Chapter 88

VOLUNTARY PROVISION OF PUBLIC GOODS

KENNETH S. CHAN, STUART MESTELMAN and R. ANDREW MULLER
McMaster University

This research addresses the predictions of the conventional model of voluntary public goods provision presented by Bergstrom, Blume, and Varian (1986) which extends the work of Warr (1983). Bergstrom et al. argue that redistributing resource endowments from people who contribute to public goods to other people who contribute to public goods will have no effect on the aggregate contributions to public goods. However, redistribution from non-contributors to contributors will result in an increase in the provision of public goods. A model which incorporates equity theory is used to generate alternative hypotheses for the behavior of individual contributors.

Tests of the predictions of the conventional voluntary contribution model are reported in Chan et al. (1996a). Aggregate contribution data from three-person public goods environments support the neutrality theorem originally presented by Warr when endowments were redistributed among contributors. When endowments are redistributed from non-contributors to contributors, the predictions of Bergstrom et al. that public good provision would increase were observed. The individual contribution data, however, did not support the predictions of the conventional model. Individuals with relatively high endowments tended to under-contribute, relative to the conventional predictions, while individuals with relatively low endowments over-contributed.

Chan et al. suggest that participants in contribution games may bring notions of fairness into the laboratory, which augment the induced payoffs provided by the experimenters. They propose that the average contribution by the group is the measure of the fair contribution. Deviations from this value will induce feelings of guilt or spite and will result in payoffs lower than the induced payoffs reflect. If the induced payoffs are augmented in this way, there is a unique individual Nash equilibrium in which individuals with lower endowments will overcontribute (relative to the predicted Nash equilibrium contribution when the payoff is not augmented) and individuals with higher endowments will under-contribute. Tests of these predictions are reported in Chan et al. (1996a) and later integrated with the psychology literature on equity theory (see Walster, Walster, and Berscheid, 1978) in Chan et al. (1997). If the induced payoffs are augmented as suggested by equity theory, the neutrality theorem generally will not hold and the effect of endowment redistribution on the aggregate level of voluntary contributions to public good provision is indeterminate.

The experimental design used by Chan et al. keeps subjects in the same three-person groups for fifteen decision periods. Chan et al. (1996b, 1997) scramble the membership in the three-person groups after each decision period. The former treatment is called a *partners* treatment, while the latter is a *strangers* treatment. The strangers treatment is

Handbook of Experimental Economics Results, Volume 1

DOI: 10.1016/S1574-0722(07)00088-1

Table 1
Individual and total endowments (and Nash equilibrium contributions)

	Treatment				
	A	B	C	D	E
Low individual endowment	20 (5)	18 (3)	15 (0)	12 (0)	9 (0)
High individual endowment	20 (5)	24 (9)	30 (15)	36 (18)	42 (21)
Total endowment	60 (15)	60 (15)	60 (15)	60 (18)	60 (21)

Note. Numbers in parentheses are the Nash equilibrium contributions for each treatment and individual and total endowments. In all cases the Pareto optimal allocation of tokens to the public good is 31 tokens.

used to keep reputation effects and signaling from influencing the decisions of subjects. Furthermore, the Chan et al. design provides an across-subject effect of endowment redistribution, while the Chan et al. design provides a within-subject effect.

The payoffs induced in these environments result in an interior Nash equilibrium and an interior Pareto optimal allocation. There is no Nash equilibrium consistent with all participants contributing nothing to the public good. The payoffs are consistent with those in Bergstrom et al. and are represented as

$$U = (e - g) + G + (e - g)G,$$

where U is the payoff to an individual, e is the individual's endowment, g is the contribution made to the group good and G is the sum of the contributions to the group good made by all individuals in the group. The endowment distributions and Nash equilibria are presented in Table 1. This is a very different environment than that developed by Isaac, McCue, and Plott (1985) and Isaac and Walker (1988) in which each participant's dominant strategy is to contribute none of his endowment to the public good. The Pareto optimal allocation, however, is for all of his endowment to be contributed to public good provision. In this environment both the Nash equilibrium contributions and the Pareto optimal contributions are in the interior of the endowment set.

Figure 1 shows the mean individual contributions over the fifteen periods when each individual has an endowment of twenty tokens and when two individuals each have endowments of 15 tokens and one has an endowment of 30 tokens. This is a partners treatment. The strong pattern of tight fluctuation around the Nash equilibrium contribution of five tokens in the equal endowment environment is very different from the pronounced decay towards the Nash equilibrium contribution displayed in the linear public goods environments (e.g., see Isaac and Walker, 1988). Regardless of whether the treatment is a partners or a strangers treatment (not illustrated), the aggregate group contributions to public good provision is very close to fifteen tokens. This is consistent with both the conventional behavioral model and the model augmented by the attitudes of fairness which are reflected in equity theory.

Also shown in Figure 1 is the time series of mean contributions by individuals with endowments of 30 tokens and 15 tokens in partners sessions. These show a clear con-

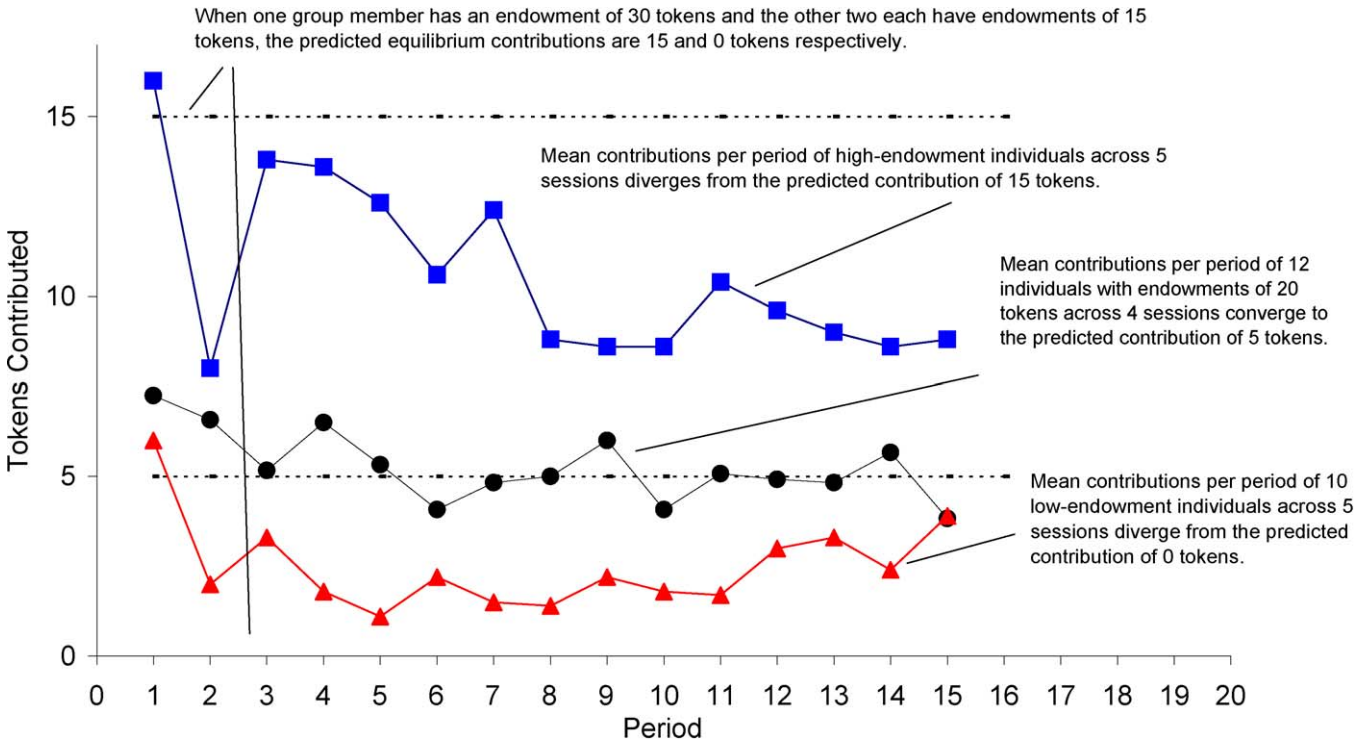

Figure 1. Time series of individual voluntary contributions for public good provision by members of 3-person groups show stability around the predicted contribution when individual endowments are equal but diverge from predicted contributions as endowments are redistributed (for partners treatment).

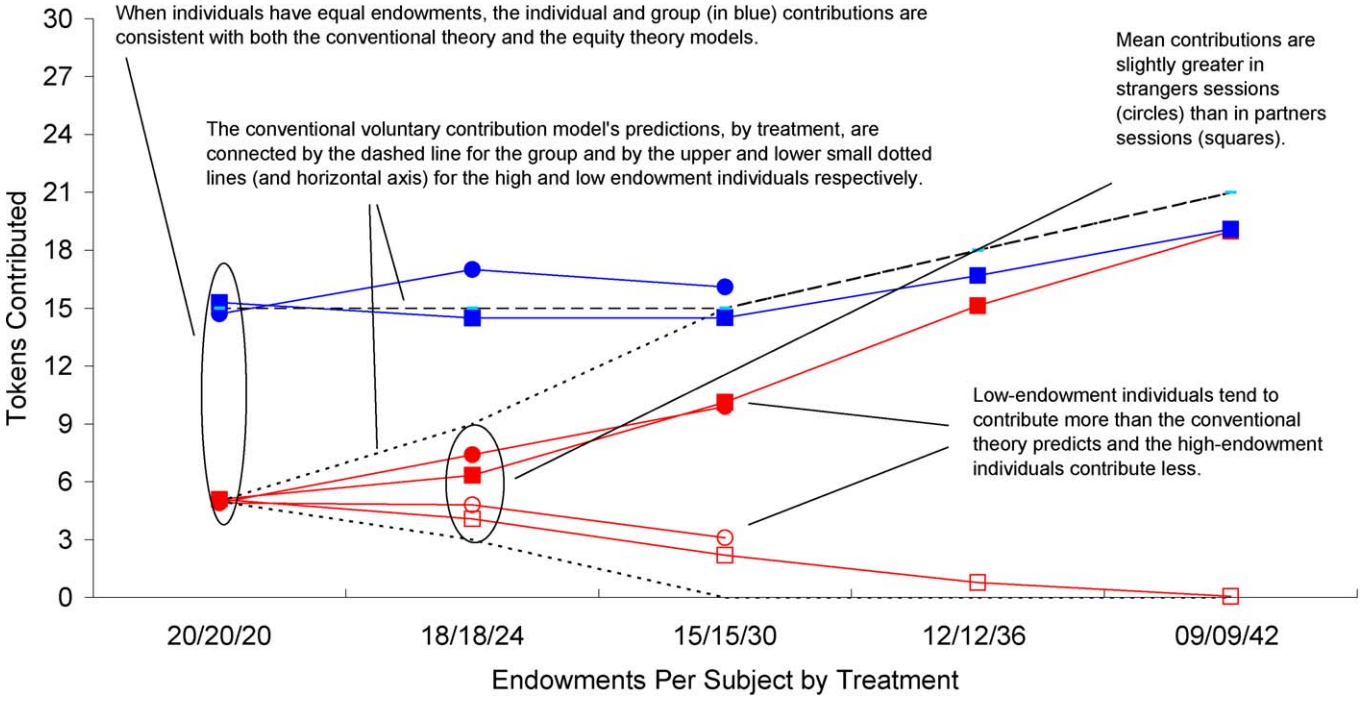

Figure 2. As endowments are redistributed, low-endowment individuals contribute more than predicted by the conventional model and high-endowment individuals contribute less. This behavior is consistent with psychology's theory of equity.

vergence below the Nash equilibrium contribution of 15 tokens and above the Nash equilibrium contribution of 0 tokens predicted by the conventional model for the high and low endowment individuals respectively.

Figure 2 summarizes data from approximately 60 periods for each of five different endowment distributions in the partners treatment and 48 periods for each of the three distributions in the strangers treatment. As the endowment distributions go from 20 tokens to each participant to 9 tokens to two participants and 42 tokens to the third participant in a group, the endowment distributions are becoming increasingly skewed. Regardless of whether participants were interacting with partners or strangers, the average individual contribution in the equal endowment environment supported both the conventional and alternative behavioral models.

As income distribution becomes slightly skewed, some differences in the aggregate contributions across partners and strangers treatments emerge. Individual contributions by high endowment individuals consistently fall short of that predicted by the conventional model while contributions by low endowment individuals exceed the prediction of the conventional model. This pattern persists as the endowment distribution becomes more and more skewed.

Aggregate data from sessions using the partners treatment suggest that the predictions of the conventional model of the voluntary contribution mechanism may be supported. Redistributing endowments among contributors leads to no change in the provision of the public good, but redistributing income from non-contributors to contributors leads to an increase in public good provision. Individual data from these laboratory environments and the strangers environments, however, suggest that some notion of fairness may be brought into the laboratory by subjects. Equity theory leads to Nash equilibrium predictions which are supported by data from these laboratory public goods experiments.

References

Bergstrom, Ted, Blume, Lawrence, Varian, Hal (1986). "On the private provision of public goods". Journal of Public Economics 29, 25–49.

Chan, Kenneth S., Godby, Rob, Mestelman, Stuart, Muller, R. Andrew (1996a). "Spite, guilt and the voluntary provision of public goods when income is not distributed equally". Canadian Journal of Economics 29, S605–S609.

Chan, Kenneth S., Mestelman, Stuart, Moir, Rob, Muller, R. Andrew (1996b). "The voluntary provision of public goods under varying income distributions". Canadian Journal of Economics 29, 54–69.

Chan, Kenneth S., Godby, Rob, Mestelman, Stuart, Muller, R. Andrew (1997). "Equity theory and the voluntary provision of public goods". Journal of Economic Behavior and Organization 32, 349–364.

Isaac, R. Mark, McCue, Kenneth F., Plott, Charles R. (1985). "Public good provision in an experimental environment". Journal of Public Economics 26, 653–670.

Isaac, R. Mark, Walker, James M. (1988). "Group size effects in public goods provision: The voluntary contribution mechanism". Quarterly Journal of Economics 103, 179–200.

Walster, Elaine, Walster, G. William, Berscheid, Ellen (1978). "Equity: Theory and Research". Allyn and Bacon, Boston.

Warr, Peter (1983). "The private provision of a public good is independent of the distribution of income". Economics Letters 13, 207–211.