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

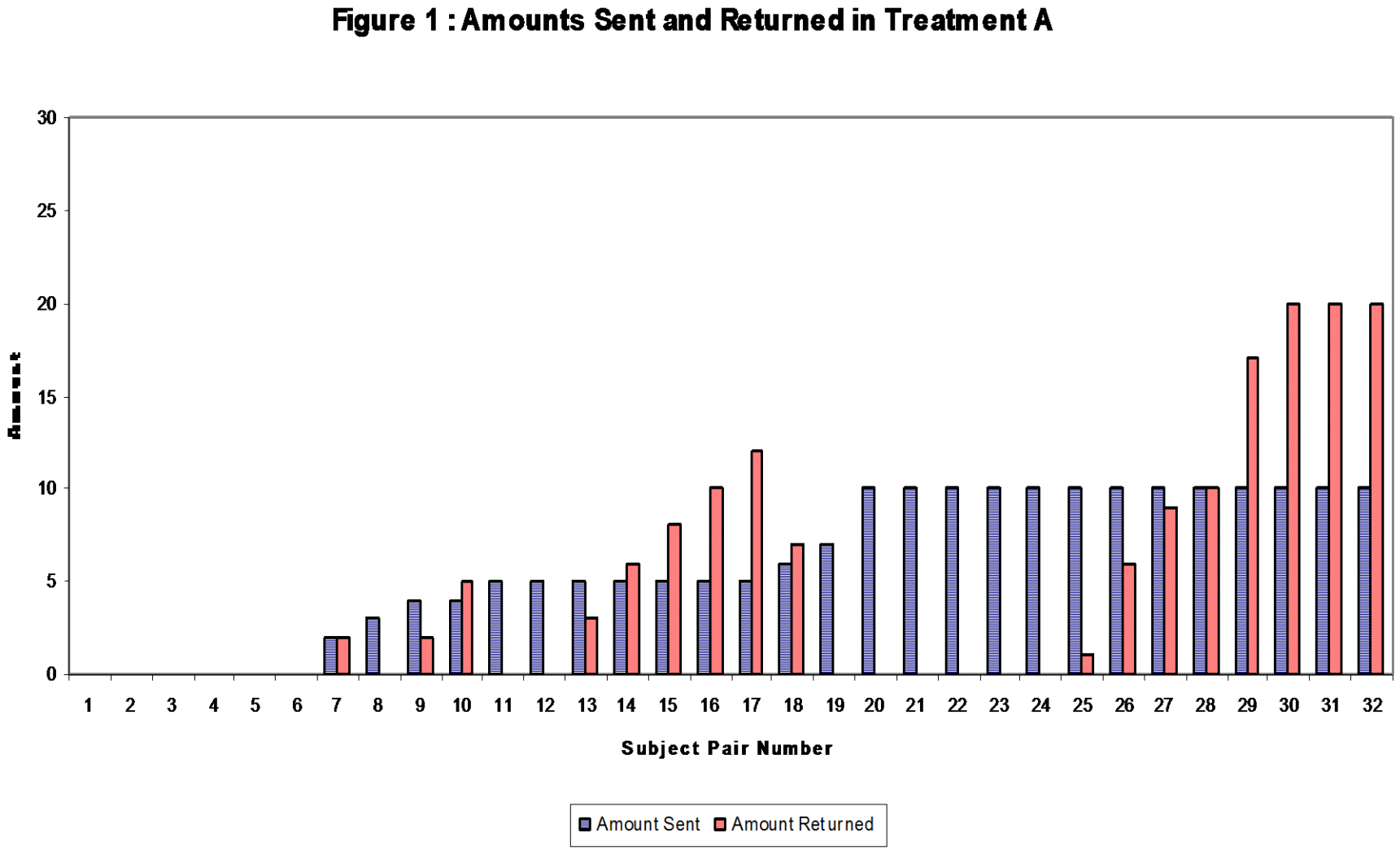
An Example: The Investment Game

- 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



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

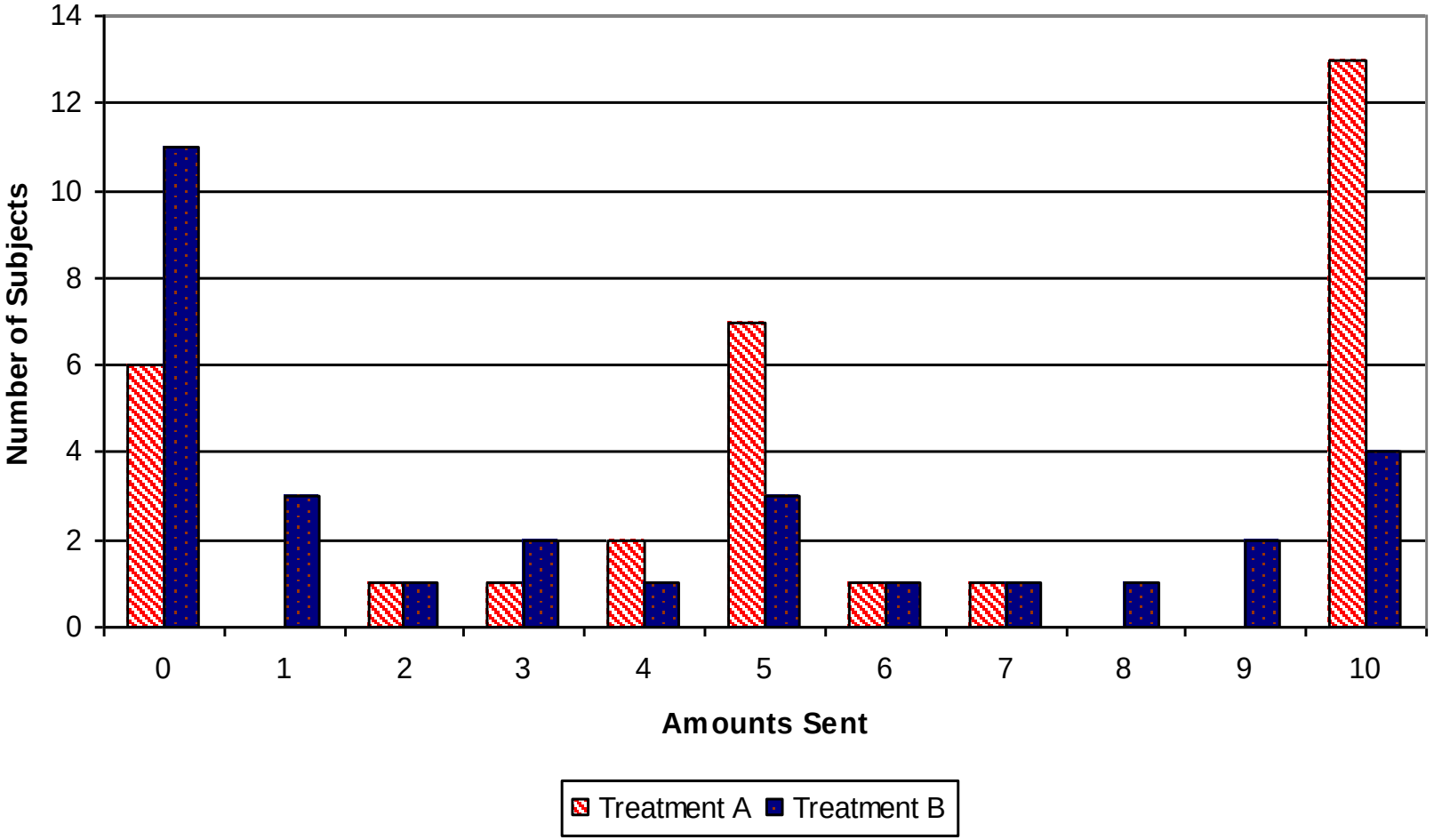
- Treatment A. Investment game (IG)

- 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

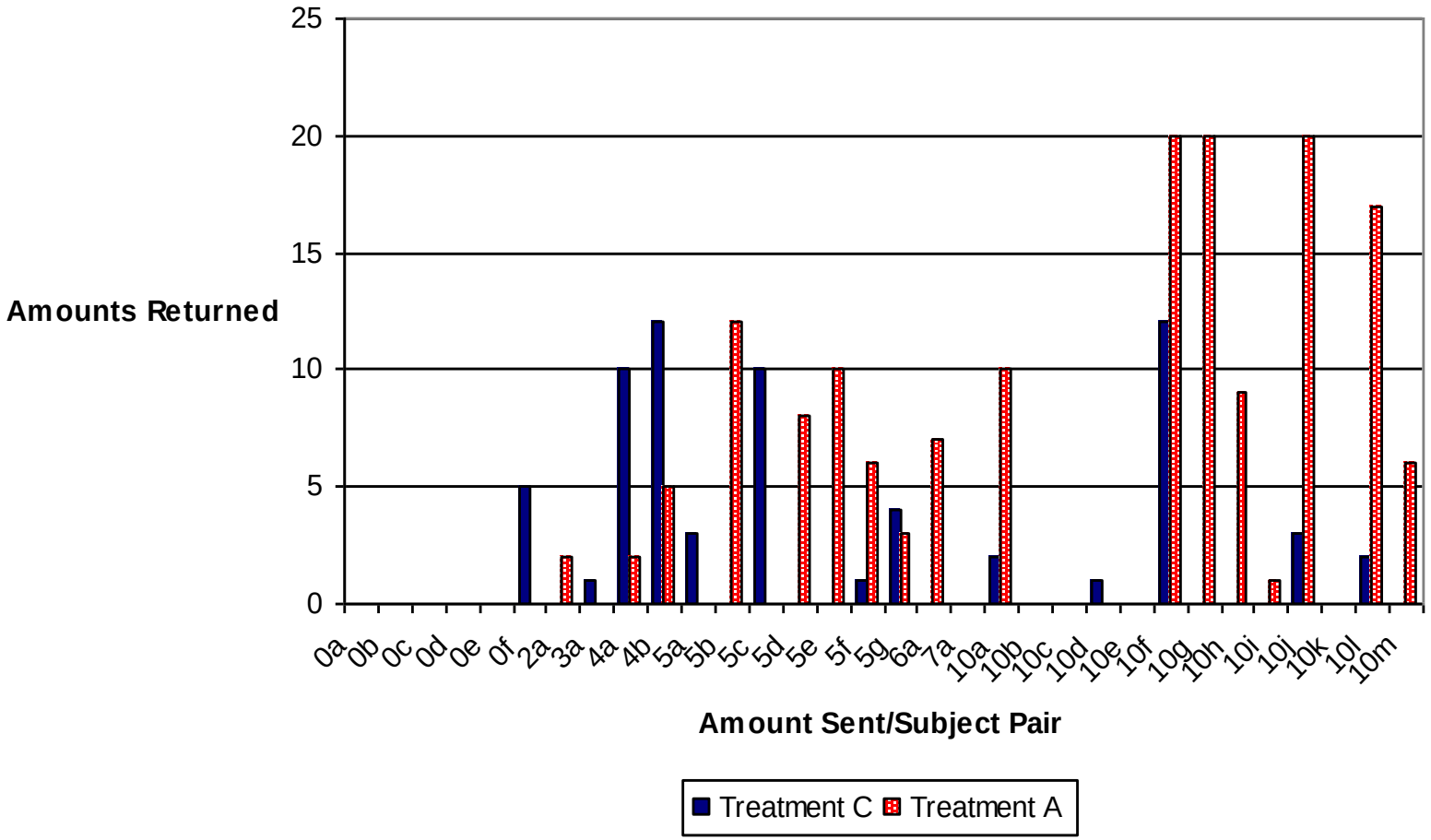
Comparison of the Amounts Sent in Treatments A and B

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 Trist 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, ..., 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

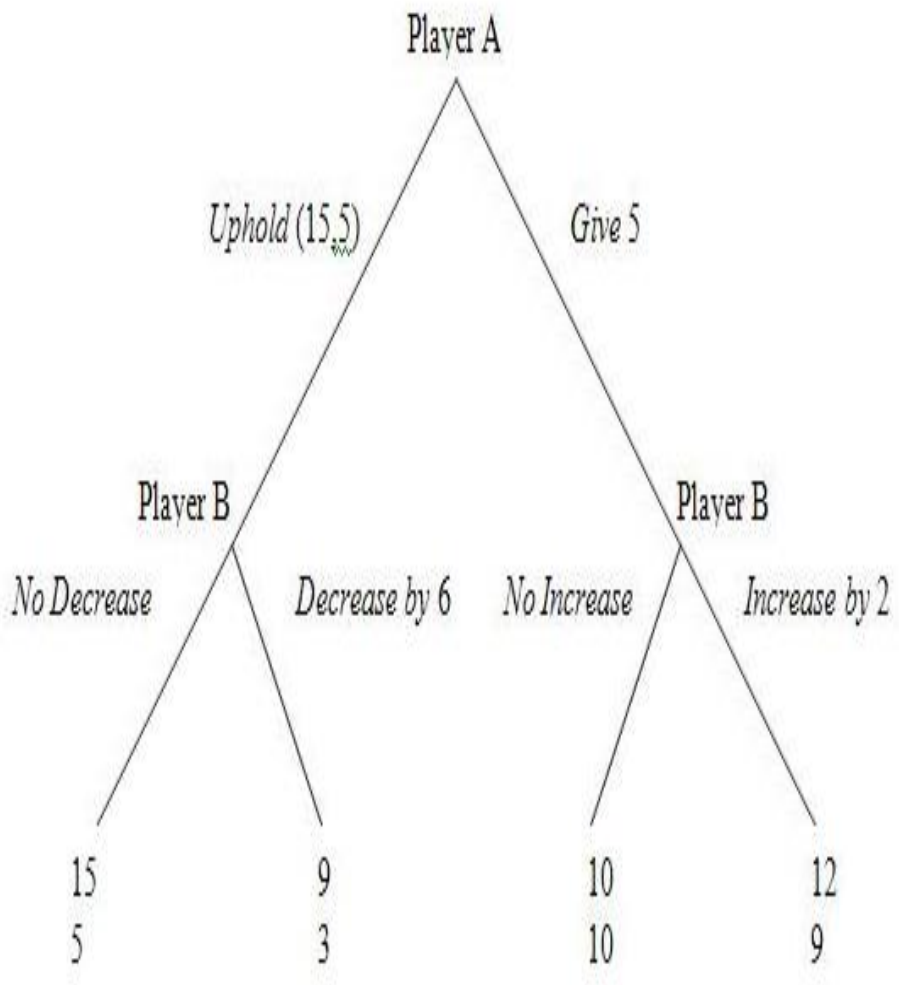
- Little empirical work on the effects of acts of commission vs. acts of omission defined relative to the status quo

  →We provide direct evidence on this

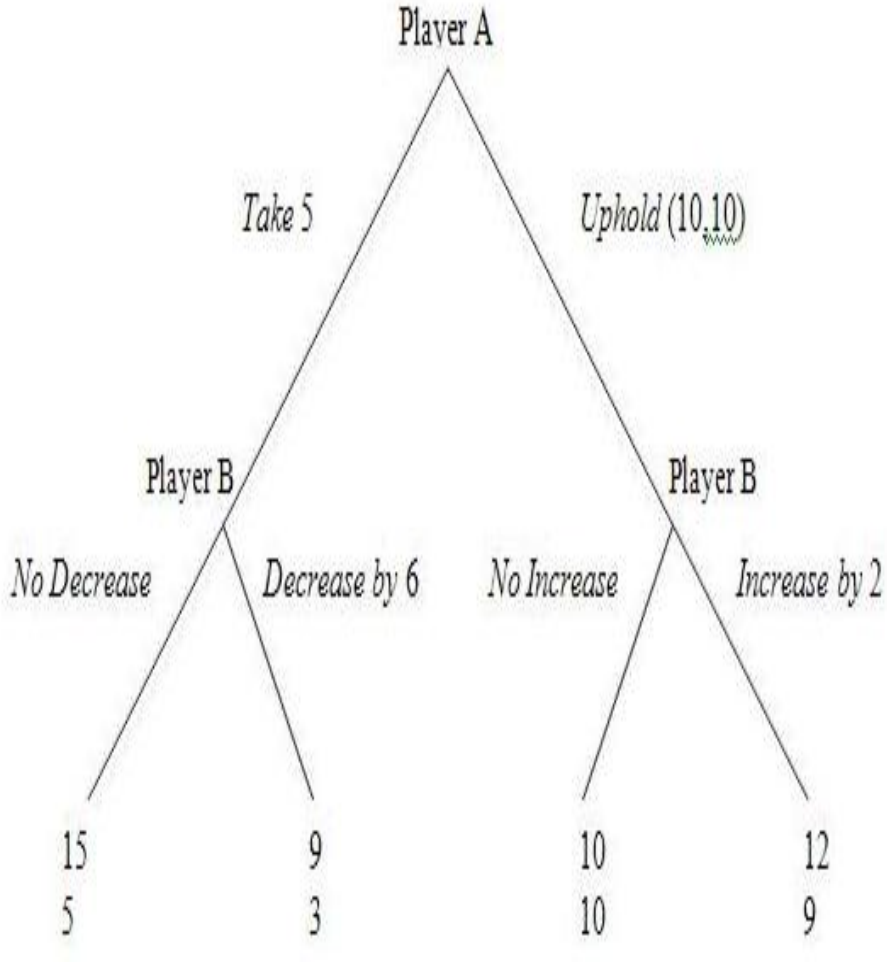
- Our main contribution is a **simple** design that addresses the central question

Diagnostic Test of Axiom S

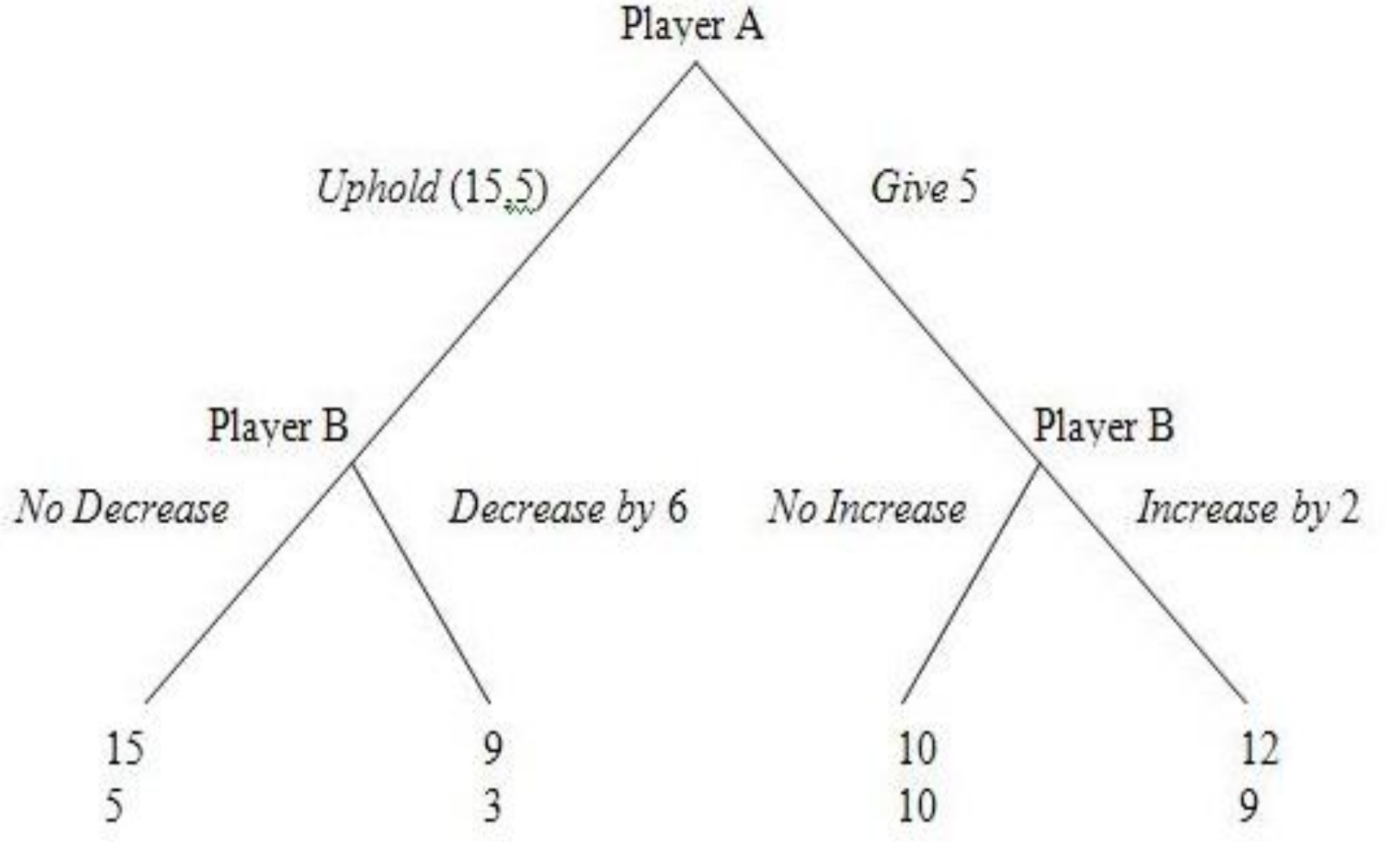
$T_{15,5}$



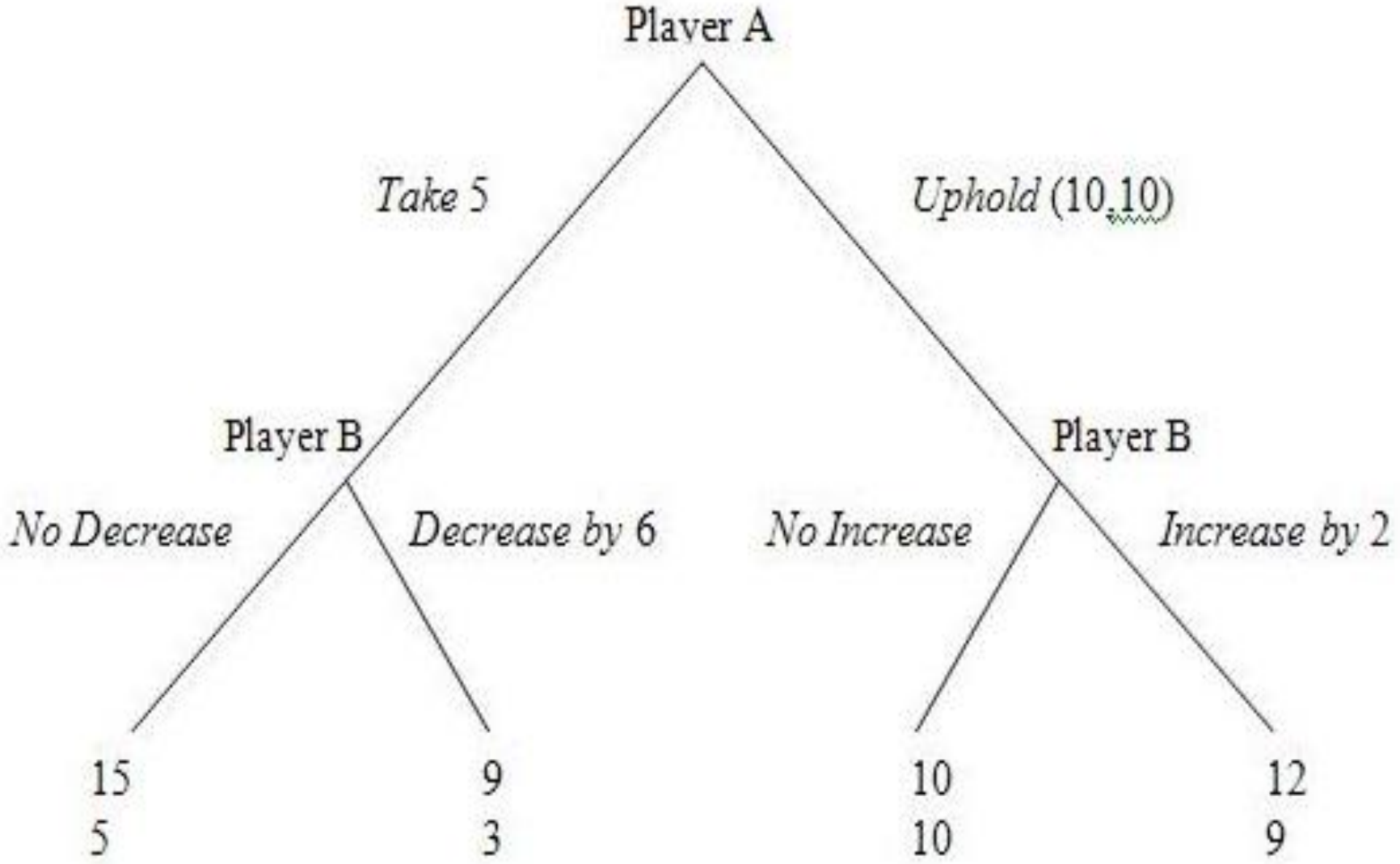
$T_{10,10}$



$T_{15,5}$ Game


Player A
Uphold (15,5)
Give 5
Player B
Player B
No Decrease
Decrease by 6
No Increase
Increase by 2
15
5
9
3
10
10
12
9

$T_{10,10}$ Game


Player A
Take 5
Uphold (10,10)
Player B
Player B
No Decrease
Decrease by 6
No Increase
Increase by 2
15
5
9
3
10
10
12
9

Testable hypotheses

- H_o: *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	

•

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

AG: Each token $y \in \{0,1,\cdots,10\}$ **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** $j = 1, 2, \ldots 4$
  - 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

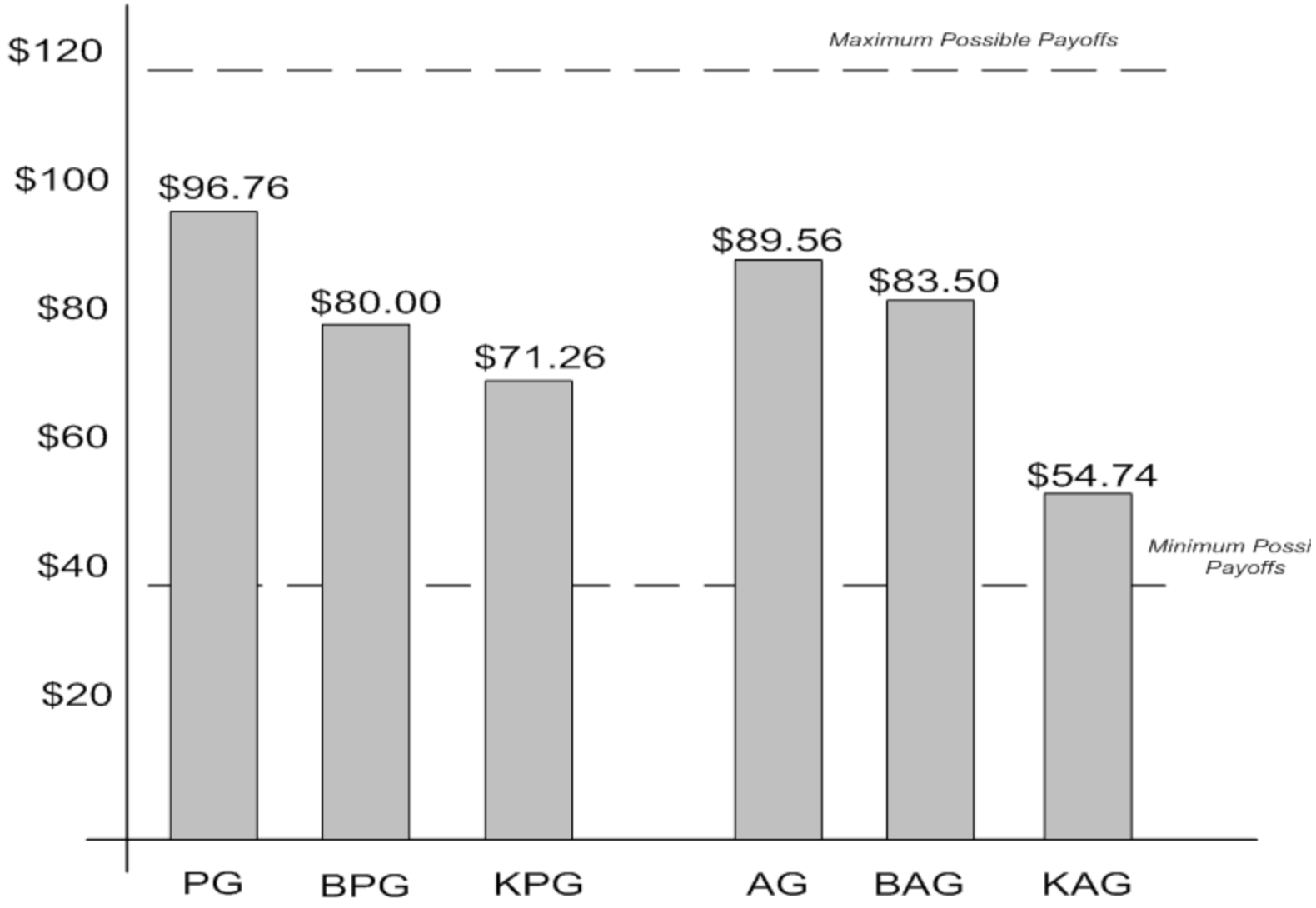


Figure 2. Ave. First Mover Decisions Represented as $ in Group Fund

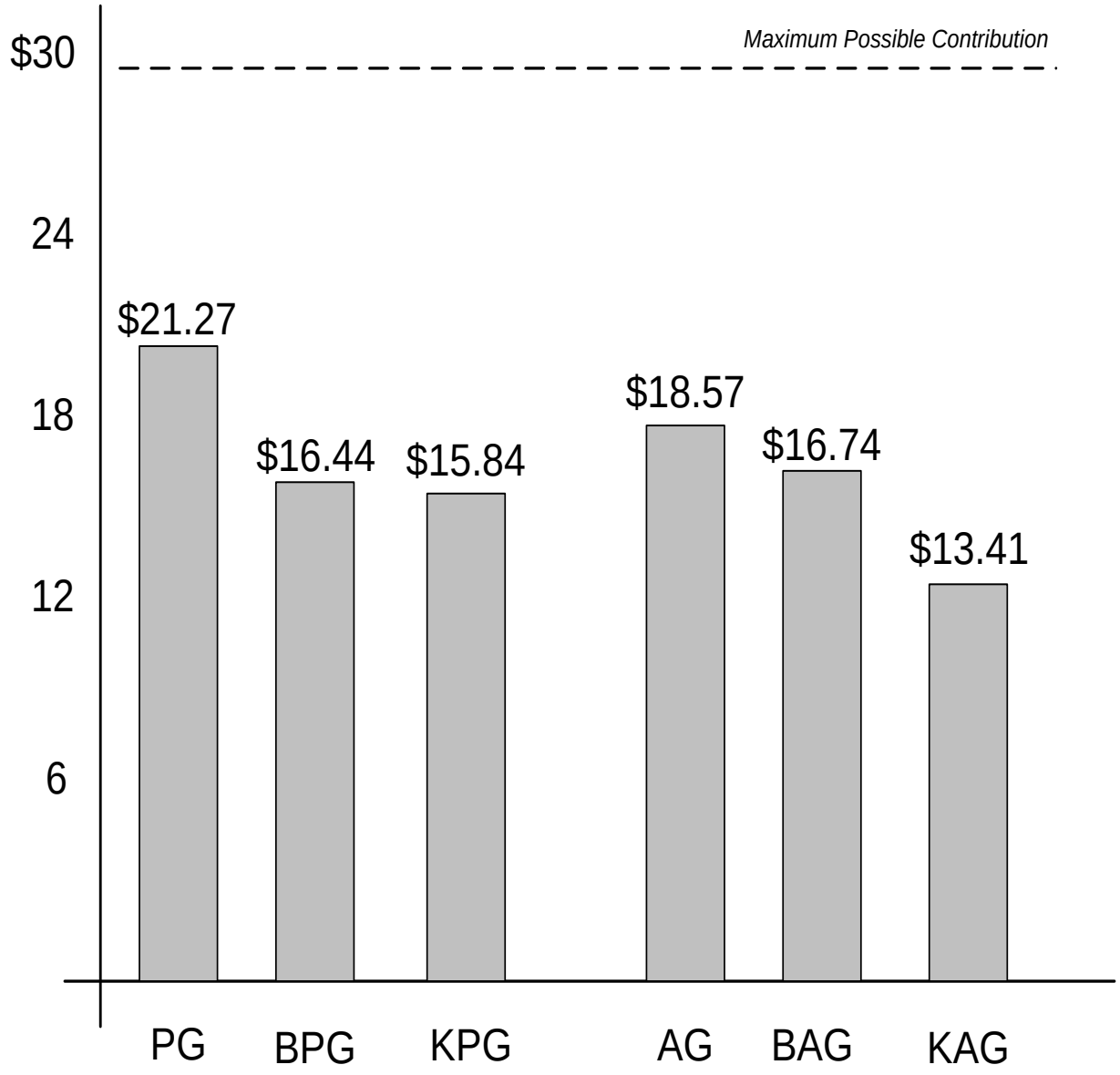
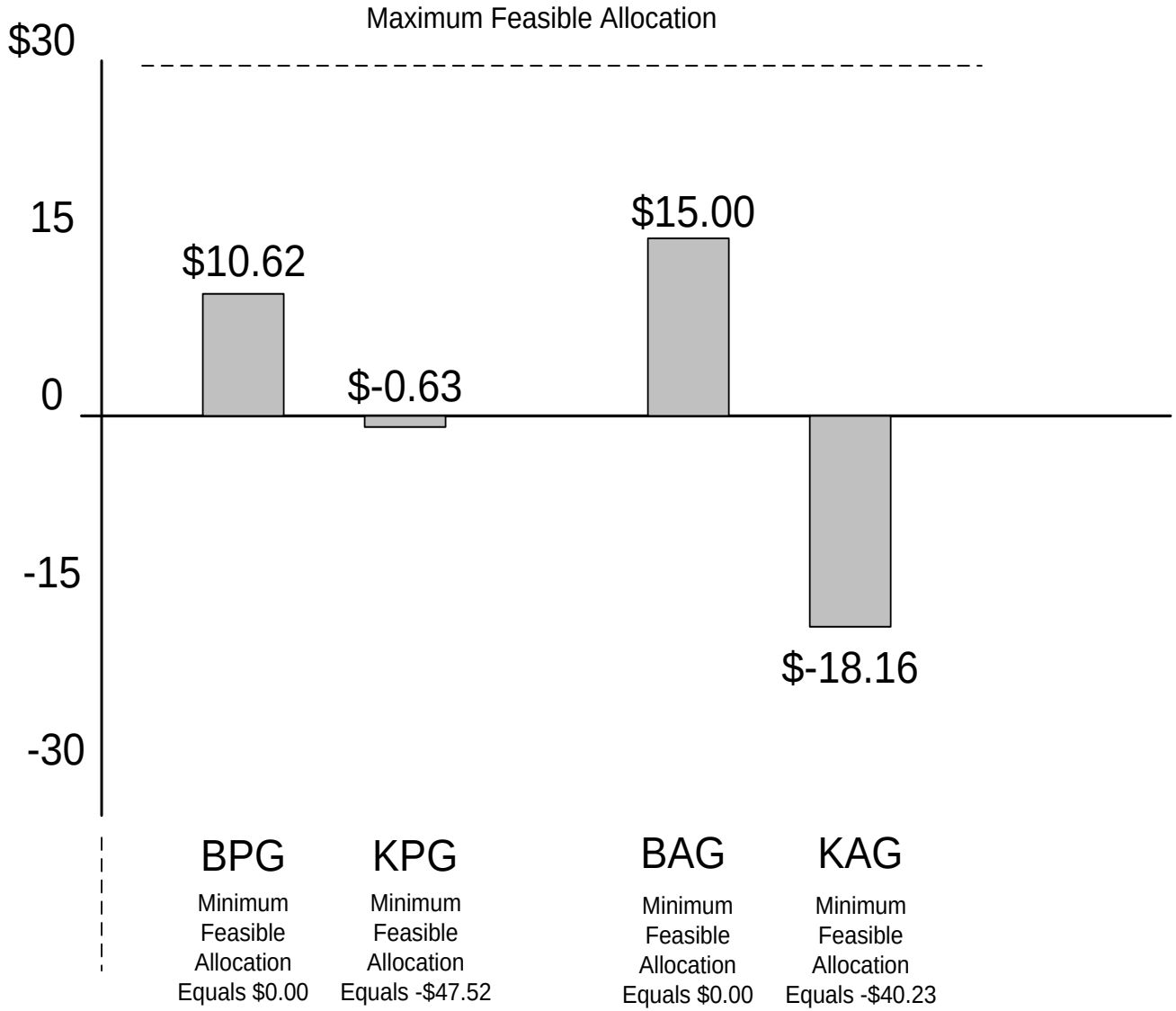


Figure 3. Ave. Sec. Mover Decisions Represented as $ in Group Fund



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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