

Homo Reciprocans: Theory and Experiment

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(Content from several sole-authored and coauthored papers)



Central Objective of the Research

Contribute to our understanding of reciprocity through a program of:

- Experimental testing
- Theoretical modeling motivated by data
- Applications of the new theory

OUTLINE

➤ Part 1. Basics:

- How can reciprocity be identified in controlled experiments?
- Does observation of reciprocity require change in economic theory?

➤ Part 2. An economic theory of reciprocity:

- Description of the theory
- Summary of previous tests of the theory

➤ Part 3: New tests and applications

- Empirical support for significance of the Status Quo
- Application to Common Pool Resources and Public Goods with & without Power Asymmetries

Part 1. Basics

Reference: J.C. Cox, “How to Identify Trust and Reciprocity”, *Games and Economic Behavior*, 2004

Theories and Models

- Use an approach grounded in economics that distinguishes between:
 - The formal regularity properties of preferences, such as completeness, transitivity, convexity, etc.; and
 - Interpretations of theory, such as identification of the commodities

Using this Distinction

- The *homo economicus* model is a special case of Neoclassical preference theory that identifies commodities in a special way:
 - **My** hot dogs and **my** hamburgers; not
 - **Your** hot dogs and **my** hot dogs
- Neoclassical preference theory includes other-regarding preferences

Defining Characteristic of Theory

- A defining characteristic of Neoclassical preference theory is that a preference ordering is a characteristic of an agent that is independent of:
 - Other agents' actions; and
 - The context in which the agent's feasible set is embedded

Purpose of the Experiments

Design experiments to identify:

- When (or if) the *homo economicus* model is inconsistent with data ... and models of other-regarding preferences are needed
- When (or if) Neoclassical theory of other-regarding preferences is inconsistent with data ... and **new theory** is needed ... that incorporates reciprocity or trust

An Example: The Investment Game

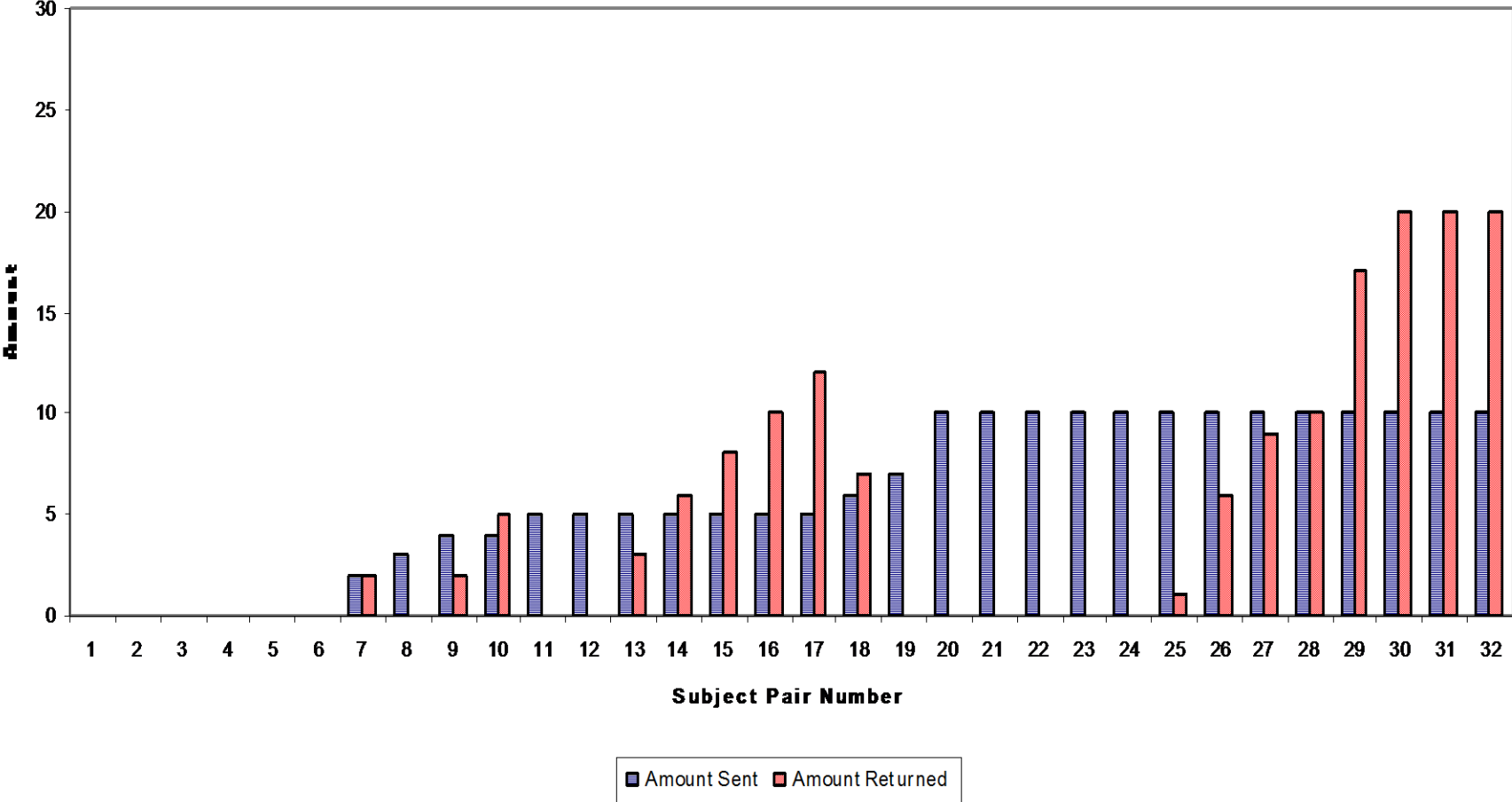
- Subjects are paired
- Each subject in each pair is given \$10
- Second movers are told to keep their \$10
- First movers can either:
 - Keep their \$10; or
 - Give some or all of it to the second mover
- Any amount given is multiplied by 3 by the experimenter

Investment Game (cont.)

- Second movers can either:
 - Keep all of any amount received; or
 - Return part or all of it to the first mover
- All of the above is common information
- The game is played only once
- *Homo economicus* model predicts zero returned and sent

Behavior in the Investment Game

Figure 1 : Amounts Sent and Returned in Treatment A



Does the subjects' behavior exhibit trust and reciprocity?

Maybe. Let's offer some definitions of these terms.

Definitions

- **Self-regarding** (or *homo economicus*) **preferences** are characterized by positively monotonic utility for one's own material payoffs and indifference about others' material payoffs
- **Other-regarding preferences** are characterized by utility that is not constant with respect to variations in one's own or others' material payoffs, including
 - Altruistic preferences
 - Inequality (or “inequity) averse preferences
 - Quasi-maximin preferences

Definitions (cont.)

- (direct) **Positive reciprocity** is a motivation to adopt a generous action that benefits someone else, at one's own cost, because that person's behavior was beneficial to oneself
- **Trust** is a belief that one agent has about another. A trusting action is one that creates the possibility of mutual benefit and the risk of (one's own) loss of utility if the other person defects

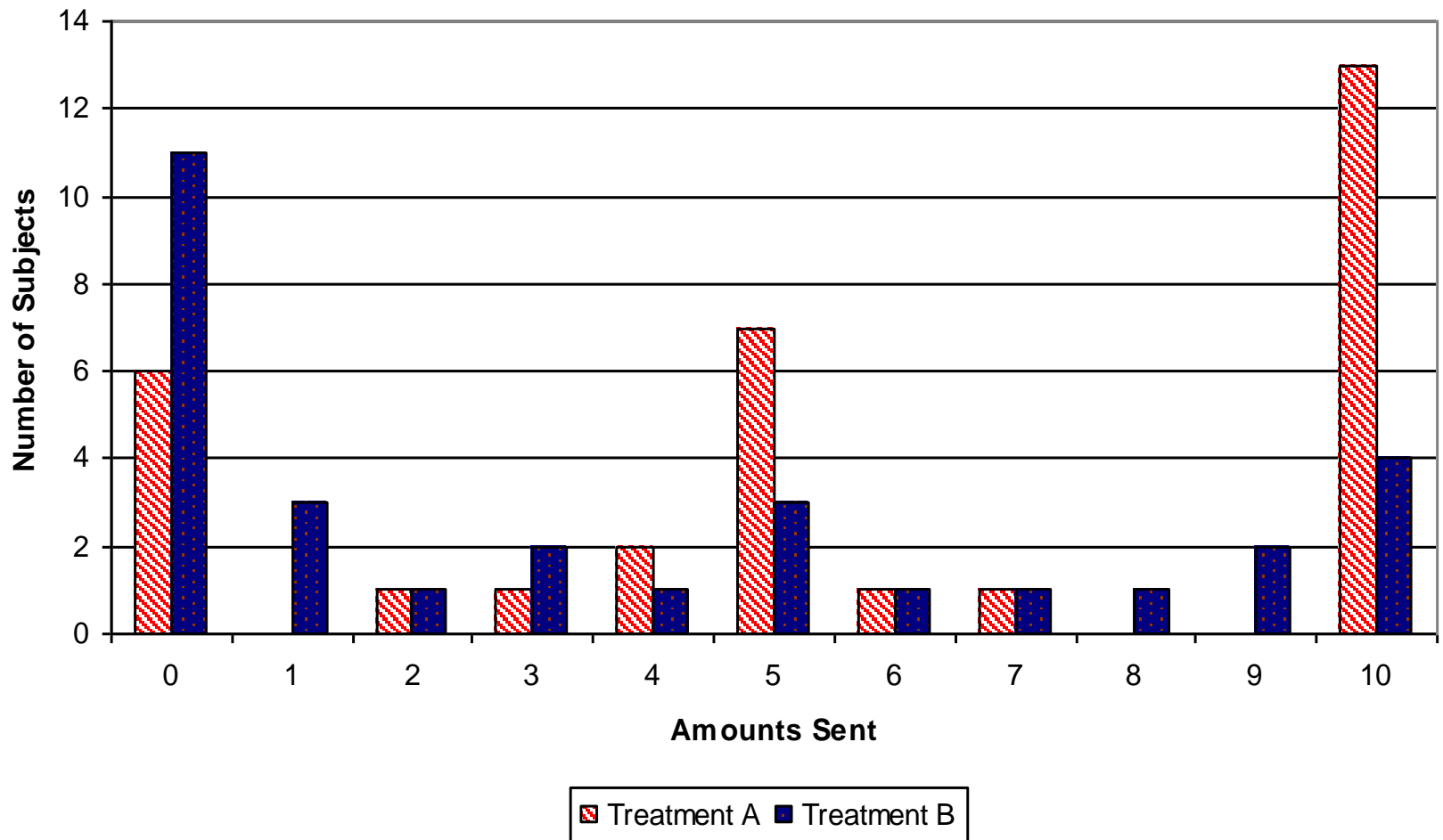
- Do subjects who send and return positive amounts in the investment game exhibit trust and reciprocity?
- How do we know how much they would have sent or returned with unconditional other-regarding preferences?

Triadic Design

- Treatment A. Investment game (IG)
- Treatment B. First mover dictator control game:
 - The same as in the first part of IG
 - **but** second mover has no decision
- Treatment C. Second mover dictator control game:
 - The same as in the second part of IG
 - **except** second mover's feasible set is assigned by the experimenter

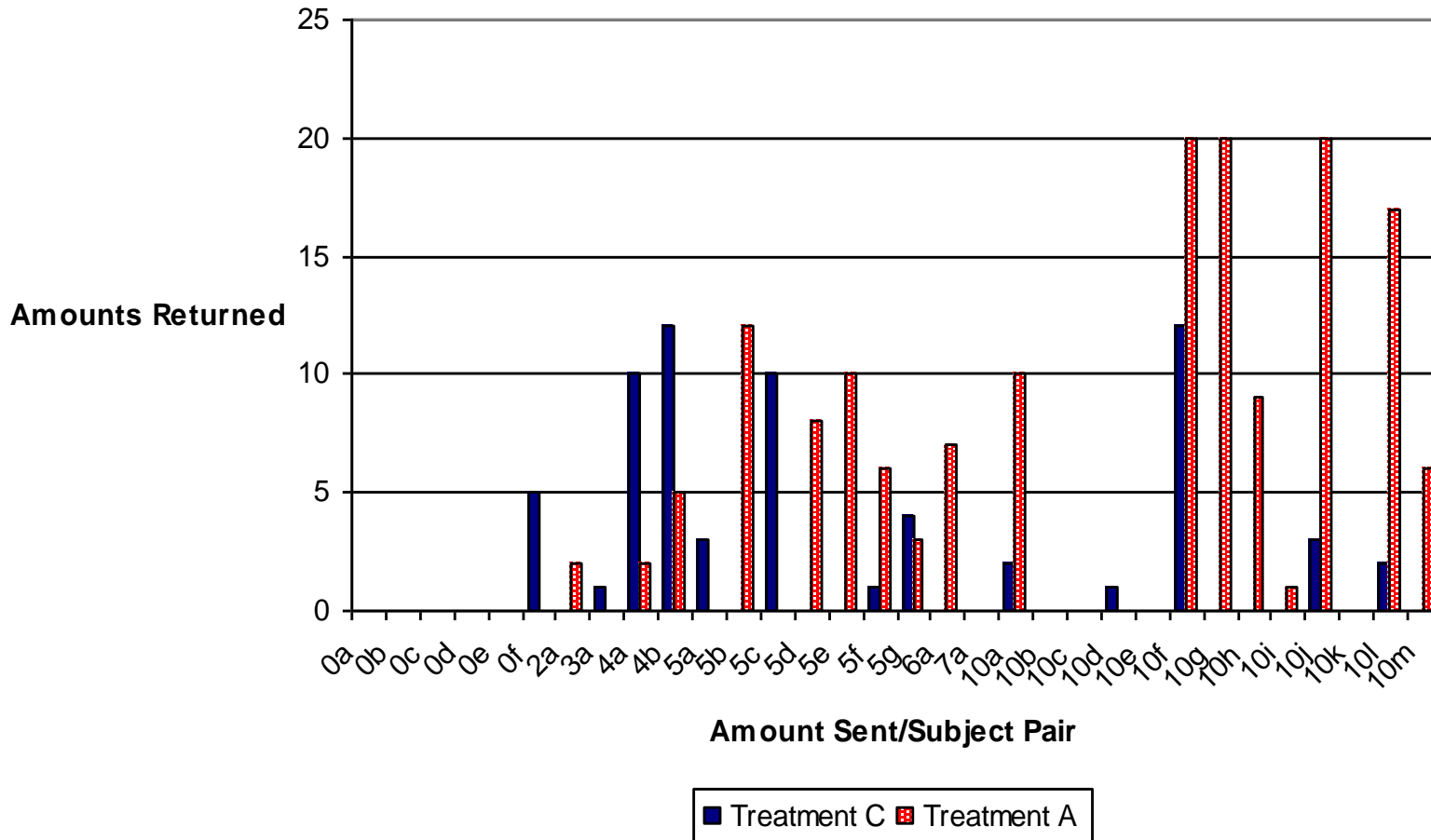
Comparison of the Amounts Sent in Treatments A and B

Figure 2 : Amounts Sent in Treatments A and B



Comparison of the Amounts “Returned” in Treatments A and C

Figure 3 : Amounts Returned in Treatments A and C



Conclusions about Behavior

- Behavior in the investment game (Tr. A) is known to exhibit trust *because* first movers send significantly more in the investment game than in the first-mover dictator control treatment (Tr. B)
- Behavior in the investment game (Tr. A) is known to exhibit positive reciprocity *because* second movers return significantly more in the investment game than in the second-mover dictator control treatment (Tr. C)

Implications for Theory

- Data-consistent models of second-mover behavior in the investment game must incorporate reciprocity
- Data-consistent models of first-mover behavior in the investment game must incorporate beliefs about others' reciprocity and other-regarding preferences

Triadic Design Experiments

Investment game (Cox, 2004, 2009)

Trust games (Cox & Deck, 2005, 2006a, 2006b)

Ultimatum mini-game (Cox & Deck, 2005)

Moonlighting game (Cox, Sadiraj & Sadiraj, 2008)

Triadic Design Experiments Identify

- Other-regarding Preferences
- Positive and Negative Reciprocity
- Trust and Fear

Part 2: Theory

References

J.C. Cox, D. Friedman & S. Gjerstad,
“A Tractable Model of Trust and Reciprocity”,
Games and Economic Behavior, 2007

J.C. Cox, D. Friedman & V. Sadiraj,
“Revealed Altruism” *Econometrica*, 2008

Neoclassical Foundations

- Neoclassical theory (e.g., Hicks, 1946; Samuelson, 1947) clarified and unified earlier work on how **opportunities** and **preferences** jointly determine outcomes for *homo economicus*
- Our paper applies those now-classic ideas to reciprocal preferences

Neoclassical Foundations (cont.)

- We focus on need to pay (**NTP**) and willingness to pay (**WTP**) one's own material payoff to change another's payoff
- Increasing WTP along indifference curves is simply **convexity**, which provides a unified account of the “social motives” efficiency, maximin, and inequality aversion

Neoclassical Generalization

- We develop a nonparametric theory of **reciprocal** preferences:
 - How choices by one player shift WTP of another player; and
 - How the (reciprocal) WTP and the NTP determine outcomes for *homo reciprocans*.

Revealed Altruism Theory

We Introduce to the Literature:

- “More Generous Than” (**MGT**), a partial ordering over opportunity sets
- “More Altruistic Than” (**MAT**), a partial ordering over preferences

Revealed Altruism Theory (cont.)

- You feel more altruistic (or less spiteful) towards others who have behaved more generously → **Axiom R**
- You react more strongly to acts of commission than to acts of omission → **Axiom S**
- Lots of mileage from classic ideas of **convexity** and **revealed preference**

More Generous Than (MGT)

Let $m^*(H)$ and $y^*(H)$ be the maximal feasible incomes in set H for SM (“me”) and FM (“you”) respectively.

Definition. Opportunity set G **MGT** F if

(a) $m^*(G) \geq m^*(F)$ and

(b) $m^*(G) - m^*(F) \geq y^*(G) - y^*(F)$

A partial ordering.

More Altruistic Than (MAT)

Definition: Preferences A **MAT** B on domain D if WTP is larger for A than for B at every point in D

- A partial ordering.
- Essentially is the single crossing property.

Reciprocity

- Assume that SM knows FM's feasible choices F, G, \dots , and sees the actual choice.

Axiom R. If G **MGT** F , then SM's preferences following choice G are **MAT** than following choice F .

Reciprocity (cont.)

Axiom S. As compared to a FM act that overturns the status quo (*commission*),

SM reacts less:

A. when FM has *no choice*; and

B. when the FM's choice of F or G upholds the status quo (*omission*).

Theory & Application

- We state and prove propositions on the observable consequences of MGT, MAT, Axiom R, Axiom S, and Convexity
- Empirical support for the propositions is found in data from
 - Investment and Dictator games
 - Carrot and Stick games
 - Stackelberg duopoly game
 - Stackelberg mini-games

Stackelberg Duopoly

- In the standard Stackelberg duopoly game:
 - The Leader chooses its quantity of output, which determines the residual demand function for the Follower
 - The Follower chooses its quantity of output, which determines the payoffs of both firms
- Data from the experiment in Huck, Muller & Normann (2001) are consistent with our theory of reciprocity but do not provide a definitive test: the game confounds convexity & reciprocity.
- So we construct the Stackelberg mini-game

Stackelberg mini-game

- Consider only 3 possible output choices for the Leader: 6 or 9 or 12
- Consider two duopoly games:
 - SMG 1: the Leader's feasible set is $\{6,9\}$
 - SMG 2: the Leader's feasible set is $\{9,12\}$
- The *homo economicus* model and social preferences models imply that a choice of 9 by the Leader will cause the Follower to choose the same output in SMG 1 as in SMG 2

Stackelberg mini-game (cont.)

- Our reciprocity theory has different implications because F_6 MGT F_9 MGT F_{12}
- If the Leader chooses F_9 rather than F_6 in the $\{F_6, F_9\}$ game his **less generous** choice makes the Follower **less altruistic** than he was ex ante
- If the Leader chooses F_9 rather than F_{12} in the $\{F_9, F_{12}\}$ game his **more generous** choice makes the Follower **more altruistic** than he was ex ante

SMG 1 & SMG 2 Provide A Diagnostic Test of Axiom R

A test of an implication that contradicts standard revealed preference theory:

- That SM will choose a smaller output when FM forgoes 12 to choose 9 than when FM forgoes 6 to choose 9

Results for Mini-game Data

- The data
 - Support the prediction from Axiom R
 - Reject the prediction from unconditional social preference and homo economics models

Part 3: New Applications

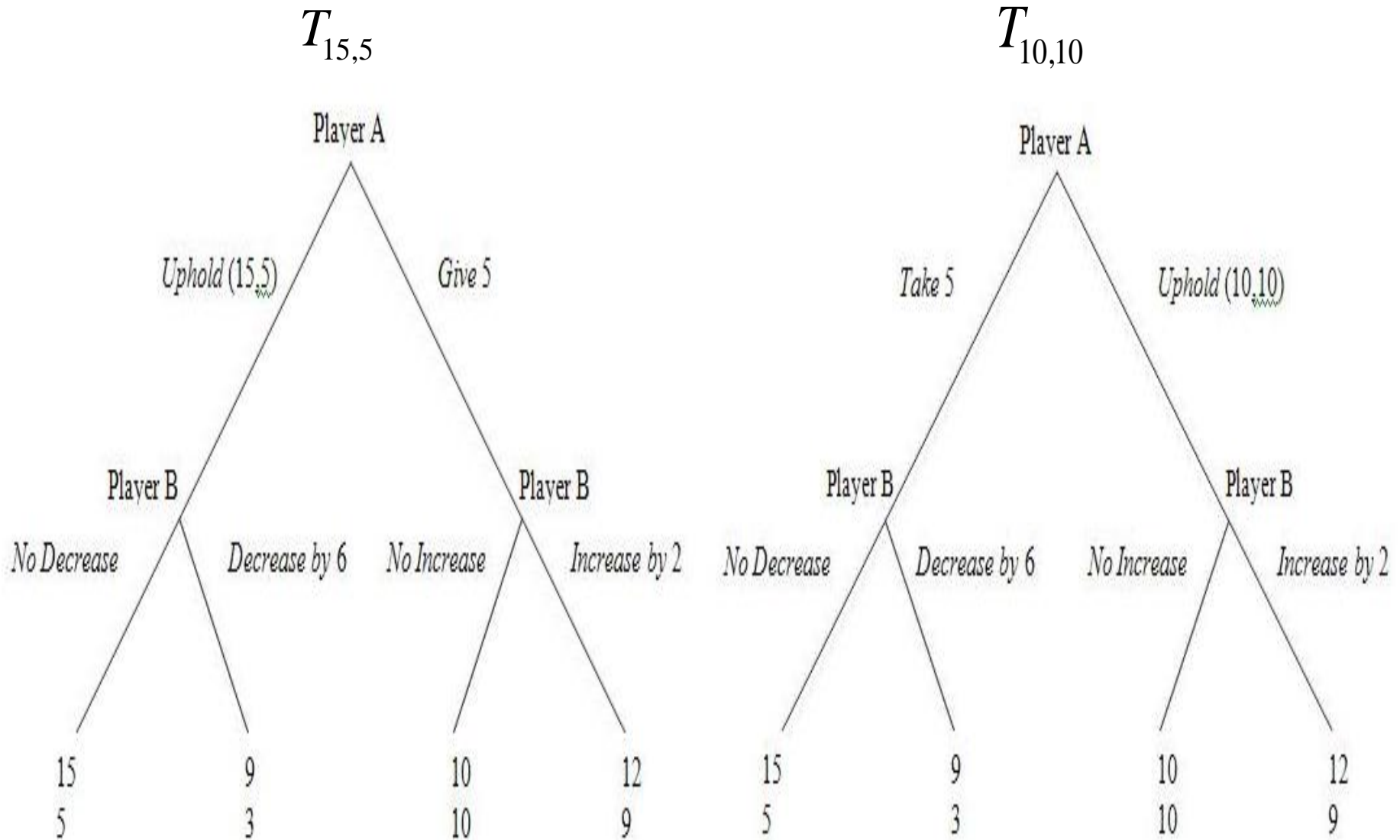
Reference

J.C. Cox, M. Servátka & R. Vadovič, “Status Quo Effects in Fairness Games: Reciprocal Responses to Acts of Commission vs. Acts of Omission” ExCEN Working Paper, 2013

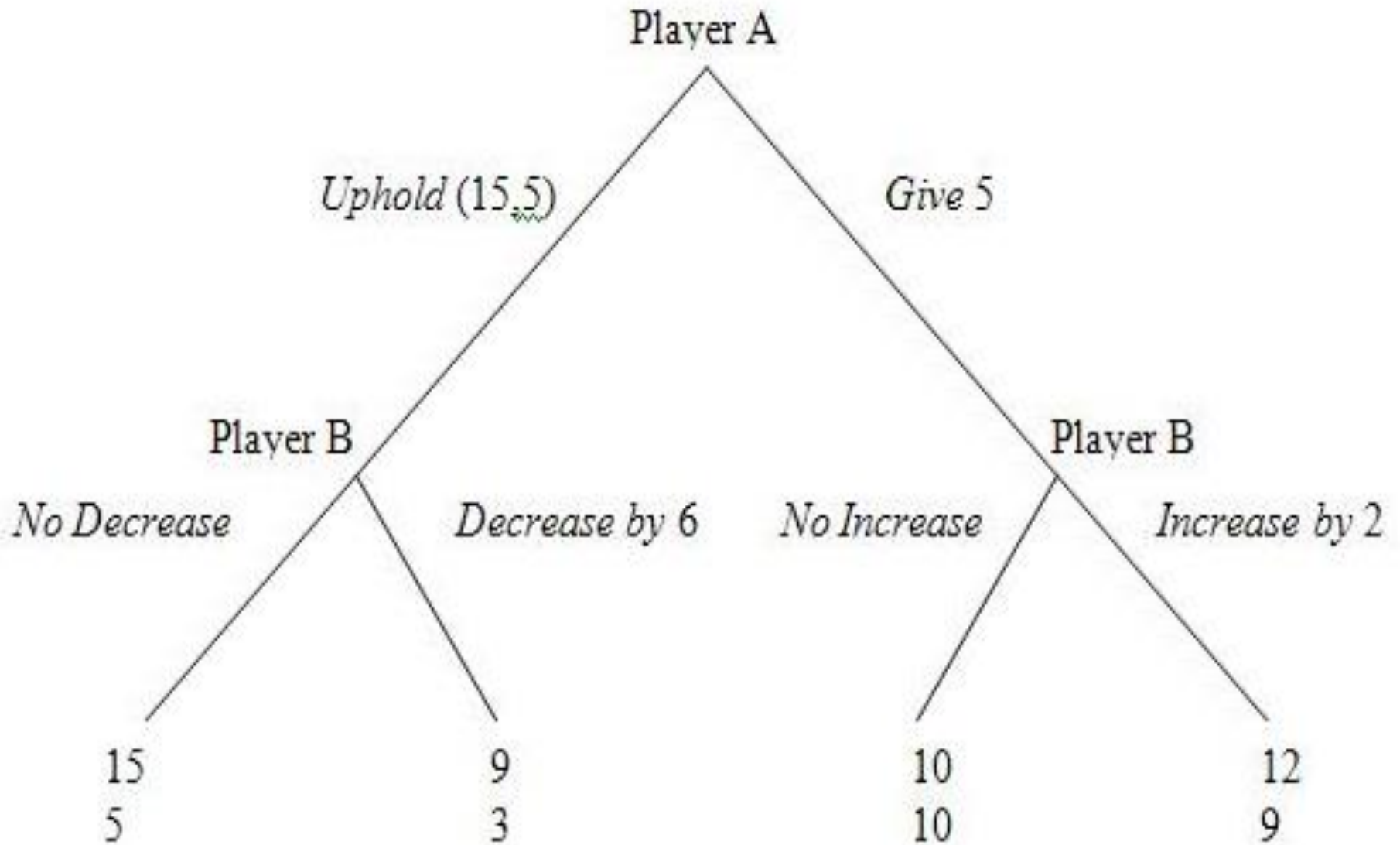
Our Contribution

- Little empirical work on the effects of acts of commission vs. acts of omission defined relative to the status quo
 - We provide direct evidence on this
- Our main contribution is a **simple** design that addresses the central question

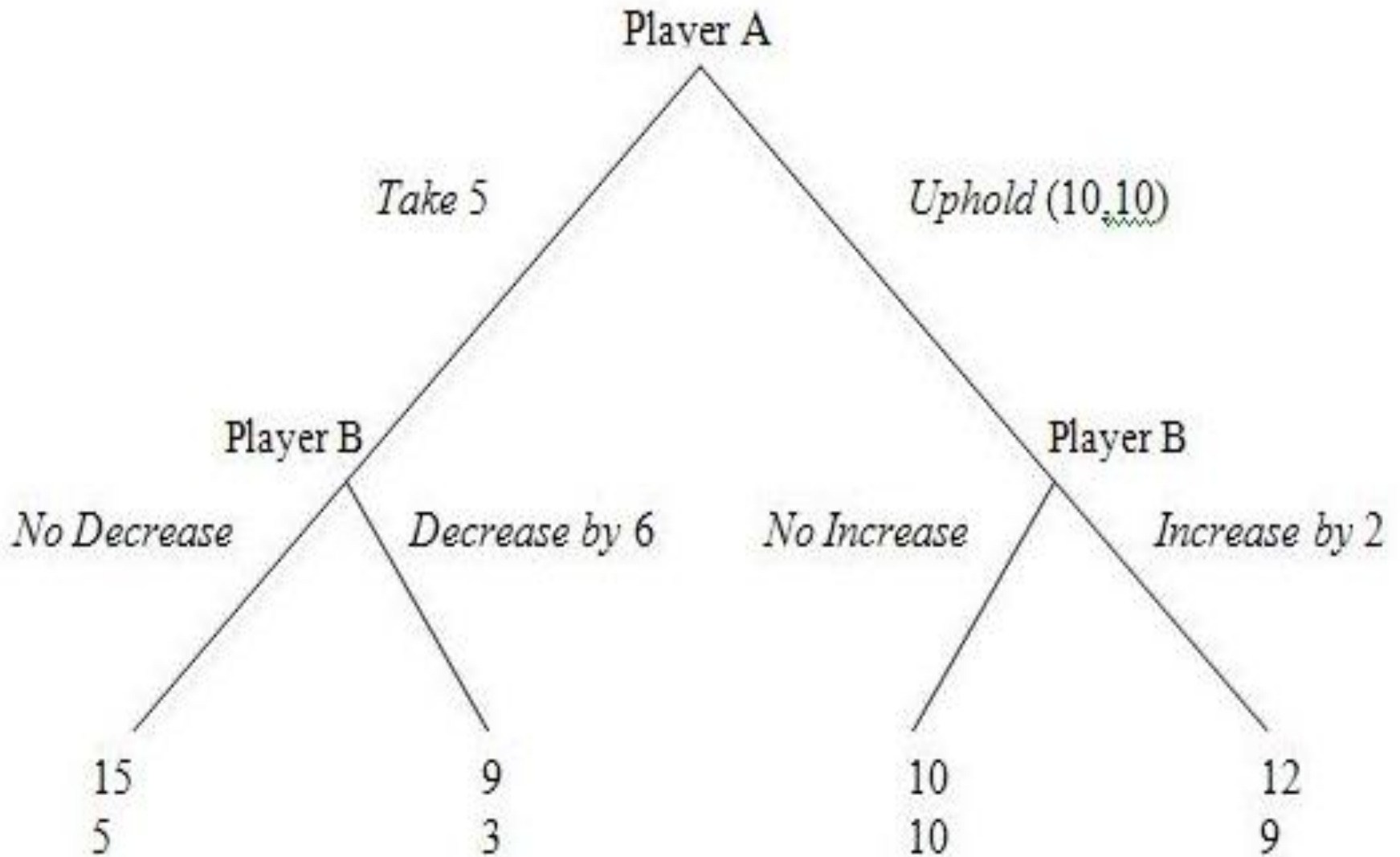
Diagnostic Test of Axiom S



$T_{15,5}$ Game



$T_{10,10}$ Game



Testable hypotheses

- H_0 : *The distribution of Player B choices across the four terminal nodes is the same in treatments $T_{15,5}$ and $T_{10,10}$*
- H_a : *Frequency of observation of Player B choices of No Decrease and Increase by 2 is greater in treatment $T_{15,5}$ than in treatment $T_{10,10}$*

Unearned Endowments Experiment

	No Decrease	Decrease by 6	No Increase	Increase by 2
	All Player Bs			
RANDOM $T_{15,5}$ ($n=33$)	78.8%	21.2%	63.6%	36.4%
RANDOM $T_{10,10}$ ($n=34$)	58.8%	41.2%	94.1%	5.9%
Fisher's test	0.004 (two-sided for strategies)			
Fisher's test for subgames	0.067		0.002	

Unearned Endowments Experiment – Reciprocal Player Bs

	No Decrease	Decrease by 6	No Increase	Increase by 2
	All Player Bs			
RANDOM $T_{15,5}$ ($n=17$)	58.8%	41.2%	29.4%	70.6%
RANDOM $T_{10,10}$ ($n=15$)	6.7%	93.3%	86.7%	13.3%
Fisher's test for subgames	0.002		0.001	

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Discussion

- The paper reports three experiments and a variety of tests of the data that provide support for Axiom R and Axiom S
- Subjects with reciprocal preferences are quite sensitive to acts of commission that overturn the status quo

Part 3: New Applications (cont.)

References

J.C. Cox, E. Ostrom, V. Sadiraj & J.M. Walker, “Provision vs. Appropriation in Symmetric and Asymmetric Social Dilemmas”, *Southern Economic Journal*, 2013

J.C. Cox, V. Sadiraj & U. Sen, “Caste, Efficiency and Fairness with Public Goods and Common Pool Resources”, ExCEN WP, 2013

Much-studied Social Dilemmas for Symmetric Agents

In a standard **provision game** (or linear public good game):

- Agents simultaneously **choose contributions**
- They **share equally** in the produced public good
- The central question is the significance of **under-provision**

In a standard **appropriation game** (or common-pool resource game):

- Agents simultaneously **choose extractions**
- They **share equally** in the remaining common pool
- The central question is the significance of **over-extraction**

Topic of Study

Our first central question is whether under-provision is more or less behaviorally significant than over-extraction.

Asked in this **imprecise way**, the question has **no one answer** because of varying institutions for provision and appropriation.

Sharp version of first question: In **pairs of payoff-equivalent** provision and appropriation **games**, is under-provision more or less behaviorally significant than over-extraction?

Power Asymmetries

Natural environments with public-good and common-pool social dilemmas are often characterized by **power asymmetries**.

A second central question is how power asymmetries affect the significance of under-provision and over-extraction.

A third central question is whether the data are consistent with

(a) *homo economicus* theory or

(b) consequentialist social preferences theories or

(c) revealed altruism theory (reciprocal preferences).

Experimental Design

A. Construct **pairs of payoff-equivalent provision and appropriation games** with symmetric and asymmetric power:

- All game pairs are **strategically equivalent** for *homo economicus* theory **and** all non-reciprocal **social preference theories** (Fehr-Schmidt, 1999; Bolton-Ockenfels, 2000; Charness-Rabin, 2002; Cox-Sadiraj, 2007, 2010)
- Asymmetric power game pairs are **NOT strategically equivalent** for **revealed altruism theory** (Cox, Friedman, and Sadiraj, 2008).

B. Conduct experiments with the games: one shot (single round).

Baseline Games: 4 Simultaneous Movers

Endowments

PG: **Each individual** begins with **10 tokens worth \$1 each** in an Individual Fund (IF)

AG: **Each group** begins with an endowment of **40 tokens worth \$3 each** in a Group Fund (GF)

Feasible Actions

PG: Each token $x \in \{0, 1, \dots, 10\}$ **moved from IF to GF** by person j reduces value of IF by \$1 and **increases value of GF by \$3**

AG: Each token $y \in \{0, 1, \dots, 10\}$ **moved from GF to IF** by person j **reduces value of GF by \$3** and increases IF by \$1

Boss and King Games: 3 FMs and 1 SM

- A Boss:
 - Moves second, after learning FM choices
 - Has same feasible set as FMs
- A King:
 - Moves second, after learning FM choices
 - Has extended feasible set: can take all from Group Fund

Payoff Equivalence

- The **provision and appropriation games within each pair of (baseline or boss or king) games are payoff equivalent:**
 - If the amount agent j **puts in the IF in the appropriation game equals the amount she leaves in the IF in the provision game**
 - and this is **true for all agents $j = 1, 2, \dots, 4$**
 - then **each agent k receives the same payoff in the two games.**
- Note that there is **no assumption that agents j and k make the same choice**

Hypotheses

- Homo economicus model implies

Hypothesis 1: Average payoffs in a provision or appropriation game will be the min. possible amount, \$10.

- Fixed social preferences & Revealed altruism theories imply

Hypothesis 2: Average payoffs are the same in **baseline** provision & appropriation games.

Hypotheses (cont.)

- Fixed social preferences models imply

Hypothesis 3: Average payoffs are the same in King (resp. Boss) provision & appropriation games.

- Revealed Altruism theory implies

Hypothesis 5: Kings' (resp. Bosses') contributions in the provision game are larger than the amounts they do **not** extract in the appropriation game.

Interpretation of Hypotheses 3 and 5

- Social and homo economicus (fixed) preferences theories predict that the appropriation and provision games within each of the three pairs of games will be played in the same way.
- Revealed Altruism theory (Axioms R and S) predicts that Bosses and Kings will make over-extraction from the common pool a more serious problem than under-provision of the public good.

Why Does RA Theory Have this Implication?

- Because the **feasible set** for the King (or Boss) defined by the **initial endowments** is:
 - **Least** generous possible in the Provision Game
 - **Most** generous possible in the Appropriation Game
- Hence:
 - Any **FM contributions in PG** give the King (or Boss) a **more generous** feasible set, which makes him **more altruistic** than he was, *a priori*
 - Any **FM extractions in AG** give the King (or Boss) a **less generous** feasible set, which makes him **less altruistic** than he was, *a priori*

Figure 1. Average Group Payoffs by Treatment

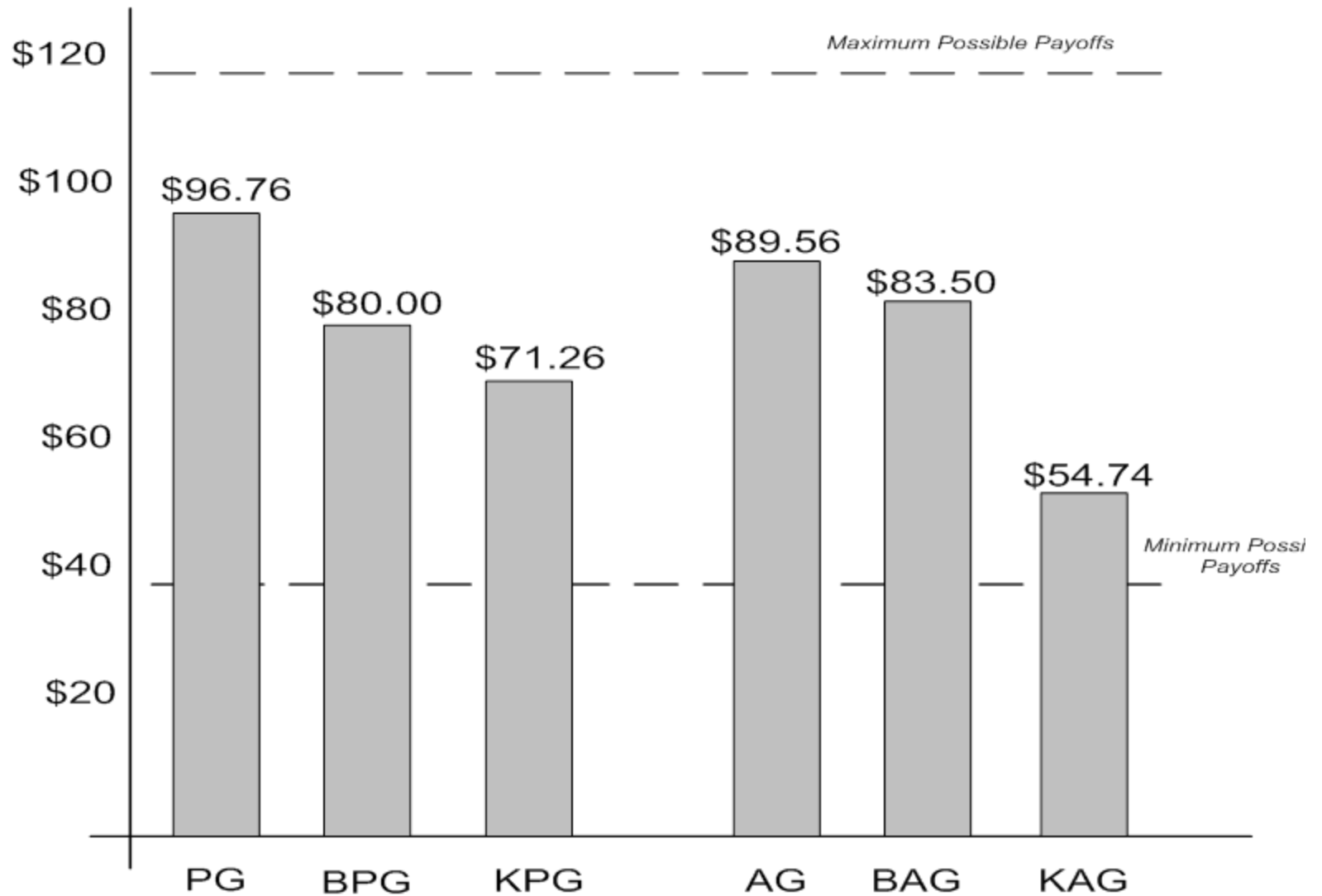


Figure 2. Ave. First Mover Decisions Represented as \$ in Group Fund

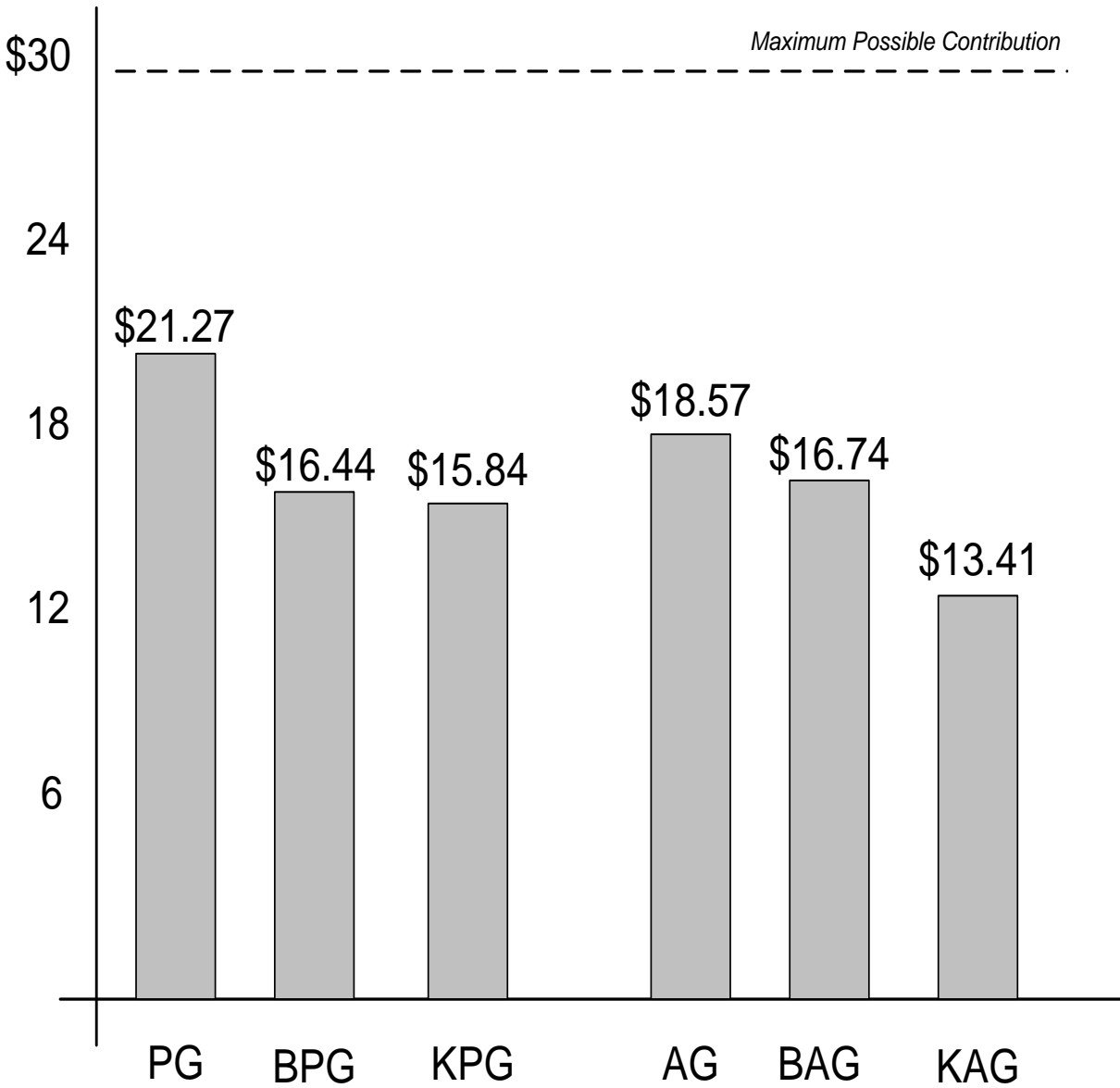
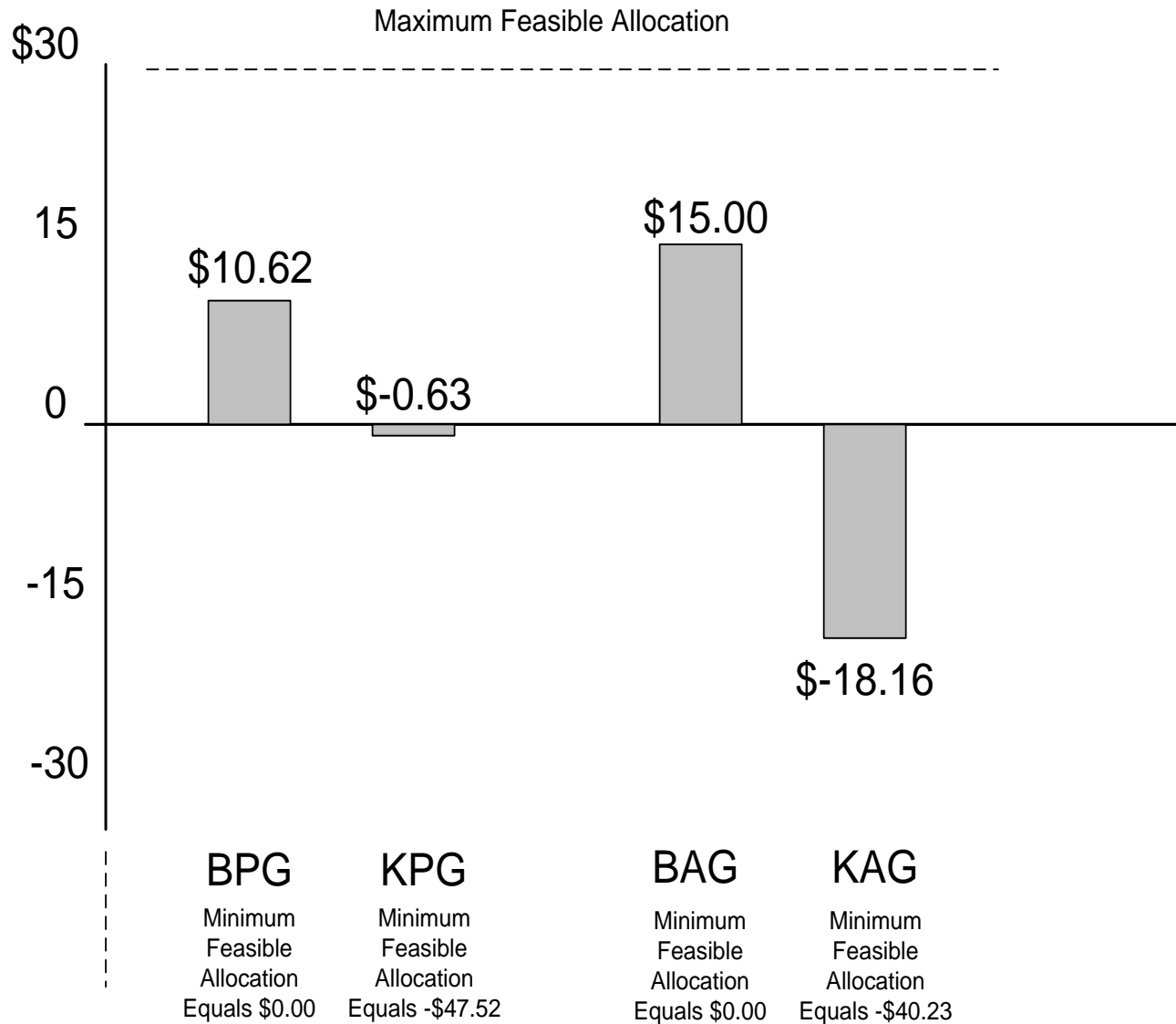


Figure 3. Ave. Sec. Mover Decisions Represented as \$ in Group Fund



General Conclusions

- Power asymmetry has worse implications for common pools than public goods
- The way in which power asymmetry affects play is:
 - Inconsistent with fixed social preferences models
 - Consistent with revealed altruism theory

Summary of Topics

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