Table 6.5 The Effects of a Provision-Point on Payoffs for Player X
(Key: *Nash Payoff*; **Payoff in the Efficient Allocation**)

		Contributions by Player X (tokens)					
		0	2	4	6	8	10
	0	*$10.0*	$ 8.0	$ 6.0	$ 4.0	$ 2.0	$ 0.0
	2	$10.0	$ 8.0	$ 6.0	$ 4.0	$ 2.0	$ 0.0
	4	$10.0	$ 8.0	$ 6.0	$ 4.0	$ 2.0	$ 0.0
Contributions by Player Y (tokens)	6	$10.0	$ 8.0	$ 6.0	$ 4.0	$ 2.0	$ 0.0
	8	$10.0	$ 8.0	$ 6.0	$ 4.0	$ 2.0	$ 0.0
	10	$10.0	$ 8.0	$ 6.0	$ 4.0	$ 2.0	***$15.0***

The payoff in this allocation is both italicized and bolded, to indicate that it is a Pareto-dominant Nash equilibrium.

Despite these characteristics, the full-contributions equilibrium is extremely unstable. Player X, for example, would be very reluctant to contribute ten tokens to the public good, if there was any significant probability that player Y would "tremble" and contribute something less than ten units. Trembling of this type might be caused by a failure of player Y to understand fully the incentives, or by uncertainty on the part of player Y regarding player X's understanding of the incentives. This instability becomes even more pronounced if the provision point depends on the contributions of more than two players. Isaac, Schmidtz, and Walker (1989) conducted a series of six sessions using the all-or-nothing provision-point condition illustrated in table 6.5. The authors used variants of a four-person, MPCR = .3 baseline design discussed above (e.g. Isaac and Walker, 1988a, 1988b) where free-riding was shown to be significant. Each session consisted of ten periods, and all participants were experienced.

The left panel of figure 6.9 presents mean contribution rates for these six sessions. As is clear from this panel, the provision point did little to damp the decay in contributions. A comparison with data for comparable no-provision-point sessions (e.g., the *4L* treatment in left panel of figure 6.6) reveals virtually no treatment effect. Given the instability of the provision-point equilibrium, this result is not surprising.[17]

[17] Another instance where Pareto dominance is not a useful device for selecting among multiple Nash equilibria is the coordination game discussed in section 2.5 of chapter 2.

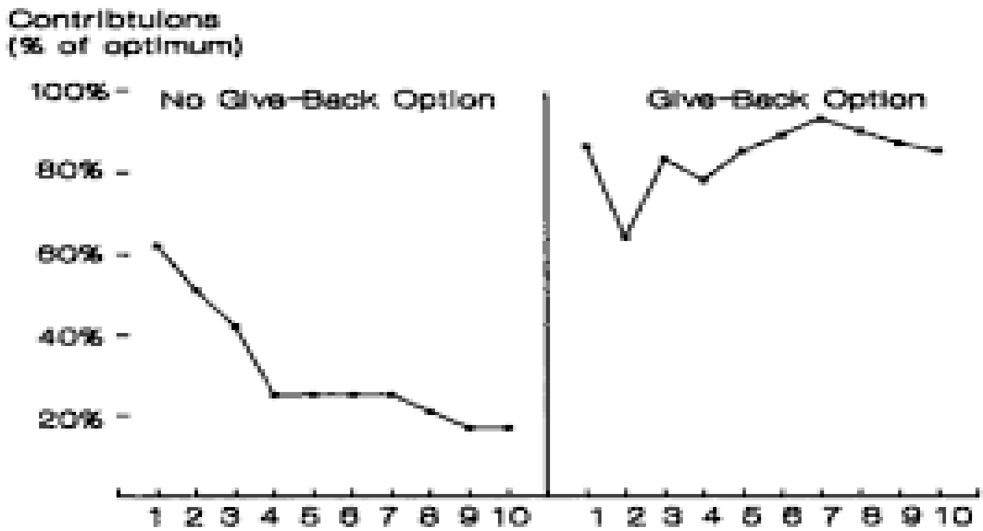

Figure 6.9 Contributions to the Group Exchange under Two Provision-Point Regimes (Source: Isaac, Schmidtz, and Walker, 1989)

The risk of contributing to the group exchange may be mitigated by refunding contributions if the provision point is not met. A *give-back* option of this type is characteristic of most natural applications of the provision-point mechanism. For example, both of the fund-drives using a provision point cited above used a give-back option.

The give-back option decreases the risk of contributions by creating a "safety net" below the provision point. The safety-net feature of the give-back option is illustrated in table 6.6 for the two-person voluntary-contributions design: For any allocation except for full contributions, player X earns \$10. Due to the "flatness" of the payoff table, there is no particular incentive to free-ride. Player X will earn \$10.00 not only by contributing 0 to the group exchange, but for *any* allocation other than (10, 10). As a consequence, with a give-back option, every allocation where both players contribute less than ten tokens is a (weak) Nash equilibrium, as indicated by the italicized payoff entries in the table.[18] Notice also that earnings jump to \$15 at the (10, 10) allocation, indicating that, as in table 6.5, the provision point is a Pareto-dominant Nash equilibrium. This equilibrium is dynamically much more stable, however, because participants are no longer concerned about the

[18] When one player contributes ten, the best response of the other is to increase contributions to ten. For this reason, some of the payoffs in the bottom row and along the right-hand column of table 6.6 are not italicized.

Table 6.6 Earnings for Player X with a Provision-Point and a Give-Back Option (Key: *Nash Payoff*; **Payoff in the Efficient Allocation**)

		Contributions by Player X (tokens)					
		0	2	4	6	8	10
Contributions by Player Y (tokens)	0	*$10.0*	*$10.0*	*$10.0*	*$10.0*	*$10.0*	$10.0
	2	*$10.0*	*$10.0*	*$10.0*	*$10.0*	*$10.0*	$10.0
	4	*$10.0*	*$10.0*	*$10.0*	*$10.0*	*$10.0*	$10.0
	6	*$10.0*	*$10.0*	*$10.0*	*$10.0*	*$10.0*	$10.0
	8	*$10.0*	*$10.0*	*$10.0*	*$10.0*	*$10.0*	$10.0
	10	$10.0	$10.0	$10.0	$10.0	$10.0	***$15.0***

"tremblings" of others. For example, although player X's earnings will fall from $15 to $10 in the event that player Y deviates from the (10, 10) allocation, player X has no incentive to reduce contributions, since $10 is guaranteed regardless of the choice of player Y.[19]

The give-back option improves observed contribution rates. The right side of figure 6.9 shows the average contribution levels for six additional sessions with both a provision-point and a give-back option. In the sessions with the give-back option, average contributions to the group exchange were slightly below the provision point, indicating that the public good was not always provided. But average contribution rates for these sessions were more than four times higher than for comparable sessions without the give-back option. Moreover, the provision point was consistently met in the last half of most sessions. Bagnoli and McKee (1991) report very similar results in a somewhat different design.

The provision-point/give-back combination does not always perform as impressively as in figure 6.9. In particular, both theoretic and behavioral complications arise if the provision point does not require full contributions by all participants. For example, suppose that a provision-point requires only 50 percent of the aggregate token endowment. In many instances, each combination of contributions that satisfy the provision-point will be a Nash equilibrium. These multiple equilibria create formidable coordination problems, because players will

[19] In game-theoretic terminology, the give-back option causes any contribution level below ten to be weakly dominated by contributing ten tokens.

members of trade and neighborhood-residence associations. But meetings, particularly those that are unstructured, become difficult in a group of any significant size, and practically impossible when the group is dispersed.

Provision Points

In a variety of natural contexts, fund drives are frequently conducted for a specific public good, under the condition that the good will only be provided in the event that a certain minimum level of funding is surpassed. The Association of Oregon Faculties, for example, successfully funded the salary for a lobbyist by soliciting contributions from all faculty in the state, under the condition that the lobbyist would be retained only if the salary ($30,000) was collected by a specified date.[15] Similarly, Bagnoli and McKee (1991) report that Canada's New Democratic party enjoyed success in a pair of fund-raising campaigns, each administered under a targeted minimum-aggregate-contributions condition.[16] The minimum-aggregate-contribution requirement will be called a *provision point.*

Unlike nonbinding communications, the addition of a provision point changes the set of Nash equilibria in a fairly straightforward way. Recall that a Nash equilibrium is evaluated in terms of whether unilateral deviations from a particular allocation would be profitable. The free-rider equilibrium emerges in the voluntary-contributions mechanism because, for any level of aggregate contributions, every individual can unilaterally increase earnings by reducing contributions to the public good, as long as the MPCR < 1.

A provision point creates additional equilibria by breaking the continuity of rewards for unilateral reductions in contributions. The effect of a provision point on incentives is easily seen in the payoffs for a single participant in a simple public-goods game. Suppose there are two participants, a player X and a player Y, each of whom has an endowment of ten tokens. As usual, tokens may be either kept (and converted to dollars at a 1-to-1 rate) or contributed to the group exchange, where the MPCR = .75.

Table 6.4 presents payoffs for player X, given various contributions levels by player X (columns) and player Y (rows). For brevity, contributions listed in the table are restricted to $2 increments. In the efficient solution, players X and Y each contribute ten tokens to the group exchange, and player X earns $15 (as does player Y). For convenience, we will refer to contributions combinations in terms of ordered pairs. The efficient solution, for example, is the (10, 10) allocation that yields the bolded $15.00 payoff in the table.

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15 See Dawes et al. (1986).

16 Both of the examples cited in the text differ from the designs to be discussed initially in that funds were collected under a "give-back" option, where contributions were returned in the event the provision point was not met. The effects of a give-back option are discussed below.