Cooperation In VCM Experiments:

Results Using the Contribution Function Approach

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1. Introduction.

The results we present below stem from a series of experiments we conducted using a new method for collecting data from voluntary contributions mechanism environments. The main virtue of our design is that it makes it possible to collect a very rich set of data. Our results are inconsistent with the hypothesis that contributions are made only by mistake (cf. Palfrey and Prisbrey, 1996) and with simple linear altruism models. The type of motivation that our evidence favors is one involving some kind of reciprocal altruism.

2. Description of the design.

The economic model we used in our experiments is most standard in experimental economics; it is the well-known voluntary contributions mechanism (hereafter, vcm) with a linear payoff function, which has been previously used in experiments by, i.a., Isaac and Walker (1988), Isaac, Walker and Williams (1994), Andreoni (1995), Palfrey and Prisbrey (1996) and Saijo and Nakamura (1996). The vcm has been one of the main tools for analyzing people's motivation in situations in which the behavior consistent with the equilibrium leads necessarily to an inefficient outcome.

For a complete description of our design and our procedures see Brandts and Schram (1996). The idea for our design comes from two rather elementary insights. First, richer data may be the key to understanding subjects' behavior more fully. Second, in previous vcm experiments, any subject's decision in any single period has always been for one, given, value of the marginal rate of substitution (mrs) between a public and a private good. For different values of the mrs, subjects' motivations and choices may vary. Hence, one might prefer to obtain information about individual choices for a variety of mrs-values.

In our experiments we ask subjects for their contribution to the public good for each of 10 different *situations*, which correspond to different values of the mrs. We call this set of

contribution levels a *contribution function*. After every subject has reported a contribution function for a period, one mrs is selected to be 'played'. This procedure is closely related to the strategy method, introduced by Selten (1967). Though subjects are not reporting strategies in response to possible moves by other players, they are reporting strategies in response to possible moves by nature (i.e., the selection of an mrs).

The difference between the situations is not only quantitative but also qualitative. For some situations contributing the whole endowment (which is 9 tokens per situation) will be a dominant choice and it will be efficient for all to contribute. This is the case when mrs<1. For some situations the dominant choice will consist in contributing nothing although it will be efficient to contribute everything. Because we use group size 4, this occurs when 1<mrs<4. For a third type of situations (mrs>4) contributing nothing will be both the dominant and the efficient choice. A contribution function will, therefore, give quite a complete picture of subjects' behavior. It will reveal each subject's deviations from the game-theoretic prediction in various circumstances.

We used two different designs in the choice of situations, 'asymmetric' and 'symmetric'. In 'asymmetric' the mrs of situation 1 was 0.25. Each situation had an mrs that was 0.5 higher than the previous one. Hence, situation 10 was characterized by mrs=4.75. This design is asymmetric, because for only 2 of the 10 situations the dominant strategy prescribes contributing the whole endowment, while for the remaining 8 situations the dominant strategy behavior consists in contributing everything. In 'symmetric' the mrs of situation 1 was 0.1. Each situation had an mrs that was 0.2 higher than the previous one. Hence, situation 10 was characterized by mrs=1.9. Note that the mrs' are symmetric around mrs=1 in this case.

3. Results.

Figure 1 shows the results aggregated over fourteen experimental sessions run in Amsterdam, Barcelona, Osaka and Tucson. These data were first reported on in Brandts Saijo and Schram (1997). This figure is based on 1680 complete contribution functions, which are the result of the decisions of 168 subjects over ten periods.

The main conclusions presented in the figure are:

1. when a dominant strategy yields efficiency (mrs<1 or mrs>4), most subjects follow it;
2. when a dominant strategy yields inefficiency (1<mrs<4), many subjects deviate from it by contributing;
3. when a dominant strategy yields inefficiency (1<mrs<4), contributions (hence, deviations from the dominant strategy) are declining in the mrs.

[Figure 1: about here]

Figure 2 presents the aggregate data from experiments with our symmetric design, carried out in Amsterdam and Osaka. These data also first appeared in Brandts, Saijo and Schram (1997). The main conclusions are that:

1. the error against rational choice theory is much larger for mrs>1 than for mrs<1;
2. the decline of contributions with mrs is stronger for mrs>1 than for mrs<1.

[Figure 2 about here]

4. Some insights.

We believe that these results show that contributions in the standard vcm environment are not the results of errors but of purposeful behavior. The main feature of our results, shown on figures 1 and 2, is that deviations are not symmetric around the mrs of 1, as a simple error hypothesis would predict. This evidence is reinforced by our results about individual behavior which are not reported here. It turns out that a large fraction of individuals contributes substantial amounts over 10 periods, while others contribute almost nothing from the beginning, i.e. both contributing and not contributing reflects to a large extent subjects' intended behavior.

Overall, cooperation declines over time. However, in period 10 contributions are still about 16% of endowments in 'asymmetric' and 20% in 'symmetric'. In Brandts and Schram

(1997) we present an adaptive interpretation of this behavior, in terms of the interaction between 'individualists' and 'cooperators'.

In our view, the question to be addressed is no longer whether contributions are purposeful but what kind of cooperative model will best explain the data from vcm experiments. Our analysis in Brandts and Schram (1997) suggests that simple warm glow or linear altruism models are unsatisfactory from the empirical point of view. Some kind of reciprocal motivation is needed to explain our data.

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