Game theory for playing games: sophistication in a negative-externality experiment

John M. Spraggon and Robert J. Oxoby. Economic Inquiry, Vol. 47, No. 3 (July., 2009), pp. 467–81

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Introduction

- Observed differences from theoretical predictions may be due to *inexperience* with the concepts of maximizing behavior and strategic interactions
- Unsophisticated subjects may rely on simple rules or heuristics to make decisions.
- Conduct a series of *moral hazard* experiments with *Sophisticated* and *Unsophisticated* participants

- Problems between these groups of participants?

Introduction

- Subjects choose decision numbers: higher decision numbers correspond to higher individual payoffs and higher social costs
    - decision numbers are Private Information
    - Comments about this setting???
- Tax/Subsidy instrument
- The differences between equilibria under each instrument allow us to discern how individuals' experience affects their ability to play equilibrium strategies

- Why this paper differs from public goods games?
- How different are their results from the existing literature? [Laury and Holt (2008);Cochard, Willinger, and Xepapadeas 2005; Poe et al. 2004, etc..]
- Game Theory is the answer......

EXPERIMENTAL DESIGN

- The moral hazard in this experiment is due to a regulator wanting to reduce a negative externality resulting from consumption.
- Examples?
- Groups consist of four participants,
- two of whom choose decision numbers between 0 and 100 (medium-capacity participants) and
- two between 0 and 125 (large-capacity participants).
- Both types of participants face the same private payoff function
    -

$$(1) \qquad B_n(x_n) = 25 - 0.002(x_n^{\max} - x_n)^2,$$

EXPERIMENTAL DESIGN

- These payoffs are described to the participants by way of a table, and
- private payoff is maximized when $x_n^{\max} = x_n$
- Design a mechanism that induces the agents to reveal their information and achieve an efficient level of production.
- external cost proportional to the aggregate decision number

$$X = \sum_{n=1}^{4} x_n$$

  - individual decisions x_n are private information, while X is observable.
  - $$(3) \quad T_n(X) = \begin{cases} t_n(X - X^*) + \tau_n & \text{if } X > X^* \\ s_n(X - X^*) - \beta_n & \text{if } X \leq X^* \end{cases}.$$
  - **Individual's private payoff:** $\pi_n = 25 - 0.002(x_n^{\max} - x_n)^2 - 0.3(X - 150)$

EXPERIMENTAL DESIGN

- Under the Tax/Subsidy instrument, for any X, an individual's best response x_n^* is
  - $x_n^* = x_n^{\max} - 75$
  - This is also a BR for the tax if subjects believe that $X \geq 150$
  - But if subjects believe that $X < 150$, then
  - $x_n = \min(x_n^{\max}, 150 - X_{-n})$

- Decision rule: Rules of thumb or focal points

Results

- The data were collected from eight sessions,
- each consisting of two groups of four subjects.
- Participants were recruited from economics courses
- and classified as sophisticated if they had taken an undergraduate game theory course.
- Each group consisted of either all sophisticated or all unsophisticated individuals,
- and each experiment consisted of 25 decision-making periods under either the Tax instrument or the Tax/ Subsidy instrument.
- The decision was not presented as a maximization problem.
- Sessions took approximately 90 min, and average earnings varied between $10 and $25 Canadian

Results

- **TABLE 1**
  Mean Aggregate Decision Numbers (X) by Treatment.

Instrument	Unsophisticated	Sophisticated	Total
Tax			
Mean[a]	209.96*	153.07	175.41
SE	7.43	2.24	10.77
n[b]	3	5	8
Tax/Subsidy			
Mean[a]	181.37	152.13	164.66
SE	17.34	4.35	9.13
n[b]	3	4	7
Total			
Mean[a]	195.67	152.65	169.86
SE	10.59	2.14	7.02
n[b]	6	9	15

Results by Capacity

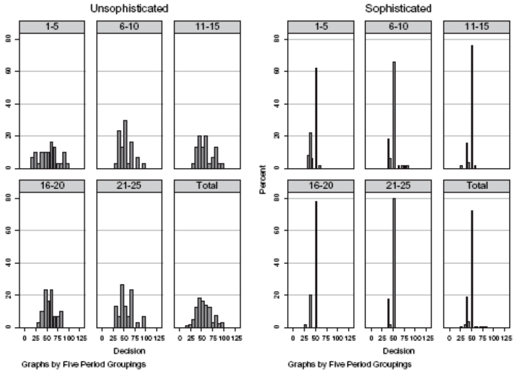
- **TABLE 4**
  Individual Results by Five-Period Groups and Treatment

Treatment		Period					
		1–5	6–10	11–15	16–20	21–25	Total
Large capacity, Tax, unsophisticated (n = 30)	Mean	55.2	53.37	59.03	56.33	56.37	56.06
	SE	4.15	2.85	3.07	2.54	3.23	1.43
	Median	57.5	50	57.5	50	51.5	50
	Mode	90	50	60	50	49.70	50
Large capacity, Tax, sophisticated (n = 50)	Mean	45.96	50.06	47.52	47.24	47.72	47.7
	SE	0.87	1.36	0.816	0.793	0.660	0.422
	Median	50	50	50	50	50	50
	Mode	50	50	50	50	50	50
Medium capacity, Tax, unsophisticated (n = 30)	Mean	46.97	47.43	48.67	48.83	52.7	48.92
	SE	3.25	3.42	3.17	2.25	2.56	1.32
	Median	50	46.5	48	50	50	50
	Mode	50	50	40	50	50	50
Medium capacity, Tax, sophisticated (n = 50)	Mean	29.72	29.34	29.24	28.10	27.78	28.84
	SE	1.33	1.61	1.09	0.726	0.681	0.510
	Median	25	25	25	25	25	25
	Mode	25	25	25	25	25	25
Large capacity, Tax/Subsidy, unsophisticated (n = 30)	Mean	53.5	53.57	47.7	47.87	44.93	49.51
	SE	3.77	3.37	3.26	2.43	1.87	1.36
	Median	51	51.5	41.5	45	45	46
	Mode	50	65	37.40	46	46	36.40
Large capacity, Tax/Subsidy, sophisticated (n = 50)	Mean	49.96	49.33	47.95	49.93	52.65	49.96
	SE	1.52	0.857	0.622	1.11	2.61	0.680
	Median	50	50	50	50	50	50
	Mode	50	50	50	50	50	50
Medium capacity, Tax/Subsidy, unsophisticated (n = 30)	Mean	46.37	39.4	34.03	41.90	44.17	41.17
	SE	4.48	2.92	3.80	3.87	4.62	1.79
	Median	42.5	40	40	39	38.5	40
	Mode	40.50	40	50	30	30.100	40
Medium capacity, Tax/Subsidy, sophisticated (n = 50)	Mean	25.3	31.58	26.5	20.83	26.33	26.11
	SE	3.10	3.12	1.14	2.24	3.30	1.22
	Median	25	25	25	25	25	25
	Mode	25	25	25	25	25	25

Results by Capacity

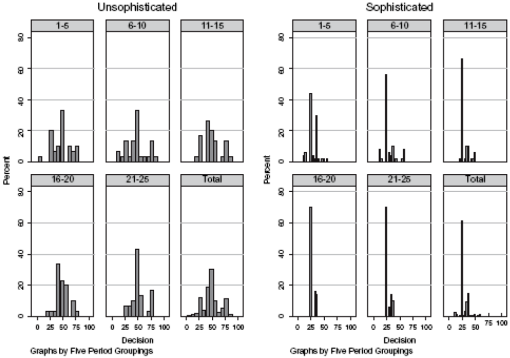
- FIGURE 1

Distributions of Individual Decisions, Tax Instrument, Large-Capacity Subjects



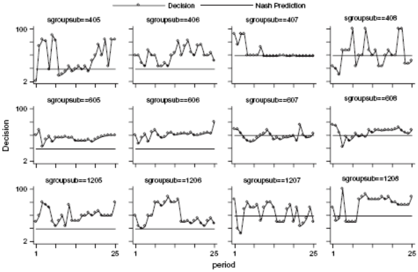
Results by Capacity

- FIGURE 2
  Distributions of Individual Decisions, Tax Instrument, Medium-Capacity Subjects



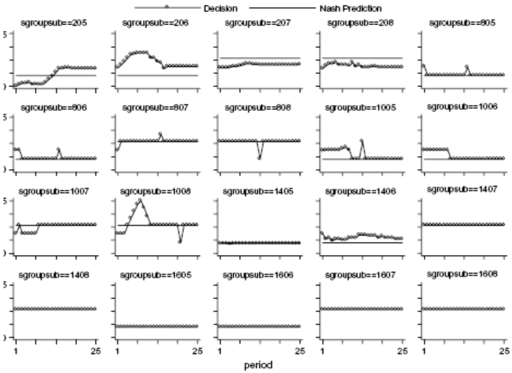
Results by Participant

- FIGURE 5
  Individual Decisions, Unsophisticated Subjects, Tax Instrument



Results by Participant

- FIGURE 7
  Individual Decisions, Sophisticated Subjects, Tax Instrument



Conclusions

- When subjects understand optimization, their behavior is rationalizable and predicted by standard economic theory.
- The behavior of subjects who are not trained in game theory displays evidence of the use of simple rules for making decisions
- Using subjects who are trained in game theory helps to control initial beliefs as not only do the individuals understand game theory, but also they know that the other people in their group understand game theory.
- The results imply that in the many experiments where we fail to observe equilibria which support theoretical predictions, inexperience with the mechanics of optimization or strategic thinking may be to blame.

Conclusions

- Let us talk about John M. Spraggon (2004)
- Similarities???
- How can we compare the results of these two papers?