

# MW24.2 Experimental Economics (SS2020)

## Public Goods Game

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### Public Good Problem

- \* non-rival (of consumption)  $\sim$  property of a commodity s.t. its consumption by one individual does *not* diminish the amount available to others
- \* non-excludable  $\sim$  property of a commodity s.t. no individual can be prevented from consuming it

	Non-excludable	Excludable
Non-rival	(pure) public good <sup>a</sup>	club good <sup>b</sup>
Rival	common-pool resource <sup>c</sup>	private good <sup>d</sup>

Examples:

- a) national defense
- b) coded broadcast
- c) public park
- d) food

### Private good:

$\Rightarrow$  all costs and benefits are *internalized*; hence free markets provide at the optimal level ( $\sim$ efficient markets hypothesis)

### Public good:

- \* because of non-excludability, there is a *positive externality* enjoyed by those who did not pay for the production
- $\Rightarrow$  not all benefits are internalized; hence the producer(s) will generally underprovide in free markets
- $\Rightarrow$  in reality, typically provided by the government (supported by taxes)
- (?) can the *voluntary contribution mechanism* (VCM) provide the optimal level of a public good?

## VCM / Linear Public Goods Game

\* Simultaneous-move,  $n$ -person game. Each player  $i$  is endowed with a budget of  $y$  and must split it between contribution to the public account  $g_i$ , s.t.  $0 \leq g_i \leq y$ , and his private consumption  $y - g_i$ . Once all the contributions have been made, each player receives the total sum multiplied by a factor of  $a$ , s.t.  $a \in (\frac{1}{n}, 1)$ .

\* individual payoff:

$$\pi_i(g_i, \dots, g_n) = y - g_i + a \cdot \sum_{j=1}^n g_j,$$

where:  $a \sim$  marginal per capita return (MPCR)

$\sum_{j=1}^n g_j \sim$  total amount of the public good produced

$\Rightarrow$  dominant strategy: contribute *nothing* since  $a < 1$  (i.e., free ride)

$\Rightarrow$  social optimum: contribute *everything* since  $n \cdot a > 1$

$\Rightarrow$  essentially, it's an  $n$ -player continuous space Prisoner's Dilemma

## Marwell and Ames [1981]

\* telephone/mail public goods game [Table 1]

\* predictions from six prominent economists and one sociologist:

— one economist said, theory had no relevant predictions!

— the rest said, theory predicts investments under 5%, but themselves predicted  $\sim 20\%$  on average (“people like taking risks”/altruism)

$\Rightarrow$  12 various manipulations confirm the weak free riding hypothesis; 40–60% contributed on average [Table 2]

$\Rightarrow$  more than three out of every four subjects stated that “about half” or more should be contributed

$\Rightarrow$  more than one out of every four subjects consider it “fair” to contribute everything

$\Rightarrow$  correlation of only 0.23 between what is considered “fair” and actual investment

## Goeree et al. [2002]

\* comparative statics of VCM w.r.t. MPCR and group size

\* individual payoff:

$$\pi_i(g_i, \dots, g_n) = y - g_i + a_i \cdot g_i + a_{-i} \cdot \sum_{j \neq i}^n g_j,$$

where:  $a_i \sim$  internal return

$a_{-i} \sim$  external return

$\sim$  decompose MPCR: private cost of contribution versus value of own contribution to others

\* within-subject design; 10 treatments; random rematching; strategy method [Table 1]

\* endowment of 25 tokens; private account pays 5; internal return  $< 5$ ; social return  $> 5$  [Table 1]

Results: [Fig. 1]

$\Rightarrow$  higher internal return increases contributions

$\Rightarrow$  higher external return increases contributions

$\Rightarrow$  larger group size increases contributions

$\Rightarrow$  contributions respond to the aggregate benefit

$\Rightarrow$  stochastic model fit to the data favors linear altruism as opposed to “warm-glow” altruism or mix between the two; no evidence of pure altruism [Fig. 3]

$\Rightarrow$  men and women appear to have the same average levels of altruism but men are more disperse in that regard [Fig. 2]

## Croson [1996]

\* Repeated public goods game; partners versus strangers

\* 10 + 10 periods; between-subject design

(?) Do contributions *deteriorate over time*<sup>1</sup> due to learning (to play the free-riding equilibrium) or strategic reasoning à la Kreps et al. [1982]?

\* 4-person group; 25 tokens; 0.5 MPCR; aggregate contribution known

Results: [Fig. 1]

⇒ contributions are dropping over time and appear to converge as far as the treatments

⇒ partners' contributions dominate those of the strangers

⇒ significant restart effect for the partners

⇒ “strategies hypothesis” consistent with the data

⇒ partners exhibit higher variance as far as individual contributions

## Fischbacher et al. [2001]

\* one-shot public goods game; strategy method for conditional contributions

(?) are people *conditionally* cooperative?

\* 4-person group; 20 tokens; 0.4 MPCR

\* conditional stage: *average* contribution known → strategy elicited

Results: [Fig. 1]

⇒ 50% of the subjects are conditionally cooperative

⇒ 30% of the subjects are free riders

⇒ 14% of the subjects exhibit “hump-shaped” contribution patterns

⇒ average behavior is conditionally cooperative

⇒ conditional cooperators exhibit a *self-serving bias*, which may explain the deteriorating contributions in repeated settings

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<sup>1</sup>This is a common finding in the literature, just like with the repeated Prisoner's Dilemma

## Suggested Literature

- Charles A Holt. *Markets, games, & strategic behavior*. Boston Pearson Addison Wesley, 2007 [Chapter 26]
- Gerald Marwell and Ruth E. Ames. Economists free ride, does anyone else?: Experiments on the provision of public goods, iv. *Journal of Public Economics*, 15(3):295–310, 1981
- Jacob Goeree, Charles Holt, and Susan Laury. Private costs and public benefits: unraveling the effects of altruism and noisy behavior. *Journal of Public Economics*, 83(2):255–276, 2002
- Rachel Croson. Partners and strangers revisited. *Economics Letters*, 53(1): 25–32, 1996
- Urs Fischbacher, Simon Gächter, and Ernst Fehr. Are people conditionally cooperative? evidence from a public goods experiment. *Economics Letters*, 71(3):397–404, 2001
- \* Ernst Fehr and Simon Gächter. Cooperation and punishment in public goods experiments. *American Economic Review*, 90(4):980–994, September 2000