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 and warm glow 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, e.g., 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 unique equilibrium leads necessarily to an inefficient outcome.

For a complete description of our design and our procedures see Brandts and Schram (2001). 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

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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 variations of our basic design which involved two different configurations of situations. The first of these configurations, called 'asymmetric,' gives a more complete view of behavior while the second, called 'symmetric,' will better reveal a conceptually important feature of our data. 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 nothing. In symmetric configuration, 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's are symmetric around MRS $= 1$; in this case there are no situations in which contributing nothing is the efficient choice.

3. Results

Figure 1 shows the results aggregated over sixteen experimental sessions with asymmetric run in Amsterdam, Barcelona, Osaka, and Tucson. These data were first reported on in Brandts, Saijo, and Schram (2004). This figure is based on 1920 complete contribution functions, which are the result of the decisions of 192 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) decline strongly with the MRS.

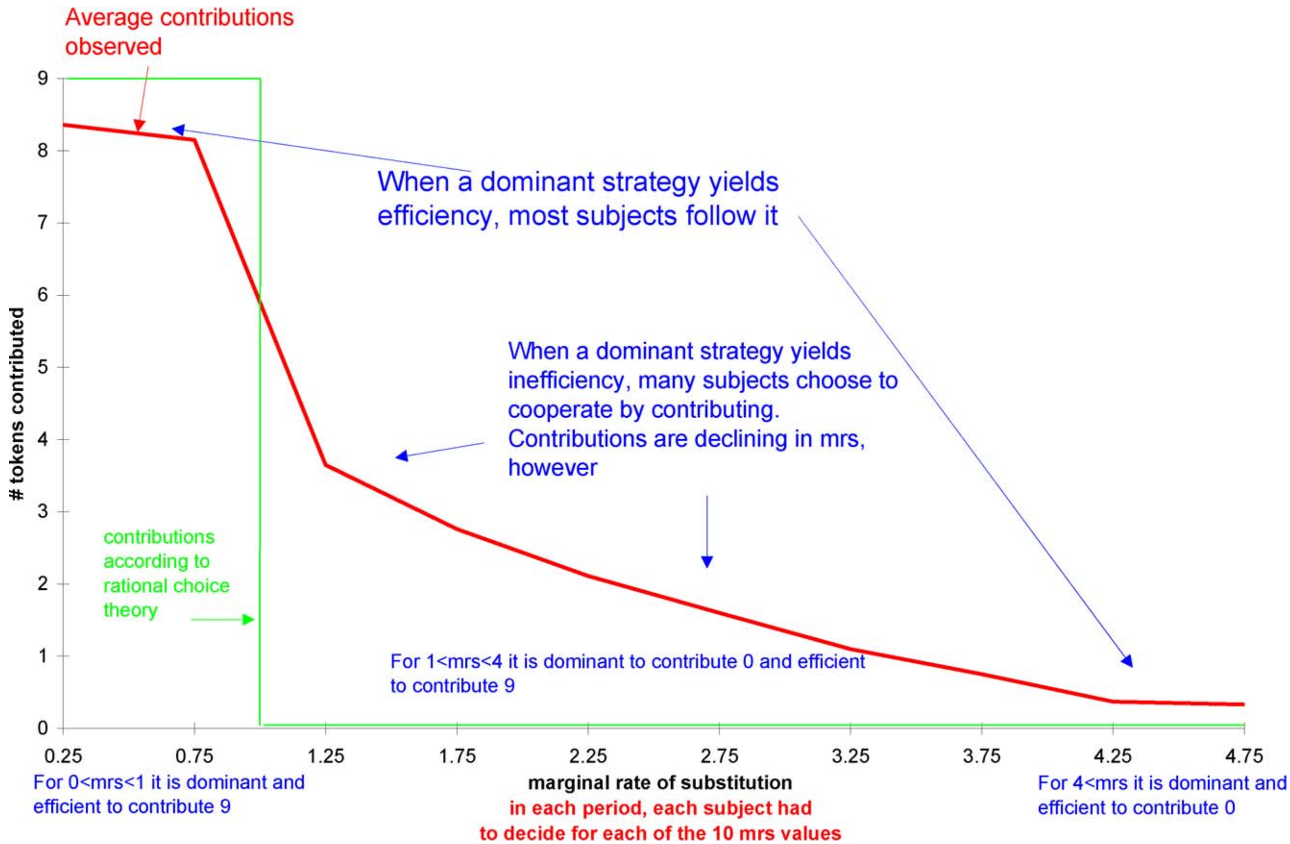

Figure 1. Contributions in the asymmetric cases. This figure gives the average number of tokens contributed (out of a total of 9) as a function of the marginal rate of substitution (mrs). The mrs varies between 0.25 and 4.75. Group size is 4. The data are based on 16 sessions with 3 groups in each session. Data for partners and strangers (8 sessions each) and countries (4 each in Japan, the Netherlands, Spain, and the United States) are aggregated.

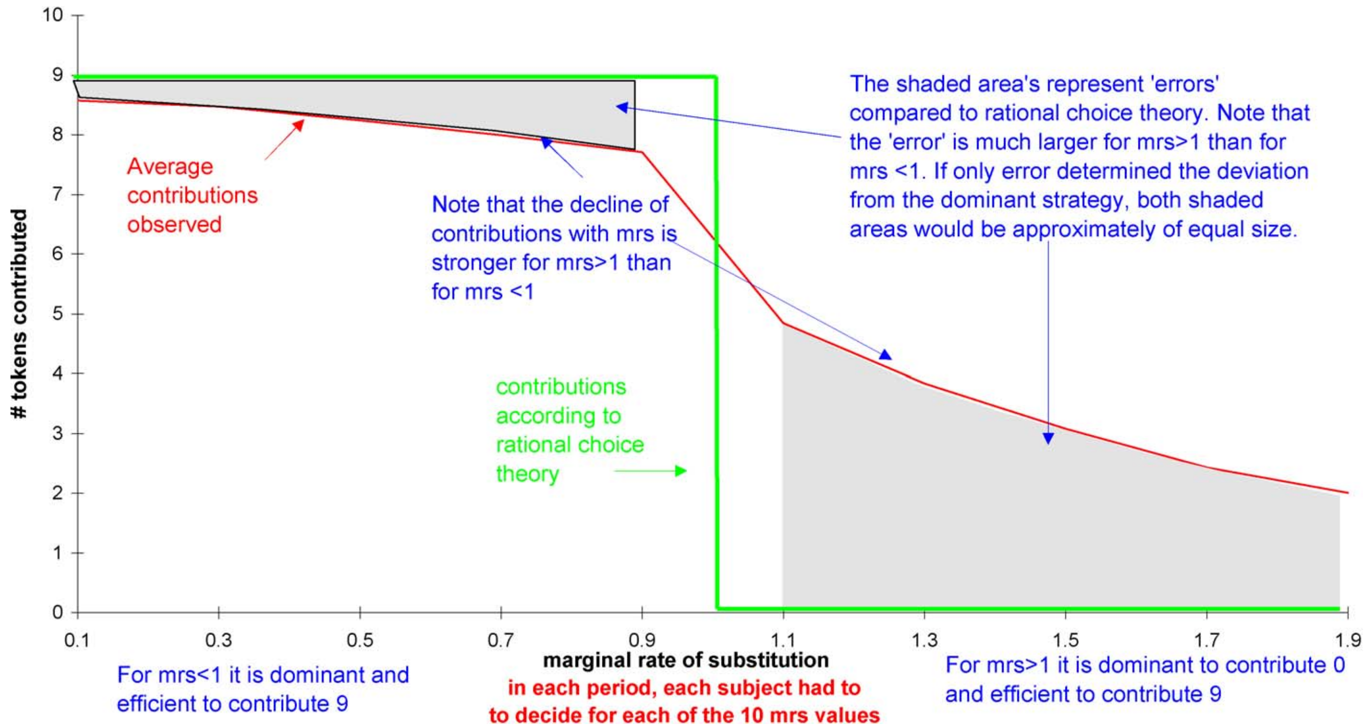

Figure 2. Contributions in the symmetric cases. This figure gives the average number of tokens contributed (out of a total of 9) as a function of the marginal rate of substitution (mrs). The mrs varies between 0.1 and 1.9 and is symmetric around mrs = 1. Group size is 4. The data are based on 4 (partners) sessions with 3 groups in each session. 2 sessions were run in Japan, and 2 in the Netherlands.

Figure 2 presents the aggregate data from experiments with our symmetric design, carried out in Amsterdam and Osaka; it is based on 480 contribution functions from 48 subjects. These data also first appeared in Brandts, Saijo, and Schram (2004). The results from this section can be used to evaluate the notion that subjects' errors depend on the cost of making them. In Figure 2 the payoff cost of an error is the same for situations 5 and 6, for situations 4 and 7, etc. Hence, in Figure 2 the situations to the right of MRS $= 1$ correspond exactly to the same set of costs of errors than those on the right. The main conclusions of our analysis revealed by Figure 2 are that:

1. the error against rational choice theory is much larger for MRS > 1 than for MRS < 1, even though the cost of error is the same on both sides of the MRS $= 1$;
2. the decline of contributions with MRS is stronger for MRS > 1 than for MRS < 1.

Both figures also reveal that when the dominant strategy yields inefficiency, subjects tend to split their endowment between the public and the private good.

4. Some Insights

The main feature of our results, shown in 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 the 10 periods of our experiments, while others contribute almost nothing from the beginning, i.e., both contributing and not contributing reflects subjects' intended behavior to a large extent. We believe that these results show that contributions in the standard VCM environment are not exclusively the results of errors but involve purposive behavior. The generation of solid evidence showing that decision errors cannot be the whole story is, in our view, an important first step towards understanding behavior in environments like this.

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 (2001), we present an adaptive interpretation of this behavior in terms of the interaction between individualists and cooperators.

Together, our results suggest that simple warm glow or linear altruism models are unsatisfactory from the empirical point of view. Some kind of reciprocal motivation – which makes people condition their behavior on that of others – is needed to explain our data. Schram (2000) discusses some of the recent models and their ability to explain the relevant evidence.

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