Matching Grants and Charitable Giving: Why People Sometimes Provide a Helping Hand to Fund Environmental Goods

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Matching grants are a prevalent mechanism for funding environmental, conservation, and natural resource projects. However, economists have largely been silent regarding the potential benefits of these mechanisms at increasing voluntary contributions. To examine the behavioral responses to different match levels, this research uses controlled laboratory experiments with generically framed instructions and introduces a general-form matching-grant mechanism, referred to as the proportional contribution mechanism (PCM). Results show that contributions are positively correlated with both the match and the induced value of the public good even when a dominant strategy is free-riding. An implication of this partial demand revelation result is that manifestations of this type of "helping hand" social preference should be counted in benefit-cost analysis.

Key Words: matching grants, public goods, charitable giving, voluntary contributions, experimental economics, warm glow, helping hand

The most common mechanism for charitable donations is a matching grant that is implemented through the income and estate tax systems (see Table 1 for examples of various countries that have tax incentives to promote charitable giving). In these cases, the true cost of the charitable contribution for the individual donor is a fraction of the actual donation since the individual will have his or her tax bill reduced by an amount that depends on the individual's applicable tax rate. According to the Giving USA Foundation (2009), in 2008 annual charitable giving in the United States exceeded $300 billion, with more than $229 billion of this amount coming directly from individuals. Previous studies have reported that matching forms of subsidy and tax deduction mechanisms for public goods generally are quite successful, and that an increase in the matching level significantly increases total donations (see, e.g., Eckel and Grossman 2003, Eckel and Grossman 2008, Peloza and Steel 2005, and Randolph 1995).

Matching grants are used extensively in the funding of environmental, conservation, and natural resource projects (see, e.g., Rondeau and List 2008). Not only do individuals donate approximately $6.6 billion to environmental and animal welfare causes (Giving USA Foundation 2009), but leading federal programs, such as the Land and Water Conservation Fund, the USDA Forest Legacy Program, and the U.S. Army's Compatible Use Buffer Program, which collectively have annual funding of approximately $450 million, traditionally require partners to provide financial matches of 20–50 percent of the total project cost. According to the U.S. General Accounting Office, more than two-thirds of all federal grants,

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Table 1. Examples of Individual Income and Estate Tax Rates for Countries That Have Incentives to Promote Private Charitable Giving

Country	Individual Income Tax Rate	Estate Tax
Austria	21–50%	15%
Belgium	25–50%	30%
Denmark	38–59%	15%
Finland	7–30.5%	16%
France	5.5–40%	40%
Germany	14–45%	30%
Greece	0–40%	20%
Ireland	20–41%	20%
Japan	5–50%	70%
Netherlands	0–52%	27%
Norway	28–49%	20%
Spain	24–43%	34%
United Kingdom	0–40%	40%
United States	21–50%	46%

Source: Roodman and Standley (2006).

nearly $150 billion in total, involved a matching grant (Huber and Runkel 2006). Other examples of the use of matching grants for large-scale environmental projects include federal efforts to restore southern Florida's ecosystems and the Everglades; the federal Transportation Enhancements Program for projects such as conservation of scenic areas, the development of multi-use trails, and environmental mitigation ($10 billion total since 1992); and the federal Water and Waste Disposal grant program.

In most cases, the matches are not direct one-to-one arrangements; instead, the amount of the match varies given the circumstance. For instance, conservation organizations such as The Nature Conservancy have sought "bargain sales" from landowners where, in effect, the organization and the individual landowner enter into a matching-grant arrangement to preserve a parcel. In state-level agricultural land protection programs, such as in Delaware and Maryland, the government has provided a varying level of match to landowners who voluntarily agree to put their lands into conservation easements. To date, these two programs collectively have spent nearly $500 million to preserve more than 350,000 acres. In Delaware, the match level has varied from 0 percent to 100 percent, with the average match provided by the landowner being 53 percent (Messer and Allen, forthcoming).

Despite the widespread use of matching grants to fund environmental projects and public goods, economic theory offers little explanation as to why the mechanism may be useful or why the level of matching influences the amount of donations. Certainly, the idea of having a donor's contributions matched by another source can be intuitively perceived as a cost-effective way of funding the public good. However, in most cases the situations and proposed matches are not incentive-compatible from the perspective of the potential donor. In other words, despite the matching grant, an individual's Nash equilibrium behavior in the standard economic theory remains to contribute nothing to the public good, especially when the number of potential donors is very large (Andreoni 1988).

A key issue to this research is how we can interpret positive contributions that occur in the field even when an individual's Nash equilibrium is, in theory, to contribute nothing (hereafter we call this behavior of positive contribution an "over-contribution"). A possible explanation for over-contribution is Andreoni's concept of "warm glow" or some other type of intrinsic motivation (see Brekke, Kverndokk, and Nyborg 2003). However, existing theories do not fully explain why the level of matching significantly impacts the total amount of donations. This paper seeks to provide some additional explanation for the nature of contributions observed in a matching grant by introducing a new explanation that is referred to as the "helping hand" hypothesis.

Whereas Andreoni (1995) conjectured that warm glow is a pervasive feature of non-coercive voluntary mechanisms, we hypothesize that the degree of over-contributions that may arise from warm glow or altruism is a function of whether the voluntary mechanism is incentive-compatible.[1] More specifically, our helping hand hypothesis can be explained as follows: When a person faces an external mechanism that is not incen-

[1] Examples exist where warm glow is not present in coercive public good mechanisms (see, for instance, Falkinger et al. 2000 and Messer et al. 2010).

tive-compatible and seems unlikely to provide a socially optimal level of the public good, the individual gains some utility by undertaking socially responsible behaviors. Once the mechanism is adjusted to be incentive-compatible and thus seems likely to provide the socially optimal level of the public good, the individual no longer offers a helping hand, but instead focuses on maximizing her personal payoff, bringing the individual's behavior closely in line with the Nash equilibrium prediction.

To examine the behavioral responses to different levels of matching in a voluntary contribution mechanism and to test the helping hand hypothesis, this research uses controlled laboratory experiments and introduces a new, general form of the matching grant, referred to as the Proportional Contribution Mechanism (PCM). The PCM can be considered a general-form extension of a matching-grant or a tax-rebate mechanism.[2] The key attributes of the PCM are that (i) the level of match can be modified by adjusting one parameter that represents a price of voluntary contribution, (ii) it can be modified to be either incentive-compatible or not by adjusting the same parameter, and (iii) it enables within-subject examination of behavior in single-shot settings. These attributes make the PCM well-suited for studying voluntary contribution behavior since the level of match, efficiency of the mechanism, and induced value of the public good can be readily adjusted to examine various situations in a controlled setting.[3]

Our experiments conducted under the PCM yield a set of novel results that contribute to the existing literature in several ways. First, we successfully demonstrate that when the PCM is incentive-compatible, people do not over-contribute, but follow Nash predictions. That is consistent with the helping hand hypothesis in an incentive-compatible case. To the best of our knowledge, this PCM is the first voluntary mechanism that is both empirically and experimentally proven to work in the sense that contributions within the mechanism generate an efficient level of a public good when it is set to be incentive-compatible.[4]

Second, this research suggests that over-contributions emerge only when the voluntary mechanism is not incentive-compatible. This implies that the degree of over-contribution depends on the efficiency of the mechanism. Thus, the helping hand hypothesis is supported even in a non–incentive-compatible case. In addition, we show that the degree of over-contribution increases with the induced values of the public good and is proportional to the level of matching even when the dominant strategy is free-riding.

Third, with these findings we provide a new interpretation for over-contributions observed in a non–incentive-compatible case; that is, contributions observed in a non–incentive-compatible mechanism can be interpreted as partial demand revelation rather than a simple manifestation of "warm glow" or "non-paternalistic altruism" since they reflect, in part, the value of public goods as well as the level of matching (or simply prices).

We assert that a series of the aforementioned findings in voluntary contributions can be established only by systematically manipulating whether an underlying voluntary mechanism is incentive-compatible or not. Overall, these results imply that people have significant concerns about efficiency when considering the funding of public goods. However, once efficiency is achieved, people lose the motivation to help or to over-contribute. The contribution patterns observed in this experiment are generally consistent with some previous experimental field research (see, e.g., Karlan and List 2007); however, this work's

[2] A matching grant can be mathematically equivalent to a tax rebate although people may behave differently in these two settings (see, e.g., Eckel and Grossman 2003). The tax rebate can be considered the most fundamental match that people consider when they contribute to charities.

[3] The PCM should not confused with the provision point mechanism (PPM) as the two mechanisms differ fundamentally with respect to the condition of providing the public good. In the PPM, a public good is provided only when the sum of the contributions exceeds a pre-set threshold. Otherwise, the public good is not provided and, in the case of a PPM with a money-back guarantee, the contributions are returned to the donor (for a further discussion see Messer, Kaiser, and Schulze 2008). Therefore, the outcome is binary as either the public good is fully provided or not. In contrast, with the PCM, partial funding of the public good is possible when the sum of contributions does not exceed the pre-set cap for the level of the public good. When contributions exceed the capped level, the public good is still provided at that capped level. This feature enables the PCM to be both incentive-compatible and non–incentive-compatible by varying just one parameter.

[4] There is a coercive and incentive-compatible mechanism, which is proven to work empirically. Falkinger et al. (2000) experimentally demonstrate a mechanism that enables subjects to provide an efficient level of public goods with a mix of subsidy and taxation schemes. For voluntary mechanisms that are not incentive-compatible, the use of context—such as involving groups in repeated discussion or a combination of discussion, voting, and status quo change—has been shown to yield socially optimal results for public goods in laboratory experiments (Brosig, Weimann, and Ockenfels 2003, Messer et al. 2007).

novelty derives from the fact that our research provides a more consistent explanation for why contributions are sensitive to the level of matching or subsidy as well as to the value of public goods observed in the field.

The results of this research provide some potential implications for the measurement of benefits from environmental and natural resource projects. There has been a long debate of whether the "willingness to pay" (WTP) estimates or voluntary contributions motivated by impure altruism should be counted in benefit-cost analysis. Some researchers argue that such contributions do not reflect any economic value of a public good, and that thus the WTP estimates should not be counted as an economic valuation of the public good (see, e.g., Kahneman and Knetsch 1992). In contrast, other researchers have argued that the WTP estimates are sensitive to the value of public goods, at least in some cases, and that therefore these values should be counted in benefit-cost analysis (see, e.g., Bateman et al. 2004). Our results support the latter in the sense that voluntary contributions reflect the economic value of the public goods even when these contributions are motivated by some sort of impure altruism and when the mechanism is not incentive-compatible where a dominant strategy is free-riding. This paper concludes by providing an alternative explanation of "helping hand" for why the voluntary contributions should be counted in the benefit-cost analysis.

Experimental Design and Procedures

All experiments were conducted in the Laboratory for Experimental Economics and Decision Research (LEEDR) at Cornell University. The subject pool consisted of ninety undergraduate students recruited from introductory economics and business classes. An experimental session took approximately forty-five minutes and each subject earned an average of fifteen U.S. dollars. Subjects were randomly appointed to a computer with a privacy shield and assigned to a group of three people. Subjects in the same group were not seated near each other and no communication was allowed between subjects. Subjects received written instructions, and the administrator provided oral instructions and answered any questions.

After a couple of practice rounds, subjects made fifteen confidential decisions on various public good programs where they could donate any amount between \$0 and \$10. Each program had a different level of match and different size of the public good (Table 2). Similar to Messer et al. (2010), the fifteen decisions were single-shot as there was no feedback between decisions, and the final determination of which three programs (one for each level of the public good) resulted in payoff to the subjects was determined at the end of the experiment by a random draw by a volunteer subject.

All sessions involved the PCM that can be described as follows:

$$\pi_i = \begin{cases} w_i - bg_i + \dfrac{1}{N}\sum_{j=1}^{N} g_j & \text{if } \sum_{j=1}^{N} g_j \le G^0 \\ w_i - bg_i + \dfrac{1}{N} G^0 & \text{if } \sum_{j=1}^{N} g_j > G^0, \end{cases}$$

where π_i is the personal payoff for each subject *i*, w_i is the endowment, g_i is the contribution to the public good, b is a proportional contribution parameter, G^0 is the capped return of the public goods, and N is the group size. A key feature of the PCM is that the proportion of contribution (referred to as b) can be modified to make the mechanism incentive-compatible.

When $b = 1$, subjects pay the entire amount of their contribution and the mechanism is the same as a standard VCM [see footnote 2 for more detailed descriptions about the differences between PCM and the provision point mechanism (PPM)]. If, instead, $b = 0.5$, then the subjects have to pay only one-half of the contribution (similar to a matching grant, tax deductions, or tax rebate).[5] For $b \le 1/3$, the PCM is incentive-compatible in groups of three people. The main advantage of the PCM is that subjects' willingness to pay (WTP) can be compared in a within-subject single-shot environment in which the mechanism is and is not incentive-compatible. Induced values, defined as the maximum payoff each subject can obtain from the public good, are obtained by capping individual payoffs from the public good (see Rondeau, Poe, and Schulze 2005). We will further discuss this feature in this section.

[5] The different incentive schemes can be arranged in the way that they become mathematically equivalent [see Eckel and Grossman (2003 and 2008) for more details].

Table 2. A Summary of Experimental Design with Respect to b, G^0, and a Number of Subjects and Observations

	# of subjects	b	G^0 (or v)	# of obs.
Situation 1	90	0.1		90
Situation 2	90	0.2		90
Situation 3	90	1/3	6(or 2)	90
Situation 4	90	0.6		90
Situation 5	90	0.9		90
Situation 6	90	0.1		90
Situation 7	90	0.2		90
Situation 8	90	1/3	15(or 5)	90
Situation 9	90	0.6		90
Situation 10	90	0.9		90
Situation 11	90	0.1		90
Situation 12	90	0.2		90
Situation 13	90	1/3	24(or 8)	90
Situation 14	90	0.6		90
Situation 15	90	0.9		90

In these experiments, each subject in a group of three people ($N = 3$) was endowed with ten "experimental dollars" ($w_i = 10$). Using these parameters, the individual decision problem is as follows:

$$(1) \quad \max_{g_i \in [0,10]} \pi_i = \begin{cases} 10 - bg_i + \frac{1}{3}G & \text{if } G = \sum_{j=1}^{3} g_j \le G^0 \\ 10 - bg_i + \frac{1}{3}G^0 & \text{otherwise.} \end{cases}$$

To understand this choice setting, let us outline several key definitions and important facts of the individual contribution problem [equation (1)].

Definition 1 (Induced Value). *The induced value of the public good is defined as the maximum payoff each subject can obtain from the public good in a group. The feature originates from the kinked payoff function in the public good at the level of G^0. In this experiment, the induced values v are equivalent to $G^0/3$, which is a Pareto optimal (P.O.) contribution that each subject must give for social or group efficiency.*

Remark 1.

$$\begin{cases} \textit{Any allocation satisfying } G = G^0 \textit{ is} \\ \quad \textit{Pareto-optimal if } b \in (0,1) \\ \textit{Any allocation satisfying } G = 0 \textit{ is} \\ \quad \textit{Pareto-optimal if } b = 1. \end{cases}$$

Prediction 1. *The best response of subject i is*

$$\begin{cases} \textit{any contribution satisfying } g_i^* = G^0 - G_{-i} \\ \quad \textit{if } \; b \in (0,1/3] \\ g_i^* = 0 \;\; \textit{if} \;\; b \in [1/3,1], \end{cases}$$

$$\textit{where } G_{-i} = \sum_{j \ne i} g_j.$$

Prediction 2 (Symmetric N.E.). *Under the PCM with $N = 3$ and $w_i = 10$:*

i. *if $b \in (0, 1/3)$, a symmetric N.E. is $g_i^* = v = G^0/3$*
ii. *if $b = 1/3$, a symmetric N.E. is $g_i^* \in [0,v] = [0, G^0/3]$*
iii. *if $b \in (1/3, 1]$, a symmetric N.E. is $g_i^* = 0$. In fact, strategy $g_i^* = 0$ is a unique dominant strategy in this case.*

Throughout this paper, our focus is on a symmetric N.E. as a benchmark for theoretical predictions. In fact, similar to a continuous contribution under a provision point mechanism (Cadsby and Maynes 1999), there are an infinite number of asymmetric Nash equilibria. This point follows from Prediction 1. Following previous experimental research, we assume that a symmetric N.E. should work as a prediction as well as a focal point of the type of coordination games, as in our experiments (see, e.g., Cadsby and Maynes 1999, Schelling 1981).

Remark 2. *Predictions 1 and 2 yield the following result:*

The PCM is

$$\begin{cases} \textit{incentive-compatible if } b \in (0,1/3] \\ \textit{not incentive-compatible if } b \in [1/3,1]. \end{cases}$$

In addition, $b = 1/3$ is the cut-off point that divides the incentive-compatibility of the PCM. Hence, at this cut-off, the PCM may or may not be incentive-compatible.

Notice that when $b \in (0,1/3]$, the mechanism is incentive-compatible in the sense that subjects are induced to honestly reveal the maximum value of the public good, v.

To test the helping hand hypothesis, we employ five different values of the proportional contribution parameter $b = \{0.1, 0.2, 1/3, 0.6, 0.9\}$ for each value of $G^0 = \{\$6, \$15, \$24\}$. Here, note that each value of $b = \{0.1, 0.2, 1/3, 0.6, 0.9\}$ can be translated into the ratios 1:9, 1:4, 1:2, 1:0.666…, and 1:0.111 in a matching grant, respectively. This ratio can be understood through an example of $b = 0.5$ for which the matching ratio is a 1:1 match.

For $b \in \{0.1, 0.2\}$, the PCM is incentive-compatible so that the symmetric N.E. strategy and a P.O. contribution are to give induced values of $v = G^0/3$. If $b \in \{0.6, 0.9\}$, then the PCM is not incentive-compatible, so the N.E. strategy is to give nothing, but the P.O. contribution is for each subject to give $v = G^0/3$. When $b = 1/3$, the mechanism is both incentive- and non–incentive-compatible, as noted in Prediction 2. The choice of these five values of b allows a comparison of how the two incentive-compatible ($b = \{0.1, 0.2\}$) and the two non–incentive-compatible ($b = \{0.6, 0.9\}$) mechanisms yield different results with one cutoff value of $b = 1/3$.

The experiment procedures were as follows. First, subjects participated in hypothetical practice rounds for up to five minutes. The spreadsheet on each subject's computer screen (equipped with a privacy shield) was programmed with Visual Basic for Applications (VBA) so that each subject could input his or her own hypothetical contribution and the other two subjects' hypothetical contributions for all fifteen treatments. The spreadsheet was programmed so that it generated the payoff consequences for a group after all three contributions were entered. Subjects were also asked to perform two primary tasks in the practice. The first task was to try at least the following three cases: the individual contributes (i) less than others, (ii) the same as others, and (iii) more than others. The second task was to identify the best strategy by imagining how the other two subjects in a group would contribute.

The purpose of practice rounds was twofold: to minimize any confusion and random decision error, and to give subjects sufficient time to think about each decision. After the practice rounds, subjects participated in rounds that involved monetary payoffs. Each subject submitted one contribution for each value of $b = \{0.1, 0.2, 1/3, 0.6, 0.9\}$. This procedure was done for each value of $G^0 = \{\$6, \$15, \$24\}$. Therefore, each subject completed fifteen different contribution situations and determined his or her contributions without feedback. In other words, no subject knew what his or her payoff was or the contributions of the other subjects in his or her group until after all fifteen decisions were made. Finally, there were ninety observations in each situation since ninety subjects were recruited, of whom each provided a single contribution decision for each of the fifteen different contribution situations. Therefore, this experiment results in 1,350 ($= 90 \times 15$) observations. The fifteen situations each subject faced are summarized in Table 2.

To prevent potential order effects, the order in which the decisions were presented was randomized. As explained to the subjects at the end of the experiment, payoffs were determined by randomly drawing, with replacement, one labeled chip out of five for each of the three cases of G^0. Each of the five labeled chips represented one of the five possible values of b.

Conceptual Framework of the Helping Hand Hypothesis

In this section, we outline the conceptual framework of the helping hand hypothesis. Similar to the approaches by Andreoni and Miller (2002) and Charness and Rabin (2002), we assume that the utility function for subject i is represented as a linear weighting function of her personal payoff and that of others in her group. Assume a group of three subjects:

$$\begin{aligned} u_i(g_i) &= \pi_i + \lambda_i \sum_{j \neq i} \pi_j \\ &= w_i - b g_i + \frac{1}{3}\sum_{j=1}^{3} g_j + \lambda_i \sum_{j \neq i} \pi_j \end{aligned} \tag{2}$$

where

$$\pi_i = w_i - b g_i + \frac{1}{3}\sum_{j=1}^{3} g_j$$

represents the personal payoff for subject $i = \{1, 2, 3\}$, and $\lambda_i \in [0, 1]$ is a parameter that captures how much individual i cares about the payoffs of others in her group. We employ this separably additive form since a simple weighting function can capture altruistic preferences in the dictator games and many other game-theoretic settings (see, e.g., Andreoni and Miller 2002, Charness and Rabin 2002).[6] Additionally, we further assume that each individual may be motivated by some internal motivation called the helping hand. The utility function is given by

$$(3)\quad u_i(g_i) = \pi_i + \lambda_i \sum_{j \neq 1} \pi_j + \alpha_i f(g_i, v)$$
$$= w_i - bg_i + \frac{1}{3}\sum_{j=1}^{3} g_j + \lambda_i \sum_{j \neq i} \pi_j + \alpha_i f(g_i, v),$$

where $\alpha_i f(g_i, v)$ is the helping hand term for subject i, and $\alpha_i \in \mathbb{R}_+$ is a parameter that captures how much subject i is affected by the helping hand motivation. To be consistent with the helping hand hypothesis, we assume that $f_g(g_i, v) > 0$, $f_{gg}(g_i, v) < 0$, $\forall g_i \in [0, v)$, and $f(u, v) = \max_g f(g_i, v)$.[7]

The helping hand motivation should be interpreted as the strength of the desire the individual i has to give a socially optimal contribution of v, irrespective of the payoff consequence.[8] The helping hand motivation can also be considered to be psychological, outcome-insensitive, and related to intrinsic motivation such as morality, while the altruism motivation is considered to be outcome-sensitive and directly related to material payoffs, including payoffs to others. Therefore, the helping hand motivation is a type of warm glow motivation or impure altruism of the type described by Andreoni (1988); however, it extends Andreoni's concept to characterize the internal motivation for voluntary contribution by relating actual contributions to the induced values of the public good.

In the experimental economics literature, warm glow is specified as a linear function of the contribution, g_i; i.e., $f(\cdot) = cg_i$, where c is some positive parameter to be estimated (see, e.g., Palfrey and Prisbrey 1997, Goeree, Holt, and Laury 2002). This specification implies that people obtain more warm glow simply by giving more regardless of the external situation. Thus, with this definition, it is difficult to distinguish such giving from the level of induced values. In contrast, the functional assumptions for the helping hand term capture both the situation in which people gain this type of marginal satisfaction and the situation in which they do not. The marginal benefit of giving based on the helping hand motivation is diminishing as the voluntary contribution gets closer to induced values of the public good, v, i.e., $f_{gg}(g_i, v) < 0$.[9] Also, the satisfaction from this helping hand motivation is assumed to reach the maximum level when each subject contributes the induced values of the public good.

The original work of warm glow by Andreoni (1989) suggests a general functional form of utility, which is generally assumed to be concave and not necessarily restricted to a linear function of cg_i. The linear specification of warm glow as adopted in experimental research does not fully capture his idea, nor does it provide the logic as to why the level of match might influence voluntary contributions. The intent of introducing the helping hand motivation in this model is to refine the warm glow idea by relating utility with an induced value in a general form of concave functions, $\alpha_i f(g_i, v)$. With this approach, we conjecture a model that better explains the positive impact of matching on voluntary contributions.[10]

The individual problem characterizes the optimum,

$$\max_{g_i \in [0,10]} u_i(g_i) = \pi_i + \lambda_i \sum_{j \neq 1} \pi_j + \alpha_i f(g_i, v)$$

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[6] There exists an exception in the literature. Landry et al. (2006) assume that warm glow is specified as a non-linear and concave function $f(g_i)$, where g_i is an individual contribution. More specifically, it is assumed to be strictly increasing and concave.

[7] We may assume that $f_g(g_i, v) = 0$ for $g_i \in [v, w_i]$. In fact, any assumption that does not affect the result $f(v, v) = \max f(g, v)$ can be assumed to be consistent with the helping hand hypothesis.

[8] Some authors claim that a socially optimal contribution of v is identified from social welfare maximization for each individual where intrinsic payoffs such as warm glow are not counted as a part of social welfare measurement (see, e.g., Elster 1989, Andreoni 2006). In other words, each individual identifies what is a socially desirable action by looking at social welfare excluding parts related to intrinsic motivation. Thus, the definition of v in this paper follows this line of argument.

[9] This assumption of diminishing intrinsic motivations is also made in Landry et al. (2006), Schulze et al. (2002), and Frey and Oberholzer-Gee (1997).

[10] More precisely, Andreoni (1989) poses a general utility function of $U(x, G, g)$, where x is a private good, G is a public good, and g is a private contribution to a public good. The new element of helping hand motivations is thus a refinement of the warm glow concept and is the introduction of induced value v in a utility function, i.e., $U(x, G, g, v)$. In this paper, we introduce the helping hand term of $\alpha_i f(g, v)$ in a separably additive way for the purpose of simplifying experimental setups and testing the hypotheses.

$$= w_i - bg_i + \frac{1}{3}G + \lambda_i \sum_{j \neq i} \pi_j + \alpha_i f(g_i, v),$$

subject to

$$G = \sum_{j=1}^{3} g_j \leq G^0 ,$$

otherwise $G = G^0$. Then the first-order conditions yield

$$-b + 1/3 + 2\lambda_i / 3 + \alpha_i f_g(g_i, v) \gtreqless 0.$$

As a benchmark for the prediction, we derive a symmetric N.E. under the assumption that each subject has the belief that the other two subjects in her group behave similarly, i.e., $\alpha_i = \alpha_j$, $\lambda_i = \lambda_j$, $i \neq j$. This assumption not only simplifies the derivation of the equilibrium but is also based on evidence of experimental research on one-shot social dilemma situations. Dawes, McTavish, and Shaklee (1977) show that in a social dilemma situation, an individual utilizes her own preference as information about what other people will do. They argue that "In the end, a subject may have a rational basis for believing that others in a group will do likewise. Whichever the source, the subjects' decisions themselves would lead them to believe that others' decisions would be like theirs" (Dawes, McTavish, and Shaklee 1977). Elster (1989) supports their findings, and names the process of developing such belief "magical thinking."

Based on our assumption, we can derive the unique equilibrium strategy behind the individual contribution behavior.

Prediction 3. *For* $b \in (0, 1/3)$, $\lambda_i \in [0,1]$, *and* $\alpha_i \in \mathbb{R}_+$, *the symmetric N.E. is* $g_i^* = v$.

Prediction 4. *For* $b \in [1/3, 1]$, *the symmetric N.E. strategy for each subject i is as follows*:

i. $g_i^* = v$ *if* $\lambda_i \geq \frac{3b-1}{2}$,

ii. g_i^* *is any contribution between 0 and v satisfying* $\alpha_i f_g(g_i, v) \leq b - 1/3 + 2\lambda_i / 3$ *and equality holds if* $g_i^* > 0$ *for*

$$\lambda_i \in [0, \frac{3b-1}{2})$$

and $\alpha_i \neq 0$,

iii. $g_i^* = 0$ *if* $\alpha_i = 0$ *and* $\lambda_i \leq \frac{3b-1}{2}$.

Recall that α_i and λ_i are the set of individual-specific parameters that characterize voluntary contributions in the optimal strategy. Given the prediction of the symmetric N.E., all of the subjects should contribute the induced values v when the PCM is incentive-compatible. When the PCM is not incentive-compatible, then contributions depend on parameter values of α_i and λ_i. The following three possible types of individual contribution behaviors are expected:

- *Selfish type*. We call subject i a "selfish" type if $\alpha_i = \lambda_i = 0$. Selfish type individuals have the utility of $u_i = \pi_i$, and contribute

(4) $$g_i^* = \begin{cases} v \text{ for } 0 \leq b < 1/3 \\ \text{any value between 0 and } v \text{ for } b = 1/3 \\ 0 \text{ for } 1/3 < b < 1. \end{cases}$$

- *Pure altruist*. We call subject i a "pure altruist" type if $\alpha_i = 0$ and $\lambda_i \in (0,1]$. Pure altruists have the utility of $u_i = \pi_i + \lambda_i \sum_{j \neq i} \pi_j$, and contribute

(5) $$g_i^* = \begin{cases} v \text{ if } \lambda_i \geq \frac{3b-1}{2}, \\ 0 \text{ otherwise.} \end{cases}$$

In addition, we call subject i a "perfect altruist" if $\lambda_i = 1$, and note that such individuals contribute $g_i^* = v$ for all the treatments of $b = \{0.1, 0.2, 1/3, 0.6, 0.9\}$.

- *Helping hand type*. We call subject i a "helping hand" type if $\alpha_i > 0$ and $\lambda_i \geq 0$. Helping hand individuals have the utility of

$$u_i = \pi_i + \lambda_i \sum_{j \neq i} \pi_j + \alpha_i f(g_i, v) ,$$

and contribute

(6)
$$g_i^* = \begin{cases} v \text{ for } \lambda_i \geq \frac{3b-1}{2}, \\ \text{any value between 0 and } v \text{ satisfying} \\ \alpha_i f_g(g_i^*, v) \leq b - 1/3 + 2\lambda_i / 3 \text{ otherwise.} \end{cases}$$

The condition of weak inequality implies that equality holds if $g_i^* > 0$; otherwise strict inequality holds. This strategy implies that when $b = \{0.1, 0.2, 1/3\}$, the subject contributes $g_i^* = v$. If $b = \{0.6, 0.9\}$, subjects contribute some value between 0 and v, depending on the set of individual specific parameters (α_i, λ_i). When b approaches unity, contributions decrease gradually.

Finally, the predictions of the three types introduced here—selfish, pure altruist, and helping hand—are graphically summarized in Figure 1, where the vertical axis is individual contribution, g_i, and the horizontal axis is proportional parameter, b.[11]

Andreoni and Miller (2002) show that in a dictator game, altruistic preferences satisfy the strong axiom of revealed preference, and that about 70 percent of subjects' altruistic preferences can be represented as a linear weighting utility function of one's own payoff and that of others. They report that one-half of the subjects can be classified as the selfish type—that is, $u_i = \pi_i$—and that about 20 percent are perfect altruists—i.e., $u_i = \pi_i + \pi_j$. Based on their findings, we can conjecture that a majority of subjects will behave selfishly if people do not possess any helping hand motivation, so they follow the strategy of equation (4). On the other hand, perfect altruists should contribute induced values for all the treatments in this experiment.

Notice that the introduction of the concept of the helping hand into the altruism framework accounts for the motivation that is particular to a voluntary contribution game. Even if most individuals are classified as selfish in the altruism framework, we claim that such individuals will, if they possess the helping hand motive, give contributions that fall close to the induced values of the public good even when $b = 1/3$. Alternatively, when $b = \{0.6, 0.9\}$, they contribute some intermediate value between 0 and v and gradually decrease their contributions as b gets closer to one. Intuitively, this contribution behavior is possible only in the presence of some helping hand motivation, i.e., $\alpha_i > 0$.

Recall that the average contribution lies between zero and the P.O. contribution in previous public goods experiments (see, e.g., Davis and Holt 1992, Ledyard 1995).[12] Given previous evidence and the data collected from this experiment, we can translate the helping hand hypothesis into a simple regression. That is, we can test whether the actual behaviors follow a symmetric N.E. of the helping hand model by running the following regression for each value of $v = \{\$2, \$5, \$8\}$.

$$(7) \qquad g_{ik} = c + \beta_1 d_1 (b - 1/3) + \beta_2 d_2 (b - 1/3) + \varepsilon_{ik},$$

where $i = 1, \ldots, 90$ denotes the subject index; $k = 1, \ldots, 5$ denotes the index of experiment treatments, $b = \{0.1, 0.2, 1/3, 0.6, 0.9\}$, or each induced value of the public good, $v = \{\$2, \$5, \$8\}$; ε_{ik} represents the disturbances that are peculiar to both individuals and treatments; d_1 is a dummy variable such that $d_1 = 1$ if $b = \{0.1, 0.2, 1/3\}$, otherwise 0; and d_2 is a dummy variable such that $d_2 = 1$ if $b = \{1/3, 0.6, 0.9\}$, otherwise 0.

Finally, the helping hand hypothesis is translated into the preceding regression as follows.

Helping Hand Hypothesis

i. $\hat{\beta}_1$ is sufficiently close to zero, being neither statistically significant nor economically significant.[13] In other words, economic incentives given by proportional parameters $b \in (0, 1/3]$ are not an important factor for the contribution decision since the helping hand model simply predicts that subjects contribute the induced value v for the public good. The intuition behind this prediction is that internal motivations represented by the helping hand are satiated at the point of $g_i^* = v$.

ii. $\hat{\beta}_2$ is strictly negative, and is statistically significant and economically significant. In addition, the estimate of $\hat{\beta}_2$ yields the prediction of overcontributions. In other words, when the PCM is not incentive-compatible, subjects will not only

[11] The logit equilibrium concept—developed by Anderson, Goeree, and Holt (1998)—may yield qualitatively the same predictions made by the helping hand model if decision errors are assumed to be significant. More precisely, the model of a pure altruist under the logit equilibrium can yield the same predictions as the one with the helping hand models suggested in this paper. Due to this fact, the practice rounds were included as part of the experiment design to minimize the influence of decision errors in the experiments.

[12] In most experiments, a P.O. contribution is in fact to give a whole endowment to a public good.

[13] We use the term "economic significance" as described in McCloskey and Ziliak (1996) and Ziliak and McCloskey (2004).

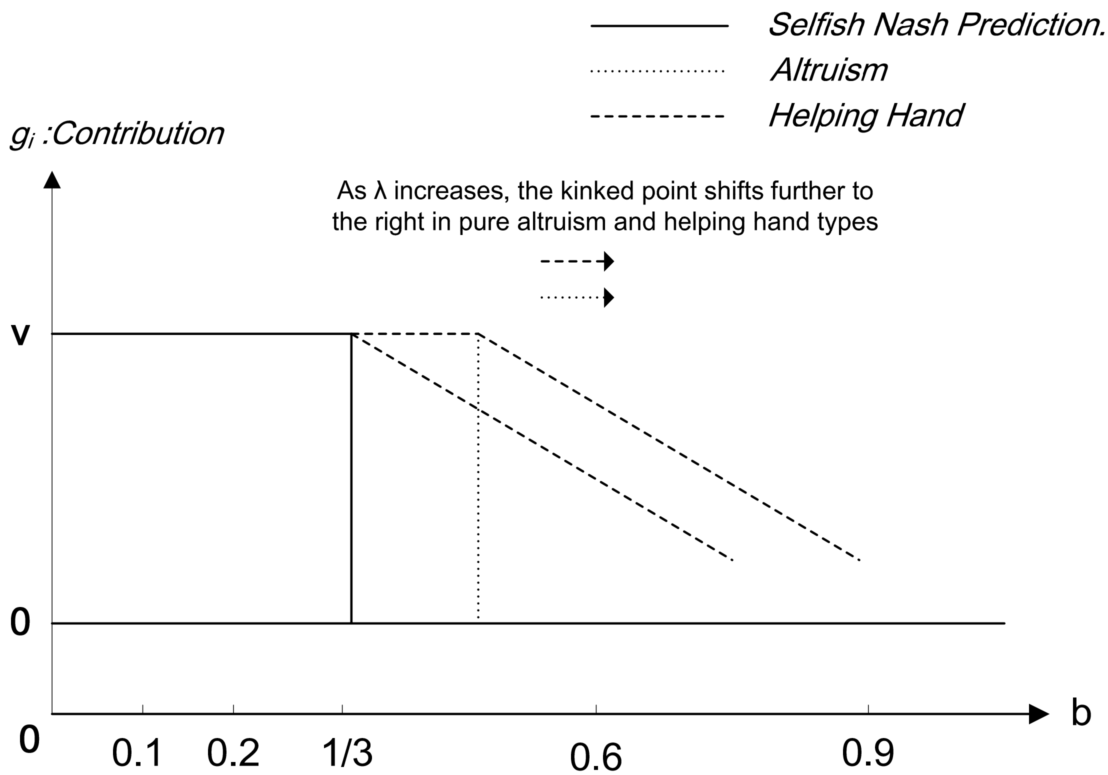


Figure 1. Predictions of Three Types of Individuals

be motivated by the helping hand and altruism but will also want to maximize their personal payoffs. This is in contrast to the case of an incentive-compatible PCM. Thus, a trade-off exists between selfish motives and both the helping hand motivation and altruism. The helping hand hypothesis asserts that the estimate of $\hat{\beta}_2$ is negative but statistically significant and that the level of contributions is some intermediate value between 0 and v. Also, contributions will decrease as b becomes larger.

iii. $\hat{c}$ is statistically significant and close to v. In other words, the estimates of the intercept are equal to the induced values of the public good.

When all three of the hypotheses are simultaneously satisfied, the predictions of regression become identical to the prediction of helping hand type individuals shown in Figure 1.

Results

In this section, we first present the frequency distributions and descriptive statistics of voluntary contributions for each treatment. We then present the regression analysis. Figures 2, 3, and 4 are frequency distributions for each treatment of $b = \{0.1, 0.2, 1/3, 0.6, 0.9\}$ with $v = \{\$2, \$5, \$8\}$, respectively. The shapes of the frequency distributions shift similarly for all the treatments of $v = \{2,5,8\}$ when b changes. When the PCM is incentive-compatible for $b = \{0.1, 0.2, 1/3\}$, the mode of distribution for each induced value is v. When $b = \{0.6, 0.9\}$ and the PCM is not incentive-compatible, the distributions exhibit diminishing frequency over higher contributions.

Note that a number of subjects responded as if they were perfect altruists by contributing v even when $b = \{0.6, 0.9\}$ for all induced values. On average, 10 percent of the individuals contribute the induced value, even though the dominant strategy is to give nothing for selfish behavior in this case. These proportions approximate those found in related research. For example, 20 percent of individuals were classified as perfect altruists in a dictator game (Andreoni and Miller 2002). This evidence is consistent with the previ-

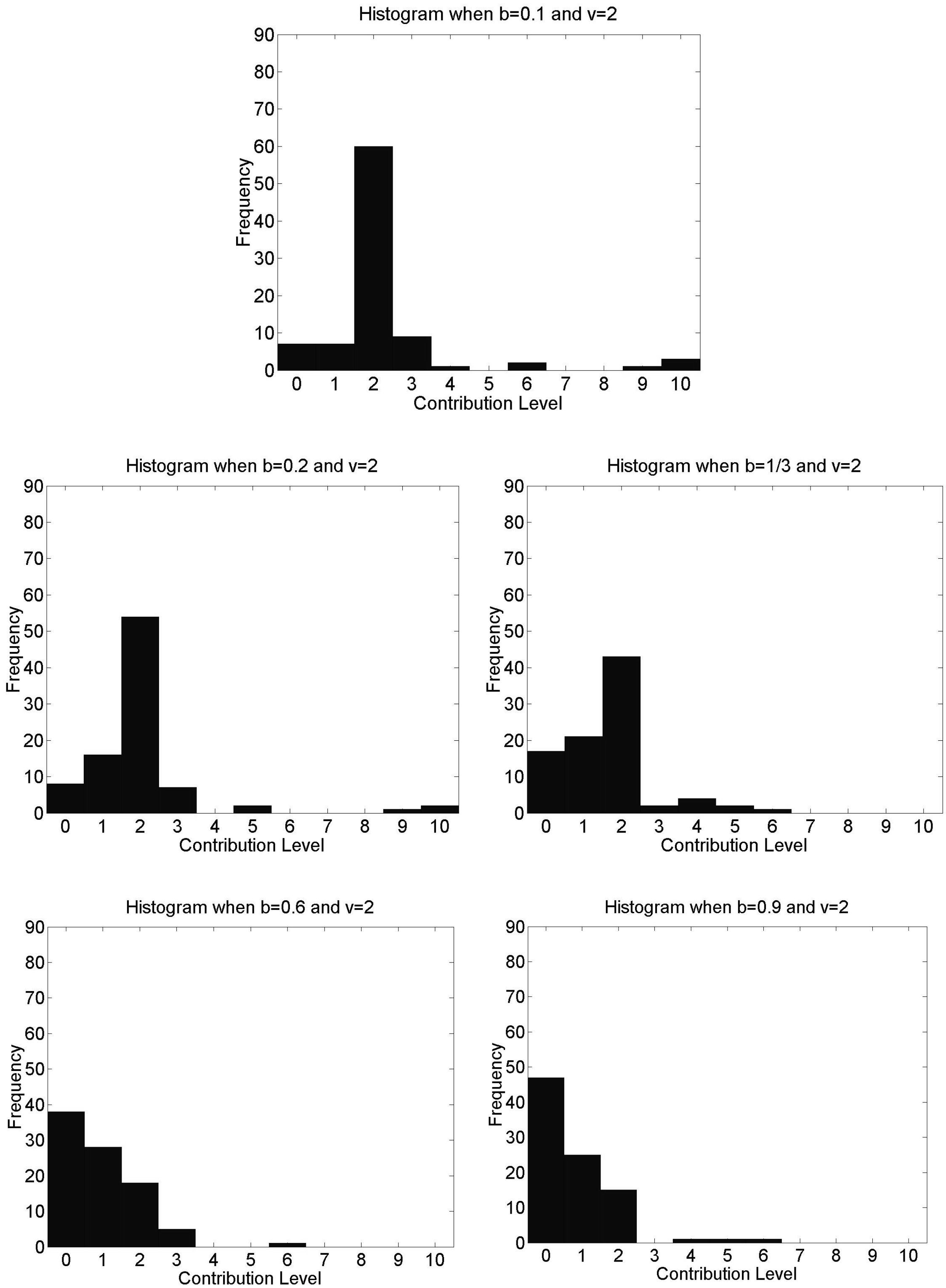


Figure 2. Histogram of v = \$2 for b = {0.1,0.2,1/3,0.6,0.9}

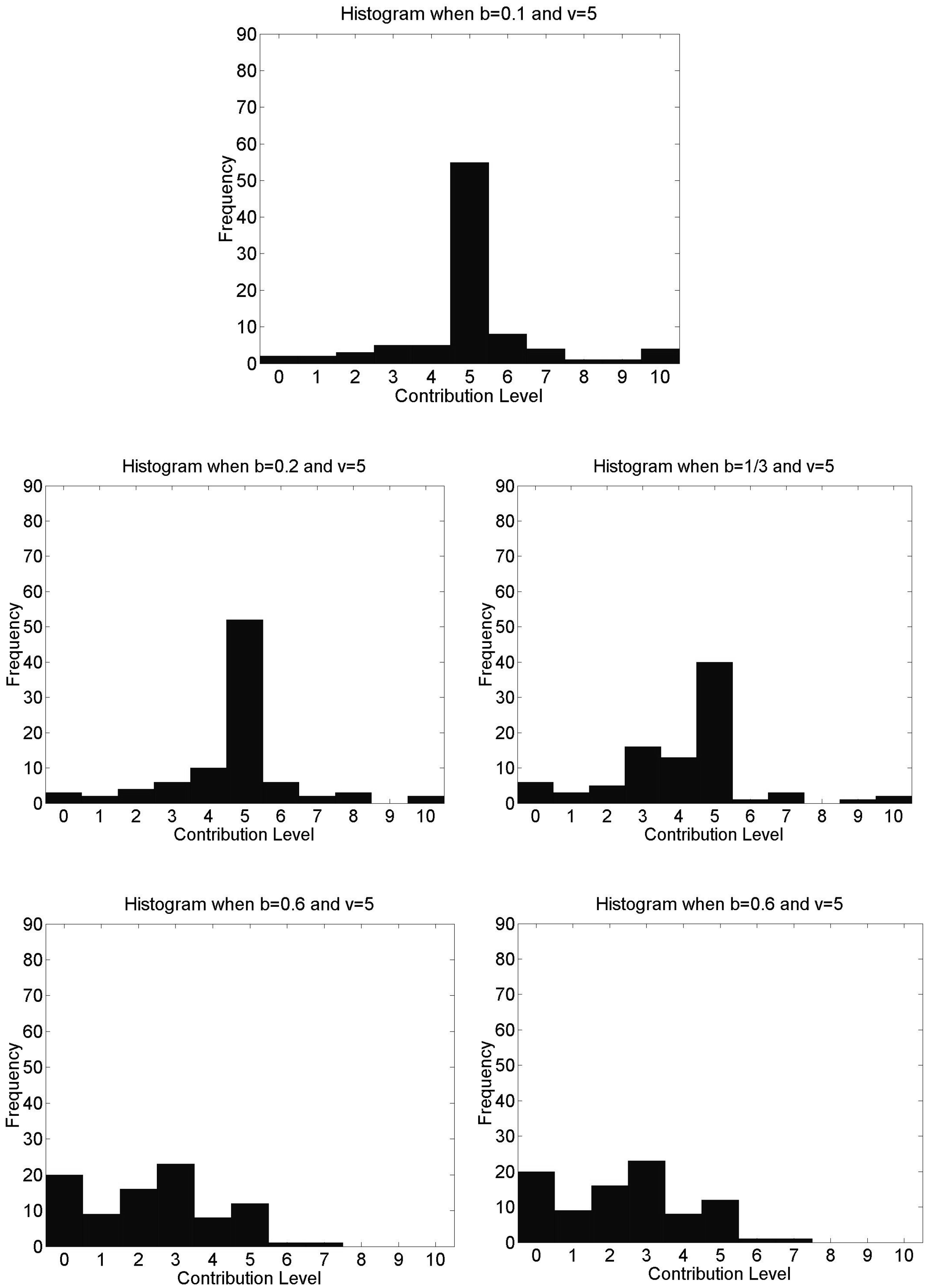


Figure 3. Histogram of *v* = $5 for *b* = {0.1,0.2,1/3,0.6,0.9}

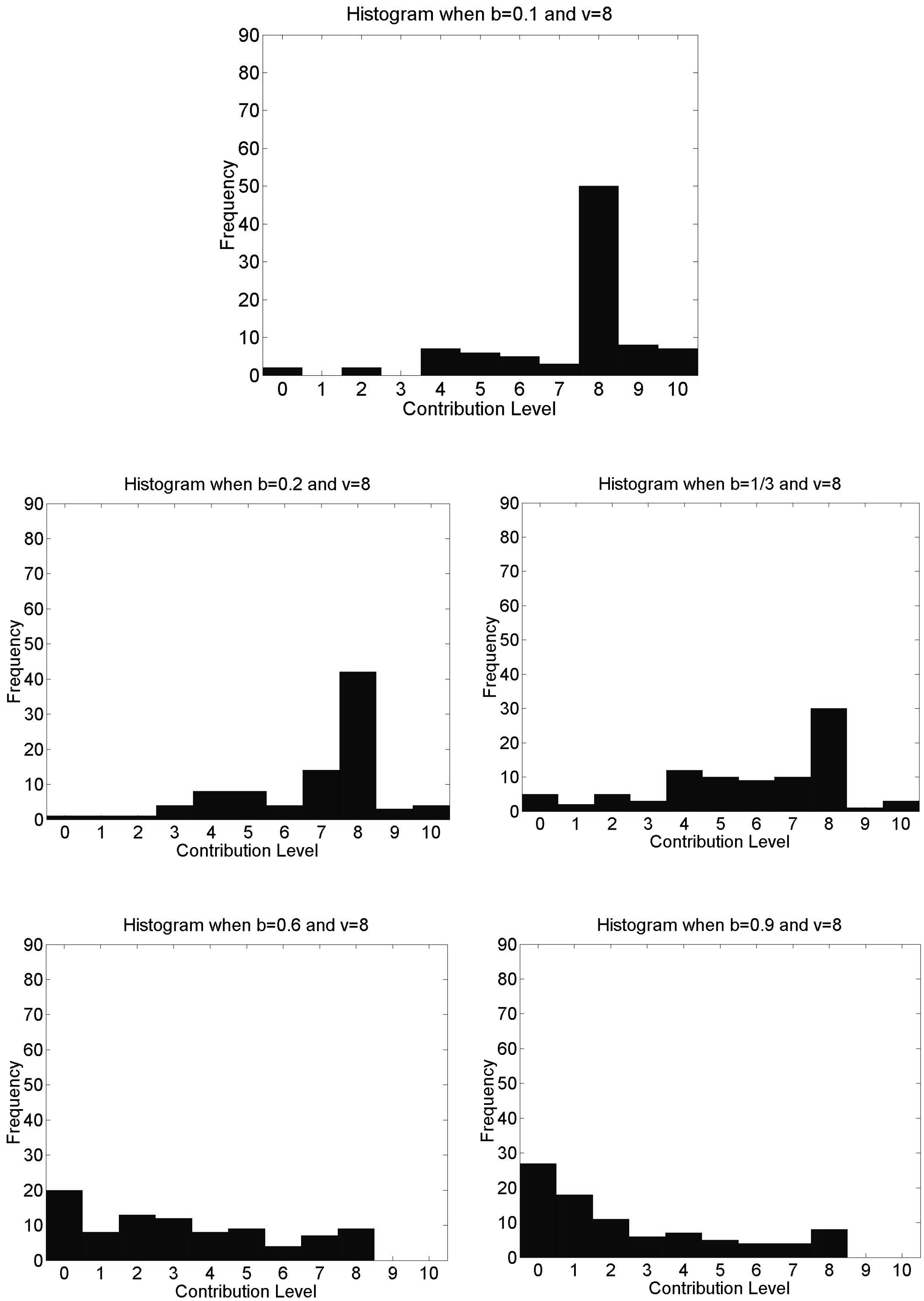


Figure 4. Histogram of $v = \$8$ for $b = \{0.1,0.2,1/3,0.6,0.9\}$

ous literature in the sense that a small number of individuals are highly altruistic and give induced values even when the mechanism is not incentive-compatible.

A majority of individuals follow the pattern of contribution behaviors underlying the frequency distribution and contribute induced values of v or close to v when $b = \{0.1, 0.2, 1/3\}$. Yet when $b = \{0.6, 0.9\}$, most subjects reduce their contributions, and the degree of reduction varies: a large portion of individuals contribute between 0 and v, while the remainder become free-riders. Intuitively, such results correspond with the helping hand hypothesis. The potential cost of contributions strongly impacts a subject's contribution behavior when the mechanism is not incentive-compatible. When the mechanism is incentive-compatible, the cost does not have the same degree of impact.

Table 3 shows the mean and median of contributions for each treatment. This result can be understood better by combining the results from the frequency distributions. The modes of the frequency distributions for $b = \{0.1, 0.2, 1/3\}$ correspond to v. At the same time, the medians shown in Table 3 are identical to these modes except in the case of $b = 1/3$ and $v = \$8$. This again confirms that many individuals give the induced values when the mechanism is incentive-compatible. Alternatively, when the PCM is not incentive-compatible for $b = \{0.6, 0.9\}$, the mean and median are between zero and v. This result is consistent with typical VCM experiments in that the average contributions are between zero and an efficient contribution. However, the new feature of this result is that contributions inversely react as the mean and median decrease when the cost of voluntary contribution is systematically increased from $b = 1/3$ to $b = 0.9$. Although the PCM with $b = 1/3$ can also be viewed as non–incentive-compatible, many individuals give contributions close to v. When $b = \{0.6, 0.9\}$, contributions lie between 0 and v and gradually decrease.

Figure 5 shows how the change in induced values of the public good, $v = \{\$2, \$5, \$8\}$, affects the mean and median of contributions for each proportional parameter b. The induced value of the public good is the horizontal axis, while the mean and median contributions are plotted on the vertical axis. The five lines each represent the mean/medians of contributions for the treatment of $b = \{0.1, 0.2, 1/3, 0.6, 0.9\}$. An additional 45-degree line that applies when contributions equal v is also drawn to show the degree of demand revelation by comparing the five lines with that 45-degree line.

Note that the median and the mean contributions are positively related to the induced values. In particular, under the non–incentive-compatible PCM, contributions remain positively related with induced values of the public good despite the N.E. of selfish individuals giving nothing. This corroborates the finding by Rondeau, Poe, and Schulze (2005) that voluntary contributions have a positive relationship with induced values even when the mechanism is not incentive-compatible.

Also note that the mean and median of contributions more closely approximate the 45-degree line of induced values as proportional parameter b gets smaller. When the PCM is incentive-compatible for $b = \{0.1, 0.2\}$, these values are very close or identical to the 45-degree line. This implies that the PCM is indeed demand-revealing when the cost of voluntary contribution gets sufficiently small. However, when the PCM is not incentive-compatible for $b = \{0.6, 0.9\}$, the slope of the lines gets flatter.

Given the aforementioned statistical results, we ran a quantile regression of equation (7) for each value of v and tested whether the estimates of parameters conform to the helping hand hypothesis. The quantile regression technique proposed by Koenker and Bassett (1978) is applied since this technique is "robust" and more "efficient" than the least squares (LS) approach where the error term is not normally distributed and varies systematically with independent variables. In our case, the frequency distributions explicitly show that the independent variable, b, systematically changes the shape of the distribution in the dependent (response) variable of contributions g_i, and thus the assumption of normality is violated (see Figures 2, 3, and 4). Therefore, it is not appropriate to apply the LS approach. However, for the purpose of the comparison, the LS estimates are also presented.

The quantile regressions estimate one parameter vector for each quantile under weaker assumptions of the error term than those of the LS approach. The requirement is that $Quant_\theta(\varepsilon_{\theta i} \mid b) = 0$ for $\theta \in [0,1]$, and no distributional assumptions on error terms are made. The quantile regression can be applied by pooling the panel data "na-

Table 3. Summary of Contributions ($) for Each Treatment

	v = \$2(G^0 = \$6)				
	b = 0.1	b = 0.2	b = 1/3	b = 0.6	b = 0.9
Mean	2.34	2.10	1.65	0.98	0.80
Median	2.00	2.00	2.00	1.00	0.40
Std. dev.	1.86	1.64	1.15	1.02	1.07
N.E.	2.00	2.00	[2.00,0.00]	0.00	0.00
	v = \$5(G^0 = \$15)				
	b = 0.1	b = 0.2	b = 1/3	b = 0.6	b = 0.9
Mean	5.02	4.71	4.14	2.45	1.74
Median	5.00	5.00	5.00	2.75	1.00
Std. dev.	1.78	1.69	1.88	1.76	1.70
N.E.	5.00	5.00	[5.00,0.00]	0.00	0.00
	v = \$8(G^0 = \$24)				
	b = 0.1	b = 0.2	b = 1/3	b = 0.6	b = 0.9
Mean	7.32	6.82	5.82	3.26	2.55
Median	8.00	8.00	6.42	3.00	1.52
Std. dev.	2.04	2.01	2.55	2.68	2.66
N.E.	8.00	8.00	[8.00,0.00]	0.00	0.00

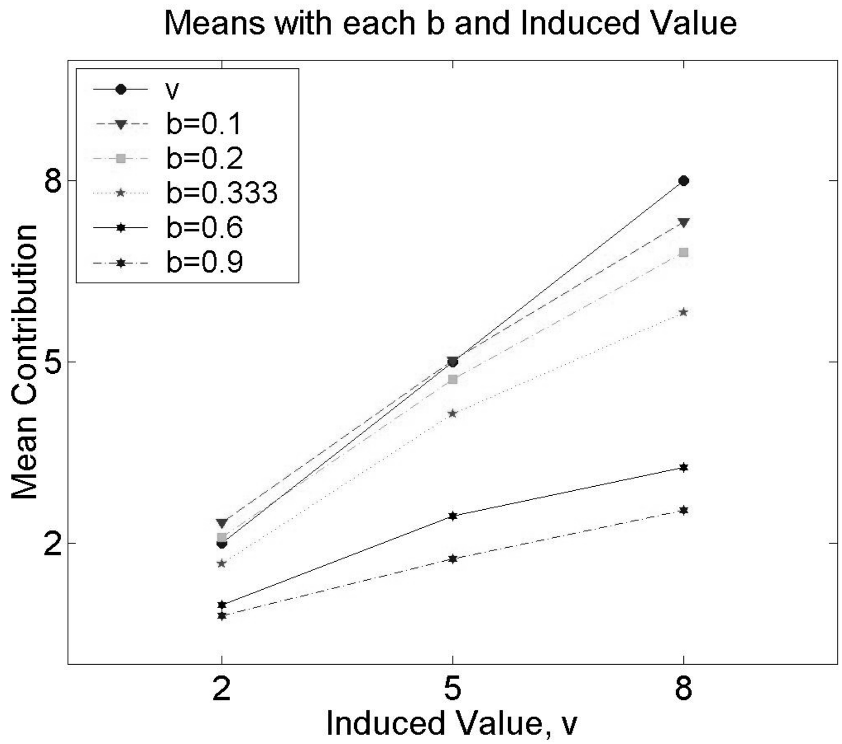
Notes: A sample size is n = 90 for each mean and median.

ively" and the estimator is still consistent (Lipsitz et al. 1997, Jung 1996). The standard errors of parameters of interest are derived by non-parametric bootstrap methods (see Buchinsky 1998). In addition, several quantile regressions for $\theta = \{0.3, 0.4, 0.5, 0.6, 0.7, 0.8\}$ could be run to clarify the heterogeneity of contribution behaviors. For the purpose of comparison, the random effects model is employed as one result from the LS approaches.[14]

The quantile regressions above the median ($\theta = \{0.8, 0.7, 0.6, 0.5\}$) show that the helping hand hypothesis holds. The estimates of the intercept are sufficiently close to the induced values of v, while $\hat{\beta}_1$ is not statistically significant at the 0.05 level or economically insignificant so that $\hat{\beta}_1 \approx 0$ for all the quantile regressions above the median of $\theta = \{0.8, 0.7, 0.6, 0.5\}$ (see Table 2).[15] In contrast, $\hat{\beta}_2$ is statistically significant for all of the levels of the quantile regressions, and the estimates show that contributions decrease as b gets bigger. These results imply that most subjects do not change their contribution behavior when the

[14] The Wu-Hausman test was conducted to determine whether a random or fixed effects model is more appropriate. The result was in favor of the random effects model. In addition, we double-checked whether there are any order effects of three induced values $v = \{2, 5, 8\}$ that were randomly assigned for each session by including a set of dummy variables. Each dummy variable represents one sequence consisting of $v = \{2, 5, 8\}$ that was implemented in a session. These tests find that none of the dummy variables exhibit statistical significance. Therefore, these dummy variables are omitted from the regressions in this manuscript; however, they are available from the authors upon request.

[15] In the case where b = 1/3, v = 8, and θ = 0.5, the estimate of the intercept is 6, and β_1 is -8.57 and statistically significant (see Table 4). This exception to the broad trend is due to the fact that the number of subjects who contributed more than induced values did not reach the median, falling short by several subjects, though many subjects still contributed close to v. This result may be parallel with that in Saijo and Nakamura (1995). They also considered the incentive-compatible voluntary contribution mechanism; however, a dominant strategy is to give full contribution out of endowment. They found that many subjects did not make full contribution as theory predicts and concluded that the observed behaviors may be motivated by "spiteful motive" to increase the ranking of ultimate payoffs among subjects in a group rather than maximizing an individual subject's own payoff. In turn, our results in frequency distributions show that the number of subjects who contributed induced values gradually decreases as induced values, v, increase from \$2 to \$8 in the incentive-compatible PCM, especially with b = 1/3. Thus, we conjecture that a different kind of motive, such as spitefulness, may emerge when the required contribution for group efficiency is close to a whole endowment even under the efficient mechanism. This would be an interesting topic to address in the future.



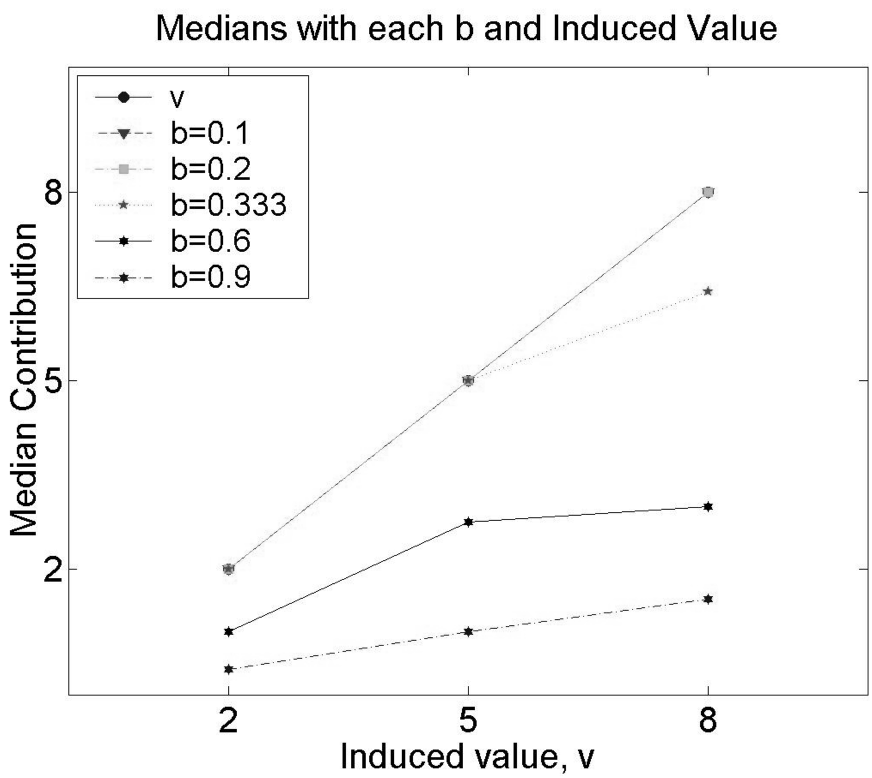


Figure 5. Mean, Median, and Induced Value for Each Treatment of $b = \{0.1, 0.2, 1/3, 0.6, 0.9\}$

PCM is incentive-compatible, and instead follow a symmetric N.E. strategy. When the PCM is not incentive-compatible, subjects gradually reduce their contributions as *b* gets close to one.

Note that the LS estimates of a random effects model are not similar to those of the quantile regressions above the median (see Table 4). For instance, the estimated intercept of constant terms in the LS approach is significantly below an induced value of *v* for each regression, while it is approximately equal to *v* in the results of quantile regression above the median ($\theta = \{0.8,0.7,0.6, 0.5\}$). The apparent cause for this discrepancy is that LS estimates are very sensitive with the outliers observed in the experiments and that the distributions of contributions are not normally distributed (see Figures 2, 3, and 4). In this situation, we have to rely on a large sample property to validate an LS approach of random effects models and its corresponding *t* or *F* tests. However, the number of observations for each regression is 450, so an LS approach is not reliable. Therefore it can be concluded that the quantile regressions better capture the distribution of contribution behaviors.

What can we learn from the regression and statistical results? First, contributing the induced values of the public good is pervasive in an incentive-compatible PCM, while high heterogeneity of contributions is observed in a non–incentive-compatible PCM, as shown in quantile regressions and frequency distributions. On the whole, contributions are decreasing in *b*, which seems to indicate that the helping hand motivation plays a role. Second, the induced values for the public good may be a key determinant in characterizing over-contribution observed in this experiment. Economic theory predicts that a zero contribution is a unique dominant strategy for $b = \{0.6,0.9\}$. However, the frequency distributions are clearly different across $v = \{2,5,8\}$ for the same value of $b = \{0.6,0.9\}$, and high induced values positively impact over-contribution, which is in line with the findings established in the threshold public goods experiments (Rondeau, Poe, and Schulze 2005, Rondeau, Schulze, and Poe 1999). Thus, we further conjecture that the helping hand term may have the property of being at least weakly increasing in *v*, i.e., $f_v(g_i,v) \geq 0$.

Conclusion

Despite widespread use of matching-grant mechanisms to fund environmental, natural resource, and conservation projects throughout the world, little is known about why this mechanism may help increase voluntary contributions. This research has introduced a new experimental mechanism, referred to as the proportional contribution mechanism (PCM), that enables an examination of the nature of voluntary public good contributions in single-shot settings. The uniqueness of the PCM comes from the fact that it can be modified to be both incentive-compatible or not by adjusting only one parameter. This is not possible with other voluntary mechanisms.

A conceptual framework and model of the helping hand hypothesis were formulated. The helping hand hypothesis asserts that when a person faces an external environment that is not incentive-compatible and that seems unlikely to provide a socially optimal level of the public good, the individual gains some utility by undertaking socially responsible behaviors. However, when the mechanism is incentive-compatible and thus seems likely to provide a socially optimal level of the public good, the individual no longer offers a helping hand, but instead focuses on maximizing her personal payoff, bringing the individual's behavior in line with the standard Nash equilibrium predictions.

The experimental results are consistent with the helping hand hypothesis. When the mechanism is incentive-compatible, subjects report warm-glow–free values for public goods via voluntary contributions. When the PCM is not incentive-compatible, contributions decrease as the price of contributions (reflected by parameter *b*) increases, but are positively correlated with induced values. This implies that when the mechanism is not incentive-compatible, people offer a helping hand and gain utility by undertaking a socially responsible behavior.

The research results further suggest that over-contribution reflects, in part, the value for the public good and can be considered partial demand revelation even in a non–incentive-compatible mechanism. These trends observed in the experimental results are novel and are consistent with the helping hand hypothesis outlined. Overall, our results suggest that people's social preferences depend on the induced value of the public good

Table 4. Estimates of Regressions for Different Induced Values

	Q_{30}	Q_{40}	Q_{50}	Q_{60}	Q_{70}	Q_{80}	LS
v = \$2							
Constant	1.00*	1.75*	2.00*	2.00*	2.00*	2.00*	1.57*
	0.12	0.31	0.09	1.34e-8	2.92e-9	0.05	0.13
β_1	-4.29*	-1.07	-1.19e-8	8.99e-8	8.99e-8	0	-3.41
	0.49	1.34	0.37	6.82e-8	1.50e-8	1.21	0.67
β_2	-1.76*	-3.09*	-3.53*	-1.76*	-1.76*	0.00	-1.53*
	0.20	0.60	0.35	0.57	0.12	0.73	0.28
v = \$5							
Constant	3.50*	4.00*	5.00*	5.00*	5.00*	5.00*	4.00*
	0.34	0.38	0.18	0.01	1.47e-8	0.01	0.17
β_1	-6.43*	-4.29*	-2.39e-8	1.55e-7	-1.14e-7	-.75	-4.61
	1.47	1.61	0.80	0.10	7.48e-8	1.78	0.87
β_2	-6.00*	-5.74*	-7.06*	-6.09*	-5.29*	-3.53*	-4.32*
	0.87	0.89	0.59	0.72	0.68	0.74	0.37
v = \$8							
Constant	4.00*	5.00*	6.00*	7.50*	8.00*	8.00*	5.53*
	0.38	0.37	0.43	0.50	0.13	0.03	0.23
β_1	-17.14*	-12.86*	-8.57*	-2.14	-3.18e-7	2.70e-7	-8.14*
	2.85	1.60	1.83	2.20	0.92	0.92	1.14
β_2	-7.06*	-7.08*	-8.82*	-9.70*	-8.82*	-5.29*	-5.85*
	0.94	0.92	0.99	1.20	1.27	1.29	0.48

Notes: N = 450 for each induced value. * indicates significance below 0.05. Additional regression statistics are available from the authors upon request.

as well as on its price, and thus that people possess an efficiency concern in voluntary contribution behavior.

Note that, at the individual level, data and regression analyses remain incomplete when the PCM is not incentive-compatible. Consistent with previous VCM research, the quantile regressions reveal a variety of individual contribution behaviors. A significant portion of subjects behave according to the helping hand prediction, another group of subjects contribute at levels equivalent to their induced values, and a small fraction of subjects continuously free-ride. However, we did not estimate a set of individual-specific parameters because of the small degrees of freedom. Identifying these types of cooperative behavior remains an area of research to be addressed in the future.

Finally, these research results have implications for the discussions on the measurement of benefits in environmental and natural resource projects. Many WTP estimates for environmental goods are obtained by employing non–incentive-compatible mechanisms. As represented by the discussion between Kahneman and Knetsch (1992) and Smith (1992), whether to include WTPs for environmental goods in the benefit-cost analysis remains an unsettled issue. These experimental results support the idea that contributions or WTPs driven by helping hand motivations should be counted in benefit-cost analyses, since they reflect, at least in part, the value of the public good even when the mechanism is not incentive-compatible and the dominant strategy is free-riding.

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