Rationality-Based Preference Aggregation*

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Abstract

We study how individual rationality affects group decision making using large-scale experiments with randomly assigned pairs. We develop a nonparametric revealed preference measure of bargaining power that applies to all subjects without requiring rationality or parametric utility functions. More rational individuals exert substantially greater influence on group decisions. Group decision quality increases with the rationality of the more rational member and decreases with the gap between members. The advantage of rational members is larger when communication is easier. Results establish causal effects of rationality on both bargaining power and collective choice quality.

Keywords: Collective choice; Preference aggregation; Rationality extension; Revealed preference; Experiment

1 Introduction

Most economic decisions are made by groups. Households allocate consumption and investment (Davis, 1976; Browning and Chiappori, 1998), committees set policy (Austen-Smith and Banks, 1996), and firms are governed by boards (Adams et al., 2010). A foundational assumption in the study of group decision making is that individuals are rational

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(Chiappori, 1992; Feddersen and Pesendorfer, 1998). Yet substantial heterogeneity exists in individual rationality, measured by consistency with utility maximization (Choi et al., 2007). More rational individuals accumulate more wealth and make better financial decisions (Choi et al., 2014). Individual decision-making ability, proxied by education, cognitive ability, or financial literacy, influences household outcomes and bargaining power (Behrman et al., 2012; Yilmazer et al., 2015; Guiso et al., 2023; Gu et al., 2023). We ask: how does individual rationality affect group decision making?

We argue that individual rationality shapes both the quality of group decisions and the distribution of bargaining power within groups. Rationality affects group outcomes through two channels. First, consistent preferences are easier to communicate and more credible during deliberation. Individuals whose choices satisfy revealed preference axioms exhibit consistency across contexts, making preferences easier to articulate. Empirical evidence shows that group members evaluate each other more positively and perceive information as higher quality when preferences appear consistent, while inconsistency reduces perceived competence and undermines influence (Mojzisch et al., 2014; Wittenbaum et al., 1999; Festinger, 1957; Matz and Wood, 2005). Second, rational members can identify dominated alternatives and improve decision quality. Whether groups decide better than individuals depends on the distribution of rationality within groups (Charness and Sutter, 2012; Cooper and Kagel, 2005). Highly rational members guide deliberation toward better choices, while heterogeneity in rationality creates informational frictions that reduce efficiency. Testing these mechanisms requires measuring individual rationality and bargaining power within a unified framework and establishing causal links between them.

We conduct large-scale panel experiments with randomly formed pairs making choices under risk. Our design follows Choi et al. (2007). Subjects choose between two Arrow securities corresponding to two equally probable states of nature with a series of randomly drawn linear budget sets. We study 652 pairs (1,304 individuals) from 12 middle schools in South Korea at baseline (August 2016) and four months later at endline (December 2016).

The experiment proceeds in two stages. In the first stage, each subject makes 18 individual portfolio choices facing randomly drawn budget sets. In the second stage, subjects are randomly matched into pairs within their classroom. One member of each pair, designated the mover, relocates to sit with their partner. Each pair receives 90 seconds to discuss how they will make choices in the upcoming collective decisions. No specific guidance is provided on how to reach consensus. After discussion, pairs make 18 collective decisions under the same decision environment as individual choices. Collective decisions are common allocation decisions: both members receive identical payoffs from the selected portfolio.

Random assignment eliminates selection bias from partner choice. At baseline, partners cannot select based on anticipated decision-making compatibility. This allows us to identify causal effects of individual rationality on group outcomes. Observational studies of couples or households confound these effects with unobserved factors related to matching (Abdellaoui et al., 2013; Bateman and Munro, 2005). Couples may select partners based on decision-making compatibility and develop idiosyncratic consensus mechanisms over time. Random assignment eliminates these confounds. Pairing occurs within classrooms, where subjects already know each other. This creates a natural environment for joint decision making while preserving experimental control.

We measure rationality using Afriat's (1972) Critical Cost Efficiency Index (CCEI), which quantifies the minimum budget relaxation needed to eliminate all violations of the Generalized Axiom of Revealed Preference (GARP). Our central methodological contribution is a nonparametric, revealed preference measure of individual bargaining power in group decisions. Existing approaches either impose strong parametric assumptions about preferences (Chiappori, 1988, 1992; Browning et al., 2013; Gu et al., 2023) or provide only comparative statics without recovering individual bargaining weights (Ambrus et al., 2015; Baillon et al., 2016). Our approach combines their strengths while avoiding their limitations.

We propose a revealed preference index for bargaining power that measures how closely individual choices match group choices, without assuming any functional form for preferences. The logic is simple: if group decisions look more like individual i's decisions than individual j's decisions, then individual i has more bargaining power. We implement this as follows. Start with the group's choices and compute their CCEI. Then merge individual i's choices with the group's choices, creating a combined dataset, and compute its CCEI. The CCEI must weakly decline because adding more choices can only introduce additional GARP violations. The size of the decline measures how different individual i's choices are from the group's choices. We then add individual j's choices to obtain a dataset containing all choices from both individuals and the group, and compute its CCEI. We normalize individual i's distance by the total distance and average over the two possible orders of adding individuals to make the index order-independent. The resulting index ranges from 0, meaning the individual fully determines group choices, to 1, meaning the individual has no influence. By construction, the two members' indices sum to one. The index has a Shapley value interpretation: it allocates to each member her marginal contribution to the total preference disagreement between individuals and the group.

This measure applies to all subjects regardless of rationality level, requires no functional form assumptions about preferences, and produces individual-level bargaining weights for every subject. We validate the measure in two ways. First, we show it correlates strongly with survey responses about perceived influence in group decisions. Subjects who report their preferences were strongly reflected in group outcomes have significantly lower distance indices than those who report their partner's preferences dominated. Second, we conduct Monte Carlo simulations using a parametric data-generating process with known bargaining weights. The nonparametric index closely tracks the true weights, confirming its interpretation as a measure of bargaining power.

We find that more rational individuals exert substantially greater influence on group decisions. The revealed preference distance is 0.35 to 0.44 lower for the more rational member of each pair, depending on specification. This is a large effect: the index ranges from 0 to 1, both members' indices sum to one, and the coefficient magnitude implies that moving from the less rational to the more rational member shifts the index by roughly 40 percentage points. This result holds controlling for individual characteristics including risk preferences, cognitive ability, friendship status, and demographics. Individual rationality matters more than any other observable characteristic for determining bargaining power. Shapley decomposition of regression R-squared shows that individual rationality measure is a primary factor explaining the individual-level variations in bargaining weights.

The quality of group decisions depends on the rationality of both members. When both members have CCEI above the median, groups exhibit high rationality (mean CCEI 0.96). When both have CCEI below the median, groups perform poorly (mean CCEI 0.83). When one member has high CCEI and one has low CCEI, group quality falls between these extremes (mean CCEI 0.91). Regression analysis confirms this pattern. Group CCEI increases with the maximum CCEI of the two members (coefficient 0.31 to 0.40) and decreases with the gap in CCEI between members (coefficient -0.20 to -0.26). These effects are robust to controls for individual characteristics and strengthen over time. The patterns suggest that bargaining power mediates the relationship between individual rationality and group outcomes: groups with rational members make better choices when those members have influence, but heterogeneity in rationality reduces quality by creating disagreement.

The findings also shed light on when rationality matters most for bargaining power. The advantage of rational members is larger when pairs are mutual friends or same gender, conditions where communication may be easier. Greater rationality corresponds to more consistent and clearer preferences, facilitating articulation during deliberation. This interpretation aligns with evidence that communication improves efficiency in collective decision making (Goeree and Yariv, 2011) and that group members with clearer positions exert greater influence during deliberation (Burnstein et al., 1973). The heterogeneity effects we document suggest that the relationship between rationality and influence is not uniform across all group contexts. In pairs where social distance is lower, the more rational member's advantage in bargaining power increases substantially. This pattern is consistent with rationality operating through a communication channel: when members can more easily exchange information and understand each other's reasoning, the clarity advantage conferred by consistent preferences becomes more valuable. Conversely, in pairs where communication is more difficult, other factors such as assertiveness or social status may play a larger role in determining influence, partially offsetting the advantage of rationality. These findings contribute to understanding the mechanisms through which individual characteristics translate into bargaining power and highlight the importance of group composition for the efficiency of collective decisions.

We contribute to three literatures. First, we extend revealed preference methods from individual choice (Afriat, 1967; Varian, 1982; Choi et al., 2007) to group settings. Structural estimation of collective models specifies group utility as a weighted average of individual utilities, where weights represent bargaining power (Chiappori, 1988, 1992; Browning et al., 2013). Estimation requires functional form assumptions and price variation or exclusion restrictions to identify parameters (Lewbel and Pendakur, 2008; Gu et al., 2023). Reduced-form approaches regress household outcomes on individual characteristics using instruments or distribution factors (Chiappori et al., 2002; Browning and Chiappori, 1998), providing comparative statics rather than levels of bargaining power. Our index provides a theory-free measure of influence that applies to all subjects without parametric assumptions.

Second, we contribute to experimental studies of group decision making under risk. A substantial literature compares group and individual choices (Baker et al., 2008; Charness and Sutter, 2012), with mixed findings on whether groups are more rational or risk averse. Other studies examine how individual risk preferences aggregate into group preferences. For instance, Ambrus et al. (2015) find that group lottery choices reflect the preferences of median members and those close to the median. Baillon et al. (2016) study how different decision rules affect group rationality. Abdellaoui et al. (2013) compare risk preferences of couples with those of individuals. Our contribution is threefold. We measure individual bargaining power nonparametrically for all subjects, enabling us to identify determinants of influence within groups. We establish that rationality, not just preference intensity or position, drives bargaining power. We demonstrate that groups with rational members make better decisions, linking decision quality to the distribution of rationality rather than simply comparing groups to individuals.

Third, we contribute to the literature on collective household decision making (Browning et al., 2014). Studies document that individual characteristics such as cognitive ability, education, and financial literacy affect household outcomes and bargaining power (Behrman et al., 2012; Yilmazer et al., 2015; Guiso et al., 2023; Gu et al., 2023). These studies rely on observational data where matching is endogenous and use proxies for decision-making ability. We use random assignment to establish causal effects of rationality, measured directly through revealed preference tests, on both the quality of collective choices and the distribution of bargaining power.

The remainder of the paper proceeds as follows. Section 2 describes the experimental design and data. Section 3 presents our measures of rationality, bargaining power, and risk preference. Section 4 reports results on group rationality, preference aggregation, and bargaining power. Section 5 concludes.

2 Experiment and Data Collection

We conducted large-scale panel experiments from 12 middle schools in Daegu city, the fourth largest city in South Korea, in coordination with the Daegu Metropolitan Office of Education, over two periods with a four-month interval, in August (baseline) and December (endline) 2016. The baseline and endline studies consisted commonly of two parts; 1) the experiments of individual and group decision-making under risk, and 2) surveys of friendship and student's characteristics including cognitive and noncognitive skills. We implemented the same set of surveys and experiments in both baseline and endline studies to facilitate panel analysis. The data collection of experiments and surveys was conducted through oTree (Chen et al. 2015). For each student, we provided a laptop that was connected to the internet via a wifi router in each classroom. Appendix Figure XXX presents a photograph from our data collection fieldwork. We randomized the order of these parts across classes to control the order effects.

We conducted a friendship survey with all registered 7th graders in the 12 schools, but due to budget constraints, the experiments and other surveys were conducted with students in four randomly selected classrooms in each school. Four classrooms randomly selected in the baseline study were selected again in the endline study. We conducted the experiments and surveys concurrently in four classrooms, with four trained experimenters (research assistants) assigned prior to the fieldwork. To minimize variation in implementation, we provided standardized presentation slides and scripts.[1] Any remaining differences across experimenters are absorbed by school-by-class fixed effects, which are included in all regression specifications. Importantly, the same experimenter visited the same classroom at both baseline and endline.

2,749 students participated in the baseline friendship survey and 2,589 students completed the friendship survey in the endline study. For the experiments of individual and group decision-making under risk, 1,573 students participated in the baseline, and 1,468 students participated again in the endline study. Due to data cleaning and attrition, the final sample consists of 1,304 individuals and 652 groups who completed the experiments

[1]See the online appendix XXX for slides and scripts.

and surveys in both baseline and endline studies.

2.1 Experiment

Our experimental design closely follows the one proposed by Choi et al. (2007). In the experiment, a decision maker (DM) makes a series of choices under risk. Each choice is interpreted as selecting an optimal portfolio of Arrow securities within a linear budget set. Specifically, there are two equally probable states of nature, denoted by $s \in S = \{r, b\}$, and two corresponding Arrow securities. The DM allocates their wealth between these two Arrow securities. A choice is represented by (x_r, x_b) in a normalized linear budget set, $p_r x_r + p_b x_b = 1$, where $x_s \geq 0$ denotes the demand for the security that pays off in state s, and $p_s > 0$ is its unit price. More details in section 8 of the Online Appendix are provided.

In the experiment, each subject first makes 18 independent rounds of individual decisions with randomly drawn budget sets. Each round started with the computer choosing a linear budget set, intersecting with each axis between 300 KRW and 3000 KRW, but at least one of the intercepts is greater than or equal to 1500 KRW.[2] Then, a subject moved a mouse pointer in the computer screen along the selected linear budget line. At this moment, a small box next to the pointer displayed the exact monetary value of the portfolio in KRW. By clicking the left mouse button, the subject made a decision, and the following decision round continued with a new budget line randomly and independently chosen. More detailed information and full experimental instructions, including sample screenshots of the experiment, are available in section XXX of the Online Appendix.

After the 18 rounds of individual choices, subjects played collective decision problems with a classmate partner. For this, subjects were randomly matched into a pair within a classroom, and one, called the mover, was asked to move and sit with her partner. Each paired subjects were allowed 90 seconds to discuss how to make choices in the next rounds of collective decisions. The free conversation was approved, and no particular guidance was given to the subjects on the way of making consensus. After their discussion, subjects made 18 rounds of collective decisions in the same decision environment.

One notable feature is that the subjects made decisions of common allocation. That is, if

[2] The average exchange rate in 2016 for the US dollar to KRW was 1161.

the chosen portfolio became a realized payoff, then both subjects were paid exactly the same amount of money, and they were informed this payoff rule in the beginning of the collective decision experiment. Some students were not able to find a partner when their classroom consisted of an odd number of students. For this reason, we analyze 1572 students who were matched with a classmate.

The 10-minute break was given to subjects after the rounds of collective choices; then students participated friendship survey where they listed up to 10 closest friend from the same grade, which was followed by a short math test as a cognitive ability survey and a non-cognitive survey.[3] We include survey responses as covariates in later econometric analysis.

During a series of experiments, subjects were not provided with any feedback on their experimental outcomes. At the end of the experiment, the computer selected one decision round for each subject's individual decisions, where each round was equally probable to be chosen. In addition, the computer chose one decision round for each pair's collective decisions with equal probabilities. Each subject was paid the amount that he had earned in the selected individual and collective decision rounds.[4]

Remarks on the experimental design. All the subjects participated in joint decisions after finishing their individual choices. Indeed, we find some but small differences between single and collective decisions, which might result from the learning by introspection; however, they are not main concerns of the current paper. Instead of the differences between individual and collective decisions, we focus on how the properties of individual decisions influence those in group decisions.[5] In addition, the current experimental design is natural and easy to implement. For example, it would be an awkward situation to make a collective

[3]The non-cognitive survey includes questionnaires measuring (1) the Rosenberg self-esteem scale, (2) life satisfaction, and (3) perception about studying. See section 7 for details of the related questions and statistics.

[4]We only informed the total payoffs to the subject after experiments. Therefore, subjects could not distinguish the source of the monetary payoffs. As our subjects were adolescents, the payoffs were paid in electric money, which can be spent at about 10 thousands of chain convenience stores in the country. This payment rule was requested by the teachers in the field for educational purpose.

[5]There are several papers analyzing differences between individual and group decisions, and they employed either a between-subject design (e.g., Cooper and Kagel 2005; Charness et al. 2007; Shupp and Williams 2007) or an within-subject design in which the order effect is considered explicitly (e.g., Masclet et al. 2009; Deck et al. 2012). On the contrary, for the papers examining aggregation of individual decisions into group decisions (e.g., Ambrus et al. 2015; Palma et al. 2011), subjects are required to participate in individual decisions and group decisions sequentially as in the current paper.

choice before getting used to the decision environment. Note also that the learning from feedback is not likely to exist as subjects were notified of their payoffs at the end of the experiments.

The constructed pairs within a classroom provide two particular benefits. First, we can study the causal effect of individual characteristics on group decisions, excluding the effect of hidden factors could be related to the self-matching process. Those factors exist in previous experimental evidence on couples' decisions in the literature (e.g., Abdellaoui et al. 2013; Bateman and Munro 2005; Palma et al. 2011; Yang and Carlsson 2016). Couples could have considered the quality of their joint decision in real life in the matching stage.[6] Moreover, couples often tend to develop their own ways of opinion consensus. These factors obviously matter for collective decisions, but they are not directly observable to a researcher.

Second, we might construct a more realistic collective decision environment compared to the joint decision with strangers. Although we may manage this concern by recruiting subjects who are strangers to each other, it might be far different from joint decision environment in reality.[7] As we usually coordinate with someone whom we already know, we believe that it is better to pair up subjects who feel natural to make joint decision with conversations.

2.2 Complementary Survey

In addition to the experiment, we conducted a survey to collect a rich set of student characteristics, including both cognitive and non-cognitive skills as well as friendship networks. The purpose of the survey was to compile characteristics that might mediate the quality of group decisions and individuals' bargaining power.

To measure cognitive skills, we administered a standardized academic achievement test consisting of five mathematics questions. These questions were designed by the Korean Institute for Curriculum and Evaluation— the government body responsible for national standardized tests and the college entrance examination— to ensure they reflected material that middle school students were expected to have learned. On average, students answered

[6]For more discussion on the matching in the marriage market, see Browning et al. (2014).

[7]Ambrus et al. (2015), Baillon et al. (2016), Bone et al. (1999), Charness et al. (2007), Cooper and Kagel (2005), and Deck et al. (2012) are examples of such subject recruitment methods.

2.6 questions correctly (Table 1). Non-cognitive skills were measured using the Big Five personality test.

We also collected information on classroom friendship networks. Each student was presented with a roster of classmates and asked to nominate up to 10 best friends. Based on these responses, we calculated the number of friendship nominations received (in-degree) and the number of nominations made (out-degree). On average, students nominated 4.6 friends and were nominated by a similar number of peers, 4.6 (Table 1). We additionally identified mutual and one-sided friendship relationships within each pair.

3 Measurements and Empirical Specification

- Add signpost here later to overview the section

3.1 Consistency with Utility Maximization

In our experiment, a subject chooses a portfolio allocation $\mathbf{x}$ from the budget set $\{\mathbf{x} \in \mathbb{R}^2_+ : \mathbf{p} \cdot \mathbf{x} \leq 1\}$. A dataset $\mathcal{D} = \{(\mathbf{p}^t, \mathbf{x}^t)\}_{t=1}^T$ refers to the collection of a subject or group's decisions in T choice problems. Afriat (1967) shows that a dataset $\mathcal{D}$ can be rationalized by a well-behaved (piecewise linear, continuous, increasing, and concave) utility function, if and only if the dataset satisfy GARP. Portfolio $\mathbf{x}^t$ is said to be directly revealed preferred to $\mathbf{x}^s$, denoted by $\mathbf{x}^t R^D \mathbf{x}^s$, if a subject chooses $\mathbf{x}^t$ when $\mathbf{p}^t \cdot \mathbf{x}^t \geq \mathbf{p}^t \cdot \mathbf{x}^s$. We define P^D as the strict direct revealed preference relation, and R as the transitive closure of R^D. GARP requires that if portfolio $\mathbf{x}^t$ is revealed preferred to $\mathbf{x}^s$ (that is, $\mathbf{x}^t R \mathbf{x}^s$), then $\mathbf{x}^s$ is not strictly and directly revealed preferred to $\mathbf{x}^t$ (i.e., not $\mathbf{x}^t P^D \mathbf{x}^s$).

Because GARP provides an exact test of utility maximization–either the data satisfy GARP or they do not, we assess how nearly a choice dataset complies with GARP by using the Critical Cost Efficiency Index (CCEI) proposed by Afriat (1972) and widely used in the literature (e.g., Choi et al. 2007; Choi et al. 2014; Polisson et al. 2020). For any number $0 \leq e \leq 1$, define the direct revealed preference relation $R^D(e)$ as follows: $\mathbf{x}^t R^D(e) \mathbf{x}^s$ if $e\mathbf{p}^t \cdot \mathbf{x}^t \geq \mathbf{p}^t \cdot \mathbf{x}^s$, and define $R(e)$ as the transitive closure of $R^D(e)$. The CCEI of the dataset $\mathcal{D}$, denoted by e^*, is the largest value of e such that the dataset $\mathcal{D}$ with the relation $R(e)$ satisfies GARP. It measures the fraction by which all budget constraints must be shifted in order to remove all violations of GARP. Let e_i^* and e_g^* denote the CCEIs of the dataset of individual i's choices and group g's choices, respectively.

As in the table 1, the means (and standard deviation) of CCEIs are 0.900 (0.133) for the individual choice data and 0.912 (0.141) for the group choice data in the baseline study, and respectively, 0.932 (0.120) and 0.936 (0.128) for the endline study.

We also test the consistency with utility maximization with alternative measures such as the money pump index (Echenique et al. 2011; Smeulders et al. 2013) and the Houtman and Max index (Houtman and Maks 1985). Compliance with stochastic monotonicity in addition to utility maximization (Polisson et al. 2020) is also considered. The results are reported in section XXX of the Online Appendix.

3.2 Revealed Bargaining Power

We propose a nonparametric, revealed preference measure of individual bargaining power on group decisions. The main idea is to assess how close an individual choice dataset is to that of group choices; an individual in the group is said to have a *larger* **revealed bargaining power** if her choice dataset is *closer* to that of group choices, compared to the choice dataset of her partner.

To formalize this idea, we start with the group data and combine it with each individual's data sequentially, and compute a corresponding CCEI and check how much a drop of CCEI is observed by adding individuals' datasets in each step. Let us denote the combination of individual i's data and the group g's data, denoted by $\mathcal{D}^{ig} = \{\{(\mathbf{p}^{t,i}, \mathbf{x}^{t,i})\}_{t=1}^{T} \cup \{(\mathbf{p}^{t,g}, \mathbf{x}^{t,g})\}_{t=1}^{T}\}$, and the combination of two individuals i and j's data and the group g's data, denoted by $\mathcal{D}^{ijg} = \{\{(\mathbf{p}^{t,i}, \mathbf{x}^{t,i})\}_{t=1}^{T} \cup \{(\mathbf{p}^{t,j}, \mathbf{x}^{t,j})\}_{t=1}^{T} \cup \{(\mathbf{p}^{t,g}, \mathbf{x}^{t,g})\}_{t=1}^{T}\}$. We then compute the CCEI of each combined dataset, denoted by e_{ig}^* and e_{ijg}^*, respectively.

We consider the difference of CCEIs for the group data and the combined dataset with individual i's data, $e_g^* - e_{ig}^*$, normalized by the difference of CCEIs for the group data and the combined dataset with two individuals' data, $e_g^* - e_{ijg}^*$. This difference captures a revealed preference distance between the group data and individual i' data and is positive since it should be always the case that $e_{ig}^* \leq e_g^*$. Similarly for the difference $e_g^* - e_{ijg}^*$. In doing so, there are two sequential procedures available; beginning with the addition of individual

i's data ($i \to j$) or individual j's data ($j \to i$). We then define the following measure of normalized distance for each sequence $i \to j$

$$I_{ig}^{i \to j} = \frac{e_g^* - e_{ig}^*}{e_g^* - e_{ijg}^*}, \quad I_{jg}^{i \to j} = \frac{e_{ig}^* - e_{ijg}^*}{e_g^* - e_{ijg}^*}$$

Note that for each sequence $i \to j$, $I_{ig}^{i \to j} + I_{jg}^{i \to j} = 1$. To have a procedure-independent measure, we define a revealed preference measure of how 'close' individual i's data is to the group data as follows

$$I_{ig} = \tfrac{1}{2} I_{ig}^{i \to j} + \tfrac{1}{2} I_{ig}^{j \to i} = \frac{1}{2} \frac{e_g^* - e_{ig}^*}{e_g^* - e_{ijg}^*} + \frac{1}{2} \frac{e_{jg}^* - e_{ijg}^*}{e_g^* - e_{ijg}^*}$$

This index I_{ig} captures a revealed preference distance (revealed bargaining power) between the group data and individual i's data, and is bounded between 0 and 1 by construction. A value of 0 indicates that the individual solely determined the group decision, whereas a value of 1 implies that the individual had virtually no influence on the group choice.

The above revealed bargaining-power index can be interpreted as a Shapley allocation in a cost game as follows. Define the coalition cost as the group members' "preference distance" from full consistency, $c(S) = e_g - e_{Sg} \geq 0$, where $S \in \{i, j, ij\}$ and e_{Sg} is the CCEI after merging the choice data generated by the members of S into group choice data g.[8] $c(S)$ is non-negative because the CCEI is non-increasing in set-inclusion order.[9] The normalized Shapley cost share of individual i averages i's marginal cost over all coalition orders, normalized by the grand cost $c(\{i, j\}) = e_g - e_{ijg} > 0$, assuming that at least one of the two members has preferences not perfectly aligned with the group choice data.[10]

This interpretation guarantees three properties: efficiency, symmetry (equivalently, order-independence), and a dummy property: (i) efficiency means that the indices exhaust total preference disagreement (i.e., $I_1 + I_2 = 1$), (ii) symmetry presents that agents with identical marginal effects on the CCEI have the same index (i.e., relabeling players does not change

[8]We frame the discussion via Shapley-style cost sharing as the Shapley value provides a canonical allocation rule (Shapley 1953) with strong axiomatic support (Young 1985). Classic cost-sharing applications include airport games and serial cost sharing (Curiel et al. 1987; Moulin and Shenker 1992).

[9]That is, $D \subsetneq D'$ implies that $\text{CCEI}(D') \leq \text{CCEI}(D)$.

[10]In the degenerate case $c(\{i, j\}) = 0$, all marginal costs are zero and the normalized shares are undefined. The degenerate case means that the two agents share the same preferences, and there is no conflict of interest in group decisions. In this case, we assign equal bargaining power.

their indexes), and (iii) dummy indicates that if adding data generated by agent i never changes the CCEI (i.e., $e_{ig} = e_g$ and $e_{ijg} = e_{jg}$ for all $j \neq i$), then $I_i = 0$.[11]

Finally, we remark that our revealed bargaining-power measure is well defined as long as the underlying consistency index satisfies set monotonicity and the data are not degenerate with respect to that index. The maximum money-pump index (Echenique et al. 2011) and the Houtman–Maks index (Houtman and Maks 1985) satisfy the set monotonicity; by contrast, the mean money-pump index does not. See Appendix XX for proofs.

- Add theoretical discussion when EC is ready

Does the Index Represent a Bargaining Weight? Our proposed measure extends the CCEI framework to capture how closely group decisions align with those of individual members. Because the measure is non-parametric, it can be computed for all subjects, whereas parametric approaches to bargaining analysis typically require restricting attention to individuals with sufficiently high CCEI scores (Choi et al. 2007). The natural question, then, is how valid our interpretation of the proposed index as a measure of bargaining weight. We validate this interpretation in two ways: (i) by showing that the index correlates with subjects' own perceptions of bargaining power, and (ii) through a simulation exercise demonstrating that the index tightly tracks bargaining weights in a parametric data-generating process.

First, following the endline choice experiment, we elicited participants' perceived bargaining power using two survey questions:

1. *If you had individually made decisions under the same choice environments as in the group experiment, how similar do you think those decisions would have been?*

2. *During the collective choice experiment, whose preferences were most reflected in the final choices?*

Figure 1 shows that our index aligns closely with these self-reported perceptions. In the left panel, we plot the mean of the bargaining index and its 95% confidence interval by

[11] The underlying Shapley cost shares before normalization satisfy additivity, but additivity need not hold after normalization by the total cost. In order to normalize bargaining powers sum to one, the revealed bargaining power index does not have an additivity.

subjects' responses to the first question. Among those who reported that their individual decisions would have been "very different," the average index value—which measures the distance between group and individual decisions—is 0.599 [CI: 0.547, 0.652]. The mean decreases monotonically as subjects indicate that their individual decisions would have been closer to the group decision, reaching 0.449 [CI: 0.424, 0.474] among those who reported their decisions would have been "very similar." Similarly, the right panel illustrates that the index is smaller among subjects who stated that their preferences were more reflected in the group outcome than their partner's; the mean of the index is 0.630 [CI: 0.590 0.670] among those who reported that their partners' preferences were more reflected, while it is 0.425 [CI: 0.390 0.461] among their own preferences were reported to be more reflected.

Second, we conduct a simulation exercise to compare our index with bargaining weights derived from a standard parametric model of group utility:

$$U_g = \alpha U_i + (1 - \alpha) U_j.$$

Here, $\alpha \in [0, 1]$ represents the relative bargaining weight of individual i, consistent with the assumption of Pareto efficiency (e.g., Chiappori 1988; Chiappori 1992). In practice, specifying this model requires additional functional-form assumptions about individual utilities—commonly CRRA or CARA preferences within rank-dependent utility models such as in Choi et al. (2007). Our simulation results show that the non-parametric index closely tracks α, validating its interpretation as a measure of bargaining power.

3.3 Simulation Procedure and Results

We conduct a Monte Carlo simulation to examine the relationship between the true bargaining power parameter α used in data generation and our CCEI-based bargaining measure I_{1g}. The procedure is as follows.

1. **Basic Setting**

   In each round, individuals i and j face a budget constraint, from which they each make their own consumption choice. In addition, a group decision is also made under the same budget set.

We assume Constant Relative Risk Aversion (CRRA) preferences. The individual utility function is

$$U(x, y; \rho) = \begin{cases} \dfrac{x^{1-\rho}}{1-\rho} + \dfrac{y^{1-\rho}}{1-\rho}, & \text{if } \rho \neq 1, \\ \\ \ln(x) + \ln(y), & \text{if } \rho = 1, \end{cases}$$

where ρ denotes the coefficient of risk aversion, and x and y represent the quantities of two Arrow–Debreu securities.

The group utility is a weighted combination of the two individuals' utilities, reflecting bargaining power:

$$U_g(x, y; \alpha, \rho_i, \rho_j) = \alpha\, U_i(x, y; \rho_i) + (1-\alpha)\, U_j(x, y; \rho_j),$$

where $\alpha \in [0, 1]$ is the bargaining weight on individual i.

2. **Stochastic Choice Rule**

   Choices follow a *logit choice model*. Each individual evaluates 1,000 points uniformly spaced along the budget line,[12] and computes utility at each point. The probability that the k-th point is chosen is

$$P(k) = \frac{\exp(\gamma U_k)}{\sum_j \exp(\gamma U_j)},$$

   where U_k is the utility of (x_k, y_k). When $\gamma \to 0$, choices are almost random; when $\gamma \to \infty$, choices approach perfectly rational utility maximization.

3. **Fix Model Parameters**

   Set $\rho_i = 0.3,\ \rho_j = 0.7,\ \gamma = 30$. The number of Monte Carlo repetitions is $B = 100$, and each agent faces 50 budget sets.

4. **Construct the Set of Budget Constraints**

   Using our sample from the actual experiment, we extract the intercepts $(\text{intercept}_x, \text{intercept}_y)$ that define the budget lines, rescale them by dividing each by 1400, and randomly sample 50 unique budget sets. The same 50 budget sets are used for individuals i, j, and the group in all simulation runs.

[12] We randomly select 1,000 feasible portfolios (x_k, y_k) on the budget line with equal spacing between them, including both intercepts of the budget line.

5. **Iterate Over Bargaining Power Values**

   For each $\alpha \in \{0.0, 0.1, \ldots, 1.0\}$, the following procedure is performed.

   (a) Simulate individual and group choices. Individuals i and j choose under their own CRRA utilities; the group chooses under $U_g(x, y) = (1 - \alpha)U_j(x, y) + \alpha U_i(x, y)$ via the logit formula.

   (b) Repeat $B = 100$ runs. Because logit choice is stochastic, we simulate B independent datasets for each α and record outcomes.

   (c) Compute CCEI-based indices. For each dataset, we can compute $ccei_1$, $ccei_2$, $ccei_g$, $ccei_{1g}$, $ccei_{2g}$, $ccei_{hlg}$ and finally the revealed bargaining power index.

$$I_{1g} = \frac{1}{2}\left[\frac{ccei_g - ccei_{1g}}{ccei_g - ccei_{hlg}} + 1 - \frac{ccei_g - ccei_{2g}}{ccei_g - ccei_{hlg}}\right].$$

   (d) Compute the average $\overline{I}_{1g}(\alpha)$ across the $B = 100$ datasets.

Results

Figure 2 illustrates the relationship between the true bargaining power α used in the data-generating process and the average simulated CCEI-based measure $\overline{I}_{1g}(\alpha)$. A close alignment between the red 45° line ($\alpha = I_{1g}$) and the simulated points indicates that our measure accurately recovers the underlying bargaining power.

3.4 Risk Preference

Finally, to ask how group's risk preference is shaped by those of individuals, we first adopt the following nonparametric measure of risk preference. For each choice in a given budget set, k, we measure the degree of risk aversion as the relative demand share of the more expensive asset at the choice. That is, if $p_1 > p_2$, x_1 is more expensive than x_2 and the degree of risk aversion, ra^k is defined as $\frac{x_1^k}{x_1^k + x_2^k}$. Similarly, if $p_2 > p_1$, it is defined as $\frac{x_2^k}{x_1^k + x_2^k}$. Then we take the average of ra^k across 18 individual and group choices, respectively.

Since the probability of choosing each state is exactly $\frac{1}{2}$, a risk-neutral or risk-seeking agent chooses the corner solution that maximizes the expected value. In this case, our measure of risk aversion is equal to zero. On the contrary, an extremely risk averse agent would choose a point on the 45° degree line which makes the risk aversion measure of $\frac{1}{2}$.

Therefore, the measure of risk aversion ra^j ranges between 0 and $\frac{1}{2}$. The bigger it is, the more risk aversion the choice reveals.

For each individual or collective data, we compute the average of the risk aversion measure as a risk aversion measure for the individual or the group. The means (and standard deviation) of the individual and collective risk aversion are 0.322 (0.134) and 0.297 (0.142) in the baseline data and 0.297 (0.153) and 0.265 (0.154) in the endline data.

3.5 Empirical Specification

First, to formally test the effect of individual-level rationality on group-level consistency, we estimate the following model:

$$CCEI_{gct} = \alpha + \beta_1 \, \mathrm{CCEI}_{\max,gt} + \beta_2 \, \mathrm{CCEI}_{\mathrm{dist},gt} + \gamma X_{gt} + \tau_c + \varepsilon_{gct}, \tag{3.1}$$

where $CCEI_{gct}$ denotes the collective rationality of pair g formed within a class c, measured by the pair's CCEI in time $t = \{0, 1\}$. $\mathrm{CCEI}_{\max,gt}$ is the maximum of the two members' individual CCEIs, and $\mathrm{CCEI}_{\mathrm{dist},gt}$ is the absolute difference between them. The vector X_g includes rich characteristics of the group — the maximum and within-group differences in members' heights, math test scores, Big Five personality traits, and in-class friendship measures (in-degree and out-degree connections). Gender composition of the pair is also included, and its effect is allowed to vary with whether the school is a co-ed or single-sex school.[13] We also control for the maximum and within-group difference in risk preferences. τ_c are class fixed effects. In extended specifications, we add an endline indicator and its interactions with $\mathrm{CCEI}_{\max,gt}$ and $\mathrm{CCEI}_{\mathrm{dist},gt}$. All models are estimated using a balanced panel of 652 groups (1,304 individuals), with robust standard errors clustered at the class level.

Next, we use the following specification to quantify how individuals' CCEIs determine their bargaining weight.

$$\begin{aligned} I_{igt} = \alpha + \beta_1 \, \text{Higher CCEI}_{it} + \beta_2 \, \text{Endline}_t + \beta_3 \, (\text{Higher CCEI}_{it} \times \text{Endline}_t) \\ + \gamma_1 X_{igt} + \tau_c + \varepsilon_{igt} \end{aligned} \tag{3.2}$$

where I_{igt} is the nonparametric bargaining index proposed in subsection 3.2 for individual

[13]For 18 students with missing math or personality scores, missing values are imputed with zeros, and corresponding missing indicators are included.

i in group g at time t. Higher CCEI$_{it}$ equals one if individual i is more rational than their partner at time t, and zero otherwise. Endline$_t$ equals one for the endline period and zero for baseline. X_{igt} is a set of control variables that captures i's characteristics as well as her partners. For example, for math scores, we include $MathScore_i - MathScore_j$, where i and j are members of the same pair. The full set of controls includes differences in heights, Big Five personality traits, and in-class friendship measures (both in-degree and out-degree), as well as gender composition and dyadic friendship within the pair.[14] Class fixed effects, τ_c, are also included in all specifications.

Finally, to study how individuals' risk preference shape group preference, we run the following regression:

$$RA_{gt} = \alpha + \beta_1\, RA_{i_1^{CCEI}gt} + \beta_2\, RA_{i_2^{CCEI}gt} + \beta_3\, RA_{i_1^{CCEI}gt} \times \text{Endline}_t + \beta_4\, RA_{i_2^{CCEI}gt} \times \text{Endline}_t + \Sigma_l \gamma_l RA_{i_1^{x^l}gt} + \tau_c + \varepsilon_{gct}. \quad (3.3)$$

To run this regression we first order individuals within each pair based on CCEIs from their individual decisions. $RA_{i_1^{CCEI}gt}$ is risk preference of higher CCEI individual, and $RA_{i_2^{CCEI}gt}$ is her partner's. This equation tests the following two things. First, $\beta_1, \beta_2 > 0$ means that both individuals' risk preference shape group's risk preference. Second, $\beta_1 > \beta_2$ tests if risk preference of more rational individual matters more, thus complementing results from equation 3.2 through asking the same question but focusing on risk preference. We further include interactions with the endline dummy to check if any of these patterns evolves over time. Furthermore, for each of other demographic, cognitive and non-cognitive characteristics x^l, we also include risk preference of the individual with higher value to study the role of these other characteristics. Same as before, τ_c is class fixed effect and ε_{gct} captures any residuals.

4 Illustrative Cases

Figure 3 illustrates the decisions of four selected groups from the experiment. For each group, the two panels correspond to the two individuals, displayed shown side by side.

[14]Missing values in math scores and Big Five personality traits are imputed with zeros, and corresponding missing indicators are included.

Within each panel, we plot all 36 choices: 18 individual decisions and 18 collective decisions.

As described in section 2 in detail, each decision involves choosing a portfolio consisting of two Arrow securities with equal state probabilities (1/2 each). In each figure, the horizontal axis represents the relative price, $\log(p_2/p_1)$, and the vertical axis represents the share of asset x_2 in the decision, defined as $\frac{x_2}{x_1+x_2}$. As described by Choi et al. (2007), a perfectly risk neutral agent would choose $\frac{x_2}{x_1+x_2} = 1$ when $\log(p_2/p_1) < 0$, and $\frac{x_2}{x_1+x_2} = 0$ when $\log(p_2/p_1) > 0$. On the contrary, an extremely risk averse agent would always equate the share of asset 1 and 2, yielding $\frac{x_2}{x_1+x_2} = 0.5$. In all figures, individual decisions of the higher-rationality member are marked by red dots, those of the lower-rationality member by blue dots, and collective (group) decisions by black "X" markers.

Panel A of Figure 3 describes a case where the group's decisions closely mirror those of the more rational individual. The blue dots largely overlap with black X markers, while red dots diverge from them. Both the more rational individual and the group's CCEI is 0.99, while the CCEI of the other individual is 0.88. Risk preferences of the less rational individual, the more rational individual, and group are 0.38, 0.50, and 0.48, respectively, confirming the similarity between the more rational individual's choices and group's choices. Notably, our bargaining index is 0.00 for the more rational individual but 0.96 for the less rational individual, demonstrating that our revealed preference distance effectively captures the (inverse) bargaining power within the group.

Panel B shows a case where individual CCEIs differ less from each other, and group choices reflect a mix of both individuals' choices. Group's risk preference is 0.28, lying in between those of two individuals, 0.24 and 0.34. Our bargaining indices are also 0.24 and 0.76 for the more and less rational individuals, again showing that group choices reflect compromises from both individuals. The individuals' CCEIs are lower than those in Panel A, and the group's CCEI (0.91) is also notably lower than the 0.99 observed in Panel A. Taken together, Panels A and B make exemplary cases aligned with our hypothesis: that individual CCEIs and risk preferences shape group-level outcomes, and that rationality asymmetries translate into bargaining power.

Panel C illustrates a case where the two individuals' CCEIs are nearly identical (0.99 and 0.98), yet the more risk-averse member appears to dominate the group's decisions for some reasons. Risk preferences are 0.36 and 0.43 for the two individuals, compared to 0.45 for the group. Our bargaining index is 0.33 and 0.67 for the more and less risk-averse members, respectively. Such a case motivates us to explore whether demographic, cognitive, or non-cognitive traits explain bargaining power beyond rationality alone.

Finally, Panel D shows a case where the group's choices deviate substantially from both individuals' choices, leading to lower CCEI and risk preferences than either member individually. This illustrates the possibility of coordination failure: even highly rational individuals may struggle to aggregate preferences when making joint decisions. Since our bargaining index is normalized, it takes values 1.00 and 0.00 for the two individuals.

These cases highlight that our rich choice data allow us to measure how group decisions track or diverge from those of their members, and our measures are good summary of individual and group choices. At the same time, the heterogeneity across groups highlights the need for systematic analysis on to what extent individual rationality and risk preferences are key determinants of group rationality, risk preference, as well as individuals' bargaining power.

5 Results

5.1 Balance Test

We first begin by assessing whether the random assignment was successfully implemented, which allows us to establish causal relationship between individuals' (and their choices') characteristics and properties of groups' choices. Specifically, we test whether key outcome variables (CCEI and risk aversion) and individual characteristics are correlated within each pair by running the following regression.

$$y_{igc} = \beta y_{jgc} + \tau_c + \epsilon_{igc}, \tag{5.1}$$

where y_{igc} is characteristics of one randomly selected student i of a pair c formed within a class c, and y_{jgc} is that of her partner.[15] If randomization was properly implemented, outcomes and characteristics of one individual should not systematically predict those of her

[15] Table A1 presents results from regressions where the mover is treated as the dependent variable.

partner within the same pair ($\beta = 0$). We paired students within each class, so class fixed effects τ_c are included. We restrict the analysis to baseline because the endline survey was conducted four months after the baseline. During this period, the initial pairing may have influenced students' characteristics, for example by fostering friendships or by allowing them to gain information about their partner's risk preferences during the baseline experiment.

Summary statistics and balance test results are presented in Table 1. We report estimated coefficients and p-values from regressions in which the characteristics of one randomly selected student in each pair are treated as the dependent variable.

Overall, baseline variables are well balanced across individuals within each pair, with no statistically significant differences. The joint Wald tests in the last row indicate that we cannot reject the null hypothesis that all twelve coefficients are jointly zero. These results assures that the randomization procedure was successful, allowing for causal inference on the impact of individual rationality, risk preference, and other characteristics on group choice outcomes.

5.2 Rationality Extension

This section examines whether groups with more rational individuals make more rational collective decisions. First to illustrate the relationship between individual- and group-level rationality, we begin by comparing the cumulative distribution functions (CDFs) of collective CCEIs based on the individual CCEIs of group members. Figure 4 shows three cases: the solid red line represents groups in which both members have CCEIs above the sample median; the dotted blue line corresponds to groups where one member's CCEI is above the median while the other's is below; and the solid black line represents groups in which both members have CCEIs below the median. In both the baseline and endline, the distribution represented by the red line first-order stochastically dominates that of the blue line, which in turn dominates that of the black line.[16]

Table 2 summarizes estimates from running a regression in equation 3.1. Column (1) reports the pooled effects in our panel. First of all, regression results confirm the pattern in

[16]Kolmogorov–Smirnov tests confirm that the distributions differ across groups in both baseline and endline. In the baseline, the KS distance between the (Low, Low) and (Low, High) groups is 0.24 ($p < 0.001$), and between (Low, High) and (High, High) is 0.13 ($p = 0.06$). In the endline, the distances are 0.16 ($p = 0.01$) and 0.17 ($p = 0.003$), respectively.

Figure 4 that individual rationality is an importance source of group's rationality. Groups tend to be more rational when the more rational member has a higher individual CCEI. When the more rational individual's CCEI is one standard deviation higher, the group's CCEI is half standard deviation higher (0.403 * XXX /XXX =0.5). The less rational member also plays a role: greater CCEI gaps between members are associated with lower collective rationality; when the less rational member's CCEI is one standard deviation lower, the group's CCEI is XXX standard deviation lower (-0.258 * XXX/XXX). Column (2) shows that the overall consistency of group decision, and how it relates to individual CCEIs does not change over the course of one semester.

On the contrary, column (3) illustrates that observable characteristics play a limited role in explaining the quality of group decisions. Although the table presents only math scores and mutual friendship to save space, we control a very rich set of observable characteristics including gender, height, non-cognitive ability, and in-degree/out-degree friendship of individuals students. Coefficients in front of math score and mutual friendship are mostly statistically insignificant except for a marginal effect of maximum math score between two individuals; when the maximum math score increases by 1 standard deviation (XXX), group CCEI increases by XXX (0.010*XXX). R-squared of the model (3), 0.124, is much lower than that of model (2), 0.169, and further notably, a model with only class fixed effects has R-squared of XXX.[17]

In column (4), we include both individual CCEIs and other characteristics. The result confirms that individual CCEIs are importance source of group CCEI, while all other covariates explain group CCEIs minimally. Figure XXX shows the Shapley decomposition exercise of column (4), which confirm this story again; individual CCEIs explain 36.7% of total R2, whereas gender, height, gender, height, cognitive/non-cognitive ability, and friendship of individuals students jointly explain only 13.2% of total R2. 11% is further explained by time dummy and the interaction of it with individual CCEIs. The remaining 39% of R2 is explained by class FEs that capture not only student sorting across different schools/classes but also any possible difference in experiment environment.

[17]F-stat for CCEI-associated variables in column (2) on top of class fixed effects is XXX (p-value= XXX), and f-stat for all observable characteristics together in column (3) is XXX (p-value = XXX).

Tables X(FGARP), X(Max MPI), and X(HM index) report consistent findings when F GARP, Max MPI, and the HM index are used instead of the CCEI. Furthermore, one might be concerned about to what extent our result is explained by the correlation between consistency of decisions and risk aversion. Particularly if students choose only corner solution

5.3 Revealed Preference Analysis of Preference Aggregation

Next, we examine whether the preference of a group is closer to that of its more rational member. We use a revealed-preference framework to infer each member's bargaining power in shaping group decisions. This approach estimates the extent to which an individual influences the group outcome.

We now extend the analysis by using the Revealed Bargaining Power index I_{ig}, introduced in Section 3.2. Recall that I_{ig} measures the revealed preference distance between individual i and their group, ranging from 0 (full influence) to 1 (no influence).

Next, using our index, we assess whether a group's choices align more closely with those of its more rational member. Figure 6 plots the CDFs of the revealed preference distance separately for high- and low-rationality members. By construction, the two CDFs are symmetric, since the index sums to one within each pair. The figure shows that high-rationality members consistently exhibit smaller distances, indicating greater bargaining power.

We then estimate Equation (3.2), as in the risk preference analysis. The only difference is that the outcome variable is now I_{ig}. Table 3 reports the results. Columns (1)–(3) report estimates without controls, and Columns (4)–(6) include the full set of controls. In all specifications, the coefficient on *High CCEI* is negative and statistically significant, implying that more rational members exert greater influence over group decisions. The estimated coefficients range from -0.353 to -0.443, a substantial magnitude given the index's $[0, 1]$ range and the fact that both members' values sum to one.

Including an endline indicator shows that this influence slightly increases over time: the interaction term *Endline* $\times$ *High CCEI* is negative, indicating that high-rationality members gain additional bargaining power in the endline. These findings are robust to controls for individual CCEI and risk aversion: bargaining power increases with CCEI and decreases with risk aversion.

We find no noticeable heterogeneity by gender, math score, height, or friendship (Table XXX, het).[18] This suggests that standard rationality measures, rather than demographic or social traits, are the key drivers of influence in group decisions.

Finally, Table A4 reports the results of the Shapley decomposition, showing both the values and the percentage contributions to the regression R^2. The estimates are based on the full specification, including all controls and interaction terms used in our analysis.[19] Variables are grouped into eight blocks: Time, CCEI, Risk, Friendship, Demographic/Cognitive/Noncognitive, Mover, Survey Attrition, and Class. The results highlight that CCEI is by far the most important factor in explaining bargaining power. In contrast, other observable characteristics, even when combined with a wide set of interaction terms designed to maximize their explanatory potential, account for only a limited share of the R^2.[20]

5.4 How Is Groups Risk Preference Shaped?

To assess whether the more rational individual is closer to the group's preference, we first identify the more rational individual who has the higher CCEI within each pair.[21] The degree of risk aversion is measured as the relative demand share of the more expensive asset in a choice, as described in Section 3.4.

Figure A4 shows the CDFs of the absolute difference in risk preferences between each individual and the group, $|RA_i - RA_g|$, for high- and low-rationality members within each pair. High-rationality members tend to have preferences closer to the group's, and this gap

[18] Because the bargaining power measures of two members in a pair sum to one by construction, clustering at the pair level produces standard errors of zero. Although our regressions cluster at the class level, we adjust the heterogeneity analysis to avoid this issue by randomly selecting one member from each pair and using only that individual's baseline and endline observations.

[19] These include interactions with time, HighCCEI within group, and the triple interaction with time and HighCCEI.

[20] The Demographic/Cognitive/Noncognitive block consists of Gender, Math, Height, and Personality variables (along with their interaction terms). Among these, Gender accounts for the largest share of explanatory power. For the Class block, we created dummies for each class and included them in the regression model.

[21] There are XXX pairs where two individuals have the same CCEIs. In these case, we compare the CCEIs calculated after including the group decision data, denoted as $CCEI_{ig}$ (XXX pairs). If these are also equal, the mover is designated as high-rationality. A mover is an individual who moved to their partner's desk and made the decision together using the partner's laptop.

widens in the endline.[22]

Table 4 presents the estimation results of equation 3.3. Column (1) shows that the group's risk preference increases by XXX ($p < 0.05$) and XXX ($p < 0.05$) when the more rational and less rational individuals' preferences increase by 1 standard deviation of XXX, respectively. Furthermore, groups' risk preference is affected more by the more rational individuals' risk preference, and the difference is significant at 5 percent level (see the bottom of the table). Column (2) shows that such a higher impact of more rational individual's risk preference on group's risk preference increases in the endline. Test results at the bottom of the table shows that the difference in effects between the more rational and the less rational individuals' risk preference is not statistically significant in the baseline, but it is in the endline.

In column (3), we explore other observable characteristics that might matter for differential individual effect on group decision. Similar to the previous section, we find that risk preference of an individual with higher math score matters more, although the difference in effect is only marginally significant at the 10 percent level. All other characteristics do not channel how individual's risk preference aggregated into that of groups. Column (4) confirms the message so far when we include both individual CCEIs and other characteristics. In column (5), we further control for group fixed again to control for any group level characteristics that are invariant between baseline and endline, and find that still the coefficient in front of risk preference of higher CCEI individual is larger than her partners', although the difference becomes statistically insignificant.

Overall, the results illustrate that individual risk preferences are the main source of group risk preference while confirming that individual's rationality is an important source that determine whether they have larger impact on the characteristics of group decisions.

5.5 When Does Individual Rationality Determine Bargaining Weight More?

In this section, we investigate further under which condition the more rational individual exerts a larger bargaining power. One plausible mechanism is that greater rationality corresponds to more consistent and "clearer" preferences, which are easier to articulate in

[22]Kolmogorov–Smirnov tests confirm significant differences between the two distributions: KS distance $= 0.10$ ($p = 0.01$) in the baseline and 0.16 ($p < 0.001$) in the endline.

deliberation. The importance of existence and volume of communication in group deliberation has proven to be importance in experimental studies (XXX proper cites here Burnstein et al. 1973, Goeree & Yariv 2011).

Consistent with such prior studies, we find suggestive evidence that the bargaining advantage of more rational members is amplified under situations where communicating their preference might be easier. In figure XXX, we present the coefficient in front of $1(HigherCCEI)_{it}$ estimated from the equation XXX, from regressions separately by subgroups based on the characteristics of pair. In panel A, we show that the revealed preference distance is smaller (so the bargaining weight is larger) for the more rational individuals when two individuals are mutual friends than when not. Similarly, we find that the more rational individuals' choices are more similar to those of the group when two individuals have same sex. But, such differences are not statistically significant.

However, we find that the more rational individuals have a larger or smaller bargaining power by students' non-cognitive characteristics and how the class is structured. Specifically, we find that when both individual reported that they value trust, and when they have more time to have discussion with other classmates during their class ours mediate the extent to which the more rational individual exert larger barganing power.

6 Conclusion

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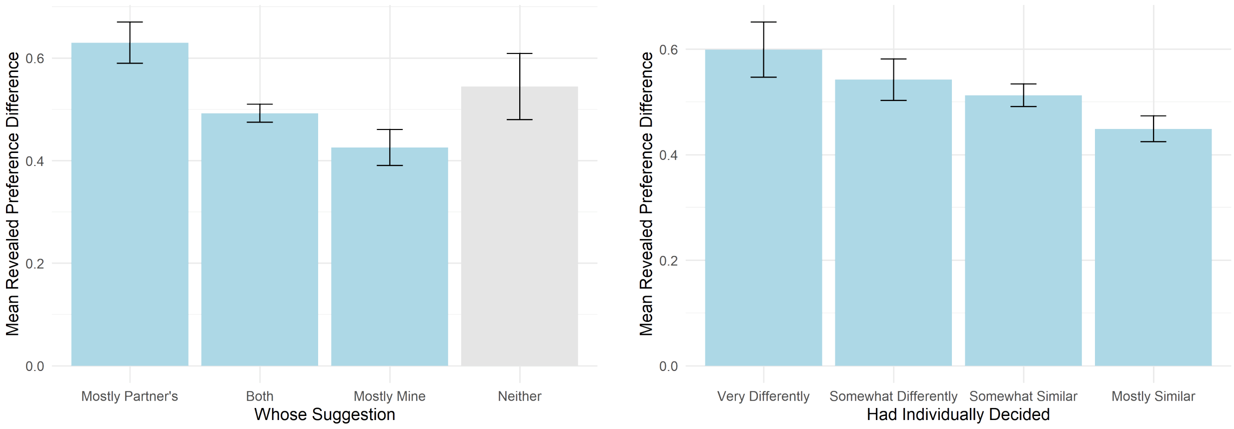
Figures

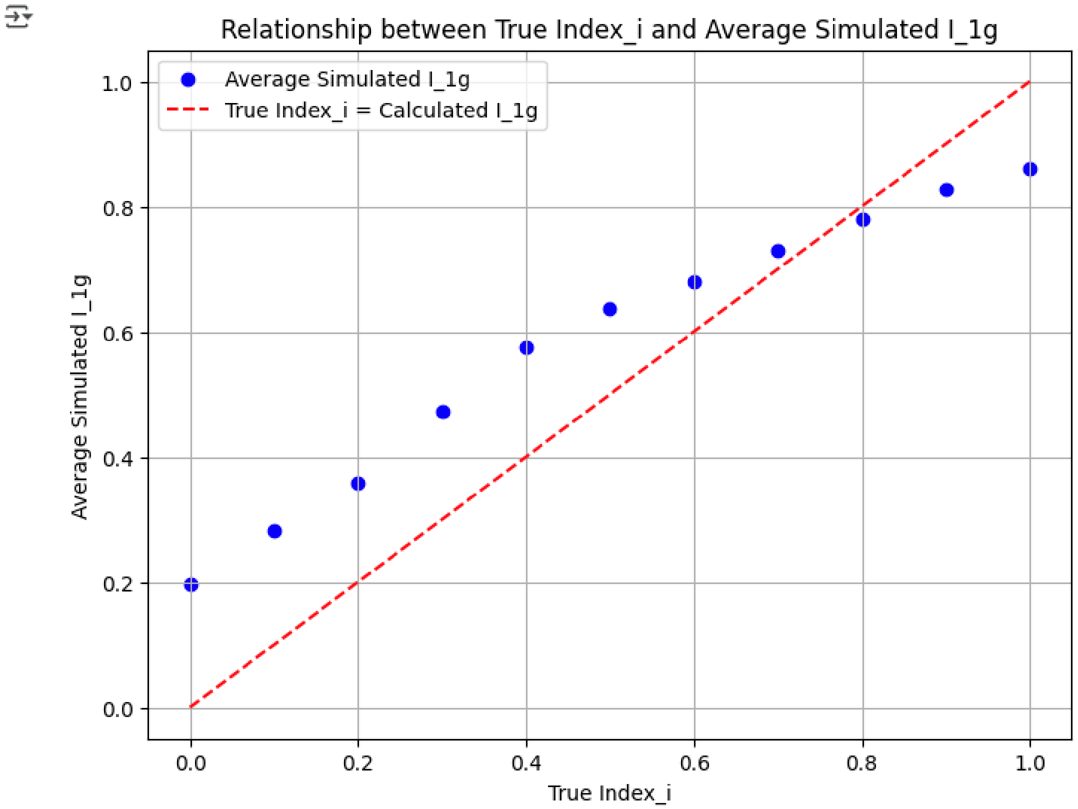
Figure 1: Validation of bargaining measure using survey data



(a) (b)

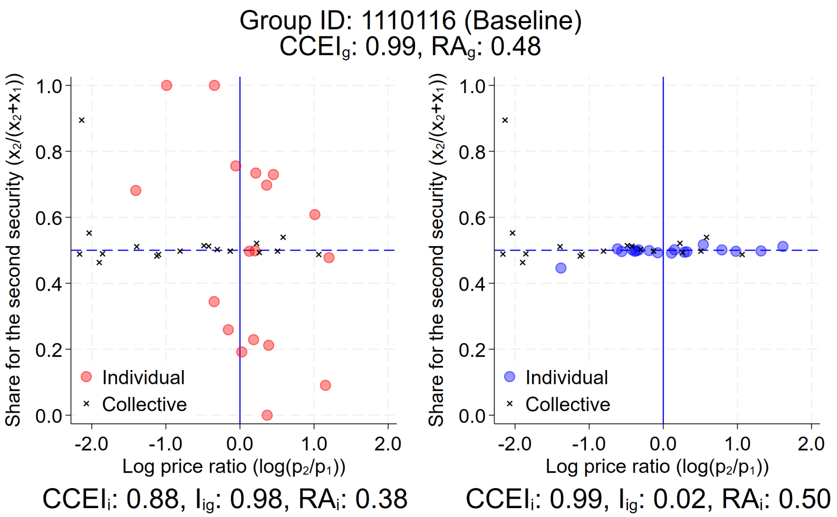
Notes: This figure presents the monotone relationship between the revealed preference bargaining distance measure that we propose and survey questions that elicit bargaining power in group decisions.

Figure 2: Simulation Results: Relationship between True I_{1g} and *Average Simulated* I_{1g}

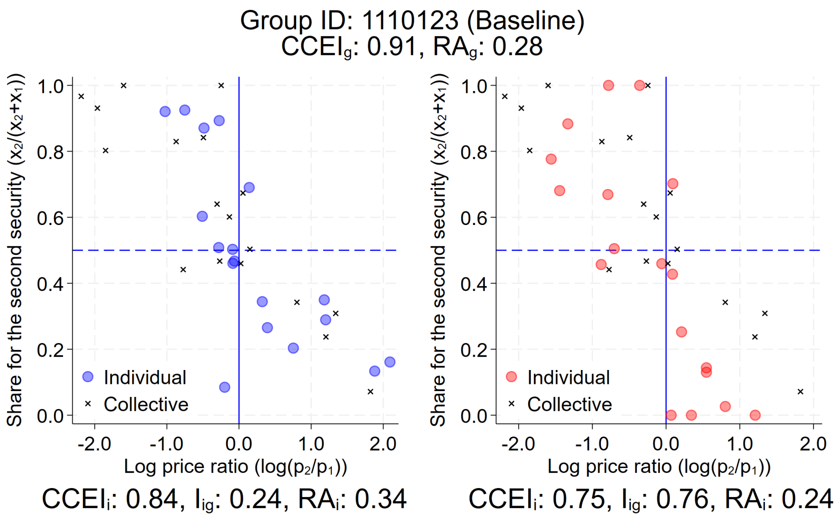


Notes: This figure reports the

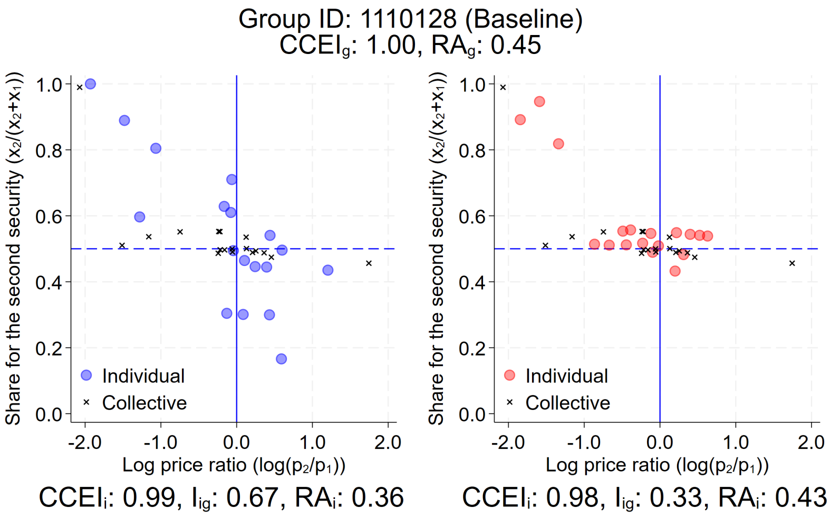
Figure 3: Selected Individuals for Illustration



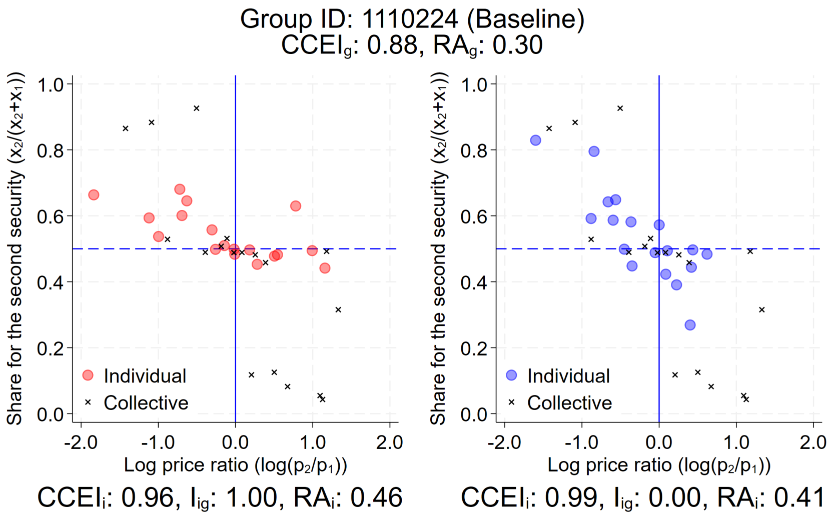
(a) Panel A



(b) Panel B



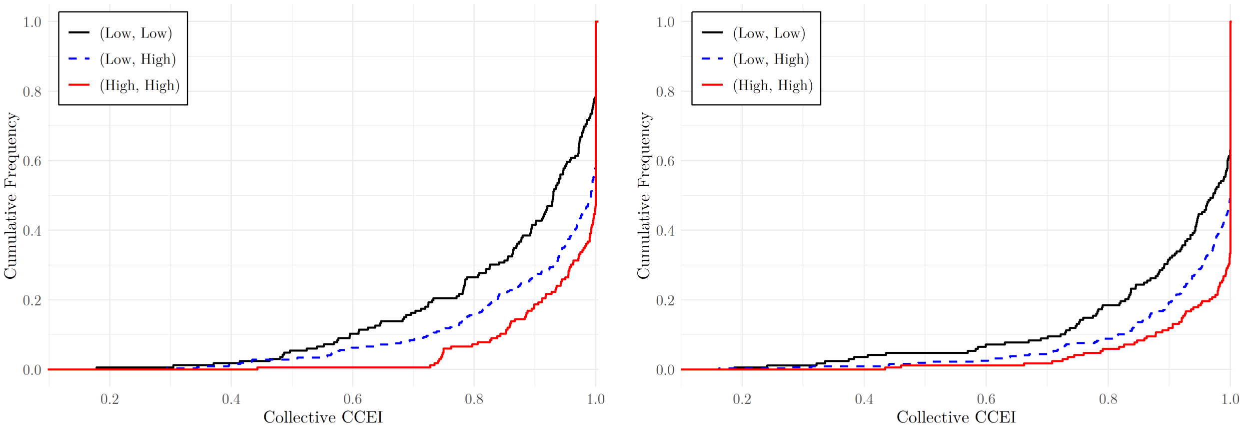
(c) Panel C



(d) Panel D

Notes: This figure illustrates portfolio choices for four groups, selected to highlight heterogeneity in behavior. Each combined figure displays the decisions of two members within the same group: the left panel represents the stayer, while the right panel represents the mover. Individual decisions are shown as colored circles, while collective (group) decisions are shown as black crosses (X). The blue markers indicate the more rational individual, whereas the red markers indicate the less rational individual.

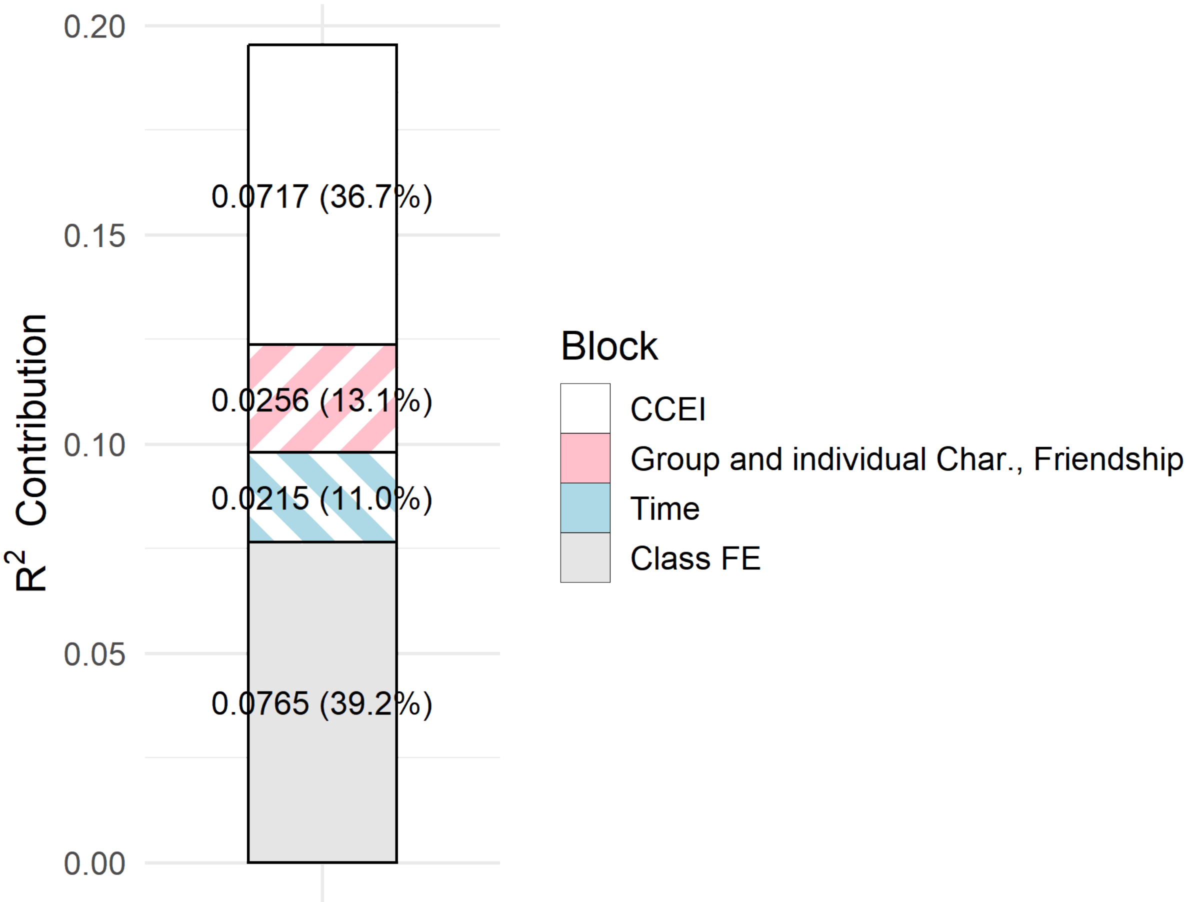
Figure 4: CDFs of Collective Rationality



(a) Baseline (b) Endline

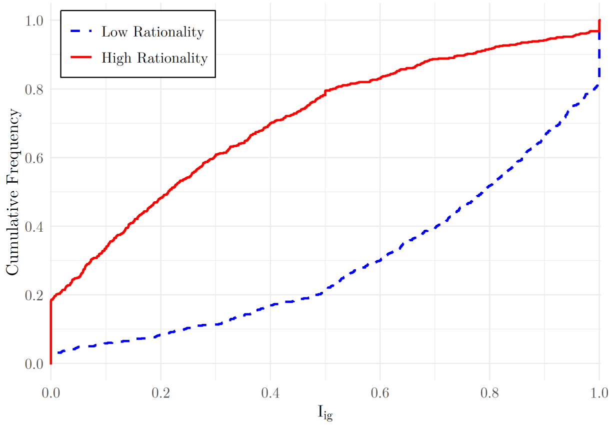
Notes: This figure presents the cumulative distribution functions (CDFs) of collective rationality, measured by $ccei_g$, for three groups, defined based on whether each individual in a pair is above or below the sample median in individual rationality.

Figure 5: Shapley Decomposition of Collective CCEI

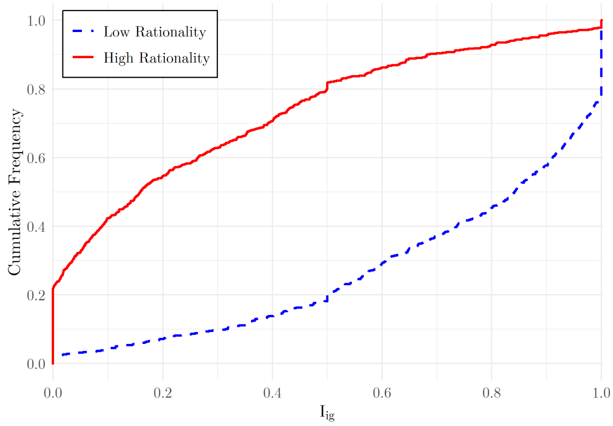


Notes: This figure reports the Shapley–Owen–Shorrocks decomposition of the regression R^2 from Table 2, Column 4. Explanatory variables are grouped into (i) CCEI variables, (ii) group and friendship characteristics, (iii) time variables and (iv) class fixed effects.

Figure 6: CDFs of Revealed Preference Distance



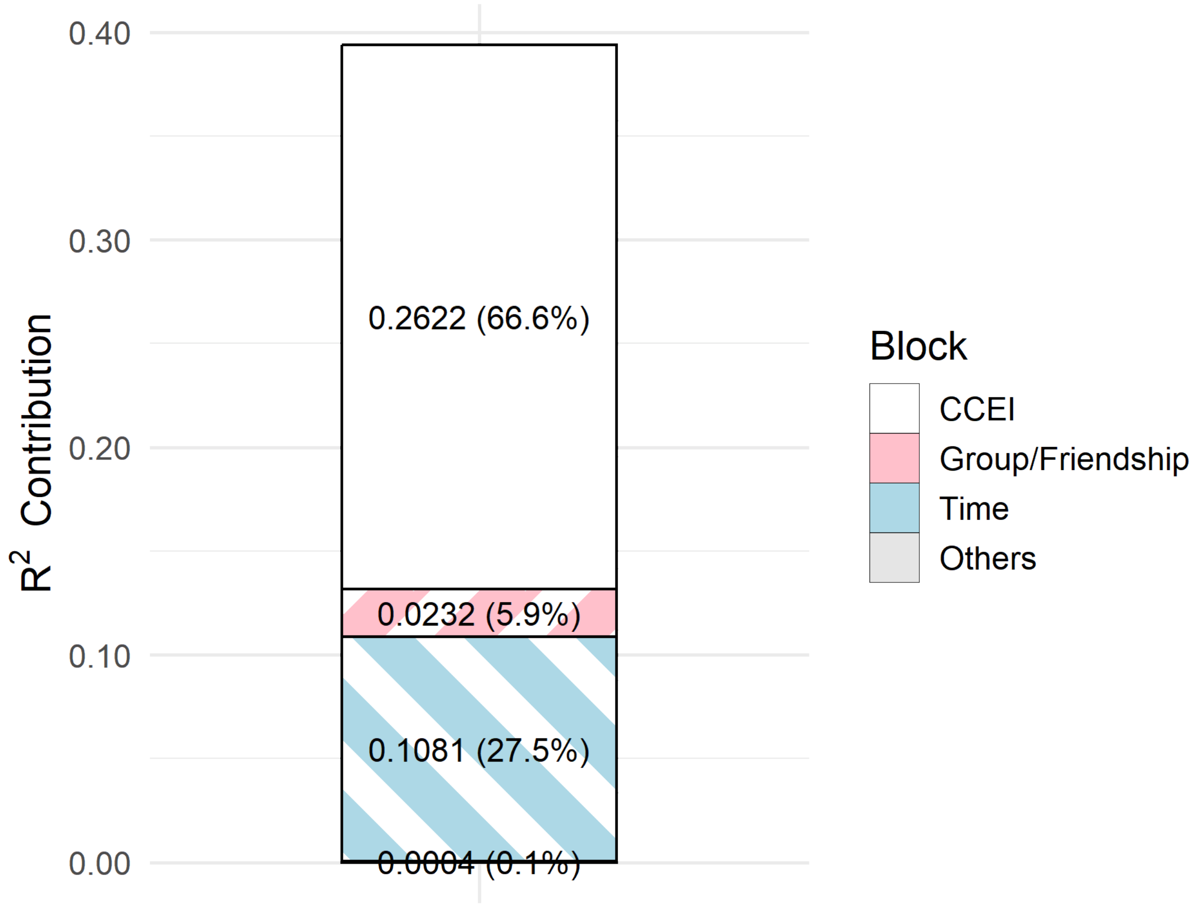
(a) Baseline



(b) Endline

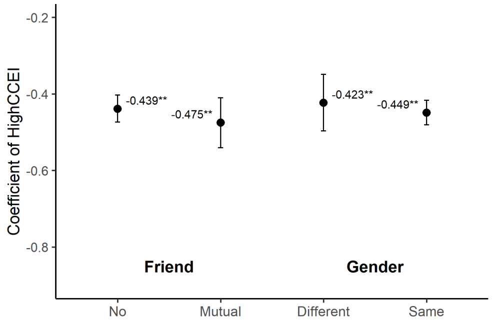
Notes: This figure presents cumulative distribution functions (CDFs) of the revealed preference distance in rationality between the individual and the group (I_{ig}), for two groups within each pair, classified by relative individual rationality. The "high" and "low" rationality labels are assigned by comparing the individuals' $ccei_i$ values; if these are equal, the comparison moves to $ccei_{ig}$, and if still tied, the mover is considered the "high" rationality individual.

Figure 7: Shapley Decomposition of CCEI bargaining weight

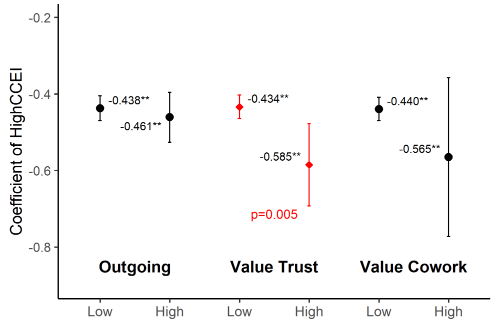


Notes: This table reports the Shapley–Owen–Shorrocks decomposition of the regression R^2 from Table 3, Column 4. Explanatory variables are grouped into (i) CCEI variables, (ii) group and friendship characteristics, (iii) time variables and (iv) others. Others include mover status and class fixed effects.

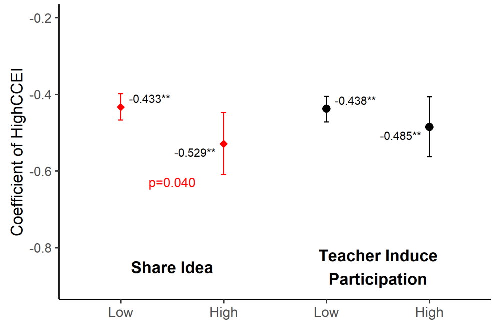
Figure 8: Heterogeneity Analysis



(a) Panel A: Mutual friendship, observable characteristics



(b) Panel B: PBL related



(c) Panel C: Class participation without mentioning PBL

Notes: This figure illustrates the heterogeneity of the HighCCEI coefficients. Confidence intervals are at the 95% level. We tested whether the two coefficients for each pair are statistically different. *Value Trust* and *PBL Share Idea* were found to be significantly different, highlighted with a red diamond, and the corresponding p-values are displayed below the lines. Statistical significance of the coefficients is denoted by ** $p < 0.05$ and *** $p < 0.01$.

Tables

Table 1: Summary Statistics and Balance Test

Outcome Variable	Summary Statistics		Balance Test		
	Mean	SD	β	(SE)	P-value
	(1)	(2)	(3)	(4)	(5)
Panel A: Measures from the Experiment					
CCEI	0.900	0.133	0.054	(0.047)	0.247
Risk Aversion	0.322	0.134	-0.007	(0.042)	0.874
Panel B: Other Characteristics					
Male	0.608	0.488	0.048	(0.042)	0.252
Height	163.513	8.187	0.010	(0.040)	0.812
Friendship Network:					
Out-Degree	4.630	2.535	-0.030	(0.043)	0.489
In-Degree	4.623	2.692	0.003	(0.041)	0.951
Math Score	2.657	1.515	-0.066	(0.041)	0.109
Big 5 Personality:					
Outgoing	3.570	1.006	0.020	(0.043)	0.639
Opened	3.568	0.865	0.002	(0.042)	0.969
Agreeable	2.848	0.744	0.058	(0.043)	0.179
Conscientious	3.386	0.859	0.045	(0.044)	0.309
Stable	2.500	0.810	0.003	(0.041)	0.943
Joint test: $\beta_k = 0 \ \forall k$			$\chi^2(12) = 8.55$, P-value $= 0.741$		

Notes: Columns (1)–(2) report the mean, and standard deviation of each outcome variable across all individuals. Columns (4)–(6) report regression results of each individual's outcome variable on their partner's corresponding variable. The number of observation is 1,304 for measures from the experiment, male, height, and friendship network. It is 1,286 for cognitive and non-cognitive measures due to survey attrition. In column (4)-(6), each row describes estimate and p-value from each regression. The balance test assigns individuals randomly within each pair. All regressions control for class fixed effects. The joint hypothesis tests the null that all coefficients are equal to zero. Out-degree friendship is the number of classmates the respondent nominated as friends. In-degree friendship is the number of classmates who nominated the respondent.

Table 2: Collective CCEI

$CCEI_g$	(1)	(2)	(3)	(4)	(5)
$\text{CCEI}_{\text{max},gt}$	0.362**	0.350**		0.323**	0.242*
	(0.081)	(0.096)		(0.092)	(0.106)
$\text{CCEI}_{\text{dist},gt}$	-0.234**	-0.271**		-0.263**	-0.162**
	(0.045)	(0.057)		(0.056)	(0.044)
Endline		0.028		-0.011	
		(0.181)		(0.183)	
Endline × $\text{CCEI}_{\text{max},gt}$		-0.027		0.012	
		(0.183)		(0.184)	
Endline × $\text{CCEI}_{\text{dist},gt}$		0.078		0.075	
		(0.072)		(0.073)	
Math $\text{Score}_{\text{max},gt}$			0.010*	0.005	0.007
			(0.004)	(0.004)	(0.006)
Math $\text{Score}_{\text{dist},gt}$			-0.003	-0.001	0.002
			(0.003)	(0.003)	(0.005)
$(Female_i, Female_j)$			0.000	0.000	0.000
			(.)	(.)	(.)
$(Female_i, Male_j)$			-0.008	-0.007	0.000
			(0.021)	(0.020)	(.)
$(Male_i, Female_j)$			-0.010	-0.010	0.000
			(0.020)	(0.019)	(.)
$(Male_i, Male_j)$			0.022	0.020	0.000
			(0.016)	(0.018)	(.)
$Friends_{max}$			0.005*	0.005*	0.007+
			(0.002)	(0.002)	(0.004)
$Friends_{dist}$			-0.007*	-0.006*	-0.005
			(0.003)	(0.003)	(0.004)
No Friendship			0.000	0.000	0.000
			(.)	(.)	(.)
One-sided Friendship			0.011	0.008	-0.008
			(0.013)	(0.012)	(0.015)
Mutual Friendship			-0.029+	-0.026	-0.032
			(0.016)	(0.016)	(0.025)
N	1304	1304	1304	1304	1304
R-squared	0.166	0.169	0.124	0.195	0.639
Group Characteristics	No	No	Yes	Yes	Yes
Friendship Characteristics	No	No	Yes	Yes	Yes

Notes: All models are estimated using pooled OLS. Robust standard errors are clustered at the class level. Group characteristics include gender, height, math scores and the Big five personality traits, as well as missing indicators. Friendship characteristics include the number of friends, popularity within the class, and whether two students within a group identified each other as friends. +, *, ** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 3: Preference aggregation using CCEI

I_{ig}	(1)	(2)	(3)	(4)	(5)
HighCCEI	-0.447**	-0.411**		-0.405**	-0.421**
	(0.016)	(0.024)		(0.024)	(0.022)
post		0.036+		0.034+	
		(0.018)		(0.018)	
$HighCCEI_{post}$		-0.071+		-0.067+	
		(0.037)		(0.036)	
$Math\ Score_i$			-0.001	-0.000	-0.001
			(0.001)	(0.000)	(0.001)
$Math\ Score_{diff}$			-0.021**	-0.012*	-0.001
			(0.006)	(0.005)	(0.007)
$(Female_i, Female_j)$			0.000	0.000	0.000
			(.)	(.)	(.)
$(Female_i, Male_j)$			0.056**	0.019	0.000
			(0.019)	(0.017)	(.)
$(Male_i, Female_j)$			-0.056**	-0.020	0.000
			(0.019)	(0.017)	(.)
$(Male_i, Male_j)$			-0.000	-0.000	0.000
			(0.001)	(0.000)	(.)
$Friends_{max}$			-0.000	-0.000	-0.000
			(0.000)	(0.000)	(0.000)
$Friends_{diff}$			-0.002	0.004	-0.007
			(0.004)	(0.003)	(0.004)
$Popularity_{max}$			-0.000	0.000	-0.000
			(0.000)	(0.000)	(0.000)
$Popularity_{max}$			0.000	-0.002	0.002
			(0.003)	(0.002)	(0.005)
No Friendship			0.000	0.000	0.000
			(.)	(.)	(.)
One-sided Friendship			-0.000	-0.000	0.000
			(0.001)	(0.000)	(0.000)
Mutual Friendship			-0.001	-0.001	0.000
			(0.001)	(0.001)	(0.000)
Constant	0.723**	0.706**	0.465**	0.675**	0.713**
	(0.008)	(0.012)	(0.060)	(0.029)	(0.011)
N	2228	2228	2228	2228	2228
R-squared	0.382	0.384	0.039	0.396	0.731
Group Characteristics	No	No	Yes	Yes	Yes
Friendship Characteristics	No	No	Yes	Yes	Yes
Cluster Level	Class	Class	Class	Class	Individual

Notes: All models are estimated using pooled OLS. Group characteristics include gender, height, math scores, the Big Five personality traits, and missing indicators. Friendship characteristics include the number of friends, popularity within the class, and whether two students within a group mutually identified each

Table 4: RA aggregation and bargaining

RA_g	(1)	(2)	(3)	(4)	(5)
$RA_{HighCCEI}$	0.472**	0.421**		0.323**	0.307**
	(0.028)	(0.037)		(0.076)	(0.092)
$RA_{LowCCEI}$	0.355**	0.352**		0.280**	0.243**
	(0.036)	(0.036)		(0.061)	(0.085)
Endline		-0.037**		-0.039**	
		(0.013)		(0.014)	
Endline × $RA_{HighCCEI}$		0.084^{+}		0.091*	
		(0.043)		(0.044)	
$RA_{HighMathScore}$			0.388**	0.073^{+}	0.026
			(0.059)	(0.043)	(0.047)
$RA_{LowMathScore}$			0.316**	0.000	0.000
			(0.062)	(.)	(.)
$RA_{HighHeight}$			-0.015	-0.023	-0.101
			(0.046)	(0.044)	(0.062)
$RA_{HighMale}$			0.035	0.018	0.070
			(0.050)	(0.050)	(0.073)
$RA_{HighFriends}$			0.069	0.066	0.046
			(0.054)	(0.054)	(0.051)
$RA_{HighPopularity}$			-0.023	-0.027	-0.029
			(0.050)	(0.051)	(0.060)
$RA_{HighAgree}$			-0.074	-0.072	-0.135^{+}
			(0.047)	(0.048)	(0.070)
$RA_{HighCons}$			0.058	0.059	0.023
			(0.041)	(0.040)	(0.064)
$RA_{HighOpen}$			0.086	0.087	0.166*
			(0.053)	(0.053)	(0.073)
$RA_{HighOut}$			0.062	0.055	0.029
			(0.047)	(0.047)	(0.064)
$RA_{HighStab}$			-0.070	-0.074^{+}	-0.056
			(0.043)	(0.042)	(0.051)
Constant	0.026^{+}	0.049**	0.025^{+}	0.053**	0.102**
	(0.014)	(0.017)	(0.013)	(0.017)	(0.022)
N	1304	1304	1304	1304	1304
R-squared	0.409	0.412	0.424	0.431	0.754
p-values from test					
$RA_{HighCCEI} = RA_{LowCCEI}$	0.016				0.282
$(RA_{HighCCEI} = RA_{LowCCEI})$ in baseline		0.181		0.401	
$(RA_{HighCCEI} = RA_{LowCCEI})$ in endline		0.002		0.004	
$(RA_{HighMath} = RA_{LowMath})$			0.097		
Cluster Level	Class	Class	Class	Class	Group

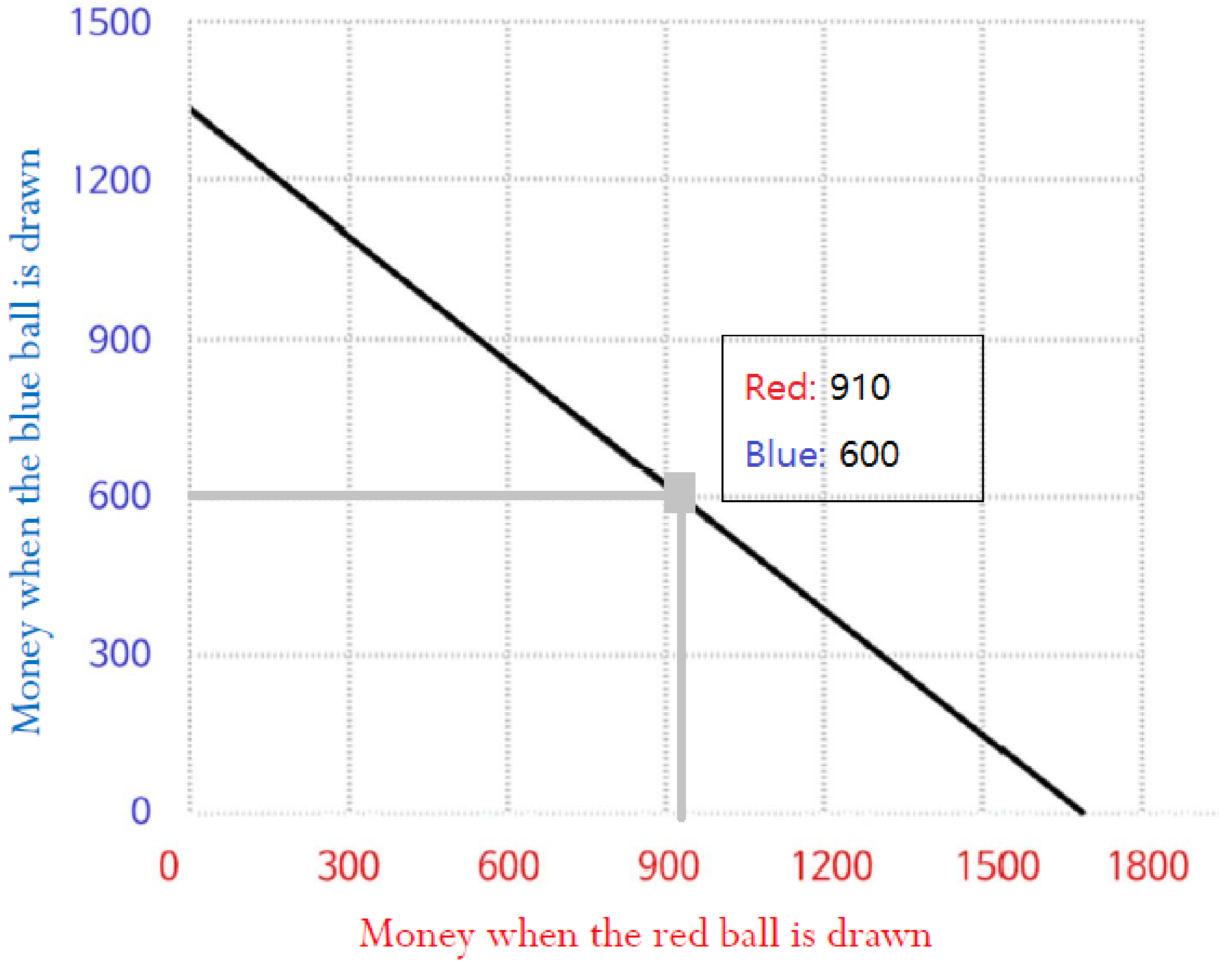
Notes: All models are estimated using pooled OLS. +, *, ** denote significance at the 10%, 5%, and 1%

7 Appendix Figures & Tables

Figure A1: Photograph from the fieldwork

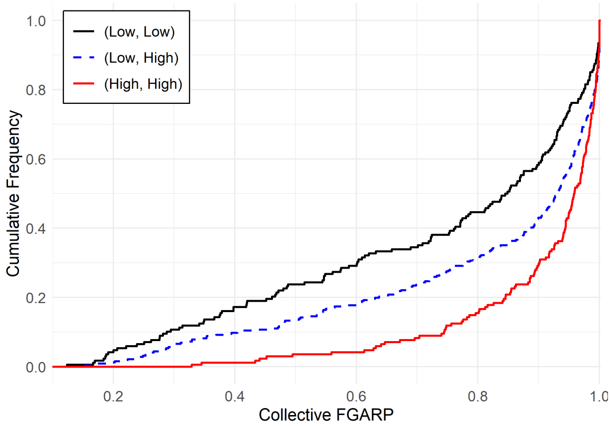
Notes: XXX

Figure A2: Illustration of the experiment

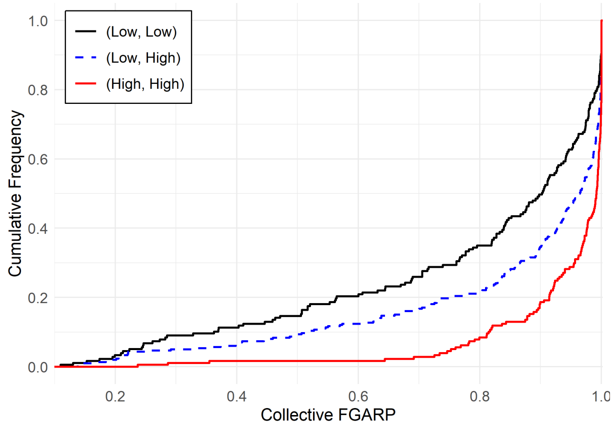


Notes: Given the budget line (i.e., determined by the prices of two Arrow securities), the students select a point along the line. Each axis is measured in Korean Won, where 1,000 KRW corresponds to 0.72 USD.

Figure A3: Summary CDFs of Rationality Measures

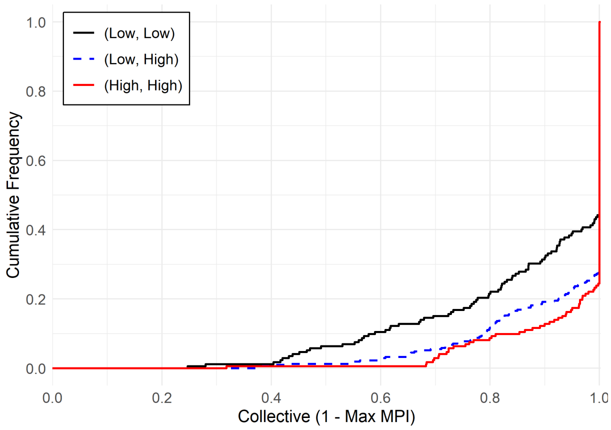


(a) Baseline

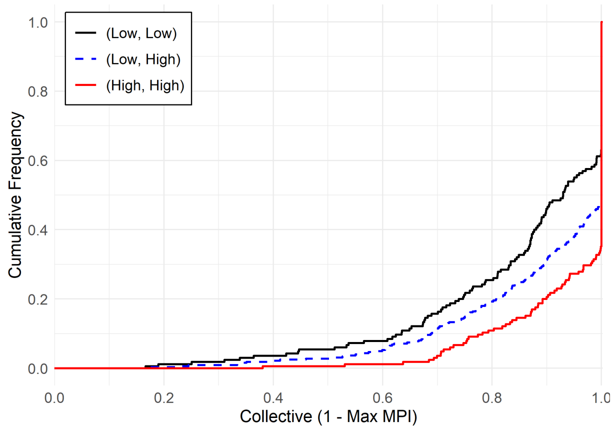


(b) Endline

Panel A: F-GARP



(c) Baseline

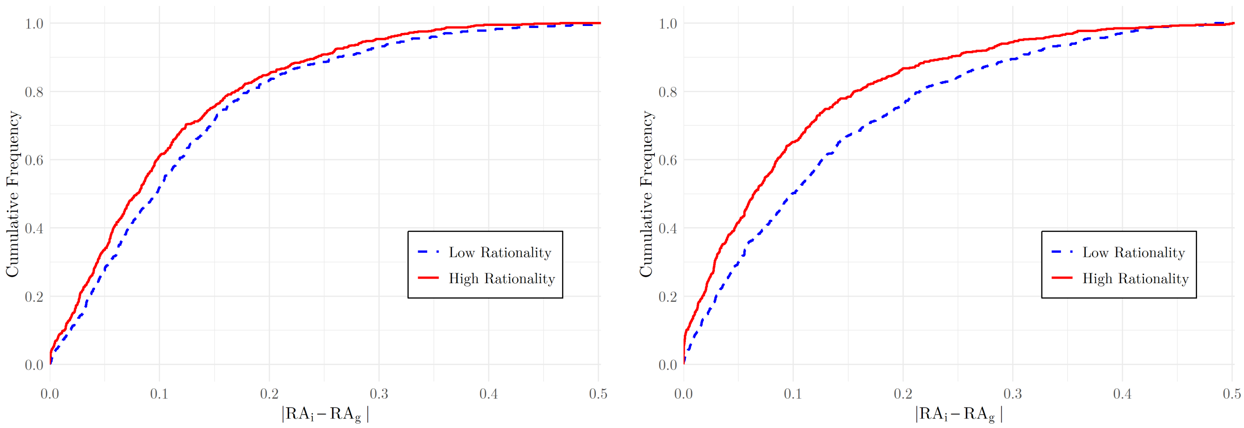


(d) Endline

Panel B: (1−Max MPI)

Notes: This figure presents the cumulative distribution functions (CDFs) of collective rationality, measured by $FGARP_g$ and (1-$MaxMPI_g$), for three groups, defined based on whether each individual in a pair is above or below the sample median in individual rationality.

Figure A4: CDFs of Risk Preference Distance



(a) Baseline

(b) Endline

Notes: This figure presents cumulative distribution functions (CDFs) of the absolute difference in risk aversion between the individual and the group ($|RA_i - RA_g|$), for two groups within each pair, classified by relative individual rationality. The "high" and "low" rationality labels are assigned by comparing the individuals' $ccei_i$ values; if these are equal, the comparison moves to $ccei_{ig}$, and if still tied, the mover is considered the "high" rationality individual.

Table A1: Balance Test using Mover's as Dep. Var.

Outcome Variable	β (SE)	P-value
CCEI	0.042 (0.041)	0.314
Risk Aversion	-0.017 (0.042)	0.679
Math Score	-0.061 (0.042)	0.145
Male	0.058 (0.040)	0.156
Outgoing	0.032 (0.041)	0.435
Opened	0.016 (0.039)	0.684
Agreeable	0.078 (0.044)	0.075
Conscientious	0.023 (0.042)	0.581
Stable	0.031 (0.041)	0.449
Height	-0.007 (0.042)	0.877
Out-Degree Friendship	-0.023 (0.041)	0.574
In-Degree Friendship	0.003 (0.040)	0.931
Joint test: $\beta_k = 0\ \forall k$	$\chi^2(12) = 10.25$	0.594

Notes: This table reports regression results of each individual's outcome variable on their partner's corresponding variable. Each row describes estimate and p-value from each regression. This table uses the mover as the dependent variable. All regressions control for class fixed effects. The joint hypothesis tests the null that all coefficients are equal to zero. Out-degree friendship is the number of classmates the respondent nominated as friends. In-degree friendship is the number of classmates who nominated the respondent.

Table A2: Rationality Extension: with RA & Corner

	(1)	(2)	(3)
CCEI_max, gt	0.324**	0.287**	0.342***
	(0.095)	(0.090)	(0.095)
CCEI_dist, gt	-0.263***	-0.239***	-0.268***
	(0.058)	(0.055)	(0.058)
Endline	-0.010	-0.033	-0.022
	(0.187)	(0.184)	(0.185)
Endline × CCEI_max, gt	0.012	0.032	0.022
	(0.189)	(0.186)	(0.186)
Endline × CCEI_dist, gt	0.075	0.078	0.070
	(0.075)	(0.073)	(0.074)
Math Score_max, gt	0.005	0.005	0.005
	(0.004)	(0.004)	(0.004)
Math Score_dist, gt	-0.001	-0.001	-0.001
	(0.003)	(0.003)	(0.003)
Oneside Friendship	0.008	0.006	0.006
	(0.012)	(0.012)	(0.012)
Mutual Friendship	-0.026	-0.028	-0.027
	(0.016)	(0.017)	(0.017)
RA_max, gt		-0.175***	
		(0.045)	
RA_dist, gt		0.082*	
		(0.036)	
Corner Ratio_max, gt			0.067**
			(0.021)
Corner Ratio_dist, gt			-0.067**
			(0.022)
N	1304	1304	1304
R-squared	0.195	0.208	0.203
Class Fixed Effect	yes	yes	yes
Gender & Height	yes	yes	yes
(Non)Cognitive Ability	yes	yes	yes
Friendship Network	yes	yes	yes

Notes: All models are estimated using pooled OLS. Robust standard errors are clustered at the class level. Individual controls include gender, height, math scores, the big five personality traits and risk aversion (each measured as the maximum and within-group distance), as well as missing indicators. School characteristics include school type (co-ed, all-boys, or all-girls school), and friendship characteristics include the number of friends and popularity within the class. *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table A3: Rationality Extension: other CCEI measures

	(1)	(2)
FGARP_max, gt	0.411***	
	(0.078)	
FGARP_dist, gt	-0.190***	
	(0.049)	
Endline	-0.007	0.170
	(0.122)	(0.098)
Endline × FGARP_max, gt	0.022	
	(0.128)	
Endline × FGARP_dist, gt	0.005	
	(0.069)	
Oneside Friendship	0.029	-0.010
	(0.019)	(0.014)
Mutual Friendship	-0.011	0.023
	(0.022)	(0.017)
(1 - Max MPI)_max, gt		-0.197**
		(0.065)
(1 - Max MPI)_dist, gt		0.026
		(0.040)
Endline × $(1 -$ Max MPI$)$_max, gt		-0.160
		(0.100)
Endline × $(1 -$ Max MPI$)$_dist, gt		0.175**
		(0.062)
N	1304	1304
R-squared	0.193	0.153
Class Fixed Effect	yes	yes
Gender & Height	yes	yes
(Non)Cognitive Ability	yes	yes
Friendship Network	yes	yes

Notes: All models are estimated using pooled OLS. Robust standard errors are clustered at the class level. Individual controls include gender, height, math scores, the big five personality traits and risk aversion (each measured as the maximum and within-group distance), as well as missing indicators. School characteristics include school type (co-ed, all-boys, or all-girls school), and friendship characteristics include the number of friends and popularity within the class. *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table A4: Shapley Decomposition of R^2

Blocks	Shapley Value	Contribution (% of R^2)
Time	0.0215	11.0
CCEI	0.0718	36.7
Group/Friendship	0.0258	13.2
Class FE	0.0763	39.0
Total	0.1954	100.0

Notes: This table reports the Shapley–Owen–Shorrocks decomposition of the regression R^2 from Table 2, Column 4. Explanatory variables are grouped into (i) time variables, (ii) CCEI variables, (iii) group and friendship characteristics, and (iv) class fixed effects.

Table A5: Literature Review

Paper	**Data**	**Decision Ability Proxy**	**Decision Quality Proxy**	**Findings**
Behrman et al. (AER, 2012)	EPS 2006 (Chile) Individuals aged 24–65 N = 13,054	Financial literacy; Schooling	Household wealth accumulation	0.2 SD increase in fin. literacy $\rightarrow$ $13,800 net wealth; Financial literacy has a larger effect on wealth than schooling
Guiso et al. (JFE, 2023)	SHIW 1991-2014 (Italy) Married couples HH = 8000	Education; Income	Financial returns; Market participation; Portfolio diversification	Gender equality improves couples' decision quality.; The effects of equality are small when both spouses have very low or very high education.
Gu et al. (RFS, 2023)	HILDA (Australia) Married couples HH = 3,400	Education; Cognitive ability; Employment; Earnings	Gender gap in bargaining power (husband vs. wife)	Average bargaining power: husband 60%, wife 40%; Half of the gender gap explained by gender norms
Ke (AEA P&P, 2018)	Cross-country stock data (25 countries)	Education; GDP; Inequality (country-level)	Household stock market participation (Country-level)	1 SD increase in traditional gender norms $\rightarrow$ 4.3pp decrease in stock participation; Gender norms reduce women's influence in financial decisions
Thornquist et al. (working paper)	Sweden 2000-06 N = 2,425,143 HH = 928,164	Degree in econ.	Gender gap in bargaining power	Having an economics degree increases both spouses' investment participation and risk-taking
Friedberg et al. (working paper)	HRS 1992 (U.S.) Married couples HH = 4,237	Education; Earnings	Decision-making power (Self-report)	Education increases one's own bargaining power while decreasing the spouse's; Higher wife income, work hours, and past earnings share reduce husband's bargaining power
Yilmazer et al. (REH, 2015)	HRS 1992-2006 (U.S.) Couples HH = 2,012	Education; Earnings; Wealth	Decision-making power (Self-report)	The share of risky assets increases with the risk tolerance of the spouse who has a higher bargaining power.

8 Appendix: Decision Problem

Figure A5 illustrates the decision environment faced by the subjects. The horizontal axis represents the values of x_r, and the vertical axis denotes the values of x_b. Points A, B, and C represent possible portfolio choices on a common linear budget set corresponding to a given price pair (p_r, p_b) with $p_r < p_b$. Portfolio A lies on the 45° line (dashed), yielding a constant return regardless of the realized state. Portfolio B corresponds to the case where all wealth is allocated to the cheaper security associated with state r. Portfolio C represents an intermediate allocation between A and B.

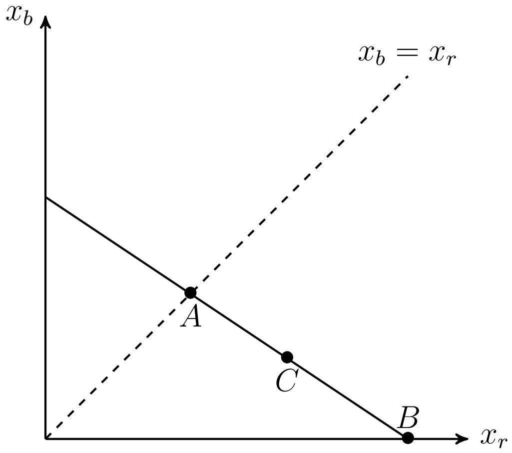


Figure A5: An illustration of the experimental design

9 Appendix: Revealed Bargaining Power Index

The revealed bargaining power index is well-defined whenever the underlying rationality measure satisfies set monotonicity. In this section, we first present the definition of set monotonicity for rationality measures and provide examples of measures that satisfy it. We then formalize the revealed bargaining power index for such measures and show the properties it satisfies.

9.1 Set Monotonicity and Examples

A (finite) choice dataset is denoted by $D = (p^t, x^t)t = 1^T$ with price vectors $p^t \in \mathbb{R}^L{++}$ and chosen bundles $x^t \in \mathbb{R}^L_+$ for all $t = 1, \ldots, T$. Let $m : \mathcal{D} \to \mathbb{R}$ be a rationality measure, where $\mathcal{D}$ is a set of choice datasets. We first define *set monotonicity* of the measure: higher values of $m(D)$ represent more rational choices as follows:

Definition 1 *The measure m satisfies set monotonicity if and only if*

$$D \subseteq D' \;\Rightarrow\; m(D) \geq m(D'). \tag{9.1}$$

In other words, whenever new choice data are added, the rationality measure weakly decreases. We consider the following rationality measures and determine which satisfy set monotonicity with proofs: (i) CCEI; (ii) money-pump indices (Max MPI, Min MPI, and Median MPI); (iii) the Houtman–Maks index (HM measure); and (iv) the Varian measure.

CCEI. For each $e \in (0, 1]$, define the *direct e-revealed preference* relation by

$$x^t \succeq_e x^s \iff p^t \cdot x^s \leq e(p^t \cdot x^t) \quad \text{and} \quad x^t \succ_e x^s \iff p^t \cdot x^s < e(p^t \cdot x^t). \tag{9.2}$$

A dataset is said to satisfy *e-GARP* if there is no sequence $t_1, \ldots, t_K$ with $x^{t_1} \succeq_e x^{t_2} \succeq_e \cdots \succeq_e x^{t_K}$ and $x^{t_K} \succ_e x^{t_1}$ (**PolissonQuah2022**). The case $e = 1$ is the usual GARP. **PolissonQuah2022** show that for a given dataset D, CCEI(D) is the largest uniform efficiency e that restores GARP as CCEI$(D) = \sup\{e \in (0, 1] \mid D \text{ satisfies } e\text{-GARP}\}$.

We now claim that CCEI satisfies the set-monotonicity.

Proposition 1 *Let S and T be finite choice datasets with $S \subseteq T$. Then, it follows that* CCEI$(S) \geq$ CCEI(T).

Proof. For a given $e \in (0, 1]$, define $x^t \succeq_e^D x^s$ if and only if $p^t \cdot x^s \leq e(p^t \cdot x^t)$. Dataset D satisfies e-GARP if there is no chain $x^{t_1} \succeq_e^D \cdots \succeq_e^D x^{t_K}$ with $x^{t_K} \succ_e^D x^{t_1}$. Let $\text{CCEI}(D) = \sup\{e \mid D \text{ satisfies } e\text{-GARP}\}$.

Suppose that T satisfies e-GARP for some $e \in (0, 1]$. Then, since $S \subseteq T$, the restriction of $\succeq_e^T$ to S equals $\succeq_e^S$. Thus, S does not violate e-GARP; that is, any violating chain in S would also violate it in T. Consequently, every e feasible for T is also feasible for S, which implies that $\text{CCEI}(S) \geq \text{CCEI}(T)$. Therefore, CCEI satisfies the set monotonicity. ■

Money Pump Index.

Moutman-Maks Index.

Varian Measure.

9.2 Properties of the Revealed Bargaining Power Index