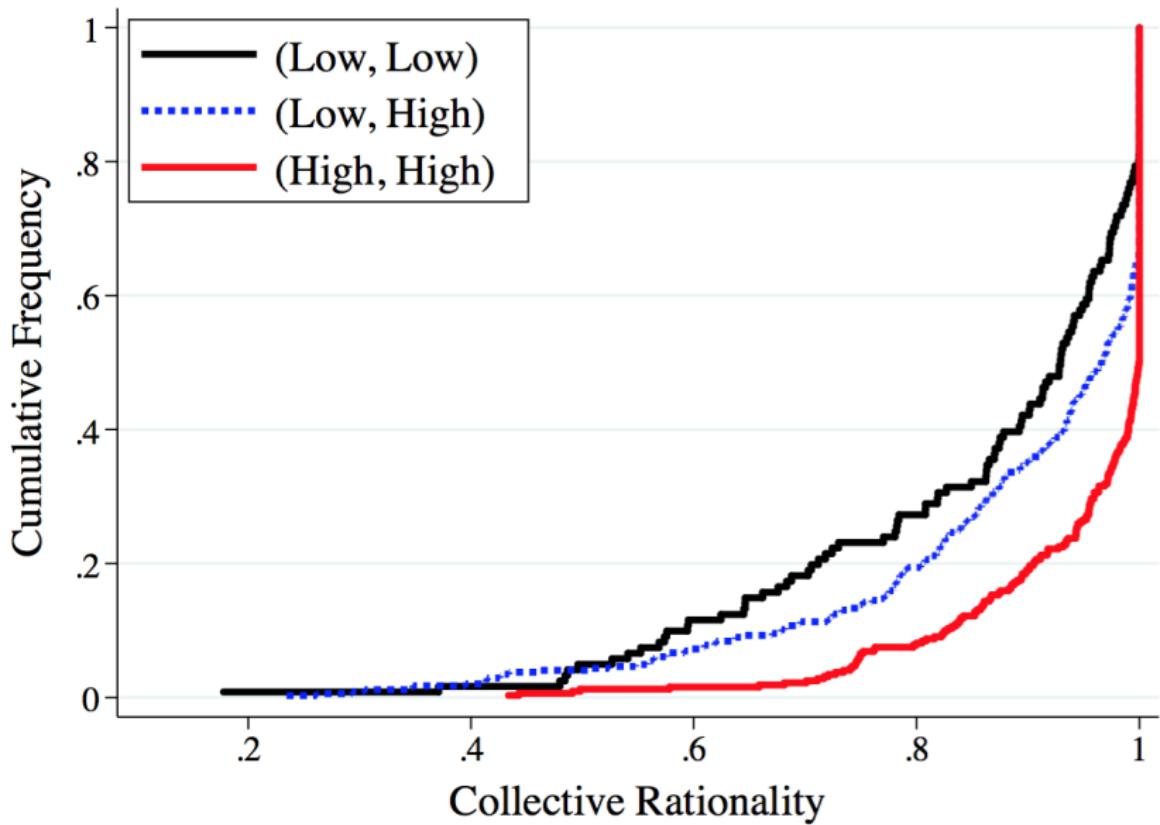
CCEI is defined as the supremum over all the numbers e_v 's.

Measurement: Afriat's Efficiency Index (a.k.a. CCEI)

- By definition, $\text{CCEI} \in [0, 1]$.
- The bigger CCEI is, the less severe violation of GARP.
- **Research Question:**

Individual Rationality $\uparrow \Rightarrow$ Group Rationality $\uparrow?$

Result 1: Rationality Extension



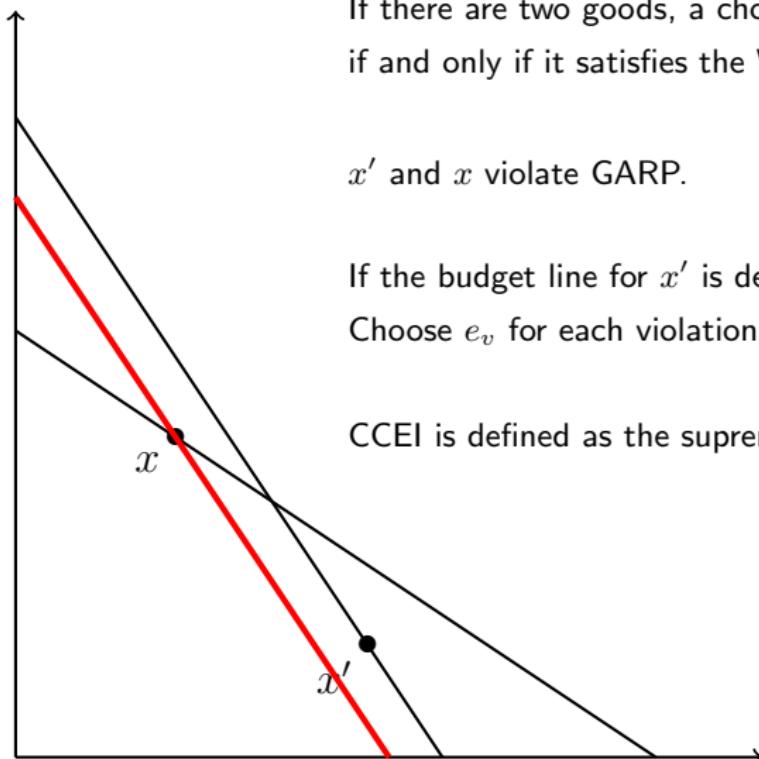
Result 1: Rationality Extension

- Kolmogorov-Smirnov Test
- Results:
 - Dictator game: We find substantial increase of giving amount.
 - Public goods game: We do not find any significant increase of cooperation.

Collective CCEI	Coefficient			
	Model 1	Model 2	Model 3	Model 4
CCEI_Max	0.024*** (0.011)	0.013 (0.010)	0.026** (0.015)	0.002 (0.014)
CCEI_Max_Non-Mover	0.049*** (0.012)	0.044*** (0.011)	0.042*** (0.014)	0.047*** (0.015)
CCEI_Distance	0.050*** (0.008)	0.041*** (0.007)	0.036*** (0.010)	0.041*** (0.009)
Risk_Aversion_Max	0.010 (0.008)	0.015** (0.007)	0.014 (0.009)	0.015 (0.013)
Risk_Aversion_Distance	-0.013 (0.015)	0.022 (0.021)	0.015 (0.021)	0.028 (0.022)
Non_Coed	0.004 (0.011)	0.003 (0.010)	-0.005 (0.010)	0.012 (0.010)
Math_Score		-0.007* (0.004)	0.009* (0.004)	-0.005 (0.004)
Math_Distance		-0.000 (0.008)	-0.005 (0.008)	-0.005 (0.009)
Constant	0.308*** (0.047)	0.184*** (0.085)	0.237*** (0.051)	0.127*** (0.092)
Class Fixed Effect	Yes	Yes	Yes	Yes
Individual Characteristics	Yes	Yes	Yes	Yes
Friendship	Yes	Yes	Yes	Yes
Observations	9,377	9,377	4,584	4,793
R-squared	0.036	0.185	0.187	0.188

Result 2: Preference Aggregation

Measurement: A Non-Parametric Measurement



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

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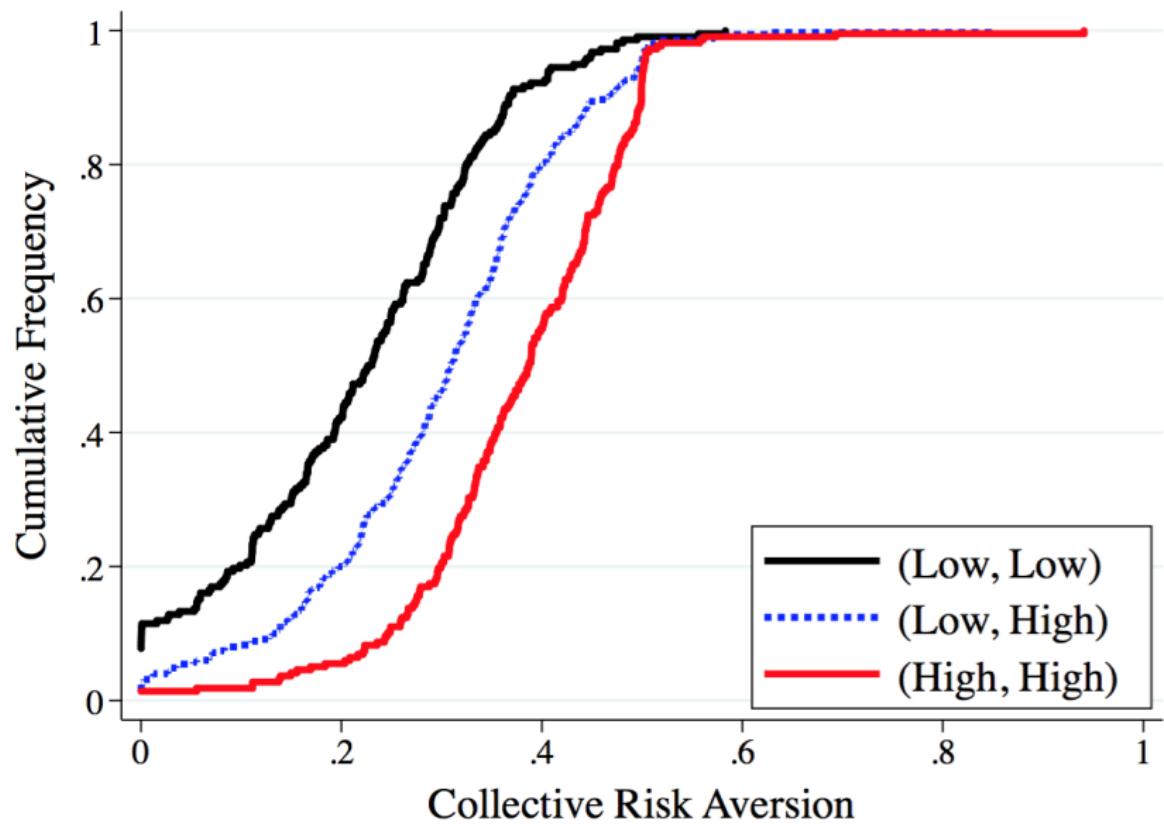
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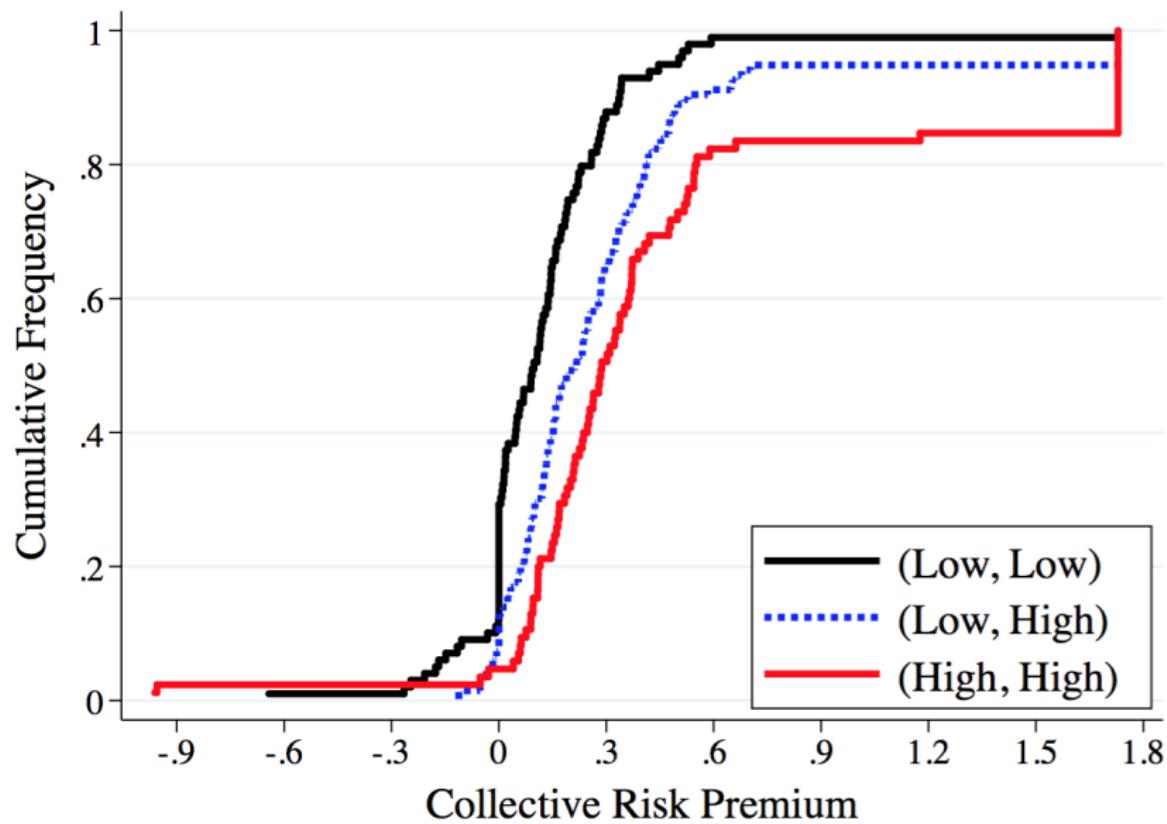
Measurement

- Expected utility form
- Rank dependent utility form (RDU)
- Aggregation of utility types
- Assuming CARA, we can also estimate risk premium for each observation.

Result 2: Risk Preference Aggregation



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Result 3: Efficiency

Measurement

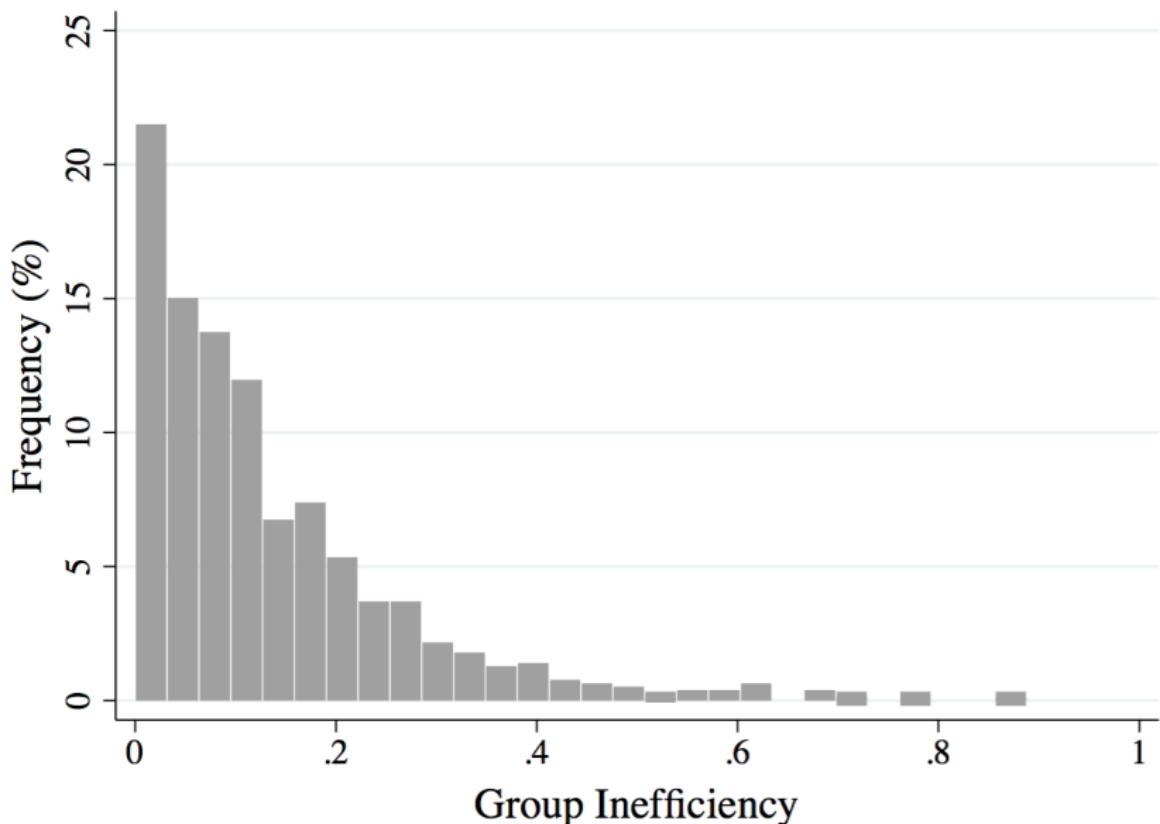
- For given budget set, let x_1^* and x_2^* be the optimal portfolio choice of agent 1 and agent 2, respectively.
- Claim:** A group choice x_c is **Pareto efficient** if and only if $x_c \in [x_1^*, x_2^*]$.
- Given this, we measure the group inefficiency as the average utility loss:

$$\text{Inefficiency}_g = \frac{1}{18} \sum_{k=1}^{18} \frac{1}{2} \sum_{i=1}^2 \frac{u_i(x) - u_i(x_c)}{u_i(x) - u_i(x_w)}.$$

where

- x_c : group choice
- x_w : the worst outcome in budget k
- By definition, $\text{Loss}_g \in [0, 1]$.

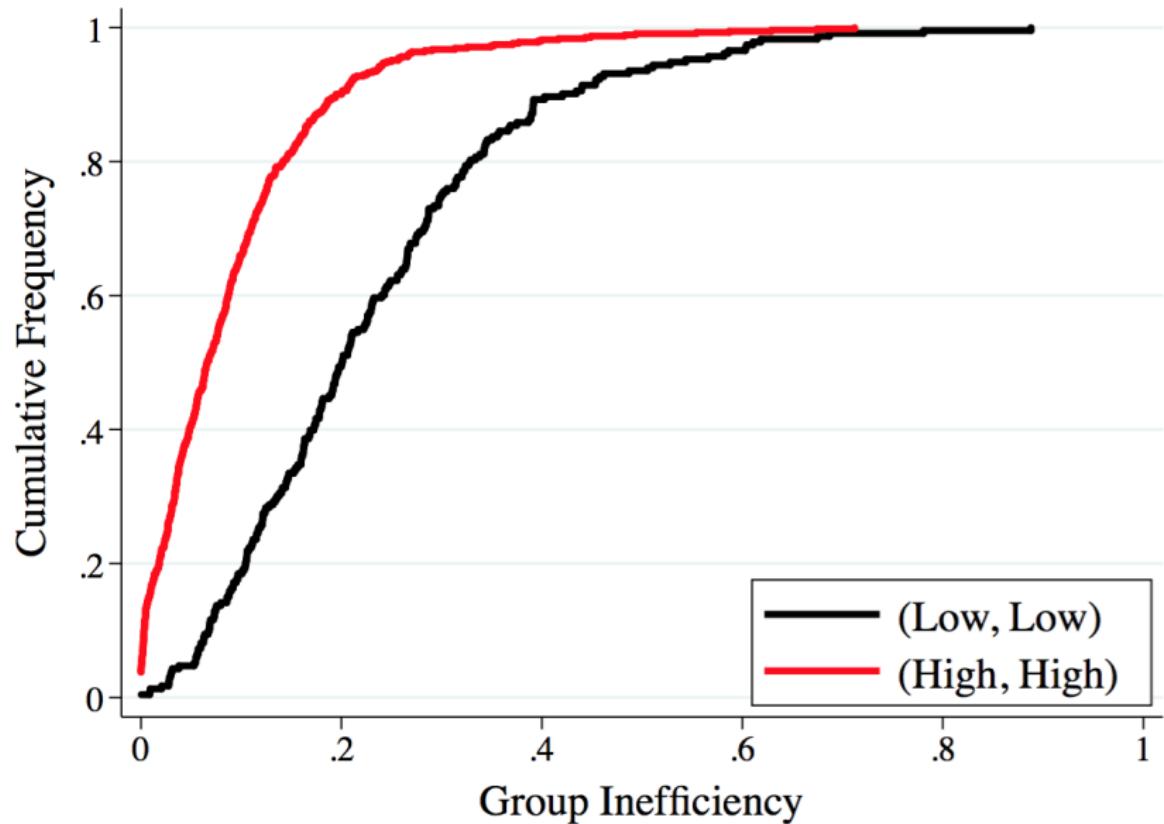
Measurement: Distribution of Group Inefficiency



Analysis

- **Research Question:** How is the group inefficiency related to the group rationality and risk preference?

Pareto Efficiency



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Conclusion



Robustness

Varian's Efficiency Index



Introduction: Risk Perception

1. Genetics: White males were more likely to perceive risks as being smaller (Bickerstaff, 2004; Flynn et al., 1994).
2. Psychology:
 - availability bias
 - experience
3. Knowledge and Information: public v.s. experts
4. Other factors
 - culture: Chinese individuals are significantly less risk-averse than individuals from Western countries when making financial decisions (Weber and Hsee, 1998).
 - power: high-power groups adopt a more positive attitude toward potential risks (Anderson and Galinsky, 2006; Magee et al., 2007; Geng et al, 2018).
 - social inequality: Sweden people with foreign backgrounds did perceive risks as higher than native people, but no difference between men and women.

Introduction: Implication

- Health

- “미세먼지의 위험성에 대해서 잘 인식하지 못하는 사람들도 적지 않았다. 경기도 고양시에서 폐지 줍는 일을 하는 조모(82) 씨는 미세먼지가 무섭지 않다고 했다. 그는 노인들이 미세먼지에 더 취약하다는 지적에 “**70평생 먼지 들이켜고도 잘 살았다**”고 말했다”
 - 헤럴드 경제, [미세먼지의 습격⑦] 거리가 일터인 택배원·배달원 “마스크쓰고 일 못해요”, 2018. 1. 17. –

Introduction: Implication

- Health

- 비용-편익 분석의 핵심은 특정 정책의 비용과 편익에 대한 정확한 추정을 기반으로 한다. 결과적으로 효과적이고 합리적인 정책은 그 정책 대상에 대한 정확한 가치의 추정을 바탕으로 그에 상응하는 정책을 수립하는데에서 출발할 수 있을 것이다. 환경정책도 여기서 예외가 될 수는 없다. 즉, 효과적이고 합리적인 환경정책은 해당 환경자원에 대한 정확한 가치의 추정이 선행되어야 한다는 것이고 이렇게 추정된 가치에 대한 자료를 근거로 정책의 우선순위나 당위성을 확보할 수 있다는 것이다. 그런데, 환경정책에서 가장 어려운 부분이 바로 여기에 존재한다. 환경자원은 그 특성상 시장이 존재하지 않는 경우가 많으며 기타 시장재화와는 다르게 특정 환경자원의 화폐적 가치를 직접적으로 추정하기가 어렵다. 환경자원의 가치 추정에서의 어려움을 극복하기 위해 제안된 가치평 가기법들은 여러 가지가 존재한다. 이 중에서도 가장 광범위하게 사용되고 있는 기법은 가상 시장에 기반을 두어 그 환경자원의 가치를 직접적으로 유도하는 방식인 진술선호법 중 하나인 조건부가치평가법(contingent valuation method)을 꼽을 수 있다.

- Policy: 시민참여단의 성, 연령, 거주 권역, 교육수준 등의 특성에 따라 건설 재개 및 중단에 대한 응답에 차이가 있는지를 알아보기 위해 차이검정을 실시했다. 먼저 성별에 따른 차이를 보면 남자 66.3연령별로 보면 20대는 56.8권역별로 살펴보면 수도권 시민참여단은 건설 재개와 중단에 대해 전국 평균과 유사한 경향을 보여 주었다. 호남권